AGENDA

Technical Committee on Electrical Safety in the Workplace (EEW-AAA)
First Draft Meeting for 2018 Edition of NFPA 70E
August 17 - 21, 2015 @ Hyatt Regency Schaumburg (Chicago), IL

08-15-01 Call to order & chair welcome to members & guests
08-15-02 NFPA staff review of fire alarm and exit procedures
08-15-03 Roll Call/Introductions of members & guests
08-15-04 NFPA staff review of meeting procedures and document processing
08-15-05 Chair review of committee meeting schedule, start/stop, breaks, and lunch periods:
   1) Start at 8:00 AM, 15 minute breaks in AM & PM to be announced by the Chair,
   2) Lunch period of 1-hour, taken around noon as the flow of the meeting dictates, and
   3) Ending at 5:00 PM or as otherwise directed by the Chair and/or agreed upon by the Committee
08-15-06 Comments/questions from committee members and/or guests regarding meeting procedures and revision schedule/process
08-15-07 Approval of June 2013 Second Draft meeting report
08-15-08 Task Group and Special Task Group Reports & Processing of Public Comments
08-15-09 Old Business
08-15-10 New Business
08-15-11 Adjournment
1) Date(s) and location of meeting: June 24 - 27, 2013, Savannah, GA.

2) List names of guests in attendance: See attached Appendix A.

3) List names of guests addressing the Panel/TC, the subject of their address, and the length of time they spoke:

   Jim Coyne, Coyne First Aid, spoke for 5 minutes on Sec. 110.2(C) and the need for annual CPR and similar emergency training. Dr. Lloyd Gordon, Los Alamos National Laboratory, spoke for 5 minutes on electropathology considerations for the DC shock hazard, including threshold values.

4) Number of Public Comments acted upon: About 230

5) Number of Second Revisions created: 61

6) List any Task Groups appointed to work subsequent to the Second Draft Meeting, along with the names of members of the Task Group(s):

   None were appointed, but there was some discussion under New Business regarding the possible need for some special task groups to work between now and the next revision cycle. The topics for these special task groups included the following:

   1. Certification of PPE. This involves Tables 130.7(C)(14) and 130.7(F) which describe standards for protective equipment and other equipment. This task group would study the need for certification to the referenced standards, and how certification requirements could be addressed in the 70E document.

   2. Chapter 3, Articles 330, 340 and 350. This task group would look at Chapter 3 articles related to lasers, power electronic equipment, and research and development laboratories. The goal would be to organize and update these articles relative to best practices and current information.
3. Annex F – This involves Annex F material related to hazard analysis and risk estimations. This task group would study the need for this annex, and if needed, what changes or additions to this information might be needed to make it more usable and applicable to the 70E document.

4. Annex K – The Committee believes that Annex K, General Categories of Electrical Hazards, may not be accurate or indicative of the current research and science of the arc flash hazard. This task group would study Annex K, including a very comprehensive Public Comment (PC-185) from Dr. Tammy Gammon that was rejected but held for the next cycle regarding Annex K material.

7) List any request contained in a Responses or Statement that require NEC Correlating Committee attention: none

8) List any Public Comments or Second Revisions, in your opinion that needs to be referred to another TC for information or correlation: none

9) List any Public Comments or Second Revisions that should be referred to the Toxicity Advisory Committee: none

10) List all Public Comments or Second Revisions related to combustibles in plenums or other air handling spaces: none

11) Identify any issues that should be brought to the attention of the NFPA Research Foundation for their input and assistance: none

12) List any general requests for information or assistance from the NEC Correlating Committee: none
Public Input No. 166-NFPA 70E-2015 [ Global Input ]

Change "footwear" to "leather workshoes"

Type your content here ...

Statement of Problem and Substantiation for Public Input

Even though "footwear" may be used by some other standards, it is not descriptive and does not add clarity, as was initially intended. Field workers understand what is meant by "leather workshoes" immediately. Changing the wording would add clarity and usability to the document.

Submitter Information Verification

Submitter Full Name: JAMES WHITE
Organization: SHERMCO INDUSTRIES INC
Affiliation: International Electrical Testing Association (NETA)
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Mon Jun 08 11:20:13 EDT 2015
In all portions of the standard where they appear, change the phrases “50 volts or more” and “below 50 volts”, (and similar phrases) to “where a shock hazard exists” and “where no shock hazard exists”, respectfully.

Statement of Problem and Substantiation for Public Input

The potential for injury due to shock is primarily determined by the magnitude of current flowing through the body, the path of the current flow through the body and the time duration of exposure. A companion PI is being submitted to change the definition of “Shock Hazard”. This revision of the term “Shock Hazard” is needed to support this global revision of the phrases. Changing those phrases is necessary in order to correctly describe when a person is exposed to the potential for injury due to shock and when they are not. The voltage level is only one of the variables that determine this potential. The path through the body is sufficiently covered by the existing text of the standard. The time duration is not. These companion PIs introduce this concept and includes time duration as one of the variables. Time duration is critical in determining the potential for shock injury and thus protective measure required to prevent such injury.

Submitter Information Verification

Submitter Full Name: DAVID PACE
Organization: OLIN CORPORATION
Affiliation: Self
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Mon Jun 22 17:05:25 EDT 2015
Delete all mandatory references to other standards within the NFPA 70E standard.

Statement of Problem and Substantiation for Public Input

NFPA 70E is governed by the NEC Style Manual which prohibits mandatory references to other standards in section 4.2 as follows:

4.2 References to Other Standards. References to other standards shall not be in mandatory Code text. References to product standards shall be in an informative annex. References to other Standards shall be in the Informational Notes.

All references to other standards must be relocated to Informational Notes or in an Annex.

The Correlating Committee should review the process of having Technical Committees reference other standards in any manner whatsoever when the technical committee has never seen the standard. If other standard developing bodies wish to have their standard referenced in an Informational Note or in an Annex, the Technical Committee must be given an opportunity to review the standard.

Submitter Information Verification

Submitter Full Name: JAMES DOLLARD
Organization: IBEW LOCAL UNION 98
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Mon Jun 29 10:58:22 EDT 2015
Public Input No. 309-NFPA 70E-2015 [ Global Input ]

Revise all occurrences of word "accident" to the term "incident."

The word "accident" occurs three times in the document:
130.7(E)(1)
330.3(B)(2)d.
C.1

Type your content here ...

Statement of Problem and Substantiation for Public Input

The word "accident" is being replaced in Occupational Health and Safety Language with the more global term "incident" to embrace all workplace occurrences (i.e. accident, close call, near miss, etc.).

See ANSI/AIHA Standard Z10–2012 OHSMS definition of Incident: An event in which a work-related injury or illness (regardless of severity) or fatality occurred or could have occurred (commonly referred to as a "close call" or "near miss").

See CSA Standard Z1000-2015 definition of Incident: an occurrence arising in the course of work that resulted in or could have resulted in an injury, illness, adverse effect to health, or fatality.

The proposed revision will also create consistency within the document, where the term "incident" used in a similar context. See Table 130.7(C)(15)(A)(a); Article 130.7(C)(7)(c); 130.7(D)(1)(3); 310.5(C)(1)(2); 340.7(A) and 340.7(B).

This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee.

Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee.
Street Address: 
City: 
State: 
Zip: 
Submit Date: Mon Jun 29 12:57:28 EDT 2015
Public Input No. 310-NFPA 70E-2015 [ Global Input ]

Revise all occurrences of the word "accidental" to "unintentional" and all occurrences of the word "accidentally" to "unintentionally."

The word "accidental" is used 13 times in the document:
- Five occurrences in Chapter 1
- Five occurrences in Chapter 2
- Three occurrences in Annex N

The word "accidentally" occurs three times in the document:
- Article 100 definition of Enclosed
- Article 100 definition of Enclosure
- Article 130.7(D)(1)(f)

Statement of Problem and Substantiation for Public Input

This will correlate with the current Occupational Health and Safety shift away from use of the word "accident." It will also create consistency within the document. The term "unintentional" is currently used nine times in the document, usually in a similar context. See Article 90.2(A)(2) Informational Note and Article 205.15.

This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee.

Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee.
Street Address:
City:
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Submittal Date: Mon Jun 29 13:24:40 EDT 2015
Revise the use of the terms “qualified”, “Qualified Person”, “Unqualified Person”, “designated person” and “qualified electrician” throughout the standard

This public input is submitted as a global input for clarity, readability. This Public Input provides the work in legislative text to reduce time required by assigned task group(s). It is anticipated that an assigned task group can review and edit the proposed revisions accordingly.

NFPA 70E and the NEC work hand-in-hand towards the goal of electrical safety. The NEC addresses all installation requirements and 70E addresses only those work practice related requirements for persons not fully protected by the installation requirements in the NEC.

This public input addresses the use of the terms “qualified”, “Qualified Person”, “Unqualified Person”, “designated person” and “qualified electrician” and procedures that involve only a qualified person(s) to perform the work. The person in charge shall have overall responsibility. An audit shall be conducted at least annually by a qualified person(s) additionally trained as required in 110.2(D)(1)(b) 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.

It was necessary to explain the reasoning behind these suggested changes before jumping into specific sections.

Clarity is needed. All persons have training and experience. All training and experience is different and we need to get that right in the standard. We need to “say exactly what we mean.” We must remove the level of subjectivity that presently exists. It is for that reason that we offer the following global changes to the use of the terms “qualified”, “Qualified Person”, “Unqualified Person”, “designated person” and “qualified electrician.”

It was necessary to explain the reasoning behind these suggested changes before jumping into specific sections.

NOTE: These suggested revisions are not intended to change any requirement developed by the 70E Technical Committee. These suggested revisions provide needed clarity in the present text.

<table>
<thead>
<tr>
<th>Delete the defined term “Unqualified Person” in Article 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Article 100 Unqualified Person……..</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Revise all uses of the term “unqualified persons”</th>
</tr>
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<tbody>
<tr>
<td>All uses of the term “unqualified persons” with suggested revisions are included below.</td>
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</tbody>
</table>

| Revise 110.2(D)(1)(a) (2) Unqualified Other Persons, Unqualified persons | Persons that are not qualified on the equipment or methods involved shall be trained in, and be familiar with, any electrical safety-related practices necessary for their safety. |
|-----------------------------------------------------------------------|
| (a) Such Qualified 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. A person can be considered qualified with respect to certain equipment and methods but still be unqualified for others. |

| Revise 110.2(D)(2) | (1) Testing. Only qualified persons additionally trained as required in 110.2(D)(1)(b) 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 where an electrical hazard exists. |
|--------------------|
| (2) Unqualified Other Persons, Unqualified persons. Persons that are not qualified on the equipment or methods involved shall be trained in, and be familiar with, any electrical safety-related practices necessary for their safety. |

| Revise 110.4(A)(1) | (1) Testing. Only qualified persons additionally trained as required in 110.2(D)(1)(b) 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 where an electrical hazard exists. |
|--------------------|
| Informational Note: An example of direct exposure is the qualified electrician who works where work is performed on the motor starter control, the power circuits, or the motor. An example of indirect exposure is the person who works where work is performed on the coupling between the motor and compressor. |

| Revise 120.2(C)(2) | (2) Form of Control. Two forms of hazardous electrical energy control shall be permitted: simple lockout/tagout and complex lockout/tagout (see 120.2(D)). For the simple lockout/tagout, the qualified person additionally trained as required in 110.2(D)(1)(b) shall be in charge. For the complex lockout/tagout, the person in charge shall have overall responsibility. |
|--------------------|
| (3) Audit Procedures. An audit shall be conducted at least annually by a qualified person(s) additionally trained as required in 110.2(D)(1)(b) 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. |

| Revise 120.2(D)(1) | (1) Simple Lockout/Tagout Procedure. All lockout/tagout procedures that involve only a qualified person(s) additionally trained as required in 110.2(D)(1)(b) deenergizing one set of conductors or circuit part source for the sole purpose of safeguarding employees from exposure to electrical hazards 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. |
|--------------------|
| (n) Temporary Release for Testing/Positioning. The procedure shall clearly identify; |
| (1) the steps necessary for temporary release. |

| Revise 120.2(F)(2)(n) | (n) Temporary Release for Testing/Positioning. The procedure shall clearly identify; |
|------------------------|
| (1) the steps necessary for temporary release. |
(2) and The qualified persons that are additionally trained as required in 110.2(D)(1)(b)

(3) The responsibilities when the job or task requiring lockout/tagout is to be interrupted temporarily for testing or positioning of equipment; The steps shall be identical to the steps for return to service.

Revise 130.2(B)
(2)(b)
(8) Means employed to restrict the access of unqualified persons that are not qualified on the equipment or methods involved from the work area [see 130.3]

Revise 130.2(B)(3)
(3) Exemptions to Work Permit. An energized electrical work permit shall not be required if a qualified person additionally trained as required in 110.2(D)(1)(b) is provided with and uses appropriate safe work practices and PPE in accordance with Chapter 1 under any of the following conditions:
(1) Testing, troubleshooting, and voltage measuring
(2) Thermography and visual inspections if the restricted approach boundary is not crossed
(3) Access to and egress from an area with energized electrical equipment if no electrical work is performed and the restricted approach boundary is not crossed
(4) An energized electrical work permit shall not be required when general housekeeping and miscellaneous non-electrical tasks are performed and the restricted approach boundary is not crossed

Revise 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 additionally trained as required in 110.2(D)(1)(b) shall be permitted to work on electrical conductors or circuit parts that have not been put into an electrically safe work condition.

Revise 130.4(C)
130.4(C) Limited Approach Boundary. Only qualified persons additionally trained as required in 110.2(D)(1)(b) shall be permitted to cross the limited approach boundary. (Note, this new parent text is suggested for clarity, the present structure of 130.4(C) is directed at persons that are not qualified. A general requirement in the parent text provides clarity)

Revise 130.4(C)(1)
(1) Approach by Unqualified Persons not Qualified on the Equipment or Methods Involved. Unless permitted by 130.4(C)(3), an unqualified person not qualified on the equipment or methods involved as required in 110.2(D)(1)(b) shall not be permitted to approach nearer than the limited approach boundary of energized conductors and circuit parts.

Revise 130.4(C)(2)
(2) Working at or Close to the Limited Approach Boundary. Where one or more unqualified persons not qualified on the equipment or methods involved as required in 110.2(D)(1)(b) are working at or close to the limited approach boundary, the designated qualified person additionally trained as required in 110.2(D)(1)(b) that is in charge of the work space where the electrical hazard exists shall advise the unqualified person(s) that are not qualified on the equipment or methods involved as required in 110.2(D)(1)(b) of the electrical hazard and warn him or her to stay outside of the limited approach boundary.

Revise 130.4(C)(3)
(3) Entering the Limited Approach Boundary. Where there is a need for an unqualified person(s) that is not qualified on the equipment or methods involved as required in 110.2(D)(1)(b) to cross the limited approach boundary, a qualified additionally trained as required in 110.2(D)(1)(b) person shall:
(1) Advise him or her of the possible hazards and
(2) Provide continuous escort the unqualified person(s) while inside the limited approach boundary.
(3) Prohibit persons not qualified on the equipment or methods involved as required in 110.2(D)(1)(b) from crossing Under no circumstance shall the escorted unqualified person(s) be permitted to cross the restricted approach boundary.

Revise 130.4(D)
(4) Restricted Approach Boundary. Only qualified persons additionally trained as required in 110.2(D)(1)(b) shall be permitted to cross the restricted approach boundary.
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(D)(a) and Table 130.4(D)(b), unless one of the following conditions applies:
(1) The qualified person is insulated or guarded from the energized electrical conductors or circuit parts operating at 50 volts or more. Insulating gloves or insulating gloves and 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 contact exposed energized electrical conductors or circuit parts, a combination of 130.4(D)(1), 130.4(D)(2), and 130.4(D)(3) shall be used to protect the uninsulated body parts.
(2) The energized electrical conductors or circuit part operating at 50 volts or more are insulated from the qualified person and from any other conductive object at a different potential.
(3) The qualified person is insulated from any other conductive object.
| Revise 130.6(N) | (N) Safety Interlocks. Only qualified persons additionally trained as required in 110.2(D)(1)(b), following the requirements for working inside the restricted approach boundary as covered by 130.4(C) 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. |
| Revise 130.7(D)(1)(f) | (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 while an employee is working within the limited approach boundary of energized conductors or circuit parts that might be accidentally 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 be guarded to prevent unqualified persons from contact with the energized conductors or circuit parts. |
| Revise 130.7(E)(3) | (3) Attendees. If signs and barricades do not provide sufficient warning and protection from electrical hazards, an attendant shall be stationed to warn and protect employees. The primary duty and responsibility of an attendant providing manual signaling and alerting shall be to keep persons not qualified on the equipment or methods involved as required in 110.2(D)(1)(b) unqualified employees outside a work area where the unqualified employee or persons might be exposed to electrical hazards. An attendant shall remain in the area as long as there is a potential for employee persons to be exposed to the electrical hazards. |
| Revise 130.8(B) | (B) Determination of Insulation Rating. A qualified person additionally trained as required in 110.2(D)(1)(b) shall determine if the overhead electrical lines are insulated for the lines' operating voltage. |
| Revise 130.8(E) | (E) Approach Distances for Unqualified Persons. Whenever unqualified persons not qualified as required in 110.2(D)(1)(b) are working on the ground or in an elevated position near overhead lines, the location shall be such that the employee and the longest conductive object the employee might contact do not come closer to any unguarded, energized overhead power line than the limited approach boundary in Table 130.4(D)(a), column 2 or Table 130.4(D)(b), column 2. |
| Revise 205.1 | 205.1 Qualified Persons. Employees who perform maintenance on electrical equipment and installations shall be qualified persons additionally trained as required in 110.2(D)(1)(b) as required in Chapter 1 and shall be trained in, and familiar with, the specific maintenance procedures and tests required. |
| Revise 310.4(B) | (B) Unqualified Other Persons. (1) Training. Unqualified persons not qualified as required in 310.4(A) shall be trained to identify electrical hazards to which they could be exposed and the proper methods of avoiding the hazards. (2) In Cell Line Working Zone. When there is a need for a qualified person to enter the cell line working zone to perform a specific task, that person shall be advised of the electrical hazards by the designated qualified person in charge to ensure that the unqualified person is safeguarded. |
| Revise C.1.1 | C.1.1 Unqualified Persons. Safe Approach Distance by Other Than Qualified Persons. Unqualified persons not qualified on the equipment or methods involved as required in 110.2(D)(1)(b) are safe when they maintain a distance from the exposed energized conductors or circuit parts, including the longest conductive object being handled, so that they cannot contact or enter a specified air insulation distance to the exposed energized electrical conductors or circuit parts. This safe approach distance is the limited approach boundary. Further, persons must not cross the arc flash boundary unless they are wearing appropriate personal protective clothing and are under the close supervision of a qualified person. Only when continuously escorted by a qualified person should an unqualified person not qualified on the equipment or methods involved as required in 110.2(D)(1)(b) cross the limited approach boundary. Under and under no circumstance should an unqualified person cross the restricted approach boundary, where special shock protection techniques and equipment are required. |
| Revise C.2.1.2 | C.2.1.2 Column 2. The distances in column 2 are based on OSHA's rule for unqualified persons not qualified on the equipment or methods involved to maintain a 3.05 m (10 ft) clearance for all voltages up to 50 kV (voltage-to-ground), plus 100 mm (4.0 in.) for each 10 kV over 50 kV. |
| Revise F.3.1.4 | F.3.1.4 Training. Training, with regard to the proper interaction and for foreseeable inappropriate interaction with the electrical system, must be completed. The intent of the training is to ensure that all affected personnel are able to understand when and how hazardous situations can arise and how to best reduce the risk associated with those situations. Typically, training for individuals interacting with electrical systems will include technical information regarding hazards, hazardous situations, or both as well as information related to potential failure modes that could... |
affect risk. This type of training generally will be provided by a trainer who has an in-depth understanding of electrical system design, as well as experience in the field of adult education. Less technical training content could be appropriate in situations in which only awareness of electrical hazards is needed to ensure that unqualified personnel not qualified on the equipment or methods involved do not interact with the electrical system.

<table>
<thead>
<tr>
<th>Revise Figure F.5.2</th>
<th>Revise fourth row of Table as follows:</th>
</tr>
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<tbody>
<tr>
<td>Unqualified person</td>
<td>Persons not qualified on the equipment or methods involved</td>
</tr>
<tr>
<td>Performing electrical work</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Revise Figure J.1 Part II List Item (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(5) Means employed to restrict the access of unqualified persons not qualified on the equipment or methods involved from the work area</td>
</tr>
</tbody>
</table>

The following requirements contain the use of the term “qualified person” correctly within the context of the individual requirement and no revision is necessary.

- 110.4(A)(4)
- 110.4(B)(3)(b)  
- 130.7(A) IN #2  
- 130.8(F)(1)(2)  
- 205.14(3)  
- 310.4(A)  
- 310.5  
- 340.7  
- 350.2 Definition of Competent Person

**Statement of Problem and Substantiation for Public Input**

Clarity is needed. All persons have training and experience. All training and experience is different and we need to get that right in the standard. We need to “say exactly what we mean.” We must remove the level of subjectivity that presently exists. It is for that reason that we offer the following global changes to the use of the terms “qualified”, “Qualified Person”, “Unqualified Person”, “designated person” and “qualified electrician.”

**Submitter Information Verification**

- **Submitter Full Name:** MICHAEL JOHNSTON
- **Organization:** NATIONAL ELECTRICAL CONTRACTOR
- **Street Address:**
- **City:**
- **State:**
- **Zip:**
- **Submittal Date:** Mon Jun 29 15:07:52 EDT 2015
Global recommendation across the entire NFPA 70E document: Revise all mandatory text or tabular references to ASTM standards and other standards to informational notes or informative Annexes to improve usability and attain compliance with the NEC Style Manual, establish consistency with the NEC Style Manual requirements, and address implications of incorporation by reference laws regarding public access to legally adopted standards. See the recommendations below as suggested methods to correct these identified problems.

The NEC Style Manual Requirement related to references to other standards is as follows:

4.2 References to Other Standards. References to other standards shall not be in mandatory Code text. References to product standards shall be in an informative annex. References to other standards shall be in the Informational Notes.

Note that there are currently no exceptions to that NEC Style Manual requirement. All NFPA technical committees under the responsibility of the NEC Correlating Committee are expected to comply with the provisions in the NEC Style Manual.

To that end, this public input assists the committee to make the revisions necessary to correct the document. The following are suggested starting points that can effectively resolve identified problems with Section 130.7(C)(14), Table 130.7(C)(14), Table 130.7(F) and Table 130.7(C) (7)(c) and others...

Recommendation 1: Delete Section 130.7(C)(14) and insert a new Informational Note No. 2 following Section 130.7 as follows:

130.7(A) General. (text unchanged)
130.7(B) Care of Equipment. (text unchanged)

Informational Note No. 1: (text unchanged)

Informational Note No. 2: Annex Q provides a list of standards that contain necessary information on use, care, testing, and other requirements for personal protection equipment.

Renumber Sections 130.7(C)(15) as 130.7(C)(14)

Recommendation 2: Relocate Existing Tables 130.7(C)(14), Table 130.7(F) and the right hand column of Table 130.7(C)(7)(c) into Annex A or a newly created Informational Annex Q titled Standards on Protective Equipment, Rubber Insulating Equipment, and Other Protective Equipment. This new Annex can contain all the current tables that provide mandatory references to ASTM and other standards. The Table designations could remain the same to simplify the revision process of converting these mandatory references into informational references and guidance for the users.

Recommendation 3: Remove the right hand column of Table 130.7(C)(7)(c) and add the designation and title of these three ASTM reference standards to appropriate Table in new Annex Q. Change the asterisk to Informational Note as follows:

Informational Note: Annex Q provides the ASTM designations that contain information and requirements for in-service care of line hose and covers, insulating blankets, gloves, and sleeves.

Recommendation 4: Globally identify all references to ASTM and other standards within the text and either delete them or revise the section to include an informational note reference to that standard for additional information. If a requirement(s) from an ASTM standard is necessary in 70E, include that identifiable part of the ASTM standard in the text or tables of 70E, rather than referring to the entire standard or compliance. Many of the requirements in the ASTM documents apply to manufacturers. Users of 70E should not be expected to meet all those requirements, only those applicable to them. This recommendation is going to require an assigned task group to identify and revise each section where this NEC Style Manual violation and incorporation by reference problem occurs. On example is provided as follows:

Revise Section 130.7(E) as follows:

(E) Alerting Techniques.

(1) Safety Signs and Tags. Safety signs, safety symbols, or accident prevention tags shall be used where necessary to warn employees about electrical hazards that might endanger them. Such signs and tags shall meet the requirements of ANSI Z535, Series of Standards for Safety Signs and Tags, given in Table 130.7(F).

Informational Note No. 1: ANSI Z535.4-2011, Product Safety Signs and Labels, provides guidelines for suitable font sizes, words, colors, symbols, and location requirements for labels.

Informational Note No. 2: Safety signs, tags, and barricades used to identify energized “look-alike” equipment can be employed as an additional preventive measure.

Safety Signification: All NFPA Technical Committees are required to follow the NFPA Regulations Governing Committee Projects. NFPA has developed Style Manual requirements that must be followed when technical committees perform their work on their assigned standard(s). This is an important responsibility for all NFPA Technical Committees. The mandatory requirements in NFPA 70E should not reference other standards. This is in conflict with the NEC Style Manual and can create legal problems for NFPA. The informational notes development work consistently and in compliance with the regulations and applicable style manuals. The proposed revisions in this public input are only suggestions and possible starting points only. Since the NEC Correlating Committee has the responsibility to ensure that the various technical committees are meeting the Style Manual and regulations, this submitter requests that the 70E Committee and the Chair refer this global public input to the NEC Correlating Committee for guidance, direction, and possible action during the 2018 70E development cycle.
throughout the standard could provide the reference to these standards. By moving the tables and mandatory references to these standards, Style Manual conformance is achieved. The current mandatory references within text and tables also have the problems and implications of incorporation by reference (IBR) access, meaning that public access must be provided where the standard is legally adopted. I’m not sure the 70E Committee or NFPA intended this, but it is reality. If this is taken to task by someone, or by an organization, access will be required to be provided to these standards, and without charge. This is a serious problem for NFPA. By making converting the tables and ASTM references and Tables to informational notes or Informational Annexes, the user still has the appropriate references for guidance and additional information, if they need it. Most users of the standard typically do not have access to these standards and the contained information and requirements. Users of NFPA 70E need to comply with the requirements in NFPA 70E. If mandatory requirements are necessary from ASTM standards or others, then use the methods provided in the extracted material policy and process to incorporate the specific identifiable part of the ASTM standard(s) into 70E, for the benefit of users and enforcers. To reference the entire ASTM standard as a mandatory requirement is a blanket approach that sends users aimlessly into an unfamiliar standard. NFPA Technical Committees must all perform their standards development work consistently and in compliance with the regulations and applicable style manuals. This submitter requests that the 70E Committee and the Chair refer this global public input to the NEC Correlating Committee for direction and action during the 2018 70E development cycle.

Submitter Information Verification

Submitter Full Name: MICHAEL JOHNSTON
Organization: NATIONAL ELECTRICAL CONTRACTOR
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jun 30 07:42:06 EDT 2015
Public Input No. 35-NFPA 70E-2015 [ Global Input ]

Replace: "ANSI/ISA-61010-1 (82.02.01)/UL 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements"

with: "UL 61010-2-033, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 2: Particular Requirements for Hand-Held Multimeters and Other Meters, for Domestic and Professional Use, Capable of Measuring Mains Voltage".

Statement of Problem and Substantiation for Public Input

Informational notes in 110.4(A)(2) and 120.1(5) direct the reader to UL 61010-1 for requirements for testing instruments. However, anyone currently purchasing UL 61010-1 will not find any requirements for voltage measuring instruments, such as voltmeters. This includes measurement category ratings (CAT ratings). The UL 61010-2-033 standard is a new first edition issued in 2014 and is the correct standard to reference.

This also applies to Annex B.1.8.

Submitter Information Verification

Submitter Full Name: Mark Scott
Organization: Lawrence Berkeley National Laboratory
Street Address:
City:
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Submittal Date: Fri Feb 06 13:24:56 EST 2015
Public Input No. 395-NFPA 70E-2015 [ Global Input ]

Change “Forward” to “Foreword” in 70E header on pages 70-2, 70-3, and 70-4.

Statement of Problem and Substantiation for Public Input

The foreword section has the word “forward” incorrectly used in the header of the standard on the subsequent “foreword” pages. This may not be a global change (since it is editorial), but I did not see a way to include in Terraview other than as a global input.

Submitter Information Verification

Submitter Full Name: RON WIDUP
Organization: SHERMCO INDUSTRIES
Affiliation: NETA
Street Address:
City:
State:
Zip:
Submittal Date: Sat Jul 04 12:04:58 EDT 2015
Public Input No. 401-NFPA 70E-2015 [ Global Input ]

Global Change proposed throughout the entire document:
Make cal/cm² the primary measurement and J/cm² secondary measurement (in parenthesis).
In other words, change # J/cm² (# cal/cm²) to # cal/cm² (# J/cm²)

Additional Proposed Changes

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description Approved</th>
</tr>
</thead>
<tbody>
<tr>
<td>PubInput-Rohrer-70E-Global-Cal.doc</td>
<td></td>
</tr>
</tbody>
</table>

Statement of Problem and Substantiation for Public Input

For clarification and readability, I suggest that we place the "cal/cm²" value as the primary measurement for incident energy (list first and outside the parentheses), and place the "J/cm²" value in the secondary position (listed second and inside the parentheses). Although Joules is the metric measurement, and it is the measurement used in the 1584 calculations, PPE values and the values that appear on Arc Flash Risk Assessment Labels are predominantly (if not exclusively) listed in "cal/cm²," and as a result the end-users of this document relate to the cal/cm² value.

Submitter Information Verification

Submitter Full Name: TIM ROHRER
Organization: EXISCAN LLC
Affiliation: Exiscan LLC
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Sat Jul 04 13:38:46 EDT 2015
Public Input No. 419-NFPA 70E-2015 [ Global Input ]

Global change to modify the use of the words “maintain, maintains, or maintained” throughout the document when it applies to something other than “to keep in an existing state (as of repair, efficiency, or validity)”.

The following articles have the words “maintain, maintains, or maintained” used in such a way that it could be modified to meet the intent of the global change. Individual proposals will be submitted for each section. The problematic wording is shown [as such]. The suggested changes are highlighted in [brackets].

### Article 100

**Labeled.** Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that [maintains] (performs) periodic inspection of production of listed equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

**Listed.** Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that [maintains] (performs) periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

### 110.2(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] (retained) 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.

### 110.2(F)

**(F) Procedures.** The employer shall [maintain] (retain) a copy of the procedures required by this section and shall make the procedures available to all employees.

130.7(D)(1)(i)

(i) Physical or Mechanical Barriers. Physical or mechanical (field-fabricated) barriers shall be installed no closer than the restricted approach boundary distance given in Table 130.4(D)(a) and Table 130.4(D)(b). While the barrier is being installed, the restricted approach boundary distance specified in Table 130.4(D)(a) and Table 130.4(D)(b) shall be [maintained] (adhered to), or the energized conductors or circuit parts shall be placed in an electrically safe work condition.

130.8(F)

**(F) Vehicular and Mechanical Equipment.**

(1) Elevated Equipment. Where any vehicle or mechanical equipment structure will be elevated near energized overhead lines, it shall be operated so that the limited approach boundary distance of Table 130.4(D)(a), column 2 or Table 130.4(D)(b), column 2, is [maintained] (adhered to). However, under any of the following conditions, the clearances shall be permitted to be reduced:

205.2

205.2 Single-Line Diagram. A single-line diagram, where provided for the electrical system, shall be [maintained] (delete the word “maintained”) in a legible condition and shall be kept current.

205.5

205.5 Spaces About Electrical Equipment. All working space and clearances required by electrical codes and standards shall be [maintained] (adhered to).

340.7(B)

(6) [Maintaining] (Assuring) good housekeeping around the equipment and work space

### Annex C

**C.1 Preparation for Approach.** Observing a safe approach distance from exposed energized electrical conductors or circuit parts is an effective means of [maintaining] (assuring) electrical safety. As the distance between a person and the exposed energized conductors or circuit parts decreases, the potential for electrical accident increases.

**Annex C**

**C.1.1 Unqualified Persons, Safe Approach Distance.**

Unqualified persons are safe when they [maintain] (remain at) a distance from the exposed energized conductors or circuit parts, including the longest conductive object being handled, so that they cannot contact or enter a specified air insulation distance to the exposed energized electrical conductors or circuit parts.

Annex C

**C.2.1.2 Column 2.** The distances in column 2 are based on OSHA’s rule for unqualified persons to [maintain] (keep) a 3.05 m (10 ft) clearance for all voltages up to 50 kV (voltage-to-ground), plus 100 mm (4.0 in.) for each 10 kV over 50 kV.

Annex F

**F.1 Risk Assessment (General)**

Risk assessment includes a comprehensive review of the hazards, the associated foreseeable tasks, and the protective measures that are required in order to [maintain] (assure) a tolerable level of risk, including the following:

Annex G

9.4(3)

(3) The person in charge shall [maintain] (provide) a sign-in/sign-out log for all personnel entering the area.

Annex N

**N.4.5 Vehicles with Loads in Excess of 4.25 m (14 ft) in Height.**

This policy requires that all vehicles with loads in excess of 4.25 m (14 ft) in height use specific procedures to [maintain] (remain at) safe working clearances when in transit below overhead lines.

Annex N

**N.4.5(6)**

If proper working clearances cannot be [maintained] (adhered to), the job must be shut down until a safe route can be established or the necessary repairs or relocations have been completed to ensure that a safe working clearance has been achieved.

Statement of Problem and Substantiation for Public Input

Substantiation:

In electrical standards, the word “maintain” or “maintained” is most often used in the context of keeping electrical and personal protective equipment in an existing state of safe and reliable performance. We do this to assure the electrical worker and the public that the electrical and personal protective equipment is kept in a condition whereby it will...
operate as intended and as designed, years after it is placed in service.

However, there are several instances where the term “maintain, maintains, or maintained” is used when, for clarity, a different word or words could be used without altering the intent of the article or section.

Having the 70E standard focus on the important aspect of the words “maintain, maintains, or maintained” (keeping electrical and personal protective equipment in an existing state) as it applies to electrical safety in the workplace will add clarity, and will help focus the user of the document on the meaning, which will lead to a better understanding of the intent and ultimately a safer use and application of the words “maintain, maintains, or maintained”.

For reference, Merriam-Webster defines the word “maintain” as:

**MAINTAIN**

transitive verb

1: to keep in an existing state (as of repair, efficiency, or validity): preserve from failure or decline <maintain machinery>

2: to sustain against opposition or danger: uphold and defend <maintain a position>

3: to continue or persevere in: CARRY ON, KEEP UP <couldn’t maintain his composure>

4a: to support or provide for <has a family to maintain>

b: SUSTAIN <enough food to maintain life>

5: to affirm in or as if in argument: ASSERT <maintained that the earth is flat>

http://www.merriam-webster.com/dictionary/maintain

The following articles have the words “maintain, maintains, or maintained” used in such a way that it could be modified to meet the intent of the global change. Individual proposals will be submitted for each section. The problematic wording is shown [as such]. The suggested changes are highlighted in {brackets}.

**Article 100**

Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that [maintains] {performs} periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

**Article 100**

Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that [maintains] {performs} periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

**110.2(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] {retained} 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.

**110.2(F) (F) Procedures.** The employer shall [maintain] {retain} a copy of the procedures required by this section and shall make the procedures available to all employees.

**130.7(D)(1)(i) (i) Physical or Mechanical Barriers.** Physical or mechanical (field-fabricated) barriers shall be installed no closer than the restricted approach boundary distance given in Table 130.4(D)(a) and Table 130.4(D)(b). While the barrier is being installed, the restricted approach boundary distance specified in Table 130.4(D)(a) and Table 130.4(D)(b) shall be [maintained] {adhered to}, or the energized conductors or circuit parts shall be placed in an electrically safe work condition.

**130.8(F) (F) Vehicular and Mechanical Equipment.**

(1) Elevated Equipment. Where any vehicle or mechanical equipment structure will be elevated near energized overhead lines, it shall be operated so that the limited approach boundary distance of Table 130.4(D)(a), column 2 or Table 130.4(D)(b), column 2, is [maintained] {adhered to}. However, under any of the following conditions, the clearances shall be permitted to be reduced:

**205.2**

**205.2 Single-Line Diagram.** A single-line diagram, where provided for the electrical system, shall be [maintained] {delete the word “maintained”} in a legible condition and shall be kept current.

**205.5**

**205.5 Spaces About Electrical Equipment.** All working space and clearances required by electrical codes and standards shall be [maintained] {adhered to}.

**340.7(B) (6) [Maintaining] [Assuring] good housekeeping around the equipment and work space**

Annex C
C.1 Preparation for Approach. Observing a safe approach distance from exposed energized electrical conductors or circuit parts is an effective means of [maintaining] {assuring} electrical safety. As the distance between a person and the exposed energized conductors or circuit parts decreases, the potential for electrical accident increases.

Annex C

C.1.1 Unqualified Persons, Safe Approach Distance.

Unqualified persons are safe when they [maintain] {remain at} a distance from the exposed energized conductors or circuit parts, including the longest conductive object being handled, so that they cannot contact or enter a specified air insulation distance to the exposed energized electrical conductors or circuit parts.

Annex C

C.2.1.2 Column 2. The distances in column 2 are based on OSHA's rule for unqualified persons to [maintain] {keep} a 3.05 m (10 ft) clearance for all voltages up to 50 kV (voltage-to-ground), plus 100 mm (4.0 in.) for each 10 kV over 50 kV.

Annex F;

F.1 Risk Assessment (General)

Risk assessment includes a comprehensive review of the hazards, the associated foreseeable tasks, and the protective measures that are required in order to [maintain] {assure} a tolerable level of risk, including the following:

Annex G

9.4(3)

(3) The person in charge shall [maintain] {provide} a sign-in/sign-out log for all personnel entering the area.

Annex N

N.4.5

N.4.5 Vehicles with Loads in Excess of 4.25 m (14 ft) in Height. This policy requires that all vehicles with loads in excess of 4.25 m (14 ft) in height use specific procedures to [maintain] {remain at} safe working clearances when in transit below overhead lines.

Annex N

N.4.5(6)

If proper working clearances cannot be [maintained] {adhered to}, the job must be shut down until a safe route can be established or the necessary repairs or relocations have been completed to ensure that a safe working clearance has been achieved.

Submitter Information Verification

Submitter Full Name: RON WIDUP
Organization: SHERMCO INDUSTRIES
Affiliation: NETA
Street Address:
City:
State:
Zip:
Submittal Date: Sun Jul 05 13:28:40 EDT 2015
Public Input No. 434-NFPA 70E-2015 [ Global Input ]

Delete all mathematical symbols within the standard and replace with text for clarity.

Statement of Problem and Substantiation for Public Input

The use of the mathematical symbols for greater than, less than etc. has created confusion in the implementation of the standard. Clarity is needed.

Submitter Information Verification

Submitter Full Name: JAMES DOLLARD
Organization: IBEW LOCAL UNION 98
Street Address: 
City: 
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Zip: 
Submittal Date: Sun Jul 05 19:32:52 EDT 2015
Public Input No. 439-NFPA 70E-2015 [ Global Input ]

see attachment: Global Change: In all tables, add a new column on the left to number table rows.

Additional Proposed Changes

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
<th>Approved</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015_July_6_Global_Change_PI.docx</td>
<td>Global Change: In all tables, add a new column on the left to number table rows. The attached example is partially extracted from Table 130.7(C)(15)(A). It does not contain complete text.</td>
<td></td>
</tr>
</tbody>
</table>

Statement of Problem and Substantiation for Public Input

Our working group had a devil of a time working on tables such as 130.7(C)(15) during conference calls. We were continually interrupted by, “Wait a minute, where are you looking at?” On small tables it is not much of a problem, but on huge tables such as this [where a table goes on for page after page] we need some sort of reference. This public input proposes a GLOBAL CHANGE to make all tables in NFPA 70E include, as the first column, a row identification. The example included as part of this PI suggests how the rows could be numbered. Table 130.7(C)(15) has subsections (A) and (B). In this example, row identifiers have a corresponding prefix of (a) or (b), respectively, followed by a numeric identifier in ascending order; i.e., (a)(1), (a)(2), etc. Where a table has split cells, row identifiers for each split section are identified with an additional alphabetical suffix in ascending order; i.e., (a), (b), etc. This simple addition of a row identification column, which likely would require an update to the Style Manual, will go a long way toward making NFPA 70E more user-friendly.

Submitter Information Verification

Submitter Full Name: STEPHEN MCCLUER  
Organization: APC BY SCHNEIDER ELECTRIC  
Affiliation: Steve McCluer LLC  
Street Address:  
City:  
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Zip:  
Submittal Date: Mon Jul 06 09:47:04 EDT 2015
Table 130.7(C)(15)(A)(a) Arc Flash Hazard Identification of Alternating Current (ac) and Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Row</th>
<th>Task</th>
<th>Equipment Condition*</th>
<th>Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)(1)</td>
<td>Reading a panel meter…</td>
<td>Any</td>
<td>No</td>
</tr>
</tbody>
</table>
| (a)(2)(a) | Normal operation of a…. | All of the following:  
The equipment is properly installed  
The equipment is properly maintained  
All equipment doors are closed and secured  
All equipment covers are in place and secured  
There is no evidence of impending failure | No |
| (a)(2)(b) | One or more of the following:  
The equipment is not properly installed  
The equipment is not properly maintained  
Equipment doors are open or not secured  
Equipment covers are off or not secured  
There is evidence of impending failure | Yes |
| (a)(3) | For ac systems: Work on… | Any | Yes |
| (a)(4) | For dc systems: Work on… | Any | Yes |
| (a)(5)(a) | Voltage testing on individual… | All of the following  
The equipment is properly installed  
The equipment is properly maintained  
All equipment doors are closed and secured  
All equipment covers are in place and secured  
There is no evidence of impending failure | No |
| (a)(5)(b) | One or more of the following:  
The equipment is not properly installed  
The equipment is not properly maintained  
Equipment doors are open or not secured  
Equipment covers are off or not secured  
There is evidence of impending failure | Yes |
| (a)(6) | Removal or installation of CBs… | Any | Yes |
| (a)(7)(a) | Removal or installation of covers… | All of the following:  
The equipment is properly installed  
The equipment is properly maintained  
There is no evidence of impending failure | No |
| (a)(7)(b) | One or more of the following:  
The equipment is not properly installed  
The equipment is not properly maintained  
There is evidence of impending failure | |
| (a)(8) | Removal of bolted covers… | Any | Yes |
| (a)(9)(a) | Removal of battery intercell… | All of the following  
The equipment is properly installed  
The equipment is properly maintained | No |
Covers for all other equipment are in place and secured
There is no evidence of impending failure

(a)(9)(b) One or more of the following:
The equipment is not properly installed
The equipment is not properly maintained
Equipment doors are open or not secured
Equipment covers are off or not secured
There is evidence of impending failure

| (a)(10) Opening hinged doors… | Any | Yes |
| (a)(11) Perform infrared thermography… | Any | No |
| (a)(12) Application of temporary…. | Any | Yes |
| (a)(13) Work on control circuits… | Any | No |
| (a)(14) Insertion or removal of individual… | Any | Yes |
| (a)(15) Insertion or removal (racking)… | Any | Yes |
| (a)(16) Insertion or removal of plug-in… | Any | Yes |
| (a)(17) Insulated cable examination with no…Any | No |
| (a)(18) Insulated cable examination with… Any | Yes |
| (a)(19) Work on exposed energized… Any | Yes |
| (a)(20) Insertion and removal of revenue… Any | Yes |
| (a)(21) For dc systems, insertions or… Any | Yes |
| (a)(22) For dc systems, insertions or… Any | No |
| (a)(23) For dc systems, maintenance on… Any | No |
| (a)(24) For dc systems, work on exposed… Any | Yes |
| (a)(25)(a) Arc-resistant switchgear… | All of the following:
The equipment is properly installed
The equipment is properly maintained
All equipment doors are closed and secured
There is no evidence of impending failure |
| (a)(25)(b) One or more of the following:
The equipment is not properly installed
The equipment is not properly maintained
Equipment doors are open or not secured
Equipment covers are off or not secured
There is evidence of impending failure |
| (a)(26) Opening voltage transformers… Any | Yes |
| (a)(27) Outdoor disconnect switch… Any | Yes |
| (a)(28) Outdoor disconnect switch… Any | Yes |

Note: Hazard identification is one component of risk assessment. Risk assessment involves…

*The phrase properly installed, as used in this table means…
Table 130.7(C)(15)(A)(b) Arc Flash Hazard PPE Categories for Alternating Current (ac) Systems

<table>
<thead>
<tr>
<th>Row</th>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>(b)(1)</td>
<td>Panelboards or other equipment rated 240 V and below</td>
<td>1</td>
<td>485 mm (19 in.)</td>
</tr>
<tr>
<td></td>
<td>Parameters: maximum of 25kA...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b)(2)</td>
<td>Panelboards or other equipment rated &gt;240 V and up to 600 V</td>
<td>2</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td></td>
<td>Parameters: maximum of 55kA...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b)(3)</td>
<td>600-V class motor control centers (MCCs)</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td></td>
<td>Parameters: maximum of 65kA...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b)(4)</td>
<td>600-V class motor control centers (MCCs)</td>
<td>4</td>
<td>4.3 m (14 ft)</td>
</tr>
<tr>
<td></td>
<td>Parameters: maximum of 42kA...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b)(5)</td>
<td>600-V class switchgear (with power circuit breakers...</td>
<td>4</td>
<td>6 m (20 ft)</td>
</tr>
<tr>
<td></td>
<td>Parameters: maximum of 35kA...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b)(6)</td>
<td>Other 600-V class (277 V through 600 V, nominal) equipment</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td></td>
<td>Parameters: maximum of 65kA...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b)(7)</td>
<td>NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV</td>
<td>4</td>
<td>2 m (40 ft)</td>
</tr>
<tr>
<td></td>
<td>Parameters: maximum of 35kA...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b)(8)</td>
<td>Metal-clad switchgear, 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td></td>
<td>Parameters: maximum of 35 kA...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b)(9)</td>
<td>Arc-resistant switchgear Type 1 or 2 [for clearing times of...</td>
<td>N/A (doors closed)</td>
<td>N/A (doors closed)</td>
</tr>
<tr>
<td></td>
<td>Parameters: maximum of 35 kA...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b)(10)</td>
<td>Parameters: maximum of 35 kA...</td>
<td>4 (doors open)</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>(b)(11)</td>
<td>Other equipment 1 kV through 16 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td></td>
<td>Parameters: maximum of 35 kA...</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: For equipment rated 600 volts and below, and protected by upstream current-limiting fuses or...

Substantiation

Our working group had a devil of a time working on tables such as 130.7(C)(15) during conference calls. We were continually interrupted by, “Wait a minute, where are you looking at?” On small tables it is not much of a problem, but on huge tables such as this (where a table goes on for page after page) we need some sort of reference. This public input proposes a GLOBAL CHANGE to make all tables in NFPA 70E include, as the first column, a row identification. The example included as part of this PI suggests how the rows could be numbered. Table 130.7(C)(15) has subsections (A) and (B). In this example, Row identifiers have a corresponding prefix of (a) or (b), respectively, followed by a numeric identifier in ascending order; i.e., (a)(1), (a)(2), etc. Where a table has split cells, row identifiers for each split section are identified with an additional alphabetical suffix in ascending order; i.e., (a), (b), etc. This simple addition of a row identification column, which likely would require an update to the Style Manual, will go a long way toward making NFPA 70E more user-friendly.

Stephen W. McCluer,
Steve McCluer LLC
Public Input No. 47-NFPA 70E-2015 [ Global Input ]

Throughout standard remove references to the following and replace with the following:

1. ANSI/AIHA and replace with ANSI/ASSE.
2. ANSI/IEEE and replace with IEEE.
3. ANSI/ISA and replace with ISA.

Statement of Problem and Substantiation for Public Input

Recommended updates to correlate with PI-45 and PI-46.

Related Public Inputs for This Document

<table>
<thead>
<tr>
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<th>Relationship</th>
</tr>
</thead>
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<tr>
<td>Public Input No. 46-NFPA 70E-2015 [Section No. B.1]</td>
<td>Referenced current SDO names, addresses, standard names, numbers, and editions.</td>
</tr>
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</table>

Submitter Information Verification

Submitter Full Name: Aaron Adamczyk
Organization: [ Not Specified ]
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Sun Feb 08 00:12:11 EST 2015
Public Input No. 470-NFPA 70E-2015 [ Global Input ]

Renumber Article 130 so that AC shock tables and DC shock tables have separate section numbers. Renumber Article 130 so that AC PPE tables and DC PPE tables have separate section numbers.

Statement of Problem and Substantiation for Public Input

Referencing, revising, and using the standard is confusing and overly complicated due subdivisions of sections.

Submitter Information Verification

Submitter Full Name: PAUL DOBROWSKY
Organization: INNOVATIVE TECHNOLOGY SERVICES
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jul 06 12:55:09 EDT 2015
Public Input No. 471-NFPA 70E-2015 [ Global Input ]

Replace "short-circuit current" with "available fault current throughout the standard."

Statement of Problem and Substantiation for Public Input

The terms "available fault current" and "short circuit current" and similar terms are used inconsistently in this standard. The terms are also used inconsistently in the NEC but "available fault current", "fault current" or similar are used in several key sections such as 110.9, 110.10, 110.24, and in some definitions.

The term "short-circuit current rating" is defined in NEC Article 100 and the term "fault current" is used to describe what is available. Many definitions are extracted from NEC 100.

I understand a Correlating Committee task group has been established to review these terms. The terms used in NFPA 70E should be consistent with their use in the NEC.

Submitter Information Verification

Submitter Full Name: PAUL DOBROWSKY
Organization: INNOVATIVE TECHNOLOGY SERVICES
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Mon Jul 06 13:02:28 EDT 2015
Relocate Article 120 as Article 130 and Article 130 as 120.

Statement of Problem and Substantiation for Public Input

The requirement of establishing an electrically safe work condition appears in 130.2, after the process of establishing one is described in 120.1. It seems more appropriate to have the rule first, then how to implement the rule. I expect an interesting discussion.

Submitter Information Verification

Submitter Full Name: PAUL DOBROWSKY
Organization: INNOVATIVE TECHNOLOGY SERVICES
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jul 06 15:43:07 EDT 2015
Public Input No. 531-NFPA 70E-2015 [ Global Input ]

Relocate Article 120 as Article 130 and Article 130 as 120.

Statement of Problem and Substantiation for Public Input

The requirement of establishing an electrically safe work condition appears in 130.2, after the process of establishing one is described in 120.1. It seems more appropriate to have the rule first, then how to implement the rule.

Submitter Information Verification

Submitter Full Name: PAUL DOBROWSKY
Organization: INNOVATIVE TECHNOLOGY SERVICES
Street Address:
City: 
State: 
Zip: 
Submittal Date: Mon Jul 06 15:59:08 EDT 2015
Propose that all references to risk assessment be changed back to hazard analysis and the convoluted risk assessment annex be removed or revised to assist with JSA/JHA.

The risk assessment approach is: 1. Antithetical to OSHA requirements. This existing risk assessment approach is incongruent with OSHA’s Electrical Safety Related Work Practice Standard. OSHA does not allow hazard exposures predicated on such criteria as “severity of possible injuries” or “frequency of exposures”. Such an approach with respect to OSHA regulatory enforcement borders on what OSHA calls “willful” standard violations. OSHA trainers are already teaching this antithesis nationwide.

2. NFPA does not publish standard requirements that “lacks supporting scientific documentation”. In fact NFPA recently commissioned The Fire Protection Research Foundation to establish that requirements in NFPA 1911 lacked supporting scientific documentation and consequently the requirements did not belong in the NFPA standard. Interviews with 70E committee members indicate that NFPA 70E was modeled after other standards primarily, ANSI Z10 and other European Standards (including ISO Standards). In fact one committee member specifically stated that it was for the express purpose of “harmonization”.

NFPA 70E risk assessments was predicated and modeled upon “harmonized with ANSI Z10. ANSI Z10 has already determined and specifically stated within the standard (Z-10) that “It should be noted that the science behind determining the relationships between hazard, exposure and risk has not sufficiently evolved to be precise or predictive.” No study need be commissioned to establish the “junk science” behind “risk assessment” in NFPA 70E since it’s already stated in print in Z10.

An ANSI Z10 committee member interview has this committee member on record stating that it was never the intent that this Z10 standard be applied to or have (what he called) “hazard specific standards” modeled after it (such as an electrical hazard standard such as NFPA 70E). It was to be a very general in nature standard for overall and broader managerial guidance.

3. The ANSI Z10 standard was predicated modeled/ harmonized with several European Standards including ISO Standards. Research into these base standards indicate that the scope of these standards as well as intent and content address (in nearly all of these base standards) issues dealing with “global warming”, “climate change”, “carbon footprint”, and “carbon trading”, with ISO 2600 on “social responsibility” thrown in for good measure. None of this has any congruence or applicability to occupational safety or electrical hazards! In fact the United States has been writing electrical standards dating back to 1897 (first NEC) with many local and city electrical codes predating that as far back as 1890. We in the US have far greater experience writing electrical codes and standards predating European countries by at least a half century. They should be harmonizing with our electrical standards not the other way around.

It is recommended that all references to “risk assessment” be changed back to hazard analysis throughout 70E.

Statement of Problem and Substantiation for Public Input

Propose that all references to risk assessment be changed back to hazard analysis and the convoluted risk assessment annex be removed or revised to assist with JSA/JHA.

The risk assessment approach is: 1. Antithetical to OSHA requirements. This existing risk assessment approach is incongruent with OSHA’s Electrical Safety Related Work Practice Standard. OSHA does not allow hazard exposures predicated on such criteria as “severity of possible injuries” or “frequency of exposures”. Such an approach with respect to OSHA regulatory enforcement borders on what OSHA calls “willful” standard violations. OSHA trainers are already teaching this antithesis nationwide.

2. NFPA does not publish standard requirements that “lacks supporting scientific documentation”. In fact NFPA recently commissioned The Fire Protection Research Foundation to establish that requirements in NFPA 1911 lacked supporting scientific documentation and consequently the requirements did not belong in the NFPA standard. Interviews with 70E committee members indicate that NFPA 70E was modeled after other standards primarily, ANSI Z10 and other European Standards (including ISO Standards). In fact one committee member specifically stated that it was for the express purpose of “harmonization”.

NFPA 70E risk assessments was predicated and modeled upon “harmonized with ANSI Z10. ANSI Z10 has already determined and specifically stated within the standard (Z-10) that “It should be noted that the science behind determining the relationships between hazard, exposure and risk has not sufficiently evolved to be precise or predictive.” No study need be commissioned to establish the “junk science” behind “risk assessment” in NFPA 70E since it’s already stated in print in Z10.

An ANSI Z10 committee member interview has this committee member on record stating that it was never the intent that this Z10 standard be applied to or have (what he called) “hazard specific standards” modeled after it (such as an electrical hazard standard such as NFPA 70E). It was to be a very general in nature standard for overall and broader managerial guidance.

3. The ANSI Z10 standard was predicated modeled/ harmonized with several European Standards including ISO Standards. Research into these base standards indicate that the scope of these standards as well as intent and content address (in nearly all of these base standards) issues dealing with “global warming”, “climate change”, “carbon footprint”, and “carbon trading”, with ISO 2600 on “social responsibility” thrown in for good measure. None of this has any congruence or applicability to occupational safety or electrical hazards! In fact the United States has been writing electrical standards dating back to 1897 (first NEC) with many local and city electrical codes predating that as far back as 1890. We in the US have far greater experience writing electrical codes and standards predating European countries by at least a half century. They should be harmonizing with our electrical standards not the other way around.

It is recommended that all references to “risk assessment” be changed back to hazard analysis throughout 70E.

Submitter Information Verification

Submitter Full Name: JOHN GRZYWACZ
Organization: John "Grizzy" Grzywacz Inc.
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jul 06 17:11:03 EDT 2015
Use “available fault current” as a standard phrase for referring to the current available and use “short circuit current” only as part of the phrase “short-circuit current rating.”

Additional Proposed Changes

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Statement of Problem and Substantiation for Public Input

NOTE: This Public Input appeared as “Reject but Hold” in Public Comment No. 220 of the A2014 Second Draft Report for NFPA 70E and per the Regs. at 4.4.8.3.1.

The terms are not used consistently in the standard and it creates confusion. The NEC typically uses the terms in this manner.

Submitter Information Verification

Submitter Full Name: TC on EEW-AAA
Organization: NFPA Technical Committee on Electrical Safety in the Workplace
Street Address:
City:
State:
Zip:
Submittal Date: Thu Mar 26 16:21:22 EDT 2015
Public Input No. 90-NFPA 70E-2015 [ Global Input ]

Replace "5 J/cm\(^2\) (1.2 cal/cm\(^2\))" with "1.2 cal/cm\(^2\) (5 J/cm\(^2\))"

Additional Proposed Changes

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<tr>
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Statement of Problem and Substantiation for Public Input

NOTE: This Public Input appeared as “Reject but Hold” in Public Comment No. 237 of the A2014 Second Draft Report for NFPA 70E and per the Regs. at 4.4.8.3.1.

Change the order of J and cal/cm\(^2\) since the standard clearly defines Incident Energy as "typically expressed in cal/cm\(^2\)," and since no one in the field talks in J.

The change would provide clarity and consistency with the document.

Submitter Information Verification

Submitter Full Name: TC on EEW-AAA
Organization: NFPA Technical Committee on Electrical Safety in the Workplace
Street Address:
City:
State:
Zip:
Submittal Date: Thu Mar 26 16:46:46 EDT 2015
(A) Covered.

This standard addresses electrical safety-related work practices, safety-related maintenance requirements, and other administrative controls 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. 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

Informational Note: This standard addresses safety of workers whose job responsibilities entail interaction with energized electrical equipment and systems with potential exposure to energized electrical equipment and circuit parts hazards. Concepts in this standard are often adapted to other workers whose exposure to electrical hazards is unintentional or not recognized as part of their job responsibilities. The highest risk for injury from electrical hazards for other workers involve unintentional contact with overhead power lines and electric shock from machines, tools, and appliances.

Statement of Problem and Substantiation for Public Input

Revised "entail" to "involve" for clarity for users of the document.

Added "energized" to "electrical equipment" to correlate with the purpose of the document.

Revised "potential exposure to energized electrical equipment and circuit parts" to potential exposure to electrical hazards for clarity as "electrical hazards" is a defined term.

The Task Group used the following principles when deciding whether or not to use "exposed" with "energized":

1. Required when referring to shock hazards in general;
2. Not required when "exposed" is inferred (i.e. preceded by qualifier "within the limited approach boundary of...");
3. Not required when referring to all electrical hazards or arc flash hazards.

This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the term "exposed" with the term "energized."

Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the term "exposed" with the term "energized."

Street Address: City:
State:
Zip:
Submittal Date: Fri Jun 26 13:31:06 EDT 2015
Public Input No. 168-NFPA 70E-2015 [ Section No. 90.3 ]

90.3 Standard Arrangement.
This standard is divided into the introduction and three chapters, as shown in Figure 90.3. Chapter 1 applies generally for safety-related work practices; Chapter 2 applies to addresses safety-related maintenance requirements for electrical equipment and installations in workplaces; and Chapter 3 supplements or modifies Chapter 1 with safety requirements for special equipment.

Informative annexes are not part of the requirements of this standard but are included for informational purposes only.

Figure 90.3 Standard Arrangement.

Additional Proposed Changes

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Statement of Problem and Substantiation for Public Input

This Public input is one of three being submitted on behalf of a task group consisting of Rod West, Carey Cook, Daleep Mohla, James W. Stallcup (Jr.), Samuel Stonerock, and Tom Dyson. These inputs address Sections 90.3, 90.4 and 90.5. The first PI addresses Section 90.3. The proposal is to modify this section to add clarity and reduce redundant language. As part of this, a new figure 90.3 is included. The second PI addresses Section 90.4. This proposal is to eliminate this entire section to be consistent with the format in the NEC. The list of informative annexes is redundant with the table of contents which appears just a few pages before this in the standard. It is suggested that subsequent sections not be renumbered but rather leave 90.4 open for potential future to address enforcement of this standard. The third PI adds a new section, 90.5(D), to explain the informative annexes to users of the standard. The proposed language for 90.5(D) is modeled after 90.5(D) in the NEC.

Submitter Information Verification

Submitter Full Name: Rodney West
Organization: Schneider Electric
Street Address:
City:
State:
Zip:
Submittal Date: Fri Jun 12 09:56:29 EDT 2015
Public Input No. 169-NFPA 70E-2015 [Section No. 90.4]

90.4 Organization

This standard is divided into the following 3 chapters and 16 informative annexes:

1. Chapter 1 - Safety-Related Work Practices
2. Chapter 2 - Safety-Related Maintenance Requirements
3. Chapter 3 - Safety Requirements for Special Equipment
5. Informative Annex B - Informational References
6. Informative Annex C - Limits of Approach
7. Informative Annex D - Incident Energy and Arc Flash Boundary Calculation Methods
8. Informative Annex E - Electrical Safety Program
10. Informative Annex G - Sample Lockout/Tagout Procedure
11. Informative Annex H - Guidance on Selection of Protective Clothing and Other Personal Protective Equipment
12. Informative Annex I - Job Briefing and Planning Checklist
13. Informative Annex J - Energized Electrical Work Permit
14. Informative Annex K - General Categories of Electrical Hazards
15. Informative Annex L - Typical Application of Safeguards in the Cell Line Working Zone
18. Informative Annex O - Safety-Related Design Requirements
19. Informative Annex P - Aligning Implementation of This Standard with Occupational Health and Safety Management Standards

Statement of Problem and Substantiation for Public Input

This Public input is one of three being submitted on behalf of a task group consisting of Rod West, Carey Cook, Daleep Mohla, James W. Stallcup (Jr.), Samuel Stonerock, and Tom Dyson. These inputs address Sections 90.3, 90.4 and 90.5. The first PI addresses Section 90.3. The proposal is to modify this section to add clarity and reduce redundant language. As part of this, a new figure 90.3 is included. The second PI addresses Section 90.4. This proposal is to eliminate this entire section to be consistent with the format in the NEC. The list of informative annexes is redundant with the table of contents which appears just a few pages before this in the standard. It is suggested that subsequent sections not be renumbered but rather leave 90.4 open for potential future to address enforcement of this standard. The third PI adds a new section, 90.5(D), to explain the informative annexes to users of the standard. The proposed language for 90.5(D) is modeled after 90.5(D) in the NEC.

Submitter Information Verification

Submitter Full Name: Rodney West
Organization: Schneider Electric
Street Address:
City:
State:
Zip:
Submittal Date: Fri Jun 12 10:19:11 EDT 2015
Public Input No. 170-NFPA 70E-2015 [ New Section after 90.5(C) ]

90.5(D) Informative Annexes.
Nonmandatory information relative to the use of this standard is provided in informative annexes. Informative annexes are not part of the requirements of this standard, but are included for information purposes only.

Statement of Problem and Substantiation for Public Input

This Public input is one of three being submitted on behalf of a task group consisting of Rod West, Carey Cook, Daleep Mohia, James W. Stallcup (Jr.), Samuel Stonerock, and Tom Dyson. These inputs address Sections 90.3, 90.4 and 90.5. The first PI addresses Section 90.3. The proposal is to modify this section to add clarity and reduce redundant language. As part of this, a new figure 90.3 is included. The second PI addresses Section 90.4. This proposal is to eliminate this entire section to be consistent with the format in the NEC. The list of informative annexes is redundant with the table of contents which appears just a few pages before this in the standard. It is suggested that subsequent sections not be renumbered but rather leave 90.4 open for potential future to address enforcement of this standard. The third PI adds a new section, 90.5(D), to explain the informative annexes to users of the standard. The proposed language for 90.5(D) is modeled after 90.5(D) in the NEC.

Submitter Information Verification

Submitter Full Name: Rodney West
Organization: Schneider Electric
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Fri Jun 12 10:22:48 EDT 2015
Maintenance, Condition of
Condition of Maintenance is the state of the electrical equipment at the time of interaction, factoring in the necessary adjustments, lubrication, cleaning, torquing, and other related tasks in accordance with the manufacturer’s recommendations and applicable industry codes and standards.

Statement of Problem and Substantiation for Public Input
The phrase “condition of maintenance” exists in two locations, 110.1(B) and 130.5(3). Adding the definition provides clarity to the intent of the phrase.

Submitter Information Verification
Submitter Full Name: RON WIDUP
Organization: SHERMCO INDUSTRIES
Affiliation: NETA
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Sat Jul 04 11:57:56 EDT 2015
Title of New Content

Boundary, Prohibited Approach. An approach limit at a distance from an exposed energized electrical conductor or circuit part within which work is considered the same as making contact with the electrical conductor or circuit part.

Statement of Problem and Substantiation for Public Input

The elimination of the Prohibited Approach Boundary creates a dangerous situation in managing work performed on uninsulated energized conductors. There is a difference between working near uninsulated energized conductors and intentionally touching them. The hazard (and the risk) is greater. OSHA, in Section 1910.333(c)(2), requires persons working on energized equipment to have knowledge in special precautionary techniques. While not defined by OSHA, OSHA recognizes the difference between working on and working near.

The Committee removed the Prohibited Approach Boundary because there were no additional requirements for working within the Prohibited Approach Boundary. The committee should have corrected that issue instead of removing the boundary. Many companies are utilizing the Energized Electrical Work Permit for working within the Limited Approach Boundary, as the 2012 Edition of NFPA 70E recommended. Additionally, companies have developed separate permitting requirements for working on uninsulated energized conductors. By removing the Prohibited Approach Boundary has set up a situation where many people are removing any requirements associated with “working on”. This will increase the number of “working on” tasks that will be performed and increase injuries associated with it. By removing this boundary the committee has inadvertently condoned “working on” by stating there are no additional requirements for performing “working on”. The arc flash hazard has not been considered in this. If the task exposes a person to an arc flash hazard the hazard to the hands is considerably higher than to other parts of the body that are further away from the arcing point.

The Prohibited Approach Boundary needs to be reinstated as it was defined and presented in the 2012 Edition of NFPA 70E.

Submitter Information Verification

Submitter Full Name: DANNY LIGGETT
Organization: THE DUPONT COMPANY INC
Affiliation: Self
Street Address:
City:
State:
Zip:
Submittal Date: Sun Jul 05 10:47:04 EDT 2015
Boundary, Arc Flash.

When an arc flash hazard exists, an An approach limit at a distance from a prospective, an arc source within which a person could receive a second degree burn if an electrical arc flash were to occur, at which incident energy equals 5 J/cm² (1.2 cal/cm²).

Informational Note: According to the Stoll skin burn injury model the onset of a second degree burn is possible by an exposure of unprotected skin is likely to an electric arc flash above the incident energy level occur at an exposure of 5 J/cm² (1.2 cal/cm²).

Statement of Problem and Substantiation for Public Input

This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.

The proposed definition is consistent with:
1. Section 130.5(B) Arc flash boundary, which states: The arc flash boundary shall be the distance at which the incident energy equals 5 J/cm² (1.2 cal/cm²).
2. Risk assessment principles: Stating that the boundary exists when the hazard exists can become a circular argument. By defining the boundary scientifically this is avoided.

Submitter Information Verification

<table>
<thead>
<tr>
<th>Field</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Submitter Full Name</td>
<td>DANIEL ROBERTS</td>
</tr>
<tr>
<td>Organization</td>
<td>SCHNEIDER ELECTRIC</td>
</tr>
<tr>
<td>Affiliation</td>
<td>This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.</td>
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<tr>
<td>Street Address</td>
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<tr>
<td>Submittal Date</td>
<td>Mon Jun 29 15:45:46 EDT 2015</td>
</tr>
</tbody>
</table>
Arc Flash Hazard.
A dangerous condition associated with the possible release of energy caused by an electric arc.

Informational Note No. 1: An arc flash hazard may exist 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. Under normal operating conditions, enclosed energized equipment that has been properly installed and maintained is not likely to pose an arc flash hazard.

Informational Note No. 2: See Table 130.7(C)(15)(A)(a) for examples of activities that could pose an arc flash hazard.

Statement of Problem and Substantiation for Public Input
The term "arc flash" hazard does not effectively emphasize the threat of thermal burn injury or convey the wide range of hazards presented by an arcing fault explosion. A "flash" typically refers to a flash of brief, intense light, and arcing incidents often present a visual hazard. However, a "flash" burn has been defined in at least some medical literature as a superficial burn. (Substantiation is provided in 2015 IEEE ESW paper which has been accepted to IEEE IAS Transactions.)

Submitter Information Verification
Submitter Full Name: TAMMY GAMMON
Organization: [ Not Specified ]
Street Address: City:
State:
Zip:
Submittal Date: Wed Jun 03 14:45:06 EDT 2015
### Public Input No. 319-NFPA 70E-2015 [Definition: Arc Flash Hazard.]

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<th>Arc Flash Hazard.</th>
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<tbody>
<tr>
<td>A dangerous condition associated with the possible release of energy caused by an electric arc.</td>
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</tbody>
</table>

- Informational Note No. 1: An **arc flash hazard may exist** 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, **is not likely to pose an arc flash hazard**. Informational Note No. 2: See Table 130.7(C)(15)(A)(a) for examples of activities that could **increase the likelihood of an arc flash hazard incident occurring**.

### Statement of Problem and Substantiation for Public Input

This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.

The proposed revision seeks to harmonize the Informational Note No. 1 with the risk assessment principles found in the document. Rather than state that a hazard does or does not exist, it is more appropriate to refer to the likelihood of occurrence of an arc flash incident. The phrase “likelihood of occurrence” occurs 17 times in a similar context in the 2015 edition of the document.

### Submitter Information Verification

<table>
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<tr>
<th>Name</th>
<th>Organization</th>
<th>Street Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>DANIEL ROBERTS</td>
<td>SCHNEIDER ELECTRIC</td>
<td>This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.</td>
</tr>
<tr>
<td>City:</td>
<td>State:</td>
<td>Zip:</td>
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**Submit Date:** Mon Jun 29 15:33:45 EDT 2015
Public Input No. 411-NFPA 70E-2015 [ Definition: Arc Flash Hazard. ]

Arc Flash Hazard.
A dangerous condition associated with the possible release of energy caused by an electric arc.
Informational Note No. 1: An arc flash hazard may exist 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. Under normal operating conditions, enclosed energized equipment that has been properly installed and maintained is not likely to pose an arc flash hazard. Informational Note No. 2: See Table 130.7(C)(15)(A)(a) for examples of activities that could pose an arc flash hazard.

Statement of Problem and Substantiation for Public Input

This statement is not accurate. If the electrical equipment contained within the enclosure has an arc flash incident energy of 1.2 cal/cm² or greater then there is the possibility of an arc flash hazard. Experience within the company that I work for has shown that equipment with an arc flash incident energies as low as 1.2 cal/cm² will cause the door of the enclosure to open in an arcing event. This in turn exposes the person, interacting with the electrical equipment, to potential injury. To have this statement in the standard is misleading and gives people a false sense of security. The arc flash hazard is a serious hazard which causes in excess of 4000 injuries per year. Recent testing has also shown that doors of electrical equipment do come open in arcing events.

Submitter Information Verification

Submitter Full Name: DANNY LIGGETT
Organization: THE DUPONT COMPANY INC
Affiliation: Self
Street Address:
City:
State:
Zip:
Submittal Date: Sun Jul 05 09:59:49 EDT 2015
Public Input No. 472-NFPA 70E-2015 [Definition: Arc Flash Hazard]

Arc Flash Hazard.
A dangerous condition associated with the possible release of energy caused by current leaving the intended path and creating an electric arc.

Informational Note No. 1: An arc flash hazard may exist 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. Under normal operating conditions, enclosed energized equipment that has been properly installed and maintained is not likely to pose an arc flash hazard.

Informational Note No. 2: See Table 130.7(C)(15)(A)(a) for examples of activities that could pose an arc flash hazard.

Statement of Problem and Substantiation for Public Input
The suggested change is intended to help clarify when an arc flash hazard exists.
This PI does not change the Informational Notes

Submitter Information Verification
Submitter Full Name: PAUL DOBROWSKY
Organization: INNOVATIVE TECHNOLOGY SERVICES
Street Address:
City:
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Submittal Date: Mon Jul 06 13:18:42 EDT 2015
Public Input No. 330-NFPA 70E-2015 [Definition: Arc Rating.]

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: Traditionally flame resistant fabrics are those that meet the requirements of NFPA 701, Standard Methods of Fire Tests for Flame Propagation of Textiles and Films. In this standard, clothing that is arc-rated and flame resistant, in accordance with ASTM F1506, is required to meet the requirements of the fire test in ASTM D6413/D6413M, Standard Test Method for Flame Resistance of Textiles (Vertical Test). Therefore flame resistant fabrics in accordance with NFPA 701 will not be suitable for use in arc-rated clothing.

Informational Note No. 3: 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. 4: 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 specimen is predicted to cause the onset of a second degree skin burn injury based on the Stoll curve.

Informational Note No. 5: 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 an area of 1.6 cm² (0.5 in²) or an opening of 2.5 cm (1.0 in.) in any dimension.


Statement of Problem and Substantiation for Public Input

The traditional way in which the term flame resistant is used is by referring to testing via NFPA 701. This is not how the term flame resistant is used in NFPA 70E, since the term is based on the fire test in ASTM F1506. In ASTM F1506 the fire test used is ASTM D6413. Therefore, the new informational note is an important clarification.

Related Public Inputs for This Document

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<td>Public Input No. 331-NFPA 70E-2015 [Section No. A.3.2]</td>
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</table>
Public Input No. 322-NFPA 70E-2015 [ Definition: Boundary, Limited Approach. ]

**Boundary, Limited Approach.**
An approach limit at a distance from an exposed energized electrical conductor or circuit part within which a shock hazard exists.

**Statement of Problem and Substantiation for Public Input**

This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.

The brevity of the proposed revised definition provides clarity.

The proposed revision is also consistent with risk assessment principles: Stating that the boundary exists when the hazard exists can become a circular argument. This is avoided when the boundary is defined by solely using the clearly defined term “exposed.”

**Submitter Information Verification**

Submitter Full Name: DANIEL ROBERTS  
Organization: SCHNEIDER ELECTRIC  
Affiliation: This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.

Street Address:  
City:  
State:  
Zip:  
Submittal Date: Mon Jun 29 15:55:53 EDT 2015
**Public Input No. 183-NFPA 70E-2015 [ Definition: Boundary, Restricted Approach. ]**

**Boundary, Restricted Approach.**

An approach limit at a distance from an exposed energized electrical conductor or circuit part within which there is an increased likelihood of electric shock, due to electrical arc-over combined with inadvertent movement, for personnel working in close proximity to the energized electrical conductor or circuit part. Above 750 volts AC, this boundary is analogous to OSHA’s Minimum Approach Distance which, if penetrated, is considered the same as making contact with the electrical conductor or circuit part.

**Statement of Problem and Substantiation for Public Input**

The definition, "Boundary, Prohibited Approach", was not carried forward from the 2012 edition to the 2015 edition, therefore there is currently no analogous definition in the 2015 edition that identifies work that is considered the same as making contact with the electrical conductor or circuit part even though an employee is not actually making contact. Penetrating OSHA’s Minimum Approach Distance identifies work that is considered the same as making contact with the electrical conductor or circuit part. Therefore adding to the definition referencing OSHA’s Minimum Approach Distance conforms the Restricted Boundary to OSHA’s Minimum Approach Distance.

**Submitter Information Verification**

Submitter Full Name: ALVIN HAVENS  
Organization: e-Hazard Management, LLC  
Street Address:  
City:  
State:  
Zip:  
Submittal Date: Tue Jun 16 16:37:51 EDT 2015
**Public Input No. 323-NFPA 70E-2015 [ Definition: Boundary, Restricted Approach. ]**

**Boundary, Restricted Approach.**
An approach limit at a distance from an exposed energized electrical conductor or circuit part within which there is an increased likelihood of electric shock due to electrical arc-over combined with inadvertent movement, for personnel working in close proximity to the energized electrical conductor or circuit part.

**Statement of Problem and Substantiation for Public Input**

This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.

1. The brevity of the proposed revised definition provides clarity.
2. The deleted phrase does not add any additional value to the definition.

**Submitter Information Verification**

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Mon Jun 29 16:01:27 EDT 2015
Public Input No. 443-NFPA 70E-2015 [ Definition: Electrical Hazard. ]

**Electrical Hazard.**

A dangerous condition such that contact or equipment failure can result in electric shock, arc flash burn, thermal burn, or blast, associated with the possible release of energy caused by an electric arc or by contact or approach to energized electrical conductors or circuit parts.

*Informational Note:* Class 2 power supplies, listed low voltage lighting systems, and similar sources are examples of circuits or systems that are not considered an electrical hazard.

**Statement of Problem and Substantiation for Public Input**

This PI is intended to clarify the present definition of electrical hazard. As written, the definition tries to define the hazard by the injuries that can result rather than by the characteristics of the hazard. In addition, the definition uses a vague concept of "equipment failure." While equipment failure is not a hazard, it could possibly create a hazardous condition depending on the nature of the failure.

It is well understood that a hazard is a source of harm (70E definition: A source of possible injury or damage to health). The definition of electrical hazard should therefore describe the source of harm, not the cause of the source or the nature of harm. Note how the definitions of arc flash hazard and shock hazard achieve this goal. This PI is intended to align the definition of electrical hazard with this approach.

**Submitter Information Verification**

Submitter Full Name: RODNEY WEST
Organization: SCHNEIDER ELECTRIC
Street Address: 
City: 
State: 
Zip: 
Submital Date: Mon Jul 06 10:06:36 EDT 2015
Public Input No. 73-NFPA 70E-2015 [ Definition: Electrical Hazard. ]

Electrical Hazard.
A dangerous condition such that contact or equipment failure can result in electric shock, arc flash burn, thermal burn, or arc blast injury. (see annex K).

Informational Note: Class 2 power supplies, listed low voltage lighting systems, and similar sources are examples of circuits or systems that are not considered an electrical hazard.

Statement of Problem and Substantiation for Public Input
To make the Electrical Hazard definition consistent with Annex K.

Related Public Inputs for This Document

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Submitter Information Verification
Submitter Full Name: ZANE MEVEY
Organization: CITY OF WICHITA
Street Address: City: State: Zip: Submittal Date: Wed Mar 18 22:10:07 EDT 2015
Electrical Safety.
Recognizing, identifying hazards associated with the use of electrical energy and taking precautions so that hazards do not cause injury or death utilizing control measures from the hierarchy of risk control methods to reduce the risk associated with those hazards.

Statement of Problem and Substantiation for Public Input
This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.

The proposed revision seeks to harmonize the definition with the risk assessment principles in use throughout the document of “hazard identification” and the “hierarchy of risk control” in the found document. See 110.1(G) and 110.2(D)(1)(b)(4).

Submitter Information Verification
Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Mon Jun 29 16:05:57 EDT 2015
### 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 ensure the absence of voltage, and grounded if temporary protective grounding equipment has been applied, if determined necessary.

### Statement of Problem and Substantiation for Public Input
Change the term "grounded" to "temporary protective grounding equipment" to be consistent with 120.3.

### Submitter Information Verification

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<th>Submitter Full Name:</th>
<th>PAUL DOBROWSKY</th>
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<td>Submittal Date:</td>
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Qualified Person.
One who has demonstrated skills and knowledge related to the construction and operation of electrical equipment and installations and has received safety training to identify and avoid the hazards involved and reduce the associated risk.

Statement of Problem and Substantiation for Public Input
This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.

The proposed revision seeks to harmonize the definition with the risk assessment principles in use throughout the document: hazards are identified and risk is reduced. See 110.1(G) and 110.2(D)(1)(b)(4).

Submitter Information Verification

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<td>Mon Jun 29 16:09:24 EDT 2015</td>
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Public Input No. 479-NFPA 70E-2015 [ Definition: Risk Assessment. ]

Risk Assessment.
An overall process that identifies hazards, estimates the potential severity likelihood of occurrence of injury or damage to health, estimates the likelihood potential severity of occurrence of injury or damage to health, and determines if protective measures are required.

Informational Note: As used in this standard, arc flash risk assessment and shock risk assessment are types of risk assessments.

Statement of Problem and Substantiation for Public Input
Change the order of the sentence to match what is used in the definition of risk for consistency. Likelihood of occurrence occurs first, then severity.

Submitter Information Verification
Submitter Full Name: PAUL DOBROWSKY
Organization: INNOVATIVE TECHNOLOGY SERVICES
Street Address: 
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State: 
Zip: 
Submittal Date: Mon Jul 06 13:48:47 EDT 2015
Shock Hazard
A dangerous condition associated with the possible release of energy, having the potential for injury resulting from a combination of the magnitude of current flowing through the body, the path of the current flow through the body and the time duration of exposure, caused by contact or approach to energized electrical conductors or circuit parts.

Statement of Problem and Substantiation for Public Input

The potential for injury due to shock is primarily determined by the magnitude of current flowing through the body, the path of the current flow through the body and the time duration of exposure. A companion PI is being submitted to change globally the phrases “50 volts and above” and “below 50 volts”, and other similar phrases, to “where a shock hazards exists” and “where no shock hazard exists” respectively. This revision of the term “Shock Hazard” is needed to support that global revision of the phrases. Changing those phrases is necessary in order to correctly describe when a person is exposed to the potential for injury due to shock and when they are not. The voltage level is only one of the variables that determine this potential. The path through the body is sufficiently covered by the existing text of the standard. The time duration is not. These companion PIs introduce this concept and includes time duration as one of the variables. Time duration is critical in determining the potential for shock injury and thus protective measure required to prevent such injury.

Submitter Information Verification

Submitter Full Name: DAVID PACE
Organization: OLIN CORPORATION
Affiliation: Self
Street Address:
City:
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Zip:
Submittal Date: Mon Jun 22 16:56:04 EDT 2015
Public Input No. 260-NFPA 70E-2015 [ Definition: Shock Hazard. ]

Shock Hazard.
A dangerous condition associated with the possible release of energy caused by contact or approach to exposed, energized electrical conductors or circuit parts.

Statement of Problem and Substantiation for Public Input

The term “exposed” is added as the reference is to shock hazards in general.
The Task Group used the following principles when deciding whether or not to use “exposed” with “energized”:
1. Required when referring to shock hazards in general;
2. Not required when “exposed” is inferred (i.e. preceded by qualifier “within the limited approach boundary of…”);
3. Not required when referring to all electrical hazards or arc flash hazards.
This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the term “exposed” with the term “energized.”

Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the term “exposed” with the term “energized.”
Street Address:
City:
State:
Zip:
Submittal Date: Fri Jun 26 13:47:12 EDT 2015
Public Input No. 184-NFPA 70E-2015 [ Definition: Working On (energized electrical conductors or ... ]

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 on energized electrical conductors or circuit parts, with approved test equipment that does not require making any physical change to the equipment, electrical circuit parts or conductors; repair is any physical alteration of electrical equipment, to electrical circuit parts or conductors (such as making or tightening connections, removing or replacing components, etc.).

Statement of Problem and Substantiation for Public Input

1. The definition starts out using the term “electrical circuit parts and conductors” and then switches to “electrical equipment” when defining the two categories of “working on”. Replacing the term “electrical equipment” with the term “electrical circuit parts and conductors” will make the second half of definition consistent with the first half of the definition.
2. Making it clear in the second half of the definition that the repair work is physical alteration of electrical circuit parts and conductors as opposed to physical alteration of electrical equipment will support Article 130.2(B)(1)(1), requiring an Energized Electrical Work Permit when work is performed within the restricted approach boundary, i.e., physically altering electrical circuit parts and conductors.

Submitter Information Verification

Submitter Full Name: ALVIN HAVENS
Organization: e-Hazard Management, LLC
Street Address:
City:
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Zip:
Submittal Date: Tue Jun 16 16:48:41 EDT 2015
Incident Energy Exposure Level (IEEL)

Please consider adding a definition for Incident Energy Exposure Level. The current definition for Incident Energy does not adequately address a workers exposure level. Article 130.5(C)(1) states that the incident energy exposure level shall be based on the working distance of the employee's face and chest areas from a prospective arc source for the specific task to be performed. Incident Energy Exposure Level is not currently in the list of definitions.

In addition to this proposed change I would like to suggest modifying the definition for Incident Energy to identify a specific distance from an arcing point. Currently when an incident energy is initially calculated it is done at a default distance of 18 inches (the distance from the tips of the fingers to the chest area). An employee's actual exposure level is effected by distance and other factors and further calculations are needed to establish the employee's actual exposure level. If the definition for Incident Energy Exposure Level was added and the Incident Energy definition changed to reflect a distance of 18" then these two definitions could be easily distinguished from one another.

The problem that I see occurring is that a calculation for Incident energy at 18 inches is completed and labels are then placed on equipment indicating the incident energy at 18 inches and no further calculations are performed. The incident energy listed on the label then becomes the trigger for the arc rated clothing an employee is required to wear regardless of the task performed or the distance he is from the equipment. Defining incident energy as "The amount of thermal energy impressed on a surface, 18 inches from the source, generated during an electrical arc event. Incident energy is typically expressed in calories per square centimeter (cal/cm²)." will distinguish incident energy from the incident energy exposure level of the employee.

Statement of Problem and Substantiation for Public Input

Confusion between incident energy and incident energy exposure level would be cleared up with the addition of a definition for incident energy exposure level. Additionally arc rated clothing would be selected based on a workers actual exposure rather than applying the default boundary of 18 inches for a calculated incident energy for every situation.

Submitter Information Verification

Submitter Full Name: RICHARD WATERS
Organization: BATELLE ENERGY ALLIANCE
Street Address:
City:
State:
Zip:
Submittal Date: Tue Apr 28 16:56:51 EDT 2015
Public Input No. 141-NFPA 70E-2015 [ New Definition after Definition: Electrical Safety. ]

**Definition of Electrical Safety Program**

Electrical Safety Program: A safety management system for the long-term implementation of electrical safety principles, consisting of documented policies, processes, and procedures, that directs activities appropriate to the risk associated with electrical hazards. As part of the employer’s overall Occupational Health and Safety Management System (OHSMS), the electrical safety program is subject to auditing and other continuous improvement processes that ensure incorporation of applicable best practices and effectiveness in preventing electrical injuries.

**Statement of Problem and Substantiation for Public Input**

Adds a definition for Electrical Safety Program and ties it to the Occupational Health and Safety Management System (OHSMS) in ANSI Z10.

The lack of definition introduces some significant uncertainty in the term. Article 110.1 introduces the term but without a unifying concept of what it should be, only identifying certain elements. While subject matter experts are used to the concept and enjoy familiarity with the term, organizations trying to implement an electrical safety program from scratch often struggle with defining exactly what is being discussed. This is especially true when attempting to build a convincing business case for establishing an electrical safety program, and securing senior management support and funding for such a major initiative.

As a result, electrical safety initiatives are often stunted and unable to reach the sustainable momentum necessary to ensure long-term effectiveness. Instead, companies can point to abbreviated paper policies that offer a semblance of compliance but no real substance. This can be worse than not having a documented policy at all, as embedded safety professionals then struggle to define exactly what is missing.

**Submitter Information Verification**

Submitter Full Name: Mark Scott  
Organization: Lawrence Berkeley National Laboratory  
Street Address:  
City:  
State:  
Zip:  
Submittal Date: Sun Apr 26 16:46:02 EDT 2015
Add to Article 100, Definitions, the definition for “Employee (Person) In Charge”
Employee (Person) In Charge: A qualified person in charge of completing an electrical task and the safety of assigned personnel. (This is not to be confused with a management supervisor who might be an unqualified person.)

Statement of Problem and Substantiation for Public Input

1. 70E uses either term, Employee or Person In charge six times in the text of the Standard.
2. OSHA uses the term three times in three paragraphs.
3. NESC uses the term in seven different rules
4. None of the three documents define the term.
5. This role is so important, especially in high voltage work, it needs to be defined and clearly understood that a qualified person, as defined by 70E, is to fill the role of Employee (Person) In Charge.

Submitter Information Verification

Submitter Full Name: ALVIN HAVENS
Organization: e-Hazard, Management, LLC
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jun 16 16:55:00 EDT 2015
Public Input No. 281-NFPA 70E-2015 [ New Definition after Definition: Equipment. ]

**Equipment Ground-Fault Protection Device (EGFPD):**
A device that operates to disconnect the electric circuit from the source of supply when ground-fault current exceeds the ground-fault pick-up level marked on the device.

Informational Note: Ground-fault current pick-up level of equipment ground-fault protection devices is adjustable from 6 to 100 mA.

Additional Proposed Changes

<table>
<thead>
<tr>
<th>File Name</th>
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<tbody>
<tr>
<td>EGFPD_vs_GFCIs.pdf</td>
<td>Tripping characteristic of EGFPD compared to GFCIs Classes A, C, and D</td>
</tr>
</tbody>
</table>

Statement of Problem and Substantiation for Public Input

This new definition is added to allow referencing EGFPD devices by another PI for Article 110.4(C).

Although EGFPDs are rated as equipment protection by UL, they are tested to both UL943 GFCI standard and UL 1053 Ground-Fault Sensing and Relaying Equipment. Therefore, EGFPD offer protection similar to GFCIs.

EGFPDs should not be confused with ground-fault protection of equipment (GFPE). EGFPDs are equipped with a tripping mechanism similar to GFCIs and therefore are capable of interrupting power when a ground-fault is detected.

EGFPDs use the same GFCIs tripping characteristic and therefore an EGFPD will clear a ground-fault within the same clearing time of a GFCI provided that the fault-current magnitude is higher than the device set trip level. EGFPDs differ from GFCIs in:

1. Tripping level is adjustable in the range of 6 to 100 mA (GFCIs have a fixed trip level; 6 mA or Class A and 20 mA for Classes C, D, and E)
2. Monitoring equipment grounding conductor continuity is not required (a mandate for Classes C, D, and E GFCIs).

Unfortunately, some industrial systems have leakage current more than 20 mA during normal operation. For those systems, the use of Classes C, D, or E GFCIs defined by UL 943C is impractical. Therefore, EGFPDs could be used to provide some protection to personnel when GFCIs cannot be used.

Although, some commercial EGFPDs are equipped with internal means to monitor equipment grounding conductor continuity, this feature is not available in all devices because it is not a required feature by UL for these devices. Therefore, in order to insure the grounding conductor continuity, a ground continuity monitor relay can be used in conjunction with EGFPDs.

References:


Related Public Inputs for This Document

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<th>Related Input</th>
<th>Relationship</th>
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<tr>
<td>Public Input No. 280-NFPA 70E-2015 [New Definition after Definition: Ground-Fault Circuit](Inte...</td>
<td>EGFPD devices are complimentary protection to special-purpose GFCIs (SPGFCI)</td>
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Submitter Information Verification

Submitter Full Name: [Not Specified]
Organization: [Not Specified]
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Sat Jun 27 16:29:53 EDT 2015
Public Input No. 286-NFPA 70E-2015 [ New Definition after Definition: Equipment. ]

**Equipment Ground-Fault Protective Device (EGFPD).**
A device that operates to disconnect the electric circuit from the source of supply when ground-fault current exceeds the ground-fault pick-up level marked on the device.

Informational Note: Ground-fault current pick-up level of equipment ground-fault protective devices is adjustable from 6 to 100 mA.

Additional Proposed Changes

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<tr>
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<td>EGFPD device tripping characteristics compared to GFCIs Classes A, C, and D</td>
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Statement of Problem and Substantiation for Public Input

This PI is added to allow a reference to EGFPD by another PI for Article 110.4(C). This new definition would clarify and define the difference between EGFPDs and Ground Fault Protection of Equipment (GFPE) defined by Section 230.95 of the NEC. EGFPDs are discussed in the UL Online Certification Directory "FTTE. GuideInfo Equipment Ground-fault Protective Devices" and their requirements for identification for use. This document is available at:


Related Public Inputs for This Document

- Related Input
  - Public Input No. 287-NFPA 70E-2015 [Section No. 110.4(C)]
  - Public Input No. 288-NFPA 70E-2015 [Section No. 110.4(D)]

Submitter Information Verification

Submitter Full Name: NEHAD EL-SHERIF
Organization: [ Not Specified ]
Street Address: City: State: Zip: Submittal Date: Sun Jun 28 13:51:56 EDT 2015
Public Input No. 280-NFPA 70E-2015 [ New Definition after Definition: Ground-Fault Circuit Inter... ]

Ground-Fault Circuit Interrupter, Special Purpose (SPGFCI).
A device intended for the protection of personnel that functions to de-energize a circuit or portion thereof within an established period of time when a current to ground exceeds the values established for Class C, D, and E devices.

Informational Note: Classes C, D, and E ground-fault circuit-interrupters trip when the current to ground is 20 mA or higher and do not trip when the current to ground is less than 15 mA. For further information, see UL 943C, Outline of Investigation for Special Purpose Ground-Fault Circuit Interrupters.

Additional Proposed Changes

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</table>

Statement of Problem and Substantiation for Public Input

This change is proposed to allow for the inclusion of GFCI Classes other than Class A since Class A GFCI is the only accepted GFCI in the NFPA 70E standard.

UL 943C provides further guidance on special purpose ground-fault circuit interrupters intended for use in one of the following applications:

1. Where the voltage to ground is greater than 150-volts and equipment grounding or double insulation is required by the National Electrical Code NFPA 70.
2. Where the voltage to ground is 150-volts or less and equipment grounding or double-insulation is provided, but the use of a Class A ground-fault circuit-interrupter is not practical.

Such devices operate at 20 mA or less to prevent fibrillation and require an equipment grounding conductor in the protected circuit with an internal means within the device to monitor equipment grounding conductor continuity. Ground-fault circuit-interrupters addressed by UL 943C are divided into three classes, Class C, D and E, based upon voltage rating and the characteristics of the grounding circuit.

References:


Related Public Inputs for This Document

Public Input No. 281-NFPA 70E-2015 [New Definition after Definition: Equipment]

Submitter Information Verification

Submitter Full Name: [Not Specified]
Organization: [Not Specified]
Street Address:  
City:  
State:  
Zip:  
Submittal Date: Sat Jun 27 16:07:40 EDT 2015
Public Input No. 285-NFPA 70E-2015 [New Definition after Definition: Ground-Fault Circuit Interrupter, Special Purpose (GFCI)]

Ground-Fault Circuit Interrupter, Special Purpose (GFCI).
A device intended for the protection of personnel that functions to de-energize a circuit or portion thereof within an established period of time when a current to ground exceeds the values established for a Class C, D, and E devices.

Informational Note: Classes C, D, and E ground-fault circuit-interrupters trip when the current to ground is 20 mA or higher and do not trip when the current to ground is less than 15 mA. For further information, see UL 943C, Outline of Investigation for Special Purpose Ground-Fault Circuit Interrupters.

Additional Proposed Changes

<table>
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<th>Description</th>
<th>Approved</th>
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<tbody>
<tr>
<td>GFCI_Classes.pdf</td>
<td>Tripping Characteristics of GFCI Classes A, C, and D</td>
<td></td>
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</table>

Statement of Problem and Substantiation for Public Input

This change is proposed to allow for the inclusion of GFCI Classes other than Class A since Class A GFCI is the only accepted GFCI in the 2015 NFPA 70E standard.

UL 943C provides further guidance on special purpose ground-fault circuit interrupters intended for use in one of the following applications:

1. Where the voltage to ground is greater than 150-volts and equipment grounding or double insulation is required by the National Electrical Code NFPA 70.
2. Where the voltage to ground is 150-volts or less and equipment grounding or double-insulation is provided, but the use of a Class A ground-fault circuit-interrupter is not practical.

Such devices operate at 20 mA or less to prevent fibrillation and require an equipment grounding conductor in the protected circuit with an internal means within the device to monitor equipment grounding conductor continuity. Ground-fault circuit-interrupters addressed by UL 943C are divided into three classes, Class C, D and E, based upon voltage rating and the characteristics of the grounding circuit.

References:


Related Public Inputs for This Document

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<thead>
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<th>Related Input</th>
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<tr>
<td>Public Input No. 287-NFPA 70E-2015 [Section No. 110.4(C)]</td>
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<td>Public Input No. 288-NFPA 70E-2015 [Section No. 110.4(D)]</td>
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Submitter Information Verification

Submitter Full Name: NEHAD EL-SHERIF
Organization: [Not Specified]
Street Address: [Not Specified]
City: [Not Specified]
State: [Not Specified]
Zip: [Not Specified]
Submittal Date: Sun Jun 28 13:45:00 EDT 2015
Public Input No. 477-NFPA 70E-2015 [ New Definition after Definition: Hazardous. ]

**TITLE OF NEW CONTENT**

Host. An entity that is responsible for the facilities.

Informational Note. A host can be an employer or owner, or their designee, a lessee, or renter etc.

---

**Statement of Problem and Substantiation for Public Input**

The term "host" as used in 1103 is unclear as to its meaning. The onsite employer does not always have qualified employees or even any employees. Alternatively the term can be described in 110.3 as an Informational Note.

**Submitter Information Verification**

Submitter Full Name: PAUL DOBROWSKY
Organization: INNOVATIVE TECHNOLOGY SERVICES
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Mon Jul 06 13:41:27 EDT 2015
Public Input No. 77-NFPA 70E-2015 [ New Definition after Definition: Motor Control Center. ]

Normal Operation.
Interaction with the electrical equipment where all of the following conditions are satisfied:
(1) The equipment is properly installed.
(2) The equipment is properly maintained.
(3) The equipment doors are closed and secured.
(4) The equipment covers are in place and secured.
(5) There is no evidence of impending failure.

Informational Note: The phrase, properly installed, means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer's recommendations. The phrase, properly maintained, means that the equipment has been maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards. The phrase, evidence of impending failure, means that there is evidence such as arcing, overheating, loose or bound equipment parts, visible damage, or deterioration.

Statement of Problem and Substantiation for Public Input

This proposal is asking that normal operation be defined as an interaction with electrical equipment. The information about what that means is being moved from 130.2(A)(4) including the informational note and used in the definition.

Another proposal is asking to delete all the material after the phrase Normal Operation in 130.2(A)(4).

Submitter Information Verification

Submitter Full Name: ROGER ZIEG
Organization: ZIEG ELEC
Street Address:
City:
State:
Zip:
Submittal Date: Thu Mar 19 12:40:35 EDT 2015
Public Input No. 216-NFPA 70E-2015 [ New Definition after Definition: Shock Hazard. ]

**TITLE OF NEW CONTENT**

Informational Note:
UL 493 contains information on time-current relationships for magnitudes of current flow through the body and time durations of that current flow that are considered safe and those that are considered dangerous and a source of possible injury.

**Statement of Problem and Substantiation for Public Input**

The potential for injury due to shock is primarily determined by the magnitude of current flowing through the body, the path of the current flow through the body and the time duration of exposure. A companion PI is being submitted to change globally the phrases "50 volts and above" and "below 50 volts", and other similar phrases, to "where a shock hazard exists" and "where no shock hazard exists" respectively. This revision of the term "Shock Hazard" is needed to support that global revision of the phrases. Changing those phrases is necessary in order to correctly describe when a person is exposed to the potential for injury due to shock and when they are not. The voltage level is only one of the variables that determine this potential. The path through the body is sufficiently covered by the existing text of the standard. The time duration is not. These companion PIs introduce this concept and includes time duration as one of the variables. Time duration is critical in determining the potential for shock injury and thus protective measure required to prevent such injury.

**Submitter Information Verification**

Submitter Full Name: DAVID PACE  
Organization: OLIN CORPORATION  
Affiliation: Self  
Street Address:  
City:  
State:  
Zip:  
Submittal Date: Mon Jun 22 17:01:08 EDT 2015
Public Input No. 194-NFPA 70E-2015 [ New Definition after Definition: Short-Circuit Current Rati... ]

TITLE OF NEW CONTENT
Site specific PPE : Add definition. This term is referenced only once in the standard but not defined any where.

Statement of Problem and Substantiation for Public Input

The term “Site specific PPE” is cited in the standard and clearly is important. It is presently undefined and in fact has no explanation of its meaning and left to the reader’s interpretation.

Submitter Information Verification

Submitter Full Name: JOHN WILLIAM GNAN
Organization: GNAN ENGINEERING SERVICES INC
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Thu Jun 18 17:28:10 EDT 2015
Public Input No. 399-NFPA 70E-2015 [ New Definition after Definition: Voltage, Nominal. ]

**Working Distance**

**working distance:** The dimension between the prospective arc source and the face and chest area of the employee positioned in place to perform the assigned task.

**Informational Note:** working distance is the sum of the distance between the employee and the front of the equipment and the distance from the front of the equipment to the potential arc source inside the equipment for the enclosed equipment or from the potential arc source to the employee for open equipment.

**Statement of Problem and Substantiation for Public Input**

A definition of working distance is needed in the definition section in Article 100. This term is used at multiple locations in the document but is not defined. Understanding of this term is critical for employee safety.

**Submitter Information Verification**

Submitter Full Name: DALEEP MOHLA
Organization: DCM ELECTRICAL CONSULTING SERV
Street Address:  
City:  
State:  
Zip:  
Submittal Date: Sat Jul 04 12:44:13 EDT 2015
### Public Input No. 353-NFPA 70E-2015 [ New Section after 105.3 ]

**TITLE OF NEW CONTENT**

105.4 Safe Work Priorities. Removing the electrical shock, arc flash, and arc blast hazards shall be the first priority and method in implementation of safety-related work practices. Justified energized work using appropriate personal protective equipment shall be the last method of implementing safety-related work practices as provided in this standard.


### Statement of Problem and Substantiation for Public Input

Substantiation: NFPA 70E has improved the safety culture in the electrical industry by leaps and bounds over the life and growth of the standard. However, there is still work to be done to shift the cultural thinking of electrical workers from use of PPE and working hot as a first choice to removal of the hazard as the first choice and top priority. This new section is proposed to incorporate clear wording that helps clarify this point that currently only exists in the Informational Note to 110.1(G) and in the text of 130.2(A)(1). Many in the electrical industry need clearer direction. Having this language provides a clear requirement that positively will improve the decision-making processes of qualified persons and reduce the risks that are taken daily. This will also assist employers in training their employees about energized work policies and also be useful when demonstrating a need to remove the power so employees can safely perform the work.

### Submitter Information Verification

**Submitter Full Name:** MICHAEL JOHNSTON  
**Organization:** NATIONAL ELECTRICAL CONTRACTOR  
**Street Address:**  
**City:**  
**State:**  
**Zip:**  
**Submittal Date:** Wed Jul 01 16:27:13 EDT 2015
Public Input No. 175-NFPA 70E-2015 [ Section No. 105.3 ]

105.3 Responsibility.
   (A) Employer Responsibility. The employer shall provide the necessary, safety-related work practices and shall train the employee, who shall then implement necessary employee training.
   (B) Employee Responsibility. The employee shall implement the safety-related work practices provided by the employer.

Statement of Problem and Substantiation for Public Input

In most cases the employer does not provide the training required for qualified and unqualified persons. Typically a third party vendor, or other entity with qualified trainers provides the training. It is the job of the employer to ensure that the required training has been implemented and to document who, when and where the training was provided. Training in electrical safe work practices will be different for all types of workplaces and types of exposure based upon the hazards and the tasks performed. It is imperative to qualify that the employer provided the "necessary" training for each employee.

This requirement is separated into first level subdivisions for clarity and emphasis on each parties responsibility.

Submitter Information Verification

Submitter Full Name: JAMES DOLLARD
Organization: IBEW LOCAL UNION 98
Street Address:
City:
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Submittal Date: Mon Jun 15 13:49:34 EDT 2015
105.3 Responsibility.
The employer shall provide the safety-related work practices and shall train the employee, who shall then implement, use them.

Statement of Problem and Substantiation for Public Input

Employers are responsible for implementing as the term is used in 110.1. These terms are not used consistently.

Submitter Information Verification

Submitter Full Name: PAUL DOBROWSKY
Organization: INNOVATIVE TECHNOLOGY SERVICES
Street Address:
City:
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Zip:
Submittal Date: Mon Jul 06 13:57:33 EDT 2015
Public Input No. 354-NFPA 70E-2015 [ Section No. 105.4 ]

105.4 Organization.
Chapter 1 of this standard is divided into five articles. Article 100 provides definitions for terms used in one or more of the chapters of this document. Article 105 provides for application of safety-related work practices. Article 110 provides general requirements for electrical safety-related work practices. Article 120 provides requirements for establishing an electrically safe work condition. Article 130 provides requirements for work involving electrical hazards.

Statement of Problem and Substantiation for Public Input
Renumbered to allow for new 105.4 as proposed.

Submitter Information Verification
Submitter Full Name: MICHAEL JOHNSTON
Organization: NATIONAL ELECTRICAL CONTRACTOR
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jul 01 16:29:04 EDT 2015
Public Input No. 57-NFPA 70E-2015 [ New Section after 110.1 ]

(B) Inspection
The electrical safety program shall include an inspection element that ensures newly installed or modified electrical equipment or systems do not increase the risk of exposure by a worker to an electrical hazard under normal operating conditions.

Statement of Problem and Substantiation for Public Input

NFPA 70E correctly establishes, in many citations, a bounding criteria that electrical equipment shall be "properly installed" in order to perform a permitted action. The problem with that well-intentioned statement is that nowhere does the document tell the user how to confirm the equipment or system was "installed in accordance with applicable industry codes and standards," as stated in the note to Table 130.7(C)(15)(A)(a). Original installations typically are under the jurisdiction of a governmental body that will approve the installation before authorizing the system to be energized. Too often, however, the approval by a delegated person stops when the lights come on. Consequently, the unqualified persons in a workplace have no assurance that electrical equipment will not expose them to an electrical hazard when they simply are operating equipment within its designed parameters. Since 2009, NFPA 70E contains no installation rules. Removal of the installation rules that would apply to modifications of existing electrical systems left a void in the overall electrical safety program. The original installation is controlled through a local governing body, while work practices on or around the electrical equipment is managed through compliance with NFPA 70E. Except in the rare occasion when the local AHJ aggressively enforces acceptable modifications to existing systems, the employers are not applying the proper amount of diligence to ensure the safety of the workers and validate the assumptions that rely on "properly installed." This public input mandates the employer consider this critical element of electrical safety by documenting an installation inspection program as part of the overall electrical safety program.

Submitter Information Verification

Submitter Full Name: Bobby Gray
Organization: Hoydar/Buck, Inc.
Affiliation: None
Street Address: 
City: 
State: 
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Submittal Date: Mon Feb 23 13:24:10 EST 2015
Public Input No. 394-NFPA 70E-2015 [ Section No. 110.1(B) ]

| (B) Condition of Maintenance. | The electrical safety program shall include elements that consider condition of maintenance of electrical equipment and systems. |

Statement of Problem and Substantiation for Public Input

The term “maintenance” is used throughout the standard and has different meanings depending on the context. Adding the words “Condition of” before the word “Maintenance” adds clarity as to the intent of 110.1(B), and also it correlates to the wording within the body of the section.

Submitter Information Verification

Submitter Full Name: RON WIDUP
Organization: SHERMCO INDUSTRIES
Affiliation: NETA
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Sat Jul 04 12:01:13 EDT 2015
Public Input No. 539-NFPA 70E-2015 [ Section No. 110.1(C) ]

(C) Awareness and Self-Discipline.
The electrical safety program shall contain requirements designed to provide an awareness of the potential electrical hazards to employees who work in an environment with the presence of electrical hazards. The program shall be developed to provide the required self-discipline for all employees who must perform work that may involve electrical hazards. The program shall instill safety principles and controls.

Statement of Problem and Substantiation for Public Input

This PI is being submitted by the Article 110 Task Group in effort to improve clarity of intent. The second and third sentences are deleted as they are vague and unenforceable. A program cannot provide self discipline, nor can it instill principles. The reference in the third sentence to safety principles and controls is repeated in 110.1(D).

Submitter Information Verification

Submitter Full Name: MARK MCNELLIS
Organization: SANDIA NATIONAL LABORATORIES
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jul 06 16:45:30 EDT 2015
Public Input No. 162-NFPA 70E-2015 [ New Section after 110.1(G) ]

Job Safety Analysis (JSA)

Before starting each job a qualified electrical person shall complete a detailed job safety analysis. The analysis shall identify, in sequential order, the individual tasks associated with the performance of each job. The specific hazard(s) and the severity and likelihood of unintentional injury shall be considered for each individual task. Control methods for reducing the likelihood of unintentional injury for each task shall be identified. The results of the job safety analysis shall determine if each task can be safely performed. The job safety analysis shall be documented.

Informational Note: For an example of a Job Safety Analysis (JSA) see Informative Annex XX.

Additional Proposed Changes

<table>
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<th>Description</th>
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<tr>
<td>Informative_Annex_Job_Safety_Analysis.docx</td>
<td>This Informative Annex is proposed to provide explanatory information for the incorporation of the Job Safety Analysis into the Electrical Safety Program in support of this Public Input.</td>
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</table>

Statement of Problem and Substantiation for Public Input

The Electrical Safety Program requirements in 110.1, nor elsewhere in 70E is a practical tool provided for electrical workers to analyze the specific steps in a job and determine if the job can be safely performed.

This Public Input would require the Electrical Safety Program to provide for practical implementation of a documented method to analyze each step of an electrical job, assess the electrical hazard and determine whether or not it can be safely performed. Section 110.1(G) currently requires a Risk Assessment Procedure, but does not not provide for the level of assessment needed at the job level. Informative Annex F addresses management control methods, but does not provide a simplified method or tool for workers. Section 110.1(H) currently requires a Job Briefing. This new section would also provide the detail needed to properly conduct a thorough job briefing.

Per OSHA publication 3071: “One of the best ways to determine and establish proper work procedures is to conduct a job hazard analysis. A job hazard analysis is one component of the larger commitment of a safety and health management system.”

Related Public Inputs for This Document

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<tr>
<th>Related Input</th>
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<tr>
<td>Public Input No. 163-NFPA 70E-2015 [Section No. 110.1(H)]</td>
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Submitter Information Verification

Submitter Full Name: RANDY BARNETT
Organization: NTT TRAINING
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Thu Jun 04 17:00:49 EDT 2015
(G) Risk Assessment Procedure.

An electrical safety program shall include a risk assessment procedure that addresses employee exposure to electrical hazards. The risk assessment procedure 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 a hierarchy of methods

Preventive and protective risk control methods shall 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: The hierarchy of risk control methods specified in ANSI/AIHA Z10, American National Standard for Occupational Health and Safety Management Systems, is as follows:

1. Elimination
2. Substitution
3. Engineering controls
4. Awareness
5. Administrative controls
6. PPE

For more information regarding the hierarchy of risk control.

Informational Note No. 2: The risk assessment procedure may include identifying when a second person could be required and the training and equipment that person should have.

Informational Note No. 3: For an example of a risk assessment procedure, see Informative Annex F.

Statement of Problem and Substantiation for Public Input

The second sentence was revised to correlate with the first sentence:
Sentence # 1. An employer provides the procedure
Sentence # 2. The employee uses the procedure

The information regarding the hierarchy or risk control was moved from Informational Note No. 1 to positive text to correlate with the mandatory requirement in 110.2(D)(1)(b)(4)d, which specifies that a qualified person must be able to select the appropriate risk control methods from the hierarchy of controls identified in 110.1(G), including personal protective equipment.

This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the terms "procedure," "practice," "program" and "process."

The Task Group recommendations regarding the use of the terms "practice," "procedure," "process" or "program" are based on:
1. The context in which the term was used;
2. The definitions of each term as found in the Merriam-Webster on-line dictionary;
3. Practice: to do something customarily (e.g. "work practice")
4. Procedure: a series of steps followed in a regular definite order (e.g. "lockout/tagout procedure")
5. Process: a series of actions or operations conducing to an end (e.g. "Risk Assessment – An overall process that...")
6. Program: a plan or system under which action may be taken toward a goal (e.g. "electrical safety program")

Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the terms "procedure," "practice," "program" and "process."
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jun 29 09:45:30 EDT 2015
Public No. 396-NFPA 70E-2015 [Section No. 110.1(G)]

(G) Risk Assessment Procedure.
An electrical safety program shall include a risk assessment procedure that addresses employee exposure to electrical hazards. The procedure 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 a hierarchy of methods

Informational Note No. 1: The hierarchy of risk control methods specified in ANSI/AIHA Z10, American National Standard for Occupational Health and Safety Management Systems, is as follows:

1. Elimination
2. Substitution
3. Engineering controls
4. Awareness
5. Administrative controls
6. PPE

Risk control methods 1, 2 and 3 involve engineering design choices that permanently reduce injury risk, with no action required by workers at risk. Guidance for equipment and facility design choices that permanently reduce risk are generally outside the scope of this standard. Selection and application of risk control measures 4, 5 and 6 are generally under responsibility of worker supervision, task planners and workers at risk and are described in detail in this standard.

Informational Note No. 2: The risk assessment procedure may include identifying when a second person could be required and the training and equipment that person should have.

Informational Note No. 3: For an example of a risk assessment procedure, see Informative Annex F.

Statement of Problem and Substantiation for Public Input

After reference to the Hierarchy of Risk Control Methods was added to the 2015 revision to NFPA 70E, I have seen examples of misunderstanding of its application. Without additional guidance in NFPA70E, the electrical safety community that looks to NFPA 70E may not grasp the full potential of engineering design choices that permanently impact risk reduction. As examples of misunderstanding, the NFPA Candidate Handbooks for both Certified Electrical Safety Compliance Professional (page 19) and Certified Electrical Safety Worker (page 17) both incorrectly describe Create an Electrically-Safe Work Condition as examples of Hazard Elimination. This proposal provides clarification that control methods of Elimination, Substitution and Engineering Controls are typically outside the control of task planners and workers at risk.

The excerpts from the two handbooks are reproduced here:

From CESCP Applicant Handbook p19 and CESW Applicant Handbook p17

iii. Identify methods to control the risk associated with electrical hazards
   a. Hazard elimination (i.e., create an electrically-safe work condition)

Although only recently included in NFPA 70E, the Hierarchy of Risk Controls has been described in safety management systems standards for decades, including MIL Std 882, OHSAS 18001, ANSI Z10, CSA Z1000 and ISO 14001. It is also described in the book, Advanced Safety Management, by Fred Manuele, a leading expert and advocate for disciplined application of the Hierarchy of Risk Control methods.

Essential to understanding that Create an Electrically-Safe Work Condition (ESWC) is not an example of Hazard Elimination is recognition that:
1. An ESWC is not permanent, but temporary
2. Achieving an ESWC involves a series of procedures and practices, each with some degree of residual risk that must be addressed for the worker performing the procedures to achieve the ESWC.
3. When a hazard is eliminated, there are no residual risks. However, an ESWC typically involves residual risks associated with time and space boundaries. Work must be performed within the start and stop time limits of the ESWC plan, and within the physical space boundaries of the ESWC plan. Staying within these limits is highly dependent on error free human performance, attention to detail, communications, temporary barriers and warnings and work sequencing involving all personnel involved in planning, supervising and executing work. The residual risk of physical boundary limits of an ESWC is described in NFPA 70E 130.7 (E) (4) Alerting Techniques – Look-Alike Equipment.

Submitter Information Verification

Submitter Full Name: Lanny Floyd
Organization: Electrical Safety Group Inc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Sat Jul 04 12:10:45 EDT 2015
Public Input No. 437-NFPA 70E-2015 [Section No. 110.1(G)]

(G) Risk Assessment Procedure.

An electrical safety program shall include a risk assessment procedure that addresses employee exposure to electrical hazards. The procedure 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 a hierarchy of methods as follows:
   a. Elimination
   b. Substitution
   c. Engineering Controls
   d. Awareness
   e. Administrative Controls
   f. PPE


Informational Note No. 2: The risk assessment procedure may include identifying when a second person could be required and the training and equipment that person should have.

Informational Note No. 3: For an example of a risk assessment procedure, see Informative Annex F.

Statement of Problem and Substantiation for Public Input

The hierarchy of controls in the existing Informational Note are referenced in a mandatory fashion in 110.2(D)(1)(b)(4). This revision places the hierarchy of controls in positive text and retains the existing IN.

Submitter Information Verification

Submitter Full Name: JAMES DOLLARD
Organization: IBEW LOCAL UNION 98
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Mon Jul 06 07:41:51 EDT 2015
### Public Input No. 163-NFPA 70E-2015 [Section No. 110.1(H)]

**Job Briefing.**

Before starting each job, the employee in charge shall conduct a job briefing with the employees involved. The briefing shall cover the required Job Safety Analysis, and such subjects as hazards associated with the job, work procedures involved, special precautions, energy source controls, PPE 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.

Informational Note: For an example of a job briefing form and planning checklist, see Figure I.1.

### Statement of Problem and Substantiation for Public Input

This change would require review of the job safety analysis as part of the job briefing. (related to PI 162).

### Related Public Inputs for This Document

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<thead>
<tr>
<th>Related Input</th>
<th>Relationship</th>
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<tbody>
<tr>
<td>Public Input No. 162-NFPA 70E-2015 [New Section after 110.1(G)]</td>
<td>Pi 163 provides a requirement to review the Job Safety Analysis submitted by PI 162</td>
</tr>
</tbody>
</table>

### Submitter Information Verification

Submitter Full Name: RANDY BARNETT  
Organization: NTT TRAINING  
Street Address:  
City:  
State:  
Zip:  
Submittal Date: Thu Jun 04 17:39:19 EDT 2015
Job Briefing.

Before starting each job that involves exposure to electrical hazards, 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, PPE 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.

Informational Note: For an example of a job briefing form and planning checklist, see Figure I.1.

Statement of Problem and Substantiation for Public Input

The need for a "job briefing" should be clarified. The job briefing required here in 110.1(H) is specifically for electrical hazards. In many cases there are other hazards and NFPA 70E addresses only electrical hazards.

Submitter Information Verification

Submitter Full Name: JAMES DOLLARD
Organization: IBEW LOCAL UNION 98
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Mon Jun 15 14:07:50 EDT 2015
Public Input No. 209-NFPA 70E-2015 [ Section No. 110.1(H) ]

(H) Job Briefing.

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, PPE 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. The job briefing can be verbal instructions prior to start of a job or can be included in the work package given to the employee covering all information required by this section.

Informational Note: For an example of a job briefing form and planning checklist, see Figure I.1.

Statement of Problem and Substantiation for Public Input

An employee may be working alone with work assigned at the start of shift for multiple assignments. The necessary instructions including details of work, methods to be employed is part of the detail package provided to the employee. Work package is required to contain all the information required by this section for employee safety if verbal directions are not provided before starting each job.

Submitter Information Verification

Submitter Full Name: DALEEP MOHLA
Organization: DCM ELECTRICAL CONSULTING SERV
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Sat Jun 20 13:00:57 EDT 2015
Public Input No. 236-NFPA 70E-2015 [ New Section after 110.1(I) ]

(i) Incident Investigations. An electrical safety program shall include an incident investigation procedure that addresses electrical incidents. The procedure shall identify the following:

1. Types of incidents to be investigated
2. Methods of investigating and reporting
3. Investigation team
4. Tracking recommended actions
5. Measuring the effectiveness of actions

Informational Note 1: Incident investigations should address gaps in the Electrical Safety Program and recommend changes to the Electrical Safety Program or the employer's overall occupational health and safety management system, when one exists.

Informational Note 2: To ensure that the incident investigation procedure is effective the employer should audit the procedure for improvement opportunities and completeness.

Authors Note 1 - not for publication: The NFPA 70E 2015 provides an exemplary description for an overall electrical Safety Program in 110.1. With these guidelines in place, it is still possible for omissions and errors on the employer's side due to unforeseen circumstances or reasons. It could also be stated that examples of the Electrical Safety Program Principles (110.1 (D)), Controls (110.1 (E)) and Procedures (110.1(F)) appearing in Annex E are not exhaustive which further supports the possibility of omissions or errors which could lead to an incident.

An incident can be an accident which results in harm or loss or a near miss/hit which does not result in harm or loss. All incidents have root causes inherent in either the employers Electrical Safety Program or the overall health and safety management system, if one exists.

In prescribing the need for an incident investigation procedure, this standard is forcing the employer to continuously improve either the Electrical Safety Program or the overall health and safety management system, if one exists.

It is for this primary reason that the author strongly suggests the incorporation of this incident investigation clause in the NFPA 70E 2018 (and onwards)

Authors Note 2 - not for publication: In the Informational Note 2, the employer is being requested to audit the incident investigation procedure to determine its effectiveness. This request differs from the auditing requirement in 110.1 (I) which the author interprets as an audit to ensure that the incident investigation is indeed present in the Electrical Safety Program.

Authors Note 3 - not for publication: The heading 110.1 (I) Electrical Safety Auditing should be moved to 110.1 (J) Electrical Safety Auditing. This is intentional to re-iterate the fact that the Electrical Safety Program should be audited to ensure that an Incident Investigation procedure is in place.

Authors Note 4 - not for publication: The heading 110.1 (I) Incident Investigations shall appear under section 110.1 Electrical Safety Program.

Additional Proposed Changes

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<td>The attached uploaded file is a copy of the proposed additions to the NFPA 70E 2018. It is added as a safety measure in the event of the online submission not appearing in the correct format. This addition is aimed for insertion at 110.1 (I) (above the &quot;Auditing&quot; Clause.</td>
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Statement of Problem and Substantiation for Public Input

Authors Note 1: The NFPA 70E 2015 provides an exemplary description for an overall electrical Safety Program in 110.1. With these guidelines in place, it is still possible for omissions and errors on the employer's side due to unforeseen circumstances or reasons. It could also be stated that examples of the Electrical Safety Program Principles (110.1 (D)), Controls (110.1 (E)) and Procedures (110.1(F)) appearing in Annex E are not exhaustive which further supports the possibility of omissions or errors which could lead to an incident. An incident can be an accident which results in harm or loss or a near miss/hit which does not result in harm or loss. All incidents have root causes inherent in either the employers Electrical Safety Program or the overall health and safety management system, if one exists.

In prescribing the need for an incident investigation procedure, this standard is forcing the employer to continuously improve either the Electrical Safety Program or the overall health and safety management system, if one exists.

It is for this primary reason that the author strongly suggests the incorporation of this incident investigation clause in the NFPA 70E 2018 (and onwards)

Authors Note 2: In the Informational Note 2, the employer is being requested to audit the incident investigation procedure to determine its effectiveness. This request differs from the auditing requirement in 110.1 (I) which the author interprets as an audit to ensure that the incident investigation is indeed present in the Electrical Safety Program.

Authors Note 3: The heading 110.1 (I) Electrical Safety Auditing should be moved to 110.1 (J) Electrical Safety Auditing. This is intentional to re-iterate the fact that the Electrical Safety Program should be audited to ensure that an Incident Investigation procedure is in place.

Authors Note 4: The heading 110.1 (I) Incident Investigations shall appear under section 110.1 Electrical Safety Program.

Submitter Information Verification

<table>
<thead>
<tr>
<th>Name: Zarheer Jooma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization: South African Bureau of Standards (SABS Chair of Electrical Safety Standards) and IEC TC78 Member</td>
</tr>
<tr>
<td>Street Address: University of Witswatersrand, South Africa. Postgraduate Student on Electrical Safety Systems.</td>
</tr>
<tr>
<td>City:</td>
</tr>
<tr>
<td>State:</td>
</tr>
<tr>
<td>Zip:</td>
</tr>
<tr>
<td>Submittal Date: Tue Jun 23 02:08:32 EDT 2015</td>
</tr>
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NFPA 70E - A2017 FD Meeting Agenda Page 85
Public Input No. 327-NFPA 70E-2015 [Section No. 110.1(I)]

(1) Electrical Safety Auditing.
   (1) Electrical Safety Program Audit.
   The electrical safety program shall be audited to verify that the principles and procedures of the electrical safety program are in compliance with this standard. Audits shall be performed at intervals not to exceed 3 years.

(2) Field Work Audit.
   Field work shall be audited to verify that 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. Audits shall be performed at intervals not to exceed 1 year.

(3) Lockout Program and Procedure Audit
   The lockout program and procedures required by Article 120.2 shall be audited by a qualified person at intervals not to exceed 1 year.
   The audit shall cover at least one lockout in progress.
   The audit shall be designed to identify and correct deficiencies in:
   a) The lockout program and procedures;
   b) The lockout training; and
   c) Worker execution of the lockout procedure.

(4) Documentation.
   The audits required by 110.1 shall be documented.

Statement of Problem and Substantiation for Public Input

This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.

The content of the proposed new section 110.1(I)(3) has been relocated from 120.2(C)(3) and editorially revised for clarity. Locating all of the auditing requirements in one section of the document provides clarity and ease of reference.

Related Public Inputs for This Document

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Submitter Information Verification

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<tr>
<th>Name</th>
<th>SCHNEIDER ELECTRIC</th>
</tr>
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<tr>
<td>Affiliation</td>
<td>This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.</td>
</tr>
<tr>
<td>Street Address:</td>
<td></td>
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<td>City:</td>
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<tr>
<td>Submittal Date:</td>
<td>Mon Jun 29 16:17:23 EDT 2015</td>
</tr>
</tbody>
</table>
Public Input No. 458-NFPA 70E-2015 [Section No. 110.1(l)(2)]

(2) Field Work.
Field work for electrical diagnostic or repair shall be audited to verify that the requirements contained in the procedures of the electrical safety program are being followed. This requirement is to have an auditor observe the field work. 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. Audits shall be performed at intervals not to exceed 1 year.

Statement of Problem and Substantiation for Public Input

Many people still interpret the present requirements as being met by matching up paperwork between work orders, people assigned, their qualifications, training, job briefing documentation, written electrical safety program, and other documents for all in-house work. They interpret field work as only off-site work.

Submitter Information Verification

Submitter Full Name: PETER WALSH
Organization: MERSEN
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Mon Jul 06 12:06:45 EDT 2015
110.2 Training Requirements.
(A) Electrical Safety Training.
The training requirements contained in this section shall apply to employees exposed to an electrical hazard when the risk associated with that hazard is not reduced to a safe level by the applicable electrical installation requirements. Such employees shall be trained to understand the specific hazards associated with electrical energy. They shall be trained in safety-related work practices and procedural requirements, as necessary, to provide protection from the electrical hazards associated with their respective job or task assignments. Employees shall be trained to identify and understand the relationship between electrical hazards and possible injury.

Informational Note: For further information concerning installation requirements, see NFPA 70, National Electrical Code.

(B) Type of Training.
The training required by this section 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.

(C) Emergency Response Training.
(1) Contact Release.
Employees exposed to shock hazards shall be trained in methods of safe release of victims from contact with exposed energized electrical conductors or circuit parts. Refresher training shall occur annually.

(a) Employees responsible for responding to medical emergencies shall be trained in first aid and emergency procedures.

(b) Employees responsible for responding to medical emergencies shall be trained in cardiopulmonary resuscitation (CPR). Refresher training shall occur annually.

(c) Employees responsible for responding to medical emergencies shall be trained in the use of an automated external defibrillator (AED) if an employer's emergency response plan includes the use of this device. Refresher training shall occur annually.

(D) Employee Training.
Employers shall verify at least annually that employee training required by this section is current.

(A) Documentation.
The employer shall document that the training required by this section has occurred.

(B) Employee Training.
(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. A person can be considered qualified with respect to certain equipment and methods, but still be unqualified for others.

(b) 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(D)(a) and Table 130.4(D)(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 110.1(F)

E

G. including personal protective equipment

(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 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.

(d) Tasks that are performed less often than once per year shall require retraining before the performance of the work practices involved.

(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.

(2) **Retraining.**

Unqualified persons shall be trained in, and be familiar with, any electrical safety-related practices necessary for their safety.

(3) **Retraining.**

Retraining in safety-related work practices and applicable changes in this standard shall be performed at intervals not to exceed three years. An employee shall receive additional training (or retraining) if any of the following conditions exist:

(1) The supervision or annual inspections indicate that 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 that are different from those that the employee normally uses.

(3) The employee must employ safety-related work practices that are not normally used during his or her regular job duties.

-E

\[E\]

- Type of Training

Documentation

-
The training required by 110.2(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.

(5) Electrical Safety Training Documentation. The employer shall document that each employee has received the training required by 110.2(A). This documentation shall:

- be;
- (a) Be made when the employee demonstrates proficiency in the work practices involved and shall be;
- (b) Be maintained for the duration of the employee’s employment;
- (c) Contain the content of the training, each employee’s name, and dates of training.

Informational Note No. 1:

Content of the training could include one or more of the following: course syllabus, course curriculum, outline, table of contents or training objectives.

Informational Note No. 2:

Employment records that indicate that an employee has received the required training are an acceptable means of meeting this requirement.

(B) Lockout Procedure Training.

(1) Initial Training

Employees that could be involved in or affected by the lockout procedures required by 120.2 shall be trained in:

- a) The lockout procedures; and
- b) Their responsibility in the execution of the procedures.

New or reassigned employees shall be trained to understand the lockout/tagout procedure as it relates to their new assignments.

(2) Retraining.

Retraining in the lockout procedures shall be performed:

- a) When the procedures are revised; and
- b) At intervals not to exceed 3 years.

(3) Lockout Training Documentation

- (a) The employer shall document that each employee has received the training required by 110.2(B). The documentation shall contain the content of the training, each employee’s name, and the dates of the training.

- (b) The documentation shall be made when the employee demonstrates proficiency in the work practices involved.

Informational Note: Content of the training could include one or more of the following: course syllabus, course curriculum, outline, table of contents, or training objectives.

(C) Emergency Response Training.

(1) Contact Release

Employees exposed to shock hazards shall be trained in methods of safe release of victims from contact with exposed energized electrical conductors or circuit parts. Refresher training shall occur annually.

- (a) First Aid, Emergency Response, and Resuscitation.

- (b) Employees responsible for responding to medical emergencies shall be trained in first aid and emergency procedures.

- (c) Employees responsible for responding to medical emergencies shall be trained in cardiopulmonary resuscitation (CPR). Refresher training shall occur annually.

- (d) Employees responsible for responding to medical emergencies shall be trained in the use of an automated external defibrillator (AED) if an employer’s emergency response plan includes the use of this device. Refresher training shall occur annually.

(2) Training Verification

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

(4) Documentation

The employer shall document that the training required by 110.2(C) has occurred.

Statement of Problem and Substantiation for Public Input

This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.

While the proposed revision appears substantial in form, it is mostly a reorganization of content with the intent of creating consistency and clarity. It is proposed that all training requirements be located in one section of the document and reorganized for clarity and ease of use. Accordingly, it is proposed that the lockout training requirements in 120.2(B)(2) to (4) be relocated to 110.2 with some minor editorial revisions for clarity and consistency. The proposed reorganization and relocation of training of requirements then Article 110.2 would flow as follows:

(A) Electrical Safety Training

(1) Qualified Person
(2) Unqualified Persons
(3) Retraining
(4) Type of Training
(5) Electrical Safety Training Documentation

(B) Lockout Procedure Training

(1) Initial Training
(2) Retraining
(3) Lockout Training Documentation
(4) Contact Release
(5) First Aid, Emergency Response, and Resuscitation
(6) Training Verification

(C) Emergency Response Training

(1) Contact Release
(2) First Aid, Emergency Response, and Resuscitation
(3) Training Verification
(4) Emergency Response Training Documentation
Related Public Inputs for This Document

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Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.
Street Address:
City:
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Zip:
Submittal Date: Mon Jun 29 16:39:48 EDT 2015
Public Input No. 218-NFPA 70E-2015 [Section No. 110.2(B)]

Type of Training.

The training required by this section shall be a combination of classroom and on-the-job or a combination of the two training. The type and extent of the training provided shall be determined by the risk to the employee.

Statement of Problem and Substantiation for Public Input

Information relating to new technology, testing, codes and standards revisions, and other items may not be known to individuals conducting on-the-job training and thus cannot be conveyed to others in the work group. Revisions to this standard would be a good example. On-the-job training is valuable and necessary but by itself does not replace classroom training on subjects not known to individuals conducting the on-the-job training.

Submitter Information Verification

Submitter Full Name: DAVID PACE
Organization: OLIN CORPORATION
Affiliation: Self
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jun 22 17:08:13 EDT 2015
Public Input No. 416-NFPA 70E-2015 [ Section No. 110.2(B) ]

(B) Type of Training.
The training required by this section 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.

Statement of Problem and Substantiation for Public Input

The complexity of electrical safety cannot be taught by on the job training alone. I am an electrician and have worked in the electrical trade my entire life. I understand the level of knowledge that exists in electrical personnel that are in both construction and maintenance. While most do understand the basics of electricity and the fact that electricity will shock you most do not understand the mechanics of how electricity harms the body. Nor do they understand the safe work practices they need to utilize to protect themselves.

The National Electrical Code is revised every three years. Most localities require classroom training be obtained to renew electrical licenses. This keeps the person current with the latest changes and requirements for electrical installations. NFPA 70E is also revised every three years. As we learn more about electrical safe work practices and modify 70E to include that information we should also require personnel who will be exposed to electrical hazards to receive classroom training to learn this information. On the job training alone will not accomplish this.

Submitter Information Verification

Submitter Full Name: DANNY LIGGETT
Organization: THE DUPONT COMPANY INC
Affiliation: Self
Street Address:
City:
State:
Zip:
Submittal Date: Sun Jul 05 11:50:46 EDT 2015
Public Input No. 535-NFPA 70E-2015 [ Section No. 110.2(C)(1) ]

(1) Contact Release.
Employees exposed to shock hazards shall be trained in methods of responsible for the safe release of victims from contact with exposed energized electrical conductors or circuit parts. Refresher training shall be trained in methods of safe release. Refresher training shall occur annually.

Statement of Problem and Substantiation for Public Input
This PI is being submitted by the Article 110 Task Group in effort to clarify the section and identify that the individuals responsible for providing contact release need this training. This is consistent with sections 110.2(C)(2)(a, b, and c).

Submitter Information Verification
Submitter Full Name: MARK MCNELLIS
Organization: SANDIA NATIONAL LABORATORIES
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Mon Jul 06 16:36:32 EDT 2015
### Public Input No. 58-NFPA 70E-2015 [ Section No. 110.2(C)(1) ]

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<td>Employees exposed to shock hazards shall be trained in methods of safe release of victims from contact with exposed energized electrical conductors or circuit parts if their assigned duties warrant such training. Refresher training shall occur annually.</td>
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### Statement of Problem and Substantiation for Public Input

Unqualified persons will not be assigned tasks intentionally where they will be exposed to shock, but, they may be assigned responsibility to respond to a qualified worker that made contact with energized parts, rendering him or her unable to voluntarily release themselves from the condition. The responding person must be able to take appropriate action that will not create an unsafe situation for themselves or others, while effectively releasing the victim. This input will ensure everyone that needs it is trained on the proper methods of release.

### Submitter Information Verification

<table>
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<th>Submitter Full Name: Bobby Gray</th>
</tr>
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<tr>
<td>Organization: Hoydar/Buck, Inc.</td>
</tr>
<tr>
<td>Affiliation: None</td>
</tr>
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Public Input No. 537-NFPA 70E-2015 [ New Section after 110.2(C)(2) ]

Informational Note No. 1: Employees responsible for responding to medical emergencies as identified in this requirement might not be first responders, or medical professionals. Such employees could be a second person, safety watch, craftsperson, etc.

Statement of Problem and Substantiation for Public Input

This PI is being submitted by the Article 110 Task Group in effort to clarify that the person responsible for providing contact release, first aid, CPR, etc may not be a medical professional and is often another craftsperson

Submitter Information Verification

Submitter Full Name: MARK MCNELLIS
Organization: SANDIA NATIONAL LABORATORIES
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jul 06 16:40:42 EDT 2015
Public Input No. 181-NFPA 70E-2015 [ Section No. 110.2(C)(2) ]

(2) First Aid, Emergency Response, and Resuscitation.
   (a) Employees responsible for responding to medical emergencies shall be trained in first aid and emergency procedures.
   (b) Employees responsible for responding to medical emergencies shall be trained in cardiopulmonary resuscitation (CPR). Refresher training shall occur annually.
   (c) Employees responsible for responding to medical emergencies shall be trained in the use of an automated external defibrillator (AED) if an employer’s emergency response plan includes the use of this device. Refresher training shall occur annually based on certification requirements of the training agency.

Statement of Problem and Substantiation for Public Input

The proposed change will allow the user to retrain AED based on the certification requirements of the training agency rather than require annual re-training. Annual retraining exceeds the recertification requirement for most recognized training agencies such as American Red Cross, American Safety and Health Institute (ASHI) and American Heart Association (AHA) and others that currently certify AED for 2 years.

Submitter Information Verification

Submitter Full Name: JOHN MCALHANEY
Organization: SAVANNAH RIVER NUCLEAR SOL.
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jun 16 09:39:37 EDT 2015
Public Input No. 549-NFPA 70E-2015 [Section No. 110.2(C)(2)]

(2) First Aid, Emergency Response, and Resuscitation.
   (a) Employees responsible for responding to medical emergencies shall be trained in first aid and emergency procedures. Refresher training shall occur in accordance with the requirements of the certifying body.
   (b) Employees responsible for responding to medical emergencies shall be trained in cardiopulmonary resuscitation (CPR). Refresher training shall occur annually.
   (c) Employees responsible for responding to medical emergencies shall be trained in the use of an automated external defibrillator (AED) if an employer’s emergency response plan includes the use of this device. Refresher training shall occur annually.

Statement of Problem and Substantiation for Public Input
This PI is being submitted by the Article 110 task Group. This change is an attempt to add consistency to this section and the rest of 110.2(C)(2) regarding retraining.

Submitter Information Verification
Submitter Full Name: MARK MCNELLISS
Organization: SANDIA NATIONAL LABORATORIES
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jul 06 17:38:31 EDT 2015
Public Input No. 207-NFPA 70E-2015 [Section No. 110.2(D)(1)]

(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. A person can be considered qualified with respect to certain equipment and methods but still be unqualified for others.

(b) Such persons permitted to work within the limited approach boundary shall, at a minimum, be additionally trained in all of the following:

3. Skills and techniques necessary to distinguish exposed energized electrical conductors and circuit parts from other parts of electrical equipment
4. Skills and techniques necessary to determine the nominal voltage of exposed energized electrical conductors and circuit parts
5. Approach distances specified in Table 130.4(D)(a) and Table 130.4(D)(b) and the corresponding voltages to which the qualified person will be exposed
6. Decision-making process necessary to be able to do the following:
   7. Perform the job safety planning
   8. Identify electrical hazards
   9. Assess the associated risk
   10. Select the appropriate risk control methods from the hierarchy of controls identified in 110.1(F), including personal protective equipment

(k) 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 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.

(l) Tasks that are performed less often than once per year shall require retraining before the performance of the work practices involved.

(m) 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.

(o) 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.

Statement of Problem and Substantiation for Public Input
This belongs in retraining section

Submitter Information Verification
Submitter Full Name: DALEEP MOHLA
Organization: DCM ELECTRICAL CONSULTING SERV
Street Address:
City:
State:
Zip:
Submittal Date: Sat Jun 20 12:43:43 EDT 2015
Public Input No. 402-NFPA 70E-2015 [ Section No. 110.2(D)(1) ]

(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 methods, 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:

(4) Skills and techniques necessary to distinguish exposed energized electrical conductors and circuit parts from other parts of electrical equipment

(5) Skills and techniques necessary to determine the nominal voltage of exposed energized electrical conductors and circuit parts

(6) Approach distances specified in Table 130.4(D)(a) and Table 130.4(D)(b), and the corresponding voltages to which the qualified person will be exposed

(7) Decision-making process necessary to be able to do the following:

(8) Perform the job safety planning

(9) Identify electrical hazards

(10) Assess the associated risk

(11) Select the appropriate risk control methods from the hierarchy of controls identified in 110.1(F), including personal protective equipment

(l) 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 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.

(m) Tasks that are performed less often than once per year shall require retraining before the performance of the work practices involved.

(n) 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.

(o) 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.

**Statement of Problem and Substantiation for Public Input**

Clarification:
The concept that the personnel is qualified for specific jobs or tasks is related to but independent of the concept being familiar with techniques, PPE, etc., and is important enough to warrant being mentioned as a specific point, as opposed to being at the end of section (a).

Also, is “method” the most appropriate word, or are we actually talking about tasks, as is mentioned throughout the document?

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Submittal Date: Sat Jul 04 14:10:54 EDT 2015
Public Input No. 115-NFPA 70E-2015 [ Section No. 110.2(D)(2) ]

(2) Unqualified Persons. Unqualified persons shall be trained in, and be familiar with, any electrical safety-related practices necessary for their safety. Specific requirements are:

(A) They must know what is safe to touch and what is not safe to touch in the specific areas they will be entering.

(B) They must know what the maximum voltage of the area is.

(C) They must be trained in the recognition and proper use of protective equipment that will be used to provide protection for them and in the work practices necessary for performing their specific work assignments within the area.

(D) They must know the limited approach boundaries for the maximum voltage within the area, and the skills and techniques necessary to maintain those distances.

(E) They must be trained to recognize the electrical hazards to which they may be exposed and the skills and techniques necessary to control or avoid those hazards.

Statement of Problem and Substantiation for Public Input

Prior edition did not specify training for unqualified persons with any detail. Thus employers are left to determine what training is required for “their safety” which may not be sufficient.

In 2015 under the Settlement (EEI v. OSHA, Docket No. 14-1098) OSHA has clarified what specific basic level of training is required for qualified non-electrical workers under 1910.269. Although the terminology between 70E and 1910.269 differs, both recognize that all workers must receive a basic level of training in electrical hazard recognition and electrical hazard avoidance.

The proposal copies OSHA’s requirements from the Settlement under 1910.269 word-for-word in clarifying what specific training is required for unqualified workers for clarity.

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Submitter Full Name: Paul Campbell
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Submittal Date: Mon Apr 13 11:42:10 EDT 2015
(3) Retraining.
Retraining in safety-related work practices and applicable changes in this standard shall be performed at intervals not to exceed three years. An employee shall receive additional training (or retraining) if any of the following conditions exists:

(1) The supervision or annual inspections indicate that 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 that are different from those that the employee would normally use.

(3) The employee must employ safety-related work practices that are not normally used during his or her regular job duties.

(4) The employee’s job duties change.

Statement of Problem and Substantiation for Public Input

Document clarity
This condition is not currently considered.

Submitter Information Verification

Submitter Full Name: Drake Drobnick
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Street Address: 
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Submittal Date: Tue Jan 27 13:46:38 EST 2015
(3) Retraining.
Retraining in safety-related work practices and applicable changes in this standard shall be performed at intervals not to exceed three years. An employee shall receive additional training (or retraining) if any of the following conditions exist:

(1) The supervision or annual inspections indicate that 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 that are different from those that the employee would normally use.

(3) The employee must employ safety-related work practices that are not normally used during his or her regular job duties.

(4) Tasks that are performed less often than once per year before the performance of the work practices involved.

Statement of Problem and Substantiation for Public Input
This text has been relocated from 110.2 (D)(d) because it relates to retraining requirement and belongs in the Retraining section 110.2(D)(3). The relocated text has been edited to remove the phrase “shall require retraining” as it is covered by the title and leading statement.

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Submitter Full Name: DALEEP MOHLA
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Submittal Date: Sat Jun 20 12:54:28 EDT 2015
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.

- **Informational Note No. 1:** To show proficiency a qualified person shall observe the work practices involved and document proficiency of the person performing the tasks.
- **Informational Note No. 2:** Content of the training could include one or more of the following: course syllabus, course curriculum, outline, table of contents or training objectives.
- **Informational Note No. 2:** Employment records that indicate that an employee has received the required training are an acceptable means of meeting this requirement.

### Statement of Problem and Substantiation for Public Input

The addition of this informative note is to clarify that proficiency shall be documented. The existing informative note #2 in 110.2(E) applies to the training requirement. Informative note #2 is not clear that it also applies to the documentation of proficiency requirement.

### Submitter Information Verification

<table>
<thead>
<tr>
<th>Submitter Full Name</th>
<th>DARYLD CROW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization</td>
<td>DRC CONSULTING LTD</td>
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<td>Wed Jun 17 11:34:19 EDT 2015</td>
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Public Input No. 219-NFPA 70E-2015 [ Section No. 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, the qualifications of the trainer, each employee’s name, and dates of training.

Informational Note No. 1: Content of the training could include one or more of the following: course syllabus, course curriculum, outline, table of contents or training objectives.

Informational Note No. 2: Employment records that indicate that an employee has received the required training are an acceptable means of meeting this requirement.

Statement of Problem and Substantiation for Public Input

The trainer must have the knowledge and understanding of the material in order for the training to be effective and meaningful. With the popularity of this standard, a lot of companies are offering training classes, and there are a lot of trainers out there. Some of them do not have the knowledge and understanding needed to meet the training requirements of this standard.

Submitter Information Verification

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Affiliation: Self
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Submittal Date: Mon Jun 22 17:10:55 EDT 2015
Public Input No. 237-NFPA 70E-2015 [Section No. 110.2(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.

Informational Note No.1: Content of the training could include one or more of the following: course syllabus, course curriculum, outline, table of contents or training objectives.

Informational Note No.2: Employment records that indicate that an employee has received the required training are an acceptable means of meeting this requirement.

Informational Note No.3: Employers may document demonstration of proficiency by relying on an employee's previous training as long as the employer: (1) Confirms that the employee has the job experience appropriate to the work to be performed, (2) through an examination or interview, makes an initial determination that the employee is proficient in the relevant safety-related work practices before he or she performs any work tasks assigned, and (3) supervises the employee closely until that employee has demonstrated proficiency in all the work practices he or she will employ.

Statement of Problem and Substantiation for Public Input

add information note #3 to add information on methods to document proficiency as required in 110.2(E)

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Submittal Date: Tue Jun 23 17:28:56 EDT 2015
Public Input No. 303-NFPA 70E-2015 [Section No. 110.3]

110.3 Host and Owner and Contract Employers’ Responsibilities

(A) Host Employer, Owner, Employer Responsibilities.

1. The host employer or designated employer shall inform contract employers of the following:
   1. Known hazards that are covered by this standard, that are related to the contract employer’s work, and that might not be recognized by the contract employer or its employees
   2. Information about the employer’s installation that the contract employer needs to make the assessments required by Chapter 1

2. The host employer or designated employer shall report observed contract employer–related violations of this standard to the contract employer.

(B) Contract Employer Responsibilities.

1. The contract employer shall ensure that each of his or her employees is instructed in the hazards communicated to the contract employer by the host employer or employer. This instruction shall be in addition to the basic training required by this standard.
   1. Any unique hazards presented by the contract employer’s work
   2. Hazards identified during the course of work by the contract employer that were not communicated by the host employer or designated employer
   3. The measures the contractor took to correct any violations reported by the host employer, owner or designated employer under 110.3(A) (2) and to prevent such violation from recurring in the future

(C) Documentation.

Where the host employer or designated 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 or designated employer and the contract employer.

Statement of Problem and Substantiation for Public Input

This requirement is modeled after language in OSHA 1926.950(c) and 1910.269(a)(3). These OSHA regulations deal with electric power generation, transmission and distribution. It is imperative to note that NFPA 70E 90.2(B)(4) specifically exempts electric power generation, transmission and distribution from the requirements of this standard. The use of the term “host” works in 1926.269 and 1910.950 because the host is an electric utility with a very large network of transmission and distribution. The utility company is the “owner”.

The use of the word “host” is confusing and should be deleted. This term serves no function in the commercial environment. No one knows who the “host” is when applying 110.3. Revising this text to reference the owner or the owners designated employee which may be a general contractor provides necessary clarity.

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Submittal Date: Mon Jun 29 11:46:21 EDT 2015
Public Input No. 188-NFPA 70E-2015 [ Section No. 110.3(A) ]

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<th>Safe Work practices. On multiemployer worksites (in all industries) more than one employee may be responsible for hazardous conditions that violate safe work practices.</th>
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<td>(A)</td>
<td>Host Employer Responsibilities.</td>
</tr>
<tr>
<td>1.</td>
<td>The host employer shall inform contract employers of the following:</td>
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<td>1.1</td>
<td>Known hazards that are covered by this standard, that are related to the contract employer’s work, and that might not be recognized by the contract employer or its employees</td>
</tr>
<tr>
<td>1.2</td>
<td>Information about the employer’s installation that the contract employer needs to make the assessments required by Chapter 1</td>
</tr>
<tr>
<td>2.</td>
<td>The host employer shall report observed contract employer–related violations of this standard to the contract employer.</td>
</tr>
</tbody>
</table>

Statement of Problem and Substantiation for Public Input

Adding this wording will ensure users of the standard understand that more than one employer may be responsible for hazards in the workplace.

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Submittal Date: Wed Jun 17 13:40:08 EDT 2015
Public Input No. 220-NFPA 70E-2015 [Section No. 110.3(A)]

(A) Pre-Qualification. The previous level of electrical safety training and experience for contract employees shall be evaluated before they are brought on site to determine whether or not that training and experience is sufficient for them to be considered, by the Host employer, to be Qualified Person(s) for the work to be done and the electrical hazards involved.

(B) Host Employer Responsibilities.

1. The host employer shall inform contract employers of the following:
   
   (1) Known hazards that are covered by this standard, that are related to the contract employer’s work, and that might not be recognized by the contract employer or its employees.
   
   (2) Information about the employer’s installation that the contract employer needs to make the assessments required by Chapter 1.

2. The host employer shall report observed contract employer-related violations of this standard to the contract employer.

Statement of Problem and Substantiation for Public Input

In the same way the training and experience has to be evaluated for direct employees for them to be considered Qualified for the job, contract employees must pass that same evaluation. The contract employer also may not know what is required and supply individuals without proper training and experience, without understanding they are doing so. There are journeyman and master electricians that don’t have the training and experience required to meet the requirements to be considered Qualified as related to this standard. Unless this evaluation is performed before work begins, the potential exists for unqualified people to be assigned work exposing them to the risk of injury.

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Submittal Date: Mon Jun 22 17:17:52 EDT 2015
Public Input No. 534-NFPA 70E-2015 [Section No. 110.3(A)(1)]

1. Known hazards that are covered by this standard, that are related to the contract employer’s work, and that might not be recognized by the contract employer or its employees
2. Known information about the employer’s installation that the contract employer needs to make the assessments required by Chapter 1

Statement of Problem and Substantiation for Public Input

This editorial change is being submitted by the Article 110 Task Group in effort to make the section more consistent with sections 110.3(A)(1)(1) and 110.3(C)

Submitter Information Verification

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Submit Date: Mon Jul 06 16:29:57 EDT 2015
## 110.4 Use of Electrical Equipment

### (A) Use of Equipment

All equipment shall be used and operated in accordance with any instructions included in the listing or labeling and manufacturer's instructions.

### (B) Test Instruments and Equipment

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.

2. **Rating.** Test instruments, equipment, and their accessories shall be rated for circuits and equipment where they are utilized.

---

**Informational Note:** See ANSI/ISA-61010-1 (82.02.01)/UL 61010-1, *Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements*, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 volts and below.

### (C) Portable Electric Equipment

This section applies to the use of cord- and plug-connected equipment, including cord sets (extension cords).

1. **Handling and Storage.** Portable equipment shall be handled and stored in a manner that will not cause damage. Flexible electric cords connected to equipment shall not be used for raising or lowering the equipment. Flexible cords shall not be fastened with staples or hung in such a fashion as could damage the outer jacket or insulation.

2. **Grounding-Type Equipment.**

   - (a) A flexible cord used with grounding-type utilization equipment shall contain an equipment grounding conductor.
   - (b) Attachment plugs and receptacles shall not be connected or altered in a manner that would interrupt continuity of the equipment grounding conductor.
   - (c) Adapters that interrupt the continuity of the equipment grounding conductor shall not be used.

3. **Testing.**

   - (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:** Cord- and plug-connected equipment and flexible cord sets (extension cords) that remain connected once they are put in place and are not exposed to damage shall not be required to be visually inspected until they are relocated.
   - (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 that are 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.

4. **Conductive Work Locations.** Portable electric equipment used in highly conductive work locations (such as those inundated with water or other 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 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.

5. **Connecting Attachment Plugs.**

   - (a) Employees' hands shall not be wet when plugging and unplugging flexible cords and cord- and plug-connected equipment if energized equipment is involved.
   - (b) Energized plug and receptacle connections shall be handled only with insulating protective equipment if the condition of the connection could provide a conductive path to the employee's hand (e.g., if a cord connector is wet from being immersed in water).

6. **Manufacturer's Instructions.** Portable equipment shall be used in accordance with the manufacturer's instructions and safety warnings.

---

**C (D)** 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. **Maintenance and Construction.**

   - (a) GFCI protection shall be provided where an employee is operating or using cord- and plug-connected tools related to maintenance and construction activity supplied by 125-volt, 15-, 20-, or 30-ampere circuits. Where employees operate or use equipment supplied by greater than 125-volt, 15-, 20-, or 30-ampere circuits, GFCI protection on an assured equipment grounding conductor program shall be implemented.

3. **Outdoors.**

   - (a) 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 greater than 125-volt, 15-, 20-, or 30-ampere circuits, GFCI protection on an assured equipment grounding conductor program shall be implemented.

---

**D (E)** Ground-Fault Circuit-Interrupter Protection Devices.

GFCI protection devices shall be tested in accordance with the manufacturer's instructions.
Statement of Problem and Substantiation for Public Input

.205.3 provides guidance for equipment maintenance, but there are no clear guidance for use and operation of equipment. Addition of this new section will clarify that all equipment use and operation has to follow listing and labeling instructions and manufacturer’s instructions for safety.

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Submittal Date: Fri Jun 19 15:58:16 EDT 2015
Public Input No. 329-NFPA 70E-2015 [Section No. 110.4]

110.4. Use of Electrical Equipment.

(A) Test Instruments and Equipment.

110.4. Test Instruments and Equipment.

(A) 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 within an electrical hazard area.

(B) Rating.

Test instruments, equipment, and their accessories shall be rated for circuits and equipment where they are utilized.

Informational Note: See ANSI/ISA-61010-1 (82.02.01)/UL 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use.

1 Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 volts and below.

(C) Design.

Test instruments, equipment, and their accessories shall be designed for the environment to which they will be exposed and for the manner in which they will be utilized.

(D) Visual Inspection and Repair.

Test instruments and equipment and all associated test leads, cables, power cords, probes, and connectors shall be visually inspected for external defects and damage before each use. 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 that are necessary to render the equipment safe has done so.

(E) Operation Verification.

When test instruments are used for testing the absence of voltage on conductors or circuit parts operating at 50 volts or more at voltages equal to or greater than 50 Vac or 100 Vdc; the operation of the test instrument shall be verified on a known voltage source before and after an absence of voltage test is performed.

110.5. Portable Electric Equipment.

This section applies to the use of cord- and plug-connected equipment, including cord sets (extension cords).

(A) Grounding-Type Equipment.

(a) A flexible cord used with grounding-type utilization equipment shall contain an equipment grounding conductor.

(b) Attachment plugs and receptacles shall not be connected or altered in a manner that would interrupt continuity of the equipment grounding conductor. Additionally, these devices shall not be altered in order to allow use in a manner that was not intended by the manufacturer.

(c) Adapters that interrupt the continuity of the equipment grounding conductor shall not be used.


(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: Cord- and plug-connected equipment and flexible cord sets (extension cords) that remain connected once they are put in place and are not exposed to damage shall not be required to be visually inspected until they are relocated.

(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.

(E) Connecting Attachment Plugs.

(a) Employees’ hands shall not be wet when plugging and unplugging flexible cords and cord- and plug-connected equipment if energized equipment is involved.

(b) Energized plug and receptacle connections shall be handled only with insulating protective equipment if the condition of the connection could provide a conductive path to the employee’s hand (e.g., if a cord conductor is wet from being immersed in water).

(c) Locking-type connectors shall be secured after connection.

(F) Manufacturer’s Instructions.

Portable equipment shall be used in accordance with the manufacturer’s instructions and safety warnings.

(A) Ground-Fault Circuit-Interrupter (GFCI) Protection.

全体员工 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.

(B) Maintenance and Construction.

GFCI protection shall be provided where an employee is operating or using cord- and plug-connected tools related to maintenance and construction activity supplied by 125-volt, 15-, 20-, or 30-ampere circuits. Where employees operate or use equipment supplied by greater than 125-volt, 15-, 20-, or 30-ampere circuits, GFCI protection or an assured equipment grounding conductor program shall be implemented.

(C) Outdoors.

GFCI protection shall be provided where 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 or use equipment supplied by greater than 125-volt, 15-, 20-, or 30-ampere circuits, GFCI protection or an assured equipment grounding conductor program shall be implemented.

(D) Testing Ground-Fault Circuit-Interrupter Protection Devices.

GFCI protection devices shall be tested in accordance with the manufacturer’s instructions.

110.6. Electrical Conductors and Equipment at Hazardous Locations.

(A) General.

Employees shall be provided with ground-fault circuit-interrupter (GFCI) protection for personnel identified for portable use shall be permitted.

(B) Maintenance and Construction.

GFCI protection shall be provided where an employee is operating or using cord- and plug-connected tools related to maintenance and construction activity supplied by 125-volt, 15-, 20-, or 30-ampere circuits. Where employees operate or use equipment supplied by greater than 125-volt, 15-, 20-, or 30-ampere circuits, GFCI protection or an assured equipment grounding conductor program shall be implemented.

(C) Outdoors.

GFCI protection shall be provided where 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 or use equipment supplied by greater than 125-volt, 15-, 20-, or 30-ampere circuits, GFCI protection or an assured equipment grounding conductor program shall be implemented.

(D) Testing Ground-Fault Circuit-Interrupter Protection Devices.

GFCI protection devices shall be tested in accordance with the manufacturer’s instructions.
110.7 Overcurrent Protection Modification.
Overcurrent protection of circuits and conductors shall not be modified, even on a temporary basis, beyond what is permitted by applicable portions of electrical codes and standards dealing with overcurrent protection.

   Informational Note: For further information concerning electrical codes and standards dealing with overcurrent protection, refer to Article 240 of NFPA 70, National Electrical Code.

110.8 Temporary Protective Grounding Equipment.

   (A) Placement. Temporary protective grounding equipment shall be placed at such locations and arranged in such a manner as to prevent each employee from being exposed to a shock hazard (hazardous differences in electrical potential). The location, sizing, and application of temporary protective grounding equipment shall be identified as part of the employer’s job planning.

   (B) Capacity. Temporary protective grounding equipment 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.

   (C) Equipment Approval. Temporary protective grounding equipment shall meet the requirements of ASTM F855, Standard Specification for Temporary Protective Grounds to be Used on De-energized Electric Power Lines and Equipment.

   (D) Impedance. Temporary protective grounding equipment 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.

Statement of Problem and Substantiation for Public Input

This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.

It is proposed that Article 110.4 be separated into 5 Articles for clarity.

During the 2015 cycle the NFPA Correlating Committee directed the 70E Technical Committee to review the title of 110.4 “Use of Electrical Equipment.” It was noted by the Correlating Committee that the title is vague and confusing.

The proposed approach deletes the title and groups similar material into separate Articles, each with a meaningful title.

Concurrently, it is also proposed that the material found in 120.3 Temporary Protective Grounding Equipment be relocated without revision to the end of Article 110. The information in Article 120.3 deals primarily with Temporary Protective Grounding Equipment from an equipment perspective rather than a work practices perspective and as such is more appropriately located with similar material at the end of Article 110.

The proposed reorganization of Article 110.4 would flow as follows:

- **110.4 Test Instruments and Equipment**
  - (A) Testing
  - (B) Rating
  - (C) Design
  - (D) Visual Inspection and Repair
  - (E) Operation Verification

- **110.5 Portable Cord- and Plug-Connected Electric Equipment**
  - (A) Handling and Storage
  - (B) Grounding-Type Equipment
  - (C) Visual inspection and Repair of Portable Cord- and Plug-Connected Equipment and Flexible Cord Sets
  - (D) Conductive Work Locations
  - (E) Connecting Attachment Plugs
  - (F) Manufacturer’s Instructions

- **110.6 Ground-Fault Circuit Interrupter (GFCI) Protection**
  - (A) General
  - (B) Maintenance and Construction
  - (C) Outdoors

- **110.7 Overcurrent Protection Modification**
  - (A) Placement
  - (B) Capacity
  - (C) Equipment Approval
  - (D) Impedance

Testing Ground-Fault Circuit Interrupter (GFCI) Protection Devices

110.8 Temporary Protective Grounding Equipment.

- (A) Placement
- (B) Capacity
- (C) Equipment Approval
- (D) Impedance

Related Public Inputs for This Document

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Submitter Information Verification

<table>
<thead>
<tr>
<th>Name:</th>
<th>DANIEL ROBERTS</th>
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</thead>
<tbody>
<tr>
<td>Organization:</td>
<td>SCHNEIDER ELECTRIC</td>
</tr>
<tr>
<td>Affiliation:</td>
<td>This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.</td>
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<td>Mon Jun 29 17:05:21 EDT 2015</td>
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103 of 693
110.4 Use of Electrical Equipment.

(A) Test Instruments and Equipment.

(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.

(2) Rating.
Test instruments, equipment, and their accessories shall be rated for circuits and equipment where they are utilized.

Informational Note: See ANSI/UL510-1 and ANSI/UL6101-1, Safety Requirements for Electrical Measurement, Control, and Laboratory Use Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 300 volts and below.

(B) Portable Electric Equipment.

This section applies to the use of cord- and plug-connected equipment, including cord sets (extension cords).

(1) 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: Cord- and plug-connected equipment and flexible cord sets (extension cords) that remain connected once they are put in place and are not exposed to damage shall not be required to be visually inspected until they are relocated.

(2) Rating.
Test instruments, equipment, and their accessories shall be designed for the environment to which they will be exposed and for the manner in which they will be utilized.

(3) Design.
Test instruments, equipment, and their accessories shall be designed to prevent damage and for their intended use.

(4) Visual Inspection and Repair.

Employee shall use it until a person(s) qualified to perform the repairs and tests necessary to render the equipment safe has done so.

(5) Operation Verification.
When test instruments are used for testing the absence of voltage on conductors or circuit parts operating at 50 volts or more, the operation of the test instrument shall be verified on a known voltage source before and after an absence of voltage test is performed.

(C) Ground-Fault Circuit-Interrupter (GFCI) Protection.

Portable equipment shall be handled and stored in a manner that will not cause damage. Flexible electric cords connected to equipment shall not be used for raising or lowering the equipment. Flexible cords shall not be fastened with staples or hung in such a fashion as could damage the outer jacket or insulation.

(1) Testing.
When test instruments are used for testing the absence of voltage on conductors or circuit parts operating at 50 volts or more, the operation of the test instrument shall be verified on a known voltage source before and after an absence of voltage test is performed.

(2) Rating.
Test instruments, equipment, and their accessories shall be rated for circuits and equipment where they are utilized.

Informational Note: See ANSI/UL510-1 and ANSI/UL6101-1, Safety Requirements for Electrical Measurement, Control, and Laboratory Use Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 300 volts and below.

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(4) Visual Inspection and Repair.

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(2) Rating.
Test instruments, equipment, and their accessories shall be rated for circuits and equipment where they are utilized.

Informational Note: See ANSI/UL510-1 and ANSI/UL6101-1, Safety Requirements for Electrical Measurement, Control, and Laboratory Use Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 300 volts and below.

(B) Portable Electric Equipment.

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(1) 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: Cord- and plug-connected equipment and flexible cord sets (extension cords) that remain connected once they are put in place and are not exposed to damage shall not be required to be visually inspected until they are relocated.

(2) Rating.
Test instruments, equipment, and their accessories shall be designed for the environment to which they will be exposed and for the manner in which they will be utilized.

(3) Design.
Test instruments, equipment, and their accessories shall be designed to prevent damage and for their intended use.

(4) Visual Inspection and Repair.

Employee shall use it until a person(s) qualified to perform the repairs and tests necessary to render the equipment safe has done so.

(5) Operation Verification.
When test instruments are used for testing the absence of voltage on conductors or circuit parts operating at 50 volts or more, the operation of the test instrument shall be verified on a known voltage source before and after an absence of voltage test is performed.
(E) Overcurrent Protection Modification.

Overcurrent protection of circuits and conductors shall not be modified, even on a temporary basis, beyond what is permitted by applicable portions of electrical codes and standards dealing with overcurrent protection.

Informational Note: For further information concerning electrical codes and standards dealing with overcurrent protection, refer to Article 240 of NFPA 70, National Electrical Code.

Statement of Problem and Substantiation for Public Input

Relocate this section in Article 130 possibly as a new 130.6. Most of the remaining requirements in 110 are for the employer to implement into their electrical safety program. The training on test instruments is already included in 110.2(D)(1)(e). Article 13) contains work practices the employees are to use.

Submitter Information Verification

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Organization: INNOVATIVE TECHNOLOGY SERVICES
Street Address:
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Submittal Date: Mon Jul 06 14:04:59 EDT 2015
(2) Rating.
Test instruments and equipment shall be listed and labeled and shall be used in accordance with any instructions included in listing and labeling. Test instruments, equipment, and their accessories shall be rated for circuits and equipment where they are utilized.

Informational Note: See ANSI/ISA-61010-1 (82.02.01)/UL 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 volts and below.

Statement of Problem and Substantiation for Public Input

Test instruments are critical to establish an electrically safe work condition. It is important that all such instruments shall be listed and labeled and used according to any instructions in the listing and labeling to protect workers. Numerous incidents have been reported where test instruments were incorrectly applied. The instructions used in listing and labeling can be used to meet the requirements of employee training for proper use and limitations of test instruments.

Submitter Information Verification

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Street Address:
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Submittal Date: Fri Jun 12 17:05:51 EDT 2015
Public Input No. 304-NFPA 70E-2015 [ Section No. 110.4(A)(5) ]

(5) Operation Verification.
When test instruments are used for testing the absence of voltage on conductors or circuit parts operating at 50 volts or more, the operation of the test instrument shall be verified on a known voltage source before and after an absence of voltage test is performed.

Informational Note: Verifying the operation of a test instrument for systems 600-volts and less typically involves a known live source such as an energized 125-volt receptacle. The verification step is to ensure that the test instrument is operating properly. There is no requirement that the verification be at the same voltage as the equipment being placed into an electrically safe work condition.

Statement of Problem and Substantiation for Public Input

There is confusion in the industry due to some training programs instructing participants to always verify the operation of a test instrument on the same voltage as the equipment being deenergized. No such requirement exists. For example, in a remote pump house a 480-volt motor starter may need to be placed in an electrically safe work condition. The installer/maintainer will need to verify operation of his/her test instrument. The verification could take place in a receptacle at 125-volts. However, where this misconception exists, the installer must access energized equipment at 480-volts which may require exposing energized parts at 480-volts with significant incident energy available.

Submitter Information Verification
Submitter Full Name: JAMES DOLLARD
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Submittal Date: Mon Jun 29 12:00:17 EDT 2015
Public Input No. 359-NFPA 70E-2015 [ Section No. 110.4(A)(5) ]

(5) Operation Verification. When test instruments are used for testing the absence of voltage on conductors or circuit parts operating at 50 volts or more, the operation of the test instrument shall be verified on any known voltage source before and after an absence of voltage test is performed.

Statement of Problem and Substantiation for Public Input

The proposed revision will provide clarification and reduce some apparent confusion about the voltage level necessary to determine proper operation of the test instrument. Using the properly rated voltage test instrument is already a requirement in 120.1 and 110.4(A)(2).

Submitter Information Verification

Submitter Full Name: MICHAEL JOHNSTON
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Submittal Date: Thu Jul 02 10:09:57 EDT 2015
Public Input No. 488-NFPA 70E-2015 [Section No. 110.4(A)(5)]

Statement of Problem and Substantiation for Public Input

Delete this subdivision as it is already in 120.1(5). Having duplicate text does not improve clarity or usability of the standard.

Submitter Information Verification

Submitter Full Name: PAUL DOBROWSKY
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Submittal Date: Mon Jul 06 14:07:37 EDT 2015

When test instruments are used for testing the absence of voltage on conductors or circuit parts operating at 50 volts or more, the operation of the test instrument shall be verified on a known voltage source before and after an absence of voltage test is performed.
Public Input No. 221-NFPA 70E-2015 [ Section No. 110.4(B)(3) ]


(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:

   Cord

   Stationary cord- and plug-connected equipment and flexible cord sets (extension cords) that remain connected once they are put in place and are not exposed to damage installed such that the cord and plug are not subject to physical damage during normal use shall not be required to be visually inspected until inspected except when they are initially installed, 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.

Statement of Problem and Substantiation for Public Input

The revised wording clarifies that this exception only applies to equipment that is stationary, specifies that the installation is such that the cord and plug supplying the equipment are not subject to physical damage and includes the cases of initial installation and repair as requiring inspection.

Submitter Information Verification

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Submittal Date: Mon Jun 22 17:23:08 EDT 2015
Public Input No. 222-NFPA 70E-2015 [Section No. 110.4(B)(4)]

(4) Conductive Work Locations.
(a) Portable electric equipment used in highly conductive work locations (such as those inundated with water or other 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: (b) 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. Where these alternative tools and equipment are available, they shall be used in lieu of those powered from a 120 volt ac source.

Statement of Problem and Substantiation for Public Input

More and more tools and equipment powered from alternative sources are available that will perform the work to be done. Use of these alternatives not just minimizes the potential for injury due to shock, they eliminate it. This standard should require any advance in materials, tools, methods, technology, etc. that eliminate potential for injury to any electrical hazard. Where alternatives are available, this standard should not allow for the use of electrically powered tools and equipment.

Submitter Information Verification

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Submittal Date: Mon Jun 22 17:28:02 EDT 2015
Public Input No. 158-NFPA 70E-2015 [Section No. 110.4(B)(6)]

(6) Manufacturer’s Instructions. Portable equipment shall not be used in accordance with the manufacturer’s instructions and safety warnings.

Statement of Problem and Substantiation for Public Input

The problem with existing wording is a matter of enforcement. As written, the user of portable equipment would be obligated to provide the manufacturer’s instructions, which may no longer exist or be available. The proposed revised wording places the burden of proof on the enforcement agent to show non-compliance.

Submitter Information Verification

Submitter Full Name: BOBBY GRAY
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Street Address: 
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Submit Date: Wed Jun 03 12:05:14 EDT 2015
Public Input No. 287-NFPA 70E-2015 [Section No. 110.4(C)]

Ground-Fault Circuit-Interrupter (GFCI), Special Purpose Ground-Fault Circuit-Interrupter (SPGFCI), and Equipment Ground-Fault Protective Device (EGFPD) Protection.

(1) General.
Employees shall be provided with ground-fault circuit-interrupter (GFCI) protection or special purpose GFCI (SPGFCI) protection, where required by applicable state, federal, or local codes and standards. Listed cord sets or devices incorporating listed GFCI protection or SPGFCI protection, for personnel identified for portable use shall be permitted.

(2) Maintenance and Construction.
GFCI protection shall be provided where an employee is operating or using cord- and plug-connected tools related to maintenance and construction activity supplied by 125-volt, 15-, 20-, or 30-ampere circuits. Where employees operate or use equipment supplied by greater than 125-volt, 15-, 20-, or 30-ampere circuits, GFCI protection, SPGFCI protection, EGFPD protection, or an assured equipment grounding conductor program shall be implemented.

(3) 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 operate outdoors or use equipment supplied by greater than 125-volt, 15-, 20-, or 30-ampere circuits, GFCI protection, SPGFCI protection, EGFPD protection, or an assured equipment grounding conductor program shall be implemented.

Additional Proposed Changes

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Statement of Problem and Substantiation for Public Input

Substantiation for include SPGFCI devices in the standard:

Fatality Statistics continue to show electrocutions as a significant cause of death at the work place. The 2015 NFPA 70E Standard, Annex K states that electrocutions are the fourth leading cause of industrial fatalities. It also stated that the National Safety Council estimates that about 1000 fatalities every year are due to electrocution, where more than 50% of them take place on system voltage less than 600 V. Moreover, approximately 30,000 non-fatal electrical shock accidents occur every year.

UL 943C identifies protective devices designated as special purpose GFCI (SPGFCI) and thus designed to meet the both NEC and NFPA 70E definition of devices intended for personnel protection. Updating the NFPA 70E code to include SPGFCIs designed and approved for industrial applications per UL 943C holds the promise of significantly reducing loss of life at the work place.

References:


Substantiation for include EGFPD devices in the standard:

Although EGFPDs are rated as equipment protection by UL, they are tested to both UL943 GFCI standard and UL 1053 Ground-Fault Sensing and Relaying Equipment. Therefore, EGFPD offer protection similar to GFCIs.

EGFPDs should not be confused with ground-fault protection of equipment (GFPE). EGFPDs are equipped with a tripping mechanism similar to GFCIs and therefore are capable of interrupting power when a ground-fault is detected.

EGFPDs use the same GFCIs tripping characteristic and therefore an EGFPD will clear a ground-fault within the same clearing time of a GFCI provided that the fault-current magnitude is higher than the device set trip level. EGFPDs differ from GFCIs in:

1. Tripping level is adjustable in the range of 6 to 100 mA (GFCIs have a fixed trip level; 6 mA for Class A and 20 mA for Classes C, D, and E)
2. Monitoring equipment grounding conductor continuity is not required (a mandate for Classes C, D, and E GFCIs).

Unfortunately, some industrial systems have natural leakage current of more than 20 mA during normal operation. The submitter of this PI has experiences a leakage of more than 50 mA while testing an arc welder and a plasma cutter. A similar situation was encountered at a brick manufacture running 6 wet saws (concrete cutters) feed from one source. For those systems, the use of Classes C, D, or E GFCIs defined by UL 943C is impractical. Therefore, EGFPDs could be used to provide some protection to personnel when GFCIs cannot be used.

Although, some commercial EGFPDs are equipped with internal means to monitor equipment grounding conductor continuity, this feature is not available in all devices because it is not a required feature by UL for these devices. Therefore, in order to insure the grounding conductor continuity, a ground continuity monitor relay can be used in conjunction with EGFPDs.

References:


Related Public Inputs for This Document

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<td>Includes the definition of SPGFCI devices referenced in this PI</td>
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<tr>
<td>Public Input No. 286-NFPA 70E-2015 [New Definition after Definition: Equipment ]</td>
<td>Includes the definition of EGFPD devices referenced in this PI</td>
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Sections 110.4(C)(2), 110.4(C)(3)

(2) Maintenance and Construction.
GFCI protection shall be provided where an employee is operating or using cord sets or plug-connected tools related to maintenance and construction activity supplied by 125-volt, 15-, 20-, or 30-ampere circuits. Where employees operate or use equipment supplied by greater than 125-volt, 15-, 20-, or 30-ampere circuits, GFCI protection or an assured equipment grounding conductor program shall be implemented.

(3) Outdoors.
GFCI protection shall be provided when an employee is outdoors and operating or using cord sets or plug-connected equipment supplied by 125-volt, 15-, 20-, or 30-ampere circuits. Where employees working outdoors operate or use equipment supplied by greater than 125-volt, 15-, 20-, or 30-ampere circuits, GFCI protection or an assured equipment grounding conductor program shall be implemented.

Statement of Problem and Substantiation for Public Input

Document clarity
OSHA Subpart S 1910.304 (b)(3)(ii)(c) requires cord sets to be protected.

Submitter Information Verification

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Affiliation: N/A
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Submittal Date: Tue Jan 27 13:51:27 EST 2015
Public Input No. 288-NFPA 70E-2015 [Section No. 110.4(D)]

(D) Ground-Fault Circuit-Interrupter, Special Purpose Ground-Fault Circuit-Interrupter and Equipment Ground-Fault Protective Device Protection Devices. GFCI, SPGFCI, and EGFPD protection devices shall be tested in accordance with the manufacturer's instructions.

Statement of Problem and Substantiation for Public Input

This PI is suggested to be consistent with the current standard format. It provides testing instructions for SPGFCI and EGFPD protection device introduced to the standard via PIs 285, 286 and 287.

Related Public Inputs for This Document

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<td>Includes the definition of SPGFCI devices referenced in this PI</td>
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<td>Public Input No. 286-NFPA 70E-2015 [New Definition after Definition: Equipment]</td>
<td>Includes the definition of EGFPD devices referenced in this PI</td>
</tr>
<tr>
<td>Public Input No. 287-NFPA 70E-2015 [Section No. 110.4(C)]</td>
<td>References the applications of SPGFCI and EGFPD devices</td>
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Submitter Information Verification

Submitter Full Name: NEHAD EL-SHERIF
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Street Address:
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Submittal Date: Sun Jun 28 15:50:39 EDT 2015
**Public Input No. 139-NFPA 70E-2015 [ Article 120 ]**

**Article 120 Establishing an Electrically Safe Work Condition**

120.1 Verification of an Electrically Safe Work Condition.

An electrically safe work condition shall be achieved when performed in accordance with the procedures of 120.2 and verified by the following process:

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 fully disconnected position.

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

5. Use an adequately rated test instrument to test each phase conductor or circuit part to verify it is de-energized. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground. Before and after each test, determine that the test instrument is operating satisfactorily through verification on a known voltage source. Informational Note: See ANSI/ISA 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 volts and below.

6. Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or 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 ground connecting devices rated for the available fault duty.

120.2 De-energized Electrical Equipment That Has Lockout/Tagout Devices Applied.

Each employer shall identify, document, and implement a lockout/tagout program that develops and implements policies, processes and procedures conforming to Article 120 to safeguard employees from exposure to electrical hazards. The lockout/tagout procedure program shall be appropriate for the experience and training of the employees and conditions as they exist in the workplace.

(A) General Policy.

All electrical circuit conductors and circuit parts shall be considered energized until the source(s) of energy is (are) removed, at which time they shall be considered de-energized. All electrical conductors and circuit parts shall not be considered to be in an electrically safe work condition until all of the applicable requirements of Article 120 have been met.

Informational Note: See 120.1 for the six-step procedure to verify an electrically safe work condition.

All electrical conductors and circuit parts that have been disconnected, but not under lockout/tagout; tested; and grounded (where appropriate) shall not be considered to be in an electrically safe work condition, and safe work practices appropriate for the circuit voltage and energy level shall be used. Lockout/tagout requirements shall apply to fixed, permanently installed equipment; to temporarily installed equipment; and to portable equipment.

(B) Principles of Lockout/Tagout Execution.

1. 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.
   - Informational Note: An example of direct exposure is the qualified electrician who works on the motor starter control, the power circuits, or the motor. An example of indirect exposure is the person who works on the coupling between the motor and compressor.

2. Training.

   - All persons who could be exposed or affected by the lockout/tagout program shall be trained to understand the established procedure process to control the energy and their responsibility in the procedure and its execution. New or reassigned employees shall be trained to understand the lockout/tagout procedure program as it relates to their new assignments.

3. Retraining.

   Retraining shall be performed:
   - (a) When the established procedure program is revised
   - (b) At intervals not to exceed 3 years
   - (c) Training Documentation.
     - (a) The employer shall document that each employee has received the training required by this section.
     - (b) The documentation shall be made when the employee demonstrates proficiency in the work practices involved.
   - (d) The documentation shall contain the content of the training, each employee’s name, and the dates of the training.

   Informational Note: Content of the training could include one or more of the following: course syllabus, course curriculum, outline, table of contents, or training objectives.

4. Plan Planning.

   A plan, All lockout/tagout procedures shall be developed on the basis of the existing electrical equipment and system and shall use up-to-date diagrammatic drawing representation(s).

5. Control of Energy.

All sources of electrical energy shall be controlled in such a way as to minimize employee exposure to electrical hazards.

6. Identification.

The lockout/tagout device shall be unique and readily identifiable as a lockout/tagout device.

7. Voltage.

   Voltage shall be removed and absence of voltage verified.

8. Coordination.

   The established electrical lockout/tagout procedure program shall be coordinated with all of the employer’s procedures associated with overall lockout/tagout of program for all other energy sources, and with the employer’s overall electrical safety program.


   (1) Procedures Program.

   The employer shall establish a lockout/tagout procedure program, for the organization, provide training to employees, provide equipment necessary to execute the details of the procedure program, audit execution of the procedures to ensure employee understanding/compliance, and audit the procedure program every 3 years for improvement opportunity and completeness.

   (2) Form of Control.

   Two forms of hazardous electrical energy control shall be permitted: simple lockout/tagout and complex lockout/tagout (see 120.2(D)). For the simple lockout/tagout process, the qualified person shall be in charge. For the complex lockout/tagout process, the person in charge shall have overall responsibility.

   Informational Note: For an example of a lockout/tagout procedure, see Informative Annex G.
(3) Audit of Procedures.
An audit shall be conducted at least annually by a qualified person and shall cover at least one lockout/tagout procedure, in progress and the procedure details. The audit shall be designed to correct deficiencies in the established electrical lockout/tagout procedures, in the overall lockout/tagout program, or in employee understanding.

(1) Simple Lockout/Tagout Procedure Process.
All lockout/tagout procedures, activities, that involve only a qualified person(s) de-energizing one set of conductors or circuit part source for the sole purpose of safeguarding employees from exposure to electrical hazards shall be considered to be a simple lockout/tagout. Simple, The simple lockout/tagout plan, process, shall not be required to be written procedures for each application. Each worker shall be responsible for his or her own lockout/tagout.

(2) Complex Lockout/Tagout Procedure Process.
(a) All The complex lockout/tagout plans process shall be permitted required, where one or more of the following exist:
   (1) Multiple energy sources
   (2) Multiple crews
   (3) Multiple locations
   (4) Multiple crafts
   (5) Multiple disconnecting means
   (6) Multiple employers
   (7) Job or task that continues for more than one work period
   (8) Particular sequences
   (9) Audit of Procedures.
   (10) Multiple employers
   (11) Multiple disconnecting means

(b) The complex lockout/tagout procedure shall vest primary responsibility in an authorized employee for a set number of employees working under the protection of a group lockout or tagout device (such as an operation lock). The person in charge shall be held accountable for safe execution of the complex lockout/tagout procedure.

(c) Each authorized employee shall affix a personal lockout or tagout device to the group lockout device, group lockbox, or comparable mechanism when he or she begins work and shall remove those devices when he or she stops working on the machine or equipment being serviced or maintained.

(d) The complex lockout/tagout procedure shall address all the concerns of employees who might be exposed. All complex The complex lockout/tagout plans process, shall identify the method to account for all persons who might be exposed to electrical hazards in the course of the lockout/tagout.

(3) Coordination.
(a) The established electrical lockout/tagout procedure process shall be coordinated with all other employer’s procedures for control of exposure to electrical energy sources such that all employer’s procedural requirements are adequately addressed on a site basis.

(b) The procedure for control of exposure to electrical hazards shall be coordinated with other procedures for control of other hazardous energy sources such that they are based on similar/identical concepts.

(c) The electrical lockout/tagout procedure process shall always include voltage testing requirements where there might be direct exposure to electrical hazards.

(d) Electrical lockout/tagout devices shall be permitted to be similar to lockout/tagout devices for control of other hazardous energy sources, such as pneumatic, hydraulic, thermal, and mechanical, if such devices are used only for control of hazardous energy and for no other purpose.

(E) Equipment.
(1) Lock Application.
Energy isolation devices for machinery or equipment installed after January 2, 1990, shall be capable of accepting a lockout device.

(2) Lockout/Tagout Device.
Each employer shall supply, and employees shall use, lockout/tagout devices and equipment necessary to execute the requirements of 120.2(E). Locks and tags used for control of exposure to electrical hazards shall be unique, shall be readily identifiable as lockout/tagout devices, and shall be used for no other purpose.

(3) Lockout Device.
(a) A lockout device shall include a lock (either keyed or combination).
(b) The lockout device shall include a method of identifying the individual who installed the lockout device.

(c) 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.

(d) Lockout devices shall be attached to prevent operation of the disconnecting means without resorting to undue force or the use of tools.

(e) 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.

(f) Lockout devices shall be suitable for the environment and for the duration of the lockout.

(g) Whether keyed or combination locks are used, the key or combination remain in the possession of the individual installing the lock or the person in charge, when provided by the established procedure.

(4) Tagout Device.
(a) A tagout device shall include a tag together with an attachment means.

(b) The tagout device shall be readily identifiable as a tagout device and suitable for the environment and duration of the tagout.

(c) A tagout device attachment means shall be capable of withstanding at least 224.4 N (50 lb) of force exerted at a right angle to the disconnecting means surface.

(d) Tags shall contain a statement prohibiting unauthorized operation of the disconnecting means or removal of the tag.

(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. Where a hold card is used, the tagout procedure shall include the method of accounting for personnel who are working under the protection of the hold card.

(5) Electrical Circuit Interlocks.
Up-to-date diagrammatic drawings shall be consulted to ensure that no electrical circuit interlock operation can result in reenergizing the circuit being worked on.

(6) Control Devices.
Locks/tags shall be installed only on circuit disconnecting means. Control devices, such as pushbuttons or selector switches, shall not be used as the primary isolating device.

(F) Procedures Program.
The employer shall maintain a copy of the procedures, program, required by this section and shall make the program and associated procedures available to all employees.
The procedure program shall require planning, including the requirements of 120.2(F)(1)(a) through 120.2(F)(2)(n).

(a) Locating Sources. Up-to-date single-line drawings shall be 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.

(b) Exposed Persons. The planning process shall identify persons who might be exposed to an electrical hazard and the PPE required during the execution of the job or task.

(c) Person In Charge. The planning process shall identify the person in charge and his or her responsibility in the lockout/tagout.

(d) Simple Lockout/Tagout. Simple lockout/tagout procedure process shall be in accordance with 120.2(D)(1).

(e) Complex Lockout/Tagout. Complex lockout/tagout procedure process shall be in accordance with 120.2(D)(2).

(2) Elements of Control.

The procedure program shall identify which elements of control are required to be detailed in each procedure.

(a) De-energizing Equipment (Shutdown). The procedure shall establish the person who performs the switching and where and how to de-energize the load.

(b) Temporary Protective Grounding Equipment. The procedure shall require for releasing stored electric or mechanical energy that might endanger personnel. All capacitors shall be discharged, and high capacitance elements shall 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.

(c) Disconnecting Means. The procedure shall identify how to verify that the circuit is de-energized (open).

(d) Responsibility. The procedure shall identify the person who is responsible for verifying that the lockout/tagout procedure is implemented and who is responsible for ensuring that the task is completed prior to removing locks/tags. A mechanism to accomplish lockout/tagout for multiple (complex) jobs/tasks where required, including the person responsible for coordination, shall be included.

(e) Verification. The procedure shall verify that equipment cannot be restarted. The equipment operating controls, such as pushbuttons, selector switches, and electrical interlocks, shall be operated or otherwise it shall be verified that the equipment cannot be restarted.

(f) Testing. The procedure shall establish the following:

(1) Voltage detector to be used, the required PPE, and the person who will use it to verify proper operation of the voltage detector before and after use.

(2) Requirement to define the boundary of the electrically safe work condition.

(i) Grounding. Grounding requirements for the circuit shall be established, including whether the temporary protective grounding equipment 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.

(j) Coordination. The procedure program shall establish how coordination is accomplished with other jobs or tasks in progress, including related jobs or tasks at remote locations, including the person responsible for coordination.

(k) Accountability for Personnel. A method shall be identified in the procedure program to account for all persons who could be exposed to hazardous energy during the lockout/tagout.

(l) Lockout/Tagout Application. The procedure program shall clearly identify when and where lockout applies, in addition to when and where tagout applies, and shall address the following:

(17) Lockout shall be defined as installing a lockout device on all sources of hazardous energy such that operation of the disconnecting means is prohibited and no removal of the lock is required to operate the disconnecting means.

(18) Tagout shall be defined as installing a tagout device on all sources of hazardous energy, such that operation of the disconnecting means is prohibited. The tagout device shall be installed in the same position available for the lockout device.

(19) Where it is not possible to attach a lock to existing disconnecting means, the disconnecting means shall be used as the only means to put the circuit in an electrically safe work condition.

(20) The use of lockout procedures without a lock shall be permitted only in cases where equipment design precludes the installation of a lock on an energy isolation device(s). When tagout is employed, at least one additional safety measure shall be employed. In such cases, the procedure shall clearly establish responsibilities and accountability for each person who might be exposed to electrical hazards.

Informational Note: Examples of additional safety measures include the removal of an isolating circuit element such as fuses, blocking of the controlling switch, or opening an extra disconnecting device to reduce the likelihood of inadvertent energization.

(u) Removal of Lockout/Tagout Devices. The procedure program shall identify the details for removing locks or tags when the installing individual is unavailable. When locks or tags are removed by someone other than the installer, the employer shall attempt to locate that person prior to removing the lock or tag. When the lock or tag is removed because the installer is unavailable, the installer shall be informed prior to returning to work.

(v) Release for Return to Service. The procedure program 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, and temporary protective grounding equipment 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.

(w) Temporary Release for Testing/Positioning. The procedure shall clearly identify the steps and qualified persons' responsibilities when the job or task requiring lockout/tagout is to be interrupted temporarily for testing or positioning of equipment; then the steps shall be identical to the steps for return to service.

Informational Note: See 110.4(A) for requirements when using test instruments and equipment.
(B) Capacity.
Temporary protective grounding equipment 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.

(C) Equipment Approval.
Temporary protective grounding equipment shall meet the requirements of ASTM F855, Standard Specification for Temporary Protective Grounds to be Used on De-energized Electric Power Lines and Equipment.

(D) Impedance.
Temporary protective grounding equipment 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.

Statement of Problem and Substantiation for Public Input

The current writeup of Article 120 leaves a lot of room for misinterpretation because there is no clear distinction in terms. Specifically, the article appears to use the terms "plan", "process", and "procedure" somewhat interchangeably and inconsistently. This is especially confusing when the reader is unsure of how much detail should go into each LOTO procedure versus what should be established in the overall program or associated implementing processes. In this proposed writeup I suggest that there be a hierarchy of terms and that we use the right terms for the right application. The program is the overall institutional document and includes policies, processes and procedures necessary to implement lockout/tagout in the organization. The policy is an overall statement of intent or directive. Processes are repeatable activities that include structured planning requirements or other ways to develop individual procedures, in alignment with the overall policy/policies. Procedures are step-by-step written instructions to achieve a task or set of tasks in accordance with the parent processes.

While this may be of little import for smaller organizations with few lockout/tagout procedures, large organizations with various levels of centralization/decentralization need clear guidance in the standard to properly structure an effective overall lockout/tagout program.

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Article 120 Establishing an Electrically Safe Work Condition

120.1 Verification of an Electrically Safe Work Condition.
An electrically safe work condition shall be achieved when performed in accordance with the procedures of 120.2, and verified by the following process:

(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 fully disconnected position.

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

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

Informational Note: See ANSI/ISA 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 volts and below.

(6) Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or 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 ground connecting devices rated for the available fault duty.

120.2 De-energized Electrical Equipment That Has Lockout/Tagout Devices Applied.

Each employer shall identify.

120.1 Lockout/Tagout Program

Each employer shall establish, document, and implement lockout/tagout procedures conforming to Article 120 to safeguard employees. The lockout program shall specify lockout procedures to safeguard workers from exposure to electrical hazards. The lockout/tagout procedure shall be:

a) Be appropriate for the experience and training of the employees and conditions as they exist in the workplace.

A. General. All electrical circuit conductors and circuit parts shall be considered energized until the source(s) of energy is (are) removed, at which time they shall be considered de-energized. All electrical requirements of Article 120 have been met.

b) Meet the requirements of Article 120; and

c) Apply to fixed, permanently installed equipment, temporarily installed equipment, and portable equipment.

The employer shall:

a) Provide the equipment necessary to execute lockout procedures;

b) Provide lockout training to workers in accordance with 110.2;

c) Audit the lockout program in accordance with 110.1; and

d) Audit execution of the lockout procedures in accordance with 110.1.

Informational Note: For an example of a lockout/tagout program, see Informative Annex G.

120.3 Principles of Lockout/Tagout Execution.

(A) General.

Electrical circuit conductors and circuit parts shall not be considered in an electrically safe work condition until such time that electrical circuit conductors and circuit parts are in an electrically safe work condition. Electrical conductors and circuit parts that have been disconnected, but not under lockout/tagout, tested, and grounded (where appropriate), shall not be considered in an electrically safe work condition, and safe work practices appropriate for the circuit voltage and energy level shall be used.

Lockout/tagout requirements shall apply to fixed, permanently installed equipment, temporarily installed equipment, and portable equipment.

(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 procedure.

Informational Note: An example of direct exposure is the qualified electrician who works on the motor starter control, the power circuits, or the motor. An example of indirect exposure is the person who works on the coupling between the motor and compressor.
(2) Training.
All persons who could be exposed or affected by the lockout/tagout shall be trained to understand the established procedure to control the energy and their responsibility in the procedure and its execution. New or reassigned employees shall be trained to understand the lockout/tagout procedure as it relates to their new assignments.

(3) Retraining.
Retraining shall be performed:
(1) When the established procedure is revised
(2) At intervals not to exceed 3 years

(A) Training Documentation.

(a) The employer shall document that each employee has received the training required by this section.
(b) The documentation shall be made when the employee demonstrates proficiency in the work practices involved.
(c) The documentation shall contain the content of the training, each employee's name, and the dates of the training.

Informational Note: Content of the training could include one or more of the following: course syllabus, course curriculum, outline, table of contents, or training objectives.

(B) Plan.
A plan shall be:

C) Lockout/Tagout Procedure.
A lockout/tagout procedure shall be developed on the basis of the existing electrical equipment and system and shall use up-to-date diagrammatic drawing representation(s).

(1) Control of Energy.
All sources of electrical energy shall be controlled in such a way as to minimize employee exposure to electrical hazards.

(2) Identification.
The lockout/tagout device shall be unique and readily identifiable as a lockout/tagout device.

(3) Voltage.
Voltage shall be removed and absence of voltage verified.

(4) Coordination.
The established electrical lockout/tagout procedure shall be coordinated with all of the employer's procedures associated with lockout/tagout of other energy sources.

(D) Form of Control.

(1) Procedures.
The employer shall establish lockout/tagout procedures for the organization, provide training to employees, provide equipment necessary to execute the details of the procedure, audit execution of the procedures to ensure employee understanding/compliance, and audit the procedure for improvement opportunity and completeness.

(H) Forms of Control of Hazardous Electrical Energy.

Two forms of hazardous electrical energy control shall be permitted: simple lockout/tagout and complex lockout/tagout [see 120.2(D)]. For the simple lockout/tagout, the qualified person shall be in charge. For the complex lockout/tagout, the person in charge shall have overall responsibility.

Informational Note: For an example of a lockout/tagout procedure, see Informative Annex G.

(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 employees' understanding.

(D) Hazardous Electrical Energy Control Procedure.

(1) Simple Lockout/Tagout Procedure.
All lockout/tagout procedures that involve only a qualified person(s) de-energizing one set of conductors or circuit part source for the sole purpose of safeguarding employees from exposure to electrical hazards 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.

(2) 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 disconnecting means
(7) Particular sequences
(8) Job or task that continues for more than one work period

(i) All complex lockout/tagout procedures shall require a written plan of execution that identifies the person in charge.

(k) The complex lockout/tagout procedure shall vest primary responsibility in an authorized employee for a set number of employees working under the protection of a group lockout or tagout device (such as an operation lock). The person in charge shall be held accountable for safe execution of the complex lockout/tagout.

(l) Each authorized employee shall affix a personal lockout or tagout device to the group lockout device, group lockbox, or comparable mechanism when he or she begins work and shall remove those devices when he or she stops working on the machine or equipment being serviced or maintained.

(m) The complex lockout/tagout procedure shall address all the concerns of employees who might be exposed. All complex lockout/tagout plans shall identify the method to account for all persons who might be exposed to electrical hazards in the course of the lockout/tagout.
(3) Coordination.

(a) The established electrical lockout/tagout procedure shall be coordinated with all other employer’s procedures for control of exposure to electrical energy sources such that all employer’s procedural requirements are adequately addressed on a site basis.

(b) The procedure for control of exposure to electrical hazards shall be coordinated with other procedures for control of other hazardous energy sources such that they are based on similar/identical concepts.

(c) The electrical lockout/tagout procedure shall always include voltage testing requirements where there might be direct exposure to electrical hazards.

(d) Electrical lockout/tagout devices shall be permitted to be similar to lockout/tagout devices for control of other hazardous energy sources, such as pneumatic, hydraulic, thermal, and mechanical, if such devices are used only for control of hazardous energy and for no other purpose.

(E) 120.3 Lockout/Tagout Equipment.

(1) Lock Application.

Energy isolation devices for machinery or equipment installed after January 2, 1990, shall be capable of accepting a lockout device.

(2) Lockout/Tagout Device.

Each employer shall supply, and employees shall use, lockout/tagout devices and equipment necessary to execute the requirements of 120.2(E). Locks and tags used for control of exposure to electrical hazards shall be unique, shall be readily identifiable as lockout/tagout devices, and shall be used for no other purpose.

(3) Lockout Device.

(a) A lockout device shall include a lock (either keyed or combination).

(b) The lockout device shall include a method of identifying the individual who installed the lockout device.

(c) 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.

(d) Lockout devices shall be attached to prevent operation of the disconnecting means without resorting to undue force or the use of tools.

(e) 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.

(f) Lockout devices shall be suitable for the environment and for the duration of the lockout.

(g) 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.

(4) Tagout Device.

(a) A tagout device shall include a tag together with an attachment means.

(b) The tagout device shall be readily identifiable as a tagout device and suitable for the environment and duration of the tagout.

(c) A tagout device attachment means shall be capable of withstanding at least 224.4 N (50 lb) of force exerted at a right angle to the disconnecting means surface.

The tag attachment means shall be nonreusable, attachable by hand, self-locking, nonreleasable, and equal to an all-environmental tolerant nylon cable tie.

(d) Tags shall contain a statement prohibiting unauthorized operation of the disconnecting means or removal of the tag.

(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. Where a hold card is used, the tagout procedure shall include the method of accounting for personnel who are working under the protection of the hold card.

(5) Electrical Circuit Interlocks.

Up-to-date diagrammatic drawings shall be consulted to ensure that no electrical circuit interlock operation can result in reenergizing the circuit being worked on.

(6) Control Devices.

Locks/tags shall be installed only on circuit disconnecting means. Control devices, such as pushbuttons or selector switches, shall not be used as the primary isolating device.

(F) Procedures.

The employer shall maintain a copy of the procedures required by this section and shall make the procedures available to all employees.

(1) Planning.

The procedure shall require planning, including the requirements of 120.2(F) (1)(a) through 120.2(F) (2)(n).

(a) Locating Sources. Up-to-date single-line drawings shall be 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.

(b) Exposed Persons. The plan shall identify persons who might be exposed to an electrical hazard and the PPE required during the execution of the job or task.

(c) Person In Charge. The plan shall identify the person in charge and his or her responsibility in the lockout/tagout.

(d) Simple Lockout/Tagout. Simple lockout/tagout procedure shall be in accordance with 120.2(D) (1).

(e) Complex Lockout/Tagout. Complex lockout/tagout procedure shall be in accordance with 120.2(D) (2).
(2) Elements of Control.

The procedure shall identify elements of control.

(a) De-energizing Equipment (Shutdown). The procedure shall establish the person who performs the switching and where and how to de-energize the load.

(b) 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.

(c) Disconnecting Means. The procedure shall identify how to verify that the circuit is de-energized (open).

(d) Responsibility. The procedure shall identify the person who is responsible for verifying that the lockout/tagout procedure is implemented and who is responsible for ensuring that the task is completed prior to removing locks/tags. A mechanism to accomplish lockout/tagout for multiple (complex) jobs/tasks where required, including the person responsible for coordination, shall be included.

(e) Verification. The procedure shall verify that equipment cannot be restarted. The equipment operating controls, such as pushbuttons, selector switches, and electrical interlocks, shall be operated or otherwise it shall be verified that the equipment cannot be restarted.

(f) Testing. The procedure shall establish the following:

- Voltage detector to be used, the required PPE, and the person who will use it to verify proper operation of the voltage detector before and after use
- Requirement to define the boundary of the electrically safe work condition
- Requirement to test before touching every exposed conductor or circuit part(s) within the defined boundary of the work area
- Requirement to retest for absence of voltage when circuit conditions change or when the job location has been left unattended
- Planning considerations that include methods of verification where there is no accessible exposed point to take voltage measurements

(g) Grounding. Grounding requirements for the circuit shall be established, including whether the temporary protective grounding equipment 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.

(h) Shift Change. A method shall be identified in the procedure to transfer responsibility for lockout/tagout to another person or to the person in charge when the job or task extends beyond one shift.

(i) Coordination. The procedure shall establish how coordination is accomplished with other jobs or tasks in progress, including related jobs or tasks at remote locations, including the person responsible for coordination.

(j) Accountability for Personnel. A method shall be identified in the procedure to account for all persons who could be exposed to hazardous energy during the lockout/tagout.

(k) Lockout/Tagout Application. The procedure shall clearly identify when and where lockout applies, in addition to when and where tagout applies, and shall address the following:

- Requirement to retest for absence of voltage when circuit conditions change or when the job location has been left unattended
- Requirement to retest for absence of voltage when circuit conditions change or when the job location has been left unattended
- Planning considerations that include methods of verification where there is no accessible exposed point to take voltage measurements

(l) Testing. The procedure shall establish the following:

- Voltage detector to be used, the required PPE, and the person who will use it to verify proper operation of the voltage detector before and after use
- Requirement to define the boundary of the electrically safe work condition
- Requirement to test before touching every exposed conductor or circuit part(s) within the defined boundary of the work area
- Requirement to retest for absence of voltage when circuit conditions change or when the job location has been left unattended
- Planning considerations that include methods of verification where there is no accessible exposed point to take voltage measurements

(m) Removal of Lockout/Tagout Devices. The procedure shall identify the details for removing locks or tags when the installing individual is unavailable. When locks or tags are removed by someone other than the installer, the employer shall attempt to locate that person prior to removing the lock or tag. When the lock or tag is removed because the installer is unavailable, the installer shall be informed prior to returning to work.

(n) 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 sources of stored energy have been blocked or otherwise relieved. Other sources of stored energy shall be blocked or otherwise relieved. 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.

(o) Temporary Release for Testing/Positioning. The procedure shall clearly identify the steps and qualified persons’ responsibilities when the job or task requiring lockout/tagout is to be interrupted temporarily for testing or positioning of equipment; then the steps shall be identical to the steps for return to service. Informational Note: See 110.4(A) for requirements when using test instruments and equipment.

179.3. Temporary Protective Grounding Equipment.

(A) - Placement.
Temporary protective grounding equipment shall be placed at such locations and arranged in such a manner as to prevent each employee from being exposed to a shock hazard (hazardous differences in electrical potential). The location, sizing, and application of temporary protective grounding equipment shall be identified as part of the employee’s job planning.

(B) - Capacity.
Temporary protective grounding equipment 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.

(C) - Equipment Approval.
Temporary protective grounding equipment shall meet the requirements of ASTM F855, Standard Specification for Temporary Protective Grounds to be Used on De-energized Electric Power Lines and Equipment.

(D) - Impedance.
Temporary protective grounding equipment 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.
120.4 Procedure to Establish and Verify an Electrically Safe Working Condition. An electrically safe work condition shall be established and verified by the following procedure:

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 fully disconnected position.

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

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

Informational Note: See ANSI/ISA 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 volts and below.

6. Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or 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 ground connecting devices rated for the available fault duty.

Informational Note: For temporary protective grounding equipment requirements see 110.8.

Statement of Problem and Substantiation for Public Input

This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.

The proposed reorganization of the material in Article 120 does not seek to create significant technical changes; rather, the intent is to reorganize the material for a better flow of logic as follows:

- 120.1 Lockout/Tagout Program
- 120.2 Lockout/Tagout Principles
- 120.3 Lockout/Tagout Equipment
- 120.4 Procedure to Establish and Verify an Electrically Safe Working Condition

Existing content has been reorganized under these basic topics. It is proposed that the training and auditing requirements of Article 120 be relocated and reorganized with similar requirements found in 110. Separate Public Inputs have been created for this purpose.

Related Public Inputs for This Document

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Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.
Street Address: 
City: 
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Submittal Date: Tue Jun 30 10:10:54 EDT 2015
Verification of an Electrically Safe Work Condition.

An electrically safe work condition shall be achieved when performed in accordance with the procedures of 120.2 and verified by the following process:

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 fully disconnected position.

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

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

   Informational Note No. 1: See ANSI/ISA 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 volts and below.

   IEC 61243-3, Live working - Voltage detectors - Part 3: Two-pole low-voltage type, for specific test methods for testing for absence of voltage 1000 volts and below.

   Informational Note No. 2: See IEC 61243-1, Live working - Voltage detectors - Part 1: Capacitive type to be used for voltages exceeding 1 kV a.c., IEC 61243-2, Live working - Voltage detectors - Part 2: Resistive type to be used for voltages of 1 kV to 36 kV a.c., or IEC 61243-5, Live working - Voltage detectors - Part 5: Voltage detecting systems (VDS), for specific methods for testing for absence of voltage 1000 volts and above.

6. Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or 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 ground connecting devices rated for the available fault duty.

Statement of Problem and Substantiation for Public Input

ANSI/IEC 6160101-1 is the wrong reference. This document defines the proper design of test equipment to prevent a flashover in the event of a transient. It never covers specific requirements for a voltage tester or the technique for using that device. Thus the standard never covers the required function (measuring the presence of voltage). ANSI/IEC 60101-1 is the appropriate reference for test instrument design requirements in Article 110.4 but not when applied to testing for voltage where a specific test instrument is required.

There are no ANSI standards for this purpose. Instead we have to look to international standards. IEC 61243 series defines the test method for testing for presence of voltage and covers 4 different types of devices. Two wire resistive devices ("multimeters") under 1,000 volts are covered under IEC 61243-3. Capacitive "tics" type meters for 1 kV and above are defined under IEC 61243-1. Resistive devices (e.g. Biers PD50) for 1-38 kV are defined under IEC 61243-2. Permanently installed voltage detectors for 1 kV and above (e.g. ABB VisiVolt) are defined under IEC 61243-5.

Submitter Information Verification

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Submittal Date: Mon Apr 13 12:16:42 EDT 2015
Public Input No. 131-NFPA 70E-2015 [ Section No. 120.1 ]

120.1 Verification of an Electrically Safe Work Condition.

An electrically safe work condition shall be achieved when performed in accordance with the procedures of 120.2 and verified by the following process:

(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 fully disconnected position.

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

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

(6) Test each phase conductor with a non-contact voltage tester.

(7) Test each phase conductor or circuit part both phase-to-phase and phase-to-ground.

Informational Note: See ANSI/ISA 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 volts and below.

(8) Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or 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 ground connecting devices rated for the available fault duty.

Statement of Problem and Substantiation for Public Input

The statement that each conductor or circuit part should be tested phase to phase and phase to ground requires the use of a tester with 2 leads. In the event of tester failure or misapplication of the test leads to the energized parts, this could cause an incident to occur. A non-contact tester allows the use of a single point, i.e. one handed operation, to verify that the conductor is "not energized" which is not the same as "deenergized". The non-contact tester is a safer means of testing whether the conductor is still energized and addressing that condition. Once that step is taken, then the phase to phase and phase to ground testing can verify that the conductor is deenergized. This would minimize the incidental contact with energized parts in the event that the conductor was still energized.

Submitter Information Verification

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Submittal Date: Tue Apr 14 16:58:54 EDT 2015
Public Input No. 144-NFPA 70E-2015 [Section No. 120.1]

120.1 Verification of an Electrically Safe Work Condition.

An electrically safe work condition shall be achieved when performed in accordance with the procedures of 120.2 and verified by the following process:

(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 fully disconnected position.

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

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

Exception: Panel-mounted test instruments shall be permitted for the purpose of establishing an electrically safe work condition on equipment <600V when the following conditions are satisfied:

(a) The test instrument tests each phase conductor or circuit part both phase-to-phase and phase-to-ground to verify it is de-energized.

(b) Before and after each test, it can be determined that the test instrument is operating satisfactorily through verification on a known source.

(c) Before and after each test, the test instrument is verified to be in direct contact with the circuit part being tested.

(d) A positive indication is provided to confirm the absence of voltage has been verified (lack of an indication shall not imply the absence of voltage).

Informational Note: See ANSI/ISA 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1500 volts and below.

(6) Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or 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 ground connecting devices rated for the available fault duty.

Additional Proposed Changes

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Statement of Problem and Substantiation for Public Input

The process of verifying the absence of voltage is usually performed with a handheld test instrument and relies primarily on PPE and administrative controls (training on procedures that meet the requirements of NFPA 120.1 and 120.2) to mitigate the risk of exposure to electrical hazards. When using a handheld tester, the person performing the voltage verification test is exposed to electrical hazards (while verifying that the tester is working prior to and after the test, and during the test if the equipment had not been de-energized). This requires PPE which can help mitigate risk; however, it does not remove the hazard and is only effective at mitigating risk if used and worn correctly. Because the process of using a handheld test instrument is highly dependent on human input, interaction, and interpretation, it is susceptible to mistakes, errors, and interruptions.

Handheld instruments are susceptible to mechanical and electrical failure, as well as misuse and deficiencies in their design, selection, and use when establishing an electrically safe work condition have contributed to electrical incidents that resulted in personal injury and plant downtime.

The current language does not encourage the use or development of alternative solutions which have the potential to control the risk of exposure to electrical hazards through more effective means such as elimination through design, substitution, or engineering controls (the Hierarchy of Risk Controls, Figure 1), as is recommended in Annex O. Worker safety and the efficiency of the process could be improved, as well as addressing many of these shortcomings with handheld test instruments for certain applications, by designing or retrofitting equipment with a permanently installed voltage tester. An installed tester makes it possible to determine whether voltage is present without or before accessing electrical equipment, thus preventing exposure to energized parts. An installed voltage test system is as effective as a handheld tester and in many cases, will offer additional benefits (Table 1).

The current language in NFPA 70E 120.1 does not require the test instrument be portable or handheld and it does not specifically prohibit use of an installed voltage test instrument. However, if an installed voltage tester were to be used, the existing requirements are not sufficient to ensure worker safety and the test result. Thus, this proposal includes language to clarify the process of using an installed tester to ensure it is completed in a manner that is equivalent to that of a handheld tester.

Part (a) and (b) of the proposed text match the existing text in part (5) to test for voltage phase-to-phase and phase-to-ground to verify that the tester is functioning before and after the voltage test. The requirement to test the installation in part (c) is intended to confirm that the device is in contact with the circuit part being tested before and after each test. It is essential to confirm that the tester is directly in contact with the circuit part before and after each test to ensure that if a de-energized condition is confirmed it is because voltage is not present on the circuit part being monitored and not because the tester is not connected to a conductor. This is an important step for panel-mount testers because the test will likely be initiated before the panel is opened with no direct line of site to the circuit part. The requirement for positive indications in part (d) is important to ensure the integrity of the voltage verification test and safeguard against errors due to a device failure or indicator failure. If absence of voltage is actively indicated by a signal, the user will know that the test has been completed.

Establishing an electrically safe work condition is one area of NFPA 70E where it is important to encourage and promote Prevention through Design (PtD) principles, especially when considering the frequency with which this task occurs in the workplace. This is recognized in Annex O, but could be even more effective if incorporated into the body of the standard. PtD can and should be applied to hazards in work processes for all workers, including those who perform maintenance tasks. Although limited, research has begun to show that when regulations that include PID principles, they are effective in reducing workplace injuries. In industrialized countries such as the UK and Australia where PID legislation is more prevalent, the workplace fatality rates are a fraction (Figure 2) of what they are in the US.

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Submittal Date: Wed May 06 14:57:44 EDT 2015
120.1 Verification of an Electrically Safe Work Condition.

An electrically safe work condition shall be achieved when performed in accordance with the procedures of 120.2 and verified by the following process:

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 fully disconnected position.

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

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

   Informational Note No. 1: See ANSI/ISA 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 volts and below.

   Informational Note No. 2: Rating of a test instrument can include both voltage and Category.

6. Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or 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 ground connecting devices rated for the available fault duty.

Statement of Problem and Substantiation for Public Input

It is not well understood that rating also includes category rating. The is no change proposed to the existing informational note other than to make it informational note No. 1. Informational note No. 2 is added to clarify that a rating of test equipment may include voltage rating and IEC Category rating.

Submitter Information Verification

Submitter Full Name: PALMER HICKMAN
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Submittal Date: Wed Jun 03 10:16:40 EDT 2015
Public Input No. 290-NFPA 70E-2015 [Section No. 120.1]

120.1 Verification of an Electrically Safe Work Condition.
An electrically safe work condition shall be achieved when performed in accordance with the procedures of 120 with 120.2, and verified by the following process as follows:

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 fully disconnected position.
4. Apply lockout/tagout devices in accordance with a documented and established policy.
5. Use an adequately rated test instrument to test each phase conductor or circuit part to verify it is de-energized. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground. Before and after each test, determine that the test instrument is operating satisfactorily through verification on a known voltage source.

Informational Note: See ANSI/ISA 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 volts and below.

6. Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or 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 ground connecting devices rated for the available fault duty.

Statement of Problem and Substantiation for Public Input

Both "procedures" and "process" were deleted as neither term provided clarity to the requirement. The brevity of the revised statement provides clarity.

This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the terms "procedure," "practice," "program" and "process."

The Task Group recommendations regarding the use of the terms "practice," "procedure," "process" or "program" are based on:
1. The context in which the term was used;
2. The definitions of each term as found in the Merriam-Webster on-line dictionary:
   Practice: to do something customarily (e.g. "work practice")
   Procedure: a series of steps followed in a regular definite order (e.g. "lockout/tagout procedure")
   Process: a series of actions or operations conducing to an end (e.g. "Risk Assessment – An overall process that..."
   Program: a plan or system under which action may be taken toward a goal (e.g. "electrical safety program")

Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the terms "procedure," "practice," "program" and "process."
Street Address: 
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Submittal Date: Mon Jun 29 09:54:27 EDT 2015
**Public Input No. 305-NFPA 70E-2015 [Section No. 120.1]**

120.1 Verifications of an Electrically Safe Work Condition.

Verification of an Electrically Safe Work Condition shall be achieved when performed in accordance with the procedures of 120.2 and verified by the following process in the order presented:

1. Determine all possible sources of electrical supply to the specific equipment. Check applicable up-to-date drawings, diagrams, and identification tags.
2. 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. Release stored electrical energy.
5. Release stored mechanical energy.
6. Apply lockout/tagout devices in accordance with a documented and established policy.
7. Use an adequately rated test instrument to test each phase conductor or circuit part to verify it is de-energized. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground. Before and after each test, determine that the test instrument is operating satisfactorily through verification on a known voltage source.
8. Informational Note: See ANSI/ISA 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 volts and below.
9. Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or 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 ground connecting devices rated for the available fault duty.

**Statement of Problem and Substantiation for Public Input**

The order of sections 120.1 and 120.2 need to be reversed. One need go no further than the parent text in section 120.1 where the standard clearly instructs the user to apply the procedures in 120.2 and then verify with the following process. New text is added to instruct the user to verify in the order given as required in 1910.333(b).

New list items (4) and (5) are added to comply with both 1910.333(b) and the requirements in 120.2 for release of electrical and mechanical energy.

Note: the Terra software inadvertently underlined list items (6) and (7) which are not new. Terra also added the existing informational note as a new list item (8) which is not correct; the informational note follows the existing text moved to list item (7).

**Related Public Inputs for This Document**

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120.1 Verification of an Electrically Safe Work Condition.

An electrically safe work condition shall be achieved when performed in accordance with the procedures of 120.2 and verified by the following process:

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 fully disconnected position.

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

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

6. Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or 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 ground connecting devices rated for the available fault duty.

Informational Note No. 1: To determine proper operation of the test instrument referenced in Section 120.1(5) for verification of the absence of voltage and establishing an electrically safe working condition, any known voltage source within the meter rating can be used to determine meter functionality.

Informational Note No. 2: See ANSI/ISA 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 volts and below.

Statement of Problem and Substantiation for Public Input

The proposed informational note will provide clarification and reduce some apparent confusion about the voltage level necessary to determine proper operation of the test instrument. Using the properly rated voltage test instrument is already a requirement in 120.1 and 110.4(A)(2).

Submitter Information Verification

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Submittal Date: Mon Jun 29 12:19:59 EDT 2015
120.1 Verification of an Electrically Safe Work Condition.
An electrically safe work condition shall be achieved when performed in accordance with the procedures of 120.2 and verified by the following process:

(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 fully disconnected position.

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

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

Informational Note No. 1: Verifying the operation of a test instrument for systems 600-volts and less typically involves a known live source such as an energized 125-volt receptacle. The verification step is to ensure that the test instrument is operating properly. There is no requirement that the verification be at the same voltage as the equipment being placed into an electrically safe work condition.

Informational Note No. 2: See ANSI/ISA 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 volts and below.

(6) Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or 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 ground connecting devices rated for the available fault duty.

Statement of Problem and Substantiation for Public Input
There is confusion in the industry due to some training programs instructing participants to always verify the operation of a test instrument on the same voltage as the equipment being de-energized. No such requirement exists. For example, in a remote pump house a 480-volt motor starter may need to be placed in an electrically safe work condition. The installer/maintainer will need to verify operation of his/her test instrument. The verification could take place in a receptacle at 125-volts. However, where this misconception exists, the installer must access energized equipment at 480-volts which may require exposing energized parts at 480-volts with significant incident energy available.

Submitter Information Verification
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Submittal Date: Mon Jun 29 14:49:52 EDT 2015
Verification of an Electrically Safe Work Condition.

An electrically safe work condition shall be achieved when performed in accordance with the procedures of 120.2 and verified by the following process:

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 fully disconnected position.
4. Apply lockout/tagout devices in accordance with a documented and established policy.
5. Use an adequately rated test instrument to test each phase conductor or circuit part to verify it is de-energized. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground. Before and after each test, determine that the test instrument is operating satisfactorily through verification on a known voltage source.
   Informational Note: See ANSI/ISA 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 volts and below.
6. Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or 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 ground connecting devices rated for the available fault duty, temporary protective grounding equipment in accordance with 120.3.

Statement of Problem and Substantiation for Public Input

This Public Input is submitted by the Article 120 Task Group charged with identifying modifications to improve the usability and accuracy of Article 120. TG members included: Louis Barrios, Tom Norwood, Lee Hale, Bruce Bowman, Danny Liggett and Len Cicero.

The term “ground connecting devices” is not a recognized term. Changing this term to “temporary protective grounding equipment” better aligns the term with how it is used elsewhere in the Standard, such as 120.3 and 120.2(F)(2)(g).

Submitter Information Verification

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Street Address: 
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Submittal Date: Tue Jun 30 21:14:59 EDT 2015
Public Input No. 417-NFPA 70E-2015 [Section No. 120.1]

120.1 Verification Process of Achieving an Electrically Safe Work Condition.
An electrically safe work condition shall be achieved when performed in accordance with the procedures of 120.2 and verified by the following process:

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 fully disconnected position.
4. Apply lockout/tagout devices in accordance with a documented and established policy.
5. Use an adequately rated test instrument to test each phase conductor or circuit part to verify it is de-energized. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground. Before and after each test, determine that the test instrument is operating satisfactorily through verification on a known voltage source.
   Informational Note: See ANSI/ISA 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 volts and below.
6. Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or 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 ground connecting devices rated for the available fault duty.

Statement of Problem and Substantiation for Public Input
Return the title of this section to the 2012 Edition of NFPA 70E. "Verification" is the incorrect term. This section outlines the process for establishing an electrically safe work condition. Verification is a part of that process (Step 5). Before an electrically safe work condition can be verified it must first be established. The current title of this section is misleading.

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Submittal Date: Sun Jul 05 12:56:45 EDT 2015
Public Input No. 435-NFPA 70E-2015 [ Section No. 120.1 ]

120.1 Verification of an Electrically Safe Work Condition.

An electrically safe work condition shall be achieved when performed in accordance with the procedures of 120.2 and verified by the following process:

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 fully disconnected position.
   
   Exception: Testing for absence of voltage on the load side of disconnecting device(s) shall be permitted in lieu of a visual verification provided testing does not introduce unacceptable risks.

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

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

   Informational Note: See ANSI/ISA 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 volts and below.

6. Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or 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 ground connecting devices rated for the available fault duty.

Statement of Problem and Substantiation for Public Input

Step (3) Article 120.1 states, “wherever possible, verify all blades are fully open on disconnecting devices or that drawout type circuit breakers are withdrawn to the fully disconnected position.” This requirement is intended to provide verification that all blades or contacts of the disconnecting device(s) are opened and isolated from the hazardous energy.

The phrase “wherever possible”, implies it is not always possible for a user to perform this verification, but no alternative or equivalent method is provided to achieve compliance with this step for achieving an electrically safe work condition.

The proposed Exception permits a voltage test on the load side of the disconnecting device as an alternative method to verify blade position of the disconnecting devices.

Load side voltage testing provides a method that makes it “possible” to verify isolation of the disconnecting device 100% of the time regardless of 1) the type of device used (disconnect switch, non-drawout molded case breaker, rackable breaker, etc.) or, 2) design features of the device that may prohibit a visual inspection (i.e. guarded or shielded blades).

Load side voltage testing, when performed at or near the work location, also provides an additional safety benefit of validating the correct source switch/breaker has been operated since visual blade verification of the wrong source disconnecting device could result in a false sense of security that the hazardous energy source has been isolated.

Submitter Information Verification

Submitter Full Name: JOHN MCALHANEY
Organization: SAVANNAH RIVER NUCLEAR SOL.
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jul 06 05:05:25 EDT 2015
Public Input No. 493-NFPA 70E-2015 [ Section No. 120.1 ]

120.1 Verification of Creating an Electrically Safe Work Condition.
An electrically safe work condition shall be achieved when performed in accordance with the procedures of 120.2 and verified by the following process:

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 fully disconnected position.

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

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

   Informational Note: See ANSI/ISA 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use. Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 volts and below.

6. Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or 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 ground connecting devices rated for the available fault duty.

Statement of Problem and Substantiation for Public Input

Most of the steps in 120.1 are not verification steps but are part of a process. Operating a disconnecting means does not verify. Visually verifying blades are in the open position and verifying the absence of voltage are verification steps.

Submitter Information Verification

Submitter Full Name: PAUL DOBROWSKY
Organization: INNOVATIVE TECHNOLOGY SERVICES
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Mon Jul 06 14:15:19 EDT 2015
120.1 Verification of an Electrically Safe Work Condition.
An electrically safe work condition shall be achieved when performed in accordance with the procedures of 120.2 and verified by the following process:

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 fully disconnected position.

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

5. Use an adequately rated test instrument to test each phase conductor or circuit part to verify it is de-energized. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground. Before and after each test, determine that the test instrument is operating satisfactorily through verification on a known voltage source. Exception. Non-contact test instruments shall be permitted to be used on electrical systems over 1000 volts.

6. Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or 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 ground connecting devices rated for the available fault duty.

Statement of Problem and Substantiation for Public Input

It is common practice to use non-contact type instruments on these systems but interpretations are that they do not meet the phase to phase and phase to ground requirement.

Submitter Information Verification

Submitter Full Name: PAUL DOBROWSKY
Organization: INNOVATIVE TECHNOLOGY SERVICES
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Mon Jul 06 14:23:17 EDT 2015
120.1 Verification of an Electrically Safe Work Condition.
An electrically safe work condition shall be achieved when performed in accordance with the procedures of 120.2 and verified by the following process:

(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 fully disconnected position.
(4) Apply lockout/tagout devices in accordance with a documented and established policy.
(5) Use an adequately rated test instrument to test each phase conductor or circuit part to verify it is de-energized. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground. Before and after each test, determine that the test instrument is operating satisfactorily through verification on a known voltage source.

Informational Note: See ANSI/ISA 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 volts and below.

(6) Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or 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 ground connecting devices, temporary protective grounding equipment, rated for the available fault duty current.

Statement of Problem and Substantiation for Public Input

The term "temporary protective grounding equipment" is consistent with 120.3. Fault "current" is a more appropriate term than "duty"

Submitter Information Verification

Submitter Full Name: PAUL DOBROWSKY
Organization: INNOVATIVE TECHNOLOGY SERVICES
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Mon Jul 06 14:31:41 EDT 2015
Public Input No. 59-NFPA 70E-2015 [ Section No. 120.1 ]

120.1 Verification of an Electrically Safe Work Condition.

An electrically safe work condition shall be achieved when performed in accordance with the procedures of 120.2 and verified by the following process:

(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 fully disconnected position.

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

(5) (a) Voltage levels 0-600V nominal - Use an adequately rated test instrument to test each phase conductor or circuit part to verify it is de-energized. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground. Before and after each test, determine that the test instrument is operating satisfactorily through verification on a known voltage source.

   (b) Voltage levels above 600VAC nominal - An adequately rated and approved, non-contact voltage detector may be used to test each phase conductor or circuit part to verify it is de-energized. Verify operation of voltage detector before and after each use.

   **Warning**: Non-contact type voltage detectors may not read the presence of electrical energy in ungrounded or shielded electrical systems. These systems would require verification as per 120.1(5)(a) above.

   **Informational Note**: The stronger electrical fields that exist in these higher voltages allows a more reliable operation of non-contact type voltage detectors.

   **Informational Note**: See ANSI/ISA 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 volts and below.

(6) Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or 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 ground connecting devices rated for the available fault duty.

Statement of Problem and Substantiation for Public Input

Since article 120.1 does not establish any voltage levels, it implies all testing should be performed this way. The steps involved in verification force the electrical worker to use a contact type test instrument. This is not a problem at low voltages - 1000v and under. However, higher voltages would require purchasing a contact type meter and making physical connection checks with it. Just verifying the proper function of these types of meters before and after can introduce additional hazards. Proximity high voltage detectors have been in the industry for many years and have proven reliable at these levels. Additionally they are safer and easier to perform functionality checks on. With note 6 reminding about the use of discharge or grounding probes, any stored capacity energy should not be an issue. The use of a discharge probe, additionally following the use of the non-contact detector, would lower any hazard risk greatly as well. Even the informational note below of 120.1(5) references test instruments for 1000v and below, so it seem the steps where put together with only 600v systems in mind.

Submitter Information Verification

Submitter Full Name: BRIAN TYLER
Organization: CITIZENS THERMAL
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Tue Feb 24 11:27:17 EST 2015
120.1 Verification of an Electrically Safe Work Condition.

An electrically safe work condition shall be achieved when performed in accordance with the procedures of 120.2 and verified by the following process:

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 fully disconnected position.

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

5. Use an adequately rated test instrument to test each phase conductor or circuit part to verify it is de-energized. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground. Before and after each test, apply lockout/tagout devices in accordance with a documented and established policy.

6. Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or 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 ground connecting devices rated for the available fault duty.

Informational Note 1: See ANSI/ISA 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 volts and below.

Statement of Problem and Substantiation for Public Input

In the existing text, the meaning of "each" is not clear and could be interpreted as requiring verification of the operation of the test instrument before and after every phase-to-phase and phase-to-ground test, not just once before and after the collective set of tests for a single circuit.

Submitter Information Verification

Submitter Full Name: RACHEL BUGARIS
Organization: PANDUIT CORP
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Tue Mar 10 14:31:00 EDT 2015
120.1  Verification of an Electrically Safe Work Condition.
An electrically safe work condition shall be achieved when performed in accordance with the procedures of \ref{120.1} and \ref{120.2} and verified by the following process:

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 fully disconnected position.
4. Apply lockout/tagout devices in accordance with a documented and established policy.
5. Use an adequately rated test instrument to test each phase conductor or circuit part to verify it is de-energized. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground. Before and after each test, determine that the test instrument is operating satisfactorily through verification on a known voltage source.

   Informational Note: See ANSI/ISA 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use. Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 volts and below.

6. Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or 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 ground connecting devices rated for the available fault duty.

Statement of Problem and Substantiation for Public Input

The recommendation of this Public Input (PI) is to relocate the existing 120.1 as 120.3 and relocate the provisions of 120.2 as 120.1 and relocate existing 120.3 as 120.2. In addition, this PI recommends revising the existing 120.1 (now recommended to be relocated as 120.3) to read "...with the procedures of 120.1 and 120.2..." to recognize that grounding is included as what is required to be verified in (6) of the six steps of verification. These recommendations will put these requirements in the correct order: (1) Deenergized Electrical Equipment..., (2) Temporary Protective Grounding, and (3) Verification. It seems logical that verification should come last. It seems logical that the grounding that is required to be verified in the "Verification" requirements (see existing 120.1(6)) should come before the requirements to verify.

Submitter Information Verification

Submitter Full Name: Palmer Hickman
Organization: Electrical Training Alliance
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jan 20 16:57:18 EST 2015
120.1 Verification of an Electrically Safe Work Condition.

An electrically safe work condition shall be achieved when performed in accordance with the procedures of 120.2 and verified by the following process:

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 fully disconnected position.

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

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

6. Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or 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 ground connecting devices rated for the available fault duty.

Informational Note: See ANSI/ISA 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 volts and below.

IEC 61243.1 Live Working Voltage Detectors -- Part 1: Capacitive type to be used for voltages exceeding 1 kV a.c., or IEC 61243.2 Live Working -- Voltage Detectors -- Part 2: Resistive type to be used for voltage of 1 kV to 36 kV a.c., or IEC 61243.3 Live Working -- Voltage Detectors -- Part 3: Two-pole low voltage type.

Additional Proposed Changes

File Name Description Approved
PC_30.pdf 70E-PC 30

Statement of Problem and Substantiation for Public Input

NOTE: This Public Input appeared as "Reject but Hold" on Public Comment No. 30 of the A2014 Second Draft Report for NFPA 70E and per the Regs. at 4.4.8.3.1.

The ANSI standard that is referred to only provides safety design requirements for test equipment. It does not actually provide any requirements in terms of providing the function of testing for absence of voltage at all. The same standard is applicable for instance to "polarity testers". The ANSI standard should be referenced in 110.4 which addresses safety standards for test instruments and equipment, not in this section where a specific test is required. Furthermore, the referenced standard is only applicable below 1,000 Volts. The proposed referenced standards provide voltage measurement requirements for any voltage.

Submitter Information Verification

Submitter Full Name: TC on EEW-AAA
Organization: NFPA Technical Committee on Electrical Safety in the workplace
Street Address:
City:
State:
Zip:
Submittal Date: Thu Mar 26 11:44:35 EDT 2015
120.1 Verification of an Electrically Safe Work Condition.
An electrically safe work condition shall be achieved when performed in accordance with the procedures of 120.2 and verified by the following process:

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 fully disconnected position.
4. Apply lockout/tagout devices in accordance with a documented and established policy.
5. Use an adequately rated test instrument to test each phase conductor or circuit part to verify it is de-energized. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground. Before and after each test, determine that the test instrument is operating satisfactorily through verification on a known voltage source.

Informational Note: See ANSI/ISA 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 volts and below.
6. Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or 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 ground connecting devices rated for the available fault duty.

Additional Proposed Changes
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<th>Description Approved</th>
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Statement of Problem and Substantiation for Public Input

NOTE: This Public Input appeared as “Reject but Hold” in Public Comment No. 54 of the A2014 Second Draft Report for NFPA 70E and per the Regs. at 4.4.8.3.1.

ANSI/UL/IEC 61010 refers to design of the meter itself which make it possible to take measurements safely without the meter exploding. It does not specify HOW to properly take measurements at any voltage. The only known standard for this is an IEC standard. Meter safety properly belongs in section 110. The revision deletes this informational note as it is not only incorrect but leads the prospective reader to an ANSI standard that does not provide the needed information (requirements for a meter to take measurements up to 1,000 volts) but instead into a design document (requirements to keep a meter from exploding due to a transient in the system).

Submitter Information Verification

Submitter Full Name: TC on EEW-AAA
Organization: NFPA Technical Committee on Electrical Safety in the Workplace
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Thu Mar 26 11:58:31 EDT 2015
120.1 Verification of an Electrically Safe Work Condition.
An electrically safe work condition shall be achieved when performed in accordance with the procedures of 120.2 and verified by the following process:

1. Determine all possible sources of electrical supply to the specific equipment. Check applicable up-to-date, by using accurate electrical drawings, diagrams, and/or 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 fully disconnected position.

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

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

   Informational Note: See ANSI/ISA 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 volts and below.

6. Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or 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 ground connecting devices rated for the available fault duty.

**Additional Proposed Changes**

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**Statement of Problem and Substantiation for Public Input**

NOTE: This Public Input appeared as “Reject but Hold” in Public Comment No. 191 of the A2014 Second Draft Report for NFPA 70E and per the Regs. at 4.4.8.3.1.

up-to-date is not defined

**Submitter Information Verification**

Submitter Full Name: TC on EEW-AAA
Organization: NFPA Technical Committee on Electrical Safety in the Workplace
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Thu Mar 26 16:03:56 EDT 2015
Public Input No. 94-NFPA 70E-2015 [ Section No. 120.1 ]

120.1 Verification of an Electrically Safe Work Condition.

An electrically safe work condition shall be achieved when performed in accordance with the procedures of 120.2 and verified by the following process:

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 fully disconnected position.

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

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

Informational Note: See ANSI/ISA 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 volts and below.

6. Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or 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 ground connecting devices rated for the available fault duty.

Statement of Problem and Substantiation for Public Input

Some users have read the affected text to mean that if a drawout circuit breaker exists, it must be withdrawn whether or not it is providing isolation for establishing an electrical safe work condition. The proposed language will clarify the rule applies only to isolating devices.

Submitter Information Verification

Submitter Full Name: Bobby Gray
Organization: Hoydar/Buck, Inc.
Affiliation: None
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Tue Mar 31 15:44:01 EDT 2015
120.2.1  De-energized Electrical Equipment That Has Lockout/Tagout Devices Applied.

Each employer shall identify, document, and implement lockout/tagout procedures conforming to Article 120 to safeguard employees from exposure to electrical hazards. The lockout/tagout procedure shall be appropriate for the experience and training of the employees and conditions as they exist in the workplace.

(A) General.

All electrical circuit conductors and circuit parts shall be considered energized until the source(s) of energy is (are) removed, at which time they shall be considered de-energized. All electrical conductors and circuit parts shall not be considered to be in an electrically safe work condition until all of the applicable requirements of Article 120 have been met.

Informational Note: See 120.1 for the six-step procedure to verify an electrically safe work condition.

Electrical conductors and circuit parts that have been disconnected, but not under lockout/tagout; tested; and grounded (where appropriate) shall not be considered to be in an electrically safe work condition, and safe work practices appropriate for the circuit voltage and energy level shall be used. Lockout/tagout requirements shall apply to fixed, permanently installed equipment; to temporarily installed equipment; and to portable equipment.

(B) Principles of Lockout/Tagout Execution.

(1) 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.

Informational Note: An example of direct exposure is the qualified electrician who works on the motor starter control, the power circuits, or the motor. An example of indirect exposure is the person who works on the coupling between the motor and compressor.

(2) Training.

All persons who could be exposed or affected by the lockout/tagout shall be trained to understand the established procedure to control the energy and their responsibility in the procedure and its execution. New or reassigned employees shall be trained to understand the lockout/tagout procedure as it relates to their new assignments.

(3) Retraining.

Retraining shall be performed:

(a) When the established procedure is revised

(b) At intervals not to exceed 3 years

(4) Training Documentation.

(a) The employer shall document that each employee has received the training required by this section.

(b) The documentation shall be made when the employee demonstrates proficiency in the work practices involved.

(c) The documentation shall contain the content of the training, each employee’s name, and the dates of the training.

Informational Note: Content of the training could include one or more of the following: course syllabus, course curriculum, outline, table of contents, or training objectives.

(5) Plan.

A plan shall be developed on the basis of the existing electrical equipment and system and shall use up-to-date diagrammatic drawing representation(s).

(6) Control of Energy.

All sources of electrical energy shall be controlled in such a way as to minimize employee exposure to electrical hazards.

(7) Identification.

The lockout/tagout device shall be unique and readily identifiable as a lockout/tagout device.

(8) Voltage.

Voltage shall be removed and absence of voltage verified.

(9) Coordination.

The established electrical lockout/tagout procedure shall be coordinated with all of the employer’s procedures associated with lockout/tagout of other energy sources.

(C) Responsibility.

(1) Procedures.

The employer shall establish lockout/tagout procedures for the organization, provide training to employees, provide equipment necessary to execute the details of the procedure, audit execution of the procedures to ensure employee understanding/compliance, and audit the procedure for improvement opportunity and completeness.

(2) Form of Control.

Two forms of hazardous electrical energy control shall be permitted: simple lockout/tagout and complex lockout/tagout [see 120.2(D)]. For the simple lockout/tagout, the qualified person shall be in charge. For the complex lockout/tagout, the person in charge shall have overall responsibility.

Informational Note: For an example of a lockout/tagout procedure, see Informative Annex G.

(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.

(D) Hazardous Electrical Energy Control Procedure.

(1) Simple Lockout/Tagout Procedure.

All lockout/tagout procedures that involve only a qualified person(s) de-energizing one set of conductors or circuit part source for the sole purpose of safeguarding employees from exposure to electrical hazards 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.
(2) Complex Lockout/Tagout Procedure.
   (a) A complex lockout/tagout plan shall be permitted where one or more of the following exist:
      (2) Multiple energy sources
      (3) Multiple crews
      (4) Multiple crafts
      (5) Multiple locations
      (6) Multiple employers
      (7) Multiple disconnecting means
      (8) Particular sequences
      (9) Job or task that continues for more than one work period

   (j) All complex lockout/tagout procedures shall require a written plan of execution that identifies the person in charge.
   (k) The complex lockout/tagout procedure shall vest primary responsibility in an authorized employee for a set number of employees working under the protection of a group lockout or tagout device (such as an operation lock). The person in charge shall be held accountable for safe execution of the complex lockout/tagout.
   (l) Each authorized employee shall affix a personal lockout or tagout device to the group lockout device, group lockbox, or comparable mechanism when he or she begins work and shall remove those devices when he or she stops working on the machine or equipment being serviced or maintained.
   (m) The complex lockout/tagout procedure shall address all the concerns of employees who might be exposed. All complex lockout/tagout plans shall identify the method to account for all persons who might be exposed to electrical hazards in the course of the lockout/tagout.

   (3) Coordination.
      (a) The established electrical lockout/tagout procedure shall be coordinated with all other employer’s procedures for control of exposure to electrical energy sources such that all employer’s procedural requirements are adequately addressed on a site basis.
      (b) The procedure for control of exposure to electrical hazards shall be coordinated with other procedures for control of other hazardous energy sources such that they are based on similar/identical concepts.
      (c) The electrical lockout/tagout procedure shall always include voltage testing requirements where there might be direct exposure to electrical hazards.
      (d) Electrical lockout/tagout devices shall be permitted to be similar to lockout/tagout devices for control of other hazardous energy sources, such as pneumatic, hydraulic, thermal, and mechanical, if such devices are used only for control of hazardous energy and for no other purpose.

   (E) Equipment.
      (1) Lock Application.
         Energy isolation devices for machinery or equipment installed after January 2, 1990, shall be capable of accepting a lockout device.

   (2) Lockout/Tagout Device.
      Each employer shall supply, and employees shall use, lockout/tagout devices and equipment necessary to execute the requirements of 120.2(E). Locks and tags used for control of exposure to electrical hazards shall be unique, shall be readily identifiable as lockout/tagout devices, and shall be used for no other purpose.

   (3) Lockout Device.
      (a) A lockout device shall include a lock (either keyed or combination).
      (b) The lockout device shall include a method of identifying the individual who installed the lockout device.
      (c) A lockout device shall include a lock (either keyed or combination).
      (d) A lockout device shall include a method of identifying the individual who installed the lockout device.
      (e) 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.
      (f) Lockout devices shall be suitable for the environment and for the duration of the lockout.
      (g) 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.

   (4) Tagout Device.
      (a) A tagout device shall include a tag together with an attachment means.
      (b) The tagout device shall be readily identifiable as a tagout device and suitable for the environment and duration of the tagout.
      (c) A tagout device attachment means shall be capable of withstanding at least 224.4 N (50 lb) of force exerted at a right angle to the disconnecting means surface. The tag attachment means shall be nonreusable, attachable by hand, self-locking, nonreleasable, and equal to an all-environmental tolerant nylon cable tie.
      (d) Tags shall contain a statement prohibiting unauthorized operation of the disconnecting means or removal of the tag.
      (e) 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 removal of the tag.

   (5) Electrical Circuit Interlocks.
      Up-to-date diagrammatic drawings shall be consulted to ensure that no electrical circuit interlock operation can result in reenergizing the circuit being worked on.

   (6) Control Devices.
      Locks/tags shall be installed only on circuit disconnecting means. Control devices, such as pushbuttons or selector switches, shall not be used as the primary isolating device.

   (F) Procedures.
      The employer shall maintain a copy of the procedures required by this section and shall make the procedures available to all employees.
      (1) Planning.
         The procedure shall require planning, including the requirements of 120.2(F) (1)(a) through 120.2(F) (2)(n).
         (a) Locating Sources. Up-to-date single-line drawings shall be 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.
         (b) Exposed Persons. The plan shall identify persons who might be exposed to an electrical hazard and the PPE required during the execution of the job or task.
         (c) Person In Charge. The plan shall identify the person in charge and his or her responsibility in the lockout/tagout.
         (d) Simple Lockout/Tagout. Simple lockout/tagout procedure shall be in accordance with 120.2(D) (1).
         (e) Complex Lockout/Tagout. Complex lockout/tagout procedure shall be in accordance with 120.2(D) (2).
(2) Elements of Control.
The procedure shall identify elements of control.

(a) De-energizing Equipment (Shutdown). The procedure shall establish the person who performs the switching and where and how to de-energize the load.

(b) 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.

(c) Disconnecting Means. The procedure shall identify how to verify that the circuit is de-energized (open).

(d) Responsibility. The procedure shall identify the person who is responsible for verifying that the lockout/tagout procedure is implemented and who is responsible for ensuring that the task is completed prior to removing locks/tags. A mechanism to accomplish lockout/tagout for multiple (complex) jobs/tasks where required, including the person responsible for coordination, shall be included.

(e) Verification. The procedure shall verify that equipment cannot be restarted. The equipment operating controls, such as pushbuttons, selector switches, and electrical interlocks, shall be operated or otherwise it shall be verified that the equipment cannot be restarted.

(f) Testing. The procedure shall establish the following:

- Voltage detector to be used, the required PPE, and the person who will use it to verify proper operation of the voltage detector before and after use.
- Requirement to define the boundary of the electrically safe work condition.
- Requirement to test before touching every exposed conductor or circuit part(s) within the defined boundary of the work area.
- Requirement to retest for absence of voltage when circuit conditions change or when the job location has been left unattended.

(i) Grounding. Grounding requirements for the circuit shall be established, including whether the temporary protective grounding equipment 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.

(m) Shift Change. A method shall be identified in the procedure to transfer responsibility for lockout/tagout to another person or to the person in charge when the job or task extends beyond one shift.

(n) Coordination. The procedure shall establish how coordination is accomplished with other jobs or tasks in progress, including related jobs or tasks at remote locations, including the person responsible for coordination.

(o) Accountability for Personnel. A method shall be identified in the procedure to account for all persons who could be exposed to hazardous energy during the lockout/tagout.

(p) Lockout/Tagout Application. The procedure shall clearly identify when and where lockout applies, in addition to when and where tagout applies, and shall address the following:

- Lockout shall be defined as installing a lockout device on all sources of hazardous energy such that operation of the disconnecting means is prohibited and forcible removal of the lock is required to operate the disconnecting means.
- Tagout shall be defined as installing a tagout device on all sources of hazardous energy, such that operation of the disconnecting means is prohibited. The tagout device shall be installed in the same position available for the lockout device.
- Where it is not possible to attach a lock to existing disconnecting means, the disconnecting means shall not be used as the only means to put the circuit in an electrically safe work condition.
- The use of tagout procedures without a lock shall be permitted only in cases where equipment design precludes the installation of a lock on an energy isolation device(s). When tagout is employed, at least one additional safety measure shall be employed. In such cases, the procedure shall clearly establish responsibilities and accountability for each person who might be exposed to electrical hazards.

Informational Note: Examples of additional safety measures include the removal of an isolating circuit element such as fuses, blocking of the controlling switch, or opening an extra disconnecting device to reduce the likelihood of inadvertent energization.

(u) Removal of Lockout/Tagout Devices. The procedure shall identify the details for removing locks or tags when the installing individual is unavailable. When locks or tags are removed by someone other than the installer, the employer shall attempt to locate that person prior to removing the lock or tag. When the lock or tag is removed because the installer is unavailable, the installer shall be informed prior to returning to work.

(v) 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, and temporary protective grounding equipment 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.

Informational Note: See 110.4(A) for requirements when using test instruments and equipment.

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Statement of Problem and Substantiation for Public Input

Sections 120.1 and 120.2 need to be reversed. The parent text of 120.1 directs the standard user to apply the procedures in 120.2 and verify in 120.1.

Related Public Inputs for This Document

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<th>Relationship</th>
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<td>Public Input No. 305-NFPA 70E-2015 [Section No. 120.1]</td>
<td></td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: JAMES DOLLARD
Organization: IBEW LOCAL UNION 98
Street Address: 200 Main St.
City: Chicago
State: IL
Zip: 60601

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Each employer shall:

- identify, establish, document, and implement a lockout/tagout procedure conforming to Article 120 to safeguard employees.

The lockout/tagout procedure shall specify lockout/tagout procedures to safeguard workers from exposure to electrical hazards. The lockout/tagout procedure shall be:

(a) Be appropriate for the experience and training of the employees.
(b) Meet the requirements of Article 120; and
(c) Apply to fixed, permanently installed equipment, temporarily installed equipment, and portable equipment.

Informational Note: A lockout/tagout procedure is a prescriptive series of steps followed in a regular definite order to achieve an electrically safe work condition.

Statement of Problem and Substantiation for Public Input

The revised text clarifies that an employer must create a lockout/tagout program, and that the program must have procedures. This approach is consistent with 110.1 Electrical Safety Program.

The general requirements of the program and procedures are placed in a list format for ease of reference. List item (c) is relocated from the last sentence in 120.2(A).

The informational note is added to clarify what is intended by the phrase “lockout/tagout procedure.”

This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the terms “procedure,” “practice,” “program,” and “process.”

The Task Group recommendations regarding the use of the terms “practice,” “procedure,” “process,” or “program” are based on:

1. The context in which the term was used;
2. The definitions of each term as found in the Merriam-Webster on-line dictionary:
   - Practice: to do something customarily (e.g. “work practice”)
   - Procedure: a series of steps followed in a regular definite order (e.g. “lockout/tagout procedure”)
   - Process: a series of actions or operations conducing to an end (e.g. “Risk Assessment – An overall process that...”)
   - Program: a plan or system under which action may be taken toward a goal (e.g. “electrical safety program”)

Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the terms “procedure,” “practice,” “program,” and “process.”
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jun 29 09:58:43 EDT 2015
Each employer shall identify, document, and implement lockout/tagout procedures conforming to Article 120 to safeguard employees from exposure to electrical hazards. The lockout/tagout procedures shall be appropriate for the experience and training of the employees and conditions as they exist in the workplace. The employer shall describe the process used to implement a lockout/tagout program in a documented policy.

Statement of Problem and Substantiation for Public Input

Making the work procedure plural is editorial and provides consistency in the remainder of the existing language. Article 120 uses multiple terms to identify the applicable documents. For example, 120.1(4) states the lock that is used to control the electrically safe work condition must be identified in a "policy," but Article 120 does not require the employer to publish a policy document. Other documents are called "plans," "procedures," and the "established procedure." The Article is not clear as to which, if any, of the documents are the same with different references. This public input seeks to require a policy that will complete the requirement in 120.1(4).

Submitter Information Verification

Submitter Full Name: Bobby Gray
Organization: Hoydar/Buck, Inc.
Affiliation: None
Street Address:
City:
State:
Zip:
Submittal Date: Tue Mar 31 15:57:44 EDT 2015
Public Input No. 292-NFPA 70E-2015 [ Section No. 120.2(A) ]

(A) General.

All electrical circuit conductors and circuit parts shall be considered energized until the source(s) of energy is (are) removed, at which time they shall be considered de-energized. All electrical conductors and circuit parts shall not be considered to be in an electrically safe work condition until all of the applicable requirements of Article 120 have been met.

Informational Note: See 120.1 for the six-step procedure steps to verify an electrically safe work condition.

Electrical conductors and circuit parts that have been disconnected, but not under lockout/tagout; tested; and grounded (where appropriate) shall not be considered to be in an electrically safe work condition, and safe work practices appropriate for the circuit voltage and energy level shall be used. Lockout/tagout requirements shall apply to fixed, permanently installed equipment; to temporarily installed equipment; and to portable equipment.

Statement of Problem and Substantiation for Public Input

The phrase “six-step procedure” was deleted it did not provide clarity to the requirement. The brevity of the revised statement provides clarity. This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the terms “procedure,” “practice,” “program” and “process.”

The Task Group recommendations regarding the use of the terms “practice,” “procedure,” “process” or “program” are based on:
1. The context in which the term was used;
2. The definitions of each term as found in the Merriam-Webster on-line dictionary:
   - Practice: to do something customarily (e.g. "work practice")
   - Procedure: a series of steps followed in a regular definite order (e.g. "lockout/tagout procedure")
   - Process: a series of actions or operations conducing to an end (e.g. "Risk Assessment – An overall process that...")
   - Program: a plan or system under which action may be taken toward a goal (e.g. "electrical safety program")

Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the terms “procedure,” “practice,” “program” and “process.”
Street Address: City:
State:
Zip:
Submittal Date: Mon Jun 29 10:01:21 EDT 2015
Public Input No. 348-NFPA 70E-2015 [ Section No. 120.2(A) ]

(A) General.
All electrical circuit conductors and circuit parts shall be considered energized until the source(s) of energy is (are) removed, at which time they shall be considered
dee-energized. All electrical conductors and circuit parts shall not be considered to be in an electrically safe work condition until all of the applicable requirements of
Article 120 have been met. Informational Note: See
and verified in accordance with 120.1
for the six-step procedure to verify an electrically safe work condition

Electrical conductors and/or circuit parts that have been disconnected, but not under lockout/tagout; tested; and grounded (where appropriate) shall not be considered to
be in an electrically safe work condition, and safe work practices appropriate for the circuit voltage and energy level shall be used. Lockout/tagout requirements shall
apply to fixed, permanently installed equipment; to temporarily installed equipment; and to portable equipment.

Statement of Problem and Substantiation for Public Input
This Public Input is submitted by the Article 120 Task Group charged with identifying modifications to improve the usability and accuracy of Article 120. TG members included:

The addition of "verified in accordance with 120.1" allows the deletion of the Informational Note and makes following the steps in 120.1 a requirement in order to be considered an
electrically safe work condition.

The deleted informational note and additional text is redundant to the requirements already stated in 120.2(A) and 130.2.

Submitter Information Verification
Submitter Full Name: LOUIS BARRIOS
Organization: SHELL GLOBAL SOLUTIONS
Affiliation: Article 120 Task Group
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jun 30 20:43:35 EDT 2015
Public Input No. 93-NFPA 70E-2015 [ Section No. 120.2(A) ]

(A) General.

All electrical circuit conductors and circuit parts shall be considered energized until the source(s) of energy is (are) removed, at which time they shall be considered de-energized. All electrical conductors and circuit parts shall not be considered to be in an electrically safe work condition until all of the applicable requirements of Article 120 have been met.

Informational Note: See 120.1 for the six-step procedure to verify an electrically safe work condition.

Electrical conductors and circuit parts that have been disconnected, but not under lockout/tagout; tested; and grounded (where appropriate) shall not be considered to be in an electrically safe work condition, and safe work practices appropriate for the circuit voltage and energy level shall be used. Lockout/tagout requirements shall apply to fixed, permanently installed equipment; to temporarily installed equipment; and to portable equipment, when an uncontrolled release of electrical hazardous energy could result in an injury to a worker.

Statement of Problem and Substantiation for Public Input

As currently written, the text is not clear in its intended application. The rules of Article 120 for lockout, taken literally, apply to portable tools stored on a shelf. The allowance for portable tools and equipment should reflect the same approach excluding cord and plug connected electrical equipment as OSHA does in 1910.147(a)(2)(iii)(A) “Work on cord and plug connected electric equipment for which exposure to the hazards of unexpected energization or start up of the equipment is controlled by the unplugging of the equipment from the energy source and by the plug being under the exclusive control of the employee performing the servicing or maintenance” [shall be exempted from the requirements of the standard]. On the other hand, by limiting the application to equipment only, it could imply that the rules of Article 120 would not apply when a part of an electrical system is to be placed into an electrically safe work condition to make the work location safe, even though servicing or maintenance of electrical equipment is not being performed. The proposed language will expand the use of lockout beyond specific equipment to work locations and electrical systems, and exclude the perceived application of cord and plug connected portable electric tools or equipment.

Submitter Information Verification

Submitter Full Name: Bobby Gray
Organization: Hoydar/Buck, Inc.
Affiliation: None
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Tue Mar 31 15:21:16 EDT 2015
Employee Involvement.
Each person who could be exposed directly or indirectly to a source of electrical energy shall be involved in the lockout/tagout procedure.

Informational Note: An example of direct exposure is the qualified electrician who works on the motor starter control, the power circuits, or the motor. An example of indirect exposure is the person who works on the coupling between the motor and compressor.

Statement of Problem and Substantiation for Public Input

“Process” was revised to “procedure” in accordance with the context and the definition of the terms. This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the terms “procedure,” “practice,” “program” and “process.”

The Task Group recommendations regarding the use of the terms “practice,” “procedure,” “process” or “program” are based on:
1. The context in which the term was used;
2. The definitions of each term as found in the Merriam-Webster on-line dictionary:
   Practice: to do something customarily (e.g. “work practice”)
   Procedure: a series of steps followed in a regular definite order (e.g. “lockout/tagout procedure”)
   Process: a series of actions or operations conducing to an end (e.g. “Risk Assessment – An overall process that..."
   Program: a plan or system under which action may be taken toward a goal (e.g. “electrical safety program”)

Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the terms “procedure,” “practice,” “program” and “process.”
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jun 29 10:04:08 EDT 2015
Retraining shall be performed:

(a) When the established procedure is revised
(b) At intervals not to exceed 3 years
(c)

Statement of Problem and Substantiation for Public Input

Document clarity

There is no OSHA requirement to retrain employees in Principles of Lockout/Tagout Execution every three years. What was the Committee's vision?

1910.147 calls for a documented annual verification of procedures and demonstrated employee proficiency.

Submitter Information Verification

Submitter Full Name: Drake Drobnick
Organization: [ Not Specified ]
Affiliation: N/A
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Sat Feb 07 12:58:05 EST 2015
### Public Input No. 48-NFPA 70E-2015 [ Section No. 120.2(B)(3) ]

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<td>(3) Retraining.</td>
<td>Retraining shall be performed:</td>
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<td>(a)</td>
<td>When the established procedure is revised</td>
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<tr>
<td>(b)</td>
<td>At intervals not to exceed 3 years</td>
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<tr>
<td>(c)</td>
<td>When the employee shows lack of knowledge or skill</td>
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### Statement of Problem and Substantiation for Public Input

Document clarity

1910.147 calls for a documented annual verification of procedure and demonstrated employee proficiency.

### Submitter Information Verification

**Submitter Full Name:** Drake Drobnick  
**Organization:** [ Not Specified ]  
**Affiliation:** N/A  
**Street Address:**  
**City:**  
**State:**  
**Zip:**  
**Submittal Date:** Sun Feb 08 19:16:06 EST 2015
(5) Plan.
A plan shall be developed on the basis of the existing electrical equipment and system and shall use up-to-date diagrammatic drawings as accurate electrical drawings.

Additional Proposed Changes

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<thead>
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<th>File Name</th>
<th>Description Approved</th>
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<tbody>
<tr>
<td>PC_190.pdf</td>
<td>70E-PC190</td>
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Statement of Problem and Substantiation for Public Input

NOTE: The following Public Input appeared as “Reject but Hold” in Public Comment No. 190 of the A2014 Second Draft Report for NFPA 70E and per the Regs. at 4.4.8.3.1.

up-to-date diagrammatic drawings are not defined.

Submitter Information Verification

Submitter Full Name: TC on EEW-AAA
Organization: NFPA Technical Committee on Electrical Safety in the Workplace
Street Address: City:
State: Zip:
Submittal Date: Thu Mar 26 16:01:16 EDT 2015
(9) Coordination.
The established electrical lockout/tagout procedure shall be coordinated with all of the employer's procedures associated with lockout/tagout of other energy sources.

(10) Control of Electrically Safe Work Condition.
The established electrical lockout/tagout procedure shall describe the process used to apply lockout/tagout devices when establishing an electrically safe work condition in accordance with 120.1(4).

Statement of Problem and Substantiation for Public Input

Section 120.1, item (4), mandates that lockout/tagout devices be applied according to the established policy. But, the requirements in 120.2 don't require the employer to place the information into the established policy. This public input will eliminate the apparent gap in requirements.

Submitter Information Verification

Submitter Full Name: BOBBY GRAY
Organization: HOYDARBUCK INC
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Wed Jun 03 11:51:18 EDT 2015
Public Input No. 96-NFPA 70E-2015 [ Section No. 120.2(B)(9) ]

(9) Coordination.
The established electrical lockout/tagout procedure and policy shall be coordinated with all of the employer's procedures associated with lockout/tagout of other energy sources.

Statement of Problem and Substantiation for Public Input

Article 120 uses multiple terms to describe required documents. The context in the affected text implies the document should be a policy that describes the electrical hazardous energy control program as referenced in 120.1(4).

Submitter Information Verification

Submitter Full Name: Bobby Gray
Organization: Hoydar/Buck, Inc.
Affiliation: None
Street Address:
City:
State:
Zip:
Submittal Date: Tue Mar 31 16:25:21 EDT 2015
Public Input No. 294-NFPA 70E-2015 [Section No. 120.2(C)(2)]

(2) Form of Control.
Two forms of hazardous electrical energy control shall be permitted: simple lockout/tagout and complex lockout/tagout (see 120.2(D)). For the simple lockout/tagout, the qualified person shall be in charge. For the complex lockout/tagout, the person in charge shall have overall responsibility.

Informational Note: For an example of a lockout/tagout procedure program, see Informative Annex G.

Statement of Problem and Substantiation for Public Input

“Procedure” was revised to “program” as Annex G is an example of a program that contains procedures.
This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the terms “procedure,” “practice,” “program” and “process.”

The Task Group recommendations regarding the use of the terms “practice,” “procedure,” “process” or “program” are based on:
1. The context in which the term was used;
2. The definitions of each term as found in the Merriam-Webster online dictionary:
   Practice: to do something customarily (e.g. “work practice”)
   Procedure: a series of steps followed in a regular definite order (e.g. “lockout/tagout procedure”)
   Process: a series of actions or operations conducing to an end (e.g. “Risk Assessment – An overall process that...”)
   Program: a plan or system under which action may be taken toward a goal (e.g. “electrical safety program”)

Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the terms “procedure,” “practice,” “program” and “process.”
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jun 29 10:05:56 EDT 2015
Public Input No. 146-NFPA 70E-2015 [Section No. 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.

Change
A lockout/tagout audit for all procedures shall occur annually by a qualified person. Preferably from an outside group. If no outside group is available, then should be checked by supervisor or manager in charge. Annual audits should also be of a live lockout/tagout evolution by each employee to retain proficiency in lockout/tagout procedure details. The audits shall be designed to correct deficiencies in the established electrical lockout/tagout procedure or in the employee understanding. This ensures that we catch the deficiencies in training and also if there has been any changes to the equipment which would alter the lockout/tagout procedures.

Statement of Problem and Substantiation for Public Input

There is no clear outline for auditing all procedures or personnel. In NFPA 70E example LOTO annex G. 12.0 there was a space for noting the last time that procedure was reviewed and the next time it will be reviewed. Not to exceed a year.

Submitter Information Verification

Submitter Full Name: MICHAEL WINNINGHAM
Organization: QUALCOMM
Street Address:
City:
State:
Zip:
Submittal Date: Sat May 09 14:14:54 EDT 2015
Public Input No. 140-NFPA 70E-2015 [Section No. 120.2(D)]

(D) Hazardous Electrical Energy Control Procedure.

(1) Simple Lockout/Tagout Procedure.

All lockout/tagout procedures that involve only a qualified person(s) de-energizing one set of conductors or circuit part source for the sole purpose of safeguarding employees from exposure to electrical hazards, and do not require a complex lockout/tagout per 120.2(D)(2), 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.

(2) Complex Lockout/Tagout Procedure.

(a) A complex lockout/tagout plan shall be permitted where required where one or more of the following conditions exist:

(2) Multiple energy sources
(3) Multiple, disconnecting means to isolate one energy source
(4) Stored energy source, or possibility of induced voltage
(5) Energy isolation not within sight (visible and not more than 15 m (50 ft)) from the equipment to be worked upon
(6) Particular sequence required for shutdown or startup that is not already captured in 120.1
(7) Past employer experience with the simple lockout/tagout procedure includes an incident with unexpected activation or reenergization of the machine or equipment during servicing or maintenance

(b) In addition, where a lockout/tagout would otherwise meet the requirements for the simple lockout/tagout procedure (none of the conditions in 120.2(D)(2)(a) exist), a complex lockout/tagout plan shall be required when one or more of the following conditions exist and have the potential for creating gaps in communication about the condition of the lockout/tagout:

(9) Multiple crews
(10) Multiple crafts
(11) Multiple locations
(12) Multiple employers
(13) Particular sequences
(14) Job or task that continues for more than one work period
(15) Shifts with new workers

(p) All complex lockout/tagout procedures shall require a written plan of execution that identifies the person in charge.

(q) The complex lockout/tagout procedure shall vest primary responsibility in an authorized employee for a set number of employees working under the protection of a group lockout or tagout device (such as an operation lock). The person in charge shall be held accountable for safe execution of the complex lockout/tagout.

(r) Each authorized employee shall affix a personal lockout or tagout device to the group lockout device, group lockbox, or comparable mechanism when he or she begins work and shall remove those devices when he or she stops working on the machine or equipment being serviced or maintained.

(s) The complex lockout/tagout procedure shall address all the concerns of employees who might be exposed. All complex lockout/tagout plans shall identify the method to account for all persons who might be exposed to electrical hazards in the course of the lockout/tagout.

(3) Coordination.

(a) The established electrical lockout/tagout procedure shall be coordinated with all other employer’s procedures for control of exposure to electrical energy sources such that all employer’s procedural requirements are adequately addressed on a site basis.

(b) The procedure for control of exposure to electrical hazards shall be coordinated with other procedures for control of other hazardous energy sources such that they are based on similar/identical concepts.

(c) The electrical lockout/tagout procedure shall always include voltage testing requirements where there might be direct exposure to electrical hazards.

(d) Electrical lockout/tagout devices shall be permitted to be similar to lockout/tagout devices for control of other hazardous energy sources, such as pneumatic, hydraulic, thermal, and mechanical, if such devices are used only for control of hazardous energy and for no other purpose.

Statement of Problem and Substantiation for Public Input

The current text for Article 120.2(D)(1)-(2) leaves a lot to be desired, both in clarity and alignment with OSHA 1910.147 requirements. Although 1910.147 specifically excludes electrical, 1910.333 does not address written plans for lockout/tagout as specified in 120.2(D)(2)(b). Many employers therefore default to the requirements of 1910.147 in a combined Hazardous Energy Control Program. This is also required to some extent by NFPA 70E Article 120.2(D)(3).

The proposed text addresses these issues in the following way:

- Makes it clear that a simple lockout/tagout cannot be performed if it presents any of the conditions triggering a complex lockout/tagout.
- Makes it clear that a written complex lockout/tagout procedure is required (not permitted) when any of the conditions triggering complex lockout/tagout exist
- Adds presence of stored energy or possible induced voltage as a trigger for complex lockout/tagout. This is already common practice as dictated by 1910.147(c)(4)(i)(exception #3), Also required by inference in 120.3(A). The complex lockout/tagout written plan is the logical place to identify location, sizing, and application of temporary personal protective grounds.
- Clarifies meaning of “particular sequence” by pointing to 120.1. If following 120.1 is the only sequence required, then it is not a “particular sequence”.
- Clarifies meaning of “multiple locations” by using NEC definition of “in sight from”. Otherwise this can (and has) been stretched to include the entire building or site of operations, rendering the condition meaningless. This is generally consistent with the NEC requirement for disconnecting means to be located within sight of equipment.
- Adds requirement from 1910.147(c)(4)(i)(exception #8), regarding past employer experience

For the other conditions (multiple crews/crafts/employers/shifts) complex lockout/tagout should be permitted, not required. Or, required where the lack of written procedure will create a predictable gap in communications about the condition of the lockout/tagout, and this gap could lead to harm to employees or other personnel. Always requiring written procedures for multiple crews/crafts/employers/shifts is not always meaningful or necessary, and the paperwork drill may actually disincentivize the application of simple lockout/tagout. Since we are now only talking about single point isolations without stored energy, without a particular sequence, and in the same location, there is usually very
Submitter Information Verification

Submitter Full Name: Mark Scott
Organization: Lawrence Berkeley National Laboratory
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Sun Apr 26 14:50:43 EDT 2015
Public Input No. 295-NFPA 70E-2015 [ Section No. 120.2(D)(1) ]

(1) Simple Lockout/Tagout Procedure.

All lockout/tagout procedures that involve only a qualified person(s) de-energizing one set of conductors or circuit part source for the sole purpose of safeguarding employees from exposure to electrical hazards shall be considered to be a simple lockout/tagout. Simple lockout/tagout plans, procedures, shall not be required to be written for each application. Each worker shall be responsible for his or her own lockout/tagout.

Statement of Problem and Substantiation for Public Input

"Plan" was revised to "procedure" for consistency with the title and the first sentence.

This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the terms "procedure," "practice," "program" and "process."

The Task Group recommendations regarding the use of the terms "practice," "procedure," "process" or "program" are based on:

1. The context in which the term was used;
2. The definitions of each term as found in the Merriam-Webster on-line dictionary:
   - Practice: to do something customarily (e.g. "work practice")
   - Procedure: a series of steps followed in a regular definite order (e.g. "lockout/tagout procedure")
   - Process: a series of actions or operations conducing to an end (e.g. "Risk Assessment – An overall process that...")
   - Program: a plan or system under which action may be taken toward a goal (e.g. "electrical safety program")

Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the terms "procedure," "practice," "program" and "process."
Street Address:
City:
State:
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Submittal Date: Mon Jun 29 10:12:27 EDT 2015
Public Input No. 347-NFPA 70E-2015 [ Section No. 120.2(D)(1) ]

(1) Simple Lockout/Tagout Procedure.

All lockout/tagout procedures that involve only a qualified person(s) de-energizing one set of conductors or circuit part source for the sole purpose of safeguarding employees from exposure to electrical hazards 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.

Exception: Lockout/tagout is not required for work on cord-, and plug-, connected electric 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.

Statement of Problem and Substantiation for Public Input

This Public Input is submitted by the Article 120 Task Group charged with identifying modifications to improve the usability and accuracy of Article 120. TG members included: Louis Barrios, Tom Norwood, Lee Hale, Bruce Bowman, Danny Liggett and Len Cicero.

During the 2012 edition of NFPA 70E, 120.2(D)(1) Individual Qualified Employee Control Procedure was deleted from the standard. This clause permitted work to be performed without the application of locks and tags on the disconnecting means provided the disconnecting means is adjacent to the conductors, circuit parts and equipment being worked on and provided that the disconnecting means was clearly visible to the individual qualified person involved in the work.

Removal of this clause impacted the ability to isolate cord and plug connected equipment without requiring the application of locks and tags, which is still permitted by OSHA 1910.147.

OSHA 1910.147(a)(2)(ii)(A), which is an exception to the standard, states: “Work on cord and plug connected electric equipment for which exposure to the hazards of unexpected energization or start up of the equipment is controlled by the unplugging of the equipment from the energy source and by the plug being under the exclusive control of the employee performing the servicing or maintenance.”

This Public Input is submitted as an exception to the Simple Lockout/Tagout Procedure in NFPA 70E 120.2.(D)(1) to reflect lockout/tagout is not required for cord and plug connected equipment, where the cord and plug are under exclusive control of the person performing the work.

Submitter Information Verification

Submitter Full Name: LOUIS BARRIOS
Organization: SHELL GLOBAL SOLUTIONS
Affiliation: Article 120 Task Group
Street Address:
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Submittal Date: Tue Jun 30 20:33:36 EDT 2015
Public Input No. 23-NFPA 70E-2015 [Section No. 120.2(D)(2)]

(2) Complex Lockout/Tagout Procedure.

(a) A complex lockout/tagout plan shall be permitted, required, where one or more of the following exist:

(2) Multiple energy sources
(3) Multiple crews
(4) Multiple crafts
(5) Multiple locations
(6) Multiple employers
(7) Multiple disconnecting means
(8) Particular sequences
(9) Job or task that continues for more than one work period

(j) All complex lockout/tagout procedures shall require a written plan of execution that identifies the person in charge.

(k) The complex lockout/tagout procedure shall vest primary responsibility in an authorized employee for a set number of employees working under the protection of a group lockout or tagout device (such as an operation lock). The person in charge shall be held accountable for safe execution of the complex lockout/tagout.

(l) Each authorized employee shall affix a personal lockout or tagout device to the group lockout device, group lockbox, or comparable mechanism when he or she begins work and shall remove those devices when he or she stops working on the machine or equipment being serviced or maintained.

(m) The complex lockout/tagout procedure shall address all the concerns of employees who might be exposed. All complex lockout/tagout plans shall identify the method to account for all persons who might be exposed to electrical hazards in the course of the lockout/tagout.

Statement of Problem and Substantiation for Public Input

The context of 120.2(D) indicates that when certain conditions exist, as listed in 120.2(D)(2)(a), Complex LOTO with a written plan is required, not just permitted. Stating that the written LOTO plan "shall be permitted" makes the written plan optional and therefore just guidance. If that is the case, then the recommendation for a written plan should be an informational note, which is not the intent of the article.

Using the word "permitted" results in problems flowing down the requirement for Complex LOTO written plans to contract employers who may not be familiar enough with the standard. Changing the word "permitted" to "required" accurately reflects the intent of the article and facilitates implementation of NFPA 70E in contract situations.

Submitter Information Verification

Submitter Full Name: Mark Scott
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Submittal Date: Sun Feb 01 14:43:17 EST 2015
Public Input No. 296-NFPA 70E-2015 [Section No. 120.2(D)(2)]

(2) Complex Lockout/Tagout Procedure.

(a) A complex lockout/tagout plan, procedure shall be permitted where one or more of the following exist:

(2) Multiple energy sources
(3) Multiple crews
(4) Multiple crafts
(5) Multiple locations
(6) Multiple employers
(7) Multiple disconnecting means
(8) Particular sequences
(9) Job or task that continues for more than one work period

(i) All complex lockout/tagout procedures shall require a written plan of execution that identifies the person in charge.

(k) The complex lockout/tagout procedure shall vest primary responsibility in an authorized employee for a set number of employees working under the protection of a group lockout or tagout device (such as an operation lock). The person in charge shall be held accountable for safe execution of the complex lockout/tagout.

(l) Each authorized employee shall affix a personal lockout or tagout device to the group lockout device, group lockbox, or comparable mechanism when he or she begins work and shall remove those devices when he or she stops working on the machine or equipment being serviced or maintained.

(m) The complex lockout/tagout procedure shall address all the concerns of employees who might be exposed. All complex lockout/tagout plans shall identify the method to account for all persons who might be exposed to electrical hazards in the course of the lockout/tagout.

Statement of Problem and Substantiation for Public Input

"Plan" was revised to "procedure" for consistency with the title.

This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the terms "procedure," "practice," "program" and "process."

The Task Group recommendations regarding the use of the terms "practice," "procedure," "process" or "program" are based on:
1. The context in which the term was used;
2. The definitions of each term as found in the Merriam-Webster on-line dictionary:
   Practice: to do something customarily (e.g. "work practice")
   Procedure: a series of steps followed in a regular definite order (e.g. "lockout/tagout procedure")
   Process: a series of actions or operations conducing to an end (e.g. "Risk Assessment – An overall process that...")
   Program: a plan or system under which action may be taken toward a goal (e.g. "electrical safety program")

Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the terms "procedure," "practice," "program" and "process."
Street Address: PO Box 2690, Hightstown, NJ 08520
City: Hightstown
State: NJ
Zip: 08520
Submittal Date: Mon Jun 29 10:30:35 EDT 2015
Public Input No. 349-NFPA 70E-2015 [Section No. 120.2(D)(2)]

(2) Complex Lockout/Tagout Procedure.

(a) A complex lockout/tagout plan shall be permitted where one or more of the following exist:

(2) Multiple energy sources
(3) Multiple crews
(4) Multiple crafts
(5) Multiple locations
(6) Multiple employers
(7) Multiple disconnecting means
(8) Particular sequences
(9) Job or task that continues for more than one work period

(j) All complex lockout/tagout procedures shall require a written plan of execution that identifies the person in charge.

(k) The complex lockout/tagout procedure shall vest primary responsibility in an authorized employee for a set number of employees, working under the protection of a group lockout or tagout device (such as an operation lock or lockbox). The person in charge shall be held accountable for safe execution of the complex lockout/tagout.

(l) Each authorized employee shall affix a personal lockout or tagout device to the group lockout device, group lockbox, or comparable mechanism when he or she begins work and shall remove those devices when he or she stops working on the machine or equipment being serviced or maintained.

(m) The complex lockout/tagout procedure shall address all the concerns of employees who might be exposed. All complex lockout/tagout plans shall identify the method to account for all persons who might be exposed to electrical hazards in the course of the lockout/tagout.

Statement of Problem and Substantiation for Public Input

This Public Input is submitted by the Article 120 Task Group charged with identifying modifications to improve the usability and accuracy of Article 120. TG members included: Louis Barrios, Tom Norwood, Lee Hale, Bruce Bowman, Danny Liggett and Len Cicero.

The deleted text “a set number of” is vague and does not add clarity to the requirement.

“Lockbox” replaces “operation lock” because it is a broadly recognized method for executing complex lockout/tagout where individuals still apply their personal locks as a means of controlling multiple energy sources. Work under an operations lock generally does not require individuals to apply their personal locks to control the energy source. Lockbox is recognized in 120.2(D)(2)(d).

The deleted first sentence in 120.2(D)(2)(e) is vague and does not add clarity to the requirements. It is unrealistic for a lockout/tagout procedure to address “all of the concerns” of employees who might be exposed.

Submitter Information Verification

Submitter Full Name: LOUIS BARRIOS
Organization: SHELL GLOBAL SOLUTIONS
Affiliation: Article 120 Task Group
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Tue Jun 30 20:56:38 EDT 2015
Complex Lockout/Tagout Procedure.

(a) A complex lockout/tagout plan shall be permitted where one or more of the following exist:

(2) Multiple energy sources
(3) Multiple crews
(4) Multiple crafts
(5) Multiple locations
(6) Multiple employers
(7) Multiple disconnecting means
(8) Particular sequences
(9) Job or task that continues for more than one work period

(j) All complex lockout/tagout procedures shall require a written plan of execution that identifies the person in charge.

(k) The complex lockout/tagout procedure shall vest primary responsibility in an authorized employee for a set number of employees working under the protection of a group lockout or tagout device (such as an operation lock). The person in charge shall be held accountable for safe execution of the complex lockout/tagout.

(l) Each authorized employee shall affix a personal lockout or tagout device to the group lockout device, group lockbox, or comparable mechanism when he or she begins work and shall remove those devices when he or she stops working on the machine or equipment being serviced or maintained.

(m) The complex lockout/tagout procedure shall address all the concerns of employees who might be exposed. All complex lockout/tagout plans shall identify the method to account for all persons who might be exposed to electrical hazards in the course of the lockout/tagout.

Statement of Problem and Substantiation for Public Input

A complex LOTO plan shall be required for more hazardous applications. The text as written does not convey the importance of this plan or the required formality of a complex LOTO plan.

Submitter Information Verification

Submitter Full Name: MARK MCNELLIS
Organization: SANDIA NATIONAL LABORATORIES
Street Address:
City:
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Submittal Date: Mon Jul 06 16:59:48 EDT 2015
Public Input No. 97-NFPA 70E-2015 [ Section No. 120.2(D)(2) ]

(2) Complex Lockout/Tagout Procedure.

(a) A complex lockout/tagout plan, tagout procedure, shall be permitted where one or more of the following exist:

(2) Multiple energy sources
(3) Multiple crews
(4) Multiple crafts
(5) Multiple locations
(6) Multiple employers
(7) Multiple disconnecting means
(8) Particular sequences
(9) Job or task that continues for more than one work period

(j) All complex lockout/tagout procedures, plans, shall require a written plan of execution that identifies the person in charge.

(k) The complex lockout/tagout procedure, tagout plan, shall vest primary responsibility in an authorized employee for a set number of employees working under the protection of a group lockout or tagout device (such as an operation lock). The person in charge shall be held accountable for safe execution of the complex lockout/tagout.

(l) Each authorized employee shall affix a personal lockout or tagout device to the group lockout device, group lockbox, or comparable mechanism when he or she begins work and shall remove those devices when he or she stops working on the machine or equipment being serviced or maintained.

(m) The complex lockout/tagout procedure, tagout plan, shall address all the concerns of employees who might be exposed. All complex lockout/tagout plans shall identify the method to account for all persons who might be exposed to electrical hazards in the course of the lockout/tagout.

Statement of Problem and Substantiation for Public Input

Section 120.2(D) uses the terms "procedure" and "plan" interchangeably, without any apparent consistency. The context of 120.2(D) indicates that the term plan applies to an individual equipment or task, where procedure applies to a type of plan. This public input is an attempt to make the use of the terms consistent.

Submitter Information Verification

Submitter Full Name: Bobby Gray
Organization: Hoydar/Buck, Inc.
Affiliation: None
Street Address:
City:
State:
Zip:
Submittal Date: Tue Mar 31 16:37:28 EDT 2015
Public Input No. 84-NFPA 70E-2015 [ Section No. 120.2(E)(5) ]

(5) Electrical Circuit Interlocks.
Up-to-date diagrammatic Electrical drawings shall be consulted to ensure that no electrical circuit interlock operation can result in reenergizing the circuit being worked on. Electrical drawings shall be accurate.

Additional Proposed Changes

<table>
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<tr>
<th>File Name</th>
<th>Description Approved</th>
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<tr>
<td>PC_189.pdf</td>
<td>70E-PC189</td>
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</tbody>
</table>

Statement of Problem and Substantiation for Public Input

NOTE: This Public Input appeared as “Reject but Hold” in Public Comment No. 189 of the A2014 Second Draft Report for NFPA 70E and per the Regs. at 4.4.8.3.1.

Up-to-date is not defined.

Submitter Information Verification

Submitter Full Name: TC on EEW-AAA
Organization: NFPA Technical Committee on Electrical Safety in the workplace
Street Address: City: State: Zip:
Submittal Date: Thu Mar 26 15:56:48 EDT 2015
Public Input No. 223-NFPA 70E-2015 [ Section No. 120.2(F)(2) ]

(2) Elements of Control.
The procedure shall identify elements of control.

(a) De-energizing Equipment (Shutdown). The procedure shall establish the person who performs the switching and where and how to de-energize the load.

(b) 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.

(c) Disconnecting Means. The procedure shall identify how to verify that the circuit is de-energized (open).

(d) Responsibility. The procedure shall identify the person who is responsible for verifying that the lockout/tagout procedure is implemented and who is responsible for ensuring that the task is completed prior to removing locks/tags. A mechanism to accomplish lockout/tagout for multiple (complex) jobs/tasks where required, including the person responsible for coordination, shall be included.

(e) Verification. The procedure shall verify that equipment cannot be restarted. The equipment operating controls, such as pushbuttons, selector switches, and electrical interlocks, shall be operated or otherwise it shall be verified that the equipment cannot be restarted.

(f) Testing. The procedure shall establish the following:

   (1) Voltage detector to be used, the required PPE, and the person who will use it to verify proper operation of the voltage detector on a known source of voltage before and after use.

   (2) Requirement to define the boundary of the electrically safe work condition.

   (3) Requirement to test before touching every exposed conductor or circuit part(s) within the defined boundary of the work area.

   (4) Requirement to retest for absence of voltage when circuit conditions change or when the job location has been left unattended.

   (5) Planning considerations that include methods of verification where there is no accessible exposed point to take voltage measurements.

   (6) Grounding. Grounding requirements for the circuit shall be established, including whether the temporary protective grounding equipment 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.

   (7) Shift Change. A method shall be identified in the procedure to transfer responsibility for lockout/tagout to another person or to the person in charge when the job or task extends beyond one shift.

   (8) Coordination. The procedure shall establish how coordination is accomplished with other jobs or tasks in progress, including related jobs or tasks at remote locations, including the person responsible for coordination.

   (9) Accountability for Personnel. A method shall be identified in the procedure to account for all persons who could be exposed to hazardous energy during the lockout/tagout.

   (10) Lockout/Tagout Application. The procedure shall clearly identify when and where lockout applies, in addition to when and where tagout applies, and shall address the following:

       (17) Lockout shall be defined as installing a lockout device on all sources of hazardous energy such that operation of the disconnecting means is prohibited and forcible removal of the lock is required to operate the disconnecting means.

       (18) Tagout shall be defined as installing a tagout device on all sources of hazardous energy, such that operation of the disconnecting means is prohibited. The tagout device shall be installed in the same position available for the lockout device.

       (19) Where it is not possible to attach a lock to existing disconnecting means, the disconnecting means shall not be used as the only means to put the circuit in an electrically safe work condition.

       (20) The use of tagout procedures without a lock shall be permitted only in cases where equipment design precludes the installation of a lock on an energy isolation device(s). When tagout is employed, at least one additional safety measure shall be employed. In such cases, the procedure shall clearly establish responsibilities and accountability for each person who might be exposed to electrical hazards.

   (u) Removal of Lockout/Tagout Devices. The procedure shall identify the details for removing locks or tags when the installing individual is unavailable. When locks or tags are removed by someone other than the installer, the employer shall attempt to locate that person prior to removing the lock or tag. When the lock or tag is removed because the installer is unavailable, the installer shall be informed prior to returning to work.

   (v) 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, and temporary protective grounding equipment have been removed, so that the circuits and equipment are in a condition to be safely energized. Where equipment 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.

   (w) Temporary Release for Testing/Positioning. The procedure shall clearly identify the steps and qualified persons responsibilities when the job or task requiring lockout/tagout is to be interrupted temporarily for testing or positioning of equipment; then the steps shall be identical to the steps for return to service.

Statement of Problem and Substantiation for Public Input

"known source of voltage" is added to be consistent with other text of the standard.

Submitter Information Verification

Submitter Full Name: DAVID PACE
Organization: OLIN CORPORATION
Affiliation: Self
Street Address:  
City: 

http://submittals.nfpa.org/TerraViewWeb/ContentFetcher?commentPara...
Informational Note: See 110.4(A) for requirements when using test instruments and equipment.

(17) Voltage detector to be used, the required PPE, and the person who will use it to verify proper operation of the voltage detector before and after use.

(18) Lockout shall be defined as installing a lockout device on all sources of hazardous energy such that operation of the disconnecting means is prohibited and forcible removal of the lock is required to operate the disconnecting means.

(19) Where it is not possible to attach a lock to existing disconnecting means, the disconnecting means shall not be used as the only means to put the circuit in an electrically safe work condition.

(20) The use of tagout procedures without a lock shall be permitted only in cases where equipment design precludes the installation of a lock on an energy isolation device(s). When tagout is employed, at least one additional safety measure shall be employed. In such cases, the procedure shall clearly establish responsibilities and accountability for each person who might be exposed to electrical hazards.

Informational Note: Examples of additional safety measures include the removal of an isolating circuit element such as fuses, blocking of the controlling switch, or opening an extra disconnecting device to reduce the likelihood of inadvertent energization.

(u) Removal of Lockout/Tagout Devices. The procedure shall identify the details for removing locks or tags when the installing individual is unavailable. When locks or tags are removed by someone other than the installer, the employer shall attempt to locate that person prior to removing the lock or tag. When the lock or tag is removed because the installer is unavailable, the installer shall be informed prior to returning to work.

(v) 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, and temporary protective grounding equipment 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.

Informational Note: See 110.4(A) for requirements when using test instruments and equipment.

Statement of Problem and Substantiation for Public Input

The proposed informational note will provide clarification and reduce some apparent confusion about the voltage level necessary to determine proper operation of the test instrument. Using the properly rated voltage test instrument is already a requirement in 120.1 and 110.4(A)(2).

Submitter Information Verification

Submitter Full Name: MICHAEL JOHNSTON
Organization: NATIONAL ELECTRICAL CONTRACTOR
130.1 General.
Article 130 covers the following:

1. When an electrically safe work condition must be established
2. The electrical safety-related work practices necessary when establishing an electrically safe work condition contained in Article 120.
3. The electrical safety-related work practices when an electrically safe work condition cannot be established

All requirements of this article shall apply whether an incident energy analysis is completed or if Table 130.7(C)(15)(A)(a), Table 130.7(C)(15)(A)(b), 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.

Statement of Problem and Substantiation for Public Input

It is recognized that establishing an electrical safe work condition eliminates electrical hazards. It is also recognized that the process of establishing an electrical safe work condition can expose employees to electrical hazards. By adding #2, the requirements for Article 130 are more clearly linked to Article 120. Thus the requirements for PPE, arc flash/shock risk assessments and other precautions, which are necessary considerations for interacting with electrical equipment and voltage testing, become more apparent.

Another option could move 130.3 Working While Exposed to Electrical Hazards, before the requirements of 130.2 Electrically Safe Working Conditions. Changing the order would infer that absence of voltage testing would expose workers to electrical hazards.

Submitter Information Verification

Submitter Full Name: JASON WOLF
Organization: ESCO GROUP
Street Address:
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Zip:
### Public Input No. 335-NFPA 70E-2015 [ Section No. 130.1 ]

130.1 General. 
Article 130 covers the following:

1. When an electrically safe work condition must be established
2. The electrical safety-related work practices when an electrically safe work condition cannot be established

All requirements of this article shall apply whether an incident energy analysis is completed or if Table 130.7(C)(15)(A)(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.

### Statement of Problem and Substantiation for Public Input

This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.

This Public Input is created to correlate with other Public Inputs where it is proposed that:

- Table 130.7(C)(15)(A)(a) be relocated to 130.5 Arc Flash Risk Assessment; and
- Article 130.7(C)(16) be combined with 130.7(C)(15).

### Submitter Information Verification

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<tr>
<th>Submitter Full Name:</th>
<th>DANIEL ROBERTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization:</td>
<td>SCHNEIDER ELECTRIC</td>
</tr>
<tr>
<td>Affiliation:</td>
<td>This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.</td>
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<td>Submittal Date:</td>
<td>Tue Jun 30 10:51:42 EDT 2015</td>
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</table>
130.1 General.
Article 130 covers the following:
(1) When an electrically safe work condition must be established
(2) The electrical safety-related work practices when an electrically safe work condition cannot be established
All requirements of this article shall apply whether an incident energy analysis is completed or if Table 130.7(C)(15)(A)(a), Table 130.7(C)(15)(A)(b), 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.

Statement of Problem and Substantiation for Public Input
The deleted text is confusing and provides no value. It was placed in the standard in a previous edition to reconcile a potential conflict between requirements for shock protections when the table method was used to determine arc flash PPE. The potential conflict was eliminated in 2015, by removing shock protection requirements from the arc flash PPE tables. Without the history, a user has no way of understanding what the sentence is attempting to communicate.

Submitter Information Verification
Submitter Full Name: Bobby Gray
Organization: Hoydar/Buck, Inc.
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Submittal Date: Tue Mar 31 16:50:12 EDT 2015
Public Input No. 336-NFPA 70E-2015 [Section No. 130.2]

130.2 Electrically Safe Working Conditions Condition.

(A) Requirement to Establish an Electrically Safe Working Condition.

Energized electrical conductors and circuit parts, operating at voltages equal to or greater than 50 Vac or 100 Vdc shall be put into an electrically safe working 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.

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 working condition for connected equipment or to return connected equipment to service that has been placed in an electrically safe working condition, the equipment supplying the disconnecting means or isolating element shall be completely shut down in order to permit work on one circuit or piece of equipment.

(B) Exceptions to Requirement to Establish an Electrically Safe Working Condition

Energized electrical conductors and circuit parts operating at voltages equal to or greater than 50 Vac or 100 Vdc shall not be required to be put into an electrically safe working condition provided a risk assessment is performed and does not identify unacceptable risks for the task.

(A) Energized Work.

(E) Energized Electrical Equipment Work Permit.

(B) Exceptions to Requirement to Establish an Electrically Safe Working Condition

Energized electrical conductors and circuit parts operating at voltages equal to or greater than 50 Vac or 100 Vdc shall not be required to be put into an electrically safe working condition if the employer can demonstrate that de-energizing introduces additional hazards or increased risk.

1. All equipment covers are in place and secured.
2. The equipment is properly maintained.
3. The equipment doors are closed and secured.
4. The equipment is properly installed.
5. The employee is within the limited approach boundary.

Exception: Where a disconnecting means or isolating element that has been properly installed and maintained is operated, opened, closed, removed, or inserted to achieve a working condition before an employee performs work if any of the following conditions exist:

1. Performs work on electrical equipment containing such conductors or circuit parts; or
2. Enters the limited approach boundary of such conductors or circuit parts.

Exception: This requirement does not apply to:

1. Normal equipment operation; or
2. The performance of tasks required by Article 120 to establish an electrically safe working condition.

Informational Note No. 1:

Informational Note No. 2: Examples of work that might be performed within the limited approach boundary of exposed energized electrical conductors or circuit parts include performing diagnostics and testing (for example, start-up or troubleshooting) of electric circuits that can only be performed with the circuit energized and work on circuits that form an integral part of a continuous process that would otherwise need to be completely shut down in order to permit work on one circuit or piece of equipment.

4. Normal Operation

Normal operation of electric equipment shall be permitted where all of the following conditions are satisfied:

(A) Normal Operating Condition.

A normal operating condition for electrical equipment exists when:

1. The equipment is properly installed.
2. The equipment is properly maintained.
3. The equipment doors are closed and secured.
4. All equipment covers are in place and secured.
5. There is no evidence of impending failure.

Informational Note: The phrase properly installed means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer’s recommendations. The phrase properly maintained means that the equipment has been maintained in accordance with the manufacturer’s recommendations and applicable industry codes and standards. The phrase evidence of impending failure means that there is evidence such as arcing, overheating, loose or bound equipment parts, visible damage, or deterioration.
Statement of Problem and Substantiation for Public Input

This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.

The proposed revisions seek to resolve several issues:

The content is reorganized for a better flow of logic. Other than 130.2(A)(4), all proposed revisions to 130.2 are editorial in nature. The general outline of this Article will be as follows:

- **130.2(A) Requirement to Establish an Electrically Safe Working Condition**
  - When energized work is performed within the restricted approach boundary (1).
  - When the employee interacts with the equipment when conductors or circuit parts are not exposed but an increased likelihood of injury from an exposure to an arc flash hazard exists (2).

- **2(2) Elements of Work Permit.**
  - The energized electrical work permit shall include, but not be limited to, the following items:
    - Description of the circuit and equipment to be worked on and the location (1).
    - Justification for why the work must be performed in an energized condition [see 130.2(A)] (2).
    - Description of the safe work practices to be employed [see 130.3] (3).
    - Results of the shock risk assessment [see 130.4(A)] (4).
    - Voltage to which personnel will be exposed (5).
    - Limited approach boundary [see 130.4(B), Table 130.4(D)(a), and Table 130.4(D)(b)] (6).
    - Restricted approach boundary [see 130.4(B), and Table 130.4(D)(a), and Table 130.4(D)(b)] (7).

- **130.2(B) Exceptions to Requirement to Establish an Electrically Safe Working Condition**
  - When the employee interacts with the equipment when conductors or circuit parts are not exposed but an increased likelihood of injury from an exposure to an arc flash hazard exists.

- **130.2(C) Electrical Equipment Operating at Voltages Less Than 50 Vac or 100 Vdc**
  - Access to and egress from an area with energized electrical equipment if no electrical work is performed and the restricted approach boundary is not crossed (1).
  - Thermography and visual inspections if the restricted approach boundary is not crossed (2).
  - Testing, troubleshooting, and voltage measuring (3).
  - General housekeeping and miscellaneous non-electrical tasks if the restricted approach boundary is not crossed (4).

- **130.2(D) Normal Operating Condition**
  - When work is performed within the restricted approach boundary (1).
  - When the employee interacts with the equipment when conductors or circuit parts are not exposed but an increased likelihood of injury from an exposure to an arc flash hazard exists (2).

The abstract concepts of “necessary” and “safely” in the work permit section are replaced by the concrete phrase “required by this Standard.”
### Related Public Inputs for This Document

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<thead>
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<th>Related Input</th>
<th>Relationship</th>
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<td>Public Input No. 339-NFPA 70E-2015 [Section No. 130.4]</td>
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### Submitter Information Verification

**Submitter Full Name:** DANIEL ROBERTS  
**Organization:** SCHNEIDER ELECTRIC  
**Affiliation:** This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.

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<th>Tue Jun 30 11:01:16 EDT 2015</th>
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Title: NFPA 70E - A2017 FD Meeting Agenda  
Page: 192
130.2 Electrically Safe Working Conditions

(A) Electrically Safe Work Condition. Energized electrical conductors and circuit parts 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.

Exception No. 1: 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.

(A) Energized Work.

1. Additional Hazards or Increased Risk.

Exception No. 2 Energized work shall be permitted where the employer can demonstrate that de-energizing introduces additional hazards or increased risk.

2. Infeasibility.

Exception No. 3 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.

Exception No. 4 Energized electrical conductors and circuit parts that operate at less than 50 volts 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.

Informational Note No. 1: Examples of additional hazards or increased risk include, but are not limited to, interruption of life-support equipment, deactivation of emergency alarm systems, and shutdown of hazardous location ventilation equipment.

Informational Note No. 2: Examples of work that might be performed within the limited approach boundary of exposed energized electrical conductors or circuit parts because of infeasibility due to equipment design or operational limitations include performing diagnostics and testing (for example, start-up or troubleshooting) of electric circuits that can only be performed with the circuit energized and work on circuits that form an integral part of a continuous process that would otherwise need to be completely shut down in order to permit work on one circuit or piece of equipment.

(A) Normal Operation.

Exception No. 5 Normal operation of electric equipment shall be permitted where all of the following conditions are satisfied:

1. The equipment is properly installed.
2. The equipment is properly maintained.
3. The equipment doors are closed and secured.
4. All equipment covers are in place and secured.
5. There is no evidence of impending failure.

Informational Note: The phrase properly installed means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer’s recommendations. The phrase properly maintained means that the equipment has been maintained in accordance with the manufacturer’s recommendations and applicable industry codes and standards. The phrase evidence of impending failure means that there is evidence such as arcing, overheating, loose or bound equipment parts, visible damage, or deterioration.

(B) Energized Electrical Work Permit.

1. When Required.

When energized work is permitted in accordance with 130.2(A), an energized electrical work permit shall be required under the following conditions:

1. When work is performed within the restricted approach boundary
2. When the employee interacts with the equipment when conductors or circuit parts are not exposed but an increased likelihood of injury from an exposure to an arc flash hazard exists
Elements of Work Permit.
The energized electrical 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. Justification for why the work must be performed in an energized condition [see 130.2(A)]
3. Description of the safe work practices to be employed [see 130.3]
4. Results of the shock risk assessment [see 130.4(A)]
5. Voltage to which personnel will be exposed
6. Elevated approach boundary [see 130.4(B), Table 130.4(D)(a), and Table 130.4(D)(b)]
7. Restricted approach boundary [see 130.4(B), Table 130.4(D)(a), and Table 130.4(D)(b)]
8. Necessary 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)(a), Table 130.7(C)(16), and 130.7(D)]
9. Results of the arc flash risk assessment [see 130.5]
10. Available incident energy at the working distance or arc flash PPE category [see 130.5]
11. Necessary PPE to protect against the hazard [see 130.5(C), 130.7(C)(1) through (C)(16), Table 130.7(C)(15)(A)(a), Table 130.7(C)(16), and 130.7(D)]
12. Arc flash boundary [see 130.5(B)]
13. Means employed to restrict the access of unqualified persons from the work area [see 130.3]
14. Evidence of completion of a job briefing, including a discussion of any job-specific hazards [see 110.1(H)]
15. Energized work approval (authorizing or responsible management, safety officer, or owner, etc.) signature(s)

Informational Note: For an example of an acceptable energized work permit, see Figure J.1.

Exemptions to Work Permit.
An energized electrical work permit shall not be required if a qualified person is provided with and uses appropriate safe work practices and PPE in accordance with Chapter 1 under any of the following conditions:

1. Testing, troubleshooting, and voltage measuring
2. Thermography and visual inspections if the restricted approach boundary is not crossed
3. Access to and egress from an area with energized electrical equipment if no electrical work is performed and the restricted approach boundary is not crossed
4. General housekeeping and miscellaneous non-electrical tasks if the restricted approach boundary is not crossed

Statement of Problem and Substantiation for Public Input
This Public Input is intended as an editorial change. It appears that all of the existing 130.2(A) may really be exceptions to the existing 130.2. To determine if this is the case, this public input proposes to revise the present exception to 130.2 as Exception No.1 and deletes first level subdivision “(A) Energized Work” and the titles to the four existing second level subdivisions. In addition, the current text of these four existing second level subdivisions are now proposed as Exception No. 2, No. 3, No. 4, and No. 5. The existing title of 130.2 is to remain unchanged as “Electrically Safe Working Conditions” and the proposed new first level subdivision (A) title is “Electrically Safe Work Condition” to reflect the content and intent of the text contained there and to emphasize that energized work is not the primary safety-related work practice recognized by this standard or by OSHA.

Submitter Information Verification
Submitter Full Name: PALMER HICKMAN
Organization: ELECTRICAL TRAINING ALLIANCE
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State: 
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Submittal Date: Mon Jul 06 15:01:02 EDT 2015
Energized electrical conductors and circuit parts 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.

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.

Informational Note: An increased likelihood of injury from an exposure to arc flash may exist when the arc flash risk assessment has determined that an arc flash hazard exists, and employee exposure is above 1.2 cal/cm².

Statement of Problem and Substantiation for Public Input

The statement “increased likelihood of injury from an exposure to an arc flash hazard exists” does not provide clear and concise language. By adding an informational note, the intent of this statement is more clearly communicated. The existing standard language requires the user to consult Article 100 - Definitions, Article 130.7(C)(15)(A)(a) Task Table, and Article 130.2(A)(4) Normal Operation to get an understanding “increased likelihood”.

Submitter Information Verification

Submitter Full Name: JASON WOLF
Organization: ESCO GROUP
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Submittal Date: Wed Jun 24 11:55:33 EDT 2015
Energized electrical conductors and circuit parts 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.
3. The employee is within the arc flash boundary of exposed energized electrical conductors or circuit parts.

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.

Statement of Problem and Substantiation for Public Input

This language solves the condition whereby an employee causes inadvertent arc initiation by dropping a tool.

Submitter Information Verification

Submitter Full Name: Drake Drobnick
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Submittal Date: Sat Feb 07 11:38:17 EST 2015
Public Input No. 440-NFPA 70E-2015 [ Section No. 130.2 [Excluding any Sub-Sections] ]

Energized electrical conductors and circuit parts 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 restricted 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.

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.

Statement of Problem and Substantiation for Public Input

"Limited approach" is changed to "restricted approach" in order for 130.2(1) to be consistent with 130.2(B)(1)(1).

Submitter Information Verification

Submitter Full Name: VINCENT SAPORITA
Organization: Eaton Bussmann Division
Street Address: City: State: Zip:
Submittal Date: Mon Jul 06 09:58:55 EDT 2015
Energized electrical conductors and circuit parts 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.

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.

Statement of Problem and Substantiation for Public Input

The exception is redundant and no longer needed. With the addition of 130.2(A)(4) in 2015, normal operation of electrical equipment that does not create an unacceptable risk of arc flash hazard is justified. That would include operating disconnecting devices for the purpose of creating an electrically safe work condition. Therefore, the exception is no longer needed and creates confusion with the newly added justification.

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Submitter Full Name: Bobby Gray
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Submittal Date: Tue Mar 31 16:58:19 EDT 2015
Public Input No. 100-NFPA 70E-2015 [Section No. 130.2(A)]

(A) Energized Work.

(1) Additional Hazards or Increased Risk.
Energized work shall be permitted where the employer can demonstrate that de-energizing introduces additional hazards or increased risk.

Informational Note: Examples of additional hazards or increased risk include, but are not limited to, interruption of life-support equipment, deactivation of emergency alarm systems, and shutdown of hazardous location ventilation equipment.

(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.

Informational Note: Examples of work that might be performed within the limited approach boundary of exposed energized electrical conductors or circuit parts because of infeasibility due to equipment design or operational limitations include performing diagnostics and testing (for example, start-up or troubleshooting) of electric circuits that can only be performed with the circuit energized.

(3) Less Than 50 Volts.
Energized electrical conductors and circuit parts that operate at less than 50 volts 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.

Informational Note No. 1: Examples of additional hazards or increased risk include, but are not limited to, interruption of life-support equipment, deactivation of emergency alarm systems, and shutdown of hazardous location ventilation equipment.

Informational Note No. 2: Examples of work that might be performed within the limited approach boundary of exposed energized electrical conductors or circuit parts because of infeasibility due to equipment design or operational limitations include performing diagnostics and testing (for example, start-up or troubleshooting) of electric circuits that can only be performed with the circuit energized and work on circuits that form an integral part of a continuous process that would otherwise need to be completely shut down in order to permit work on one circuit or piece of equipment.

(4) Normal Operation.
Normal operation of electric equipment shall be permitted where all of the following conditions are satisfied:

(1) The equipment is properly installed.
(2) The equipment is properly maintained.
(3) The equipment doors are closed and secured.
(4) All equipment covers are in place and secured.
(5) There is no evidence of impending failure.

Informational Note: The phrase properly installed means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer’s recommendations. The phrase properly maintained means that the equipment has been maintained in accordance with the manufacturer’s recommendations and applicable industry codes and standards. The phrase evidence of impending failure means that there is evidence such as arcing, overheating, loose or bound equipment parts, visible damage, or deterioration.

Statement of Problem and Substantiation for Public Input

The section is reformatted to place the informational note directly below the rule to which the informational note applies. In addition, informational note to the infeasible justification is revised to eliminate the opportunity to perform energized work due to impact to production. The existing language implies, and an employer could interpret, the justification could be due to inconvenience rather than infeasibility.

Submitter Information Verification

Submitter Full Name: Bobby Gray
Organization: Hoydar/Buck, Inc.
Affiliation: None
Street Address: 
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Submittal Date: Tue Mar 31 17:06:20 EDT 2015
### Public Input No. 442-NFPA 70E-2015 [Section No. 130.2(A)(1)]

| (1) Additional Hazards or Increased Risk. Energized work shall be permitted where the employer can demonstrate that de-energizing introduces additional hazards or increased risk. Informational Note: Examples of additional hazards or increased risk include, but are not limited to, interruption of life-support equipment, deactivation of emergency alarm systems, and shutdown of hazardous location ventilation equipment. |

### Statement of Problem and Substantiation for Public Input

For increased clarity, Informational Note No. 1 is moved from 130.2(A)(3) to 130.2(A)(1), where it is the only informational note.

### Related Public Inputs for This Document

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<td>Informational Note No. 1 is deleted from 130.2(A)(3)</td>
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### Submitter Information Verification

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**Organization:** Eaton Bussmann Division  
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**Zip:**  
**Submittal Date:** Mon Jul 06 10:05:48 EDT 2015
Public Input No. 445-NFPA 70E-2015 [Section No. 130.2(A)(2)]

(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.

Informational Note: Examples of work that might be performed within the limited, restricted approach boundary of exposed, energized electrical conductors or circuit parts because of infeasibility due to equipment design or operational limitations include performing diagnostics and testing (for example, start-up or troubleshooting) of electric circuits that can only be performed with the circuit energized and work on circuits that form an integral part of a continuous process that would otherwise need to be completely shut down in order to permit work on one circuit or piece of equipment.

Statement of Problem and Substantiation for Public Input
For increased clarity, Informational Note No. 2 is moved from 130.2(A)(3) to 130.2(A)(2). "Limited" is changed to "restricted" to be consistent with 130.2(B)(1)(1) and the expected change to 130.2(1). "Exposed" is deleted to be consistent with other usage of energized electrical conductors throughout the document.

Related Public Inputs for This Document

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Submitter Information Verification
Submitter Full Name: VINCENT SAPORITA
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Street Address:
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Submittal Date: Mon Jul 06 10:19:04 EDT 2015
Public Input No. 125-NFPA 70E-2015 [ Section No. 130.2(A)(3) ]

(3) Less Than 50 Volts.
Energized electrical conductors and circuit parts that operate at less than 50 volts 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 unless it is determined that there will be an increased exposure to electrical burns or to explosion due to electric arcs.

Informational Note No. 1: Examples of additional hazards or increased risk include, but are not limited to, interruption of life-support equipment, deactivation of emergency alarm systems, and shutdown of hazardous location ventilation equipment.

Informational Note No. 2: Examples of work that might be performed within the limited approach boundary of exposed energized electrical conductors or circuit parts because of infeasibility due to equipment design or operational limitations include performing diagnostics and testing (for example, start-up or troubleshooting) of electric circuits that can only be performed with the circuit energized and work on circuits that form an integral part of a continuous process that would otherwise need to be completely shut down in order to permit work on one circuit or piece of equipment.

Statement of Problem and Substantiation for Public Input

1. The original verbiage requires the end user to prove a negative, that is to prove that electrical burns or shocks are not going to occur below 50 V. However:
2. No OSHA cases have occurred where a fatality has occurred below 50 V AC. There are many Codes which make the assumption that 50 V AC is safe. In fact reducing the standard below this level becomes problematic as for instance telecom systems including IEEE “Power over Ethernet” standards use 48 V, thus necessitating arc flash and/or shock protection to be able to plug in a CAT 5E connector to a laptop since there is no available engineering data for such a low voltage with regards to shock. There is some evidence of shock injuries from open circuit voltages in welders above 50 V but not when those voltages are controlled to below 50 V. There is also ample evidence to suggest that DC is safe even up to 100 V as documented in the last Code cycle.
3. There are no standards (IEEE 1584, IEEE C2, etc.) addressing injuries from burns below 50 V, and it is difficult to actually even achieve sustained arcing below 250 V given that IEEE 1584 relies on a single data point at 208 V and no other arcs were sustainable. There are also no injuries aside from those encountered by welders.
4. Thus this clause as originally written requires the end user of 70E to "prove a negative". It is far easier to pass a test where the assumption is that shock and arc flash injuries are not likely below 50 V and to provide an open ended option to apply stricter standards where warranted.

The proposed change assumes that there are no significant hazards below 50 V unless the end user has evidence to the contrary, thus making compliance easier to achieve.

Submitter Information Verification

Submitter Full Name: Paul Campbell
Organization: PotashCorp Aurora
Street Address:
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Submittal Date: Mon Apr 13 17:13:10 EDT 2015
(3) Less Than 50 Volts.

Energized electrical conductors and circuit parts that operate at less than 50 volts 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.

Informational Note No. 1: Examples of additional hazards or increased risk include, but are not limited to, interruption of life-support equipment, deactivation of emergency alarm systems, and shutdown of hazardous location ventilation equipment.

Informational Note No. 2: Examples of work that might be performed within the limited approach boundary of exposed energized electrical conductors or circuit parts because of infeasibility due to equipment design or operational limitations include performing diagnostics and testing (for example, start-up of troubleshooting) of electric circuits that can only be performed with the circuit energized and work on circuits that form an integral part of a continuous industrial process that would otherwise need to be completely shut down in order to permit work on one circuit or piece of equipment.

Informational Note No. 3: The term "continuous industrial process" is derived from its use in NFPA 70, National Electrical Code, Article 210.13, 215.10, and 230.95. If the orderly shutdown of related equipment and processes would not introduce additional or increased hazards but merely alter or interrupt production, then the de-energization of the equipment would be considered feasible.

Statement of Problem and Substantiation for Public Input

Multiple chemical and industrial plants misinterpret the meaning of "continuous industrial process" to mean "loss of production" as making de-energization "infeasible"...as in if it is perceived to cost money. Although OSHA is very clear on interpretation of the meaning if it is not in the standard, it is not understood.

The proposal is to take the verbiage word-for-word from an OSHA letter of interpretation dated December 19, 2006, and insert it as an informational note so that it becomes clear that "continuous industrial process" would point to situations where safety is severely impacted by de-energizing rather than merely production.

Submitter Information Verification

Submitter Full Name: Paul Campbell
Organization: PotashCorp Aurora
Street Address:
City:
State:
Zip:
Submittal Date: Mon Apr 13 17:24:44 EDT 2015
<table>
<thead>
<tr>
<th>Public Input No. 138-NFPA 70E-2015 [ Section No. 130.2(A)(3) ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(3) Less Than 50 Volts.</td>
</tr>
<tr>
<td>Energized electrical conductors and circuit parts that operate at less than 50 volts 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.</td>
</tr>
<tr>
<td>Informational Note No. 1: Examples of additional hazards or increased risk include, but are not limited to, interruption of life-support equipment, deactivation of emergency alarm systems, and shutdown of hazardous location ventilation equipment.</td>
</tr>
<tr>
<td>Informational Note No. 2: Examples of work that might be performed within the limited approach boundary of exposed energized electrical conductors or circuit parts because of infeasibility due to equipment design or operational limitations include performing diagnostics and testing (for example, start-up or troubleshooting) of electric circuits that can only be performed with the circuit energized and work on circuits that form an integral part of a continuous process that would otherwise need to be completely shut down in order to permit work on one circuit or piece of equipment.</td>
</tr>
<tr>
<td>There is a note 1 and note 2 after “3 Less Than 50 Volts”. As written it seems that these notes should apply to 3 where they seem more to apply to 1 or the section as a whole. This should be changed to correct.</td>
</tr>
</tbody>
</table>

**Statement of Problem and Substantiation for Public Input**

NFPA 70E, Chapter 1, Article 130.2 A

This article discusses energized work. There is a note 1 and note 2 after “3 Less Than 50 Volts”. As written it seems that these notes should apply to 3 where they seem more to apply to 1 or the section as a whole. This should be changed to correct.

**Submitter Information Verification**

<table>
<thead>
<tr>
<th>Submitter Full Name: SHAWN LAFFERTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization: EPA</td>
</tr>
<tr>
<td>Street Address:</td>
</tr>
<tr>
<td>City:</td>
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<tr>
<td>State:</td>
</tr>
<tr>
<td>Zip:</td>
</tr>
<tr>
<td>Submittal Date: Thu Apr 23 12:51:01 EDT 2015</td>
</tr>
</tbody>
</table>
Public Input No. 262-NFPA 70E-2015 [ Section No. 130.2(A)(3) ]

(3) Less Than 50 Volts.

Energized electrical conductors and circuit parts that operate at less than 50 volts 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.

Informational Note No. 1: Examples of additional hazards or increased risk include, but are not limited to, interruption of life-support equipment, deactivation of emergency alarm systems, and shutdown of hazardous location ventilation equipment.

Informational Note No. 2: Examples of work that might be performed within the limited approach boundary of exposed energized electrical conductors or circuit parts because of infeasibility due to equipment design or operational limitations include performing diagnostics and testing (for example, start-up or troubleshooting) of electric circuits that can only be performed with the circuit energized and work on circuits that form an integral part of a continuous process that would otherwise need to be completely shut down in order to permit work on one circuit or piece of equipment.

Statement of Problem and Substantiation for Public Input

The phrase "of exposed energized electrical conductors or circuit parts" is inferred by the context.
The Task Group used the following principles when deciding whether or not to use "exposed" with "energized":
1. Required when referring to shock hazards in general;
2. Not required when "exposed" is inferred (i.e. preceded by qualifier "within the limited approach boundary of...");
3. Not required when referring to all electrical hazards or arc flash hazards.

This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the term "exposed" with the term "energized."

Submitter Information Verification

<table>
<thead>
<tr>
<th>Name</th>
<th>DANIEL ROBERTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affiliation</td>
<td>SCHNEIDER ELECTRIC</td>
</tr>
<tr>
<td>Submittal Date</td>
<td>Fri Jun 26 13:51:00 EDT 2015</td>
</tr>
</tbody>
</table>
Public Input No. 388-NFPA 70E-2015 [ Section No. 130.2(A)(3) ]

(3) Less Than 50 Volts.

Energized electrical conductors and circuit parts that operate at less than 50 volts 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 electric shock injury, electrical burns or to explosion due to electric arcs.

Informational Note No. 1: Examples of additional hazards or increased risk include, but are not limited to, interruption of life-support equipment, deactivation of emergency alarm systems, and shutdown of hazardous location ventilation equipment.

Informational Note No. 2: Examples of work that might be performed within the limited approach boundary of exposed energized electrical conductors or circuit parts because of infeasibility due to equipment design or operational limitations include performing diagnostics and testing (for example, start-up or troubleshooting) of electric circuits that can only be performed with the circuit energized and work on circuits that form an integral part of a continuous process that would otherwise need to be completely shut down in order to permit work on one circuit or piece of equipment.

Statement of Problem and Substantiation for Public Input

The current clause excludes consideration that there may be a shock hazard on circuits less than 50 Volts. There are some work environments where additional risk assessment may be needed. For example, workers with full body emersion in water such as divers servicing water intakes or outfalls for industrial or municipal facilities have a different body surface exposure than a worker in a dry environment. The proposal provides guidance for more comprehensive review of electrical injury risks.

Submitter Information Verification

Submitter Full Name: Lanny Floyd
Organization: Electrical Safety Group Inc
Street Address:
City:
State:
Zip:
Submittal Date: Sat Jul 04 09:48:17 EDT 2015
Public Input No. 444-NFPA 70E-2015 [Section No. 130.2(A)(3)]

(3) Less Than 50 Volts.

Energized electrical conductors and circuit parts that operate at less than 50 volts 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.

Informational Note No. 1: Examples of additional hazards or increased risk include, but are not limited to, interruption of life-support equipment, deactivation of emergency alarm systems, and shutdown of hazardous location ventilation equipment.

Informational Note No. 2: Examples of work that might be performed within the limited approach boundary of exposed energized electrical conductors or circuit parts because of infeasibility due to equipment design or operational limitations include performing diagnosis and testing (for example, start-up or troubleshooting) of electric circuits that can only be performed with the circuit energized and work on circuits that form an integral part of a continuous process that would otherwise need to be completely shut down in order to permit work on one circuit or piece of equipment.

Statement of Problem and Substantiation for Public Input

For increased clarity, delete these two Informational Notes from 130.2(A)(3). Place existing Informational Note No. 1 in 130.2(A)(1) and Informational Note No. 2 in 130.2(A)(2).

Related Public Inputs for This Document

<table>
<thead>
<tr>
<th>Related Input</th>
<th>Relationship</th>
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<tbody>
<tr>
<td>Public Input No. 442-NFPA 70E-2015</td>
<td>(Section No. 130.2(A)(1))</td>
</tr>
<tr>
<td>Public Input No. 445-NFPA 70E-2015</td>
<td>(Section No. 130.2(A)(2))</td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: VINCENT SAPORITA
Organization: Eaton Bussmann Division
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Mon Jul 06 10:12:35 EDT 2015
Public Input No. 103-NFPA 70E-2015 [Section No. 130.2(A)(4)]

(4) Normal Operation.

Normal operation of electric equipment shall be permitted where all of the following conditions are satisfied:

1. The equipment is properly installed.
2. The equipment is properly maintained.
3. The equipment doors are closed and secured.
4. All equipment covers are in place and secured.
5. There is no evidence of impending failure.

Persons performing the normal operation of the electrical equipment shall be task specific trained to that equipment to understand the established procedures to control the energy for that specific device. This training shall include the risk hazard analysis and appropriate measures to protect against arc flash and shock hazards.

Informational Note: The phrase properly installed means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer's recommendations. The phrase properly maintained means that the equipment has been maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards. The phrase evidence of impending failure means that there is evidence such as arcing, overheating, loose or bound equipment parts, visible damage, or deterioration.

Statement of Problem and Substantiation for Public Input

People performing normal operation can be exposed to potential large arc flash hazards and shock hazards depending on the particular equipment. The current wording would allow anyone with no training to walk up and operate a circuit breaker with very high arc flash hazard potential. Despite being normal operation, there is no complete positive assurances that the equipment will not fail during operation. This is a low probability but high consequence event to operate a circuit breaker even in a normal operation mode. The current language does not require that a person be trained nor properly dressed for doing these type of operations to protect against the hazards.

Submitter Information Verification

Submitter Full Name: Joe Rachford
Organization: Nucor Steel Gallatin
Street Address:
City:
State:
Zip:
Submittal Date: Thu Apr 02 13:27:10 EDT 2015
Normal Operation.

Normal operation of electric equipment shall be permitted where all of the following conditions are satisfied:

1. The equipment is properly installed.
2. The equipment is properly maintained.
3. The equipment doors are closed and secured.
4. All equipment covers are in place and secured.
5. There is no evidence of impending failure.

Informational Note

#1: The phrase "Normal Operation" only applies to hazards that are lower than 8cal/cm².

Informational Note #2: The phrase "properly installed" means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer’s recommendations. The phrase "properly maintained" means that the equipment has been maintained in accordance with the manufacturer’s recommendations and applicable industry codes and standards. The phrase "evidence of impending failure" means that there is evidence such as arcing, overheating, loose or bound equipment parts, visible damage, or deterioration.

Statement of Problem and Substantiation for Public Input

Those who are not qualified electrical workers but are qualified to operate electrical equipment should have more PPE on when interacting with energized electrical equipment when the Risk Assessment finds a higher hazard. Paper ESW2104-18 entitled "Exposed to the Arc Hazard" shows evidence that when operating equipment with the covers closed, the latches that the equipment comes equipped with are not sufficient to handle an arc flash event at those levels of incident energy.

Submitter Information Verification

Submitter Full Name: SCOTT CARROLL
Organization: SPECTRA ENERGY
Affiliation: IEEE Member and contributor
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Wed Jan 21 08:31:02 EST 2015
Normal operation of electric equipment shall be permitted where all of the following conditions are satisfied:

1. The equipment is properly installed.
2. The equipment is properly maintained.
3. The equipment doors are closed and secured.
4. All equipment covers are in place and secured.
5. There is no evidence of impending failure.

Informational Note: The phrase “properly installed” means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer’s recommendations. The phrase “properly maintained” means that the equipment has been maintained in accordance with the manufacturer’s recommendations and applicable industry codes and standards. The phrase “evidence of impending failure” means that there is evidence such as arcing, overheating, loose or bound equipment parts, visible damage, or deterioration.

Statement of Problem and Substantiation for Public Input

The term normal work is never used in the revised task tables nor anywhere else in the Code.

Related Public Inputs for This Document

<table>
<thead>
<tr>
<th>Related Input</th>
<th>Relationship</th>
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<tbody>
<tr>
<td>Public Input No. 122-NFPA 70E-2015 [Section No. 130.2(A)(4)]</td>
<td></td>
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</table>

Submitter Information Verification

Submitter Full Name: Paul Campbell
Organization: PotashCorp Aurora
Street Address:
City:
State:
Zip:
Submittal Date: Mon Apr 13 14:09:46 EDT 2015
Public Input No. 122-NFPA 70E-2015 [Section No. 130.2(A)(4)]

(4) Normal Operation.
Normal operation of electric equipment shall be permitted where all of the following conditions are satisfied:

(1) The equipment is properly installed.
(2) The equipment is properly maintained.
  • The equipment doors are closed and secured.
  • All equipment covers are in place and secured.
(3) No exposed conductors are present.
(4) There is no evidence of potential impending failure such as a tripped overcurrent protective device, external evidence of arcing or overheating, no parts are loose or sticking, and no fluids are seeping from the enclosure.

Informational Note No. 1: The phrase properly installed means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer’s recommendations. The phrase properly maintained means that the equipment has been maintained in accordance with the manufacturer’s recommendations and applicable industry codes and standards. The phrase evidence of impending failure means that there is evidence such as arcing, overheating, loose or bound equipment parts, visible damage, or deterioration.

Informational Note No. 2: Normal work includes tasks such as opening hinged covers or doors without the use of tools and switching operations such as operating circuit breakers, fused switches, or contactors.

(5) Low hazard work.
Low hazard work includes tasks which are unlikely to cause an electric arc irrespective of equipment condition such as:

(1) Programming or reading a panel meter.
(2) Operating panel meter switches.
(3) Testing control components where control voltage is less than 125 V.
(4) Inspection while all parts of a person’s body and any conductive tools being held are outside the restricted approach boundary and not held in a position where they could fall into energized parts.

Statement of Problem and Substantiation for Public Input

Issue #1: "Normal work" references closed doors and covers. However this section fails to address "open" style equipment such as open cutouts in substations. The issue at hand is whether or not equipment is exposed where for instance it is possible for a person to accidentally fall into the equipment while attempting to operate a disconnect or circuit breaker. Revising the rule to reference exposed equipment incorporates both "open" style equipment where doors and covers are not used and in which protection is provided by location.

Issue #2: The term "evidence of impending failure" is vague and gives end users no meaningful way to interpret it. Terms taken from the newly revised OSHA 1910.269 Annex are used to revise the definition so that an average person is capable of evaluating the possibility of impending failure by visual inspection without specialized knowledge or disassembly of the equipment.

Issue #3: The term "normal work" is used but "normal work" is not defined. The proposal gives specific examples of tasks that would be considered normal work as per OSHA 1910.269 as well as IEEE ESW paper 2011-22.

Issue #3: There are a few electrical maintenance tasks which are not "normal work" but are also low hazard such as visual or thermal inspections that are outside the restricted approach boundary. These are captured by the task tables with tasks such as reading a panel meter but difficult to capture when a risk assessment with incident energy analysis is done. A 5th category is proposed for this purpose.

Related Public Inputs for This Document

<table>
<thead>
<tr>
<th>Related Input</th>
<th>Relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Input No. 121-NFPA 70E-2015 [Section No. 130.2(A)(4)]</td>
<td>Alternative to deleting the section.</td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: Paul Campbell
Organization: PotashCorp Aurora
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Mon Apr 13 14:11:21 EDT 2015
Public Input No. 128-NFPA 70E-2015 [Section No. 130.2(A)(4)]

(4) Normal Operation.
Normal operation of electric equipment shall be permitted where all of the following conditions are satisfied:

(1) The equipment is properly installed.
(2) The equipment is properly maintained.
(3) The equipment doors are closed and secured.
(4) All equipment covers are in place and secured.
(5) There is no evidence of impending failure.

Informational Note: The phrase "properly installed" means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer’s recommendations. The phrase "properly maintained" means that the equipment has been maintained in accordance with the manufacturer’s recommendations and applicable industry codes and standards. The phrase "evidence of impending failure" means that there is evidence such as arcing, overheating, loose or bound equipment parts, visible damage, or deterioration.

(5) De-energization/Re-energization
De-energization and re-energization of equipment shall be permitted.

Statement of Problem and Substantiation for Public Input

Prior editions of Code provided a section in Article 110 which referenced either tasks to place equipment into an electrically safe working condition (Article 120) or working on it while energized (Article 130). With the Code revision to remove the relevant section in Article 110 in order to emphasize energized work practices in Article 130, de-energization and re-energization activities are no longer automatically allowed under Article 130 except by perverting the "greater hazard" rule which encourages energized work and potentially invokes an EEWP. This proposal makes it clear that de-energized work is always preferred over energized work.

Submitter Information Verification

Submitter Full Name: Paul Campbell
Organization: PotashCorp Aurora
Street Address:
City: 
State: 
Zip: 
Submittal Date: Mon Apr 13 17:45:11 EDT 2015
Public Input No. 191-NFPA 70E-2015 [ Section No. 130.2(A)(4) ]

(4) Normal Operation.
Normal operation of electric equipment shall be permitted where all of the following conditions are satisfied:
(1) The equipment is properly installed.
(2) The equipment is properly maintained.
(3) The equipment doors are closed and secured.
(4) All equipment covers are in place and secured.
(5) There is no evidence of impending failure.

Informational Note: The phrase *properly installed* means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer’s recommendations. The phrase *properly maintained* means that the equipment has been maintained in accordance with the manufacturer’s recommendations and applicable industry codes and standards. The phrase *evidence of impending failure* means that there is evidence such as arcing, overheating, loose or bound equipment parts, visible damage, deterioration, or water falling onto or coming out of the electrical equipment.

Statement of Problem and Substantiation for Public Input

While it is next to impossible to list every evidence of impending failure, specifically listing water falling onto or coming out of equipment makes it clear that a failure is probably evident.

Submitter Information Verification

Submitter Full Name: ALVIN HAVENS
Organization: e-Hazard Management, LLC
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jun 17 16:54:31 EDT 2015
Normal operation of electric equipment shall be permitted where all of the following conditions are satisfied:

1. The equipment was properly designed for the application.
2. The equipment is properly installed.
3. The equipment is properly maintained.
4. The equipment has been operated within its design limits.
5. The equipment doors are closed and secured.
6. All equipment covers are in place and secured.
7. There is no evidence of impending failure.
8. There are no other factors such as age of the equipment, manufacturing defects, negative operational history, previous incidents, etc. that would increase the likelihood of equipment failure during operation.

Informational Note: The phrase properly installed means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer's recommendations. The phrase properly maintained means that the equipment has been maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards. The phrase evidence of impending failure means that there is evidence such as arcing, overheating, loose or bound equipment parts, visible damage, or deterioration.

Statement of Problem and Substantiation for Public Input

I agree that the items listed here are valid and support normal operation being allowed. There are additional factors, however, that affect this as well, and are added for consideration by the reader of the standard. “No other factors that would increase the likelihood of equipment failure during operation” are items such as the age of the equipment, manufacturing defects, negative operational history, previous incidents, etc. Even if the equipment meets all of the existing criteria, the additional items could make normal operation something that would be prohibited.

Submitter Information Verification

Submitter Full Name: DAVID PACE
Organization: OLIN CORPORATION
Affiliation: Self
Street Address: City:
State:
Zip:
Submittal Date: Mon Jun 22 17:35:50 EDT 2015
Public Input No. 244-NFPA 70E-2015 [ Section No. 130.2(A)(4) ]

(4) Normal Operation.
Normal operation of energized electric equipment shall be permitted where all of the following conditions are satisfied:

(1) The equipment is properly installed.
(2) The equipment is properly maintained.
(3) The equipment doors are closed and secured.
(4) All equipment covers are in place and secured.
(5) There is no evidence of impending failure.
(6) Acceptable risk, as indicated by a risk assessment

Informational Note No. 1: The phrase properly installed means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer’s recommendations. The phrase properly maintained means that the equipment has been maintained in accordance with the manufacturer’s recommendations and applicable industry codes and standards. The phrase evidence of impending failure means that there is evidence such as arcing, overheating, loose or bound equipment parts, visible damage, or deterioration.

Informational Note No. 2: See 130.6(K) Anticipating Failure when electrical equipment could fail and injure employees.

Information Note No.3: For more information on acceptable risk, see Informative Annex F.

Statement of Problem and Substantiation for Public Input

Adding energized more accurately describes when the 130.2(A)(4) Normal Operation applies.

Article 130.6 (K) provides additional guidance on actions employers need to take if there is evidence of impending failure.

130.2(A)(4) Normal Operation appears more appropriate for operating electrical disconnects, switches, etc, when a minimal arc flash hazard exists. It does not appear to be appropriate when interacting with electrical equipment where a higher arc flash hazard exists, such as electrical services. Higher arc flash hazards may result in higher arc blast pressures, which the equipment enclosure may not contain, and could injure an employee. Adding acceptable risk as a criteria, would allow employers to make the distinction between normal operation, and normal operation with acceptable risk. Normal operation with acceptable risk may include, PPE, start up/shut down procedures, or remote switching devices.

Submitter Information Verification

Submitter Full Name: JASON WOLF
Organization:ESCO GROUP
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jun 24 14:34:31 EDT 2015
Normal Operation.

Normal operation of electric equipment shall be permitted where all of the following conditions are satisfied:

1. The equipment is properly installed.
2. The equipment is properly maintained.
3. The equipment doors are closed and secured.
4. All equipment covers are in place and secured.
5. There is no evidence of impending failure.

Informational Note

1. Equipment is used in accordance with any instructions included in listing and labeling instructions and according to manufacturer's instructions.

Note: The phrase "properly installed" means that the employer or equipment owner ensures the equipment is installed in accordance with applicable industry codes and standards and the manufacturer's recommendations. The phrase "properly maintained" means that the employer or equipment owner ensures that the equipment has been maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards. The phrase "evidence of impending failure" means that there is evidence such as arcing, overheating, loose or bound equipment parts, visible damage, or deterioration.

Statement of Problem and Substantiation for Public Input

It is imperative for safety of personnel that equipment be used in accordance with any instructions included in listing or labeling of the equipment and in accordance with manufacturer's instructions.

Informational note has been changed to Note as Informational notes are not enforceable.

The employer is accountable for safety of employees. Note has been revised to align with OSHA requirements for accountability of equipment installation and maintenance.

Submitter Information Verification

Submitter Full Name: DALEEP MOHLA
Organization: DCM ELECTRICAL CONSULTING SERV
Street Address:
City:
State:
Zip:
Submittal Date: Sun Jun 28 12:19:13 EDT 2015
Public Input No. 418-NFPA 70E-2015 [Section No. 130.2(A)(4)]

(4) Normal Operation.
Normal operation of electric equipment shall be permitted where all of the following conditions are satisfied:

(1) The equipment is properly installed.
(2) The equipment is properly maintained.
(3) The equipment doors are closed and secured.
(4) All equipment covers are in place and secured.
(5) There is no evidence of impending failure.

Informational Note: The phrase “properly installed” means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer’s recommendations. The phrase “properly maintained” means that the equipment has been maintained in accordance with the manufacturer’s recommendations and applicable industry codes and standards. The phrase “evidence of impending failure” means that there is evidence such as arcing, overheating, loose or bound equipment parts, visible damage, or deterioration.

Statement of Problem and Substantiation for Public Input

This section serves no purpose other than to provide confusion. This section does not provide any requirements other than to state it is ok to perform normal operations. The term “normal operations” is not defined so it leads to further confusion. Nothing in NFPA 70E prevents “normal operations”. The intent of NFPA 70E should be to define what is required during normal operations when there is an electrical hazard associated with performing “normal operations”.

This statement in this section could be seen as in conflict with 130.2(2) and 130.2(B)(2)

If the committee wishes to keep this section it needs to be rewritten to provide a meaningful statement or requirement.

Submitter Information Verification

Submitter Full Name: DANNY LIGGETT
Organization: THE DUPONT COMPANY INC
Affiliation: Self
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Sun Jul 05 13:20:24 EDT 2015
Normal Operation.
Normal operation of electric equipment shall be permitted where all of the following conditions are satisfied:

1. The equipment is properly installed.
2. The equipment is properly maintained.
3. The equipment doors are closed and secured.
4. All equipment covers are in place and secured.
5. There is no evidence of impending failure.

Informational Note No. 1: The phrase “properly installed” means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer’s recommendations. The phrase “properly maintained” means that the equipment has been maintained in accordance with the manufacturer’s recommendations and applicable industry codes and standards. The phrase “evidence of impending failure” means that there is evidence such as arcing, overheating, loose or bound equipment parts, visible damage, or deterioration.

Informational Note No. 2: See 205.3 for general maintenance requirements.

Statement of Problem and Substantiation for Public Input

130.2(A)(4) covers “Normal Operation” of equipment, with 130.2(A)(4)(2) specifically covering equipment maintenance. This Public Input adds a reference to the maintenance requirements in this Standard.

Submitter Information Verification

Submitter Full Name: VINCENT SAPORITA
Organization: Eaton Bussmann Division
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Mon Jul 06 11:22:19 EDT 2015
Public Input No. 503-NFPA 70E-2015 [ Section No. 130.2(A)(4) ]

(4) Normal Operation.
Normal operation of electric equipment operating at 240 volts or less and rated at 200 amperes or less, shall be permitted where all of the following conditions are satisfied:

1. The equipment is properly installed.
2. The equipment is properly maintained.
3. The equipment doors are closed and secured.
4. All equipment covers are in place and secured.
5. There is no evidence of impending failure.

Informational Note: The phrase properly installed means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer’s recommendations. The phrase properly maintained means that the equipment has been maintained in accordance with the manufacturer’s recommendations and applicable industry codes and standards. The phrase evidence of impending failure means that there is evidence such as arcing, overheating, loose or bound equipment parts, visible damage, or deterioration.

Statement of Problem and Substantiation for Public Input

The present wording seems to allow operation of equipment at any voltage or current rating with no limitations. The values are provided as a starting point for discussion.

Submitter Information Verification

Submitter Full Name: PAUL DOBROWSKY
Organization: INNOVATIVE TECHNOLOGY SERVICES
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jul 06 14:36:30 EDT 2015

http://submittals.nfpa.org/TerraViewWeb/ContentFetcher?commentPara...
Normal Operation.

Normal operation of electric equipment shall be permitted, where all of the following conditions are satisfied: The equipment is properly installed:

- The equipment is properly maintained.
- The equipment doors are closed and secured.
- All equipment covers are in place and secured.
- There is no evidence of impending failure.

Informational Note:

The phrase 'properly installed' means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer's recommendations. The phrase 'properly maintained' means that the equipment has been maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards. The phrase 'evidence of impending failure' means that there is evidence such as arcing, overheating, loose or bound equipment parts, visible damage, or deterioration.

Statement of Problem and Substantiation for Public Input

This proposal is a second proposal dealing with the term, Normal Operation. Public Input 77-NFPA 70E-2015 proposed making the term, Normal Operation, a definition. This public input is addressing the fact that if the definition is accepted, there is no need for all the information that currently exists. Just a simple statement that Normal Operation is allowed.

Submitter Information Verification

Submitter Full Name: ROGER ZIEG
Organization: ZIEG ELEC
Street Address:
City:
State:
Zip:
Submittal Date: Thu Mar 19 13:21:56 EDT 2015
Public Input No. 18-NFPA 70E-2015 [ Section No. 130.2(B)(1) ]

(1) When Required. When energized work is permitted in accordance with 130.2(A), an energized electrical work permit shall be required under any of the following conditions:

(1) When work is performed within the restricted approach boundary
(2) When the employee interacts with the equipment when conductors or circuit parts are not exposed but an increased likelihood of injury from an exposure to an arc flash hazard exists

Statement of Problem and Substantiation for Public Input

Document clarity
The Committee’s intent was to require either condition.

Submitter Information Verification

Submitter Full Name: Drake Drobnick
Organization: [ Not Specified ]
Affiliation: N/A
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jan 27 13:41:03 EST 2015
Public Input No. 192-NFPA 70E-2015 [Section No. 130.2(B)(1)]

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
</table>
| **(1)** | **When Required.**  
When energized work is permitted in accordance with 130.2(A), an energized electrical work permit shall be required under the following conditions: |
| **(1)** | When work is performed within the restricted approach boundary |
| **(2)** | When the employee interacts with the equipment when conductors or physically alters electrical circuit parts are not exposed but an increased likelihood of injury from an exposure to an arc flash hazard exists or conductors while they are energized. |

Statement of Problem and Substantiation for Public Input

1. The current statement in Article 130.2 (B)(2) when coupled with the task table, Table 130.7(C)(15)(A)(a) Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems, confuses the issue for employees. For example, because the task of opening hinged doors, under any equipment condition, requires arc flash PPE, as stated in the table, page 36, it could be inferred that an employee needs to complete an Energized Electrical Work Permit (EEWP) just to open an MCC bucket door to do troubleshooting. Since troubleshooting does not require an EEWP it doesn’t make sense that an EEWP needs to be completed to open a hinged door. There are other similar examples in the task table, in addition.
2. It is not the intent of Table 130.7(C)(15)(A)(a) Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems to determine if an EEWP is required when doing any task listed. The intent of this table is to make clear when an employee needs to wear arc flash PPE when doing certain tasks.
3. The revision of this article makes it consistent with the revised definition of Working On (energized electrical conductors or circuit parts).

Submitter Information Verification

**Submitter Full Name:** ALVIN HAVENS  
**Organization:** e-Hazard Management, LLC  
**Street Address:**  
**City:**  
**State:**  
**Zip:**  
**Submittal Date:** Wed Jun 17 17:00:07 EDT 2015
Public Input No. 225-NFPA 70E-2015 [Section No. 130.2(B)(1)]

(1) When Required.
When energized work is permitted in accordance with 130.2(A), an energized electrical work permit shall be required under the following conditions:
  * When work is performed within the restricted approach boundary.
  * When:
    1. for work on or near exposed, live conductors or circuit parts, or
    2. when the employee interacts with the equipment when conductors or circuit parts are not exposed but an increased likelihood of injury from an exposure to an arc flash hazard exists.

Statement of Problem and Substantiation for Public Input

What triggers the need for a permit is not where you are or the type of equipment being worked on. What triggers the need for the permit is what type of work is being performed, is there an increased likelihood of an incident while performing this work, and if an incident should occur, are the hazards great enough to cause injury to individuals. This revision leaves the requirement for a permit anytime energized work is performed and removes text related to restricted approach boundary. Article 130.2(B)(3) provides exceptions to this requirement. A companion PI is being submitted to revise the wording in Article 130.2(B)(3) to remove wording related to the restricted approach boundary. Also, the existing text is not consistent with the information in Annex J, these revisions will correct that inconsistency. The information in Annex J represents the original intent of requiring an energized electrical work permit, and when one is, and is not required.

Submitter Information Verification

Submitter Full Name: DAVID PACE
Organization: OLIN CORPORATION
Affiliation: Self
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jun 22 17:42:04 EDT 2015
Public Input No. 242-NFPA 70E-2015 [Section No. 130.2(B)(1)]

(1) When Required.
When energized work is permitted in accordance with 130.2(A), an energized electrical work permit shall be required under the following conditions:

(1) When work is performed within the restricted approach boundary

(2) When the employee interacts with the equipment when conductors or circuit parts are not exposed but an increased likelihood of injury from an exposure to an arc flash hazard exists

Informational Note: An increased likelihood of injury from an exposure to arc flash may exist when the arc flash risk assessment has determined that an arc flash hazard exists, and employee exposure is above 1.2 cal/cm².

Statement of Problem and Substantiation for Public Input

The statement “increased likelihood of injury of from an exposure to an arc flash hazard exists” does not provide clear and concise language. By adding an informational note, the intent of this statement is more clearly communicated. The existing standard language requires the user to consult Article 100 - Definitions, Article 130.7(C)(15)(A)(a) Task Table, and Article 130.2(A)(4) Normal Operation to get an understanding “increased likelihood”.

Submitter Information Verification

Submitter Full Name: JASON WOLF
Organization: ESCO GROUP
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jun 24 12:00:11 EDT 2015
### Public Input No. 420-NFPA 70E-2015 [ Section No. 130.2(B)(1) ]

<table>
<thead>
<tr>
<th>(1) When Required.</th>
<th>When energized work is permitted in accordance with Section 130.2(A), an energized electrical work permit shall be required under the following conditions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>When work is performed within the restricted limited approach boundary</td>
</tr>
<tr>
<td>(2)</td>
<td>When the employee interacts with the equipment when conductors or circuit parts are not exposed but an increased likelihood of injury from an exposure to an arc flash hazard exists</td>
</tr>
</tbody>
</table>

### Statement of Problem and Substantiation for Public Input

Working within arm’s reach of uninsulated energized conductors present a hazard (and a risk). Usually to be within arm’s reach of energized uninsulated conductors requires the removal of covers or opening of a door. This is an added hazard or risk. These events need to be controlled or managed to help insure the correct questions have been asked and the appropriate planning has been done. The unintended message is that entering the Limited Approach Boundary is no longer as important.

### Submitter Information Verification

<table>
<thead>
<tr>
<th>Submitter Full Name:</th>
<th>DANNY LIGGETT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization:</td>
<td>THE DUPONT COMPANY INC</td>
</tr>
<tr>
<td>Affiliation:</td>
<td>Self</td>
</tr>
<tr>
<td>Street Address:</td>
<td></td>
</tr>
<tr>
<td>City:</td>
<td></td>
</tr>
<tr>
<td>State:</td>
<td></td>
</tr>
<tr>
<td>Zip:</td>
<td></td>
</tr>
<tr>
<td>Submittal Date:</td>
<td>Sun Jul 05 13:45:52 EDT 2015</td>
</tr>
</tbody>
</table>
Public Input No. 515-NFPA 70E-2015 [ Section No. 130.2(B)(1) ]

(1) When Required.
When energized work is permitted in accordance with 130.2(A), an energized electrical work permit shall be required under the following conditions:

(1) When work is performed within the restricted approach boundary
(2) When the employee interacts with equipment operating at 50 volts or more, when conductors or circuit parts are not exposed but an increased likelihood of injury from an exposure to an arc flash hazard exists

Statement of Problem and Substantiation for Public Input
An energized electrical permit seems to be required even for work on Class 2 circuits.
The phrase "50 volts or more" was taken from NEC 110.27.

Submitter Information Verification
Submitter Full Name: PAUL DOBROWSKY
Organization: INNOVATIVE TECHNOLOGY SERVICES
Street Address:
City: 
State: 
Zip: 
Submittal Date: Mon Jul 06 14:51:45 EDT 2015
Public Input No. 41-NFPA 70E-2015 [ New Section after 130.2(B)(2) ]

<table>
<thead>
<tr>
<th>Add a new “b” in 130.2(B)(2)(5) and renumber existing provising as indicated:</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Available incident energy or arc flash PPE category [see 130.5]</td>
</tr>
<tr>
<td>b. Working distance [see 130.5(C)(1) and 130.7(C)(15)(A)]</td>
</tr>
<tr>
<td>c. Necessary PPE to protect against the hazard [see 130.5(C), 130.7(C)(1) through (C)(16), Table 130.7(C)(15)(A)(a), Table 130.7(C)(16), and 130.7(D)]</td>
</tr>
<tr>
<td>d. Arc flash boundary [see 130.5(B)]</td>
</tr>
</tbody>
</table>

Statement of Problem and Substantiation for Public Input

This recommendation is intended to provide crucial information on the work permit and provide the same parallel information regardless of which method is used to determine arc flash PPE. Working distance is important for both methods permitted to determine arc flash PPE in accordance with 130.5(C). Working closer than the working distance associated with both the calculated distance and the distance derived from the table exposes workers to a significant increase in exposure. The corresponding working distance is already required to be known per 130.5(C)(1) and on the label when incident energy calculations are performed. See 130.5(D)(3)(a). However, even though the minimum working distance is published in "the PPE category Tables", this important minimum working distance is not required to be on the work permit. This recommendation does not require anything new other than to transfer the information from "the Tables" to the permit. A similar change is being proposed to a similar provision required to be included on the arc flash risk assessment portion of the equipment label.

Submitter Information Verification

Submitter Full Name: PALMER HICKMAN  
Organization: ELECTRICAL TRAINING ALLIANCE  
Street Address:  
City:  
State:  
Zip:  
Submittal Date: Sat Feb 07 11:01:35 EST 2015
Public Input No. 101-NFPA 70E-2015 [Section No. 130.2(B)(2)]

(2) Elements of Work Permit.

The energized electrical 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) Justification for why the work must be performed in an energized condition [see 130.2(A)]

(3) Description of the safe work practices to be employed [see 130.3]

(4) Results of the shock risk assessment [see 130.4(A)]

(5) Voltage to which personnel will be exposed

(6) Limited approach boundary [see 130.4(B), Table 130.4(D)(a) and Table 130.4(D)(b)]

(7) Restricted approach boundary [see 130.4(B), Table 130.4(D)(a) and Table 130.4(D)(b)]

(8) Necessary 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)(a), Table 130.7(C)(16), and 130.7(D)]

(9) Results of the arc flash risk assessment [see 130.5]

(10) Available incident energy at the working distance or arc flash PPE category [see 130.5]

(11) Necessary PPE to protect against the hazard [see 130.5(C), 130.7(C)(1) through (C)(16), Table 130.7(C)(15)(A)(a), Table 130.7(C)(16), and 130.7(D)]

(12) Arc flash boundary [see 130.5(B)]

(13) Means employed to restrict the access of unqualified persons from the work area [see 130.3(E)]

(14) Evidence of completion of a job briefing, including a discussion of any job-specific hazards [see 110.1(H)]

(15) Energized work approval (authorizing or responsible management, safety officer, or owner, etc.) signature(s)

Informational Note: For an example of an acceptable energized work permit, see Figure J.1.

Statement of Problem and Substantiation for Public Input

This PI is to correct an apparent errata. The reference should be to 130.7(E), Alerting Techniques. Section 130.3 does not address preventing access to unqualified persons.

Submitter Information Verification

Submitter Full Name: Bobby Gray
Organization: Hoydar/Buck, Inc.
Affiliation: None
Street Address:
City:
State:
Zip:
Submittal Date: Tue Mar 31 17:16:05 EDT 2015
Public Input No. 36-NFPA 70E-2015 [ Section No. 130.2(B)(2) ]

(2) Elements of Work Permit.
The energized electrical work permit shall include, but not be limited to, the following items:

(1) (2) Description of the circuit and equipment to be worked on and their location, including the upstream overcurrent protective device used for the arc flash risk assessment and its condition of maintenance

(2) (1) Justification for why the work must be performed in an energized condition [see 130.2(A)]

(3) Description of the safe work practices to be employed [see 130.3]

(4) Results of the shock risk assessment [see 130.4(A)]

(5) Voltage to which personnel will be exposed

(6) Limited approach boundary [see 130.4(B), Table 130.4(D)(a), and Table 130.4(D)(b)]

(7) Restricted approach boundary [see 130.4(B) and Table 130.4(D)(a) and Table 130.4(D)(b)]

(8) Necessary 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)(a), Table 130.7(C)(16), and 130.7(D)]

(9) Results of the arc flash risk assessment [see 130.5]

(10) Available incident energy at the working distance or arc flash PPE category [see 130.5]

(11) Necessary PPE to protect against the hazard [see 130.5(C), 130.7(C), 130.7(C), 1 through (C)(16), Table 130.7(C)(15)(A)(a), Table 130.7(C)(16), and 130.7(D)]

(12) Arc flash boundary [see 130.5(B)]

(13) Means employed to restrict the access of unqualified persons from the work area [see 130.3 and 130.7(E)]

(14) Evidence of completion of a job briefing, including a discussion of any job-specific hazards [see 110.1(H)]

(15) Energized work approval (authorizing or responsible management, safety officer, or owner, etc.) signature(s)

Informational Note: For an example of an acceptable energized work permit, see Figure J.1.

Statement of Problem and Substantiation for Public Input

Three things are recommended here to improve clarity and usability. First, reverse the order of list items 1 and 2 in 130.2(b)(2) to make justification first and description of the circuit second since the justification for energized work is the first step of justified energized work. This will emphasize it is the first step in justified energized work and that you do not need to go further in the permit if you cannot answer item 1. Second, documenting where the upstream overcurrent protective device used for the arc flash risk assessment is recommended. Often only the OCPD in the equipment being worked on is considered when it is typically an upstream OCPD device that needs to be considered in the analysis and where the power must be shut off in case of an emergency. Third, add "and its condition of maintenance" to correlate what is required in 130.5 where condition of maintenance must be considered.

Submitter Information Verification

Submitter Full Name: Palmer Hickman
Organization: Electrical Training Alliance
Street Address:
City:
State:
Zip:
Submittal Date: Fri Feb 06 19:06:53 EST 2015
Public Input No. 40-NFPA 70E-2015 [ Section No. 130.2(B)(2) ]

(2)  Elements of Work Permit.
The energized electrical 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)  Justification for why the work must be performed in an energized condition [see 130.2(A)]

(3)  Description of the safe work practices to be employed [see 130.3]

(4)  Results of the shock risk assessment [see 130.4(A)]

(5)  Voltage to which personnel will be exposed

(6)  Limited approach boundary [see 130.4(B), Table 130.4(D)(a), and Table 130.4(D)(b)]

(7)  Restricted approach boundary [see 130.4(B), Table 130.4(D)(a), and Table 130.4(D)(b)]

(8)  Necessary 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)(a), Table 130.7(C)(16), and 130.7(D)]

(9)  Results of the arc flash risk assessment [see 130.5]

(10) Available incident energy at the working distance

   a. or arc flash PPE category [see 130.5]

   b. Necessary PPE to protect against the hazard [see 130.5(C), 130.7(C) (1) through (C)(16), Table 130.7(C)(15)(A)(a), Table 130.7(C)(16), and 130.7(D)]

   c. Arc flash boundary [see 130.5(B)]

(11) Means employed to restrict the access of unqualified persons from the work area [see 130.3]

(12) Evidence of completion of a job briefing, including a discussion of any job-specific hazards [see 110.1(H)]

(13) Energized work approval (authorizing or responsible management, safety officer, or owner, etc.) signature(s)

Informational Note: For an example of an acceptable energized work permit, see Figure J.1.

Statement of Problem and Substantiation for Public Input

This recommendation is one of two that are interdependent. This recommendation removes "at the working distance" with a companion PI to add it on a separate line in this subdivision. The problem that would be resolved is to identify the working distance both when it is calculated and when it is obtained from the arc flash PPE category table.

Submitter Information Verification

Submitter Full Name: PALMER HICKMAN
Organization: ELECTRICAL TRAINING ALLIANCE
Street Address:
City:
State:
Zip:
Submittal Date: Sat Feb 07 10:46:27 EST 2015
Public Input No. 421-NFPA 70E-2015 [Section No. 130.2(B)(2)]

(2) Elements of Work Permit.

The energized electrical 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) Justification for why the work must be performed in an energized condition [see 130.2(A)]

(3) Description of the safe work practices to be employed [see 130.3]

(4) Results of the shock risk assessment [see 130.4(A)]

(5) Voltage to which personnel will be exposed

(6) Limited approach boundary, [see 130.4(B) , Table 130.4(D)(a) , and Table 130.4(D)(b) ]

(7) Restricted approach boundary, [see 130.4(B) , and Table 130.4(D)(a) , and Table 130.4(D)(b) ]

(8) Prohibited approach boundary, [see 130.4(B) , and Table 130.4(D)(a) and Table 130.4(D)(b) ]

(9) Necessary 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)(a) , Table 130.7(C)(16) , and 130.7(D)]

(10) Results of the arc flash risk assessment [see 130.5]

(11) Available incident energy at the working distance or arc flash PPE category, [see 130.5 ]

(12) Necessary PPEs protect against the hazard [see 130.5(C) , 130.7(C) (1) through (C)(16), Table 130.7(C)(15)(A)(a) , Table 130.7(C)(16) , and 130.7(D)]

(13) Arc flash boundary, [see 130.5(B) ]

(14) Means employed to restrict the access of unqualified persons from the work area [see 130.3]

(15) Evidence of completion of a job briefing, including a discussion of any job-specific hazards [see 110.1(H)]

(16) Energized work approval (authorizing or responsible management, safety officer, or owner, etc.) signature(s)

Informational Note: For an example of an acceptable energized work permit, see Figure J.1.

Statement of Problem and Substantiation for Public Input

The elimination of the Prohibited Approach Boundary creates a dangerous situation in managing work performed on uninsulated energized conductors. There is a difference between working near uninsulated energized conductors and intentionally touching them. The hazard (and the risk) is greater. OSHA, in Section 1910.333(c)(2), requires persons working on energized equipment to have knowledge in special precautionary techniques. While not defined by OSHA, OSHA recognizes the difference between working on and working near.

The Committee removed the Prohibited Approach Boundary because there were no additional requirements for working within the Prohibited Approach Boundary. The committee should have corrected that issue instead of removing the boundary. Many companies are utilizing the Energized Electrical Work Permit for working within the Limited Approach Boundary, as the 2012 Edition of NFPA 70E recommended. Additionally, companies have developed separate permitting requirements for working ON uninsulated energized conductors. By removing the Prohibited Approach Boundary has set up a situation where many people are removing any requirements associated with “working on”. This will increase the number of “working on” tasks that will be performed and increase injuries associated with it. By removing this boundary the committee has inadvertently condoned “working on” by stating there are no additional requirements for performing “working on”. The arc flash hazard has not been considered in this. If the task exposes a person to an arc flash hazard the hazard to the hands is considerably higher than to other parts of the body that are further away from the arcing point. (See related PI 415)

Submitter Information Verification

Submitter Full Name: DANNY LIGGETT
Organization: THE DUPONT COMPANY INC
Affiliation: Self
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Sun Jul 05 14:07:08 EDT 2015
(2) Elements of Work Permit.
The energized electrical 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 job to be done

(3) Justification for why the work must be performed in an energized condition [see 130.2(A)]

(4) Description of the safe work practices to be employed [see 130.3]

(5) Results of the shock risk assessment [see 130.4(A)]

(6) Voltage to which personnel will be exposed

(7) Limited approach boundary [see 130.4(B), Table 130.4(D)(a), and Table 130.4(D)(b)]

(8) Restricted approach boundary [see 130.4(B), Table 130.4(D)(a), and Table 130.4(D)(b)]

(9) Necessary 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)(a), Table 130.7(C)(16), and 130.7(D)]

(10) Results of the arc flash risk assessment [see 130.5]

(11) Available incident energy at the working distance or arc flash PPE category [see 130.5]

(12) Necessary PPE to protect against the hazard [see 130.5(C), 130.7(C) (1) through (C)(16), Table 130.7(C)(15)(A)(a), Table 130.7(C)(16), and 130.7(D)]

(13) Arc flash boundary [see 130.6(B)]

(14) Means employed to restrict the access of unqualified persons from the work area [see 130.3]

(15) Evidence of completion of a job briefing, including a discussion of any job-specific hazards [see 110.1(H)]

(16) Energized work approval (authorizing or responsible management, safety officer, or owner, etc.) signature(s)

Informational Note: For an example of an acceptable energized work permit, see Figure J.1.

Statement of Problem and Substantiation for Public Input

This new list item 2 is necessary because 130.2(B), as currently written, does not require a description of the job to be done. It is shown in Informative Annex J.

Submitter Information Verification

Submitter Full Name: VINCENT SAPORITA
Organization: Eaton Bussmann Division
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jul 06 11:06:55 EDT 2015
Public Input No. 510-NFPA 70E-2015 [ New Section after 130.2(B)(3) ]

130.2(B)(4) New
The completed energized electrical work permit shall be documented.

Statement of Problem and Substantiation for Public Input
The word "written" was used in the 2012 edition in 130.2(B)(1). The details of the permit need to be documented to help ensure they have been completed.

Submitter Information Verification
Submitter Full Name: PAUL DOBROWSKY
Organization: INNOVATIVE TECHNOLOGY SERVICES
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Mon Jul 06 14:44:20 EDT 2015
Public Input No. 127-NFPA 70E-2015 [ Section No. 130.2(B)(3) ]

(3) Exemptions to Work Permit.
An energized electrical work permit shall not be required if a qualified person is provided with and uses appropriate safe work practices and PPE in accordance with Chapter 1 under any of the following conditions:

1. Testing, troubleshooting, and voltage measuring
2. Thermography and visual inspections if the restricted approach boundary is not crossed
3. Access to and egress from an area with energized electrical equipment if no electrical work is performed and the restricted approach boundary is not crossed
4. General housekeeping and miscellaneous non-electrical tasks if the restricted approach boundary is not crossed
5. Voltage is less than 50 Volts AC, or 100 Volts DC.

Statement of Problem and Substantiation for Public Input

“50 Volts exception” lost in 70E-2015 which previously existed which would now require for instance an energized work permit to disconnect or connect leads to batteries which is clearly not the intent. This proposal reintroduces the 50 Volts AC (100 Volts DC) cutoff.

Submitter Information Verification

Submitter Full Name: Paul Campbell
Organization: PotashCorp Aurora
Street Address:
City:
State:
Zip:
Submittal Date: Mon Apr 13 17:41:37 EDT 2015
(3) Exemptions to Work Permit.
An energized electrical work permit shall not be required if a qualified person is provided with and uses appropriate safe work practices and PPE in accordance with Chapter 1 under any of the following conditions:

(1) Testing, troubleshooting, and voltage measuring
(2) Thermography and visual inspections if the restricted approach boundary is not crossed
(3) Access to and egress from an area with energized electrical equipment if no electrical work is performed and the restricted approach boundary is not crossed
(4) General housekeeping and miscellaneous non-electrical tasks if the restricted approach boundary is not crossed.
(5) Tasks necessary to place or remove equipment from an electrically safe working condition.

Statement of Problem and Substantiation for Public Input
Recent revisions have made it a requirement to issue an energized work permit in order to place equipment into an electrically safe work condition or to remove it from that state. Making the burden of de-energized work the same as energized work discourages de-energizing. The proposed exception encourages de-energized work whenever possible to do so by eliminating the need for an energized work permit.

Submitter Information Verification
Submitter Full Name: Paul Campbell
Organization: PotashCorp Aurora
Street Address:
City:
State:
Zip:
Submittal Date: Mon Apr 13 17:51:37 EDT 2015
(3) Exemptions to Work Permit.
An energized electrical work permit shall not be required if a qualified person is provided with and uses appropriate safe work practices and PPE in accordance with Chapter 1 under any of the following conditions:

(1) Testing, troubleshooting, and voltage measuring
(2) Thermography and visual inspections if the restricted approach boundary is not crossed
(3) Access to and egress from an area with energized electrical equipment if no electrical work is performed and the restricted approach boundary is not crossed
(4) General housekeeping and miscellaneous non-electrical tasks if the restricted approach boundary is not crossed
(5) Adjustment, monitoring, or data retrieval or equipment or components that does not require the removal of covers or doors

Statement of Problem and Substantiation for Public Input
Adjust or data retrieval of PLCs and similar devices cannot be accomplished conveniently under the existing standard. Making program changes, adjusting parameters, or data retrieval does not pose an electrical hazard that is higher than performing voltage measuring.

Submitter Information Verification
Submitter Full Name: Bryan Cole
Organization: TRC
Street Address:
City:
State:
Zip:
Submittal Date: Fri Jun 19 08:56:19 EDT 2015
Public Input No. 226-NFPA 70E-2015 [ Section No. 130.2(B)(3) ]

(3) Exemptions to Work Permit.
An energized electrical work permit shall not be required if a qualified person is provided with and uses appropriate safe work practices and PPE in accordance with Chapter 1 under any of the following conditions:

1. Testing, troubleshooting, and voltage measuring
2. Thermography and visual inspections, if the restricted approach boundary is not crossed
3. Access to and egress from an area with energized electrical equipment if no electrical work is performed, and the restricted approach boundary is not crossed
4. General housekeeping and miscellaneous non-electrical tasks, if the restricted approach boundary is not crossed

Statement of Problem and Substantiation for Public Input

What triggers the need for a permit is not where you are or the type equipment being worked on. What triggers the need for the permit is what type work is being performed, is there an increased likelihood of an incident while performing this work, and if an incident should occur, are the hazards great enough to cause injury to individuals. This revision is being submitted to revise the wording in Article 130.2(B)(3) to remove wording related to the restricted approach boundary. A companion PI to revise Article 130.2(B)(1) leaves the requirement for a permit anytime energized work is performed and removes text related to restricted approach boundary. Article 130.2(B)(3) provides exceptions to this requirement. Also, the existing text is not consistent with the information in Annex J, these revisions will correct that inconsistency. The information in Annex J represents the original intent of requiring an energized electrical work permit, and when one is, and is not required.

Submitter Information Verification

Submitter Full Name: DAVID PACE
Organization: OLIN CORPORATION
Affiliation: Self
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jun 22 17:47:32 EDT 2015
Public Input No. 403-NFPA 70E-2015 [Section No. 130.2(B)(3)]

<table>
<thead>
<tr>
<th>Exemptions to Work Permit</th>
</tr>
</thead>
<tbody>
<tr>
<td>An energized electrical work permit shall not be required if a qualified person is provided with and uses appropriate safe work practices and PPE in accordance with Chapter 1 under any of the following conditions:</td>
</tr>
<tr>
<td>(1) Testing, troubleshooting, and or voltage measuring</td>
</tr>
<tr>
<td>(2) Thermography and or visual inspections if the restricted approach boundary is not crossed</td>
</tr>
<tr>
<td>(3) Access to and egress from an area with energized electrical equipment if no electrical work is performed and the restricted approach boundary is not crossed</td>
</tr>
<tr>
<td>(4) General housekeeping and miscellaneous non-electrical tasks if the restricted approach boundary is not crossed</td>
</tr>
</tbody>
</table>

Statement of Problem and Substantiation for Public Input

Grammar / clarity:
Change “and” for “or” in sections 1 & 2. “And” would appear to require that the employee meet all of conditions in point 1 (for example) in order to satisfy the requirement that one of the points (1, 2, 3 or 4) be met. “Or” would allow one of the activities contained in that point to satisfy the overall requirement.

Submitter Information Verification

Submitter Full Name: TIM ROHRER
Organization: EXISCAN LLC
Affiliation: Exiscan LLC
Street Address: City: State:
Zip: Submittal Date: Sat Jul 04 14:15:35 EDT 2015
Public Input No. 404-NFPA 70E-2015 [ Section No. 130.2(B)(3) ]

(3) Exemptions to Work Permit.

An energized electrical work permit shall not be required if a qualified person is provided with and uses appropriate safe work practices and PPE in accordance with Chapter 1 under any of the following conditions:

1. Testing, troubleshooting, andor voltage measuring
2. Thermography, ultrasound or visual inspections if the restricted approach boundary is not crossed
3. Access to and egress from an area with energized electrical equipment if no electrical work is performed and the restricted approach boundary is not crossed
4. General housekeeping and miscellaneous non-electrical tasks if the restricted approach boundary is not crossed

Statement of Problem and Substantiation for Public Input

Clarification of technology:
Add ultrasound testing to the list with thermography and visual inspections. Ultrasound is a technology that is broadly used to detect corona, arcing and tracking (which an IR scan will not detect). The technology is used both as a condition monitoring tool, as is recommended in NFPA 70B and other relevant standards for maintenance. It is also used to enhance safety by detecting anomalies prior to entering the Restricted Approach Boundary. It is a totally passive technology (Like IR scans and visual inspection), and in and of itself does not increase the likelihood of triggering an arc. Addition of this technology to #2 provides clarification that this passive technology, that is part of routine maintenance procedures, should not require an EWP.

Submitter Information Verification

Submitter Full Name: TIM ROHRER
Organization: EXISCAN LLC
Affiliation: Exiscan LLC
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Sat Jul 04 14:17:40 EDT 2015
Public Input No. 422-NFPA 70E-2015 [Section No. 130.2(B)(3)]

(3) Exemptions to Work Permit.
An energized electrical work permit shall not be required if a qualified person is provided with and uses appropriate safe work practices and PPE in accordance with Chapter 1 under any of the following conditions:

(1) Testing, troubleshooting, and voltage measuring
(2) Thermography and visual inspections if the restricted approach boundary is not crossed
(3) Access to and egress from an area with energized electrical equipment if no electrical work is performed and the restricted approach boundary is not crossed
(4) General housekeeping and miscellaneous non-electrical tasks if the restricted approach boundary is not crossed

Statement of Problem and Substantiation for Public Input
Performing housekeeping tasks or other none electrical tasks with arm’s reach of exposed uninsulated conductors is hazardous. It is easy for the person to forget that there is an electrical hazard. Too many injuries and fatalities are a result of performing a task not related to the electrical hazards the person is exposed to. Requiring a permit for this work helps as a reminder of the hazards involved with being exposed to energized uninsulated conductors.

Submitter Information Verification
Submitter Full Name: DANNY LIGGETT
Organization: THE DUPONT COMPANY INC
Affiliation: Self
Street Address:
City:
State:
Zip:
Submittal Date: Sun Jul 05 14:17:59 EDT 2015
Public Input No. 456-NFPA 70E-2015 [ Section No. 130.2(B)(3) ]

(3) Exemptions to Work Permit.

An Electrical work shall be permitted without an energized electrical work permit shall not be required if a qualified person is provided with and uses appropriate safe work practices and PPE in accordance with Chapter 1 under any of the following conditions:

1. Testing, troubleshooting, and voltage measuring
2. Thermography and visual inspections if the restricted approach boundary is not crossed

(4) Non-Electrical Work, Access, and General Housekeeping. Non-Electrical Work shall be permitted without an energized electrical work permit under any of the following conditions:

1. Access to and egress from an area with energized electrical equipment if no electrical work is performed and the restricted limited approach boundary is not crossed
2. General housekeeping and miscellaneous non-electrical tasks if the restricted limited approach boundary is not crossed

Statement of Problem and Substantiation for Public Input

This proposal divides work into electrical work and non-electrical work. 130.2(B)(3)(3) becomes 130.2(B)(4)(1) and 130.2(B)(3)(4) becomes 130.2(B)(4)(2).

In addition the restricted approach boundary is changed to the limited approach boundary (in two places). 130.2(B)(3)(3) and (4) currently reference the restricted approach boundary. By definition, the restricted approach boundary is an approach distance limit from an exposed energized electrical conductor or circuit part. These two list items (3 and 4) reference access to or duties near electrical equipment that is closed (no exposed energized parts).

Submitter Information Verification

Submitter Full Name: VINCENT SAPORITA
Organization: Eaton Bussmann Division
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jul 06 11:36:18 EDT 2015
Public Input No. 52-NFPA 70E-2015 [ Section No. 130.2(B)(3) ]

(3) Exemptions to Work Permit.
An energized electrical work permit shall not be required if a qualified person is provided with and uses appropriate safe work practices and PPE in accordance with Chapter 1 under any of the following conditions:

(1) Testing, troubleshooting, and voltage measuring
(2) Thermography and visual inspections if the restricted approach boundary is not crossed. This activity does not include opening of doors or covers.
(3) Access to and egress from an area with energized electrical equipment if no electrical work is performed and the restricted approach boundary is not crossed
(4) General housekeeping and miscellaneous non-electrical tasks if the restricted approach boundary is not crossed

Statement of Problem and Substantiation for Public Input

Adding additional language to the Exemption to Work Permit, would clarify that removing panels or covers as it relates to thermography and visual inspections is two separate evolutions (a permit is required to for opening doors or covers) and provides correlation to the language in Table 130.7(C)(15)(A)(a)

Submitter Information Verification

Submitter Full Name: MIKE STANCIYC
Organization: MCPHEE ELECTRIC LTD
Street Address:
City:
State:
Zip:
Submittal Date: Thu Feb 12 10:23:25 EST 2015
Public Input No. 423-NFPA 70E-2015 [ Section No. 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 or within the Limited Approach Boundary of electrical conductors or circuit parts that have not been put into an electrically safe work condition. Unqualified persons shall be permitted to work within the Limited Approach Boundary of electrical conductors or circuit parts that have not been put into an electrically safe work condition as permitted in 130.4(C)(3).

Statement of Problem and Substantiation for Public Input

The current wording only tells part of the story and should include a reference to unqualified persons. A reference should be included to where the requirements are located for unqualified persons.

Submitter Information Verification

Submitter Full Name: DANNY LIGGETT
Organization: THE DUPONT COMPANY INC
Affiliation: Self
Street Address:
City:
State:
Zip:
Submittal Date: Sun Jul 05 14:36:28 EDT 2015
Public Input No. 425-NFPA 70E-2015 [New Section after 130.4]

(6) Prohibited Approach Boundary

Where there is a need for a qualified person to cross the prohibited approach boundary all of the requirements of entering the restricted approach boundary shall apply in addition to the following:

(1) The qualified person shall obtain line management approval for the performing the work

(2) The qualified person shall have training in performing tasks on energized uninsulated conductors and the safe work practices required to perform the task safely.

Statement of Problem and Substantiation for Public Input

This should be added to 130.4 as (E). The requirements added in (E) help to align the requirements of 70E with the requirements of OSHA. It is inappropriate for 70E not to address the requirements of OSHA.

The elimination of the Prohibited Approach Boundary creates a dangerous situation in managing work performed on uninsulated energized conductors. There is a difference between working near uninsulated energized conductors and intentionally touching them. The hazard (and the risk) is greater. OSHA, in Section 1910.333(c)(2), requires persons working on energized equipment to have knowledge in special precautionary techniques. While not defined by OSHA, OSHA recognizes the difference between on working on and working near.

The Committee removed the Prohibited Approach Boundary because there were no additional requirements for working within the Prohibited Approach Boundary. The committee should have corrected that issue instead of removing the boundary. Many companies are utilizing the Energized Electrical Work Permit for working within the Limited Approach Boundary, as the 2012 Edition of NFPA 70E recommended. Additionally, companies have developed separate permitting requirements for working ON uninsulated energized conductors. By removing the Prohibited Approach Boundary has set up a situation where many people are removing any requirements associated with "working on". This will increase the number of "working on" tasks that will be performed and increase injuries associated with it. By removing this boundary the committee has inadvertently condoned "working on" by stating there are no additional requirements for performing "working on". The arc flash hazard has not been considered in this. If the task exposes a person to an arc flash hazard the hazard to the hands is considerably higher than to other parts of the body that are further away from the arcing point. (See related PI-415, PI-421, PI-424)

Submitter Information Verification

Submitter Full Name: DANNY LIGGETT
Organization: THE DUPONT COMPANY INC
Affiliation: Self
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Sun Jul 05 15:05:40 EDT 2015
Public Input No. 8-NFPA 70E-2015 [ New Section after 130.4 ]

TITLE OF NEW CONTENT
130.4
(E) Documentation. The results of the shock risk assessment shall be documented.

Statement of Problem and Substantiation for Public Input

This recommendation would be consistent with what is required in 130.5(A) for arc flash risk assessment documentation and what is required by 130.2(B)(2)(4) related to “results of the shock risk assessment” required to be included on an energized electrical work permit.

Submitter Information Verification

Submitter Full Name: Palmer Hickman
Organization: Electrical Training Alliance
Street Address: 
City:  
State:  
Zip:  
Submittal Date: Tue Jan 20 17:32:12 EST 2015
130.4 Approach Boundaries to **Exposed** Energized Electrical Conductors or Circuit Parts for Shock Protection.

(A) Shock Risk Assessment.
A shock risk assessment shall determine the voltage to which personnel will be exposed, the boundary requirements, and the PPE necessary in order to minimize the possibility of electric shock to personnel.

(B) Shock Protection Boundaries.
The shock protection boundaries identified as limited approach boundary and restricted approach boundary shall be applicable **outside** for personnel approaching **personnel** exposed to energized electrical conductors or circuit parts. **Table 130.4(D)(a)** shall be used for the distances associated with various ac system voltages. **Table 130.4(D)(b)** shall be used for the distances associated with various dc system voltages.

Informational Note: In certain instances, the arc flash boundary might be a greater distance from the energized electrical conductors or circuit parts than the limited approach boundary. The shock protection boundaries and the arc flash boundary are independent of each other.

(C) Limited Approach Boundary.
<table>
<thead>
<tr>
<th>Nominal System Voltage Range, Phase to Phase&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Exposed Movable Conductor&lt;sup&gt;c&lt;/sup&gt;</th>
<th>Exposed Fixed Circuit Part</th>
<th>Restricted Approach Boundary&lt;sup&gt;b&lt;/sup&gt;; Includes Inadvertent Movement Adder</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50 V</td>
<td>Not specified</td>
<td>Not specified</td>
<td>Not specified</td>
</tr>
<tr>
<td>50 V–150 V&lt;sup&gt;d&lt;/sup&gt;</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 6 in.)</td>
<td>Avoid contact</td>
</tr>
<tr>
<td>151 V–750 V</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 6 in.)</td>
<td>0.3 m (1 ft 0 in.)</td>
</tr>
<tr>
<td>751 V–15 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
<td>0.7 m (2 ft 3 in.)</td>
</tr>
<tr>
<td>15 kV–36 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.8 m (6 ft 0 in.)</td>
<td>0.8 m (2 ft 7 in.)</td>
</tr>
<tr>
<td>36 kV–46 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>0.8 m (2 ft 9 in.)</td>
</tr>
<tr>
<td>46 kV–72.5 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>1.0 m (3 ft 3 in.)</td>
</tr>
<tr>
<td>72.6 kV–121 kV</td>
<td>3.3 m (10 ft 8 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>1.0 m (3 ft 4 in.)</td>
</tr>
<tr>
<td>138 kV–145 kV</td>
<td>3.4 m (11 ft 8 in.)</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.2 m (3 ft 10 in.)</td>
</tr>
<tr>
<td>161 kV–169 kV</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>1.3 m (4 ft 3 in.)</td>
</tr>
<tr>
<td>230 kV–242 kV</td>
<td>4.0 m (13 ft 0 in.)</td>
<td>4.0 m (13 ft 0 in.)</td>
<td>1.7 m (5 ft 6 in.)</td>
</tr>
<tr>
<td>345 kV–362 kV</td>
<td>4.7 m (15 ft 4 in.)</td>
<td>4.7 m (15 ft 4 in.)</td>
<td>2.8 m (9 ft 2 in.)</td>
</tr>
<tr>
<td>500 kV–550 kV</td>
<td>5.8 m (19 ft 0 in.)</td>
<td>5.8 m (19 ft 0 in.)</td>
<td>3.6 m (11 ft 10 in.)</td>
</tr>
<tr>
<td>765 kV–800 kV</td>
<td>7.2 m (23 ft 9 in.)</td>
<td>7.2 m (23 ft 9 in.)</td>
<td>4.9 m (15 ft 11 in.)</td>
</tr>
</tbody>
</table>

Note (1): For arc flash boundary, see 130.5(A).

Note (2): All dimensions are distance from exposed energized electrical conductors or circuit part to employee.

Note (3): The qualified person is insulated from any other conductive object.

Note (4): The qualified person is insulated from any other conductive object.

---

### Table 130.4(D)(b) Approach Boundaries to Exposed Energized Electrical Conductors or Circuit Parts for Shock Protection, Direct-Current Voltage Systems

<table>
<thead>
<tr>
<th>Nominal Potential Difference</th>
<th>Limited Approach Boundary</th>
<th>Restricted Approach Boundary; Includes Inadvertent Movement Adder</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100 V</td>
<td>Not specified</td>
<td>Not specified</td>
</tr>
<tr>
<td>100 V–300 V</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 6 in.)</td>
</tr>
<tr>
<td>301 V–1 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 6 in.)</td>
</tr>
<tr>
<td>1.1 kV–5 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
</tr>
<tr>
<td>5 kV–15 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
</tr>
<tr>
<td>15 kV–45 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
</tr>
<tr>
<td>45 kV–75 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
</tr>
<tr>
<td>75 kV–150 kV</td>
<td>3.3 m (10 ft 8 in.)</td>
<td>3.0 m (10 ft 0 in.)</td>
</tr>
<tr>
<td>150 kV–250 kV</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>3.6 m (11 ft 8 in.)</td>
</tr>
<tr>
<td>250 kV–500 kV</td>
<td>6.0 m (20 ft 0 in.)</td>
<td>6.0 m (20 ft 0 in.)</td>
</tr>
<tr>
<td>500 kV–800 kV</td>
<td>8.0 m (26 ft 0 in.)</td>
<td>8.0 m (26 ft 0 in.)</td>
</tr>
</tbody>
</table>

Note: All dimensions are distance from exposed energized electrical conductors or circuit parts to worker.

* Exposed movable conductor describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.
Statement of Problem and Substantiation for Public Input

The term "exposed" is added in the following locations as the reference is to shock hazards in general:
130.4 [Title]; Table 130.4(D)(a) [Title]; Table 130.4(D)(b) [Title]
The term "exposed" deleted in the following locations as it is inferred by the context:
130.4(D); 130.4(D)(1)
Section 130.4(B) is revised for clarity
The Task Group used the following principles when deciding whether or not to use "exposed" with "energized":
1. Required when referring to shock hazards in general;
2. Not required when "exposed" is inferred (i.e. preceded by qualifier "within the limited approach boundary of...");
3. Not required when referring to all electrical hazards or arc flash hazards.
This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the term "exposed" with the term "energized."

Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the term "exposed" with the term "energized."
Street Address: City:
State:
Zip:
Submittal Date: Fri Jun 26 13:58:34 EDT 2015
Public Input No. 339-NFPA 70E-2015 [ Section No. 130.4 ]

130.4 Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection

(A) Shock Risk Assessment General

A shock risk assessment shall

determine the

be performed to:

(1) Identify shock hazards;

(2) Estimate the likelihood of occurrence of injury or damage to health and the potential severity of injury or damage to health; and

(3) Determine if additional protective measures are required, including the use of PPE.

If additional protective measures are required, including the use of PPE, the following shall be identified:

(1) the voltage to which personnel will be exposed,

(2) the boundary requirements, and, the PPE necessary in order to minimize the possibility of electric shock to personnel.

(B) Documentation.

The results of the shock risk assessment shall be documented.

(C) Shock Protection Boundaries.

The shock protection boundaries identified as limited approach boundary and restricted approach boundary shall be applicable where approaching personnel are exposed to energized electrical conductors or circuit parts operating at voltages equal to or greater than 50 Vac or 100 Vdc. Table 130.4(D)(a) shall be used for the distances associated with various ac system voltages. Table 130.4(D)(b) shall be used for the distances associated with various dc system voltages.

Informational Note: In certain instances, the arc flash boundary might be a greater distance from the energized electrical conductors or circuit parts than the limited approach boundary. The shock protection boundaries and the arc flash boundary are independent of each other.

(C D) Limited Approach Boundary.
(1) Approach by Unqualified Persons.
   Unless permitted by 130.4(C)(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 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 him or her of the possible hazards and continuously escort the unqualified person(s) while inside the limited approach boundary. Under no circumstance shall the escorted unqualified person(s) be permitted to cross the restricted approach boundary.
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, voltages equal to or greater than 50 Vac or 100 Vdc, than the restricted approach boundary set forth in Table 130.4(D)(a) and Table 130.4(D)(b), unless one of the following conditions applies:

1. The qualified person is insulated or guarded from the energized electrical conductors or circuit parts operating at 50 volts or more voltages equal to or greater than 50 Vac or 100 Vdc. Insulating gloves or insulating gloves and sleeves are considered insulation only with regard to the energized parts upon which work is being performed.

2. The energized electrical conductors or circuit part operating at voltages equal to or greater than 50 Vac or 100 Vdc are insulated from the qualified person and from any other conductive object at a different potential.

3. The qualified person is insulated from any other conductive object.

Note: All dimensions are distance from exposed energized electrical conductors or circuit parts to employee.

Table 130.4(D)(a) Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection for Alternating-Current Systems

<table>
<thead>
<tr>
<th>Nominal System Voltage Range, Phase to Phase&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Limited Approach Boundary&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Restricted Approach Boundary&lt;sup&gt;d&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nominal Potential Difference</strong></td>
<td><strong>Exposed Movable Conductor&lt;sup&gt;c&lt;/sup&gt;</strong></td>
<td><strong>Exposed Fixed Circuit Part</strong></td>
</tr>
<tr>
<td>&lt;100 V</td>
<td>Not specified</td>
<td>Not specified</td>
</tr>
<tr>
<td>100 V–300 V</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 6 in.)</td>
</tr>
<tr>
<td>301 V–1 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 6 in.)</td>
</tr>
<tr>
<td>1.1 kV–5 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
</tr>
<tr>
<td>5 kV–15 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
</tr>
<tr>
<td>15.1 kV–45 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
</tr>
<tr>
<td>45.1 kV–75 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
</tr>
<tr>
<td>75.1 kV–150 kV</td>
<td>3.3 m (10 ft 8 in.)</td>
<td>3.0 m (10 ft 0 in.)</td>
</tr>
<tr>
<td>150.1 kV–250 kV</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>3.6 m (11 ft 8 in.)</td>
</tr>
<tr>
<td>250.1 kV–500 kV</td>
<td>6.0 m (20 ft 0 in.)</td>
<td>6.0 m (20 ft 0 in.)</td>
</tr>
<tr>
<td>500.1 kV–600 kV</td>
<td>8.0 m (26 ft 0 in.)</td>
<td>8.0 m (26 ft 0 in.)</td>
</tr>
</tbody>
</table>

Note: All dimensions are distance from exposed energized electrical conductors or circuit parts to employee.

Note (1): For arcing boundary, see 130.5(A).

Note (2): All dimensions are distance from exposed energized electrical conductors or circuit part to employee.

Note (3): The qualified person is insulated or guarded from the energized electrical conductors or circuit parts operating at 50 volts or more voltages equal to or greater than 50 Vac or 100 Vdc are insulated from the qualified person and from any other conductive object at a different potential.

Note (4): The qualified person is insulated from any other conductive object.

Table 130.4(D)(b) Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection, Direct-Current Voltage Systems

<table>
<thead>
<tr>
<th>Nominal Potential Difference</th>
<th>Limited Approach Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposed Movable Conductor&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Exposed Fixed Circuit Part</td>
</tr>
<tr>
<td>&lt;100 V</td>
<td>Not specified</td>
</tr>
<tr>
<td>100 V–300 V</td>
<td>3.0 m (10 ft 0 in.)</td>
</tr>
<tr>
<td>301 V–1 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
</tr>
<tr>
<td>1.1 kV–5 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
</tr>
<tr>
<td>5 kV–15 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
</tr>
<tr>
<td>15.1 kV–45 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
</tr>
<tr>
<td>45.1 kV–75 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
</tr>
<tr>
<td>75.1 kV–150 kV</td>
<td>3.3 m (10 ft 8 in.)</td>
</tr>
<tr>
<td>150.1 kV–250 kV</td>
<td>3.6 m (11 ft 8 in.)</td>
</tr>
<tr>
<td>250.1 kV–500 kV</td>
<td>6.0 m (20 ft 0 in.)</td>
</tr>
<tr>
<td>500.1 kV–600 kV</td>
<td>8.0 m (26 ft 0 in.)</td>
</tr>
</tbody>
</table>

Note: All dimensions are distance from exposed energized electrical conductors or circuit parts to worker.

Exposed movable conductor describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.
Statement of Problem and Substantiation for Public Input

This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.

This Public Input seeks to resolve several issues
The title of Article 130.4 is revised to shock risk assessment and the content is reorganized for two basic reasons:
(1) To reflect the full content of this section; and
(2) For consistency with the title of 130.5 Arc Flash Risk Assessment
Risk assessment content is added to 130.4(A) to align the requirements of this section with the definition of risk assessment in Article 100. The proposed wording in 130.4(A) is an adaptation of the risk assessment definition.
The abstract concepts of “PPE necessary to minimize…” in 130.4(A) second list item (3) replaced by the concrete phrase “required by this Standard.”
New section 130.4(B) Documentation is added for consistency with 130.5.
The “dc” gap is addressed by consistently revising the phrase “50 V or more” to “voltages equal to or greater than 50 Vac or 100 Vdc.”
An editorial revision is made for clarity in (3) Entering the Limited Approach Boundary.
The last sentence in Restricted Approach Boundary list item (1) is relocated to the end of the list items as it applies to all three list items.

Related Public Inputs for This Document

<table>
<thead>
<tr>
<th>Related Input</th>
<th>Relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Input No. 336-NFPA 70E-2015 [Section No. 130.2]</td>
<td>Revision of the phrase &quot;50 volts or more&quot; to &quot;operating at voltages equal to or greater than 50 Vac or 100 Vdc&quot;</td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Tue Jun 30 11:31:18 EDT 2015
(A) Shock Risk Assessment.
A shock risk assessment shall be performed and determine the following:
1) the voltage to which personnel will be exposed,
2) the shock protection boundary requirements, and
3) the PPE necessary in order to minimize the possibility of electric shock to personnel.

Statement of Problem and Substantiation for Public Input

The proposed change requires the shock risk assessment must be performed and is constant with arc flash risk assessment requirements in 130.5. Format changing for readability.

Submitter Information Verification

Submitter Full Name: JASON WOLF
Organization: ESCO GROUP
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jun 24 14:58:40 EDT 2015
Public Input No. 424-NFPA 70E-2015 [Section No. 130.4(B)]

(B) Shock Protection Boundaries.
The shock protection boundaries identified as limited approach boundary, restricted approach boundary and prohibited approach boundary shall be applicable where approaching personnel are exposed to energized electrical conductors or circuit parts. Table 130.4(D)(a) shall be used for the distances associated with various ac system voltages. Table 130.4(D)(b) shall be used for the distances associated with various dc system voltages.

Informational Note: In certain instances, the arc flash boundary might be a greater distance from the energized electrical conductors or circuit parts than the limited approach boundary. The shock protection boundaries and the arc flash boundary are independent of each other.

Statement of Problem and Substantiation for Public Input

The elimination of the Prohibited Approach Boundary creates a dangerous situation in managing work performed on uninsulated energized conductors. There is a difference between working near uninsulated energized conductors and intentionally touching them. The hazard (and the risk) is greater. OSHA, in Section 1910.333(c)(2), requires persons working on energized equipment to have knowledge in special precautionary techniques. While not defined by OSHA, OSHA recognizes the difference between working on and working near.

The Committee removed the Prohibited Approach Boundary because there were no additional requirements for working within the Prohibited Approach Boundary. The committee should have corrected that issue instead of removing the boundary. Many companies are utilizing the Energized Electrical Work Permit for working within the Limited Approach Boundary, as the 2012 Edition of NFPA 70E recommended. Additionally, companies have developed separate permitting requirements for working ON uninsulated energized conductors. By removing the Prohibited Approach Boundary has set up a situation where many people are removing any requirements associated with “working on”. This will increase the number of “working on” tasks that will be performed and increase injuries associated with it. By removing this boundary the committee has inadvertently condoned “working on” by stating there are no additional requirements for performing “working on”. The arc flash hazard has not been considered in this. If the task exposes a person to an arc flash hazard the hazard to the hands is considerably higher than to other parts of the body that are further away from the arcing point. (See related PI 415, PI-421)

Submitter Information Verification

Submitter Full Name: DANNY LIGGETT
Organization: THE DUPONT COMPANY INC
Affiliation: Self
Street Address:
City:
State:
Zip:
Submittal Date: Sun Jul 05 14:52:43 EDT 2015
### Table 130.4(D)(b) Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection, Direct-Current Voltage Systems

<table>
<thead>
<tr>
<th>Nominal System Voltage Range, Phase to Phase</th>
<th>Exposed Movable Conductor</th>
<th>Exposed Fixed Circuit Part</th>
<th>Restricted Approach Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>&lt;50 V</strong></td>
<td>Not specified</td>
<td>Not specified</td>
<td>Not specified</td>
</tr>
<tr>
<td>50 V–150 V</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 3 in.)</td>
<td>Avoid contact</td>
</tr>
<tr>
<td>151 V–750 V</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 3 in.)</td>
<td>0.3 m (1 ft 0 in.)</td>
</tr>
<tr>
<td>751 V–15 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
<td>0.7 m (2 ft 3 in.)</td>
</tr>
<tr>
<td>151 kV–36 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.8 m (6 ft 0 in.)</td>
<td>0.8 m (2 ft 7 in.)</td>
</tr>
<tr>
<td>361 kV–46 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>0.8 m (2 ft 9 in.)</td>
</tr>
<tr>
<td>461 kV–72.5 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>1.0 m (3 ft 3 in.)</td>
</tr>
<tr>
<td>72.6 kV–121 kV</td>
<td>3.3 m (10 ft 6 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>1.0 m (3 ft 4 in.)</td>
</tr>
<tr>
<td>138 kV–145 kV</td>
<td>3.4 m (11 ft 10 in.)</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.2 m (3 ft 10 in.)</td>
</tr>
<tr>
<td>161 kV–169 kV</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>1.3 m (4 ft 3 in.)</td>
</tr>
<tr>
<td>230 kV–242 kV</td>
<td>4.0 m (13 ft 0 in.)</td>
<td>4.0 m (13 ft 0 in.)</td>
<td>1.7 m (5 ft 8 in.)</td>
</tr>
<tr>
<td>345 kV–362 kV</td>
<td>4.7 m (15 ft 4 in.)</td>
<td>4.7 m (15 ft 4 in.)</td>
<td>2.8 m (9 ft 2 in.)</td>
</tr>
<tr>
<td>500 kV–550 kV</td>
<td>5.8 m (19 ft 0 in.)</td>
<td>5.8 m (19 ft 0 in.)</td>
<td>3.6 m (11 ft 10 in.)</td>
</tr>
<tr>
<td>785 kV–800 kV</td>
<td>7.2 m (23 ft 9 in.)</td>
<td>7.2 m (23 ft 9 in.)</td>
<td>4.9 m (15 ft 11 in.)</td>
</tr>
</tbody>
</table>

Note 1: For arc flash boundary, see 130.5(A).

Note 2: All dimensions are expressed in feet and inches unless specified in inches.

Note: All qualified persons 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(D)(a) and Table 130.4(D)(b), unless one of the following conditions applies:

1. The qualified person is insulated or guarded from the energized electrical conductors or circuit parts operating at 50 volts or more. Insulating gloves or insulating gloves and sleeves are considered insulation only with regard to the energized parts upon which work is being performed.

2. The qualified person is insulated from any other conductive object at a different potential.

3. The qualified person is insulated from any other conductive object.

4. The energized electrical conductors or circuit part operating at 50 volts or more are insulated from the qualified person and from any other conductive object at a different potential.

### Table 130.4(D)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.)

<table>
<thead>
<tr>
<th>Nominal System Voltage Range</th>
<th>Exposed Movable Conductors</th>
<th>Exposed Fixed Circuit Part</th>
<th>Restricted Approach Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50 V</td>
<td>Not specified</td>
<td>Not specified</td>
<td>Not specified</td>
</tr>
<tr>
<td>50 V–150 V</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 3 in.)</td>
<td>Avoid contact</td>
</tr>
<tr>
<td>151 V–750 V</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 3 in.)</td>
<td>0.3 m (1 ft 0 in.)</td>
</tr>
<tr>
<td>751 V–15 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
<td>0.7 m (2 ft 3 in.)</td>
</tr>
<tr>
<td>151 kV–36 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.8 m (6 ft 0 in.)</td>
<td>0.8 m (2 ft 7 in.)</td>
</tr>
<tr>
<td>361 kV–46 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>0.8 m (2 ft 9 in.)</td>
</tr>
<tr>
<td>461 kV–72.5 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>1.0 m (3 ft 3 in.)</td>
</tr>
<tr>
<td>72.6 kV–121 kV</td>
<td>3.3 m (10 ft 6 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>1.0 m (3 ft 4 in.)</td>
</tr>
<tr>
<td>138 kV–145 kV</td>
<td>3.4 m (11 ft 10 in.)</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.2 m (3 ft 10 in.)</td>
</tr>
<tr>
<td>161 kV–169 kV</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>1.3 m (4 ft 3 in.)</td>
</tr>
<tr>
<td>230 kV–242 kV</td>
<td>4.0 m (13 ft 0 in.)</td>
<td>4.0 m (13 ft 0 in.)</td>
<td>1.7 m (5 ft 8 in.)</td>
</tr>
<tr>
<td>345 kV–362 kV</td>
<td>4.7 m (15 ft 4 in.)</td>
<td>4.7 m (15 ft 4 in.)</td>
<td>2.8 m (9 ft 2 in.)</td>
</tr>
<tr>
<td>500 kV–550 kV</td>
<td>5.8 m (19 ft 0 in.)</td>
<td>5.8 m (19 ft 0 in.)</td>
<td>3.6 m (11 ft 10 in.)</td>
</tr>
<tr>
<td>785 kV–800 kV</td>
<td>7.2 m (23 ft 9 in.)</td>
<td>7.2 m (23 ft 9 in.)</td>
<td>4.9 m (15 ft 11 in.)</td>
</tr>
</tbody>
</table>

Note 1: For arc flash boundary, see 130.5(A).

Note 2: All dimensions are distance from energized electrical conductors or circuit parts to employee.

Note 3: For single-phase systems above 250V, select the range that is equal to the system's maximum phase-to-ground voltage multiplied by 1.732.

Note 4: See definition in Article 100 and text in 130.4(D)(2) and Informative Annex C for elaboration.

Note 5: Exposed movable conductors describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.

Note 6: This includes circuits where the exposure does not exceed 120V nominal.
Statement of Problem and Substantiation for Public Input

With the removal of the allowance to perform bare-hand live-line work in 2015, the need to describe the proper protection for this work is unnecessary. Similarly, there is not a need to describe what protection is necessary in Item 1 should a worker see a need to make contact with energized conductors. Making contact requires crossing the restricted approach boundary, which establishes PPE necessary to minimize the risk of contacting energized parts.

Submitter Information Verification

<table>
<thead>
<tr>
<th>Submitter Full Name</th>
<th>Bobby Gray</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization</td>
<td>Hoydar/Buck, Inc.</td>
</tr>
<tr>
<td>Affiliation</td>
<td>None</td>
</tr>
<tr>
<td>Street Address</td>
<td></td>
</tr>
<tr>
<td>City</td>
<td></td>
</tr>
<tr>
<td>State</td>
<td></td>
</tr>
<tr>
<td>Zip</td>
<td></td>
</tr>
<tr>
<td>Submittal Date</td>
<td>Tue Mar 31 17:23:12 EDT 2015</td>
</tr>
</tbody>
</table>
The phrase "operating at 50 volts or more" appearing several times in 130.4(D) creates confusion for DC voltages in the range of 50-99 volts because it refers to a Restricted Approach Boundary.
Approach Boundary that Table 130.4(D)(b) states does not exist. This discrepancy is eliminated by deleting this phrase in the three places where it appears and meets the intent that these requirements apply when the qualified person is within the Restricted Approach Boundary.

<table>
<thead>
<tr>
<th>Submitter Information Verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Submitter Full Name: JOSEPH KILAR</td>
</tr>
<tr>
<td>Organization:</td>
</tr>
<tr>
<td>Street Address:</td>
</tr>
<tr>
<td>City:</td>
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<td>State:</td>
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<tr>
<td>Zip:</td>
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<tr>
<td>Submittal Date: Sat Jun 20 10:43:43 EDT 2015</td>
</tr>
</tbody>
</table>

http://submittals.nfpa.org/TerraViewWeb/ContentFetcher?commentPartNo=5056
**Public Input No. 249-NFPA 70E-2015 [Section No. 130.4(D)]**

(D) **Restricted Approach Boundary.**

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(D)(a) and Table 130.4(D)(b), unless one of the following conditions applies:

1. The qualified person is insulated or guarded from the energized electrical conductors or circuit parts operating at 50 volts or more. Insulating gloves or insulating gloves and sleeves are considered protection 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 contact exposed energized electrical conductors or circuit parts, a combination of 130.4(D)(1), 130.4(D)(2), and 130.4(D)(3) shall be used to protect the uninsulated body parts.

2. The energized electrical conductors or circuit part operating at 50 volts or more are insulated from the qualified person and from any other conductive object at a different potential.

3. The qualified person is insulated from any other conductive object.

Table 130.4(D)(a) **Approach Boundaries to Exposed 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).**

<table>
<thead>
<tr>
<th>Nominal System Voltage Range, Phase to Phase&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Exposed Movable Conductor&lt;sup&gt;c&lt;/sup&gt;</th>
<th>Exposed Fixed Circuit Part</th>
<th>Limited Approach Boundary&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Restricted Approach Boundary: Includes Inadvertent Movement Adder</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50 V</td>
<td>Not specified</td>
<td>Not specified</td>
<td>Not specified</td>
<td></td>
</tr>
<tr>
<td>50 V–150 V&lt;sup&gt;d&lt;/sup&gt;</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 4 in.)</td>
<td>Avoid contact</td>
<td></td>
</tr>
<tr>
<td>151 V–750 V</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 4 in.)</td>
<td>0.3 m (1 ft 0 in.)</td>
<td></td>
</tr>
<tr>
<td>751 V–15 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
<td>0.7 m (2 ft 2 in.)</td>
<td></td>
</tr>
<tr>
<td>15.1 kV–36 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.8 m (6 ft 0 in.)</td>
<td>0.8 m (2 ft 7 in.)</td>
<td></td>
</tr>
<tr>
<td>36.1 kV–46 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>0.8 m (2 ft 7 in.)</td>
<td></td>
</tr>
<tr>
<td>46.1 kV–72.5 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>1.0 m (3 ft 3 in.)</td>
<td></td>
</tr>
<tr>
<td>72.6 kV–121 kV</td>
<td>3.3 m (10 ft 10 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>1.0 m (3 ft 4 in.)</td>
<td></td>
</tr>
<tr>
<td>138 kV–145 kV</td>
<td>3.4 m (11 ft 2 in.)</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.2 m (3 ft 10 in.)</td>
<td></td>
</tr>
<tr>
<td>161 kV–169 kV</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>1.3 m (4 ft 3 in.)</td>
<td></td>
</tr>
<tr>
<td>230 kV–242 kV</td>
<td>4.0 m (13 ft 2 in.)</td>
<td>4.0 m (13 ft 2 in.)</td>
<td>1.7 m (5 ft 7 in.)</td>
<td></td>
</tr>
<tr>
<td>345 kV–362 kV</td>
<td>4.7 m (15 ft 5 in.)</td>
<td>4.7 m (15 ft 5 in.)</td>
<td>2.8 m (9 ft 2 in.)</td>
<td></td>
</tr>
<tr>
<td>500 kV–550 kV</td>
<td>5.8 m (19 ft 0 in.)</td>
<td>5.8 m (19 ft 0 in.)</td>
<td>3.6 m (11 ft 10 in.)</td>
<td></td>
</tr>
<tr>
<td>765 kV–800 kV</td>
<td>7.2 m (23 ft 8 in.)</td>
<td>7.2 m (23 ft 8 in.)</td>
<td>4.9 m (15 ft 11 in.)</td>
<td></td>
</tr>
</tbody>
</table>

Note 1<sup>1</sup>: For arc flash boundary, see 130.5(A).

Note 2<sup>2</sup>: All dimensions are distance from exposed energized electrical conductors or circuit part to employee.

<sup>a</sup> For single-phase systems above 250V, select the range that is equal to the system’s maximum phase-to-ground voltage multiplied by 1.732.

<sup>b</sup> See definition in Article 100 and text in 130.4(D)(2) and Informative Annex C for elaboration.

<sup>c</sup> Exposed movable conductors describes a condition in which the distance is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.

<sup>d</sup> This includes circuits where the exposure does not exceed 120V nominal.

Table 130.4(D)(b) **Approach Boundaries to Exposed Energized Electrical Conductors or Circuit Parts for Shock Protection, Direct-Current Voltage Systems.**

<table>
<thead>
<tr>
<th>Nominal Potential Difference</th>
<th>Exposed Movable Conductor&lt;sup&gt;c&lt;/sup&gt;</th>
<th>Exposed Fixed Circuit Part</th>
<th>Limited Approach Boundary&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Restricted Approach Boundary: Includes Inadvertent Movement Adder</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100 V</td>
<td>Not specified</td>
<td>Not specified</td>
<td>Not specified</td>
<td></td>
</tr>
<tr>
<td>100 V–300 V</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 6 in.)</td>
<td>Avoid contact</td>
<td></td>
</tr>
<tr>
<td>301 V–1 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 6 in.)</td>
<td>0.3 m (1 ft 0 in.)</td>
<td></td>
</tr>
<tr>
<td>1.1 kV–5 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
<td>0.5 m (1 ft 9 in.)</td>
<td></td>
</tr>
<tr>
<td>5 kV–15 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
<td>0.7 m (2 ft 3 in.)</td>
<td></td>
</tr>
<tr>
<td>15.1 kV–45 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>0.8 m (2 ft 9 in.)</td>
<td></td>
</tr>
<tr>
<td>45.1 kV–75 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>1.0 m (3 ft 2 in.)</td>
<td></td>
</tr>
<tr>
<td>75.1 kV–150 kV</td>
<td>3.3 m (10 ft 10 in.)</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.2 m (4 ft 6 in.)</td>
<td></td>
</tr>
<tr>
<td>150.1 kV–250 kV</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>1.6 m (5 ft 3 in.)</td>
<td></td>
</tr>
<tr>
<td>250.1 kV–500 kV</td>
<td>6.0 m (20 ft 0 in.)</td>
<td>6.0 m (20 ft 0 in.)</td>
<td>3.5 m (11 ft 6 in.)</td>
<td></td>
</tr>
<tr>
<td>500.1 kV–800 kV</td>
<td>8.0 m (26 ft 0 in.)</td>
<td>8.0 m (26 ft 0 in.)</td>
<td>5.0 m (16 ft 5 in.)</td>
<td></td>
</tr>
</tbody>
</table>

Note: All dimensions are distance from exposed energized electrical conductors or circuit parts to worker.

<sup>1</sup> Exposed movable conductor describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.

---

**Statement of Problem and Substantiation for Public Input**

Shock protection boundaries exist for exposed energized electrical conductors or circuit parts only. Moving this information from the note, and into the Title, will increase the...
usability and understanding of the standard. The definition for exposed exists in article 100.

Submitter Information Verification

Submitter Full Name: DARYLD CROW
Organization: DRC CONSULTING LTD
Affiliation: TG for article 130.4 and 130.5
Street Address:
City:
State:
Zip:
Submittal Date: Fri Jun 26 10:39:34 EDT 2015
Statement of Problem and Substantiation for Public Input

Table 130.4(D)(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.):

<table>
<thead>
<tr>
<th>Nominal System Voltage Range, Phase to Phasea</th>
<th>Exposed Movable Conductorc</th>
<th>Exposed Fixed Circuit Part</th>
<th>Restricted Approach Boundaryb; Includes Inadvertent Movement Adderb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td>Class 2</td>
<td>Class 3</td>
<td>Class 4</td>
</tr>
<tr>
<td>&lt;50 V</td>
<td>Not specified</td>
<td>Not specified</td>
<td>Not specified</td>
</tr>
<tr>
<td>50 V–150 Vd</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 6 in.)</td>
<td>Avoid contact</td>
</tr>
<tr>
<td>151 V–750 V</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 6 in.)</td>
<td>0.3 m (1 ft 0 in.)</td>
</tr>
<tr>
<td>751 V–15 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
<td>0.7 m (2 ft 3 in.)</td>
</tr>
<tr>
<td>15 kV–36 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.8 m (6 ft 0 in.)</td>
<td>0.8 m (2 ft 7 in.)</td>
</tr>
<tr>
<td>36 kV–46 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>0.8 m (2 ft 9 in.)</td>
</tr>
<tr>
<td>46 kV–72.5 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>1.0 m (3 ft 3 in.)</td>
</tr>
<tr>
<td>72.6 kV–121 kV</td>
<td>3.3 m (10 ft 10 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>1.0 m (3 ft 4 in.)</td>
</tr>
<tr>
<td>138 kV–145 kV</td>
<td>3.4 m (11 ft 0 in.)</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.2 m (3 ft 10 in.)</td>
</tr>
<tr>
<td>161 kV–169 kV</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>1.3 m (4 ft 3 in.)</td>
</tr>
<tr>
<td>230 kV–242 kV</td>
<td>4.0 m (13 ft 0 in.)</td>
<td>4.0 m (13 ft 0 in.)</td>
<td>1.7 m (5 ft 6 in.)</td>
</tr>
<tr>
<td>345 kV–362 kV</td>
<td>4.7 m (15 ft 4 in.)</td>
<td>4.7 m (15 ft 4 in.)</td>
<td>2.8 m (9 ft 2 in.)</td>
</tr>
<tr>
<td>500 kV–550 kV</td>
<td>5.8 m (19 ft 0 in.)</td>
<td>5.8 m (19 ft 0 in.)</td>
<td>3.6 m (11 ft 10 in.)</td>
</tr>
<tr>
<td>765 kV–800 kV</td>
<td>7.2 m (23 ft 9 in.)</td>
<td>7.2 m (23 ft 9 in.)</td>
<td>4.9 m (15 ft 11 in.)</td>
</tr>
</tbody>
</table>

Note (1): For arc flash boundary, see 130.5(A).
Note (2): All dimensions are distance from exposed energized electrical conductors or circuit part to employee.

a For single-phase systems above 250V, select the range that is equal to the system's maximum phase-to-ground voltage multiplied by 1.732.

b See definition in Article 100 and text in 130.4(D)(2) and Informative Annex C for elaboration.

c Exposed movable conductors describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.

d This includes circuits where the exposure does not exceed 120V nominal.

Table 130.4(D)(b) Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection, Direct-Current Voltage Systems:

<table>
<thead>
<tr>
<th>Nominal Potential Difference</th>
<th>Limited Approach Boundary</th>
<th>Restricted Approach Boundary; Includes Inadvertent Movement Adderb</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Exposed Movable Conductorc</td>
<td>Exposed Fixed Circuit Part</td>
</tr>
<tr>
<td></td>
<td>Class 1</td>
<td>Class 2</td>
</tr>
<tr>
<td>&lt;100 V</td>
<td>Not specified</td>
<td>Not specified</td>
</tr>
<tr>
<td>100 V–300 V</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 6 in.)</td>
</tr>
<tr>
<td>301 V–1 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 6 in.)</td>
</tr>
<tr>
<td>1.1 kV–5 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
</tr>
<tr>
<td>5 kV–15 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
</tr>
<tr>
<td>15 kV–45 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
</tr>
<tr>
<td>45 kV–75 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
</tr>
<tr>
<td>75 kV–150 kV</td>
<td>3.3 m (10 ft 10 in.)</td>
<td>3.0 m (10 ft 0 in.)</td>
</tr>
<tr>
<td>150.1 kV–250 kV</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>3.6 m (11 ft 8 in.)</td>
</tr>
<tr>
<td>250 kV–500 kV</td>
<td>6.0 m (20 ft 0 in.)</td>
<td>6.0 m (20 ft 0 in.)</td>
</tr>
<tr>
<td>500 kV–800 kV</td>
<td>8.0 m (26 ft 0 in.)</td>
<td>8.0 m (26 ft 0 in.)</td>
</tr>
</tbody>
</table>

Note: All dimensions are distance from exposed energized electrical conductors or circuit part to worker.

* Exposed movable conductor describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.
This change is required to add clarification and readability.

Submitter Information Verification

Submitter Full Name: DARYLD CROW
Organization: DRC CONSULTING LTD
Affiliation: TG for articles 130.4 and 130.5
Street Address:
City:
State:
Zip:
Submittal Date: Fri Jun 26 13:34:58 EDT 2015
Public Input No. 27-NFPA 70E-2015 [ Section No. 130.4(D) ]

(D) Restricted Approach Boundary.

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(D)(a) and Table 130.4(D)(b), unless one of the following conditions applies:

1. The qualified person is insulated or guarded from the energized electrical conductors or circuit parts operating at 50 volts or more. Insulating gloves or insulating gloves and 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 contact exposed energized electrical conductors or circuit parts, a combination of 130.4(D)(1), 130.4(D)(2), and 130.4(D)(3) shall be used to protect the uninsulated body parts.

2. The energized electrical conductors or circuit part operating at 50 volts or more are insulated from the qualified person and from any other conductive object at a different potential.

3. The qualified person is insulated from any other conductive object.

Table 130.4(D)(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.)

<table>
<thead>
<tr>
<th>Nominal System Voltage Range, Phase to Phase</th>
<th>Limited Approach Boundary a</th>
<th>Exposed Movable Conductor c</th>
<th>Exposed Fixed Circuit Part</th>
<th>Restricted Approach Boundary b ; Includes Inadvertent Movement Adder</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50 V Not specified Not specified Not specified</td>
<td>Avoid contact</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50 V–150 V b</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 6 in.)</td>
<td>0.3 m (1 ft 0 in.)</td>
<td></td>
</tr>
<tr>
<td>151 V–750 V</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
<td>0.7 m (2 ft 3 in.)</td>
<td></td>
</tr>
<tr>
<td>751 V–15 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.8 m (6 ft 0 in.)</td>
<td>0.8 m (2 ft 7 in.)</td>
<td></td>
</tr>
<tr>
<td>15.1 kV–36 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>0.8 m (2 ft 9 in.)</td>
<td></td>
</tr>
<tr>
<td>36.1 kV–46 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>1.0 m (3 ft 3 in.)</td>
<td></td>
</tr>
<tr>
<td>46.1 kV–72.5 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>1.0 m (3 ft 3 in.)</td>
<td></td>
</tr>
<tr>
<td>72.6 kV–121 kV</td>
<td>3.3 m (10 ft 10 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>1.0 m (3 ft 4 in.)</td>
<td></td>
</tr>
<tr>
<td>138 kV–145 kV</td>
<td>3.4 m (11 ft 3 in.)</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.2 m (3 ft 10 in.)</td>
<td></td>
</tr>
<tr>
<td>161 kV–169 kV</td>
<td>3.6 m (11 ft 10 in.)</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>1.3 m (4 ft 3 in.)</td>
<td></td>
</tr>
<tr>
<td>230 kV–242 kV</td>
<td>4.0 m (13 ft 10 in.)</td>
<td>4.0 m (13 ft 10 in.)</td>
<td>1.7 m (5 ft 6 in.)</td>
<td></td>
</tr>
<tr>
<td>345 kV–362 kV</td>
<td>4.7 m (15 ft 4 in.)</td>
<td>4.7 m (15 ft 4 in.)</td>
<td>2.8 m (9 ft 2 in.)</td>
<td></td>
</tr>
<tr>
<td>500 kV–550 kV</td>
<td>5.8 m (19 ft 0 in.)</td>
<td>5.8 m (19 ft 0 in.)</td>
<td>3.6 m (11 ft 10 in.)</td>
<td></td>
</tr>
<tr>
<td>765 kV–800 kV</td>
<td>7.2 m (23 ft 9 in.)</td>
<td>7.2 m (23 ft 9 in.)</td>
<td>4.9 m (16 ft 1 in.)</td>
<td></td>
</tr>
</tbody>
</table>

Note(1): For arc flash boundary, see 130.5(A).

Note (2): All dimensions are distance from exposed energized electrical conductors or circuit part to employee.

a For single-phase systems above 250V, select the range that is equal to the system’s maximum phase-to-ground voltage multiplied by 1.732.

b See definition in Article 100 and text in 130.4(D)(2) and Informative Annex C for elaboration.

c Exposed movable conductor describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.

d This includes circuits where the exposure does not exceed 120V nominal.

Table 130.4(D)(b) Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection, Direct-Current Voltage Systems

<table>
<thead>
<tr>
<th>Nominal Potential Difference</th>
<th>Limited Approach Boundary</th>
<th>Exposed Movable Conductor c</th>
<th>Exposed Fixed Circuit Part</th>
<th>Restricted Approach Boundary; Includes Inadvertent Movement Adder</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100 V Not specified Not specified</td>
<td>Not specified</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 V–300 V</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 6 in.)</td>
<td>0.3 m (1 ft 0 in.)</td>
<td>Avoid contact</td>
</tr>
<tr>
<td>301 V–1 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
<td>0.7 m (2 ft 3 in.)</td>
<td></td>
</tr>
<tr>
<td>1.1 kV–5 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
<td>0.7 m (2 ft 3 in.)</td>
<td></td>
</tr>
<tr>
<td>5 kV–15 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>0.8 m (2 ft 7 in.)</td>
<td></td>
</tr>
<tr>
<td>15 kV–45 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>1.0 m (3 ft 2 in.)</td>
<td></td>
</tr>
<tr>
<td>45 kV–75 kV</td>
<td>3.3 m (10 ft 10 in.)</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.2 m (4 ft 0 in.)</td>
<td></td>
</tr>
<tr>
<td>75 kV–150 kV</td>
<td>3.6 m (11 ft 10 in.)</td>
<td>3.6 m (11 ft 10 in.)</td>
<td>1.6 m (5 ft 3 in.)</td>
<td></td>
</tr>
<tr>
<td>150 kV–250 kV</td>
<td>6.0 m (20 ft 0 in.)</td>
<td>6.0 m (20 ft 0 in.)</td>
<td>3.5 m (11 ft 8 in.)</td>
<td></td>
</tr>
<tr>
<td>250 kV–500 kV</td>
<td>8.0 m (26 ft 0 in.)</td>
<td>8.0 m (26 ft 0 in.)</td>
<td>5.0 m (16 ft 5 in.)</td>
<td></td>
</tr>
</tbody>
</table>

Note: All dimensions are distance from exposed energized electrical conductors or circuit parts to worker.

e Exposed movable conductor describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.

Statement of Problem and Substantiation for Public Input

Document clarity
The standard does not address shock protection under 50 volts.

Submitter Information Verification

Submitter Full Name: Drake Drobnick
Organization: [ Not Specified ]
Affiliation: N/A
Street Address:
City:
State:
Zip:
Submittal Date: Sun Feb 01 19:07:41 EST 2015

http://submittals.nfpa.org/TerraViewWeb/ContentFetcher?commentPara...
Public Input No. 405-NFPA 70E-2015 [ Section No. 130.4(D) ]

(D) Restricted Approach Boundary.

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. Where exposed, energized electrical conductors or circuit parts are operating at 50 volts or more, no qualified or unqualified person shall approach or take any conductive object closer than the restricted approach boundary set forth in Table 130.4(D)(a) and Table 130.4(D)(b), unless one of the following conditions applies:

1. The qualified person is insulated from any other conductive object at a different potential.
2. The energized electrical conductors or circuit part operating at 50 volts or more are insulated from the qualified person and from any other conductive object.

Table 130.4(D)(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.)

<table>
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<tr>
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<th>Exposed Movable Conductor</th>
<th>Exposed Fixed Circuit Part</th>
<th>Restricted Approach Boundaryb, Includes inadvertent movement Adder</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50 V (d)</td>
<td>Not specified</td>
<td>Not specified</td>
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</tr>
<tr>
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<td>3.0 m (10 ft 0 in.)</td>
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Note(1): For arc flash boundary, see 130.5(A).

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<table>
<thead>
<tr>
<th>Nominal Potential Difference</th>
<th>Limited Approach Boundary</th>
<th>Restricted Approach Boundary: Includes inadvertent movement Adder</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100 V</td>
<td>Not specified</td>
<td>Not specified</td>
</tr>
<tr>
<td>100 V–300 V</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 6 in.)</td>
</tr>
<tr>
<td>301 V–1 kV</td>
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</tr>
<tr>
<td>1.1 kV–5 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
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</tr>
<tr>
<td>5 kV–15 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
</tr>
<tr>
<td>15.1 kV–45 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
</tr>
<tr>
<td>45.1 kV–75 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
</tr>
<tr>
<td>75.1 kV–150 kV</td>
<td>3.3 m (10 ft 10 in.)</td>
<td>3.0 m (10 ft 0 in.)</td>
</tr>
<tr>
<td>150.1 kV–250 kV</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>3.6 m (11 ft 8 in.)</td>
</tr>
<tr>
<td>250.1 kV–500 kV</td>
<td>6.0 m (20 ft 0 in.)</td>
<td>6.0 m (20 ft 0 in.)</td>
</tr>
<tr>
<td>500.1 kV–600 kV</td>
<td>8.0 m (26 ft 0 in.)</td>
<td>8.0 m (26 ft 0 in.)</td>
</tr>
</tbody>
</table>

Note: All dimensions are distance from exposed energized electrical conductors or circuit parts to worker.

Exposed movable conductor describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.
### Clarification and readability

**Submitter Information Verification**

<table>
<thead>
<tr>
<th>Field</th>
<th>Information</th>
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<tbody>
<tr>
<td>Submitter Full Name</td>
<td>TIM ROHRER</td>
</tr>
<tr>
<td>Organization</td>
<td>EXISCAN LLC</td>
</tr>
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<td>Affiliation</td>
<td>Exiscan LLC</td>
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<td>Sat Jul 04 14:24:59 EDT 2015</td>
</tr>
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</table>
Public Input No. 426-NFPA 70E-2015 [Section No. 130.4(D)]

See next page for proposed change

exposed energized electrical conductors or circuit parts operating at 50 volts or more than 130.4(D)(b), unless one of the following conditions applies:

(1) The qualified person is insulated or guarded from the energized electrical conductors or circuit parts operating at 50 volts or more. Insulating gloves or insulating gloves and 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 contact exposed energized electrical conductors or circuit parts, a combination of 130.4(D)(1), 130.4(D)(2), and 130.4(D)(3) shall be used to protect the uninsulated body parts.

(2) The energized electrical conductors or circuit part operating at 50 volts or more are isolated from the qualified person and from any other conductive object at a different potential.

(3) The qualified person is insulated from any other conductive object.

### Table 130.4

Add new Table 130.3 (D)(a)

Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection, Alternating-Current Systems (All dimensions are distance from energized electrical conductor or circuit part to employee.

<table>
<thead>
<tr>
<th>Nominal Potential</th>
<th>Limited Approach Boundary</th>
<th>Restricted Approach Boundary: Includes Inadvertent Movement Adder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difference</td>
<td>Exposed Movable Conductor</td>
<td>Exposed Fixed Circuit Part</td>
</tr>
<tr>
<td>&lt;100 V</td>
<td>Not specified</td>
<td>Not specified</td>
</tr>
<tr>
<td>100 V–300 V</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 3 in.)</td>
</tr>
<tr>
<td>301 V–1 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 3 in.)</td>
</tr>
<tr>
<td>1.1 kV–5 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
</tr>
<tr>
<td>5 kV–15 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
</tr>
<tr>
<td>15.1 kV–45 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
</tr>
<tr>
<td>45.1 kV–75 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
</tr>
<tr>
<td>75.1 kV–150 kV</td>
<td>3.3 m (10 ft 10 in.)</td>
<td>3.0 m (10 ft 0 in.)</td>
</tr>
<tr>
<td>150.1 kV–250 kV</td>
<td>3.6 m (11 ft 10 in.)</td>
<td>3.6 m (11 ft 8 in.)</td>
</tr>
<tr>
<td>250.1 kV–500 kV</td>
<td>6.0 m (20 ft 0 in.)</td>
<td>6.0 m (20 ft 0 in.)</td>
</tr>
<tr>
<td>500.1 kV–800 kV</td>
<td>8.0 m (26 ft 0 in.)</td>
<td>8.0 m (26 ft 0 in.)</td>
</tr>
</tbody>
</table>

Note: All dimensions are distance from exposed energized electrical conductors or circuit parts to worker.

* Exposed movable conductor describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.

### Additional Proposed Changes

<table>
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<tr>
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<th>Description</th>
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<tr>
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<td>New Proposed Table 130.4</td>
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</tr>
</tbody>
</table>

### Statement of Problem and Substantiation for Public Input

The elimination of the Prohibited Approach Boundary creates a dangerous situation in managing work performed on uninsulated energized conductors. There is a difference between working near uninsulated energized conductors and intentionally touching them. The hazard (and the risk) is greater. OSHA, in Section 1910.333(c), requires persons working on energized equipment to have knowledge in special precautionary techniques. While not defined by OSHA, OSHA recognizes the difference between on working on energized electrical conductor or circuit parts operating at 50 volts or more than 130.4(D)(b), unless one of the following conditions applies:

(1) The qualified person is insulated or guarded from the energized electrical conductors or circuit parts operating at 50 volts or more. Insulating gloves or insulating gloves and 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 contact exposed energized electrical conductors or circuit parts, a combination of 130.4(D)(1), 130.4(D)(2), and 130.4(D)(3) shall be used to protect the uninsulated body parts.

(2) The energized electrical conductors or circuit part operating at 50 volts or more are insulated from the qualified person and from any other conductive object at a different potential.

(3) The qualified person is insulated from any other conductive object.

The committee removed the Prohibited Approach Boundary because there were no additional requirements for working within the Prohibited Approach Boundary. The committee should have corrected that issue instead of removing the boundary. Many companies are utilizing the Energized Electrical Work Permit for working within the Limited Approach Boundary, as the 2012 Edition of NFPA 70E recommended. Additionally, companies have developed separate permitting requirements for working ON uninsulated energized conductors. By removing the Prohibited Approach Boundary, the committee has inadvertently codified “working on” by stating there are no additional requirements for performing “working on.” The arc flash hazard has not been considered in this. If the task exposes a person to an
The arc flash hazard to the hands is considerably higher than to other parts of the body that are further away from the arcing point. (See related PI 415, PI-421, PI-424, PI-425)

Submitter Information Verification

Submitter Full Name: DANNY LIGGETT
Organization: THE DUPONT COMPANY INC
Affiliation: Self
Street Address:
City:
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Zip:
Submittal Date: Sun Jul 05 15:55:12 EDT 2015
Public Input No. 427-NFPA 70E-2015 [Section No. 130.4(D)]

(D) Restricted Approach Boundary.

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(D)(a) and Table 130.4(D)(b), unless one of the following conditions applies:

1. The qualified person is insulated or guarded from the energized electrical conductors or circuit parts operating at 50 volts or more. Insulating gloves or insulated gloves and 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 contact exposed energized electrical conductors or circuit parts, a combination of 130.4(D)(1), 130.4(D)(2), and 130.4(D)(3) shall be used to protect the uninsulated body parts.

2. The energized electrical conductors or circuit part operating at 50 volts or more are insulated from the qualified person and from any other conductive object at a different potential.

3. The qualified person is insulated from any other conductive object.

Table 130.4(D)(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.)

<table>
<thead>
<tr>
<th>Nominal System Voltage Range, Phase to Phase \footnote{(a)}</th>
<th>Exposed Movable Conductor\footnote{(c)}</th>
<th>Exposed Fixed Circuit Part</th>
<th>Restricted Approach Boundary\footnote{(b)}; Includes Inadvertent Movement Adder</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50 V \footnote{(d)}</td>
<td>Not specified</td>
<td>Not specified</td>
<td>Not specified</td>
</tr>
<tr>
<td>50 V–150 V \footnote{(d)}</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 0 in.)</td>
<td>Avoid contact</td>
</tr>
<tr>
<td>151 V–750 V</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 0 in.)</td>
<td>0.3 m (1 ft 0 in.)</td>
</tr>
<tr>
<td>751 V–15 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
<td>0.7 m (2 ft 2 in.)</td>
</tr>
<tr>
<td>15.1 kV–36 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.8 m (6 ft 0 in.)</td>
<td>0.8 m (2 ft 7 in.)</td>
</tr>
<tr>
<td>36.1 kV–46 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 2 in.)</td>
<td>0.8 m (2 ft 7 in.)</td>
</tr>
<tr>
<td>46.1 kV–72.5 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>1.0 m (3 ft 3 in.)</td>
</tr>
<tr>
<td>72.6 kV–121 kV</td>
<td>3.3 m (10 ft 8 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>1.0 m (3 ft 3 in.)</td>
</tr>
<tr>
<td>138 kV–145 kV</td>
<td>3.4 m (11 ft 0 in.)</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.2 m (3 ft 10 in.)</td>
</tr>
<tr>
<td>161 kV–169 kV</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>1.3 m (4 ft 3 in.)</td>
</tr>
<tr>
<td>230 kV–242 kV</td>
<td>4.0 m (13 ft 0 in.)</td>
<td>4.0 m (13 ft 0 in.)</td>
<td>1.7 m (5 ft 8 in.)</td>
</tr>
<tr>
<td>345 kV–362 kV</td>
<td>4.7 m (15 ft 4 in.)</td>
<td>4.7 m (15 ft 4 in.)</td>
<td>2.8 m (9 ft 2 in.)</td>
</tr>
<tr>
<td>500 kV–550 kV</td>
<td>5.8 m (19 ft 0 in.)</td>
<td>5.8 m (19 ft 0 in.)</td>
<td>3.6 m (11 ft 10 in.)</td>
</tr>
<tr>
<td>765 kV–800 kV</td>
<td>7.2 m (23 ft 9 in.)</td>
<td>7.2 m (23 ft 9 in.)</td>
<td>4.9 m (15 ft 11 in.)</td>
</tr>
</tbody>
</table>

Note (1): For arc flash boundary, see 130.5(A).

Note (2): All dimensions are distance from exposed energized electrical conductors or circuit part to employee.

\footnote{(a)} For single-phase systems above 250V, select the range that is equal to the system’s maximum phase-to-ground voltage multiplied by 1.732.

\footnote{(b)} See definition in Article 100 and text in 130.4(D)(2) and Informative Annex C for elaboration.

\footnote{(c)} Exposed movable conductors describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.

\footnote{(d)} This includes circuits where the exposure does not exceed 120V nominal.

Table 130.4(D)(b) Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection, Direct-Current Voltage Systems

<table>
<thead>
<tr>
<th>Nominal System Voltage Range, Phase to Phase</th>
<th>Exposed Movable Conductor</th>
<th>Exposed Fixed Circuit Part</th>
<th>Restricted Approach Boundary; Includes Inadvertent Movement Adder</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100 V</td>
<td>Not specified</td>
<td>Not specified</td>
<td>Not specified</td>
</tr>
<tr>
<td>100 V–300 V \footnote{(e)}</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 3 in.)</td>
<td>Avoid contact</td>
</tr>
<tr>
<td>301 V–1 kV \footnote{(f)}</td>
<td>4.0 m (13 ft 0 in.)</td>
<td>1.5 m (4 ft 11 in.)</td>
<td>1.7 m (5 ft 7 in.)</td>
</tr>
<tr>
<td>1 kV–3 kV \footnote{(f)}</td>
<td>4.7 m (15 ft 4 in.)</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.8 m (9 ft 2 in.)</td>
</tr>
<tr>
<td>3 kV–10 kV \footnote{(f)}</td>
<td>5.8 m (19 ft 0 in.)</td>
<td>3.6 m (11 ft 10 in.)</td>
<td>3.6 m (11 ft 10 in.)</td>
</tr>
<tr>
<td>10 kV–30 kV \footnote{(f)}</td>
<td>7.2 m (23 ft 9 in.)</td>
<td>7.2 m (23 ft 9 in.)</td>
<td>4.9 m (15 ft 11 in.)</td>
</tr>
</tbody>
</table>

Note (1): For single-phase systems above 250V, select the range that is equal to the system’s maximum phase-to-ground voltage multiplied by 1.732.

Note (2): The qualified person is insulated or guarded from the energized electrical conductors or circuit parts operating at 50 volts or more. Insulating gloves or insulated gloves and 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 contact exposed energized electrical conductors or circuit parts, a combination of 130.4(D)(1), 130.4(D)(2), and 130.4(D)(3) shall be used to protect the uninsulated body parts.

Note (3): The energized electrical conductors or circuit part operating at 50 volts or more are insulated from the qualified person and from any other conductive object at a different potential.

Note (4): The qualified person is insulated from any other conductive object.

Statement of Problem and Substantiation for Public Input

Delete Table 130.4(D)(b). This table is redundant. Tables (a) and (b) should be combined to have one table. This makes it simple and easier to remember distances and to manage. Having two different table just makes things more complicated than is needed.

Submitter Information Verification

Submitter Full Name: DANNY LIGGETT
Organization: THE DUPONT COMPANY INC
Affiliation: Self
Street Address: 
City: 
State: 
Zip: 
Submit Date: Sun Jul 05 16:00:55 EDT 2015
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(D)(a) and Table 130.4(D)(b), unless one of the following conditions applies:

1. The qualified person is insulated or guarded from the energized electrical conductors or circuit parts operating at 50 volts or more. Insulating gloves or insulating gloves and 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 contact exposed energized electrical conductors or circuit parts, a combination of 130.4(D)(1), 130.4(D)(2), and 130.4(D)(3) shall be used to protect the uninsulated body parts.

2. The energized electrical conductors or circuit part operating at 50 volts or more are insulated from the qualified person and from any other conductive object at a different potential.

3. The qualified person is insulated from any other conductive object.

Table 130.4(D)(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.)

<table>
<thead>
<tr>
<th>Nominal System Voltage Range, Phase to Phase</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50 V</td>
<td>Not specified</td>
<td>Not specified</td>
<td>Not specified</td>
<td>Avoid contact</td>
</tr>
<tr>
<td>50 V–150 V</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 6 in.)</td>
<td>0.8 m (2 ft 9 in.)</td>
<td></td>
</tr>
<tr>
<td>151 V–750 V</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
<td>0.7 m (2 ft 2 in.)</td>
<td></td>
</tr>
<tr>
<td>751 V–15 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.8 m (6 ft 0 in.)</td>
<td>0.8 m (2 ft 7 in.)</td>
<td></td>
</tr>
<tr>
<td>5.1 kV–15 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>0.8 m (2 ft 9 in.)</td>
<td></td>
</tr>
<tr>
<td>6.1 kV–7.25 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>1.0 m (3 ft 3 in.)</td>
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</tr>
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<td>7.26 kV–12 kV</td>
<td>3.3 m (10 ft 8 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>1.0 m (3 ft 3 in.)</td>
<td></td>
</tr>
<tr>
<td>13.8 kV–145 kV</td>
<td>3.4 m (11 ft 0 in.)</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.2 m (3 ft 10 in.)</td>
<td></td>
</tr>
<tr>
<td>161 kV–169 kV</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>1.3 m (4 ft 3 in.)</td>
<td></td>
</tr>
<tr>
<td>230 kV–242 kV</td>
<td>4.0 m (13 ft 0 in.)</td>
<td>4.0 m (13 ft 0 in.)</td>
<td>1.7 m (5 ft 8 in.)</td>
<td></td>
</tr>
<tr>
<td>345 kV–362 kV</td>
<td>4.7 m (15 ft 4 in.)</td>
<td>4.7 m (15 ft 4 in.)</td>
<td>2.8 m (9 ft 2 in.)</td>
<td></td>
</tr>
<tr>
<td>500 kV–550 kV</td>
<td>5.8 m (19 ft 0 in.)</td>
<td>5.8 m (19 ft 0 in.)</td>
<td>3.6 m (11 ft 10 in.)</td>
<td></td>
</tr>
<tr>
<td>765 kV–800 kV</td>
<td>7.2 m (23 ft 9 in.)</td>
<td>7.2 m (23 ft 9 in.)</td>
<td>4.9 m (15 ft 11 in.)</td>
<td></td>
</tr>
</tbody>
</table>

Note (1): For arc flash boundary, see 130.5(A).

Note (2): All dimensions are distance from exposed energized electrical conductors or circuit part to employee.

a For single-phase systems above 250V, select the range that is equal to the system’s maximum phase-to-ground voltage multiplied by 1.732.

b See definition in Article 100 and text in 130.4(D)(2) and Informative Annex C for elaboration.

c Exposed movable conductors describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.

d This includes circuits where the exposure does not exceed 120V nominal.

Table 130.4(D)(b) Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection, Direct-Current Voltage Systems

<table>
<thead>
<tr>
<th>Nominal System Voltage Range</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50 V</td>
<td>Not specified</td>
<td>Not specified</td>
<td>Not specified</td>
<td>Avoid contact</td>
</tr>
<tr>
<td>10–51 V</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 6 in.)</td>
<td>0.3 m (1 ft 0 in.)</td>
<td></td>
</tr>
<tr>
<td>301 V–1 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
<td>0.7 m (2 ft 2 in.)</td>
<td></td>
</tr>
<tr>
<td>1.1 kV–5 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>1.0 m (3 ft 2 in.)</td>
<td></td>
</tr>
<tr>
<td>5 kV–15 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.2 m (4 ft 0 in.)</td>
<td></td>
</tr>
<tr>
<td>15.1 kV–45 kV</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>1.6 m (5 ft 3 in.)</td>
<td></td>
</tr>
<tr>
<td>45.1 kV–75 kV</td>
<td>6.0 m (20 ft 0 in.)</td>
<td>6.0 m (20 ft 0 in.)</td>
<td>3.5 m (11 ft 6 in.)</td>
<td></td>
</tr>
<tr>
<td>75.1 kV–150 kV</td>
<td>8.0 m (26 ft 0 in.)</td>
<td>8.0 m (26 ft 0 in.)</td>
<td>5.0 m (16 ft 5 in.)</td>
<td></td>
</tr>
</tbody>
</table>

Note: All dimensions are distance from exposed energized electrical conductors or circuit parts to worker.

c Exposed movable conductor describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.
hazardous. Until OSHA revises their stance on this issue NFPA 70E needs to be aligned with the OSHA requirements.

Submitter Information Verification

Submitter Full Name: DANNY LIGGETT
Organization: THE DUPONT COMPANY INC
Affiliation: Self
Street Address:
City:
State:
Zip:
Submittal Date: Sun Jul 05 16:11:49 EDT 2015
During the last revision cycle the 50 volt threshold for shock boundaries was changed to 100 volts for direct current systems. This was done with very little debate and was normally applied to overhead line conductors supported by poles.

Table 130.4(Da) 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.)

Table 130.4(Db) Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection, Direct-Current Voltage Systems

Note (1): For arc flash boundary, see 130.5(A).
Note (2): All dimensions are distance from exposed energized electrical conductors or circuit part to employee.

a For single-phase systems above 250V, select the range that is equal to the system's maximum phase-to-ground voltage multiplied by 1.732.
b See definition in Article 100 and text in 130.4(D)(2) and Informative Annex C for elaboration.
c Exposed movable conductors describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is
d normally applied to overhead line conductors supported by poles.
d This includes circuits where the exposure does not exceed 120V nominal.

Statement of Problem and Substantiation for Public Input

During the last revision cycle the 50 volt threshold for shock boundaries was changed to 100 volts for direct current systems. This was done with very little debate and was
changed based upon limited information. It would be prudent to revisit this issue.

To start off a comparison should be made between NFPA 70, NFPA 70E and the OSHA documents to see how each standard treats this issue. It is important that the 70E committee consider this when reviewing this public input.

With regard to alternating current systems both 70, 70E and OSHA are steadfast with the 50 volts boundary. However, as we turn to the increasing use of direct current systems the demarcation is all over the board.

The National Electrical Code references both 50 volts and 60 volts dc in various sections. From my research the 60 volts nomenclature was changed within certain sections to account for the float voltage of battery systems since 99% of the time direct current systems operate over 50 volts. “60 volts dc” would eliminate any misapplication by both AHJ’s and users of the code. The other sections of the NEC that remain at “50 volts dc” do so since public input has not been submitted to resolve this conflict.

The 70E committee reviewed the issue during the prior revision cycle and raised the shock boundary to 100 volts. While this may very well be the correct boundary condition having three different demarcation points across various NFPA and OSHA standards only maintains continued confusion. This public input recommends that the 100 volts be lowered to 60 volts dc to account for the float voltage and correlate with the national electrical code and other standards. There are very few if any products that operate between 60 volts and 100 volts so there would be little to no harm in lowering this voltage.

Submitter Information Verification

Submitter Full Name: LAWRENCE AYER
Organization: BIZ COM ELECTRIC INC
Affiliation: IEC
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jul 06 10:48:38 EDT 2015
Public Input No. 457-NFPA 70E-2015 [Section No. 130.4(D)]

See the next page for proposed Revision

(1) Restricted Approach Boundary.
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(D)(a) and Table 130.4(D)(b), unless one of the following conditions applies:

1. The qualified person is insulated or guarded from the energized electrical conductors or circuit parts operating at 50 volts or more. Insulating gloves or insulated gloves and 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 contact exposed energized electrical conductors or circuit parts, a combination of 130.4(D)(1), 130.4(D)(2), and 130.4(D)(3) shall be used to protect the uninsulated body parts.

2. The energized electrical conductors or circuit parts operating at 50 volts or more are insulated from the qualified person and from any other conductive object at a different potential.

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Table 130.4(D)(a) Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection, Direct-Current Voltage Systems (All dimensions are distance from energized electrical conductor or circuit part to employee.)

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<tr>
<th>Nominal System Voltage Range, Phase to Phase</th>
<th>Exposed Movable Conductor</th>
<th>Exposed Fixed Circuit Part</th>
<th>Restricted Approach Boundaryb, Includes Inadvertent Movement Adder</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50 V</td>
<td>Not specified</td>
<td>Not specified</td>
<td>Not specified</td>
</tr>
<tr>
<td>50 V–150 V</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 6 in.)</td>
<td>Avoid contact</td>
</tr>
<tr>
<td>151 V–750 V</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 6 in.)</td>
<td>0.3 m (1 ft 0 in.)</td>
</tr>
<tr>
<td>751 V–15 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
<td>0.7 m (2 ft 2 in.)</td>
</tr>
<tr>
<td>15.1 kV–36 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.8 m (6 ft 0 in.)</td>
<td>0.8 m (2 ft 7 in.)</td>
</tr>
<tr>
<td>36.1 kV–46 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>0.8 m (2 ft 9 in.)</td>
</tr>
<tr>
<td>46.1 kV–72.5 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>1.0 m (3 ft 3 in.)</td>
</tr>
<tr>
<td>72.6 kV–121 kV</td>
<td>3.3 m (10 ft 11 in.)</td>
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<td>1.0 m (3 ft 4 in.)</td>
</tr>
<tr>
<td>138 kV–145 kV</td>
<td>3.4 m (11 ft 0 in.)</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.2 m (3 ft 10 in.)</td>
</tr>
<tr>
<td>161 kV–169 kV</td>
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<td>1.3 m (4 ft 2 in.)</td>
</tr>
<tr>
<td>230 kV–242 kV</td>
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<td>1.7 m (5 ft 8 in.)</td>
</tr>
<tr>
<td>345 kV–362 kV</td>
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<td>2.8 m (9 ft 2 in.)</td>
</tr>
<tr>
<td>500 kV–550 kV</td>
<td>5.8 m (19 ft 0 in.)</td>
<td>5.8 m (19 ft 0 in.)</td>
<td>3.6 m (11 ft 10 in.)</td>
</tr>
<tr>
<td>765 kV–800 kV</td>
<td>7.2 m (23 ft 9 in.)</td>
<td>7.2 m (23 ft 9 in.)</td>
<td>4.9 m (15 ft 11 in.)</td>
</tr>
</tbody>
</table>

Note (1): For arc flash boundary, see 130.5(A).

Note (2): All dimensions are distance from exposed energized electrical conductors or circuit part to employee.

Note (3): For single-phase systems above 250V, select the range that is equal to the system's maximum phase-to-ground voltage multiplied by 1.732.

Note (4): See definition in Article 100 and text in 130.4(D)(2) and Informative Annex C for elaboration.

Additional Proposed Changes

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
<th>Approved</th>
</tr>
</thead>
</table>

NFPA 70E - A2017 FD Meeting Agenda Page 276
(D) Restricted Approach Boundary.

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(D)(a) and Table 130.4(D)(b), unless one of the following conditions applies:

1. The qualified person is insulated or guarded from the energized electrical conductors or circuit parts operating at 50 volts or more. Insulating gloves or insulating gloves and 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 contact exposed energized electrical conductors or circuit parts, a combination of 130.4(D)(1), 130.4(D)(2), and 130.4(D)(3) shall be used to protect the uninsulated body parts.

2. The qualified electrical conductors or circuit part operating at 50 volts or more are insulated from the qualified person and from any other conductive object at a different potential.

3. The qualified person is insulated from any other conductive object.

Table 130.4(D)(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.)

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<thead>
<tr>
<th>Nominal System Voltage Range, Phase to Phase</th>
<th>Limited Approach Boundary&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Exposed Movable Conductor&lt;sup&gt;c&lt;/sup&gt;</th>
<th>Exposed Fixed Circuit Part</th>
<th>Restricted Approach Boundary&lt;sup&gt;b&lt;/sup&gt;; Includes Inadvertent Movement Adder</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50 V</td>
<td>Not specified</td>
<td>Not specified</td>
<td>Not specified</td>
<td></td>
</tr>
<tr>
<td>50 V–150 V</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 6 in.)</td>
<td>0.3 m (1 ft 0 in.)</td>
<td></td>
</tr>
<tr>
<td>151 V–750 V</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 6 in.)</td>
<td>0.7 m (2 ft 2 in.)</td>
<td></td>
</tr>
<tr>
<td>751 V–15 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
<td>0.8 m (2 ft 6 in.)</td>
<td></td>
</tr>
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<td>3.0 m (10 ft 0 in.)</td>
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<td>0.8 m (2 ft 7 in.)</td>
<td></td>
</tr>
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<td>3.0 m (10 ft 0 in.)</td>
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<td>0.8 m (2 ft 9 in.)</td>
<td></td>
</tr>
<tr>
<td>46.1 kV–72.5 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>1.0 m (3 ft 3 in.)</td>
<td></td>
</tr>
<tr>
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<td>3.3 m (10 ft 8 in.)</td>
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<td></td>
</tr>
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<td></td>
</tr>
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<td>161 kV–169 kV</td>
<td>3.6 m (11 ft 8 in.)</td>
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<td>1.3 m (4 ft 3 in.)</td>
<td></td>
</tr>
<tr>
<td>230 kV–242 kV</td>
<td>4.0 m (13 ft 0 in.)</td>
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<td>1.7 m (5 ft 8 in.)</td>
<td></td>
</tr>
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<td>345 kV–362 kV</td>
<td>4.7 m (15 ft 8 in.)</td>
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</table>

Note(1): For arc flash boundary, see 130.5(A).
Note (2): All dimensions are distance from exposed energized electrical conductors or circuit part to employee.
Note (3): For single-phase systems above 250V, select the range that is equal to the system’s maximum phase-to-ground voltage multiplied by 1.732.
Note (4): See definition in Article 100 and text in 130.4(D)(2) and Informative Annex C for elaboration.
Exposed movable conductors describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.

Table 130.4(D)(b) Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection, Direct-Current Voltage Systems

<table>
<thead>
<tr>
<th>Nominal Potential Difference</th>
<th>Limited Approach Boundary&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Exposed Movable Conductor&lt;sup&gt;c&lt;/sup&gt;</th>
<th>Exposed Fixed Circuit Part</th>
<th>Restricted Approach Boundary; Includes Inadvertent Movement Adder</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100 V</td>
<td>Not specified</td>
<td>Not specified</td>
<td>Not specified</td>
<td></td>
</tr>
<tr>
<td>100 V–300 V</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 6 in.)</td>
<td>0.3 m (1 ft 0 in.)</td>
<td></td>
</tr>
<tr>
<td>301 V–1 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 6 in.)</td>
<td>0.3 m (1 ft 0 in.)</td>
<td></td>
</tr>
<tr>
<td>1.1 kV–5 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
<td>0.5 m (1 ft 8 in.)</td>
<td></td>
</tr>
<tr>
<td>5 kV–15 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
<td>0.7 m (2 ft 2 in.)</td>
<td></td>
</tr>
<tr>
<td>15.1 kV–45 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>0.8 m (2 ft 9 in.)</td>
<td></td>
</tr>
<tr>
<td>45.1 kV–75 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>1.0 m (3 ft 2 in.)</td>
<td></td>
</tr>
<tr>
<td>75.1 kV–150 kV</td>
<td>3.3 m (10 ft 8 in.)</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.2 m (4 ft 0 in.)</td>
<td></td>
</tr>
<tr>
<td>150.1 kV–250 kV</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>1.6 m (5 ft 3 in.)</td>
<td></td>
</tr>
<tr>
<td>250.1 kV–500 kV</td>
<td>6.0 m (20 ft 0 in.)</td>
<td>6.0 m (20 ft 0 in.)</td>
<td>3.5 m (11 ft 6 in.)</td>
<td></td>
</tr>
<tr>
<td>500.1 kV–800 kV</td>
<td>8.0 m (26 ft 0 in.)</td>
<td>8.0 m (26 ft 0 in.)</td>
<td>5.0 m (16 ft 5 in.)</td>
<td></td>
</tr>
</tbody>
</table>

Note: All dimensions are distance from exposed energized electrical conductors or circuit parts to worker.

Exposed movable conductor describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.
Statement of Problem and Substantiation for Public Input

Addition of note (E), using language extracted from 29 CFR 1910.269 Appendix B, paragraph II, subparagraph B. (last sentence), would provide a link to the OSHA requirement for the usage of [voltage rated] rubber insulating gloves for those qualified workers who are “avoiding contact”, but may have inadvertent contact. The restricted approach boundary has the inadvertent movement adder included for voltage ranges greater than 150 V, but not within the range of 50V - 150 V. The justification for no inadvertent movement adder appears to come from: [70E - 2015 Informational Annex C - C.2.1.4 Column 4 text concerning “less than or equal to” 300 V: Avoid contact. Based upon experience and precautions for household 120/240 volt systems.] Commercial and industrial occupancies may not possess the same design criteria as household installations, especially in the 120/208 V 3-phase systems or in 120 volt control circuits. The language in 70E - 2015 section 130.7(C)(7)(a) requires the utilization of rubber insulating gloves with leather protectors where there is a danger of hand injury from electric shock due to CONTACT (emphasis mine) with energized electrical conductors or circuit parts. There is no present NFPA 70E guidance for shock protection for the “avoid contact” voltage range nor an inadvertent movement adder for that same voltage range, as the table seems to imply that “no contact” is likely to occur. This may lead the qualified worker to assume that no shock protection is needed for any approach to the 50 - 150 V energized electrical conductors or circuit parts.

Submitter Information Verification

Submitter Full Name: STEVEN RASMUSSEN
Organization: EATON Corporation - ELECTRICAL Services and Systems Division
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jul 06 12:01:33 EDT 2015
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(D)(a) and Table 130.4(D)(b), unless one of the following conditions applies:

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<tr>
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Table 130.4(D)(b) Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection, Direct-Current Voltage Systems

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<td>1.0 m (3 ft 3 in.)</td>
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<td>301 V–1 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
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<td>0.3 m (1 ft 0 in.)</td>
</tr>
<tr>
<td>1.1 kV–5 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
<td>0.5 m (1 ft 8 in.)</td>
</tr>
<tr>
<td>5 kV–15 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
<td>0.7 m (2 ft 8 in.)</td>
</tr>
<tr>
<td>15.1 kV–45 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 2 in.)</td>
<td>0.8 m (2 ft 9 in.)</td>
</tr>
<tr>
<td>45.1 kV–75 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
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<tr>
<td>150.1 kV–260 kV</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>1.6 m (5 ft 3 in.)</td>
</tr>
<tr>
<td>250.1 kV–500 kV</td>
<td>6.0 m (20 ft 0 in.)</td>
<td>6.0 m (20 ft 0 in.)</td>
<td>3.5 m (11 ft 6 in.)</td>
</tr>
<tr>
<td>500.1 kV–800 kV</td>
<td>8.0 m (26 ft 0 in.)</td>
<td>8.0 m (26 ft 0 in.)</td>
<td>5.0 m (16 ft 5 in.)</td>
</tr>
</tbody>
</table>

Note: All dimensions are distance from exposed energized electrical conductors or circuit parts to worker.

Exposed movable conductor describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.
Large batteries may have up to 8000 amps even though they have a low voltage. Although the voltage is not a hazard, the battery is an energy source that also has an internal possibility of fault. We need to look at batteries at all voltages not just exceeding 100 volts

Submitter Information Verification

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Submitter Full Name</td>
<td>TERRANCE MCKINCH</td>
</tr>
<tr>
<td>Organization</td>
<td>SLIFCO ELECTRIC</td>
</tr>
<tr>
<td>Street Address</td>
<td></td>
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<tr>
<td>City</td>
<td></td>
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<tr>
<td>State</td>
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<tr>
<td>Zip</td>
<td></td>
</tr>
<tr>
<td>Submittal Date</td>
<td>Mon Jul 06 13:36:03 EDT 2015</td>
</tr>
</tbody>
</table>
Public Input No. 519-NFPA 70E-2015 [Section No. 130.4(D)]

(0) Restricted Approach Boundary.
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(D)(a) and Table 130.4(D)(b), unless one of the following conditions applies:

1. The qualified person is insulated or guarded from the energized electrical conductors or circuit parts operating at 50 volts or more. Insulating gloves or insulating gloves and 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 contact exposed energized electrical conductors or circuit parts, a combination of 130.4(D)(1), 130.4(D)(2), and 130.4(D)(3) shall be used to protect the uninsulated body parts.

2. The energized electrical conductors or circuit part operating at 50 volts or more are insulated from the qualified person and from any other conductive object at a different potential.

3. The qualified person is insulated from any other conductive object.

Table 130.4(D)(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.)

<table>
<thead>
<tr>
<th>Nominal System Voltage Range, Phase to Phase</th>
<th>Exposed Movable Conductor</th>
<th>Exposed Fixed Circuit Part</th>
<th>Restricted Approach Boundaryb, Includes Inadvertent Movement Adderb</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50 V</td>
<td>Not specified</td>
<td>Not specified</td>
<td>Not specified</td>
</tr>
<tr>
<td>50 V–150 Vd</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 6 in.)</td>
<td>Avoid contact</td>
</tr>
<tr>
<td>151 V–750 V</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 6 in.)</td>
<td>0.3 m (1 ft 0 in.)</td>
</tr>
<tr>
<td>751 V–15 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
<td>0.7 m (2 ft 2 in.)</td>
</tr>
<tr>
<td>15.1 kV–36 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.8 m (6 ft 0 in.)</td>
<td>0.8 m (2 ft 7 in.)</td>
</tr>
<tr>
<td>36.1 kV–46 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>0.8 m (2 ft 9 in.)</td>
</tr>
<tr>
<td>46.1 kV–72.5 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>1.0 m (3 ft 3 in.)</td>
</tr>
<tr>
<td>72.6 kV–121 kV</td>
<td>3.3 m (10 ft 8 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
<td>1.0 m (3 ft 4 in.)</td>
</tr>
<tr>
<td>138 kV–145 kV</td>
<td>3.4 m (11 ft 0 in.)</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.2 m (3 ft 10 in.)</td>
</tr>
<tr>
<td>161 kV–169 kV</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>1.3 m (4 ft 3 in.)</td>
</tr>
<tr>
<td>230 kV–242 kV</td>
<td>4.0 m (13 ft 0 in.)</td>
<td>4.0 m (13 ft 0 in.)</td>
<td>1.7 m (5 ft 8 in.)</td>
</tr>
<tr>
<td>345 kV–362 kV</td>
<td>4.7 m (15 ft 4 in.)</td>
<td>4.7 m (15 ft 4 in.)</td>
<td>2.8 m (9 ft 2 in.)</td>
</tr>
<tr>
<td>500 kV–550 kV</td>
<td>5.8 m (19 ft 0 in.)</td>
<td>5.8 m (19 ft 0 in.)</td>
<td>3.6 m (11 ft 10 in.)</td>
</tr>
<tr>
<td>765 kV–800 kV</td>
<td>7.2 m (23 ft 9 in.)</td>
<td>7.2 m (23 ft 9 in.)</td>
<td>4.9 m (15 ft 11 in.)</td>
</tr>
</tbody>
</table>

Note(1): For arc flash boundary, see 130.5(A).
Note(2): All dimensions are distance from exposed energized electrical conductors or circuit part to employee.

d. For single-phase systems above 250V, select the range that is equal to the system’s maximum phase-to-ground voltage multiplied by 1.732.

d. See definition in Article 100 and text in 130.4(D)(2) and Informative Annex C for elaboration.

c. Exposed movable conductors describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.

Table 130.4(D)(b) Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection, Direct-Current Voltage Systems

<table>
<thead>
<tr>
<th>Nominal Potential Difference</th>
<th>Limited Approach Boundary</th>
<th>Restricted Approach Boundary; Includes Inadvertent Movement Adderb</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100 V</td>
<td>Not specified</td>
<td>Not specified</td>
</tr>
<tr>
<td>100 V–300 V</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 6 in.)</td>
</tr>
<tr>
<td>301 V–1 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 6 in.)</td>
</tr>
<tr>
<td>1.1 kV–5 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
</tr>
<tr>
<td>5 kV–15 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
</tr>
<tr>
<td>15.1 kV–45 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
</tr>
<tr>
<td>45.1 kV–75 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>2.5 m (8 ft 0 in.)</td>
</tr>
<tr>
<td>75.1 kV–150 kV</td>
<td>3.3 m (10 ft 8 in.)</td>
<td>3.0 m (10 ft 0 in.)</td>
</tr>
<tr>
<td>150.1 kV–250 kV</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>3.6 m (11 ft 8 in.)</td>
</tr>
<tr>
<td>250.1 kV–500 kV</td>
<td>6.0 m (20 ft 0 in.)</td>
<td>6.0 m (20 ft 0 in.)</td>
</tr>
<tr>
<td>500.1 kV–800 kV</td>
<td>8.0 m (26 ft 0 in.)</td>
<td>8.0 m (26 ft 0 in.)</td>
</tr>
</tbody>
</table>

Note: All dimensions are distance from exposed energized electrical conductors or circuit parts to employee.

* Exposed movable conductor describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.
Delete subdivision (3) as this appears to be left from the concept of bare hand work which was deleted in the 2015 edition.

Submitter Information Verification

Submitter Full Name: PAUL DOBROWSKY
Organization: INNOVATIVE TECHNOLOGY SERVICES
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jul 06 14:57:52 EDT 2015
(D) Restricted Approach Boundary.

Affected Text

\[ \text{No qualified person shall approach or take any conductive object closer to exposed energized electrical conductors or circuit parts operating at 50 volts or more than the restricted approach boundary set forth in Table 130.4(D)(a) and Table 130.4(D)(b), unless one of the following conditions applies:} \]
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(D)(a) and Table 130.4(D)(b) unless one of the following conditions applies:

1. The qualified person is insulated or guarded from the energized electrical conductors or circuit parts operating at 50 volts or more. Insulating gloves or insulating gloves and 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 contact exposed energized electrical conductors or circuit parts, a combination of 130.4(D)(1), 130.4(D)(2), and 130.4(D)(3) shall be used to protect the uninsulated body parts.

2. The energized electrical conductors or circuit part operating at 50 volts or more are insulated from the qualified person and from any other conductive object at a different potential.

3. The qualified person is insulated from any other conductive object.

Table 130.4(D)(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.)

<table>
<thead>
<tr>
<th>Nominal System Voltage Range, Phase to Phase</th>
<th>Exposed Movable Conductor</th>
<th>Exposed Fixed Circuit Part</th>
<th>Restricted Approach Boundaryb; Includes Inadvertent Movement Adder</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50 V</td>
<td>Not specified</td>
<td>Not specified</td>
<td>Not specified</td>
</tr>
<tr>
<td>50 V–150 V</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 6 in.)</td>
<td>Avoid contact</td>
</tr>
<tr>
<td>151 V–750 V</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.0 m (3 ft 6 in.)</td>
<td>0.3 m (1 ft 0 in.)</td>
</tr>
<tr>
<td>751 V–15 kV</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.5 m (5 ft 0 in.)</td>
<td>0.7 m (2 ft 3 in.)</td>
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</tr>
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<td>2.5 m (8 ft 0 in.)</td>
<td>1.0 m (3 ft 4 in.)</td>
</tr>
<tr>
<td>138 kV–145 kV</td>
<td>3.4 m (11 ft 4 in.)</td>
<td>3.0 m (10 ft 0 in.)</td>
<td>1.2 m (3 ft 10 in.)</td>
</tr>
<tr>
<td>161 kV–169 kV</td>
<td>3.6 m (11 ft 10 in.)</td>
<td>3.6 m (11 ft 8 in.)</td>
<td>1.3 m (4 ft 3 in.)</td>
</tr>
<tr>
<td>230 V–242 kV</td>
<td>4.0 m (13 ft 10 in.)</td>
<td>4.0 m (13 ft 0 in.)</td>
<td>1.7 m (5 ft 8 in.)</td>
</tr>
<tr>
<td>345 kV–362 kV</td>
<td>4.7 m (15 ft 6 in.)</td>
<td>4.7 m (15 ft 4 in.)</td>
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<td>3.6 m (11 ft 10 in.)</td>
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<td>765 kV–800 kV</td>
<td>7.2 m (23 ft 9 in.)</td>
<td>7.2 m (23 ft 9 in.)</td>
<td>4.9 m (15 ft 11 in.)</td>
</tr>
</tbody>
</table>

Note(1): For arc flash boundary, see 130.5(A).

Note(2): All dimensions are distance from exposed energized electrical conductors or circuit part to employee.

a For single-phase systems above 250V, select the range that is equal to the system’s maximum phase-to-ground voltage multiplied by 1.732.

b See definition in Article 100 and text in 130.4(D)(2) and Informative Annex C for elaboration.

c Exposed movable conductor describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.

d This includes circuits where the exposure does not exceed 120V nominal.

Table 130.4(D)(b) Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection, Direct-Current Voltage Systems

<table>
<thead>
<tr>
<th>Nominal System Voltage Range</th>
<th>Limited Approach Boundary</th>
<th>Restricted Approach Boundary; Includes Inadvertent Movement Adder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 130.4(D)(b)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: All dimensions are distance from exposed energized electrical conductors or circuit parts to worker.

*Exposed movable conductor describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.

Statement of Problem and Substantiation for Public Input

1. Regarding:

*Article 130.4(D) Restricted Approach Boundary.

*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(D)(a) and Table 130.4(D)(b), unless one of the following conditions applies:

a. AC vs DC Systems. AC and DC systems have different natures. Since voltages can be changed with a transformer in AC systems, high energy conductors typically will be changed to higher voltages to have less current and less $I^2R$ losses. In a -48VDC system, the voltage will stay -48V due to difficulty in conversion to higher voltages and the current will be increased in high energy conductors. The gage of the high energy conductors will be increased to reduce $I^2R$ losses. For batteries, a high gage will be used to lower voltage drop (IR) to keep the communications equipment or other capacity equipment operating longer when it is operating on batteries.

b. Interruption of an AC Current.

(1) An interruption of an AC current (with associated induced voltages) can be handled by Arc Flash Risk Assessment. The current should not be so high that its interruption would produce high induced voltages.

(2) The thermal effects of shorting the AC current can be handled by the Shock Risk Assessment, so no separate assessment is needed. The thermal effects should not be severe because $I^2R$ heating would not be so severe, since high current would not be used.

(3) So the restricted boundary for AC below 50 volts of “Not Specified” is reasonable in most cases.

c. Interruption of a DC Current.

(1) However, an interruption of a DC current of low voltage (-48V), high current causes the interruption of high ampacity current that produces high induced voltages that cause large sparks, which are not expected for the nominal -48V.

(2) The thermal effects of shorting the high current result in a burn hazard, which is not expected due to the low voltage (-48V). The thermal burn hazard could be caused by a person shorting the low voltage (-48V), high current conductor and being exposed to the heat. Another classic example is wearing a wedding ring that causes the high current to burn off a finger. However, the low voltage might not shock the person, but merely burn off his finger.

(3) So the restricted boundary for DC below 100 volts of “Not Specified” is not reasonable for high current, low voltage (-48V) DC conductors.

(4) These hazards like sparks from induced voltages and burns from high current can be encountered when doing measurements on batteries that can bring people into the proximity of high current DC conductors. They could encounter sparks and thermal burn hazards, since the battery current is not reduced by Over Current Protective Devices (OCPDs). The size of the spark should be limited by the time it takes the induced voltage to adjust back to low voltage (-48V) after an interruption.

2. Recommend adding separate assessment methods for high current, low voltage DC to cover unexpected induced voltages and thermal burning.

3. I work at US Defense Information Systems Agency and we have been using Uninterruptible Power Supplies (UPSs), batteries and diesel generators for years to provide Critical Operations Power. However, I have not seen any assessment methods for these, but I have seen warnings in many Defense documents. NFPA did add thermal management requirements to NFPA 1 (Fire Code) in 2012. These are also in Army Installation standards. However, I am not aware of how to add something to NFPA 70E on high current, low voltage conductors.

Submitter Information Verification

Submitter Full Name: DENNIS JANICEK
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Submittal Date: Fri Feb 27 16:27:57 EST 2015
Public Input No. 340-NFPA 70E-2015 [Section No. 130.5]

130.5 Arc Flash Risk Assessment.

(A) General.

(1) An arc flash risk assessment shall be performed to:
   (a) Identify arc flash hazards;
   (b) Estimate the likelihood of occurrence of injury or damage to health and the potential severity of injury or damage to health; and
   (c) Determine if additional protective measures are required, including the use of PPE.

(2) When the estimate of the potential severity of injury or damage to health and likelihood of occurrence of injury or damage to health shall take into consideration:
   (a) The design of the electrical equipment, including its overcurrent protective device and its operating time;
   (b) The electrical equipment condition of maintenance; and
   (c) Human performance.

Informational Note: See Annex X Human Performance.

(3) Table 130.5(A) shall be permitted to be used to estimate the likelihood of occurrence of an arc flash event.

(4) If additional protective measures are required, including the use of PPE, the following shall be identified:
   (a) Appropriate safety-related work practices;
   (b) The arc flash boundary;
   (c) The PPE to be used within the arc flash boundary.

Be updated when a major modification or renovation takes place. It shall be reviewed periodically, at intervals not to exceed 5 years, to account for changes in the electrical distribution system that could affect the results of the arc flash risk assessment.

Take into consideration the design of the overcurrent protective device and its opening time, including its condition of maintenance.

Informational Note No. 1: Improper or inadequate maintenance can result in increased opening 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 may not provide adequate protection from arc flash hazards.

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.

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 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 volts (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. 4: For additional direction for performing maintenance on overcurrent protective devices, see Chapter 2, Safety-Related Maintenance Requirements.

Informational Note No. 5: See IEEE 1584, Guide for Performing Arc Flash Calculations, for more information regarding estimating incident energy and the arc flash hazards boundary for three-phase systems.

[INSERT NEW TABLE 130.5 (A) HERE]

(B) Documentation.

The results of the arc flash risk assessment shall be documented.

(1) The arc flash boundary shall be the distance at which the incident energy equals 5 J/cm² (1.2 cal/cm²).

Informational Note: For information on estimating the arc flash boundary, see Informative Annex D.

(2) The arc flash boundary shall be permitted to be determined by Table 130.7(C)(15)(A) or Table 130.7(C)(15)(B), when the requirements of these tables apply.

(C) Arc Flash PPE.

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

(1) The incident energy analysis method in accordance with 130.5(E); or

(2) The arc flash PPE category method in accordance with 130.7(C)(15).

Either, but not both, methods shall be permitted to be used on the same piece of equipment. The results of an incident energy analysis to specify an arc flash PPE Category in Table 130.7(C)(15) shall not be permitted.

Incident Energy Analysis Method.

The incident energy exposure level shall be based on the working distance of the employee’s face and chest areas from a prospective arc source for the specific task to be performed. Arc-rated clothing and other PPE shall be used by the employee based on the incident energy exposure associated with the specific task.

Recognizing that incident energy increases as the distance from the arc flash decreases, additional PPE shall be used for any parts of the body that are closer than the distance at which the incident energy was determined.

The incident energy analysis shall take into consideration the design of the overcurrent protective device and its opening time, including its condition of maintenance.

Incident energy analysis estimations shall be updated when changes occur in the electrical distribution system that could affect the results of the analysis. The estimations shall also be reviewed for accuracy at intervals not to exceed 5 years.

Informational Note: For information on estimating the incident energy, see Informative Annex D. For information on selection of arc-rated clothing and other PPE, see Table H.3(b) in Informative Annex H.
(2) Arc Flash PPE Categories Method.
The requirements of 130.7(C)(15) and 130.7(C)(16) shall apply when the arc flash PPE category method is used for the selection of arc flash PPE.

(D) 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 that are likely to require examination, adjustment, servicing, or maintenance while energized shall be field-marked with a label containing all the following information:

1. Nominal system voltage
2. Arc flash boundary
3. At least one of the following:
   4. Available incident energy and the corresponding working distance, or the arc flash PPE category in Table 130.7(C)(15)(A)

   a. or 130.7(C)(15)(B) for the equipment, but not both
   b. Minimum arc rating of clothing
   c. Site-specific level of PPE

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 the data to support the information for the label shall be documented. Where the review of the arc flash hazard risk assessment data identifies a change that renders the label inaccurate, the label shall be updated.

The owner of the electrical equipment shall be responsible for the documentation, installation, and maintenance of the field-marked label.

### Table 130.5(A) Estimate of the likelihood of occurrence of an arc flash incident for ac and dc systems

<table>
<thead>
<tr>
<th>Task</th>
<th>Equipment condition (1)</th>
<th>Likelihood of occurrence (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading a panel meter while operating a meter switch</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, 120 volts or below without any other exposed energized equipment over 120 volts including opening of hinged covers to gain access</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an open rack</td>
<td>Normal</td>
<td>No</td>
</tr>
<tr>
<td>For dc systems, maintenance on a single cell of a battery system or multi-cell units in an open rack</td>
<td>Normal</td>
<td>No</td>
</tr>
<tr>
<td>Perform infrared thermography and other non-contact inspections outside the restricted approach boundary. This activity does not include opening of doors or covers. Insulated cable examination with no manipulation of cable</td>
<td>Normal</td>
<td>No</td>
</tr>
<tr>
<td>Work on energized electrical conductors and circuit parts greater than 120 volts ac or dc, including voltage testing</td>
<td>Normal</td>
<td>Yes</td>
</tr>
<tr>
<td>Removal or installation of CBs or switches</td>
<td>Normal</td>
<td>No</td>
</tr>
<tr>
<td>Opening hinged door(s) or cover(s) or removal of bolted covers (to expose bare, energized electrical conductors, and circuit parts). For dc systems, this includes bolted covers, such as battery terminal covers</td>
<td>Normal</td>
<td>No</td>
</tr>
<tr>
<td>Application of temporary protective grounding equipment, after voltage test</td>
<td>Normal</td>
<td>No</td>
</tr>
<tr>
<td>Insertion or removal of individual starter buckets from MCC</td>
<td>Normal</td>
<td>No</td>
</tr>
<tr>
<td>Insertion or removal (racking) of CBs or starters from cubicles, doors open or closed</td>
<td>Normal</td>
<td>No</td>
</tr>
<tr>
<td>Insulation cable examination with manipulation of cable</td>
<td>Normal</td>
<td>Yes</td>
</tr>
<tr>
<td>Work on exposed energized electrical conductors and circuit parts of equipment directly supplied by a panelboard or motor control centre</td>
<td>Normal</td>
<td>No</td>
</tr>
<tr>
<td>Insertion or removal of revenue meters (kW-hour, at primary voltage and current)</td>
<td>Normal</td>
<td>No</td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an enclosure</td>
<td>Abnormal</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems: Work on exposed energized electrical conductors and circuit parts of utilization equipment directly supplied by a dc source</td>
<td>Abnormal</td>
<td>Yes</td>
</tr>
<tr>
<td>Opening voltage transformer or control power transformer compartments</td>
<td>Abnormal</td>
<td>Yes</td>
</tr>
<tr>
<td>Outdoor disconnect switch operation (hookstick operated) at 1 kV through 15 kV</td>
<td>Abnormal</td>
<td>Yes</td>
</tr>
<tr>
<td>Outdoor disconnect switch operation (gang-operated, from grade) at 1 kV through 15 kV</td>
<td>Abnormal</td>
<td>Yes</td>
</tr>
<tr>
<td>Operation of a circuit breaker (CB), switch, contactor or starter</td>
<td>Normal</td>
<td>No</td>
</tr>
<tr>
<td>Voltage testing on individual battery cells or individual multi-cell units</td>
<td>Normal</td>
<td>No</td>
</tr>
<tr>
<td>Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare, energized electrical conductors, and circuit parts</td>
<td>Normal</td>
<td>No</td>
</tr>
<tr>
<td>Removal of battery intercell connector covers</td>
<td>Normal</td>
<td>No</td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 (for clearing times of &lt; 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, tested in accordance with CSA C22.2 No. 022 or IEEE C37.20.7:</td>
<td>Abnormal</td>
<td>Yes</td>
</tr>
<tr>
<td>g. Insertion or removal (racking) of CBs from cubicles;</td>
<td>Abnormal</td>
<td>Yes</td>
</tr>
<tr>
<td>g. Insertion or removal (racking) of ground and test device; or</td>
<td>Abnormal</td>
<td>Yes</td>
</tr>
<tr>
<td>g. Insertion or removal (racking) of voltage transformers on or off the bus</td>
<td>Abnormal</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Notes:

1. Equipment condition is considered to be Normal if the following circumstances apply:
   a. The equipment is properly installed in accordance with the manufacturer’s recommendations and applicable industry codes and standards;
   b. The equipment is properly maintained in accordance with the manufacturer’s recommendations and applicable industry codes and standards;
   c. Equipment doors are closed and secured;
   d. Equipment covers are in place and secured; and
There is no evidence of impending failure such as arcing, overheating, loose or bound equipment parts, visible damage, or deterioration.

(2) As defined in this document, 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 results from a hazard. Risk assessment is an overall process that includes estimates the likelihood of occurrence of injury or damage to health.

The estimate of the likelihood of occurrence contained in this Table does not cover every possible condition or situation. Where this Table identifies No for likelihood of occurrence it means that risk controls are likely adequate and that an arc flash incident is not likely to occur.

Statement of Problem and Substantiation for Public Input

This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.

This Public Input seeks to resolve several issues:
- A new Section title “(A) General” is added for clarity and to enhance alignment between Sections 130.4 and 130.5.
- Risk assessment content is added to align the requirements of this Section with the definition of risk assessment in Article 100 (the proposed wording in 130.5(A) is an adaptation of the risk assessment definition).
- The requirements of existing list items 130.5(2) and 130.5(3) are more appropriate to an incident energy analysis are so are relocated to that section. Some of the content of existing list item 130.5(2) copied and itemized under the risk assessment requirement as two factors can affect the risk assessment estimation of severity and likelihood.
- A new list item 130.5(A)(2)(c) is added to address the effect of human performance (i.e. human error) when performing a risk assessment. A separate Public Input will recommend the addition of a new “Human Performance” Annex.
- Informational Note No. 5 is editorially revised for clarity.
- Table 130.7(C)(15)(A)(a) is consolidated and relocated to 130.5 to be part of the arc flash risk assessment section of the document.

The requirement to review the data to support the information is repeated in (D) Equipment Labeling for consistency with other sections of the document.

Related Public Inputs for This Document

<table>
<thead>
<tr>
<th>Related Input</th>
<th>Relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Input No. 346-NFPA 70E-2015 [Sections 130.7(C)(15), 130.7(C)(16)]</td>
<td></td>
</tr>
<tr>
<td>Public Input No. 502-NFPA 70E-2015 [New Section after P1]</td>
<td></td>
</tr>
</tbody>
</table>

Submitter Information Verification

<table>
<thead>
<tr>
<th>Submitter Full Name:</th>
<th>DANIEL ROBERTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization:</td>
<td>SCHNEIDER ELECTRIC</td>
</tr>
<tr>
<td>Affiliation:</td>
<td>This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.</td>
</tr>
</tbody>
</table>

Submittal Date: Tue Jun 30 11:54:56 EDT 2015
An arc flash risk assessment for all tasks where a person is interacting with electrical equipment shall be performed and shall:

1. Determine if an arc flash hazard exists. If an arc flash hazard exists, the risk assessment shall determine:
   2. Appropriate safety-related work practices
   3. The arc flash boundary
   4. The PPE to be used within the arc flash boundary

5. Be updated when a major modification or renovation takes place. It shall be reviewed periodically, at intervals not to exceed 5 years, to account for changes in the electrical distribution system that could affect the results of the arc flash risk assessment.

6. Take into consideration the design of the overcurrent protective device and its opening time, including its condition of maintenance.

Informational Note No. 1: Improper or inadequate maintenance can result in increased opening 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 may not provide adequate protection from arc flash hazards.

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.

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 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 volts (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. 4: For additional direction for performing maintenance on overcurrent protective devices, see Chapter 2, Safety-Related Maintenance Requirements.

Informational Note No. 5: See IEEE 1584, Guide for Performing Arc Flash Calculations, for more information regarding arc flash hazards for three-phase systems.

Statement of Problem and Substantiation for Public Input

Existing terminology has changed from a hazard assessment to a risk assessment but still does not incorporate the fact that a task analysis must be performed. The proposed change emphasizes the task-based nature of risk assessments by reiterating terminology from the definition.

Submitter Information Verification

Submitter Full Name: Paul Campbell
Organization: PotashCorp Aurora
Street Address:
City:
State:
Zip:
Submittal Date: Mon Apr 13 12:11:21 EDT 2015
An arc flash risk assessment shall be performed and shall:

1. Determine if an arc flash hazard exists. If an arc flash hazard exists, the risk assessment shall determine:
   (2) Appropriate safety-related work practices
   (3) The arc flash boundary
   (4) The PPE to be used within the arc flash boundary

5. Be updated when a major modification or renovation takes place. It shall be reviewed periodically, at intervals not to exceed 5 years, to account for changes in the electrical distribution system that could affect the results of the arc flash risk assessment.

6. Take into consideration the design of the overcurrent protective device and its opening time, including its condition of maintenance.

7. Implement 110.1(G)(3) hierarchy of hazard control techniques to reduce the likelihood of an arc flash hazard to an acceptable level, and reduce potential exposure to the worker when the likelihood cannot be reduced to an acceptable level.

   Informational Note No. 1: Improper or inadequate maintenance can result in increased opening 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 may not provide adequate protection from arc flash hazards.

   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.

   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 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 volts (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. 4: For additional direction for performing maintenance on overcurrent protective devices, see Chapter 2, Safety-Related Maintenance Requirements.

   Informational Note No. 5: See IEEE 1584, Guide for Performing Arc Flash Calculations, for more information regarding arc flash hazards for three-phase systems.

Statement of Problem and Substantiation for Public Input

The rules regarding arc flash risk assessment and control should follow the hierarchy of controls established in Article 110. Before leaping to PPE, the last consideration in the hierarchy list, the employer should first consider mitigation methods to reduce the likelihood that an arc flash hazard will result from the activity to be performed. When the likelihood cannot be reduced to an acceptable level that would eliminate the need for PPE, energy reduction techniques should be employed to reduce the amount of PPE needed. Too much PPE can introduce additional hazards and increase the likelihood of the worker creating an arc flash hazard. Many times, through the use of ingenuity, the need for PPE can be eliminated. For example, using tools that are too short to reach between battery terminals will make an arc between terminals of a stationary battery installation not a credible event. Therefore the use of arc flash clothing would not be necessary and the safety of the job would be improved. Informational Note #3 recommends applying energy-reducing methods generally, but this public input would make the consideration mandatory for specific work activities.

Submitter Information Verification

Submitter Full Name: BOBBY GRAY
Organization: HOYDARBUCK INC
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Wed Jun 03 10:55:40 EDT 2015
An arc flash risk assessment shall be performed and shall:

1. Determine if an arc flash hazard exists. If an arc flash hazard exists, the risk assessment shall determine:
   2. Appropriate safety-related work practices
   3. The arc flash boundary
   4. The PPE to be used within the arc flash boundary

5. Be updated when a major modification or renovation takes place. It shall be reviewed periodically, at intervals not to exceed 5 years, to account for changes in the electrical distribution system that could affect the results of the arc flash risk assessment.

6. Take into consideration the design of the overcurrent protective device and its opening time, including its condition of maintenance.

Exception: An Arc Flash Risk Assessment shall not be required where all of the following conditions exist:

1. The circuit is rated at 240 volts or less,
2. The circuit is supplied by one transformer, and
3. The transformer supplying the circuit is rated less than 125 kVA.

Informational Note No. 1: Improper or inadequate maintenance can result in increased opening 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 may not provide adequate protection from arc flash hazards.

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.

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 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 volts (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. 4: For additional direction for performing maintenance on overcurrent protective devices, see Chapter 2, Safety-Related Maintenance Requirements.

Informational Note No. 5: See IEEE 1584, Guide for Performing Arc Flash Calculations, for more information regarding arc flash hazards for three-phase systems rated less than 240 volts.

Submitter Information Verification

Submitter Full Name: JAMES BRUNSSEN
Organization: TELCORDIA TECHNOLOGIES ERICSSON
Affiliation: ATIS
Street Address: City:
State: Zip:
Submittal Date: Mon Jun 15 15:27:28 EDT 2015
An arc flash risk assessment shall be performed and shall:

1. Determine if an arc flash hazard exists. If an arc flash hazard exists, the risk assessment shall determine:
   
   2. Appropriate safety-related work practices
   3. The arc flash boundary
   4. Incident energy at the working distance
   5. The PPE to be used within the arc flash boundary

6. Be updated when a major modification or renovation takes place. It shall be reviewed periodically, at intervals not to exceed 5 years, to account for changes in the electrical distribution system that could affect the results of the arc flash risk assessment.

7. Take into consideration the design of the overcurrent protective device and its opening time, including its condition of maintenance.

Informational Note No. 1: Improper or inadequate maintenance can result in increased opening 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 may not provide adequate protection from arc flash hazards.

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.

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 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 volts (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. 4: For additional direction for performing maintenance on overcurrent protective devices, see Chapter 2, Safety-Related Maintenance Requirements.

Informational Note No. 5: See IEEE 1584, Guide for Performing Arc Flash Calculations, for more information regarding arc flash hazards for three-phase systems.

Statement of Problem and Substantiation for Public Input

Document clarity

The incident energy at the working distance is required to select PPE.

This wording was included in the 2012 edition.

Submitter Information Verification

Submitter Full Name: Drake Drobnick
Organization: [Not Specified]
Affiliation: N/A
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Wed Jan 28 20:46:15 EST 2015
An arc flash risk assessment shall be performed and shall:

1. Determine if an arc flash hazard exists. If an arc flash hazard exists, the risk assessment shall determine:
   
   2. Appropriate safety-related work practices

   3. The arc flash boundary

   4. The PPE to be used within the arc flash boundary

5. Be updated when a major modification or renovation takes place or when codes and standards related to determining the arc flash hazard change. Additionally, it shall be reviewed periodically, at intervals not to exceed 5 years, to account for changes in the electrical distribution system that could affect the results of the arc flash risk assessment.

6. Take into consideration the design of the overcurrent protective device and its opening time, including its condition of maintenance.

Informational Note No. 1: Improper or inadequate maintenance can result in increased opening 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 may not provide adequate protection from arc flash hazards.

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.

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 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 volts (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. 4: For additional direction for performing maintenance on overcurrent protective devices, see Chapter 2, Safety-Related Maintenance Requirements.

Informational Note No. 5: See IEEE 1584, Guide for Performing Arc Flash Calculations, for more information regarding arc flash hazards for three-phase systems.

Statement of Problem and Substantiation for Public Input

Codes and standards used to determine the arc flash potential are periodically revised. These revisions some time result in different results. The arc flash risk assessment should be reviewed also when the codes and standards are revised to ensure that using the revised information in the codes and standards would not result in different arc flash hazard results.

Submitter Information Verification

Submitter Full Name: DAVID PACE
Organization: OLIN CORPORATION
Affiliation: Self
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Mon Jun 22 17:49:37 EDT 2015
Public Input No. 265-NFPA 70E-2015 [Section No. 130.5 [Excluding any Sub-Sections]]

An arc flash risk assessment shall be performed and shall:

1. Determine if an arc flash hazard exists. If an arc flash hazard exists, the risk assessment shall determine:
   2. Appropriate safety-related work practices
   3. The arc flash boundary
   4. The PPE to be used within the arc flash boundary

5. Be updated when a major modification or renovation takes place. It shall be reviewed periodically, at intervals not to exceed 5 years, to account for changes in the electrical distribution system that could affect the results of the arc flash risk assessment.

6. Take into consideration the design of the overcurrent protective device and its opening time, including its condition of maintenance.

Relocate notes 1 through 5 to location just below 130.5(3). They now exist below Table 130.4(D)(a).

Informational Note No. 1: Improper or inadequate maintenance can result in increased opening 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 may not provide adequate protection from arc flash hazards.

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.

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 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 volts (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. 4: For additional direction for performing maintenance on overcurrent protective devices, see Chapter 2, Safety-Related Maintenance Requirements.

Informational Note No. 5: See IEEE 1584, Guide for Performing Arc Flash Calculations, for more information regarding arc flash hazards for three-phase systems.

Statement of Problem and Substantiation for Public Input

The Informational Notes 1-5 are presently shown under Table 130.4(D)(b). This indicates they are applicable to the Table, which is incorrect. These notes are actually applicable to the text of 130.5(3). This may be a result of simple printing of the Tables, but should be located properly (as was shown in previous editions).

Submitter Information Verification

Submitter Full Name: DARYLD CROW
Organization: DRC CONSULTING LTD
Affiliation: TG for article 130.4 and 130.5
Street Address:
City:
State:
Zip:
Submittal Date: Fri Jun 26 14:01:49 EDT 2015

287 of 693
7/7/2015 9:04 AM
NFPA 70E - A2017 FD Meeting Agenda
An arc flash risk assessment shall be performed and shall:

1. Determine if an arc flash hazard exists. If an arc flash hazard exists, the risk assessment shall determine:
   2. Appropriate safety-related work practices
   3. The arc flash boundary
   4. The PPE to be used within the arc flash boundary

5. Be updated when a major modification or renovation takes place. It shall be reviewed periodically, at intervals not to exceed 5 years, to account for changes in the electrical distribution system that could affect the results of the arc flash risk assessment.

6. Take into consideration the design of the overcurrent protective device and its opening time, including its condition of maintenance.

Informational Note No. 1: Improper or inadequate maintenance can result in increased opening 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 may not provide adequate protection from arc flash hazards.

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, clearing 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, clearing time for the overcurrent protective device, arc flash energies could also increase.

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 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 volts (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. 4: For additional direction for performing maintenance on overcurrent protective devices, see Chapter 2, Safety-Related Maintenance Requirements.

Informational Note No. 5: See IEEE 1584, Guide for Performing Arc Flash Calculations, for more information regarding arc flash hazards for three-phase systems.

Statement of Problem and Substantiation for Public Input

This recommended change from "opening time" to clearing time" is intended as (to determine if it is) an editorial change to make the terminology used in this informational note consistent with the terminology used in 130.7(C)(15)(A) and the two arc flash PPE category tables.

Submitter Information Verification

Submitter Full Name: Palmer Hickman
Organization: Electrical Training Alliance
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Thu Feb 05 16:03:09 EST 2015
An arc flash risk assessment shall be performed and shall:

1. Determine if an arc flash hazard exists. If an arc flash hazard exists, the risk assessment shall determine:
   2. Appropriate safety-related work practices
   3. The arc flash boundary
   4. The PPE to be used within the arc flash boundary

5. Be updated when a major modification or renovation takes place. It shall be reviewed periodically, at intervals not to exceed 5 years, to account for changes in the electrical distribution system that could affect the results of the arc flash risk assessment reviewed before work is started in the arc flash boundary or employees are exposed to arc flash hazards. The arc flash risk assessment must be updated when changes in the job or task may expose employees to additional hazards that were not part of the original risk assessment.

6. Take into consideration the design of the overcurrent protective device and its opening time, including its condition of maintenance.

Informational Note No. 1: Improper or inadequate maintenance can result in increased opening 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 may not provide adequate protection from arc flash hazards.

Informational Note No. 2: 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.

Informational Note No. 3: The occurrence of an arcing fault inside an enclosure produces a variety of physical phenomena 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 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 volts (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. 4: For additional direction for performing maintenance on overcurrent protective devices, see Chapter 2, Safety-Related Maintenance Requirements.

Informational Note No. 5: See IEEE 1584, Guide for Performing Arc Flash Calculations, for more information regarding arc flash hazards for three-phase systems.

Statement of Problem and Substantiation for Public Input

Qualified employees are expected to be able to determine if an arc flash hazard exists. The arc flash risk assessment is part of this process. It does not make sense to conduct a risk assessment using the Tables Method, and requiring the review every 5 years when the tables are revised every 3 years. The current language in 130.5(2) appears to be more appropriate for the incident energy analysis method, and not for a general arc flash risk assessment which should be conducted prior to starting a job or task.

The arc flash risk assessment should be reviewed before starting each job when employees are exposed to an arc flash hazard. This is consistent with requirements of 110.1(H) Job Briefing. It should also take into account changes in the scope of work.

Submitter Information Verification

Submitter Full Name: JASON WOLF
Organization: ESCO GROUP
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jul 02 16:56:27 EDT 2015
Public Input No. 406-NFPA 70E-2015 [Section No. 130.5 (Excluding any Sub-Sections)]

An arc flash risk assessment shall be performed and shall:

1. Determine if an arc flash hazard exists. If an arc flash hazard exists, the risk assessment shall determine:
   - Appropriate safety-related work practices
   - The arc flash boundary
   - The PPE to be used within the arc flash boundary

2. Be updated when a major modification or renovation takes place. It shall be reviewed periodically, at intervals not to exceed 5 years, to account for changes in the electrical distribution system that could affect the results of the arc flash risk assessment.

3. Take into consideration the design of the overcurrent protective device and its opening time, including its condition of maintenance.

Informational Note No. 1: Improper or inadequate maintenance can result in increased opening 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 may not provide adequate protection from arc flash hazards.

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.

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 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 volts (nominal) systems, current limitation, and use of tested and certified infrared or visual inspection windows are available to reduce the risk associated with an arc flash incident. See Informative Annex O for Safety-Related Design Requirements.

Informational Note No. 4: For additional direction for performing maintenance on overcurrent protective devices, see Chapter 2, Safety-Related Maintenance Requirements.

Informational Note No. 5: See IEEE 1584, Guide for Performing Arc Flash Calculations, for more information regarding arc flash hazards for three-phase systems.

Statement of Problem and Substantiation for Public Input

This is a list of commonly used risk controls to either reduce available current, maximize distance from conductors, reduce likelihood of triggering the arc hazard, etc. IR windows and viewing windows eliminate the high-risk task of opening energized electrical enclosures/equipment when technicians perform periodic diagnostic inspections to evaluate the condition of equipment. Eliminating that task reduces the likelihood of triggering an incident, and is therefore a Risk Control.

IR scans and visual inspections are diagnostic inspections recommended practices in NFPA 70B NETA standards. 70E since repeatedly references “properly maintained” and refers to 70B and NETA standards in that regard. Therefore, because these types of inspections are recommended directly or indirectly in the standards, it follows that the committee would list this risk-controlling, alternate method of performing those inspections in his informational note that includes other industry standard forms of risk control.

Submitter Information Verification

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Affiliation: Exiscan LLC
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Submittal Date: Sat Jul 04 14:31:08 EDT 2015
Public Input No. 367-NFPA 70E-2015 [ Section No. 130.5(A) ]

(A) Documentation. The results of the arc flash risk assessment shall be documented. One of the following methods shall be used to meet the requirements of 130.5 arc flash risk assessment. Either, but not both, methods shall be permitted to be used on the same piece of equipment.

1 Incident Energy Analysis Method. The incident energy exposure level shall be based on the working distance of the employee’s face and chest areas from a prospective arc source for the specific task to be performed. Arc-rated clothing and other PPE shall be used by the employee based on the incident energy exposure associated with the specific task. Recognizing that incident energy increases as the distance from the arc flash decreases, additional PPE shall be used for any parts of the body that are closer than the distance at which the incident energy was determined.

Informational Note: For information on estimating the incident energy, see Informative Annex D. For information on selection of arc-rated clothing and other PPE, see Table H.3 (b) in Informative Annex H.

The incident energy analysis shall be updated when a major modification or renovation takes place. It shall be reviewed periodically, at intervals not to exceed 5 years, to account for changes in the electrical distribution system that could affect the results of the arc flash risk assessment.

2 Arc Flash PPE Categories Method. The requirements of 130.7(C)(15) and 130.7(C)(16) shall apply when the arc flash PPE category method is used for the selection of arc flash PPE.

Statement of Problem and Substantiation for Public Input

The intent of 130.5 Arc Flash Risk Assessment is clearly described in the current language. However, the method used to conduct the risk assessment is found in 130.5 (C) Arc Flash PPE. By moving the arc flash PPE selection requirements to section 130.5(A) Documentation, the standard is more organized, and the requirements for what needs to be documented are more clearly communicated.

Submitter Information Verification

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Submittal Date: Thu Jul 02 17:02:36 EDT 2015
Public Input No. 533-NFPA 70E-2015 [ New Section after 130.5(B) ]

130.5(B)
(3) No unqualified person shall cross the arc flash boundary.

Statement of Problem and Substantiation for Public Input

A new (3) is proposed to 130.5(B) to clarify that unqualified persons are not permitted to cross the arc flash boundary. This is intended to clarify this requirement much the same way that 130.4(C) clarifies the shock boundary that unqualified persons are not permitted to cross.

Submitter Information Verification

Submitter Full Name: PALMER HICKMAN
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Submittal Date: Mon Jul 06 16:23:26 EDT 2015
Public Input No. 308-NFPA 70E-2015 [ Section No. 130.5(B) ]

(8) **Arc Flash Boundary**. One of the following methods shall be used for the selection of the arc flash boundary,

(1) **Incident Energy Analysis**.

The arc flash boundary shall be the distance at which the incident energy equals 5 J/cm² (1.2 cal/cm²).

Informational Note: For information on estimating the arc flash boundary, see Informative Annex D.

(2) **Arc Flash PPE Tables**.

The arc flash boundary shall be permitted to be determined by Table 130.7(C)(15)(A)(b) or Table 130.7(C)(15)(B), when the requirements of these tables apply.

Statement of Problem and Substantiation for Public Input

This public input is editorial in nature. 130.5(B) has no parent text and two second level subdivisions without titles. This revision provides clarity and correlation with the structure of 130.5(C).

Submitter Information Verification

Submitter Full Name: JAMES DOLLARD
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Submittal Date: Mon Jun 29 12:44:43 EDT 2015
Public Input No. 261-NFPA 70E-2015 [ Section No. 130.5(B)(1) ]

(1)

The arc flash boundary shall be the distance at which the incident energy equals \( \frac{5}{\sqrt{2}} \) or 1.2 cal/cm\(^2\) / (5 J/cm\(^2\) / 1.2 cal/cm\(^2\)).

Informational Note: For information on estimating the arc flash boundary, see Informative Annex D.

Statement of Problem and Substantiation for Public Input

For clarification and readability, place the “cal/cm\(^2\)” value as the primary measurement for incident energy (list first and outside the parentheses), and place the “J/cm\(^2\)” value in the secondary position (listed second and inside the parentheses). Although Joules is the metric measurement, and it is the measurement used in the 1584 calculations, PPE values and the values that appear on Arc Flash Risk Assessment Labels are predominantly (if not exclusively) listed in “cal/cm\(^2\),” and as a result the end-users of this document relate to the cal/cm\(^2\) value.

This PI is a recommendation as a global change throughout the document.

Submitter Information Verification

Submitter Full Name: DARYLD CROW
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Affiliation: TG for article 130.4 and 130.5
Street Address: 
City: 
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Submittal Date: Fri Jun 26 13:50:21 EDT 2015
Public Input No. 228-NFPA 70E-2015 [ New Section after 130.5(B)(2) ]

130.5(B)(3) Arc Flash Boundary Access
Only Qualified persons are allowed inside the arc flash boundary. Under no circumstance shall an Unqualified Person be allowed to cross the arc flash boundary.

Statement of Problem and Substantiation for Public Input
In the case of shock boundaries, the text of this standard is clear in prohibiting Unqualified Persons from crossing the restricted approach boundary. In the case of arc flash boundaries, it is not. This PI makes it clear that an Unqualified Person is prohibited from crossing the arc flash boundary under any circumstances, which was the intent of the committee. While you don’t hear it as much today, there are still unities that say “where does it say I have to do XXX or I can’t do XXX”. This clarifies one of those areas currently missing from the text.

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Submitter Full Name: DAVID PACE  
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Street Address:  
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Submittal Date: Mon Jun 22 17:52:03 EDT 2015
Public Input No. 368-NFPA 70E-2015 [Section No. 130.5(C)]

(C) Arc Flash PPE
One of the following methods shall be used for the selection of PPE. Either, but not both, methods shall be permitted.

Selection of PPE to be used
on the same piece of equipment. The results of an incident energy analysis to specify an arc flash PPE Category in Table 130.7(C)(16) shall not be permitted.

(1) Incident Energy Analysis Method.
The incident energy exposure level shall be based on the working distance of the employee’s face and chest areas from a prospective arc source for the specific task
to be performed. Arc-rated clothing and other PPE shall be used by the employee based on the incident energy exposure associated with the specific task.

Recognizing that incident energy increases as the distance from the arc flash decreases, additional PPE shall be used for any parts of the body that are closer than the
distance at which the incident energy was determined.

Informational Note: For information on estimating the incident energy, see Informative Annex D. For information on selection of arc-rated clothing and other
PPE, see Table H.3(b) in Informative Annex H.

(2) Arc Flash PPE Categories Method.
The requirements of 130.7(C)(15) and 130.7(C)(16) shall apply when the arc flash PPE category method is used for the selection of arc flash PPE.

in the arc flash protection boundary will be determined through the Incident Energy analysis Method described in 130.5(A)(1) or the Arc Flash PPE
Categories Method described in 130.5(A)(2).

Statement of Problem and Substantiation for Public Input
The intent of 130.5 Arc Flash Risk Assessment is clearly described in the current language. However, the method used to conduct the risk assessment is found in 130.5 Arc
Flash PPE. By moving the arc flash PPE selection requirements to section 130.5(A) Documentation, the standard is more organized, and the requirements for what needs to be
documented are more clearly communicated.

Selection of arc flash PPE is based on the results of the incident energy analysis or by using the PPE categories tables. The language “The results of an incident energy analysis
to specify an arc flash PPE Category in Table 130.7(C)(16) shall not be permitted.” is not needed since it is a redundant requirement found in 130.5(A) Documentation, of the
proposed changes.

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Submittal Date: Thu Jul 02 17:08:54 EDT 2015
Public Input No. 108-NFPA 70E-2015 [ Section No. 130.5(C) [Excluding any Sub-Sections] ]

One of the following methods shall be used for the selection of PPE. Either, but not both, methods shall be permitted to be used for a continuous work task on the same piece of equipment. The results of an incident energy analysis to specify an arc flash PPE Category in Table 130.7(C)(16) shall not be permitted.

Statement of Problem and Substantiation for Public Input

The existing language does not clearly describe the intent of requirement. Taken literally, if an employer has chosen to use the PPE Category method to choose PPE to perform a specific task on a piece of electrical equipment, they never could use the incident energy analysis method compliantly for the lifetime of the equipment. There has been no technical justification provided that supports this interpretation of the requirement. So, the wording needs to reflect the intent that PPE for a particular task needs to be selected by one of the two methods independent of the other method. A different task on the same equipment at a different time should offer the user the same options for choosing appropriate PPE.

Submitter Information Verification

Submitter Full Name: Bobby Gray  
Organization: Hoydar/Buck, Inc.  
Affiliation: None
Street Address:  
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Submittal Date: Wed Apr 08 13:52:36 EDT 2015
Arc Flash PPE selection is based on the amount of thermal energy level on the person's face and body at the working distance, not the thermal energy on the hands or arms which are normally closer to the arc point than the face and body. Additional protection shall be used for all parts of the body closer than the working distance. One of the following methods shall be used for the selection of PPE. Either, but not both, methods shall be permitted to be used on the same piece of equipment. The results of an incident energy analysis to specify an arc flash PPE Category in Table 130.7(C)(16) shall not be permitted.

Statement of Problem and Substantiation for Public Input

Additional protection for parts of the body closer than the working distance is required whether incident energy analysis method is used or Arc Flash PPE categories method is used.

Submitter Information Verification

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Street Address:
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Submittal Date: Tue Jun 30 11:23:31 EDT 2015
Incident Energy Analysis Method.

The incident energy exposure level shall be based on the working distance of the employee’s face and chest areas from a prospective arc source for the specific task to be performed. Arc-rated clothing and other PPE shall be used by the employee based on the incident energy exposure associated with the specific task. Recognizing that incident energy increases as the distance from the arc flash decreases, additional PPE shall be used for any parts of the body that are closer than the distance at which the incident energy was determined.

Informational Note: For information on estimating the incident energy, see Informative Annex D. For information on selection of arc-rated clothing and other PPE, see Table H.3(b) in Informative Annex H.

<table>
<thead>
<tr>
<th>Incident Energy Exposure</th>
<th>Protective Clothing and PPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 1.2 to 12 cal/cm²</td>
<td>Arc-rated long-sleeve shirt and arc-rated pants or arc-rated coverall or arc flash suit (SR) (See Note 3.)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated face shield and arc-rated balaclava or arc flash hood (SR) (See Note 1.)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated jacket, parks, or rainwear (AN)</td>
</tr>
</tbody>
</table>

Other PPE

- Hard hat
- Arc-rated hard hat liner (AN)
- Safety glasses or safety goggles (SR)
- Hearing protection
- Heavy-duty leather gloves or rubber insulating gloves with leather protectors (SR) (See Note 4.)
- Leather footwear

<table>
<thead>
<tr>
<th>Incident Energy Exposure</th>
<th>Protective Clothing and PPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 12 cal/cm²</td>
<td>Arc-rated long-sleeve shirt and arc-rated pants or arc-rated coverall and/or arc flash suit (SR)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated arc flash suit hood</td>
</tr>
<tr>
<td></td>
<td>Arc-rated gloves</td>
</tr>
<tr>
<td></td>
<td>Arc-rated jacket, parks, or rainwear (AN)</td>
</tr>
</tbody>
</table>

Other PPE

- Hard hat
- Arc-rated hard hat liner (AN)
- Safety glasses or safety goggles (SR)
- Hearing protection
- Arc-rated gloves or rubber insulating gloves with leather protectors (SR) (See Note 4.)
- Leather footwear

AN: As needed in addition to the protective clothing and PPE required by 130.5(C)(1).
SR: Selection of one in group is required by 130.5(C)(1).

Notes:
1. Face shields with a wrap-around guard to protect the face, chin, forehead, ears, and neck area are required by 130.7(C)(10)(c). For full head and neck protection, use a balaclava or an arc flash hood.
2. All items not designated “AN” are required by 130.7(C).
3. Arc ratings can be for a single layer, such as an arc-rated shirt and pants or a coverall, or for an arc flash suit or a multi-layer system consisting of a combination of an arc-rated shirt and pants, coverall, and arc flash suit.
4. Arc flash protection provides 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.

Statement of Problem and Substantiation for Public Input

1. It is clear that the intent of 70E Standard is to encourage wearing AR PPE according to the incident energy level. This is based on Article 130.5(D) which lists the requirements for equipment labels. One requirement is to list available incident energy and the corresponding working distance, or the arc flash PPE category, but not both. The PPE categories are already located in Chapter One which, if the label has categories listed, the wearing of a particular PPE category is mandatory. Relocating Table H.3(b) from Annex H to Chapter One removes the table from an informative recommendation to a mandatory requirement.

2. Re-labeling Table H.3(b) to Table 130.5(C)(1)(a) positions the table in its proper place right after Article 130.5(C)(1).

3. Having PPE Categories and Selection of Arc-Rated Clothing and Other PPE for Use When Incident Energy Exposure Is Determined both in Chapter One makes the issue of wearing appropriate AR PPE consistent, regardless of the method used for PPE selection.

Submitter Information Verification

Submitter Full Name: ALVIN HAVENS
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Street Address: 299 of 693
Public Input No. 250-NFPA 70E-2015 [Section No. 130.5(C)(1)]

(1) Incident Energy Analysis Method.

The incident energy exposure level shall be based on the working distance of the employee’s face and chest areas from a prospective arc source for the specific task to be performed. Arc-rated clothing and other PPE shall be used by the employee based on the incident energy exposure associated with the specific task. Recognizing that incident energy increases as the distance from the arc flash decreases, additional PPE shall be used for any parts of the body that are closer than the distance at which the incident energy was determined.

The requirements in Table 130.7(C)(16) shall apply when the incident energy method is used for the selection of arc flash PPE.

Informational Note:

For additional information on estimating the incident energy, see Informational Annex D. For information on selection of arc-rated clothing and other PPE, see Table H.3(b) in Informational Annex H.

Statement of Problem and Substantiation for Public Input

The existing Table 130.7(C)(16) [recommendation is to rename this table 130.7(C)(17)] applies when the “Arc Flash PPE Category Method” in NFPA 70E is used to select arc flash PPE. The new table (relocated from H.3(b) [recommendation is to name this new table 130.7(C)(16)] applies when the “Incident Energy Method” is used to select arc flash PPE.

The information in Table H.3(b) now exists in Annex H. Annexes in NFPA 70E are for information only and are not part of the requirements in NFPA 70E. The “Incident Energy Method” for selecting arc flash clothing should be located in the requirements section of NFPA 70E (not in Annex H) the same way existing Table 130.7(C)(16) exists in article 130.7 for the selection of arc flash PPE when the “Arc Flash PPE Category Method” is used to select arc flash PPE.

See related PI 252

See the PI recommending Relocating parts of existing Table H.3(b) in Annex H to article 130.7 above existing Table 130.7(C)(16). Name the information relocated from H.3(b) table 130.7(C)(16) and rename existing Table 130.7(C)(16) to 130.7(C)(17). The new name for the new table will become Table 130.7(C)(16) with the title “Selection of minimum arc-rated clothing and other PPE for use when the incident energy method is used for the selection of arc flash PPE”.

Note: The wording in the new table may need reformatting.

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Submittal Date: Fri Jun 26 10:58:07 EDT 2015
Public Input No. 33-NFPA 70E-2015 [ New Section after 130.5(D) ]

TITLE OF NEW CONTENT
Add a new list item as 130.5(D)(3) and relocate and revise the existing 130.5(D)(3) as 130.5(D)(4) to read as follows:

(3) The corresponding working distance [see 130.5(C)(1) or Table 130.7(C)(15)(A)(b) parameters or Table 130.7(C)(15)(B) parameters]

(4) At least one of the following: ...

Statement of Problem and Substantiation for Public Input

This recommendation is intended to provide crucial information on the equipment label and provide the same parallel information regardless of which method is used to determine arc flash PPE. Working distance (either actual for calculated incident energy or minimum where Arc-Flash PPE category method is used) is important for both methods permitted to determine arc flash PPE in accordance with 130.5(C). The corresponding working distance is already required to be known per 130.5(C)(1) and on the label when incident energy calculations are performed. See 130.5(D)(3)(a). However, even though the minimum working distance is published in "the PPE category Tables", this important minimum working distance is not required to be on the label. This recommendation does not require anything new other than to transfer the information from "the Tables" to the label. A similar change is being proposed to a similar provision required to be included on the arc flash risk assessment portion of the energized electrical work permit.

Submitter Information Verification

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Submittal Date: Thu Feb 05 15:14:14 EST 2015
Public Input No. 109-NFPA 70E-2015 [Section No. 130.5(D)]

(D) 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 that are likely to require examination, adjustment, servicing, or maintenance while energized shall be field-marked with a label containing all the following information:

1. Nominal system voltage
2. Arc flash boundary
3. At least one of the following:
   4. Available incident energy and the corresponding working distance, or the arc flash PPE category in Table 130.7(C)(15)(A)(b) or 130.7(C)(15)(B) for the equipment, but not both
   5. Minimum arc rating of clothing
   6. Site-specific level of PPE

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 the data to support the information for the label shall be documented. Where the review of the arc flash hazard risk assessment identifies a change that renders the label inaccurate, the label shall be updated.

The owner of the electrical equipment shall be responsible for the documentation, installation, and maintenance of the field-marked label.

The method for selecting arc flash PPE shall be permitted to be in accordance with 130.5(C), regardless of label information.

Statement of Problem and Substantiation for Public Input

Some users have taken the requirement to place either the incident energy or PPE category on the label to mean they no longer have the option to use the other method to select PPE. Adding the proposed statement clarifies the label is intended only to communicate conditions, not mandate a method of protection.

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Submittal Date: Wed Apr 08 14:17:24 EDT 2015
Public Input No. 118-NFPA 70E-2015 [ Section No. 130.5(D) ]

(D) 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 that are likely to require examination, adjustment, servicing, or maintenance while energized shall be field-marked with a label containing all the following information:

1. Nominal system voltage
2. Arc flash boundary
3. At least one of the following:
   a. Available incident energy and the corresponding working distance, or the arc flash PPE category in Table 130.7(C)(15)(A) or 130.7(C)(15)(B) for the equipment
   b. Minimum arc rating of clothing
   c. Site-specific level of PPE

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 the data to support the information for the label shall be documented. Where the review of the arc flash hazard risk assessment identifies a change that renders the label inaccurate, the label shall be updated.

The owner of the electrical equipment shall be responsible for the documentation, installation, and maintenance of the field-marked label.

Statement of Problem and Substantiation for Public Input

In 70E-2012, the table method combined both risk and hazard analysis into a single task table which produced an "H/RC Category" (Hazard/Risk Category) which then provided appropriate PPE via Table 130.7(C)(16). Those using the incident energy method would be directed to a similar PPE table in Annex H. Some practitioners incorrectly used Table 130.7(C)(16) "backwards" incorrectly assigning H/RC Categories based on an incident energy analysis. The correct approach was to use Annex H which is substantially identical to Table 130.7(C)(16) except that the "categories" are incident energy. Thus the change in the 2015 cycle to prohibit against use of incident energy analysis method AND H/RC "categories" is valid compared to the tables in 70E-2012 due to the fact that the PPE table incorporated risk. In parallel to that effort, the 2015 task tables are now broken out into two tables. The first table incorporates risk (determines whether or not PPE is required) while the second table which only considers equipment in estimating the hazard produces a PPE Level estimate free of any risk assumptions. As these were parallel efforts, the change from "H/RC" to "PPE Level" does not appear to have been carried over into consideration for restricting use of "PPE Level" (no longer H/RC) on the same label. Due to incorporation of the new rule, plants that previously performed an incident energy analysis (preferred) and used Table 130.7(C)(16) as a "shorthand" instead of Annex H must now migrate to incident energy exclusively or develop their own site-specific table. ATPV ratings on PPE have risen modestly over the past 10-15 years. Thus local site tables are likely to bump the 4/8/25/40 cutoffs higher in recognition of PPE that is issued.

The fundamental problem that this creates is that now every site will have its own "PPE table". Service organizations that service a large number of customers are now faced with every site having local PPE tables. As long as the misuse of the PPE tables existed, PPE tables remained consistent across sites. Although previously technically incorrect, the value of the misuse to service organizations who are already in an elevated risk by having to place considerable trust in the local sites in performing a proper arc flash risk assessment is increased by confusion where no standardization for PPE exists. The technical issue with putting a PPE level on the label alongside an incident energy value no longer exists. The term "PPE Level" is now defined specifically in terms of incident energy alone and does not incorporate risk as it previously did in the 2012 and earlier editions. Thus the reason for prohibiting PPE levels alongside incident energy no longer exists. The proposal removes the prohibition in order to help continue the existing trend towards uniform PPE "levels" across all sites to minimize confusion for service groups.

Submitter Information Verification

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Submittal Date: Mon Apr 13 12:53:06 EDT 2015
Public Input No. 132-NFPA 70E-2015 [Section No. 130.5(D)]

(D) Equipment Labeling.

Electrical equipment such that have been determined through an arc flash risk assessment to contain an arc flash hazard, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are in other than dwelling units and that are likely to require examination, adjustment, servicing, or maintenance while energized shall be field-marked with a label containing all the following information:

1. Nominal system voltage
2. Arc flash boundary
3. At least one of the following:
   4. Available incident energy and the corresponding working distance, or the arc flash PPE category in Table 130.7(C)(15)(A)(b) or 130.7(C)(15)(B) for the equipment, but not both
   5. Minimum arc rating of clothing
   6. Site-specific level of PPE

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 the data to support the information for the label shall be documented. Where the review of the arc flash hazard risk assessment identifies a change that renders the label inaccurate, the label shall be updated.

The owner of the electrical equipment shall be responsible for the documentation, installation, and maintenance of the field-marked label.

Statement of Problem and Substantiation for Public Input

The rule does not provide for locations where no arc flash hazard is present, such as small, single-phase panelboards. Users are obligated to place an arc flash warning label on equipment that has been determined through an arc flash risk assessment to not contain an arc flash hazard. There is no clear direction on what should be placed on a label when no arc flash hazard exists.

Submitter Information Verification

Submitter Full Name: Bobby Gray
Organization: Hoydar/Buck, Inc.
Affiliation: None
Street Address: 
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State: 
Zip: 
Submittal Date: Wed Apr 15 09:36:16 EDT 2015
Public Input No. 133-NFPA 70E-2015 [Section No. 130.5(D)]

(D) 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 that are likely to require examination, adjustment, servicing, or maintenance while energized shall be field- or factory-marked with a label containing all the following information:

1. Nominal system voltage
2. Arc flash boundary
3. At least one of the following:
   4. Available incident energy and the corresponding working distance, or the arc flash PPE category in Table 130.7(C)(15)(A)(b) or 130.7(C)(15)(B) for the equipment, but not both
   5. Minimum arc rating of clothing
   6. Site-specific level of PPE

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 the data to support the information for the label shall be documented. Where the review of the arc flash hazard risk assessment identifies a change that renders the label inaccurate, the label shall be updated to warn qualified persons of potential electric arc flash hazards.

The owner of the electrical equipment shall be responsible for the documentation, installation, and maintenance of the field-marked label.

Statement of Problem and Substantiation for Public Input

Placing detailed information describing arc flash conditions for a particular point in time is a mistake for the following reasons:

1. It gives the impression that energized work is acceptable so long as proper PPE is worn. This conflicts with the hierarchy of controls promoted by 110.1(G).
2. It conflicts with the philosophy reflected in the adoption of the NEC requirement 110.16 and the panel statement that rejected the addition of detailed information when the requirement for an arc flash warning label was introduced into the 2002 NEC. Consequently, two NFPA documents address the same requirement differently.
3. It creates an opportunity for a worker to be under protected if the label has not been confirmed to be accurate for the particular task at a particular time.
4. It conflicts with the approach that a risk assessment should be conducted based on the task to be performed, not on a generic, one-size-fits-all recipe for all work on a particular piece of equipment.
5. It creates confusion for workers and employers for when the label applies. For example, there is nothing that states it applies only when servicing and maintenance is performed. So, some would wonder if it applies when workers are simply in the area or during normal operation. The standard fails to explain how and when the information on the label is to be used. Additionally, the standard does not provide any relief from performing an arc flash risk assessment as required by 130.3. Consequently, the information on the label is superfluous.
6. It creates an unnecessary expense and liability for an employer with no benefit in safety. Doing a task-based risk assessment when a task is performed provides a much greater margin of safety for a worker than relying on historical information.

Placing a label that reminds workers and employers of the potential of an arc flash hazard without the detailed information accomplishes the desired purpose of motivating the use of an electrically safe work condition as a primary consideration.

Submitter Information Verification

Submitter Full Name: Bobby Gray
Organization: Hoydar/Buck, Inc.
Affiliation: None
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Wed Apr 15 09:50:43 EDT 2015
Public Input No. 134-NFPA 70E-2015 [Section No. 130.5(D)]

(D) 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 that are likely to require examination, adjustment, servicing, or maintenance while energized shall be field-marked with a label containing all the following information:

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

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 the data to support the information for the label shall be documented. Where the review of the arc flash hazard risk assessment identifies a change that renders the label inaccurate, the label shall be updated.

The owner of the electrical equipment shall be responsible for the documentation, installation, and maintenance of the field-marked label.

Statement of Problem and Substantiation for Public Input

The requirement to place the voltage on an arc flash warning label is unnecessary and confusing. Since knowledge of the voltage level is necessary to perform a shock risk assessment but not an arc flash risk assessment, it provides the impression that the shock and arc flash risk assessments are not independent of each other as informed in the informational note to 130.4(B). Only qualified persons are permitted to maintain electrical equipment and a criteria to be considered qualified is to obtain the skills to determine the voltage of the equipment. So, the information regarding voltage level on the arc flash warning label provides no useful information and could create confusion.

Submitter Information Verification

Submitter Full Name: Bobby Gray
Organization: Hoydar/Buck, Inc.
Affiliation: None
Street Address:
City:
State:
Zip:
Submittal Date: Wed Apr 15 10:49:33 EDT 2015
Public Input No. 156-NFPA 70E-2015 [ Section No. 130.5(D) ]

(D) 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 that are likely to require examination, adjustment, servicing, or maintenance while energized shall be field-marked with a label containing all the following information:

1. Nominal system voltage
2. Arc flash boundary
3. At least one of the following:
   4. Available incident energy and the corresponding working distance, or the arc flash PPE category in Table 130.7(C)(15)(A)(b) or 130.7(C)(15)(B) for the equipment, but not both
   5. Minimum arc rating of clothing
   6. Site-specific level of PPE

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 the data to support the information for the label shall be documented. Where the review of the arc flash hazard risk assessment identifies a change that renders the label inaccurate, the label shall be updated.

The owner of the electrical equipment shall be responsible for the documentation, installation application, and maintenance of the field-marked label.

Statement of Problem and Substantiation for Public Input

Labels are applied, not installed. Installation requirements are outside the scope of NFPA 70E.

Submitter Information Verification

Submitter Full Name: BOBBY GRAY
Organization: HOYDARBUCK INC
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jun 03 11:37:53 EDT 2015
Public Input No. 201-NFPA 70E-2015 [Section No. 130.5(D)]

(D) 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 that are likely to require examination, adjustment, servicing, or maintenance while energized shall be field-marked with a label containing all the following information:

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

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 the data to support the information for the label shall be documented. Where the review of the arc flash hazard risk assessment identifies a change that renders the label inaccurate, the label shall be updated.

The owner of the electrical equipment shall be responsible for the documentation, installation, and maintenance of the field-marked label.

Additional Proposed Changes

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<tr>
<td>Equipment_labeling_markedRev3.docx</td>
<td>Rewrite of 130.5(D) to provide better guidance on labeling</td>
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Statement of Problem and Substantiation for Public Input

The section has been rewritten to provide specific and detailed guidance on required information, where this information should be placed and guidance on label material. A new exception has been added to replace the current language which was only valid for 70E 2012 edition and provide detailed guidance on applicability of exception clearly stating when new labels or information is needed. It also provides clear label installation directions.

The new proposed language also recognizes that complex electrical systems can be operated in multiple configurations resulting in different incident energy values. Due to limited space available on the front of equipment, there is inadequate space for multiple labels and directions. Multiple labels on the electrical equipment confuse the personnel.

This revised language will allow information required in this section to be maintained at a readily accessible location for personnel which can be updated to reflect any temporary or permanent changes in electrical distribution systems. Service equipment and branch circuit panelboards require labels because in commercial establishments without qualified electrical personnel available, a contract person(s) will need the necessary information.

Submitter Information Verification

Submitter Full Name: DALEEP MOHLA
Organization: DCM ELECTRICAL CONSULTING SERV
Street Address: City: State: Zip:
Submittal Date: Fri Jun 19 16:22:09 EDT 2015

309 of 693
7/7/2015 9:04 AM

NFPA 70E - A2017 FD Meeting Agenda Page 317
Public Input No. 268-NFPA 70E-2015 [Section No. 130.5(D)]

(D) 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 that are likely to require examination, adjustment, servicing, or maintenance while energized shall be field-marked with a label containing all the following information:

1. Nominal system voltage
2. Arc flash boundary
3. At least one of the following:
   4. Available incident energy and the corresponding working distance, or the arc flash PPE category in Table 130.7(C)(15)(A)(b) or 130.7(C)(15)(B) for the equipment, but not both.
   5. Minimum arc rating of clothing
   6. Site-specific level of PPE

Exception: Labels applied prior to September 30, 2011 are effective date of this edition of the standard shall be acceptable if they contain the available incident energy or required level of PPE. The method of calculating and the data to support the information for the label shall be documented. Where the review of the arc flash hazard risk assessment identifies a change that renders the label inaccurate, the label shall be updated.

The owner of the electrical equipment shall be responsible for the documentation, installation, and maintenance of the field-marked label.

Statement of Problem and Substantiation for Public Input
Add clarity to acceptable format requirements for arc flash equipment labels

Submitter Information Verification
Submitter Full Name: DARYLD CROW
Organization: DRC CONSULTING LTD
Affiliation: TG for article 130.4 and 130.5
Street Address:
City:
State:
Zip:
Submittal Date: Fri Jun 26 14:28:31 EDT 2015
(D) 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 that are likely to require examination, adjustment, servicing, or maintenance while energized shall be field-marked with a label containing all the following information:

1. Nominal system voltage
2. Arc flash boundary
3. At least one of the following:
   a. Available incident energy and the corresponding working distance or the arc flash category
   b. Minimum arc rating of clothing
   c. Site-specific level of PPE

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 the data to support the information for the label shall be documented. Where the review of the arc flash hazard risk assessment identifies a change that renders the label inaccurate, the label shall be updated.

The owner of the electrical equipment shall be responsible for the documentation, installation, and maintenance of the field-marked label.

Statement of Problem and Substantiation for Public Input

One major problem that exists with arc flash equipment labeling in large power systems is the incident energy changes when the power system is switched between different feeders and when generators are switched on or off the incoming power feeders. Documenting the minimum arc flash clothing and PPE that a person is required to wear when they perform operations requiring protection from an arc flash in lieu of providing arc flash labels on equipment is one method to resolve this issue. This documentation must be readily available for reference.

Submitter Information Verification

Submitter Full Name: DARYLD CROW
Organization: DRC CONSULTING LTD
Affiliation: TG for article 130.4 and 130.5
Street Address:
City:
State:
Zip:
Submittal Date: Fri Jun 26 14:36:51 EDT 2015
Public Input No. 298-NFPA 70E-2015 [Section No. 130.5(D)]

(D) Equipment Labeling.

Electrical equipment such as switchboards, switchgear, panelboards, industrial control panels, meter socket enclosures, and disconnects that are in other than dwelling units and that are likely to require examination, adjustment, servicing, or maintenance while energized shall be field-marked with a label containing all the following information:

1. Nominal system voltage
2. Arc flash boundary
3. At least one of the following:
   4. Available incident energy and the corresponding working distance, or the arc flash PPE category in Table 130.7(C)(15)(A)(b) or 130.7(C)(15)(B) for the equipment, but not both
   5. Minimum arc rating of clothing
   6. Site-specific level of PPE

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 the data to support the information for the label shall be documented. Where the review of the arc flash hazard risk assessment identifies a change that renders the label inaccurate, the label shall be updated.

The owner of the electrical equipment shall be responsible for the documentation, installation, and maintenance of the field-marked label.

Statement of Problem and Substantiation for Public Input

"Switchgear" and "disconnects" apparently were not included initially. It is common sense to include these two equipment because they are likely to require examination, adjustment, servicing, or maintenance while energized.

Submitter Information Verification

Submitter Full Name: ALVIN HAVENS
Organization: e-Hazard Management, LLC
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Mon Jun 29 11:03:13 EDT 2015
Public Input No. 312-NFPA 70E-2015 [ Section No. 130.5(D) ]

(D) 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 that are likely to require examination, adjustment, servicing, or maintenance while energized shall be field-marked with a label, or documented in a manner that is readily available to persons likely to perform equipment operations, examination, adjustments, servicing or maintenance while energized, containing all the following information:

1. Nominal system voltage
2. Arc flash boundary
3. At least one of the following:
   4. Available incident energy and the corresponding working distance, or the arc flash PPE category in Table 130.7(C)(15)(A)(b) or 130.7(C)(15)(B) for the equipment, but not both
   5. Minimum arc rating of clothing
   6. Site-specific level of PPE

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 the data to support the information for the label shall be documented. Where the review of the arc flash hazard risk assessment identifies a change that renders the label inaccurate, the label shall be updated.

The owner of the electrical equipment shall be responsible for the documentation, installation, and maintenance of the field-marked label.

Statement of Problem and Substantiation for Public Input

Electrical power systems at large facilities are complex and designed with multiple power sources that can be switched in or out of the power system as required. This flexibility can in-turn require multiple labels to be affixed to already congested equipment door panels with limited space availability. The proposed wording will also allow for another method to address the concerns of multiple labels, and the confusion created with multiple labels, as well the posting of a worst case scenario information that is likely to happen very infrequently. The added language will allow users with complex systems to address the concerns of multiple configurations, or modes of operation, with documentation that contains current and accurate information. The proposed language is based on language that exists in the National Electrical Code 2014 Ed. 210.5(C)(1)(b) for the identification of branch circuits and feeder conductors within distribution equipment.

Submitter Information Verification

Submitter Full Name: ERIC GLAUDE
Organization: CHEVRON
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jun 29 13:57:24 EDT 2015
Public Input No. 333-NFPA 70E-2015 [Section No. 130.5(D)]

(D) 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 that are likely to require examination, adjustment, servicing, or maintenance while energized shall be field-marked with a label containing all the following information:

1. Nominal system voltage
2. Arc flash boundary
3. At least one of the following:
   4. Available incident energy and the corresponding working distance, or the arc flash PPE category in Table 130.7(C)(15)(A)(b) or 130.7(C)(15)(B) for the equipment, but not both
   5. Minimum arc rating of clothing
   6. Site-specific level of PPE

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 the data to support the information for the label shall be documented. Where the review of the arc flash hazard risk assessment identifies a change that renders the label inaccurate, the label shall be updated.

The owner of the electrical equipment shall be responsible for the documentation, installation, and maintenance of the field-marked marking label.

Statement of Problem and Substantiation for Public Input

The equipment labeling requirement first appeared in the 2009 edition of NFPA 70E. This requirement has expanded on each subsequent edition. This public input clarifies that the requirement in 130.5(D) is an equipment marking label containing the specified information, but "where" the label is applied (field, factory, panel shop, etc.) is not mandated by the standard.

The submitter recognizes that similar language exists in NEC 110.16. In the development of the current 2014 NEC, CMP-1 changed the language for NEC 110.16 from "...field marked..." to "...field or factory marked...". While it is relatively straightforward to factory apply the arc flash warning labels (that comply with NEC 110.16) there are many cases where it is not possible to factory apply the equipment labels (that comply with NFPA 70E 130.5(D)) because the information is circuit specific. Thus, the public input is to simply state the required content of the marking labels, leaving the decision up to the installer on where the information is available and when and where the marking label is applied.

Note - On my TerraView screen the list items in 3a, b, and c appear underlined. However, there are no changes being proposed for these items by this PI - it appears to just be a formatting issue?

Submitter Information Verification

Submitter Full Name: RODNEY WEST
Organization: SCHNEIDER ELECTRIC
Street Address: City: State: Zip:

Submittal Date: Tue Jun 30 08:13:24 EDT 2015
Statement of Problem and Substantiation for Public Input

1) 130.5 (D) Equipment Labeling is currently listed under section 130.5 Arc Flash Risk Assessment. By moving equipment labeling to a new section, 130.6, labeling requirements would be a standalone item, not derived from the existence of an arc flash hazard. It could be misinterpreted that the labeling requirement is only applicable when the arc flash risk assessment indicates an arc flash hazard. The label is an essential part of performing both a shock risk assessment and an arc flash risk assessment, and in many day-to-day maintenance tasks, may be the sole source of information for the employee doing the risk assessment.

2) The removal of “but not both”, would allow the employer to use a site level of PPE equivalent to the PPE categories, and be compliant with the labeling requirements. It is common practice to assign a PPE category number to an incident energy exposure. This practice easily allows employees to see and understand the arc flash hazard, as well as select appropriate PPE. If used appropriately, through a site specific PPE program with proper training, using PPE categories for incident energy exposure will select the proper PPE for the arc flash hazard.

3) Field marked equipment labeling requirements are specific with what information needs to be on the label, but not how the information should be displayed. By referencing the ANSI Z535 series, arc flash/shock hazard labeling should be more consistent from facility to facility.

Related Public Inputs for This Document

<table>
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<tr>
<th>Related Input</th>
<th>Relationship</th>
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<tr>
<td>Public Input No. 365-NFPA 70E-2015 [New Section after P.1]</td>
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Submitter Information Verification

Submitter Full Name: JASON WOLF
Organization: ESCO GROUP
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Thu Jul 02 16:19:03 EDT 2015
Public Input No. 62-NFPA 70E-2015 [Section No. 130.5(D)]

(D) 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 that are likely to require examination, adjustment, servicing, or maintenance while energized shall be field-marked with a label containing all the following information:

1. Nominal system voltage
2. Arc flash boundary
3. At least one of the following:
   4. Available incident energy and the corresponding working distance, or the arc flash PPE category in Table 130.7(C)(15)(A)(b) or 130.7(C)(15)(B) for the equipment, but not both
   5. Minimum arc rating of clothing
   6. Site-specific level of PPE

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 the data to support the information for the label shall be documented. Where the review of the arc flash risk assessment identifies a change that renders the label inaccurate, the label shall be updated.

The owner of the electrical equipment shall be responsible for the documentation, installation, and maintenance of the field-marked label.

Statement of Problem and Substantiation for Public Input

Removing the word "hazard" aligns with Article 130.5.

Submitter Information Verification

Submitter Full Name: TERRY BECKER
Organization: ESPS Electrical Safety Program Solutions INC
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Mon Mar 09 16:34:54 EDT 2015
Public Input No. 342-NFPA 70E-2015 [Section No. 130.6]

130.6 Other Precautions for Personnel Activities.

(A) Alertness.
(1) When 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 50 volts or more at voltages equal to or greater than 50 Vac or 100 Vdc, and, in work situations when electrical hazards might exist.

(2) When Impaired.

Employees shall not be permitted to work within the limited approach boundary of energized electrical conductors or circuit parts operating at 50 volts or more at voltages equal to or greater than 50 Vac or 100 Vdc, or where other electrical hazards exist, while their alertness is recognizably impaired due to illness, fatigue, or other reasons.

(B) Blind Reaching.

Employees shall be instructed to not reach blindly into areas that might contain exposed energized electrical conductors or circuit parts where an electrical hazard exists.

(C) Illumination.

(1) General.

Employees shall not enter spaces where electrical hazards exist unless illumination is provided that enables the employees to perform the work safely.

(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 50 volts or more at voltages equal to or greater than 50 Vac or 100 Vdc, or where an electrical hazard exists.

(D) Conductive Articles Being Worn.

Conductive articles of jewelry and clothing (such as watchbands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread, metal headgear, or metal frame glasses) shall not be worn within the restricted approach boundary or where they present an electrical contact hazard with exposed energized electrical conductors or circuit parts.

(E) Conductive Materials, Tools, and Equipment Being Handled.

(1) General.

Conductive materials, tools, and equipment that are in contact with any part of an employee’s body shall be handled in a manner that prevents accidental contact with energized electrical conductors or circuit parts. Such materials and equipment shall include, but are not limited to, long conductive objects, such as ducts, pipes and tubes, conductive hose and rope, metal-lined rules and scales, steel tapes, pulling lines, metal scaffold parts, structural members, bull floats, and chains.

(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.

(F) Unobstructed 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 at voltages equal to or greater than 50 Vac or 100 Vdc, 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.

(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 at voltages equal to or greater than 50 Vac or 100 Vdc, or where an electrical hazard exists if movement of the door, hinged panel, and the like is likely to create a hazard.

(H) Clear Spaces.

Working space required by other codes and standards shall not be used for storage. This space shall be kept clear to permit safe operation and maintenance of electrical equipment.

(I) 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. Electrically conductive cleaning materials (including conductive solids such as steel wool, metalized cloth, and silicone carbide, as well as conductive liquid solutions) shall not be used inside the limited approach boundary unless procedures to prevent electrical contact are followed.

(J) Occasional Use of Flammable Materials.

Where flammable materials are present only occasionally, electric equipment capable of igniting them shall not be permitted to be used, unless measures are taken to prevent hazardous conditions from developing. Such materials shall include, but are not limited to, flammable gases, vapors, or liquids; combustible dust; and ignitable fibers or flyings.

Informational Note: Electrical installation requirements for locations where flammable materials are present on a regular basis are contained in NFPA 70, National Electrical Code.

(K) 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 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 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.

(L) Routine Opening and Closing of Circuits.

Load-rated switches, circuit breakers, or other devices specifically designed as disconnecting means shall be used for the opening, reversing, or closing of circuits under load conditions. Cable connectors not of the load-break type, fuses, terminal lugs, and cable splice connections shall not be permitted to be used for such purposes, except in an emergency.

(M) 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.

(N) Safety Interlocks.

Only qualified persons following the requirements for working inside the restricted approach boundary as covered by 130.4(C) 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.

Statement of Problem and Substantiation for Public Input

This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.
This Public Input seeks to resolve the "dc gap" by consistently revising the phrase "50 V or more" to "voltages equal to or greater than 50 Vac or 100 Vdc." A related Public Input has been submitted for Article 130.4.

### Submitter Information Verification

<table>
<thead>
<tr>
<th>Submitter Full Name:</th>
<th>DANIEL ROBERTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization:</td>
<td>SCHNEIDER ELECTRIC</td>
</tr>
<tr>
<td>Affiliation:</td>
<td>This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.</td>
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<tr>
<td>Street Address:</td>
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<td>City:</td>
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<td>Tue Jun 30 13:15:19 EDT 2015</td>
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</table>
Public Input No. 267-NFPA 70E-2015 [Section No. 130.6(E)(1)]

(1) General.
Conductive materials, tools, and equipment that are in contact with any part of an employee’s body shall be handled in a manner that prevents accidental contact with exposed energized electrical conductors or circuit parts. Such materials and equipment shall include, but are not limited to, long conductive objects, such as ducts, pipes and tubes, conductive hose and rope, metal-lined rules and scales, steel tapes, pulling lines, metal scaffold parts, structural members, bull floats, and chains.

Statement of Problem and Substantiation for Public Input

The term “exposed” is added as the reference is to shock hazards in general. The Task Group used the following principles when deciding whether or not to use “exposed” with “energized”:

1. Required when referring to shock hazards in general;
2. Not required when “exposed” is inferred (i.e. preceded by qualifier “within the limited approach boundary of…”);
3. Not required when referring to all electrical hazards or arc flash hazards.

This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the term “exposed” with the term “energized.”

Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the term “exposed” with the term “energized.”
Street Address:
City:
State:
Zip:
Submittal Date: Fri Jun 26 14:09:45 EDT 2015
Public Input No. 243-NFPA 70E-2015 [ Section No. 130.6(K) ]

(K) Anticipating Failure.
When there is evidence that electric equipment could fail and injure employees, the electric equipment shall be de-energized, and placed in an electrically safe work condition, unless the employer can demonstrate that de-energizing introduces additional 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 of the equipment by suitable barricades and other alerting techniques necessary for safety of the employees.

Informational Note No1: See 130.7(E) for alerting techniques.
Informational Note No.2: See Article 120 Establishing an Electrically Safe Work Condition

Statement of Problem and Substantiation for Public Input

Adding the requirements “placed in an electrically safe work condition” infers that not only should the equipment be shut down (de-energized), but also locked out. Testing and grounding should also be done if demonstrated to be feasible, and the risk is acceptable.

Submitter Information Verification

Submitter Full Name: JASON WOLF
Organization: ESCO GROUP
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jun 24 12:18:29 EDT 2015
Public Input No. 114-NFPA 70E-2015 [ Section No. 130.7(A) ]

(A) General.

Employees working in areas where electrical hazards are present shall be provided with, and shall use, protective equipment that is designed and constructed for the specific part of the body to be protected and for the work to be performed.

Informational Note No. 1: The PPE requirements of 130.7 are intended to protect a person from arc flash and shock hazards. While some situations could result in burns to the skin, even with the protection selected, burn injury should be reduced and survivable. Due to the explosive effect of some arc events, physical trauma injuries could occur. The PPE requirements of 130.7 do not address protection against physical trauma other than exposure to the thermal effects of an arc flash.

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.

Informational Note No. 3: When incident energy exceeds 40 cal/cm² at the working distance, greater emphasis may be necessary with respect to de-energizing when exposed to electrical hazards. See Article 110.1(G) Informational Note No. 1 for guidance.

Statement of Problem and Substantiation for Public Input

The informational note states that "greater emphasis may be necessary" for incident energy exceeding 40 cal/cm². There is no physical or technical limitation that occurs at 40 cal/cm². 100 cal/cm² or greater arc flash PPE is now readily available in the market. Thus the cutoff of 40 cal/cm² is arbitrary and contains no scientific merit in and of itself. In addition the fine print note provides no guidance whatsoever as to what "greater emphasis" should entail.

However the principle that the hazards should be eliminated or reduced as much as possible rather than using PPE should not be overlooked and this should be the fundamental purpose of the fine print note. As PPE is required at or above 1.2 cal/cm² in the current embodiment of the standard, emphasis on that (not arbitrary) value should be made. Second specific guidance as to addressing hazards through the use of means other than PPE is already embodied in section 110.1(G).

This proposal references back to 110.1(G) to reinforce the idea that risk assessments and risk reduction rather than PPE should be done. Otherwise, the current methodology encountered at most sites is simply to perform a risk analysis as per the tables in 70E or using some other hazard (not risk) analysis method referenced in Annex D and to require PPE as determined by the hazard analysis method. Risk mitigation MAY occur at or above 40 cal/cm² when in fact the intent of 70E (as per 110.1(G)) is to mitigate the risk when a shock or arc flash hazard exists as per the definitions (above 50 V and above 1.2 cal/cm²).

Submitter Information Verification

Submitter Full Name: Paul Campbell
Organization: PotashCorp Aurora
Street Address:
City:
State:
Zip:
Submittal Date: Mon Apr 13 11:03:14 EDT 2015
(A) General.
Employees working in areas where electrical hazards are present, exposed to electrical hazards when the risk associated with that hazard is not adequately reduced by the applicable electrical installation requirements, shall be provided with, and shall use, protective equipment that is designed and constructed for the specific part of the body to be protected and for the work to be performed.

Informational Note No. 1: The PPE requirements of 130.7 are intended to protect a person from arc flash and shock hazards. While some situations could result in burns to the skin, even with the protection selected, burn injuries should be reduced and survivable. Due to the explosive effect of some arc events, physical trauma injuries could occur. The PPE requirements of 130.7 do not address protection against physical trauma other than exposure to the thermal effects of an arc flash.

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.

Informational Note No. 3: When incident energy exceeds 40 cal/cm² at the working distance, greater emphasis may be necessary with respect to de-energizing when exposed to electrical hazards.

Statement of Problem and Substantiation for Public Input
This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee. This Public Input seeks to resolve several issues
The proposed revision to 130.7(A) provides clarity and consistency within the document. The proposed wording is adapted from 110.2(A).

The proposed deletion of Informational Note No. 3 is for several reasons:
1. The statement conflicts with the requirement to create an electrically safe working condition. Greater emphasis should always be placed on de-energizing regardless of the incident energy level.
2. The statement is often misinterpreted as indicating that blast pressure will be excessive when incident energy exceeds 40 cal/cm². This contradicts the evidence that there is no direct correlation between incident energy levels and blast pressure.
3. It should be left to an employer and employee to determine what thresholds of incident energy are acceptable and appropriate for their work place.

Submitter Information Verification
Submitter Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.
Street Address: City: State: Zip:
Submittal Date: Tue Jun 30 13:25:08 EDT 2015
(A) General.

Employees working in areas where electrical hazards are present shall be provided with, and shall use, protective equipment that is designed and constructed for the specific part of the body to be protected and for the work to be performed.

Informational Note No. 1: The PPE requirements of 130.7 are intended to protect a person from arc flash and shock hazards. While some situations could result in burns to the skin, even with the protection selected, burn injury should be reduced and survivable. Due to the explosive effect of some arc events, physical trauma injuries could occur. The PPE requirements of 130.7 do not address protection against physical trauma other than exposure to the thermal effects of an arc flash.

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.

Informational Note No. 3: When incident energy exceeds 40 cal/cm² at the working distance, greater emphasis may be necessary with respect to de-energizing when exposed to electrical hazards.

Statement of Problem and Substantiation for Public Input

This information (attempting to justify the committee work) is unnecessary in the informational note text of NFPA 70E. It is only serving the user by providing the substantiation for the requirement. The consensus of the committee results in all the information in 70E. It is more appropriate for the public record.

Submitter Information Verification

Submitter Full Name: MICHAEL JOHNSTON
Organization: NATIONAL ELECTRICAL CONTRACTOR
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Thu Jul 02 10:35:27 EDT 2015
**Public Input No. 210-NFPA 70E-2015 [ Section No. 130.7(B) ]**

(B) Care of Equipment.
Protective equipment shall be maintained in a safe, reliable condition in accordance with manufacturers’ instructions. The protective equipment shall be visually inspected before each use. Protective equipment shall be stored in a manner to prevent damage from physically damaging conditions and from moisture, dust, or other deteriorating agents.

Informational Note: Specific requirements for periodic testing of electrical protective equipment are given in 130.7(C) (14) and 130.7(F).

**Statement of Problem and Substantiation for Public Input**

Workers should be directed to consult manufacturer's instructions to ensure that equipment is properly maintained and cared for in a manner specifically intended by the PPE manufacturer. Such reference is consistent with language found in other sections of NFPA 70E.

**Submitter Information Verification**

<table>
<thead>
<tr>
<th>Submitter Full Name:</th>
<th>CRISTINE FARGO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization:</td>
<td>INTERNATIONAL SAFETY EQUIPMENT</td>
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<tr>
<td>Street Address:</td>
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<tr>
<td>Submittal Date:</td>
<td>Mon Jun 22 10:41:55 EDT 2015</td>
</tr>
</tbody>
</table>
Public Input No. 240-NFPA 70E-2015 [Section No. 130.7(B)]

(B) Care of Equipment.
Protective equipment shall be maintained in a sanitary, safe, and reliable condition. The protective equipment shall be visually inspected before each use. Protective equipment shall be stored in a manner to prevent damage from physically damaging conditions and from moisture, dust, or other deteriorating agents.

Informational Note: Specific requirements for periodic testing of electrical protective equipment are given in 130.7(C)(14) and 130.7(F).

Statement of Problem and Substantiation for Public Input
Employees who share PPE may be exposed to germs and other biological hazards; such as blood borne pathogens, if PPE is not maintained in a sanitary condition. For example, employees required to share electrically insulated gloves may have lacerations on their hands, thus contaminating the glove with blood, or exposing them to blood borne pathogens from previous uses of the gloves. It may be outside the scope of this standard to address all possible biological exposures, however, maintaining PPE in a sanitary condition is directly stated in current OSHA standards, as listed below:

1910.132(a) Application. Protective equipment, including personal protective equipment for eyes, face, head, and extremities, protective clothing, respiratory devices, and protective shields and barriers, shall be provided, used, and maintained in a sanitary and reliable condition wherever it is necessary by reason of hazards of processes or environment, chemical hazards, radiological hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical contact.

Submitter Information Verification
Submitter Full Name: JASON WOLF
Organization: ESCO GROUP
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jun 24 10:56:44 EDT 2015
Public Input No. 536-NFPA 70E-2015 [Section No. 130.7(C)(1)]

(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. The worker shall wear both shock and arc flash PPE at whichever boundary they encounter first.

Statement of Problem and Substantiation for Public Input

This public input is intended to recognize the information provided in Informational note to 130.4(B) and to provide guidance that both shock and arc flash protection shall be worn at the outermost boundary the worker encounters.

Submitter Information Verification

Submitter Full Name: PALMER HICKMAN
Organization: ELECTRICAL TRAINING ALLIANCE
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Mon Jul 06 16:37:24 EDT 2015
(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 exposed 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 be arc rated.

Informational Note: See 130.7(C)(10)(b) and (c) for arc flash protective requirements.

Statement of Problem and Substantiation for Public Input

The term “exposed” is added as the reference is to shock hazards in general.

The Task Group used the following principles when deciding whether or not to use “exposed” with “energized”:
1. Required when referring to shock hazards in general;
2. Not required when “exposed” is inferred (i.e. preceded by qualifier “within the limited approach boundary of…”);
3. Not required when referring to all electrical hazards or arc flash hazards.

This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the term "exposed" with the term "energized."

Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the term “exposed” with the term “energized.”
Street Address:
City:
State:
Zip:
Submittal Date: Fri Jun 26 14:43:47 EDT 2015
(4) Eye Protection.
Employees shall wear protective equipment for the eyes that complies with the requirements of ANSI Z87.1-2010, American National Standard Practice for Occupational and Educational Eye and Face Protection, whenever there is danger of injury from electric arcs, flashes, or from flying objects resulting from electrical explosion.

Statement of Problem and Substantiation for Public Input

The requirement does not provide instructions on how to protect the eyes. The added language will make the requirement harmonize with the OSHA requirement in 29 CFR 1910.133(b), Criteria for protective eye and face protection, which mandates that eye protection meet the requirements of ASTM Z87.1.

Submitter Information Verification

Submitter Full Name: Bobby Gray
Organization: Hoydar/Buck, Inc.
Affiliation: None
Street Address:
City:
State:
Zip:
Submittal Date: Wed Apr 08 16:43:39 EDT 2015
(7) Hand and Arm Protection.

Hand and arm protection shall be provided in accordance with 130.7(C)(7)(a), (b), and (c).

(a) Shock Protection. Employees shall wear rubber insulating gloves with leather protectors where there is a danger of hand injury from electric shock due to contact with exposed energized electrical conductors or circuit parts. Employees shall wear rubber insulating gloves with leather protectors and rubber insulating sleeves where there is a danger of hand and arm injury from electric shock due to contact with exposed energized electrical conductors or circuit parts. Rubber insulating gloves shall be rated for the voltage for which the gloves will be exposed.

Exception: Where it is necessary to use rubber insulating gloves without leather protectors, the requirements of ASTM F496, Standard Specification for In-Service Care of Insulating Gloves and Sleeves, shall be met.

(b) Arc Flash Protection. Hand and arm protection shall be worn where there is possible exposure to arc flash burn. The apparel described in 130.7(C)(10)(d) shall be required for protection of hands from burns. Arm protection shall be accomplished by the apparel described in 130.7(C)(6).

(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. Electrical protective equipment shall be subjected to periodic electrical tests. Test voltages and the maximum intervals between tests shall be in accordance with Table 130.7(C)(7)(c).

Informational Note: See OSHA 1910.137 and ASTM F496, Standard Specification for In-Service Care of Insulating Gloves and Sleeves.

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

<table>
<thead>
<tr>
<th>Rubber Insulating Equipment</th>
<th>When to Test</th>
<th>Governing Standard for Test Voltage *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blankets</td>
<td>Before first issue; every 12 months thereafter †</td>
<td>ASTM F479</td>
</tr>
<tr>
<td>Covers</td>
<td>If insulating value is suspect</td>
<td>ASTM F478</td>
</tr>
<tr>
<td>Gloves</td>
<td>Before first issue; every 6 months thereafter †</td>
<td>ASTM F496</td>
</tr>
<tr>
<td>Line hose</td>
<td>If insulating value is suspect</td>
<td>ASTM F478</td>
</tr>
<tr>
<td>Sleeves</td>
<td>Before first issue; every 12 months thereafter †</td>
<td>ASTM F496</td>
</tr>
</tbody>
</table>

* ASTM F478, Standard Specification for In-Service Care of Insulating Line Hose and Covers; ASTM F479, Standard Specification for In-Service Care of Insulating Blankets; ASTM F496, Standard Specification for In-Service Care of Insulating Gloves and Sleeves.
† If the insulating equipment has been electrically tested but not issued for service, it is not permitted to be placed into service unless it has been electrically tested within the previous 12 months.

Statement of Problem and Substantiation for Public Input

The term “exposed” is added as the reference is to shock hazards in general.

The Task Group used the following principles when deciding whether or not to use “exposed” with “energized”:
1. Required when referring to shock hazards in general;
2. Not required when “exposed” is inferred (i.e. preceded by qualifier “within the limited approach boundary of…”);
3. Not required when referring to all electrical hazards or arc flash hazards.

This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the term “exposed” with the term “energized.”

Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the term “exposed” with the term “energized.”
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Fri Jun 26 14:48:02 EDT 2015

329 of 693
Public Input No. 523-NFPA 70E-2015 [ Section No. 130.7(C)(7) ]

(7) Hand and Arm Protection.

Hand and arm protection shall be provided in accordance with 130.7(C)(7)(a), (b), and (c).

(a) Shock Protection. Employees shall wear rubber insulating gloves with leather protectors where there is a danger of hand injury from electric shock due to contact with energized electrical conductors or circuit parts. Employees shall wear rubber insulating gloves with leather protectors and rubber insulating sleeves where there is a danger of hand and arm injury from electric shock due to contact with energized electrical conductors or circuit parts. Rubber insulating gloves shall be rated for the voltage for which the gloves will be exposed.

Exception: Where it is necessary to use rubber insulating gloves without leather protectors, the requirements of ASTM F496, Standard Specification for In-Service Care of Insulating Gloves and Sleeves, shall be met.

(b) Arc Flash Protection. Hand and arm protection shall be worn where there is possible exposure to arc flash burn. The apparel described in 130.7(C)(10)(d) shall be required for protection of hands from burns. Arm protection shall be accomplished by the apparel described in 130.7(C)(6).

(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. Electrical protective equipment shall be subjected to periodic electrical tests. Test voltages and the maximum intervals between tests shall be in accordance with Table 130.7(C)(7)(c).

Informational Note: See OSHA 1910.137 and ASTM F496, Standard Specification for In-Service Care of Insulating Gloves and Sleeves.

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

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<td>Before first issue; every 12 months thereafter†</td>
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† If the insulating equipment has been electrically tested but not issued for service, it is not permitted to be placed into service unless it has been electrically shall be permitted to be stored for 6 months before being issued for use. Insulating equipment shall not be permitted to be used unless tested within the previous 12 months.

Statement of Problem and Substantiation for Public Input

The wording in the note is not clear and is subject to varying interpretations. Some say the equipment can be stored for 1 day less than a year then used for 6 months. Some say it can’t be stored for more than 6 months then used for 6 months.

Submitter Information Verification

Submitter Full Name: PAUL DOBROWSKY
Organization: INNOVATIVE TECHNOLOGY SERVICES
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jul 06 15:05:41 EDT 2015
Foot Protection.

Where an employee stands in water, snow, or in or on any other type of wet surface, while working on energized electrical circuit parts or conductors or where insulated footwear is used as protection against step and touch potential – dielectric footwear shall be required. Insulated soles shall not be used as primary electrical protection.

Informational Note: Electrical Hazard footwear meeting ASTM F2413, Standard Specification for Performance Requirements for Protective (Safety) Toe Cap Footwear, can provide a secondary source of electric shock protection under dry conditions.

Statement of Problem and Substantiation for Public Input

The article as written in the 2015 edition is too vague regarding the use and application of dielectric footwear. Revising it makes it clear that any time an employee works on energized electrical circuit parts or conductors while standing on a wet surface requires dielectric footwear.

Submitter Information Verification

Submitter Full Name: ALVIN HAVENS
Organization: e-Hazard Management, LLC
Street Address: 
City: 
State: 
Zip: 
Submit Date: Fri Jun 19 12:02:17 EDT 2015
(9) Factors in Selection of Protective Clothing.

Clothing and equipment that provide worker protection from shock and arc flash hazards shall be used. If arc-rated clothing is required, it shall cover associated parts of the body as well as all flammable apparel while allowing movement and visibility.

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.

Informational Note: Protective clothing includes shirts, pants, coveralls, jackets, and parkas worn routinely by workers who, under normal working conditions, are exposed to momentary electric arc and related thermal hazards. Arc-rated rainwear worn in inclement weather is included in this category of clothing.

(a) Layering. Nonmelting, flammable fiber garments shall be permitted to be used as underlayers in conjunction with arc-rated garments in a layered system. If nonmelting, flammable fiber garments are used as underlayers, the system arc rating shall be sufficient to prevent breakopen of the innermost arc-rated 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.

(b) Outer Layers. Garments worn as outer layers over arc-rated clothing, such as jackets or rainwear, shall also be made from arc-rated material.

(c) Underlayers. Meltable fibers such as acetate, nylon, polyester, polypropylene, and spandex shall not be permitted in fabric underlayers (underwear) next to the skin.

Exception: An incidental amount of elastic used on nonmelting fabric underwear or socks shall be permitted.

Informational Note No. 1: Arc-rated garments (e.g., shirts, trousers, and coveralls) worn as underlayers that neither ignite nor melt and drip in the course of an exposure to electric arc and related thermal hazards generally provide a higher system arc rating than nonmelting, flammable fiber underlayers.

Informational Note No. 2: Arc-rated underwear or undergarments used as underlayers generally provide a higher system arc rating than nonmelting, flammable fiber underwear or undergarments used as underlayers.

(d) Coverage. Clothing shall cover potentially exposed areas as completely as possible. Shirt and coverall sleeves shall be fastened at the wrists, shirts shall be tucked into pants, and shirts, coveralls, and jackets shall be closed at the neck.

(e) Fit. Tight-fitting clothing shall be avoided. Loose-fitting clothing provides additional thermal insulation because of air spaces. Arc-rated apparel shall fit properly such that it does not interfere with the work task.

(f) Interference. The garment selected shall result in the least interference with the task but still provide the necessary protection. The work method, location, and task could influence the protective equipment selected.

Statement of Problem and Substantiation for Public Input

Fabrics made from these fibers are prohibited from being worn unless the manufacturer can demonstrate their fabric meets the requirements of applicable standards testing. These fabrics can be, or not be worn next to the skin and can be, or not be underwear thus those words are removed.

Submitter Information Verification

Submitter Full Name: DAVID PACE
Organization: OLN CORPORATION
Affiliation: Self
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jun 22 17:55:23 EDT 2015
Public Input No. 345-NFPA 70E-2015 [ Section No. 130.7(C)(9) ]

(9) Factors in Selection of Protective Clothing.

Clothing and equipment that provide worker protection from shock and arc flash hazards shall be used in accordance with the requirements of this Standard. If arc-rated clothing is required, it shall cover associated parts of the body as well as all flammable apparel while allowing movement and visibility.

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.

Informational Note: Protective clothing includes shirts, pants, coveralls, jackets, and parkas worn routinely by workers who, under normal working conditions, are exposed to momentary electric arc and related thermal hazards. Arc-rated rainwear worn in inclement weather is included in this category of clothing.

(a) Layering. Nonmelting, flammable fiber garments shall be permitted to be used as underlayers in conjunction with arc-rated garments in a layered system. If nonmelting, flammable fiber garments are used as underlayers, the system arc rating shall be sufficient to prevent breakopen of the innermost arc-rated 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.

Informational Note: A typical layering system might include cotton underwear, a cotton shirt and trouser, and an arc-rated coverall. Specific tasks might call for additional arc-rated layers to achieve the required protection level.

(b) Outer Layers. Garments worn as outer layers over arc-rated clothing, such as jackets or rainwear, shall also be made from arc-rated material.

(c) Underlayers. Meltable fibers such as acetate, nylon, polyester, polypropylene, and spandex shall not be permitted in fabric underlayers (underwear) next to the skin.

Exception: An incidental amount of elastic used on nonmelting fabric underwear or socks shall be permitted.

Informational Note No. 1: Arc-rated garments (e.g., shirts, trousers, and coveralls) worn as underlayers that neither ignite nor melt and drip in the course of an exposure to electric arc and related thermal hazards generally provide a higher system arc rating than nonmelting, flammable fiber underlayers. Examples of such garments could include parkas, rainwear, chemical-resistant aprons, and high-visibility vests.

Informational Note No. 2: Arc-rated underwear or undergarments used as underlayers generally provide a higher system arc rating than nonmelting, flammable fiber underwear or undergarments used as underlayers.

(d) Coverage. Clothing shall cover potentially exposed areas as completely as possible. Shirt and coverall sleeves shall be fastened at the wrists, shirts shall be tucked into pants, and shirts, coveralls, and jackets shall be closed at the neck.

(e) Fit. Tight-fitting clothing shall be avoided. Loose-fitting clothing provides additional thermal insulation because of air spaces. Arc-rated apparel shall fit properly such that it does not interfere with the work task.

(f) Interference. The garment selected shall result in the least interference with the task but still provide the necessary protection. The work method, location, and task could influence the protective equipment selected.

Statement of Problem and Substantiation for Public Input

This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.

The phrase “in accordance with the requirements of this Standard” is added in the first paragraph for clarity.

The examples in parentheses in 130.7(C)(9)(c) Informational Note No. 1 are relocated to the end of the paragraph and expanded for clarity and usefulness.

Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jun 30 13:33:51 EDT 2015
Public Input No. 10-NFPA 70E-2015 [ New Section after 130.7(C)(10) ]

**TITLE OF NEW CONTENT**
Relocate 130.7(C)(10) as 130.7(C)(12) Arc Flash Protective Equipment
Relocate the second sentence of existing 130.7(C)(10)(b)(1) as an exception to 130.7(C)(10)(b)(1), relocated as 130.7(C)(12)(b)(1) if the recommended relocation occurs. This second sentence appears to be an exception to the requirement in the first sentence.

**Statement of Problem and Substantiation for Public Input**
Relocating this requirement and adding the exception as recommended is intended as editorial changes to enhance usability.

**Submitter Information Verification**
Submitter Full Name: Palmer Hickman  
Organization: Electrical Training Alliance  
Street Address:  
City:  
State:  
Zip:  
Submittal Date: Tue Jan 20 21:44:21 EST 2015
Public Input No. 436-NFPA 70E-2015 [ New Section after 130.7(C)(10) ]

TITLE OF NEW CONTENT
(I) Fall Protection Equipment. Where personal fall arrest systems are used by employees who are exposed to hazards from flames or electric arcs, the fall protection assembly shall have an arc rating that is suitable for the arc flash exposure.

Statement of Problem and Substantiation for Public Input

Arc rating requirements for fall protection equipment is not addressed in Article 130.7.

This addition provides a specific requirement to ensure that workers who are exposed to an electrical arc use fall arrest equipment that can withstand the electrical flame and arc exposure.

OSHA acknowledges the need for arc rated fall arrest equipment to workers exposed to electrical arcs as noted in the recent revision to 1910.269.

Submitter Information Verification

Submitter Full Name: JOHN MCALHANEY
Organization: SAVANNAH RIVER NUCLEAR SOL.
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jul 06 05:18:36 EDT 2015
Public Input No. 106-NFPA 70E-2015 [ Section No. 130.7(C)(10) ]

(10) Arc Flash Protective Equipment.

(a) Arc Flash Suits. Arc flash suit design shall permit easy and rapid removal by the wearer. The entire arc flash suit, including the hood’s face shield, shall have an arc rating that is suitable for the arc flash exposure. When exterior air is supplied into the hood, the air hoses and pump housing shall be either covered by arc-rated materials or constructed of nonmelting and nonflammable materials.

(b) Head Protection.

(1) An arc-rated balaclava shall be used with an arc-rated face shield 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 face shield and balaclava.

(2) An arc-rated hood shall be used when the anticipated incident energy exposure exceeds 12 cal/cm².

(c) Face Protection. Face shields shall have an arc rating suitable for the arc flash exposure. Face shields with a wrap-around 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.

Informational Note: Face shields made with energy-absorbing formulations that can provide higher levels of protection from the radiant energy of an arc flash are available, but these shields are tinted and can reduce visual acuity and color perception. Additional illumination of the task area might be necessary when these types of arc-protective face shields are used.

(d) 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) and 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/cm².

(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.

(e) Foot Protection. Heavy-duty leather footwear provide some arc flash protection to the feet and shall be used in all exposures greater than 4 cal/cm².

Additional Proposed Changes

<table>
<thead>
<tr>
<th>File Name</th>
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<tbody>
<tr>
<td>TIA_70E-15-1.pdf</td>
<td>Issued TIA 15-1, Log #1132</td>
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</table>

Statement of Problem and Substantiation for Public Input

NOTE: This public input originates from Tentative Interim Amendment No. 15-1 (Log 1132) issued by the Standards Council on August 14, 2014. Per the Regulations Governing the Development of NFPA Standards, the Technical Committee shall reconsider the matter of any TIA as Public Input for the next edition of the standard.

The original substantiation for the TIA is as follows:

The revision to Section 130.7(C)(10)(b)(1) created by 70E-SR37 and the related revisions to Table H.3(a) and Table H.3(b) created by 70E-SR61 conflicts with the following sections:

• Section 130.7(C)(1) “All parts of the body inside the arc flash boundary shall be protected”
• Section 130.7(C)(6) “Workers shall wear arc-rated clothing wherever exposure to an electric arc flash above the threshold incident-energy level for a second-degree burn, i.e., 5 J/cm² (1.2 cal/cm²), is possible.”

This conflict was identified in the negative ballot comments on SR37 and SR61 by Palmer Hickman and Rodney West.

At the request of the NFPA Correlating Committee a task group was established by NFPA 70E Technical committee Chair, David Dini, comprised of the following NFPA 70E Technical Committee members:

Rod West (chair), Louis Barrios, Steve Corrado, Paul Dobrowsky, Bobby Gray, Palmer Hickman, John Luke, Mark McNellis, and Vince Saporita.

The task group unanimously agreed on the following:

• The proposed TIA is emergency in nature as it meets the criteria of 5.1(f) in the Regulations Governing the Development of NFPA Standards; and
• The proposed resolution to the identified conflict.

Emergency Nature: As indicated in the substantiation, this proposed TIA meets the following requirement listed in 5.3 of the Regulations Governing the Development of NFPA Standards for the evaluation of emergency nature:

5.3(b) The NFPA Standard contains a conflict within the NFPA Standard or with another NFPA Standard.

Submitter Information Verification

Submitter Full Name: TC on EEW-AAA
Organization: Technical Committee on Electrical Safety in the Employee Workplace
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Tue Apr 07 14:42:52 EDT 2015
Public Input No. 28-NFPA 70E-2015 [ Section No. 130.7(C)(10) ]

(a) Arc Flash Suits. Arc flash suit design shall permit easy and rapid removal by the wearer. The entire arc flash suit, including the hood’s face shield, shall have an arc rating that is suitable for the arc flash exposure. When exterior air is supplied into the hood, the air hoses and pump housing shall be either covered by arc-rated materials or constructed of nonmelting and nonflammable materials.

(b) Head Protection.

(3) An arc-rated balaclava shall be used with an arc-rated face shield 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 face shield and balaclava.

(4) An arc-rated hood shall be used when the anticipated incident energy exposure exceeds 12 cal/cm².

(e) Face Protection. Face shields shall have an arc rating suitable for the arc flash exposure. Face shields with a wrap-around 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.

Informational Note:

1. Face shields made with energy-absorbing formulations that can provide higher levels of protection from the radiant energy of an arc flash are available, but these shields are tinted and can reduce visual acuity and color perception. Additional illumination of the task area might be necessary when these types of arc-protective face shields are used.

2. Arc rated face shields and hood windows have been shown to effectively block convective energy, emitted molten metal, and heated particles generated by an arc flash created within an enclosure. When performing switching activities while wearing this apparel, workers should face the enclosure, hold their breath, close their eyes, and not deliberately turn their heads.

(f) Hand Protection.

(7) 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) and 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/cm².

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.

(h) Foot Protection. Heavy-duty leather footwear provide some arc flash protection to the feet and shall be used in all exposures greater than 4 cal/cm².

Statement of Problem and Substantiation for Public Input

The new IN provides guidance when wearing face protection.

Removing ATPV helps the reader understand that Heavy-duty leather gloves are not arc rated.

Submitter Information Verification

Submitter Full Name: Drake Drobnick
Organization: [ Not Specified ]
Affiliation: N/A
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Sun Feb 01 19:12:28 EST 2015
Public Input No. 524-NFPA 70E-2015 [ Section No. 130.7(C)(10) ]

(10) Arc Flash Protective Equipment.

(a) Arc Flash Suits. Arc flash suit design shall permit easy and rapid removal by the wearer. The entire arc flash suit, including the hood’s face shield, shall have an arc rating that is suitable for the arc flash exposure. When exterior air is supplied into the hood, the air hoses and pump housing shall be either covered by arc-rated materials or constructed of nonmelting and nonflammable materials.

(b) Head Protection.

(3) An arc-rated balaclava shall be used with an arc-rated face shield 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 face shield and balaclava.

(4) An arc-rated hood shall be used when the anticipated incident energy exposure exceeds 12 cal/cm².

(e) Face Protection. Face shields shall have an arc rating suitable for the arc flash exposure. Face shields with a wrap-around 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.

Informational Note: Face shields made with energy-absorbing formulations that can provide higher levels of protection from the radiant energy of an arc flash are available, but these shields are tinted and can reduce visual acuity and color perception. Additional illumination of the task area might be necessary when these types of arc-protective face shields are used.

(f) Hand Protection.

(7) 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) and 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/cm².

(8) 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.

(i) Foot Protection. Heavy-duty leather footwear provides or rubber footwear provides some arc flash protection to the feet and shall be used in all exposures greater than 4 cal/cm².

Statement of Problem and Substantiation for Public Input

The standard presently appears to prohibit wearing dielectric overshoe foot wear without leather. Dielectric footwear is permitted by 130.7(C)(8) so should be permitted instead of leather. Other hazards such as chemical can be present where leather might not be appropriate.

Submitter Information Verification

Submitter Full Name: PAUL DOBROWSKY
Organization: INNOVATIVE TECHNOLOGY SERVICES
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Mon Jul 06 15:13:49 EDT 2015
Public Input No. 9-NFPA 70E-2015 [ Section No. 130.7(C)(10) ]

<table>
<thead>
<tr>
<th>Change (10) → (12)</th>
<th>Arc Flash Protective Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
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<td>Head Protection.</td>
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<td>An arc-rated balaclava shall be used with an arc-rated face shield 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 face shield and balaclava.</td>
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<td>Face Protection. Face shields shall have an arc rating suitable for the arc flash exposure. Face shields with a wrap-around 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.</td>
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Statement of Problem and Substantiation for Public Input

Relocate 130.7(C)(10) and renumber it as 130.7(C)(12) so that it is located adjacent to the related requirements of 130.7(C)(13) as the both address arc rated clothing and arc flash suits. This PI also recommends renumbering the existing 110.7(C)(11) and 130.7(C)(12) as 130.7(C)(10) and 130.7(C)(11). This relocation would also place these related requirements adjacent to each other. Also editorially correct cross references to other requirements as a result of this change if included as a First Revision.

Submitter Information Verification

Submitter Full Name: Palmer Hickman
Organization: Electrical Training Alliance
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jan 20 21:42:56 EST 2015
(12) Clothing and Other Apparel Not Permitted.

Clothing and other apparel (such as hard hat liners and hair nets) made from materials that do not meet the requirements of 130.7(C)(11) regarding melting or made from materials that do not meet the flammability requirements shall not be permitted to be worn.

Informational Note: Some flame-resistant fabrics, such as non-flame-resistant modacrylic and nondurable flame-retardant treatments of cotton, are not recommended for industrial electrical or utility applications.

Exception No. 1: Nonmelting, flammable (non–arc-rated) materials shall be permitted to be used as underlayers to arc-rated clothing, as described in 130.7(C)(11), and also shall be permitted to be used where arc-rated clothing is not required.

Exception No. 2: Where the work to be performed inside the arc flash boundary exposes the worker to multiple hazards, such as airborne contaminants, and the risk assessment identifies that the level of protection is adequate to address the arc flash hazard, non–arc-rated PPE shall be permitted.

Statement of Problem and Substantiation for Public Input

70E-2015 deleted "H/RC 0" but no longer allows any clothing except arc-rated PPE regardless of whether an arc flash hazard exists or not. This proposal reverts to the old 2012 standard allowing non-melting clothing to be used for tasks where arc-rated clothing is not required, absent evidence that meltable fibers do not cause injuries exceeding a first degree burn at an incident energy level below 1.2 cal/cm²/2.

Submitter Information Verification

Submitter Full Name: Paul Campbell
Organization: PotashCorp Aurora
Street Address:
City:
State:
Zip:
Submittal Date: Mon Apr 13 13:29:10 EDT 2015
Public Input No. 211-NFPA 70E-2015 [ Section No. 130.7(C)(14) ]

(14) Standards for Personal Protective Equipment (PPE).
PPE shall conform to the standards listed in Table 130.7(C)(14).

Informational Note: Non–arc-rated or flammable fabrics are not covered by any of the standards in Table 130.7(C)(14). See 130.7(C) (11) and 130.7(C) (12).

Table 130.7(C)(14) Standards on Protective Equipment

<table>
<thead>
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<th>Subject</th>
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<td>ASTM F1449</td>
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<td>ASTM F2757</td>
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<td>Aprons-Insulating</td>
<td>Standard Specification for Electrically Insulating Aprons</td>
<td>ASTM F2677</td>
</tr>
<tr>
<td>Eye and Face Protection-General</td>
<td>Practice for Occupational and Educational Personal Eye and Face Protection Devices</td>
<td>ANSI/ISEA Z87.1</td>
</tr>
<tr>
<td>Face-Arc Rated</td>
<td>Standard Test Method for Determining the Arc Rating and Standard Specification for Eye or Face Protective Products</td>
<td>ASTM F2178</td>
</tr>
<tr>
<td>Fall Protection</td>
<td>Standard Specification for Personal Climbing Equipment</td>
<td>ASTM F887</td>
</tr>
<tr>
<td>Footwear-Standard Performance Specification</td>
<td>Standard Specification for Performance Requirements for Protective (Safety) Toe Cap Footwear</td>
<td>ASTM F2413</td>
</tr>
<tr>
<td>Gloves-Rubber Insulating</td>
<td>Standard Specification for Rubber Insulating Gloves</td>
<td>ASTM D120</td>
</tr>
<tr>
<td>Gloves and Sleeves</td>
<td>Standard Specification for In-Service Care of Insulating Gloves and Sleeves</td>
<td>ASTM F496</td>
</tr>
<tr>
<td>Head Protection-Hard Hats</td>
<td>Requirements for Protective Headwear for Industrial Workers</td>
<td>ANSI Z89.1/ISEA Z89.1</td>
</tr>
<tr>
<td>Rainwear-Arc Rated</td>
<td>Standard Specification for Arc and Flame Resistant Rainwear</td>
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<td>ASTM D1051</td>
</tr>
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</table>

Statement of Problem and Substantiation for Public Input

Edits reflect current standard titles and alphanumeric designations.

Submitter Information Verification

Submitter Full Name: CRISTINE FARGO
Organization: INTERNATIONAL SAFETY EQUIPMENT
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jun 22 10:46:30 EDT 2015
### Public Input No. 6-NFPA 70E-2015 [ Section No. 130.7(C)(14) ]

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

PPE shall conform to the standards listed in Table 130.7(C)(14).

Informational Note: Non–arc-rated or flammable fabrics are not covered by any of the standards in Table 130.7(C)(14). See 130.7(C) (11) and 130.7(C) (12).

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</table>

Statement of Problem and Substantiation for Public Input

This Public Input is intended as an editorial change to the title to this table to make it consistent to the title of 130.7(C)(14)

Submitter Information Verification

Submitter Full Name: Palmer Hickman
Organization: Electrical Training Alliance
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Tue Jan 20 16:50:39 EST 2015
Recommend adding the new Arc Rating of Glove standard to the table.

PPE shall conform to the standards listed in **Table 130.7(C)(14)**.

Informational Note: Non–arc-rated or flammable fabrics are not covered by any of the standards in Table 130.7(C)(14). See 130.7(C) (11) and 130.7(C) (12).

**Table 130.7(C)(14) Standards on Protective Equipment**

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<th>Description Approved</th>
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<tbody>
<tr>
<td>PC_231.pdf</td>
<td>70E-PC231</td>
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</tbody>
</table>

**Statement of Problem and Substantiation for Public Input**

NOTE: This Public Input appeared as “Reject but Hold” in Public Comment No. 231 of the A2014 Second Draft Report for NFPA 70E and per the Regs. at 4.4.8.3.1.

Recommend adding to the list of standards in 130.7(C)(14) the new Arc Rating of Glove Standard. This standard has been approved by ASTM F18 at the April 2013 meeting and its inclusion will eliminate any confusion in 2015 that gloves must meet ASTM F1506 ONLY. This will make more AR gloves available to the market and provide better overall protections since cut resistant gloves can be arc rated effectively by this method but not by the methods included in ASTM F1506.

**Submitter Information Verification**

Submitter Full Name: TC on EEW-AAA
Organization: NFPA Technical Committee on Electrical Safety in the Workplace
Street Address:
City:
State:
Zip:
Submittal Date: Thu Mar 26 16:32:20 EDT 2015
When selected in lieu of the incident energy analysis of 130.5(B)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(A)(b) shall be used to determine the arc flash PPE category. The estimated maximum available short-circuit current, maximum fault-clearing times, and minimum working distances for various ac equipment types or classifications are listed in Table 130.7(C)(15)(A)(b). An incident energy analysis shall be required in accordance with 130.5 for the following:

(1) Tasks not listed in Table 130.7(C)(15)(A)(a)
(2) Power systems with greater than the estimated maximum available short-circuit current
(3) Power systems with longer than the maximum fault clearing times
(4) Tasks with less than the minimum working distance

Table 130.7(C)(15)(A)(a) Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Task</th>
<th>Equipment Condition*</th>
<th>Arc Flash PPE Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading a panel meter while operating a meter switch</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Normal operation of a circuit breaker (CB), switch, contactor, or starter</td>
<td>All of the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly installed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All equipment doors are closed and secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All equipment covers are in place and secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is no evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td>For ac systems: Work on energized electrical conductors and circuit parts, including voltage testing</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems: Work on energized electrical conductors and circuit parts of series-connected battery cells, including voltage testing</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Voltage testing on individual battery cells or individual mult-cell units</td>
<td>All of the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly installed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Covers for all other equipment are in place and secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is no evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td>Removal or installation of CBs or switches</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare energized electrical conductors and circuit parts</td>
<td>All of the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly installed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is no evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td>Removal of bolted covers (to expose bare energized electrical conductors and circuit parts). For dc systems, this includes bolted covers, such as battery terminal covers.</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Removal of battery intercell connector covers</td>
<td>All of the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly installed,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly maintained,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Covers for all other equipment are in place and secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is no evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td>One or more of the following:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly installed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Equipment doors are open or not secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Equipment covers are off or not secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td>Activity</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>Opening hinged door(s) or cover(s) (to expose bare energized electrical conductors and circuit parts)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Perform infrared thermography and other noncontact inspections outside the restricted approach boundary. This activity does not include opening of doors or covers.</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Application of temporary protective grounding equipment after voltage test</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, 120 volts or below without any other exposed energized equipment over 120 V including opening of hinged covers to gain access</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, greater than 120 V</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal of individual starter buckets from motor control center (MCC)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal (racking) of CBs or starters from cubicles, doors open or closed</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal of plug-in devices into or from busways</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insulated cable examination with no manipulation of cable</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Insulated cable examination with manipulation of cable</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Work on exposed energized electrical conductors and circuit parts of equipment directly supplied by a panelboard or motor control center</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion and removal of revenue meters (KW-hour, at primary voltage and current)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an enclosure</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an open rack</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>For dc systems, maintenance on a single cell of a battery system or multi-cell units in an open rack</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>For dc systems, work on exposed energized electrical conductors and circuit parts of utilization equipment directly supplied by a dc source</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 (for clearing times of &lt;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, tested in accordance with IEEE C37.20.7</td>
<td>All of the following:</td>
<td>No</td>
</tr>
<tr>
<td>Insertion or removal (racking) of CBs from cubicles</td>
<td>The equipment is properly installed</td>
<td></td>
</tr>
<tr>
<td>Insertion or removal (racking) of ground and test device</td>
<td>The equipment is properly maintained</td>
<td></td>
</tr>
<tr>
<td>Insertion or removal (racking) of voltage transformers on or off the bus</td>
<td>All equipment doors are closed and secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All equipment covers are in place and secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is no evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>One or more of the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly installed</td>
<td>Yes</td>
</tr>
</tbody>
</table>
### Table 130.7(C)(15)(A)(b) Arc-Flash Hazard PPE Categories for Alternating Current (ac) Systems

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panelboards or other equipment rated 240 V and below</td>
<td>1</td>
<td>485 mm (19 in.)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panelboards or other equipment rated &gt;240 V and up to 600 V</td>
<td>2</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 42 kA short-circuit current available; maximum of 0.33 sec (20 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class switchgear (with power circuit breakers or fused switches) and 600 V class switchboards</td>
<td>4</td>
<td>9 m (3 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.5 sec (30 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other 600-V class (277 V through 600 V, nominal) equipment</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metal-clad switchgear, 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 for clearing times of &lt; 0.5 sec (30 cycles) with a perspective 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, tested in accordance with IEEE C37.20.7, 1 kV through 15 kV</td>
<td>N/A (doors closed)</td>
<td>N/A (doors closed)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>4 (doors open)</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Other equipment 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: For equipment rated 600 volts and below, and protected by upstream current-limiting fuses or current-limiting 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.

### Note

- The equipment is not properly maintained
- Equipment doors are open or not secured
- Equipment covers are off or not secured
- There is evidence of impending failure

The phrase "properly installed," as used in this table, means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer's recommendations. The phrase "properly maintained," as used in this table, means that the equipment has been maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards. The phrase "evidence of impending failure," as used in this table, means that there is evidence of arcing, overheating, loose or bound equipment parts, visible damage, deterioration, or other damage.
When selected in lieu of the incident energy analysis of 130.5(C)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(B) shall be used to determine the arc flash PPE category. The estimated maximum available short circuit current, maximum arc duration and working distances for dc equipment are listed in 130.7(C)(15)(B).

An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Tasks not listed in Table 130.7(C)(15)(A)(a)
2. Power systems with greater than the estimated maximum available short circuit current
3. Power systems with longer than the maximum fault clearing times
4. Tasks with less than the minimum working distance

Informational Note No.1: The arc flash PPE category, work tasks, and protective equipment provided in Table 130.7(C)(15)(A)(a), Table 130.7(C)(15)(A)(b), and Table 130.7(C)(15)(B) were identified and selected, based on the collective experience of the NFPA 70E Technical Committee. The arc flash PPE category of the protective clothing and equipment is generally based on determination of the estimated exposure level.

Informational Note No.2: The collective experience of the NFPA 70E Technical Committee is that, in most cases, closed doors do not provide enough protection to eliminate the need for PPE in situations in which the state of the equipment is known to readily change (e.g., doors open or closed, rack in or rack out).

Informational Note No.3: The premise used by the NFPA 70E Technical Committee 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 committee.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage batteries, dc switchboards, and other dc supply sources</td>
<td>100 V &gt; Voltage &lt; 250 V</td>
<td>Voltage: 250 V</td>
</tr>
<tr>
<td>Parameters:</td>
<td></td>
<td>Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)</td>
</tr>
<tr>
<td>Short-circuit current &lt; 4 kA</td>
<td>1</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>4 kA ≤ short-circuit current &lt; 7 kA</td>
<td>2</td>
<td>1.2 m (4 ft)</td>
</tr>
<tr>
<td>7 kA ≤ short-circuit current &lt; 15 kA</td>
<td>3</td>
<td>1.8 m (6 ft)</td>
</tr>
</tbody>
</table>

Storage batteries, dc switchboards, and other dc supply sources

<table>
<thead>
<tr>
<th>Parameters:</th>
<th>Voltage ≤ 600 V</th>
<th>Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short-circuit current 1.6 kA</td>
<td>1</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>1.6 kA ≤ short-circuit current &lt; 3 kA</td>
<td>2</td>
<td>1.2 m (4 ft)</td>
</tr>
<tr>
<td>3 kA ≤ short-circuit current &lt; 7 kA</td>
<td>3</td>
<td>1.8 m (6 ft)</td>
</tr>
<tr>
<td>7 kA ≤ short-circuit current &lt; 10 kA</td>
<td>4</td>
<td>2.5 m (8 ft)</td>
</tr>
</tbody>
</table>

Note: Apparel that can be expected to be exposed to electrolyte must meet both of the following conditions:

1. Be evaluated for electrolyte protection in accordance with ASTM F1296, Standard Guide for Evaluating Chemical Protective Clothing
2. Be arc-rated in accordance with ASTM F1891, Standard Specification for Arc Rated and Flame Resistant Rainwear, or equivalent

Informational Note No.1: "Short-circuit current," as used in this table, is determined from the dc power system maximum available short-circuit, including the effects of cables and any other impedances in the circuit. 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 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 3x for arc-in-a-box [508 mm (20 in.) cube] versus open air. Engineering judgment is required when reviewing the specific conditions of the equipment and task to be performed, including the dimensions of the enclosure and the working distance involved.

Statement of Problem and Substantiation for Public Input

Remove the word "Hazard" from the heading to Table 130.7(C)(15)(A)(a) to be consistent with the related terminology used. Typically the phrase used is "arc flash PPE category" without "hazard" in NFPA 70E.
Public Input No. 346-NFPA 70E-2015 [Sections 130.7(C)(15), 130.7(C)(16)]

Sections 130.7(C)(15), 130.7(C)(16)

(15) Selection of Personal Protective Equipment (PPE) When Required for Various Tasks. Arc flash PPE Category Method.

The requirements of 130.7(C)(15) shall apply when the arc flash PPE category method is used for the selection of arc flash PPE.
When selected, the arc flash PPE category method is used for the selection of PPE for ac systems, in lieu of the incident energy analysis of 130.5(b)(1), Table 130.7(C)(15)(A)(a) shall be used to identify whether an arc flash PPE is required. When an arc flash PPE is required, Table 130.7(C)(15)(A)(b) shall be used to determine the arc flash PPE category. The estimated maximum available short-circuit current, maximum fault clearing times, and minimum working distances for various ac equipment types or classifications are listed in Table 130.7(C)(15)(A)(b). An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Power systems with greater than the estimated maximum available short-circuit current

2. Power systems with longer than the maximum fault clearing times

3. Tasks with less than the minimum working distance

Table 130.7(C)(15)(A): Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Task</th>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>485 mm (19 in.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>4.3 m (14 ft)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>6 m (20 ft)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
<td>8 m (26 ft)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8</td>
<td>3.5 m (14 ft)</td>
</tr>
</tbody>
</table>

*Note: Hazard identification is one component of risk assessment. Risk assessment involves a determination of the likelihood of occurrence of an incident, resulting from a hazard that could cause injury or damage to health. The assessment of the likelihood of occurrence contained in this table does not cover every possible condition or situation, where this table indicates that an arc flash PPE is not required, an arc flash PPE is not likely to occur.

The phrase, "properly installed", as used in this table, means that the equipment is installed in accordance with applicable industry codes and standards, and the manufacturer's recommendations and applicable industry codes and standards. The phrase, "evidence of impending failure", as used in this table, means that there is evidence of impending failure opening hinged covers to gain access to any work on control circuits with exposed energized electrical conductors and circuit parts. For dc systems, this includes bolted covers, such as battery terminal covers. Any Yes: Application of temporary protective grounding equipment after voltage test. Any Yes: Work on control circuits with exposed energized electrical conductors and circuit parts. Any Yes: Arc-resistant switchgear Type 1 or 2 (for systems in an open rack). Any Yes: Outdoor disconnect switch operation (hookstick operated) at 1 kV through 15 kV. Any Yes: Outdoor disconnect switch operation (gang-operated, from grade) at 1 kV through 15 kV. Any Yes: Insertion or removal of plug-in devices into or from busways. Any Yes: Insertion of revenue meters (kW-hour, at primary voltage and current). Any Yes: Work on exposed energized electrical conductors and circuit parts of utilization equipment directly supplied by a panelboard or motor control center. Any Yes: Insertion or removal of covers for equipment such as wireways, junction boxes, and cable trays that do not expose energized electrical conductors and circuit parts. All of the following: No: The equipment is properly maintained. The equipment is not properly maintained. Equipment doors are open or not secured. Equipment covers are off or not secured. There is no evidence of impending failure.
An incident energy analysis shall be required in accordance with 130.5 for the following:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal-clad switchgear, 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 [for clearing times of &lt; 0.5 sec (30 cycles) with a perspective 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, tested in accordance with IEEE C37.20.7, 1 kV through 15 kV</td>
<td>N/A (doors closed)</td>
<td>N/A (doors closed)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>4 (doors open)</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Other equipment 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: For equipment rated 600 volts and below, and protected by upstream current-limiting fuses or current-limiting 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.

Informational Note: A 1.5 cycle fault clearing time is typical for molded case circuit breakers rated less than 1000 V with an integral instantaneous trip. See IEEE 1584 Table 1.

(B) Direct Current (dc) Equipment.

When selected, the arc flash PPE category method is used for the selection of PPE for dc systems, in lieu of the incident energy analysis of 130.5(C)(1) - Table 130.7(C)(15)(B) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(B) shall be used to determine the arc flash PPE category. The estimated maximum available short circuit current, maximum arc duration and working distances for dc equipment are listed in 130.7(C) (15)(B). An incident energy analysis shall be required in accordance with 130.5 for the following:

- **Tasks not listed in Table 130.7(C)(15)(A)(a):**
- **1.** Power systems with greater than the estimated maximum available short circuit current
- **2.** Power systems with longer than the maximum fault clearing times
- **3.** Tasks with less than the minimum working distance

Informational Note No.1: The arc flash PPE category, work tasks, and protective equipment provided in Table 130.7(C)(15)(A) are, Table 130.7(C)(15)(A)(a), and Table 130.7(C)(15)(B) were identified and selected, based on the collective experience of the NFPA 70E Technical Committee. The arc flash PPE category of the protective clothing and equipment is generally based on determination of the estimated exposure level.

Informational Note No.2: The collective experience of the NFPA 70E Technical Committee is that, in most cases, closed doors do not provide enough protection to eliminate the need for PPE in situations in which the state of the equipment is known to readily change (e.g., doors open or closed, rack in or rack out).

Informational Note No.3: The premise used by the NFPA 70E Technical Committee 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 committee.

### Table 130.7(C)(15)(B) Arc-Flash Hazard PPE Categories for Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage batteries, dc switchboards, and other dc supply sources</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 V &gt; Voltage &lt; 250 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parameters:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage: 250 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)</td>
<td>1 ¹⁄₂</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>Short-circuit current &lt; 4 kA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 kA ≤ short-circuit current &lt; 7 kA</td>
<td>2</td>
<td>1.2 m (4 ft)</td>
</tr>
<tr>
<td>7 kA ≤ short-circuit current &lt; 15 kA</td>
<td>3</td>
<td>1.8 m (6 ft)</td>
</tr>
<tr>
<td>Storage batteries, dc switchboards, and other dc supply sources</td>
<td></td>
<td></td>
</tr>
<tr>
<td>250 V ≤ Voltage ≤ 600 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parameters:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage: 600 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)</td>
<td>1 ¹⁄₂</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>Short-circuit current 1.5 kA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5 kA ≤ short-circuit current &lt; 3 kA</td>
<td>2</td>
<td>1.2 m (4 ft)</td>
</tr>
<tr>
<td>3 kA ≤ short-circuit current &lt; 7 kA</td>
<td>3</td>
<td>1.8 m (6 ft)</td>
</tr>
<tr>
<td>7 kA ≤ short-circuit current &lt; 10 kA</td>
<td>4</td>
<td>2.5 m (8 ft)</td>
</tr>
</tbody>
</table>

Note: Apparel that can be expected to be exposed to electrolyte must meet both of the following conditions:

1. Be evaluated for electrolyte protection in accordance with ASTM F1296, Standard Guide for Evaluating Chemical Protective Clothing
2. Be arc-rated in accordance with ASTM F1891, Standard Specification for Arc Rated and Flame Resistant Rainwear, or equivalent

Informational Note No.1: “Short-circuit current,” as used in this table, is determined from the dc power system maximum available short-circuit, including the effects of cables and any other impedances in the circuit. 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 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 arc arc flash has shown a multiplier of as much as 3x for arc-in-a-box (508 mm (20 in.) cube) versus open air. Engineering judgment is required when reviewing the specific conditions of the equipment and task to be performed, including the dimensions of the enclosure and the working distance involved.
(16)---

Informational Note No. 1: “Short-circuit current,” as used in this table, is determined from the dc power system maximum available short-circuit, including the effects of cables and any other impedances in the circuit. 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 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 3x for arc-in-a-box (508 mm (20 in.) cube) versus open air. Engineering judgment is required when reviewing the specific conditions of the equipment and task to be performed, including the dimensions of the enclosure and the working distance involved.

(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)(16) shall be used to determine the required PPE for the task. Table 130.7(C)(16) 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.

Informational Note No. 1: See Informative Annex H for a suggested simplified approach to ensure adequate PPE for electrical workers within facilities with large and diverse electrical systems.

Informational Note No. 2: The PPE requirements of this section are intended to protect a person from arc flash hazards. While some situations could result in burns to the skin, even with the protection described in Table 130.7(C)(16), burn injury should be reduced and survivable. Due to the explosive effect of some arc events, physical trauma injuries could occur. The PPE requirements of this section do not address protection against physical trauma other than exposure to the thermal effects of an arc flash.

Informational Note No. 3: The arc rating for a particular clothing system can be obtained from the arc-rated clothing manufacturer.

<table>
<thead>
<tr>
<th>PPE Category</th>
<th>PPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Arc-Rated Clothing, Minimum Arc Rating of 4 cal/cm² (see Note 1)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated long-sleeve shirt and pants or arc-rated coverall</td>
</tr>
<tr>
<td></td>
<td>Arc-rated face shield (see Note 2) or arc flash suit hood</td>
</tr>
<tr>
<td></td>
<td>Arc-rated jacket, parka, rainwear, or hard hat liner (AN)</td>
</tr>
<tr>
<td></td>
<td>Protective Equipment</td>
</tr>
<tr>
<td></td>
<td>Hard hat</td>
</tr>
<tr>
<td></td>
<td>Safety glasses or safety goggles (SR)</td>
</tr>
<tr>
<td></td>
<td>Hearing protection (ear canal inserts)</td>
</tr>
<tr>
<td></td>
<td>Heavy duty leather gloves (see Note 3)</td>
</tr>
<tr>
<td></td>
<td>Leather footwear (AN)</td>
</tr>
<tr>
<td>2</td>
<td>Arc-Rated Clothing, Minimum Arc Rating of 8 cal/cm² (see Note 1)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated long-sleeve shirt and pants or arc-rated coverall</td>
</tr>
<tr>
<td></td>
<td>Arc-rated flash suit hood or arc-rated face shield (see Note 2) and arc-rated balaclava</td>
</tr>
<tr>
<td></td>
<td>Arc-rated jacket, parka, rainwear, or hard hat liner (AN)</td>
</tr>
<tr>
<td></td>
<td>Protective Equipment</td>
</tr>
<tr>
<td></td>
<td>Hard hat</td>
</tr>
<tr>
<td></td>
<td>Safety glasses or safety goggles (SR)</td>
</tr>
<tr>
<td></td>
<td>Hearing protection (ear canal inserts)</td>
</tr>
<tr>
<td></td>
<td>Heavy duty leather gloves (see Note 3)</td>
</tr>
<tr>
<td></td>
<td>Leather footwear</td>
</tr>
<tr>
<td>3</td>
<td>Arc-Rated Clothing Selected so That the System Arc Rating Meets the Required Minimum Arc Rating of 25 cal/cm² (see Note 1)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated long-sleeve shirt (AR)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated pants (AR)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated coverall (AR)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated arc flash suit jacket (AR)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated arc flash suit pants (AR)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated arc flash suit hood</td>
</tr>
<tr>
<td></td>
<td>Arc-rated gloves (see Note 3)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated jacket, parka, rainwear, or hard hat liner (AN)</td>
</tr>
<tr>
<td></td>
<td>Protective Equipment</td>
</tr>
<tr>
<td></td>
<td>Hard hat</td>
</tr>
<tr>
<td></td>
<td>Safety glasses or safety goggles (SR)</td>
</tr>
<tr>
<td></td>
<td>Hearing protection (ear canal inserts)</td>
</tr>
<tr>
<td></td>
<td>Leather footwear</td>
</tr>
<tr>
<td>4</td>
<td>Arc-Rated Clothing Selected so That the System Arc Rating Meets the Required Minimum Arc Rating of 40 cal/cm² (see Note 1)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated long-sleeve shirt (AR)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated pants (AR)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated coverall (AR)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated arc flash suit jacket (AR)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated arc flash suit pants (AR)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated arc flash suit hood</td>
</tr>
<tr>
<td></td>
<td>Arc-rated gloves (see Note 3)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated jacket, parka, rainwear, or hard hat liner (AN)</td>
</tr>
<tr>
<td></td>
<td>Protective Equipment</td>
</tr>
<tr>
<td></td>
<td>Hard hat</td>
</tr>
<tr>
<td></td>
<td>Safety glasses or safety goggles (SR)</td>
</tr>
<tr>
<td></td>
<td>Hearing protection (ear canal inserts)</td>
</tr>
<tr>
<td></td>
<td>Leather footwear</td>
</tr>
</tbody>
</table>

Notes:
AN: as needed (optional). AR: as required. SR: selection required.
(1) Arc rating is defined in Article 100.

(2) 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.

(3) If rubber insulating gloves with leather protectors are used, additional leather or arc-rated gloves are not required. The combination of rubber insulating gloves with leather protectors satisfies the arc flash protection requirement.

Statement of Problem and Substantiation for Public Input

This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.

Overview of proposed revisions

The opening sentence to 130.7(C)(15) is relocated from 130.5 and Table 130.7(C)(15)(A)(a) is relocated to Article 130.5. See related Public Input for 130.5. Articles Table 130.7(C)(15)(A) and (B) are revised accordingly: References to Table 130.7(C)(15)(A)(a) and tasks are deleted. Article 130.7(C)(16) and Table 130.7(C)(16) are moved to 130.7(C)(15) and renumbered as Article 130.7(C)(15)(C) and Table 130.7(C)(15)(C) respectively.

Rationale for the proposed revisions

The revision to the arc flash PPE category tables in the 2015 edition of 70E started the process to separate arc flash risk assessment (hazard identification; risk analysis and estimation and risk evaluation) from the selection of arc flash PPE (a risk control method). This proposed revision will complete that process:

- All risk assessment requirements are consolidated in 130.5; and
- All arc flash PPE category method requirements are consolidated in 130.7(C)(15).

A risk assessment must be performed regardless of whether the incident energy method or the arc flash PPE category method is used to select PPE. Table 130.7(C)(15)(A)(a) contains information that is used for the purposes of risk analysis and estimation: tasks and equipment condition. Therefore, Table 130.7(C)(15)(A)(a) clearly belongs in Article 130.5.

It is proposed that Article 130.7(C)(16) be combined with Article 130.7(C)(15) for clarity as all three tables referenced by these Articles are part of the same method and are intended to be used together.

Additional revisions that are unrelated to the above stated objectives

Table 130.7(C)(15)(A)(b):
The proposed note assists users of the ac Table to understand the rationale and reasonableness of the 2 cycle fault clearing time parameter used several times in this table.

Table 130.7(C)(15)(B):
The two instances when PPE Category 1 is specified in Table 130.7(C)(15)(B) the arc flash boundary of 36 inches extends well past the specified working distance of 18 inches. This creates a conflict with the requirement to protect all parts of the body within the arc flash boundary as PPE Category 1 does not require the use of a balaclava.

However, adding an arc-rated balaclava to PPE category 1 in Table 130.7(C)(16) to resolve this conflict will have the unintended consequence of requiring the use of a balaclava for tasks performed on ac panelboards rated up to 240 V where the arc flash boundary of 19 inches does not extend past the back of the head at the specified working distance of 18 inches.

Revising the two references to PPE Category 1 to Category 2 in Table 130.7(C)(15)(B) rather than adding a balaclava to PPE Category 1 in Table 130.7(C)(16) resolves the conflict in a more pragmatic way.

The following revisions are proposed to correct document errata

Table 130.7(C)(16) delete the reference to Note 2 in PPE Category 1 after “Arc-rated faceshield”. A balaclava is currently not required for PPE category 1.

PPE Category 3 and 4 after “Arc-rated gloves) revise Note 1 to Note 3 to correlate with the similar reference to Note 3 in PPE category 1 and 2.

Note to NFPA Staff

In both the pdf and the printed copy of 70E:2015 the two informational notes that belong under Table 130.7(C)(15)(B) Arc-Flash Hazard PPE Categories for Direct Current (dc) Systems are located before the table. However, in the online Public Input the two notes are located after the table.

Related Public Inputs for This Document

<table>
<thead>
<tr>
<th>Related Input</th>
<th>Relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Input No. 340-NFPA 70E-2015 [Section No. 130.5]</td>
<td>Content from 130.5 is relocated to 130.7(C)(15) and from 130.7(C)(15) to 130.5.</td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.
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City:
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Submittal Date: Tue Jun 30 13:39:47 EDT 2015
Public Input No. 358-NFPA 70E-2015 [ New Section after 130.7(C)(15)(A) ]

Informational Note to Table 130.7(C)(15)(A)(b)
Informational Note: The total kA cycles can be used to determine the allowable arc energy for any given task. The total kA cycles cannot exceed the total kA cycles as calculated from the limits given for each task.

Statement of Problem and Substantiation for Public Input

In the previous versions of the task tables, it was not possible to use the kA cycles, as the task table was based on the perceived risk and the HRC could have been reduced by 1, 2 or 3 categories based on that perceived risk. The new table method does not reduce the category and full-rated clothing and PPE must be worn regardless of the task. Because of this, the limits for the short circuit available current and the operating (clearing) time for equipment rated under 600 V tasks should be allowed to use any combination of short circuit available current and operating time that does not exceed the published totals given in the limits.

Example - Table 130.7(C)(15)(A)(b) for the equipment category 600-V class motor control centers (MCCs). Parameters: Maximum of 42 kA short-circuit current available; maximum of 0.33 sec (20 cycles) fault clearing time; working distance 455 mm (18 in.). As written, there is no flexibility if the operating time is shorter than that specified. Allowing the use of the total kA cycles would provide some flexibility.

42 kA @ 20 cycles = 840 kA cycles. If the operating time was shorter (10 cycles) the available short circuit current could be greater than the limit specified (ie. 84 kA @ 10 cycles = 840 kA cycles).

By providing the flexibility to use total kA cycles the qualified person could use the table method where no arc flash hazard warning label is available. This would provide enhanced safety for those qualified persons working where the operating time is less, but the short circuit available current may be more than the limits specified currently.

Submitter Information Verification

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Submittal Date: Thu Jul 02 09:29:09 EDT 2015
Table 130.7(C)(15)(A)(a) Arc-Flash Hazard PPE Categories for Alternating Current (ac) Systems

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panelboards or other equipment rated 240 V and below</td>
<td>1</td>
<td>485 mm (19 in.)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panelboards or other equipment rated &gt;240 V and up to 600 V</td>
<td>2</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>4</td>
<td>4.3 m (14 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 42 kA short-circuit current available; maximum of 0.33 sec (20 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class switchgear (with power circuit breakers or fused switches) and 600 V class switchboards</td>
<td>4</td>
<td>6 m (20 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.5 sec (30 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other 600-V class (277 V through 600 V, nominal) equipment</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metal-clad switchgear, 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 for clearing times of &lt; 0.5 sec (30 cycles) with a perspective 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, tested in accordance with IEEE C37.20.7, 1 kV through 15 kV</td>
<td>N/A (doors closed)</td>
<td>N/A (doors closed)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other equipment 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: For equipment rated 600 volts and below, and protected by upstream current-limiting fuses or current-limiting 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.

Statement of Problem and Substantiation for Public Input

The text in the note to Table 130.7(C)(15)(A)(a) is revised to reflect the intent of the table which is to determine whether PPE is required rather than identification of an arc flash hazard.

Submitter Information Verification

Submitter Full Name: Palmer Hickman
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Street Address:
City:
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When selected in lieu of the incident energy analysis of 130.5(B)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(A)(b) shall be used to determine the arc flash PPE category. The estimated maximum available short-circuit current, maximum fault-clearing times, and minimum working distances for various ac equipment types or classifications are listed in Table 130.7(C)(15)(A)(b). An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Tasks not listed in Table 130.7(C)(15)(A)(a)
2. Power systems with greater than the estimated maximum available short-circuit current
3. Power systems with longer than the maximum fault clearing times
4. Tasks with less than the minimum working distance

Table 130.7(C)(15)(A)(a) Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Task</th>
<th>Equipment Condition*</th>
<th>Arc Flash PPE Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading a panel meter while operating a meter switch</td>
<td>Any</td>
<td>No</td>
</tr>
</tbody>
</table>
| Normal operation of a circuit breaker (CB), switch, contactor, or starter | All of the following:  
The equipment is properly installed  
The equipment is properly maintained  
All equipment doors are closed and secured  
All equipment covers are in place and secured  
There is no evidence of impending failure | No |
| Voltage testing on individual battery cells or individual multi-cell units | All of the following:  
The equipment is properly installed  
The equipment is properly maintained  
Covers for all other equipment are in place and secured  
There is no evidence of impending failure | No |
| For ac systems: Work on energized electrical conductors and circuit parts, including voltage testing | Any | Yes |
| For dc systems: Work on energized electrical conductors and circuit parts of series-connected battery cells, including voltage testing | Any | Yes |
| Removal or installation of CBs or switches | Any | Yes |
| Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare energized electrical conductors and circuit parts | All of the following:  
The equipment is properly installed  
The equipment is properly maintained  
There is no evidence of impending failure | No |
| Removal of bolted covers (to expose bare energized electrical conductors and circuit parts). For dc systems, this includes bolted covers, such as battery terminal covers. | Any | Yes |
| Removal of battery intercell connector covers | All of the following:  
The equipment is properly installed.  
The equipment is properly maintained.  
Covers for all other equipment are in place and secured  
There is no evidence of impending failure | No |
<table>
<thead>
<tr>
<th>Task Description</th>
<th>Any</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening hinged door(s) or cover(s) (to expose bare energized electrical conductors and circuit parts)</td>
<td>Any</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Perform infrared thermography and other noncontact inspections outside the restricted approach boundary. This activity does not include opening of doors or covers.</td>
<td>Any</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Application of temporary protective grounding equipment after voltage test</td>
<td>Any</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, 120 volts or below without any other exposed energized equipment over 120 V including opening of hinged covers to gain access</td>
<td>Any</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, greater than 120 V</td>
<td>Any</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Insertion or removal of individual starter buckets from motor control center (MCC)</td>
<td>Any</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Insertion or removal (racking) of CBs or starters from cubicles, doors open or closed</td>
<td>Any</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Insertion or removal of plug-in devices into or from busways</td>
<td>Any</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Insulated cable examination with no manipulation of cable</td>
<td>Any</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Insulated cable examination with manipulation of cable</td>
<td>Any</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Work on exposed energized electrical conductors and circuit parts of equipment directly supplied by a panelboard or motor control center</td>
<td>Any</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Insertion and removal of revenue meters (kW-hour, at primary voltage and current)</td>
<td>Any</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an enclosure</td>
<td>Any</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an open rack</td>
<td>Any</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>For dc systems, maintenance on a single cell of a battery system or multi-cell units in an open rack</td>
<td>Any</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>For dc systems, work on exposed energized electrical conductors and circuit parts of utilization equipment directly supplied by a dc source</td>
<td>Any</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 (for clearing times of &lt;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, tested in accordance with IEEE C37.20.7:</td>
<td>All of the following:</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Insertion or removal (racking) of CBs from cubicles</td>
<td>All the equipment is properly installed</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Insertion or removal (racking) of ground and test device</td>
<td>All the equipment is properly maintained</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Insertion or removal (racking) of voltage transformers on or off the bus</td>
<td>All equipment doors are closed and secured</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>There is no evidence of impending failure</td>
<td>All equipment covers are in place and secured</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>One or more of the following:</td>
<td>There is no evidence of impending failure</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>The equipment is not properly installed</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The original substantiation for the Public Comment was: Workers using hot sticks or other means to operate these switches may indeed be located outside the arc flash boundary because the stick or operating mechanism provides distance from the actual device. If the worker is located outside the arc flash boundary, then no additional arc flash PPE should be required.

Note: Hazard identification is one component of risk assessment. Risk assessment involves a determination of the likelihood of occurrence of an incident, resulting from a hazard that could cause injury or damage to health. The assessment of the likelihood of occurrence contained in this table does not cover every possible condition or situation. Where this table indicates that arc flash PPE is not required, an arc flash is not likely to occur.

*The phrase properly installed, as used in this table, means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer's recommendations. The phrase properly maintained, as used in this table, means that the equipment has been maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards. The phrase evidence of impending failure, as used in this table, means that there is evidence of arcing, overheating, loose or bound equipment parts, visible damage, deterioration, or other damage.

Table 130.7(C)(15)(A)(b) Arc-Flash Hazard PPE Categories for Alternating Current (ac) Systems

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panelboards or other equipment rated 240 V and below</td>
<td>1</td>
<td>485 mm (19 in.)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panelboards or other equipment rated &gt;240 V and up to 600 V</td>
<td>2</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>4</td>
<td>4.3 m (14 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 42 kA short-circuit current available; maximum of 0.33 sec (20 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class switchgear (with power circuit breakers or fused switches) and 600 V class switchboards</td>
<td>4</td>
<td>6 m (20 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.5 sec (30 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other 600-V class (277 V through 600 V, nominal) equipment</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metal-clad switchgear, 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 [for clearing times of &lt; 0.5 sec (30 cycles) with a perspective 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, tested in accordance with IEEE C37.20.7, 1 kV through 15 kV</td>
<td>N/A (doors closed)</td>
<td>N/A (doors closed)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other equipment 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: For equipment rated 600 volts and below, and protected by upstream current-limiting fuses or current-limiting 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.
When selected in lieu of the incident energy analysis of 130.5(B)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(A)(b) shall be used to determine the arc flash PPE category. The estimated maximum available short-circuit current, maximum fault-clearing times, and minimum working distances for various ac equipment types or classifications are listed in Table 130.7(C)(15)(A)(b). An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Tasks not listed in Table 130.7(C)(15)(A)(a)
2. Power systems with greater than the estimated maximum available short-circuit current
3. Power systems with longer than the maximum fault clearing times
4. Tasks with less than the minimum working distance

Table 130.7(C)(15)(A)(a) Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Task</th>
<th>Equipment Condition*</th>
<th>Arc Flash PPE Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading a panel meter while operating a meter switch</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Normal operation of a circuit breaker (CB), switch, contactor, or starter</td>
<td>All of the following:</td>
<td>No</td>
</tr>
<tr>
<td>1. The equipment is properly installed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. The equipment is properly maintained</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. All equipment doors are closed and secured</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. All equipment covers are in place and secured</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. There is no evidence of impending failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>One or more of the following:</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>1. The equipment is not properly installed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. The equipment is not properly maintained</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Equipment doors are open or not secured</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Equipment covers are off or not secured</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. There is evidence of impending failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>For ac systems: Work on energized electrical conductors and circuit parts, including voltage testing</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems: Work on energized electrical conductors and circuit parts of series-connected battery cells, including voltage testing</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Voltage testing on individual battery cells or individual multi-cell units</td>
<td>All of the following:</td>
<td>No</td>
</tr>
<tr>
<td>1. The equipment is properly installed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. The equipment is properly maintained</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Covers for all other equipment are in place and secured</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. There is no evidence of impending failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>One or more of the following:</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>1. The equipment is not properly installed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. The equipment is not properly maintained</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Equipment doors are open or not secured</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Equipment covers are off or not secured</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. There is evidence of impending failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Removal or installation of CBs or switches</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare energized electrical conductors and circuit parts</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>1. The equipment is properly installed</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>2. The equipment is properly maintained</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. There is no evidence of impending failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any of the following:</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>1. The equipment is not properly installed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. The equipment is not properly maintained</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. There is evidence of impending failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Removal of bolted covers (to expose bare energized electrical conductors and circuit parts). For dc systems, this includes bolted covers, such as battery terminal covers.</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Removal of battery intercell connector covers</td>
<td>All of the following:</td>
<td>No</td>
</tr>
<tr>
<td>1. The equipment is properly installed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. The equipment is properly maintained</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Covers for all other equipment are in place and secured</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. There is no evidence of impending failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>One or more of the following:</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>1. The equipment is not properly installed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. The equipment is not properly maintained</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Equipment doors are open or not secured</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Equipment covers are off or not secured</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity</td>
<td>Condition</td>
<td>Result</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>Opening hinged door(s) or cover(s) (to expose bare energized electrical conductors and circuit parts)</td>
<td>The equipment is properly installed</td>
<td>Yes</td>
</tr>
<tr>
<td>Opening hinged door(s) or cover(s) where exposed conductors are not present</td>
<td>The equipment is properly maintained, There is no evidence of impending failure.</td>
<td>No</td>
</tr>
<tr>
<td>Perform infrared thermography and other noncontact inspections outside the restricted approach boundary. This activity does not include opening of doors or covers.</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Application of temporary protective grounding equipment after voltage test</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, 120 volts or below without any other exposed energized equipment over 120 V including opening of hinged covers to gain access</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, greater than 120 V</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal of individual starter buckets from motor control center (MCC)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal (racking) of CBs or starters from cubicles, doors open or closed</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal of plug-in devices into or from busways</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insulated cable examination with no manipulation of cable</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Insulated cable examination with manipulation of cable</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Work on exposed energized electrical conductors and circuit parts of equipment directly supplied by a panelboard or motor control center</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion and removal of revenue meters (kW-hour, at primary voltage and current)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an enclosure</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an open rack</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>For dc systems, maintenance on a single cell of a battery system or multi-cell units in an open rack</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>For dc systems, work on exposed energized electrical conductors and circuit parts of utilization equipment directly supplied by a dc source</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 (for clearing times of &lt;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, tested in accordance with IEEE C37.20.7:</td>
<td>All of the following:</td>
<td>No</td>
</tr>
<tr>
<td>- Insertion or removal (racking) of CBs from cubicles</td>
<td>The equipment is properly installed</td>
<td>No</td>
</tr>
<tr>
<td>- Insertion or removal (racking) of ground and test device</td>
<td>The equipment is properly maintained</td>
<td>No</td>
</tr>
<tr>
<td>- Insertion or removal (racking) of voltage transformers on or off the bus</td>
<td>All equipment doors are closed and secured</td>
<td>No</td>
</tr>
<tr>
<td>- All equipment covers are in place and secured</td>
<td>There is no evidence of impending failure</td>
<td>No</td>
</tr>
</tbody>
</table>
Submitter Information Verification

Submitter Full Name: Paul Campbell
Organization: PotashCorp Aurora

Statement of Problem and Substantiation for Public Input

If properly installed and maintained, new equipment in switchgear, panelboards, and MCC's does not contain exposed conductors. This category of task is absent from the tables. The phrase *properly installed*, as used in this table, means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer's recommendations and applicable industry codes and standards. The phrase *properly maintained*, as used in this table, means that the equipment has been maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards. The phrase *evidence of impending failure*, as used in this table, means that there is evidence of arcing, overheating, loose or bound equipment parts, visible damage, deterioration, or other damage.

### Table 130.7(C)(15)(A)(b) Arc-Flash Hazard PPE Categories for Alternating Current (ac) Systems

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panelboards or other equipment rated 240 V and below</td>
<td>1</td>
<td>485 mm (19 in.)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td>2</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>Panelboards or other equipment rated &gt;240 V and up to 600 V</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td>4</td>
<td>4.3 m (14 ft)</td>
</tr>
<tr>
<td>Other 600-V class (277 V through 600 V, nominal) equipment</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>N/A (doors closed)</td>
<td>N/A (doors closed)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Other equipment 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Electrical switches and circuit breakers</td>
<td>N/A (doors closed)</td>
<td>N/A (doors closed)</td>
</tr>
</tbody>
</table>

Note: For equipment rated 600 volts and below, and protected by upstream current-limiting fuses or current-limiting 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.
When selected in lieu of the incident energy analysis of 130.5(B)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(A)(b) shall be used to determine the arc flash PPE category. The estimated maximum available short-circuit current, maximum fault-clearing times, and minimum working distances for various ac equipment types or classifications are listed in Table 130.7(C)(15)(A)(b). An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Tasks not listed in Table 130.7(C)(15)(A)(a)
2. Power systems with greater than the estimated maximum available short-circuit current
3. Power systems with longer than the maximum fault clearing times
4. Tasks with less than the minimum working distance

### Table 130.7(C)(15)(A)(a) Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Task</th>
<th>Equipment Condition*</th>
<th>Arc Flash PPE Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading a panel meter while operating a meter switch</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Normal operation of a circuit breaker (CB), switch, contactor, or starter</td>
<td>All of the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly installed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly maintained</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>All equipment doors are closed and secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All equipment covers are in place and secured</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>There is no evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>One or more of the following:</td>
<td></td>
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<tr>
<td></td>
<td>The equipment is not properly installed</td>
<td></td>
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<tr>
<td></td>
<td>The equipment is not properly maintained</td>
<td></td>
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<tr>
<td></td>
<td>Equipment doors are open or not secured</td>
<td></td>
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<tr>
<td></td>
<td>Equipment covers are off or not secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td>For ac systems: Work on energized electrical conductors and circuit parts, including voltage testing</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems: Work on energized electrical conductors and circuit parts of series-connected battery cells, including voltage testing</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Voltage testing on individual battery cells or individual multi-cell units</td>
<td>All of the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly installed</td>
<td></td>
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<tr>
<td></td>
<td>The equipment is properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Covers for all other equipment are in place and secured</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>There is no evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>One or more of the following:</td>
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</tr>
<tr>
<td></td>
<td>The equipment is not properly installed</td>
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<tr>
<td></td>
<td>The equipment is not properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Equipment doors are open or not secured</td>
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<tr>
<td></td>
<td>Equipment covers are off or not secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td>Removal or installation of CBs or switches</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare energized electrical conductors and circuit parts</td>
<td>All of the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly installed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is no evidence of impending failure</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Any of the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly installed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td>Removal of bolted covers (to expose bare energized electrical conductors and circuit parts). For dc systems, this includes bolted covers, such as battery terminal covers:</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Removal of battery intercell connector covers</td>
<td>All of the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly installed,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Covers for all other equipment are in place and secured</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>There is no evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>One or more of the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly installed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Equipment doors are open or not secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Equipment covers are off or not secured</td>
<td></td>
</tr>
<tr>
<td>Activity</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>Opening hinged door(s) or cover(s) (to expose bare energized electrical conductors and circuit parts)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Perform infrared thermography and other noncontact inspections outside the restricted approach boundary. This activity does not include opening of doors or covers.</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Application of temporary protective grounding equipment after voltage test</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, 120 volts or below without any other exposed energized equipment over 120 V including opening of hinged covers to gain access</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, greater than 120 V</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal of individual starter buckets from motor control center (MCC)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal (racking) of CBs or starters from cubicles, doors open or closed</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal of plug-in devices into or from busways</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insulated cable examination with no manipulation of cable</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Insulated cable examination with manipulation of cable</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Work on exposed energized electrical conductors and circuit parts of equipment directly supplied by a panelboard or motor control center</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion and removal of revenue meters (kW-hour, at primary voltage and current)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an enclosure</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an open rack</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>For dc systems, maintenance on a single cell of a battery system or multi-cell units in an open rack</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>For dc systems, work on exposed energized electrical conductors and circuit parts of utilization equipment directly supplied by a dc source</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 (for clearing times of &lt;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, tested in accordance with IEEE C37.20.7:</td>
<td>All of the following:</td>
<td>No</td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 (for clearing times of &lt;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, tested in accordance with IEEE C37.20.7:</td>
<td>All of the following:</td>
<td>No</td>
</tr>
<tr>
<td>Insertion or removal (racking) of CBs from cubicles</td>
<td>The equipment is properly installed</td>
<td>No</td>
</tr>
<tr>
<td>Insertion or removal (racking) of ground and test device</td>
<td>The equipment is properly maintained</td>
<td>No</td>
</tr>
<tr>
<td>Insertion or removal (racking) of voltage transformers on or off the bus</td>
<td>All equipment doors are closed and secured</td>
<td>No</td>
</tr>
<tr>
<td>One or more of the following:</td>
<td>All equipment covers are in place and secured</td>
<td>No</td>
</tr>
<tr>
<td>The equipment is not properly installed</td>
<td>There is no evidence of impending failure</td>
<td>No</td>
</tr>
<tr>
<td>One or more of the following:</td>
<td>The equipment is not properly installed</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Statement of Problem and Substantiation for Public Input

Outdoor overhead switchgear that meets the "normal operation" criteria is no more or less hazardous for arc flash than indoor gear. Incident energy for the same system capacity (transformer size) decreases as voltage increases. In addition the distance exponent (X) for IEEE 1584 is 2 (incident energy falls off with the square of the distance) whereas for Table 10-32 shows that arcing faults for breakers account for 43% of failures while it is only 19% for disconnects. Thus it is clear that arcing faults for disconnects are much less than for breakers but it appears at least initially that medium voltage circuit breakers have a higher failure rate. Disconnects are not broken out further and this is not surprising as the device design is not substantially different. The likely reason that medium voltage equipment is less reliable in 1974 is because modern designs have incorporated better of Vacuum Switchgear at Transmission Voltages", CIGRE WG A3.27 details the scant information that is available and estimates failure rates at 0.00003 failures/year, identical to improved over the past 40 years and that medium voltage equipment failure rates are very similar to low voltage equipment.

Note: Hazard identification is one component of risk assessment. Risk assessment involves a determination of the likelihood of occurrence of an incident, resulting from a hazard that could cause injury or damage to health. The assessment of the likelihood of occurrence contained in this table does not cover every possible condition or situation. Where this table indicates that arc flash PPE is not required, an arc flash is not likely to occur.

*The phrase properly installed, as used in this table, means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer's recommendations. The phrase properly maintained, as used in this table, means that the equipment has been maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards. The phrase evidence of impending failure, as used in this table, means that there is evidence of arcing, overheating, loose or bound equipment parts, visible damage, deterioration, or other damage.

Note: For equipment rated 600 volts and below, and protected by upstream current-limiting fuses or current-limiting 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.
In addition there are significant reasons why medium voltage equipment is by design safer than low voltage equipment. Specific reasons are that due to the presence of partial discharge (tracking, corona damage) which is exacerbated by contamination by dirt and moisture and gives rise to the effect of dry banding, medium voltage equipment by necessity must be kept clean. Enclosures are in general larger and due to Code requirements, energized medium voltage parts are physically isolated from low voltage components in order to keep costs low by not requiring medium voltage insulation except on critical components. Most troubleshooting operations stay within the low voltage compartments and various interlocks and door switches enforce this by cutting off power or locking access doors. This is in contrast to the typical 600 V MCC bucket design where both control power and primary power are similarly exposed with no barriers within the same enclosure, and where even severe environmental contamination can be tolerated as long as it does not cause overheating.

Furthermore when comparing medium voltage to low voltage equipment we need only look to the differences between OSHA and MSHA. Under MSHA, medium voltage electrical equipment was outright banned from 1970 to 1983. From 1983 onwards MSHA only allowed medium voltage equipment under site specific permitting processes until the number of permits had reached over 100. In 2010, MSHA finally published a final rule lifting the ban, Federal Register Volume 75, Number 65, pages 17529-17553, revising 30 CFR Parts 18 and 75 for coal mines, following granting 52 petitions for modification from 1997 to 2010 for 5 kV equipment. In the revision, “MSHA determined that the methods the mine operator proposed to follow when using the high voltage equipment would at all times guarantee no less than the same measure of protection afforded the miners by the existing standards.” Similar language is repeated throughout the publication in the federal register.

Thus the proposal is to delete special rules for medium voltage outdoor equipment. The evidence shows that arcing fault rates are not substantially different from low voltage equipment or comparing indoor to outdoor equipment. The existing general rules for “normal operation” which do not distinguish between outdoor, medium voltage equipment and other types (leading to confusion as to which rule applies) should stand as guidance for normal operation of all types of equipment.

Submitter Information Verification

Submitter Full Name: Paul Campbell
Organization: PotashCorp Aurora
Street Address:
City:
State:
Zip:
Submittal Date: Mon Apr 13 14:45:08 EDT 2015
When selected in lieu of the incident energy analysis of 130.5(B)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(A)(b) shall be used to determine the arc flash PPE category. An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Tasks not listed in Table 130.7(C)(15)(A)(a)
2. Power systems with greater than the estimated maximum available short-circuit current
3. Power systems with longer than the maximum fault clearing times
4. Tasks with less than the minimum working distance

Table 130.7(C)(15)(A)(a) Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Task</th>
<th>Equipment Condition*</th>
<th>Arc Flash PPE Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading a panel meter while operating a meter switch</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Normal operation of a circuit breaker (CB), switch, contactor, or starter</td>
<td>All of the following: The equipment is properly installed The equipment is properly maintained All equipment doors are closed and secured All equipment covers are in place and secured There is no evidence of impending failure</td>
<td>No</td>
</tr>
<tr>
<td>For ac systems: Work on energized electrical conductors and circuit parts, including voltage testing</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems: Work on energized electrical conductors and circuit parts of series-connected battery cells, including voltage testing</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Voltage testing on individual battery cells or individual multi-cell units</td>
<td>All of the following: The equipment is properly installed The equipment is properly maintained Covers for all other equipment are in place and secured There is no evidence of impending failure</td>
<td>No</td>
</tr>
<tr>
<td>Removal or installation of CBs or switches</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare energized electrical conductors and circuit parts</td>
<td>All of the following: The equipment is properly installed The equipment is properly maintained There is no evidence of impending failure</td>
<td>No</td>
</tr>
<tr>
<td>Removal of bolted covers (to expose bare energized electrical conductors and circuit parts). For dc systems, this includes bolted covers, such as battery terminal covers.</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Removal of battery intercell connector covers</td>
<td>All of the following: The equipment is properly installed The equipment is properly maintained Covers for all other equipment are in place and secured There is no evidence of impending failure</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>One or more of the following: The equipment is not properly installed The equipment is not properly maintained Equipment doors are open or not secured Equipment covers are off or not secured There is evidence of impending failure</td>
<td>Yes</td>
</tr>
</tbody>
</table>
There is evidence of impending failure

<table>
<thead>
<tr>
<th>Activity</th>
<th>Any</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening hinged door(s) or cover(s) (to expose bare energized electrical conductors and circuit parts)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perform infrared thermography and other noncontact inspections outside the restricted approach boundary.</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Application of temporary protective grounding equipment after voltage test</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 kV, volts or below without any other exposed energized equipment over 1 kV including opening of hinged covers to gain access</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, greater than 1 kV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 kV, volts or below without any other exposed energized equipment over 1 kV, V including opening of hinged covers to gain access</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal of individual starter buckets from motor control center (MCC)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal (racking) of CBs or starters from cubicles, doors open or closed</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal of plug-in devices into or from busways</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insulated cable examination with no manipulation of cable</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Insulated cable examination with manipulation of cable</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Work on exposed energized electrical conductors and circuit parts of equipment directly supplied by a panelboard or motor control center</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion and removal of revenue meters (kW-hour, at primary voltage and current)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an enclosure</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an open rack</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>For dc systems, maintenance on a single cell of a battery system or multi-cell units in an open rack</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>For dc systems, work on exposed energized electrical conductors and circuit parts of utilization equipment directly supplied by a dc source</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 (for clearing times of &lt;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, tested in accordance with IEEE C37.20.7</td>
<td>All of the following:</td>
<td></td>
</tr>
<tr>
<td>· Insertion or removal (racking) of CBs from cubicles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>· Insertion or removal (racking) of ground and test device</td>
<td></td>
<td></td>
</tr>
<tr>
<td>· Insertion or removal (racking) of voltage transformers on or off the bus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opening voltage transformer or control power transformer compartments</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Outdoor disconnect switch operation (hookstick operated) at 1 kV through 15 kV</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Outdoor disconnect switch operation (gang-operated, from grade) at 1 kV through 15 kV</td>
<td>Any</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Note: Hazard identification is one component of risk assessment. Risk assessment involves a determination of the likelihood of occurrence of an incident, resulting from a hazard that could cause injury or damage to health. The assessment of the likelihood of occurrence contained in this table does not cover every possible condition or situation. Where this table indicates that arc flash PPE is not required, an arc flash is not likely to occur.

*The phrase properly installed, as used in this table, means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer's recommendations. The phrase properly maintained, as used in this table, means that the equipment has been maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards. The phrase evidence of impending failure, as used in this table, means that there is
evidence of arcing, overheating, loose or bound equipment parts, visible damage, deterioration, or other damage.

Table 130.7(C)(15)(A)(b) Arc-Flash Hazard PPE Categories for Alternating Current (ac) Systems

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panelboards or other equipment rated ≤ 240 V</td>
<td>1</td>
<td>485 mm (19 in.)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panelboards or other equipment rated &gt;240 V and up to 600 V</td>
<td>2</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>4</td>
<td>4.3 m (14 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 42 kA short-circuit current available; maximum of 0.33 sec (20 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class switchgear (with power circuit breakers or fused switches) and 600 V class switchboards</td>
<td>4</td>
<td>9 m (3 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.5 sec (30 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other 600-V class (277 V through 600 V, nominal) equipment</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metal-clad switchgear, 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Arc-resistant switchgear Type 1 or 2 [for clearing times of < 0.5 sec (30 cycles) with a perspective 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, tested in accordance with IEEE C37.20.7, 1 kV through 15 kV

Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)

Other equipment 1 kV through 15 kV

Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)

N/A (doors closed) N/A (doors closed)

Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)

Other equipment 1 kV through 15 kV

Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)

Note: For equipment rated 600 volts and below, and protected by upstream current-limiting fuses or current-limiting 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.

Statement of Problem and Substantiation for Public Input

The industry has a large percentage of 125V dc control circuits which switchgear manufacturers are enclosing in control cabinets. It makes sense to include this voltage level in the task where arc flash PPE is not required for work on control circuits.

While I understand that the technical committee has indicated that dc voltages 100V and above (and maybe even below) do pose an arc flash hazard, I disagree that this hazard exists within the control cabinet.

Submitter Information Verification

Submitter Full Name: Kyle Rossiter
Organization: Lockheed Martin
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Thu May 07 15:23:37 EDT 2015
When selected in lieu of the incident energy analysis of 130.5(B)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(A)(b) shall be used to determine the arc flash PPE category. The estimated maximum available short-circuit current, maximum fault-clearing times, and minimum working distances for various ac equipment types or classifications are listed in Table 130.7(C)(15)(A)(b). An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Tasks not listed in Table 130.7(C)(15)(A)(a)
2. Power systems with greater than the estimated maximum available short-circuit current
3. Power systems with longer than the maximum fault clearing times
4. Tasks with less than the minimum working distance

### Table 130.7(C)(15)(A)(a) Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Task</th>
<th>Equipment Condition*</th>
<th>Arc Flash PPE Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading a panel meter while operating a meter switch</td>
<td>Any</td>
<td>No</td>
</tr>
</tbody>
</table>
| Normal operation of a circuit breaker (CB), switch, contactor, or starter | All of the following:  
  - The equipment is properly installed  
  - The equipment is properly maintained  
  - All equipment doors are closed and secured  
  - All equipment covers are in place and secured  
  - There is no evidence of impending failure | No                     |
|                                                                        | One or more of the following:  
  - The equipment is not properly installed  
  - The equipment is not properly maintained  
  - Equipment doors are open or not secured  
  - Equipment covers are off or not secured  
  - There is evidence of impending failure | Yes                     |
|                                                                        | Metal-enclosed equipment operating above 600 V ac | No                     |
| For ac systems: Work on energized electrical conductors and circuit parts, including voltage testing | Any                  | Yes                     |
| For dc systems: Work on energized electrical conductors and circuit parts of series-connected battery cells, including voltage testing | Any                  | Yes                     |
| Voltage testing on individual battery cells or individual multi-cell units | All of the following:  
  - The equipment is properly installed  
  - The equipment is properly maintained  
  - Covers for all other equipment are in place and secured  
  - There is no evidence of impending failure | No                     |
|                                                                        | One or more of the following:  
  - The equipment is not properly installed  
  - The equipment is not properly maintained  
  - Equipment doors are open or not secured  
  - Equipment covers are off or not secured  
  - There is evidence of impending failure | Yes                     |
| Removal or installation of CBs or switches                           | Any                  | Yes                     |
| Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare energized electrical conductors and circuit parts | All of the following:  
  - The equipment is properly installed  
  - The equipment is properly maintained  
  - There is no evidence of impending failure | No                     |
|                                                                        | Any of the following:  
  - The equipment is not properly installed  
  - The equipment is not properly maintained  
  - There is evidence of impending failure | Yes                     |
| Removal of bolted covers (to expose bare energized electrical conductors and circuit parts). For dc systems, this includes bolted covers, such as battery terminal covers | Any                  | Yes                     |
| Removal of battery intercell connector covers                        | All of the following:  
  - The equipment is properly installed  
  - The equipment is properly maintained  
  - Covers for all other equipment are in place and secured  
  - There is no evidence of impending failure | No                     |
|                                                                        | One or more of the following:  
  - The equipment is not properly installed  
  - The equipment is not properly maintained  | Yes                     |
<table>
<thead>
<tr>
<th>Activity Description</th>
<th>Any</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening hinged door(s) or cover(s) (to expose bare energized electrical conductors and circuit parts)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perform infrared thermography and other non-contact inspections outside the restricted approach boundary.</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Application of temporary protective grounding equipment after voltage test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, 120 volts or below</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, greater than 120 V</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal of individual starter buckets from motor control center (MCC)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal (racking) of CBs or starters from cubicles, doors open or closed</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal of plug-in devices into or from busways</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insulated cable examination with no manipulation of cable</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Insulated cable examination with manipulation of cable</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Work on exposed energized electrical conductors and circuit parts directly supplied by a panelboard or motor control center</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion and removal of revenue meters (kW-hour, at primary voltage and current)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an enclosure</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an open rack</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>For dc systems, maintenance on a single cell of a battery system or multi-cell units in an open rack</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>For dc systems, work on exposed energized electrical conductors and circuit parts of utilization equipment directly supplied by a dc source</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 (for clearing times of &lt;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, tested in accordance with IEEE C37.20.7</td>
<td>All of the following:</td>
<td>No</td>
</tr>
<tr>
<td>Insertion or removal (racking) of CBs from cubicles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insertion or removal (racking) of ground and test device</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insertion or removal (racking) of voltage transformers on or off the bus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All equipment doors are closed and secured</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All equipment covers are in place and secured</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There is no evidence of impending failure</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Submitter Information Verification

Submitter Full Name: JAMES WHITE
Organization: SHERMCO INDUSTRIES INC
Affiliation: interNational Electrical Testing Association (NETA)

Statement of Problem and Substantiation for Public Input

Equipment rated above 600 Vac presents increased risks that may not be present at the < 600 V level. Adding the condition of "Metal-enclosed equipment rated above 600 Vac" to the section requiring the use of arc-rated PPE would enhance personnel safety without imposing a burden for all electrical workers operating open-air medium-voltage equipment.

Note: Hazard identification is one component of risk assessment. Risk assessment involves a determination of the likelihood of occurrence of an incident, resulting from a hazard that could cause injury or damage to health. The assessment of the likelihood of occurrence contained in this table does not cover every possible condition or situation. Where this table indicates that arc flash PPE is not required, an arc flash is not likely to occur.

The phrase properly installed, as used in this table, means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer's recommendations. The phrase properly maintained, as used in this table, means that the equipment has been maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards. The phrase evidence of impending failure, as used in this table, means that there is evidence of arcing, overheating, loose or bound equipment parts, visible damage, deterioration, or other damage.

Table 130.7(C)(15)(A)(b) Arc-Flash Hazard PPE Categories for Alternating Current (ac) Systems

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panelboards or other equipment rated 240 V and below</td>
<td>1</td>
<td>485 mm (19 in.)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panelboards or other equipment rated &gt;240 V and up to 600 V</td>
<td>2</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>4</td>
<td>4.3 m (14 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 42 kA short-circuit current available; maximum of 0.33 sec (20 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class switchgear with power circuit breakers or fused switches and 600 V class switchboards</td>
<td>4</td>
<td>9 m (30 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.5 sec (30 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other 600-V class (277 V through 600 V, nominal) equipment</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metal-clad switchgear, 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 for clearing times of &lt; 0.5 sec (30 cycles) with a perspective 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, tested in accordance with IEEE C37.20.7 1 kV through 15 kV</td>
<td>N/A (doors closed)</td>
<td>N/A (doors closed)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>4 (doors open)</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Other equipment 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
When selected in lieu of the incident energy analysis of 130.5(B)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(A)(b) shall be used to determine the arc flash PPE category. The estimated maximum available short-circuit current, maximum fault-clearing times, and minimum working distances for various ac equipment types or classifications are listed in Table 130.7(C)(15)(A)(b). An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Tasks not listed in Table 130.7(C)(15)(A)(a)
2. Power systems with greater than the estimated maximum available short-circuit current
3. Power systems with longer than the maximum fault clearing times
4. Tasks with less than the minimum working distance

### Table 130.7(C)(15)(A)(a) Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Task</th>
<th>Equipment Condition*</th>
<th>Likelihood of Arc Flash PPE Required Incident occurring that will require the use of arc flash PPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading a panel meter while operating a meter switch</td>
<td>Any</td>
<td>No</td>
</tr>
</tbody>
</table>
| Normal operation of a circuit breaker (CB), switch, contactor, or starter | All of the following:  
The equipment is properly installed  
The equipment is properly maintained  
All equipment doors are closed and secured  
All equipment covers are in place and secured  
There is no evidence of impending failure | No                                                                                              |
| One or more of the following:  
The equipment is not properly installed  
The equipment is not properly maintained  
Equipment doors are open or not secured  
Equipment covers are off or not secured  
There is evidence of impending failure | Yes                                                               |
| For ac systems: Work on energized electrical conductors and circuit parts, including voltage testing | Any                  | Yes                                                                                              |
| For dc systems: Work on energized electrical conductors and circuit parts of series-connected battery cells, including voltage testing | Any                  | Yes                                                                                              |
| Voltage testing on individual battery cells or individual multi-cell units | All of the following:  
The equipment is properly installed  
The equipment is properly maintained  
Covers for all other equipment are in place and secured  
There is no evidence of impending failure | No                                                                                              |
| One or more of the following:  
The equipment is not properly installed  
The equipment is not properly maintained  
Equipment doors are open or not secured  
Equipment covers are off or not secured  
There is evidence of impending failure | Yes                                                               |
| Removal or installation of CBs or switches                            | Any                  | Yes                                                                                              |
| Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare energized electrical conductors and circuit parts | All of the following:  
The equipment is properly installed  
The equipment is properly maintained  
There is no evidence of impending failure | No                                                                                              |
| Any of the following:  
The equipment is not properly installed  
The equipment is not properly maintained  
There is evidence of impending failure | Yes                                                               |
| Removal of bolted covers (to expose bare energized electrical conductors and circuit parts). For dc systems, this includes bolted covers, such as battery terminal covers. | Any                  | Yes                                                                                              |
| Removal of battery intercell connector covers                         | All of the following:  
The equipment is properly installed.  
The equipment is properly maintained.  
Covers for all other equipment are in place and secured  
There is no evidence of impending failure | No                                                                                              |
| One or more of the following:  
The equipment is not properly installed  
The equipment is not properly maintained  
Equipment doors are open or not secured  
Equipment covers are off or not secured  
There is evidence of impending failure | Yes                                                               |
<table>
<thead>
<tr>
<th>Activity Description</th>
<th>Any</th>
<th>Yes/No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening hinged door(s) or cover(s) (to expose bare energized electrical conductors and circuit parts)</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Perform infrared thermography and other non-contact inspections outside the restricted approach boundary. This activity does not include opening of doors or covers.</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Application of temporary protective grounding equipment after voltage test</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, 120 volts or below without any other exposed energized equipment over 120 V including opening of hinged covers to gain access</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, greater than 120 V</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Insertion or removal of individual starter buckets from motor control center (MCC)</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Insertion or removal (racking) of CBs or starters from cubicles, doors open or closed</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Insertion or removal of plug-in devices into or from busways</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Insulated cable examination with no manipulation of cable</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Insulated cable examination with manipulation of cable</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Work on exposed energized electrical conductors and circuit parts of equipment directly supplied by a panelboard or motor control center</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Insertion and removal of revenue meters (kW-hour, at primary voltage and current)</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an enclosure</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an open rack</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>For dc systems, maintenance on a single cell of a battery system or multi-cell units in an open rack</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>For dc systems, work on exposed energized electrical conductors and circuit parts of utilization equipment directly supplied by a dc source</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 (for clearing times of &lt;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, tested in accordance with IEEE C37.20.7:</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Insertion or removal (racking) of CBs from cubicles</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Insertion or removal (racking) of ground and test device</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Insertion or removal (racking) of voltage transformers on or off the bus</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 (for clearing times of &lt;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, tested in accordance with IEEE C37.20.7:</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Insertion or removal (racking) of CBs from cubicles</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Insertion or removal (racking) of ground and test device</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Insertion or removal (racking) of voltage transformers on or off the bus</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>The equipment is properly installed</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>The equipment is properly maintained</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>All equipment doors are closed and secured</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>All equipment covers are in place and secured</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>There is no evidence of impending failure</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>
Submitter Information Verification

| Street Address: | Organization: DRC CONSULTING LTD | Name: DARYLD CROW |

Statement of Problem and Substantiation for Public Input

The fact that equipment is properly installed and properly maintained minimizes the likelihood of an arc flash incident. It does not ensure that an arc flash will not happen.

Table 130.7(C)(15)(A)(b) Arc-Flash Hazard PPE Categories for Alternating Current (ac) Systems

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panelboards or other equipment rated 240 V and below</td>
<td>1</td>
<td>485 mm (19 in.)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td>2</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>Panelboards or other equipment rated &gt;240 V and up to 600 V</td>
<td>4</td>
<td>6 m (20 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 42 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Panelboards or other equipment rated &gt;600 V and up to 1000 V</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.5 sec (30 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Other 600-V class (277 V through 600 V, nominal) equipment</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Metal-clad switchgear, 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
</tbody>
</table>

Note: For equipment rated 600 volts and below, and protected by upstream current-limiting fuses or current-limiting 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.

Note #1: Low Probability/High Consequence issues produce the same injuries as High Probability/High Consequence issues if safe work practices and arc-rated clothing and PPE are not used and the event happens.

Note #2: Hazard identification is one component of risk assessment. Risk assessment involves a determination of the likelihood of occurrence of an incident, resulting from a hazard that could cause injury or damage to health. The assessment of the likelihood of occurrence contained in this table does not cover every possible condition or situation. Where this table indicates that arc flash PPE is not required, an arc flash is not likely to occur.

*The phrase properly installed, as used in this table, means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer's recommendations. The phrase properly maintained, as used in this table, means that the equipment has been maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards. The phrase evidence of impending failure, as used in this table, means that there is evidence of arcing, overheating, loose or bound equipment parts, visible damage, deterioration, or other damage.
When selected in lieu of the incident energy analysis of 130.5(B)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(A)(b) shall be used to determine the arc flash PPE category. The estimated maximum available short-circuit current, maximum fault-clearing times, and minimum working distances for various ac equipment types or classifications are listed in Table 130.7(C)(15)(A)(b). An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Tasks not listed in Table 130.7(C)(15)(A)(a)
2. Power systems with greater than the estimated maximum available short-circuit current
3. Power systems with longer than the maximum fault clearing times
4. Tasks with less than the minimum working distance

### Table 130.7(C)(15)(A)(a) Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Task</th>
<th>Equipment Condition*</th>
<th>Employer states Arc Flash PPE Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading a panel meter while operating a meter switch</td>
<td>Any</td>
<td>No</td>
</tr>
</tbody>
</table>
| Normal operation of a circuit breaker (CB), switch, contactor, or starter | All of the following:  
  - The equipment is properly installed  
  - The equipment is properly maintained  
  - All equipment doors are closed and secured  
  - All equipment covers are in place and secured  
  - There is no evidence of impending failure | No                                     |
|                                                                      | One or more of the following:  
  - The equipment is not properly installed  
  - The equipment is not properly maintained  
  - Equipment doors are open or not secured  
  - Equipment covers are off or not secured  
  - There is evidence of impending failure | Yes                                     |
| For ac systems: Work on energized electrical conductors and circuit parts, including voltage testing | Any                  | Yes                                     |
| For dc systems: Work on energized electrical conductors and circuit parts of series-connected battery cells, including voltage testing | Any                  | Yes                                     |
| Voltage testing on individual battery cells or individual multi-cell units | All of the following:  
  - The equipment is properly installed  
  - The equipment is properly maintained  
  - Covers for all other equipment are in place and secured  
  - There is no evidence of impending failure | No                                     |
|                                                                      | One or more of the following:  
  - The equipment is not properly installed  
  - The equipment is not properly maintained  
  - Equipment doors are open or not secured  
  - Equipment covers are off or not secured  
  - There is evidence of impending failure | Yes                                     |
| Removal or installation of CBs or switches                           | Any                  | Yes                                     |
| Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare energized electrical conductors and circuit parts | All of the following:  
  - The equipment is properly installed  
  - The equipment is properly maintained  
  - There is no evidence of impending failure | No                                     |
|                                                                      | Any of the following:  
  - The equipment is not properly installed  
  - The equipment is not properly maintained  
  - There is evidence of impending failure | Yes                                     |
| Removal of bolted covers (to expose bare energized electrical conductors and circuit parts). For dc systems, this includes bolted covers, such as battery terminal covers. | Any                  | Yes                                     |
| Removal of battery intercell connector covers                        | All of the following:  
  - The equipment is properly installed.  
  - The equipment is properly maintained.  
  - Covers for all other equipment are in place and secured  
  - There is no evidence of impending failure | No                                     |
|                                                                      | One or more of the following:  
  - The equipment is not properly installed.  
  - The equipment is not properly maintained.  
  - Equipment doors are open or not secured.  
  - Equipment covers are off or not secured.  
  - There is evidence of impending failure | Yes                                     |
<table>
<thead>
<tr>
<th>Activity Description</th>
<th>Any</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening hinged door(s) or cover(s) (to expose bare energized electrical conductors and circuit parts)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Perform infrared thermography and other noncontact inspections outside the restricted approach boundary. This activity does not include opening of doors or covers.</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Application of temporary protective grounding equipment after voltage test</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, 120 volts or below without any other exposed energized equipment over 120 V including opening of hinged covers to gain access</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, greater than 120 V</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal of individual starter buckets from motor control center (MCC)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal (racking) of CBs or starters from cubicles, doors open or closed</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal of plug-in devices into or from busways</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insulated cable examination with no manipulation of cable</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Insulated cable examination with manipulation of cable</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Work on exposed energized electrical conductors and circuit parts of equipment directly supplied by a panelboard or motor control center</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion and removal of revenue meters (kW-hour, at primary voltage and current)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an enclosure</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an open rack</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>For dc systems, maintenance on a single cell of a battery system or multi-cell units in an open rack</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>For dc systems, work on exposed energized electrical conductors and circuit parts of utilization equipment directly supplied by a dc source</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 (for clearing times of &lt;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, tested in accordance with IEEE C37.20.7:</td>
<td>All of the following:</td>
<td></td>
</tr>
<tr>
<td>· Insertion or removal (racking) of CBs from cubicles</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>· Insertion or removal (racking) of ground and test device</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>· Insertion or removal (racking) of voltage transformers on or off the bus</td>
<td>No</td>
<td></td>
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<tr>
<td>One or more of the following:</td>
<td>Yes</td>
<td></td>
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<tr>
<td>· The equipment is not properly installed</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>· The equipment is not properly maintained</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>· All equipment doors are closed and secured</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>· All equipment covers are in place and secured</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>· There is no evidence of impending failure</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>
The employer is responsible to state when arc flash clothing and other PPE is or is not required. See the requirement in OSHA 1910.269.

OSHA 1910.269 states “the employer properly installs and maintains enclosed equipment.

The Employer is responsible to ensure employees wear arc rated clothing and PPE to protect the employee from arcs and burns. The decision when the employee is required to wear arc rated clothing and other PPE is the responsibility of the employer.

### Statement of Problem and Substantiation for Public Input

The employer is responsible to state when arc flash clothing and other PPE is or is not required. See the requirement in OSHA 1910.269. OSHA 1910.269 states "the employer properly installs and maintains enclosed equipment.

The Employer is responsible to ensure employees wear arc rated clothing and PPE to protect the employee from arcs and burns. The decision when the employee is required to wear arc rated clothing and other PPE is the responsibility of the employer.

### Submitter Information Verification

**Submitter Full Name:** DARYLD CROW  
**Organization:** DRC CONSULTING LTD
When selected in lieu of the incident energy analysis of 130.5(B)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when there is an increased likelihood of initiating an arc flash event. When an increased likelihood of initiating an arc flash event exists, Table 130.7(C)(15)(A)(b) shall be used to determine the arc flash PPE category. The estimated maximum available short-circuit current, maximum fault-clearing times, and minimum working distances for various ac equipment types or classifications are listed in Table 130.7(C)(15)(A)(b). An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Tasks not listed in Table 130.7(C)(15)(A)(a)
2. Power systems with greater than the estimated maximum available short-circuit current
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4. Tasks with less than the minimum working distance

### Table 130.7(C)(15)(A)(a) Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems

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<tr>
<th>Task</th>
<th>Equipment Condition*</th>
<th>Arc Flash PPE Required</th>
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</thead>
<tbody>
<tr>
<td>Reading a panel meter while operating a meter switch</td>
<td>Any</td>
<td></td>
</tr>
<tr>
<td>Normal operation of a circuit breaker (CB), switch, contactor, or starter</td>
<td>All of the following:</td>
<td></td>
</tr>
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<td></td>
<td>The equipment is properly installed</td>
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<tr>
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<td>One or more of the following:</td>
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<td>Equipment covers are off or not secured</td>
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<tr>
<td></td>
<td>There is evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td>For ac systems: Work on energized electrical conductors and circuit parts, including voltage testing</td>
<td>Any</td>
<td></td>
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<tr>
<td>For dc systems: Work on energized electrical conductors and circuit parts of series-connected battery cells, including voltage testing</td>
<td>Any</td>
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<td>Voltage testing on individual battery cells or individual multi-cell units</td>
<td>All of the following:</td>
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<td>Removal or installation of CBs or switches</td>
<td>Any</td>
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<tr>
<td>Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare energized electrical conductors and circuit parts</td>
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<td></td>
</tr>
<tr>
<td>Removal of bolted covers (to expose bare energized electrical conductors and circuit parts). For dc systems, this includes bolted covers, such as battery terminal covers.</td>
<td>Any</td>
<td></td>
</tr>
</tbody>
</table>

*Equipment Condition*:
- **Low**
- **Normal**
- **High**
<table>
<thead>
<tr>
<th>High</th>
<th>Removal of battery intercell connector covers</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>All of the following:</td>
</tr>
<tr>
<td></td>
<td>The equipment is properly installed</td>
</tr>
<tr>
<td></td>
<td>The equipment is properly maintained</td>
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<tr>
<td></td>
<td>Covers for all other equipment are in place and secured</td>
</tr>
<tr>
<td></td>
<td>There is no evidence of impending failure</td>
</tr>
<tr>
<td>Low</td>
<td>One or more of the following:</td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly installed</td>
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<tr>
<td></td>
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<table>
<thead>
<tr>
<th>High</th>
<th>Opening hinged door(s) or cover(s) (to expose bare energized electrical conductors and circuit parts)</th>
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</thead>
<tbody>
<tr>
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<td>Any</td>
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<table>
<thead>
<tr>
<th>High</th>
<th>Perform infrared thermography and other noncontact inspections outside the restricted approach boundary. This activity does not include opening of doors or covers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Any</td>
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</tbody>
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<table>
<thead>
<tr>
<th>High</th>
<th>Application of temporary protective grounding equipment after voltage test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Any</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>High</th>
<th>Work on control circuits with exposed energized electrical conductors and circuit parts, 120 volts or below without any other exposed energized equipment over 120 V including opening of hinged covers to gain access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Any</td>
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<table>
<thead>
<tr>
<th>High</th>
<th>Work on control circuits with exposed energized electrical conductors and circuit parts, greater than 120 V</th>
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</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Any</td>
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<table>
<thead>
<tr>
<th>High</th>
<th>Insertion or removal of individual starter buckets from motor control center (MCC)</th>
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</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Any</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>High</th>
<th>Insertion or removal (racking) of CBs or starters from cubicles, doors open or closed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Any</td>
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<table>
<thead>
<tr>
<th>High</th>
<th>Insertion or removal of plug-in devices into or from busways</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Any</td>
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</table>

<table>
<thead>
<tr>
<th>High</th>
<th>Insulated cable examination with no manipulation of cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Any</td>
</tr>
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<table>
<thead>
<tr>
<th>High</th>
<th>Work on exposed energized electrical conductors and circuit parts of equipment directly supplied by a panelboard or motor control center</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Any</td>
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<table>
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<tr>
<th>High</th>
<th>Insertion and removal of revenue meters (kW-hour, at primary voltage and current)</th>
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<tbody>
<tr>
<td>Yes</td>
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<table>
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<tr>
<th>High</th>
<th>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an enclosure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Any</td>
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</table>

<table>
<thead>
<tr>
<th>High</th>
<th>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an open rack</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Any</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Low</th>
<th>For dc systems, maintenance on a single cell of a battery system or multi-cell units in an open rack</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Any</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Low</th>
<th>For dc systems, work on exposed energized electrical conductors and circuit parts of utilization equipment directly supplied by a dc source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Any</td>
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<tr>
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### NFPA 70E - A2017 FD Meeting Agenda

Table 130.7(C)(15)(A)(b) Arc-Flash Hazard PPE Categories for Alternating Current (ac) Systems

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panelboards or other equipment rated 240 V and below</td>
<td>1</td>
<td>485 mm (19 in.)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panelboards or other equipment rated &lt;240 V and up to 600 V</td>
<td>2</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>4</td>
<td>4.3 m (14 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 42 kA short-circuit current available; maximum of 0.33 sec (20 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class switchgear (with power circuit breakers or fused switches) and 600 V class switchboards</td>
<td>4</td>
<td>6 m (20 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.5 sec (30 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other 600-V class (277 V through 600 V, nominal) equipment</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 85 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metal-clad switchgear, 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 (for clearing times of &lt; 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, tested in accordance with IEEE C37.20.7</td>
<td>N/A (doors closed)</td>
<td>N/A (doors closed)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>4 (doors open)</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Other equipment 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>
Note: For equipment rated 600 volts and below, and protected by upstream current-limiting fuses or current-limiting 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.

Statement of Problem and Substantiation for Public Input

For equipment having an arc flash hazard, it is impossible to determine with 100% certainty that an arc flash event will not occur, and therefore no arc rated PPE is required, for all cases, for certain tasks listed in the tables. If the equipment has an arc flash hazard, and it is energized, the likelihood of an event occurring and presenting risk of injury to personnel may be very low but it is not zero. This and companion PIs seek to revise the text and tables to reflect this.

Submitter Information Verification

Submitter Full Name: DAVID PACE
Organization: OLIN CORPORATION
Affiliation: Self
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Mon Jun 22 17:57:41 EDT 2015
When selected in lieu of the incident energy analysis of 130.5(B)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(A)(b) shall be used to determine the arc flash PPE category. The estimated maximum available short-circuit current, maximum fault-clearing times, and minimum working distances for various ac equipment types or classifications are listed in Table 130.7(C)(15)(A)(b). An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Tasks not listed in Table 130.7(C)(15)(A)(a)
2. Power systems with greater than the estimated maximum available short-circuit current
3. Power systems with longer than the maximum fault clearing times
4. Tasks with less than the minimum working distance

Table 130.7(C)(15)(A)(a) Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Task</th>
<th>Equipment Condition*</th>
<th>Arc Flash PPE Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading a panel meter while operating a meter switch</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Normal operation of a circuit breaker (CB), switch, contactor, or starter</td>
<td>All of the following: The equipment is properly installed. The equipment is properly maintained. All equipment doors are closed and secured. All equipment covers are in place and secured. There is no evidence of impending failure.</td>
<td>No, Not</td>
</tr>
<tr>
<td>For ac systems: Work on energized electrical conductors and circuit parts, including voltage testing</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems: Work on energized electrical conductors and circuit parts of series-connected battery cells, including voltage testing</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Voltage testing on individual battery cells or individual multi-cell units</td>
<td>All of the following: The equipment is properly installed. The equipment is properly maintained. Covers for all other equipment are in place and secured. There is no evidence of impending failure.</td>
<td>No, Not</td>
</tr>
<tr>
<td>Removal or installation of CBs or switches</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare energized electrical conductors and circuit parts</td>
<td>All of the following: The equipment is properly installed. The equipment is properly maintained. There is no evidence of impending failure.</td>
<td>No</td>
</tr>
<tr>
<td>Any of the following: The equipment is not properly installed. The equipment is not properly maintained. Equipment doors are open or not secured. Equipment covers are off or not secured. There is evidence of impending failure.</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Removal of bolted covers (to expose bare energized electrical conductors and circuit parts). For dc systems, this includes bolted covers, such as battery terminal covers.</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Removal of battery intercell connector covers</td>
<td>All of the following: The equipment is properly installed. The equipment is properly maintained. Covers for all other equipment are in place and secured. There is no evidence of impending failure.</td>
<td>No, Not</td>
</tr>
<tr>
<td>Activity Description</td>
<td>Applies to</td>
<td>Results</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------------</td>
<td>------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Opening hinged door(s) or cover(s) (to expose bare energized electrical conductors and circuit parts)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Perform infrared thermography and other noncontact inspections inside the restricted approach boundary. This activity does not include opening of doors or covers.</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Application of temporary protective grounding equipment after voltage test</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, 120 volts or below without any other exposed energized equipment over 120 V including opening of hinged covers to gain access</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, greater than 120 V</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal of individual starter buckets from motor control center (MCC)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal (racking) of CBs or starters from cubicles, doors open or closed</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal of plug-in devices into or from busways</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insulated cable examination with no manipulation of cable</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Insulated cable examination with manipulation of cable</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Work on exposed energized electrical conductors and circuit parts of equipment directly supplied by a panelboard or motor control center</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion and removal of revenue meters (kW-hour, at primary voltage and current)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an enclosure</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an open rack</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>For dc systems, maintenance on a single cell of a battery system or multi-cell units in an open rack</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>For dc systems, work on exposed energized electrical conductors and circuit parts of utilization equipment directly supplied by a dc source</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 (for clearing times of &lt;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, tested in accordance with IEEE C37.20.7:</td>
<td>All of the following:</td>
<td>No</td>
</tr>
<tr>
<td>· Insertion or removal (racking) of CBs from cubicles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>· Insertion or removal (racking) of ground and test device</td>
<td></td>
<td></td>
</tr>
<tr>
<td>· Insertion or removal (racking) of voltage transformers on or off the bus</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The statement that AF PPE is "not required" can be taken literally that AF PPE is not required. I think the intent as stated in the note below the table is that the likelihood of an arc risk assessment into account. There are several actions in the table where AF PPE is "not required" but our personnel wear their PPE since if something were to happen, no matter how unlikely, they would be protected. An operation that takes place every day is "Normal operation of a circuit breaker (CB), switch, contactor or starter". Operating a CB in this case would be safe since there are no signs of impending failure:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal-clad switchgear, 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 [for clearing times of &lt; 0.5 sec (30 cycles) with a perspective 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, tested in accordance with IEEE C37.20.7, 1 kV through 15 kV</td>
<td>N/A (doors closed)</td>
<td>N/A (doors closed)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>4 (doors open)</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Other equipment 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: For equipment rated 600 volts and below, and protected by upstream current-limiting fuses or current-limiting 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.

Statement of Problem and Substantiation for Public Input

The statement that AF PPE is "not required" can be taken literally that AF PPE is not required. I think the intent as stated in the note below the table is that the likelihood of an arc fault is low, not non-existent. Recommending AF PPE would always provide some measure of protection in that event, but still allow the person performing the work to take the risk assessment into account. There are several actions in the table where AF PPE is "not required" but our personnel wear their PPE since if something were to happen, no matter how unlikely, they would be protected. An operation that takes place every day is "Normal operation of a circuit breaker (CB), switch, contactor or starter". Operating a CB on a piece of equipment with >40 cal/cm^2 would fall under Arc Flash PPE Not Required per the current standard.
Incorporating the arc flash boundary into the determination of whether Arc Flash PPE is required would take into account whether the arc flash would be contained within the equipment. An operator would typically be 18” from the door when operating a breaker. It would be difficult to quantify the level of protection that the enclosure would provide in the event of an arc flash unless the gear was arc rated, but if operator is within the arc flash boundary then the severity of injury if the enclosure does not contain the arc flash event and the operator is not wearing PPE is higher.

Submitter Information Verification

Submitter Full Name: SAM SAMARASINGHE
Organization: ELECTRICAL CORP OF AMERICA
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Thu Feb 05 10:53:50 EST 2015
When selected in lieu of the incident energy analysis of 130.5(B)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(A)(b) shall be used to determine the arc flash PPE category. The estimated maximum available short-circuit current, maximum fault-clearing times, and minimum working distances for various ac equipment types or classifications are listed in Table 130.7(C)(15)(A)(b). An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Tasks not listed in Table 130.7(C)(15)(A)(a)
2. Power systems with greater than the estimated maximum available short-circuit current
3. Power systems with longer than the maximum fault clearing times
4. Tasks with less than the minimum working distance

Table 130.7(C)(15)(A)(a) Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Voltage No</th>
<th>Task Description</th>
<th>Equipment Condition*</th>
<th>Arc Flash PPE Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading a panel meter while operating a meter switch</td>
<td>Any</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Normal operation of a circuit breaker (CB), switch, contactor, or starter</td>
<td>All of the following: The equipment is not properly installed The equipment is not properly maintained Equipment doors are open or not secured Equipment covers are off or not secured There is evidence of impending failure</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>For ac systems: Work on energized electrical conductors and circuit parts, including voltage testing</td>
<td>Any</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>For dc systems: Work on energized electrical conductors and circuit parts of series-connected battery cells, including voltage testing</td>
<td>Any</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Maintenance and testing on individual battery cells or individual multi-cell units</td>
<td>All of the following: The equipment is properly installed The equipment is properly maintained Covers for all other equipment are in place and secured The battery is in an open rack There is no evidence of impending failure Work is not in the vicinity (reachable) of a voltage differential of 100 volts or more</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>There is evidence of impending failure</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work is in the vicinity (reachable) of a voltage differential of 100 volts or more</td>
<td>One or more of the following: The equipment is not properly installed The equipment is not properly maintained Equipment doors are open or not secured Equipment covers are off or not secured Batteries are in an enclosure Work is in the vicinity (reachable) of a voltage differential of 100 volts or more</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Activity Description</td>
<td>Yes/No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------------</td>
<td>--------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Removal or installation of CBs or switches</td>
<td>Any</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare energized electrical conductors and circuit parts</td>
<td>All of the following: The equipment is properly installed, The equipment is properly maintained, There is no evidence of impending failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Any</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Removal of bolted covers (to expose bare energized electrical conductors and circuit parts). For dc systems, this includes bolted covers, such as battery terminal covers.</td>
<td>Any</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Removal of battery intercell connector covers</td>
<td>All of the following: The equipment is properly installed, The equipment is properly maintained, Covers for all other equipment are in place and secured, are non-conductive, There is no evidence of impending failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>One or more of the following: The equipment is not properly installed, The equipment is not properly maintained</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>There is evidence of impending failure</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opening hinged door(s) or cover(s) (to expose bare energized electrical conductors and circuit parts)</td>
<td>Any</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perform infrared thermography and other noncontact inspections outside the restricted approach boundary. This activity does not include opening of doors or covers.</td>
<td>Any</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Application of temporary protective grounding equipment after voltage test</td>
<td>Any</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, 120 volts or below without any other exposed energized equipment over 120 V including opening of hinged covers to gain access</td>
<td>Any</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, greater than</td>
<td>Any</td>
<td></td>
<td></td>
</tr>
<tr>
<td>120 V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insertion or removal of individual starter buckets from motor control center (MCC)</td>
<td>Any</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Insertion or removal (racking) of CBs or starters from cubicles, doors open or closed</td>
<td>Any</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Insertion or removal of plug-in devices into or from busways</td>
<td>Any</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Insulated cable examination with no manipulation of cable</td>
<td>Any</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Insulated cable examination with manipulation of cable</td>
<td>Any</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Work on exposed energized electrical conductors and circuit parts of equipment directly supplied by a panelboard or motor control center</td>
<td>Any</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Insertion and removal of revenue meters (kW-hour, at primary voltage and current)</td>
<td>Any</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an enclosure</td>
<td>Any</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>For dc systems, maintenance on a single cell of a battery system or multi-cell units in an open rack</td>
<td>Any</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

For dc systems, work on exposed energized electrical conductors and circuit parts of utilization equipment directly supplied by a dc source

Arc-resistant switchgear
Type 1 or 2 (for clearing times of <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, tested in accordance with IEEE C37.20.7:
- Insertion or removal (racking) of CBs from cubicles
- Insertion or removal (racking) of ground and test device

All of the following:
- The equipment is properly installed
- The battery is in an open rack
- Batteries are in an enclosure
- Work is in the vicinity (reachable) of a voltage differential of 100 volts or more
**Note:** Hazard identification is one component of risk assessment. Risk assessment involves a determination of the likelihood of occurrence of an incident, resulting from a hazard that could cause injury or damage to health. The assessment of the likelihood of occurrence contained in this table does not cover every possible condition or situation. Where this table indicates that arc flash PPE is not required, an arc flash is not likely to occur.

*The phrase properly installed, as used in this table, means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer's recommendations. The phrase properly maintained, as used in this table, means that the equipment has been maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards. The phrase evidence of impending failure, as used in this table, means that there is evidence of arcing, overheating, loose or bound equipment parts, visible damage, deterioration, or other damage.*

### Table 130.7(C)(15)(A)(b) Arc-Flash Hazard PPE Categories for Alternating Current (ac) Systems

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panelboards or other equipment rated 240 V and below</td>
<td>1</td>
<td>485 mm</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td>4</td>
<td>485 mm</td>
</tr>
<tr>
<td>Panelboards or other equipment rated &gt;240 V and up to 600 V</td>
<td>2</td>
<td>900 mm</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td>4</td>
<td>900 mm</td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>2</td>
<td>1.5 m</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td>4</td>
<td>1.5 m</td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>4</td>
<td>4.3 m</td>
</tr>
<tr>
<td>Parameters: Maximum of 42 kA short-circuit current available; maximum of 0.33 sec (20 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td>4</td>
<td>4.3 m</td>
</tr>
<tr>
<td>600-V class switchgear (with power circuit breakers or fused switches) and 600 V class switchboards</td>
<td>4</td>
<td>6 m</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.5 sec (30 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td>4</td>
<td>6 m</td>
</tr>
<tr>
<td>Other 600-V class (277 V through 600 V, nominal) equipment</td>
<td>2</td>
<td>1.5 m</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td>4</td>
<td>1.5 m</td>
</tr>
<tr>
<td>NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV</td>
<td>4</td>
<td>12 m</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>4</td>
<td>12 m</td>
</tr>
<tr>
<td>Metal-clad switchgear, 1 kV through 15 kV</td>
<td>4</td>
<td>12 m</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>4</td>
<td>12 m</td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 [for clearing times of &lt; 0.5 sec (30 cycles) with a perspective 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, tested in accordance with IEEE C37.20.7, 1 kV through 15 kV</td>
<td>N/A (doors closed)</td>
<td>N/A (doors closed)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>4 (doors open)</td>
<td>12 m</td>
</tr>
<tr>
<td>Other equipment 1 kV through 15 kV</td>
<td>4</td>
<td>12 m</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>4</td>
<td>12 m</td>
</tr>
</tbody>
</table>
Note: For equipment rated 600 volts and below, and protected by upstream current-limiting fuses or current-limiting 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.

### Statement of Problem and Substantiation for Public Input

There are some conflicting requirements for work on a battery which are corrected by this PI. Also, some of the conditions were irrelevant with regards to battery work. Some conditions were added that are needed to clarify when arc flash PPE is not needed. Many battery activities take place on a single cell or unit where the risk of an arc flash is negligible so as long as the work is not in the vicinity of a high voltage differential and when the work is on an open rack. The line items concerning battery maintenance and cell insertion/removal only had limited qualifiers (open rack/enclosure) whereas additional qualifiers are required to ensure safety.

### Submitter Information Verification

- **Submitter Full Name:** WILLIAM CANTOR
- **Organization:** TPI CORPORATION
- **Street Address:**
- **City:**
- **State:**
- **Zip:**
- **Submittal Date:** Fri Jul 03 08:18:57 EDT 2015
<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panelboards or other equipment rated 240 V and below supplied by</td>
<td>1</td>
<td>485 mm</td>
</tr>
<tr>
<td>molded case circuit breakers or current limiting fuses</td>
<td></td>
<td>(19 in.)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>maximum of 0.03 sec (2 cycles) fault clearing time; minimum working</td>
<td></td>
<td></td>
</tr>
<tr>
<td>distance 455 mm (18 in.) from equipment to the face and chest area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panelboards or other equipment rated &gt;240 V and up to 600 V supplied</td>
<td>2</td>
<td>900 mm</td>
</tr>
<tr>
<td>by molded case circuit breakers or current limiting fuses</td>
<td></td>
<td>(3 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>maximum of 0.03 sec (2 cycles) fault clearing time; minimum working</td>
<td></td>
<td></td>
</tr>
<tr>
<td>distance 455 mm (18 in.) from equipment to the face and chest area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs) and individual motor controllers</td>
<td>2</td>
<td>1.5 m</td>
</tr>
<tr>
<td>supplied by molded case circuit breakers, instantaneous</td>
<td></td>
<td></td>
</tr>
<tr>
<td>trip circuit breakers (motor circuit protectors) or current limiting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fuses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>maximum of 0.03 sec (2 cycles) fault clearing time; minimum working</td>
<td></td>
<td></td>
</tr>
<tr>
<td>distance 455 mm (18 in.) from equipment to the face and chest area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs) supplied by insulated case</td>
<td>4</td>
<td>4.3 m</td>
</tr>
<tr>
<td>or low voltage power circuit breakers</td>
<td></td>
<td>(14 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 42 kA short-circuit current available;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>maximum of 0.33 sec (20 cycles) fault clearing time; minimum working</td>
<td></td>
<td></td>
</tr>
<tr>
<td>distance 455 mm (18 in.) from equipment to the face and chest area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class switchgear (with power circuit breakers or fused switches)</td>
<td>4</td>
<td>6 m</td>
</tr>
<tr>
<td>and 600 V class switchboards supplied by low voltage power circuit</td>
<td></td>
<td>(20 ft)</td>
</tr>
<tr>
<td>breakers or current limiting fuses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>maximum of up to 0.5 sec (30 cycles) fault clearing time; minimum working</td>
<td></td>
<td></td>
</tr>
<tr>
<td>distance 455 mm (18 in.) from equipment to the face and chest area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other 600-V class (277 V through 600 V, nominal) equipment supplied</td>
<td>2</td>
<td>1.5 m</td>
</tr>
<tr>
<td>by molded case circuit breakers or current limiting fuses</td>
<td></td>
<td>(5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short circuit current available;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>maximum of 0.03 sec (2 cycles) fault clearing time; minimum working</td>
<td></td>
<td></td>
</tr>
<tr>
<td>distance 455 mm (18 in.) from equipment to the face and chest area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment</td>
<td>Arc Flash PPE Category</td>
<td>Arc-Flash Boundary</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; minimum working distance 910 mm (36 in.) from equipment to the face and chest area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metal-clad switchgear, 1 kV through 15 kV</td>
<td>4</td>
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</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; minimum working distance 910 mm (36 in.) from equipment to the face and chest area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 [for clearing times of &lt; 0.5 sec (30 cycles) with a perspective 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, tested in accordance with IEEE C37.20.7, 1 kV through 15 kV</td>
<td>N/A (doors closed)</td>
<td>N/A (doors closed)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; minimum working distance 910 mm (36 in.) from equipment to the face and chest area</td>
<td>4 (doors open)</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Other equipment 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; minimum working distance 910 mm (36 in.) from equipment to the face and chest area</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: For equipment rated 600 volts and below, and protected by upstream current-limiting fuses or current-limiting 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.

Informational Note: A 1.5 cycle fault clearing time is typical for molded case circuit breakers rated less than 1000 V with an integral instantaneous trip. See IEEE 1584 Table 1.

Substantiation:

The original concept of the “table method” in NFPA 70E for all applications 600 volts and below was to apply the bolted available short circuit, which would then be the maximum fault value of current and the clearing time. The clearing time included in the tables corresponded to the time at which low voltage protective devices typically open under short-circuit conditions. This
addresses all faults, arcing or otherwise. Below 600 volts, this concept has proven itself to be accurate, reliable, easy to understand and easy to apply.

There is considerable confusion in the industry on how to apply the tables, and unfortunately, they are being misapplied. There are some who believe that they should take an “estimated” value of available short circuit current and apply that value or some portion of it to a time current curve in order to use the tables. That is incorrect. In fact, instructing electrical workers to apply an estimated value of current to a time current curve extremely problematic. The tables are based upon maximum values of available short circuit current and typical clearing times.

The present format below 600 volts is based upon parameters including maximum available short circuit current and maximum clearing time. These parameters are today, as they were in the 2004 edition of NFPA 70E based upon typical clearing times. The requirement is to determine an “estimated” value of available short circuit current. It is imperative that this be understood. We are not dealing with an incident energy analysis that begins with values from the electrical utility. This is an estimation only and determining clearing time is unnecessary. We must focus on well understood typical overcurrent device applications and empirical data. The original tables were built in this manner with empirical data from the petrochemical industry and others.

The clearing times for all low voltage table equipment categories are deleted. It is unnecessary to determine clearing time with estimated values of available short circuit current. Types of overcurrent protective devices are added to ensure that the industry standard clearing time is within the existing table parameters.

It is suggested that both panelboard categories have the clearing time deleted and be limited to panelboards that are supplied by molded case circuit breakers or current limiting fuses. There is substantial data to support this suggested revision. See the IEEE white paper Paper No. PCIC-2006-2 “Applying low-voltage circuit breakers to limit arc flash energy” by George Gregory and Kevin Lippert. This paper provides significant testing results for molded case circuit breakers up to 2500-amps and proves they are in line with the typical clearing times the tables are based upon and that these devices significantly limit arc flash energies. IEEE 1584 recognizes that molded case circuit breakers have a typical clearing time of 1.5 cycles to further support this suggested revision. Additionally a new informational note to reference IEEE 1584 Table 1 is included to inform the standard user that typical clearing times for molded case circuit breakers are 1.5 cycles or less. Current limiting fuses are also included as they will perform in a similar manner when compared to all sizes of molded case circuit breakers.

The first MCC category is revised in a similar manner. It is suggested that the first MCC category has the clearing time deleted and be limited to 600-V class motor control centers (MCCs) supplied by molded case circuit breakers, instantaneous trip circuit breakers (motor circuit protectors) or current limiting fuses. This category is typically applied where an employee is working in an MCC bucket but may be used for any work on the MCC where the parameters are met.

The second MCC category is revised in a similar manner. It is suggested that the second MCC category has the clearing time deleted and be limited to 600-V class motor control centers (MCCs) supplied by insulated case or low voltage power circuit breakers. It is further suggested to reduce the parameter for available short circuit current to correlate with the category for switchboards and switchgear.

The category for switchgear and switchboards are revised in a similar manner. It is suggested that the category for switchgear and switchboards have the clearing time deleted and be limited to 600-V class switchgear (with power circuit breakers or fused switches) and 600 V class switchboards supplied by low voltage power circuit breakers or current limiting fuses.
The category for Other 600-V class (277 V through 600 V, nominal) equipment is revised in a similar manner. It is suggested that the category for Other 600-V class (277 V through 600 V, nominal) equipment have the clearing time deleted and be limited to, Other 600-V class (277 V through 600 V, nominal) equipment supplied by molded case circuit breakers or current limiting fuses. The substantiation here is the same as for the suggested revision in the panelboard categories.

This suggested revision correlates with the existing table requirements, will significantly increase the usability of the table method and will result in proper application.

The user of the standard needs additional direction on how to apply the “working distance” listed in each table parameter. There is some confusion as to the intent being the minimum or maximum distance and where the distance is applied to on the person. Clarity is needed to inform the user that the working distance is to the face and chest area, the hands and arms are permitted at a shorter distance to perform the task. The word “minimum” and the phrase “from equipment to the face and chest area” are added to clarify that the task to be performed will keep the face and chest area at the parameter distance from the equipment.
Submitter Information Verification

Submitter Full Name: JAMES DOLLARD
Organization: IBEW LOCAL UNION 98
Street Address:
City:
State:
Zip:
Submit Date: Sat Jul 04 09:25:37 EDT 2015
When selected in lieu of the incident energy analysis of 130.5(B)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(A)(b) shall be used to determine the arc flash PPE category. The estimated maximum available short-circuit current, maximum fault-clearing times, permitted overcurrent protective devices, and minimum working distances to the face and chest area for various ac equipment types or classifications are listed in Table 130.7(C)(15)(A)(b). An incident energy analysis shall be required in accordance with 130.5 for the following:

(1) Tasks not listed in Table 130.7(C)(15)(A)(a)
(2) Power systems with greater than the estimated maximum available short-circuit current
(3) Power systems with longer than the maximum fault clearing times
(4) Equipment supplied by other than the listed type of overcurrent protection
(5) Tasks with less than the minimum working distance

Table 130.7(C)(15)(A)(a) Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Task</th>
<th>Equipment Condition*</th>
<th>Arc Flash PPE Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading a panel meter while operating a meter switch</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Normal operation of a circuit breaker (CB), switch, contactor, or starter</td>
<td>All of the following:&lt;br&gt; - The equipment is properly installed&lt;br&gt; - The equipment is properly maintained&lt;br&gt; - All equipment doors are closed and secured&lt;br&gt; - All equipment covers are in place and secured&lt;br&gt; - There is no evidence of impending failure</td>
<td>No</td>
</tr>
<tr>
<td>One or more of the following:&lt;br&gt; - The equipment is not properly installed&lt;br&gt; - The equipment is not properly maintained&lt;br&gt; - Equipment doors are open or not secured&lt;br&gt; - Equipment covers are off or not secured&lt;br&gt; - There is evidence of impending failure</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>For ac systems: Work on energized electrical conductors and circuit parts, including voltage testing</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems: Work on energized electrical conductors and circuit parts of series-connected battery cells, including voltage testing</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Voltage testing on individual battery cells or individual multi-cell units</td>
<td>All of the following:&lt;br&gt; - The equipment is properly installed&lt;br&gt; - The equipment is properly maintained&lt;br&gt; - Covers for all other equipment are in place and secured&lt;br&gt; - There is no evidence of impending failure</td>
<td>No</td>
</tr>
<tr>
<td>One or more of the following:&lt;br&gt; - The equipment is not properly installed&lt;br&gt; - The equipment is not properly maintained&lt;br&gt; - Equipment doors are open or not secured&lt;br&gt; - Equipment covers are off or not secured&lt;br&gt; - There is evidence of impending failure</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Removal or installation of CBs or switches</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare energized electrical conductors and circuit parts</td>
<td>All of the following:&lt;br&gt; - The equipment is properly installed&lt;br&gt; - The equipment is properly maintained&lt;br&gt; - There is no evidence of impending failure</td>
<td>No</td>
</tr>
<tr>
<td>Any of the following:&lt;br&gt; - The equipment is not properly installed&lt;br&gt; - The equipment is not properly maintained&lt;br&gt; - There is evidence of impending failure</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Removal of bolted covers (to expose bare energized electrical conductors and circuit parts). For dc systems, this includes bolted covers, such as battery terminal covers.</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Removal of battery intercell connector covers</td>
<td>All of the following:&lt;br&gt; - The equipment is properly installed&lt;br&gt; - The equipment is properly maintained&lt;br&gt; - Covers for all other equipment are in place and secured&lt;br&gt; - There is no evidence of impending failure</td>
<td>No</td>
</tr>
<tr>
<td>One or more of the following:&lt;br&gt; - The equipment is not properly installed&lt;br&gt; - The equipment is not properly maintained&lt;br&gt; - Equipment doors are open or not secured&lt;br&gt; - Equipment covers are off or not secured</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>
Table 130.7(C)(15)(A)(b) Arc-Flash Hazard PPE Categories for Alternating Current (ac) Systems

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panelboards or other equipment rated 240 V and below</td>
<td>1</td>
<td>485 mm (19 in.)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panelboards or other equipment rated &gt;240 V and up to 600 V</td>
<td>2</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>4</td>
<td>4.3 m (14 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 42 kA short-circuit current available; maximum of 0.33 sec (20 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class switchgear (with power circuit breakers or fused switches) and 600 V class switchboards</td>
<td>4</td>
<td>6 m (20 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.5 sec (30 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other 600-V class (277 V through 600 V, nominal) equipment</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metal-clad switchgear, 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 [for clearing times of &lt; 0.5 sec (30 cycles) with a perspective 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, tested in accordance with IEEE C37.20.7, 1 kV through 15 kV</td>
<td>N/A (doors closed)</td>
<td>N/A (doors closed)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 (doors open)</td>
<td>12 m (40 ft)</td>
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</tr>
<tr>
<td>Other equipment 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: For equipment rated 600 volts and below, and protected by upstream current-limiting fuses or current-limiting 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.
When selected in lieu of the incident energy analysis of 130.5(B)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(A)(b) shall be used to determine the arc flash PPE category. The estimated maximum available short-circuit current, maximum fault-clearing times, and minimum working distances for various ac equipment types or classifications are listed in Table 130.7(C)(15)(A)(b). These table are only applicable when all of the following conditions are met. An incident energy analysis shall be required in accordance with 130.5 for the following: if all conditions below are not met:

1. Tasks not are listed in Table 130.7(C)(15)(A)(a)
2. Power systems with greater than the estimated is equal or less than the maximum available short-circuit current
3. Power systems with longer than in table 130.7 (C)(15)(A)(b) for the respective tasks.
4. Power systems overcurrent protective devices clearing time is equal or less than the maximum fault clearing times in table 130.7 (C)(15)(A)(b) for the respective tasks
5. Tasks with less working distances equal or larger than the minimum working distance in table 130.7  (C) (15)(A)(b) for the respective tasks to be performed.

<table>
<thead>
<tr>
<th>Task</th>
<th>Equipment Condition</th>
<th>Arc Flash PPE Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading a panel meter while operating a meter switch</td>
<td>Any</td>
<td>No</td>
</tr>
</tbody>
</table>
| Normal operation of a circuit breaker (CB), switch, contactor, or starter | All of the following:  
The equipment is properly installed  
The equipment is properly maintained  
All equipment doors are closed and secured  
All equipment covers are in place and secured  
There is no evidence of impending failure | No                     |
| For ac systems: Work on energized electrical conductors and circuit parts, including voltage testing | Any | Yes |
| Voltage testing on individual battery cells or individual multi-cell units | All of the following:  
The equipment is properly installed  
The equipment is properly maintained  
Covers for all other equipment are in place and secured  
There is no evidence of impending failure | No                     |
| Removal or installation of CBs or switches                          | Any                 | Yes                     |
| Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare energized electrical conductors and circuit parts | All of the following:  
The equipment is properly installed  
The equipment is properly maintained  
There is no evidence of impending failure | No                     |
| Removal of bolted covers (to expose bare energized electrical conductors and circuit parts). For dc systems, this includes bolted covers, such as battery terminal covers. | Any | Yes |
| Removal of battery intercell connector covers                       | All of the following:  
The equipment is properly installed.  
The equipment is properly maintained  
Covers for all other equipment are in place and secured  
There is no evidence of impending failure | No                     |
| One or more of the following:  
The equipment is not properly installed  
The equipment is not properly maintained  
Equipment doors are open or not secured  
Equipment covers are off or not secured  
There is evidence of impending failure | Yes |

Table 130.7(C)(15)(A)(a) Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems
The wording has been revised for clarity to indicate when the tables can be used and when an incident energy analysis is required.

Note: For equipment rated 600 volts and below, and protected by upstream current-limiting fuses or current-limiting circuit breakers sized at 200 amperes or less, the manufacturer’s recommendations and applicable industry codes and standards. The phrase *properly maintained*, as used in this table, means that the equipment has been maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards. The phrase *evidence of impending failure*, as used in this table, means that there is evidence of arcing, overheating, loose or bound equipment parts, visible damage, deterioration, or other damage.

Table 130.7(C)(15)(A)(b) Arc-Flash Hazard PPE Categories for Alternating Current (ac) Systems

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panelboards or other equipment rated 240 V and below</td>
<td>1</td>
<td>485 mm (19 in.)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panelboards or other equipment rated &gt;240 V and up to 600 V</td>
<td>2</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>4</td>
<td>4.3 m (14 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 42 kA short-circuit current available; maximum of 0.33 sec (20 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class switchgear (with power circuit breakers or fused switches) and 600 V class switchboards</td>
<td>4</td>
<td>6 m (20 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.5 sec (30 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other 600-V class (277 V through 600 V, nominal) equipment</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metal-clad switchgear, 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 [for clearing times of &lt; 0.5 sec (30 cycles) with a perspective 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, tested in accordance with IEEE C37.20.7, 1 kV through 15 kV</td>
<td>N/A (doors closed)</td>
<td>N/A (doors closed)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>4 (doors open)</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Other equipment 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: For equipment rated 600 volts and below, and protected by upstream current-limiting fuses or current-limiting 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.

Statement of Problem and Substantiation for Public Input

The wording has been revised for clarity to indicate when the tables can be used and when an incident energy analysis is required.

Submitter Information Verification

Submitter Full Name: DAELEEP MOHLA
Organization: DCM ELECTRICAL CONSULTING SERV
Street Address:
City:
State:
When selected in lieu of the incident energy analysis of 130.5(B)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(A)(b) shall be used to determine the arc flash PPE category. The estimated maximum available short-circuit current, maximum fault-clearing times, and minimum working distances for various ac equipment types or classifications are listed in Table 130.7(C)(15)(A)(b). An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Tasks not listed in Table 130.7(C)(15)(A)(a)
2. Power systems with greater than the estimated maximum available short-circuit current
3. Power systems with longer than the maximum fault clearing times
4. Tasks with less than the minimum working distance

### Table 130.7(C)(15)(A)(a) Arc Flash Hazard Identification for Flash PPE Determination for Alternating Current (ac) and Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Task</th>
<th>Equipment Condition*</th>
<th>Arc Flash PPE Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading a panel meter while operating a meter switch</td>
<td>Any</td>
<td>No</td>
</tr>
</tbody>
</table>
| Normal operation of a circuit breaker (CB), switch, contactor, or starter | All of the following:  
  - The equipment is properly installed  
  - The equipment is properly maintained  
  - All equipment doors are closed and secured  
  - All equipment covers are in place and secured  
  - There is no evidence of impending failure | No                     |
| For ac systems: Work on energized electrical conductors and circuit parts, including voltage testing | Any | Yes |
| For dc systems: Work on energized electrical conductors and circuit parts of series-connected battery cells, including voltage testing | Any | Yes |
| Voltage testing on individual battery cells or individual multi-cell units | All of the following:  
  - The equipment is properly installed  
  - The equipment is properly maintained  
  - Covers for all other equipment are in place and secured  
  - There is no evidence of impending failure | No                     |
| Removal or installation of CBs or switches                           | Any                   | Yes                     |
| Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare energized electrical conductors and circuit parts | Any of the following:  
  - The equipment is not properly installed  
  - The equipment is not properly maintained  
  - There is evidence of impending failure | Yes                     |
| Removal of bolted covers (to expose bare energized electrical conductors and circuit parts). For dc systems, this includes bolted covers, such as battery terminal covers | Any | Yes |
| Removal of battery intercell connector covers                        | All of the following:  
  - The equipment is properly installed  
  - The equipment is properly maintained  
  - Covers for all other equipment are in place and secured  
  - There is no evidence of impending failure | No                     |
| One or more of the following:  
  - The equipment is not properly installed  
  - The equipment is not properly maintained  
  - There is evidence of impending failure | Yes                     |
Statement of Problem and Substantiation for Public Input

This table determines the need for arc flash PPE. It does not determine whether there is an arc flash hazard. This Public Input is submitted to editorially correct the title of the table to be consistent with what is determined by this table. See the title to the right column to this table, for example: "Arc Flash PPE Required." See also the first sentence of 130.7(C)(15)(A). See also the last sentence to the "note" to this table.

Table 130.7(C)(15)(A)(b) Arc-Flash Hazard PPE Categories for Alternating Current (ac) Systems

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panelboards or other equipment rated 240 V and below</td>
<td>1</td>
<td>485 mm (19 in.)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panelboards or other equipment rated &gt;240 V and up to 600 V</td>
<td>2</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>4</td>
<td>4.3 m (14 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 42 kA short-circuit current available; maximum of 0.33 sec (20 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class switchgear (with power circuit breakers or fused switches) and 600 V class switchboards</td>
<td>4</td>
<td>6 m (20 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.5 sec (30 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other 600-V class (277 V through 600 V, nominal) equipment</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metal-clad switchgear, 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 for clearing times of &lt; 0.5 sec (30 cycles) with a perspective 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, tested in accordance with IEEE C37.20.7, 1 kV through 15 kV</td>
<td>N/A (doors closed)</td>
<td>N/A (doors closed)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>4 (doors open)</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Other equipment 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: For equipment rated 600 volts and below, and protected by upstream current-limiting fuses or current-limiting 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.

Submitter Information Verification

Submitter Full Name: Palmer Hickman
Organization: Electrical Training Alliance
Street Address: 
City: 
State: 

http://submittals.nfpa.org/TerraViewWeb/ContentFetcher?commentPara...
When selected in lieu of the incident energy analysis of 130.5(B)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(A)(b) shall be used to determine the arc flash PPE category. The estimated maximum available short-circuit current, maximum fault-clearing times, and minimum working distances for various ac equipment types or classifications are listed in Table 130.7(C)(15)(A)(b). An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Tasks not listed in Table 130.7(C)(15)(A)(a)
2. Power systems with greater than the estimated maximum available short-circuit current
3. Power systems with longer than the maximum fault clearing times
4. Tasks with less than the minimum working distance

Table 130.7(C)(15)(A)(a) Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Task</th>
<th>Equipment Condition*</th>
<th>Arc Flash PPE Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading a panel meter while operating a meter switch</td>
<td>Any</td>
<td>No</td>
</tr>
</tbody>
</table>
| Normal operation of a circuit breaker (CB), switch, contactor, or starter | All of the following:  
The equipment is properly installed  
The equipment is properly maintained  
All equipment doors are closed and secured  
All equipment covers are in place and secured  
There is no evidence of impending failure | No                     |
| For ac systems: Work on energized electrical conductors and circuit parts, including voltage testing | Any                  | Yes                    |
| For dc systems: Work on energized electrical conductors and circuit parts of series-connected battery cells, including voltage testing | Any                  | Yes                    |
| Voltage testing on individual battery cells or individual multi-cell units | All of the following:  
The equipment is properly installed  
The equipment is properly maintained  
Covers for all other equipment are in place and secured  
There is no evidence of impending failure | No                     |
| Removal or installation of CBs or switches                           | Any                  | Yes                    |
| Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare energized electrical conductors and circuit parts | All of the following:  
The equipment is properly installed  
The equipment is properly maintained  
There is no evidence of impending failure | No                     |
| Removal of bolted covers (to expose bare energized electrical conductors and circuit parts). For dc systems, this includes bolted covers, such as battery terminal covers. | Any                  | Yes                    |
| Removal of battery intercell connector covers                        | All of the following:  
The equipment is properly installed  
The equipment is properly maintained  
Covers for all other equipment are in place and secured  
There is no evidence of impending failure | No                     |
<table>
<thead>
<tr>
<th>Activity</th>
<th>Any</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening hinged door(s) or cover(s) (to expose bare energized electrical conductors and circuit parts)</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Perform infrared thermography and other noncontact inspections outside the restricted approach boundary. This activity does not include opening of doors or covers.</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Application of temporary protective grounding equipment after voltage test</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, 120 volts or below without any other exposed energized equipment over 120 V including opening of hinged covers to gain access</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, greater than 120 V</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal of individual starter buckets from motor control center (MCC)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal (racking) of CBs or starters from cubicles, doors open or closed</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal of plug-in devices into or from busways</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insulated cable examination with no manipulation of cable</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Insulated cable examination with manipulation of cable</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Work on exposed energized electrical conductors and circuit parts of equipment directly supplied by a panelboard or motor control center</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion and removal of revenue meters (kW-hour, at primary voltage and current)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an enclosure</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an open rack</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>For dc systems, maintenance on a single cell of a battery system or multi-cell units in an open rack</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>For dc systems, work on exposed energized electrical conductors and circuit parts of utilization equipment directly supplied by a dc source</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 (for clearing times of &lt;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, tested in accordance with IEEE C37.20.7:</td>
<td>All of the following:</td>
<td>No</td>
</tr>
<tr>
<td>Insertion or removal (racking) of CBs from cubicles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insertion or removal (racking) of ground and test device</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insertion or removal (racking) of voltage transformers on or off the bus</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

No evidence of impending failure

Yes evidence of impending failure
Thermography and other noncontact inspections are by their nature not going to increase the risk of triggering an arc after the enclosure is open and the equipment is shown to be "stable." For this reason, regardless of installation, maintenance, or covers, if the equipment has been opened, and is stable, the technician is at a low risk of seeing an arc during their short-term, non-invasive, passive diagnostic task.

For this reason, regardless of installation, maintenance, or covers, if the equipment has been opened, and is stable, the technician is at a low risk of seeing an arc during their short-term, non-invasive, passive diagnostic task. However, that same technician should be concerned if there is "evidence of impending failure." In other words, the equipment's status is inherently unstable if there is evidence of impending failure, and the technician would be advised to wear PPE if their task is determined to be necessary to properly diagnose the nature of the problem that has been identified.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panelboards or other equipment rated 240 V and below</td>
<td>1</td>
<td>485 mm (19 in.)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panelboards or other equipment rated &gt;240 V and up to 600 V</td>
<td>2</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>4</td>
<td>4.3 m (14 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 42 kA short-circuit current available; maximum of 0.33 sec (20 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class switchgear (with power circuit breakers or fused switches) and 600 V class switchboards</td>
<td>4</td>
<td>6 m (20 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.5 sec (30 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other 600-V class (277 V through 600 V, nominal) equipment</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metal-clad switchgear, 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
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<td></td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 [for clearing times of &lt; 0.5 sec (30 cycles) with a perspective 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, tested in accordance with IEEE C37.20.7, 1 kV through 15 kV</td>
<td>N/A (doors closed)</td>
<td>N/A (doors closed)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other equipment 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: For equipment rated 600 volts and below, and protected by upstream current-limiting fuses or current-limiting 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.
Related Public Inputs for This Document

<table>
<thead>
<tr>
<th>Related Input</th>
<th>Relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Input No. 551-NFPA 70E-2015 [Section No. 130.7(C)(15)(A)]</td>
<td></td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: TIM ROHRER
Organization: EXISCAN LLC
Affiliation: Exiscan LLC
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Sat Jul 04 14:53:30 EDT 2015
When selected in lieu of the incident energy analysis of 130.5(B)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(A)(b) shall be used to determine the arc flash PPE category and arc flash boundary based on the associated minimum working distance. The estimated maximum available short-circuit current, maximum fault-clearing times at the associated maximum short-circuit current, and minimum working distances for various ac equipment types or classifications are listed in Table 130.7(C)(15)(A)(b). An incident energy analysis shall be required in accordance with 130.5 for the following:

1) **Tasks not listed in Table 130.7(C)(15)(A)(a)**

2) **Power systems with greater than the estimated maximum available short-circuit current**

3) **Power systems with longer than the maximum fault clearing times at the associated maximum short-circuit current**

4) **Tasks with less than the minimum working distance**

Table 130.7(C)(15)(A)(a) Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Task</th>
<th>Equipment Condition*</th>
<th>Arc Flash PPE Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading a panel meter while operating a meter switch</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Normal operation of a circuit breaker (CB), switch, contactor, or starter</td>
<td>All of the following:  The equipment is properly installed  The equipment is properly maintained  All equipment doors are closed and secured  All equipment covers are in place and secured  There is no evidence of impending failure</td>
<td>No</td>
</tr>
<tr>
<td>For ac systems: Work on energized electrical conductors and circuit parts, including voltage testing</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Voltage testing on individual battery cells or individual multi-cell units</td>
<td>All of the following:  The equipment is properly installed  The equipment is properly maintained  Covers for all other equipment are in place and secured  There is no evidence of impending failure</td>
<td>No</td>
</tr>
<tr>
<td>For dc systems: Work on energized electrical conductors and circuit parts of series-connected battery cells, including voltage testing</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Removal or installation of CBs or switches</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare energized electrical conductors and circuit parts</td>
<td>All of the following:  The equipment is properly installed  The equipment is properly maintained  There is no evidence of impending failure</td>
<td>No</td>
</tr>
<tr>
<td>Removal of bolted covers (to expose bare energized electrical conductors and circuit parts). For dc systems, this includes bolted covers, such as battery terminal covers.</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Removal of battery intercell connector covers</td>
<td>All of the following:  The equipment is properly installed  The equipment is properly maintained  Covers for all other equipment are in place and secured  There is no evidence of impending failure</td>
<td>No</td>
</tr>
</tbody>
</table>

*Equipment Condition: The equipment is properly installed, properly maintained, doors are closed and secured, covers are in place and secured, and there is no evidence of impending failure.
One or more of the following:
- The equipment is not properly installed
- The equipment is not properly maintained
- Equipment doors are open or not secured
- Equipment covers are off or not secured
- There is evidence of impending failure

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panelboards or other equipment rated 240 V and below</td>
<td>1</td>
<td>485 mm (19 in.)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td>1</td>
<td>485 mm (19 in.)</td>
</tr>
<tr>
<td>Panelboards or other equipment rated &gt;240 V and up to 600 V</td>
<td>2</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td>2</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>4</td>
<td>4.3 m (14 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 42 kA short-circuit current available; maximum of 0.33 sec (20 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td>4</td>
<td>4.3 m (14 ft)</td>
</tr>
<tr>
<td>600-V class switchgear (with power circuit breakers or fused switches) and 600 V class switchboards</td>
<td>4</td>
<td>6 m (20 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.5 sec (30 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td>4</td>
<td>6 m (20 ft)</td>
</tr>
<tr>
<td>Other 600-V class (277 V through 600 V, nominal) equipment</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Metal-clad switchgear, 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 for clearing times of &lt; 0.5 sec (30 cycles) with a perspective 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, tested in accordance with IEEE C37.20.7, 1 kV through 15 kV</td>
<td>N/A (doors closed)</td>
<td>N/A (doors closed)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>4 (doors open)</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Other equipment 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
</tbody>
</table>

Note: For equipment rated 600 volts and below, and protected by upstream current-limiting fuses or current-limiting 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.

Statement of Problem and Substantiation for Public Input

Adding "at the associated maximum short-circuit current" is intended to clarify that determining "the maximum fault clearing times" is to be based on the clearing time based on the maximum short-circuit listed in the parameters in Table 130.7(C)(15)(A)(b) and not any level (including low values) that could be associated with a system or circuit. This provision has been interpreted to include cases where low levels of short-circuit current cause extended clearing times.

Submitter Information Verification

Submitter Full Name: PALMER HICKMAN
Organization: ELECTRICAL TRAINING ALLIANCE
Street Address:
When selected in lieu of the incident energy analysis of 130.5(B)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(A)(b) shall be used to determine the arc flash PPE category. The estimated maximum available short-circuit current, maximum fault-clearing times, and minimum working distances for various ac equipment types or classifications are listed in Table 130.7(C)(15)(A)(b). An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Tasks not listed in Table 130.7(C)(15)(A)(a)
2. Power systems with greater than the estimated maximum available short-circuit current
3. Power systems with longer than the maximum fault clearing times
4. Tasks with less than the minimum working distance

Table 130.7(C)(15)(A)(a) Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Task</th>
<th>Equipment Condition*</th>
<th>Arc Flash PPE Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading a panel meter while operating a meter switch</td>
<td>Any</td>
<td>No</td>
</tr>
</tbody>
</table>
| Normal operation of a circuit breaker (CB), switch, contactor, or starter | All of the following:  
  - The equipment is properly installed  
  - The equipment is properly maintained  
  - All equipment doors are closed and secured  
  - All equipment covers are in place and secured  
  - There is no evidence of impending failure | No |
| | One or more of the following:  
  - The equipment is not properly installed  
  - The equipment is not properly maintained  
  - Equipment doors are open or not secured  
  - Equipment covers are off or not secured  
  - There is evidence of impending failure | Yes |
| For ac systems: Work on energized electrical conductors and circuit parts, including voltage testing | Any | Yes |
| For dc systems: Work on energized electrical conductors and circuit parts of series-connected battery cells, including voltage testing | Any | Yes |
| Voltage testing on individual battery cells or individual multi-cell units | All of the following:  
  - The equipment is properly installed  
  - The equipment is properly maintained  
  - Covers for all other equipment are in place and secured  
  - There is no evidence of impending failure | No |
| | One or more of the following:  
  - The equipment is not properly installed  
  - The equipment is not properly maintained  
  - Equipment doors are open or not secured  
  - Equipment covers are off or not secured | Yes |
<table>
<thead>
<tr>
<th>Activity</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Removal or installation of CBs or switches</td>
<td>Any</td>
</tr>
<tr>
<td>Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare energized electrical conductors and circuit parts</td>
<td>All of the following: The equipment is properly installed and The equipment is properly maintained</td>
</tr>
<tr>
<td>Removal of bolted covers (to expose bare energized electrical conductors and circuit parts). For dc systems, this includes bolted covers, such as battery terminal covers.</td>
<td>Any</td>
</tr>
<tr>
<td>Removal of battery intercell connector covers</td>
<td>All of the following: The equipment is properly installed and The equipment is properly maintained and Covers for all other equipment are in place and secured and There is no evidence of impending failure</td>
</tr>
<tr>
<td>Opening hinged door(s) or cover(s) (to expose bare energized electrical conductors and circuit parts)</td>
<td>Any</td>
</tr>
<tr>
<td>Perform infrared thermography and other noncontact inspections outside the restricted Limited approach boundary. This activity does not include opening of doors or covers.</td>
<td>Any</td>
</tr>
<tr>
<td>Application of temporary protective grounding equipment after voltage test</td>
<td>Any</td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, 120 volts or below without any other exposed energized equipment over 120 V including opening of hinged covers to gain access</td>
<td>Any</td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, greater than 120 V</td>
<td>Any</td>
</tr>
<tr>
<td>Insertion or removal of individual starter buckets from motor control center (MCC)</td>
<td>Any</td>
</tr>
</tbody>
</table>

There is evidence of impending failure

- The equipment is not properly installed
- The equipment is not properly maintained

One or more of the following:
- The equipment is not properly installed
- The equipment is not properly maintained
- Equipment doors are open or not secured
- Equipment covers are off or not secured
- There is evidence of impending failure

Opening hinged door(s) or cover(s) (to expose bare energized electrical conductors and circuit parts)

Performance of infrared thermography and other noncontact inspections outside the restricted Limited approach boundary. This activity does not include opening of doors or covers.

Application of temporary protective grounding equipment after voltage test

Work on control circuits with exposed energized electrical conductors and circuit parts, 120 volts or below without any other exposed energized equipment over 120 V including opening of hinged covers to gain access

Work on control circuits with exposed energized electrical conductors and circuit parts, greater than 120 V

Insertion or removal of individual starter buckets from motor control center (MCC)
<table>
<thead>
<tr>
<th>Activity</th>
<th>Arc Flash PPE Categories</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion or removal (racking) of CBs or starters from cubicles, doors open or closed</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal of plug-in devices into or from busways</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insulated cable examination with no manipulation of cable</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Insulated cable examination with manipulation of cable</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Work on exposed energized electrical conductors and circuit parts of equipment directly supplied by a panelboard or motor control center</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion and removal of revenue meters (kW-hour, at primary voltage and current)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an enclosure</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an open rack</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>For dc systems, maintenance on a single cell of a battery system or multi-cell units in an open rack</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>For dc systems, work on exposed energized electrical conductors and circuit parts of utilization equipment directly supplied by a dc source</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 (for clearing times of &lt;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, tested in accordance with IEEE C37.20.7:</td>
<td>All of the following:</td>
<td></td>
</tr>
<tr>
<td>- Insertion or removal (racking) of CBs from cubicles</td>
<td>The equipment is properly installed</td>
<td>No</td>
</tr>
<tr>
<td>- Insertion or removal (racking) of ground and test device</td>
<td>All equipment doors are closed and secured</td>
<td></td>
</tr>
<tr>
<td>- Insertion or removal (racking) of voltage transformers on or off the bus</td>
<td>All equipment covers are in place and secured</td>
<td></td>
</tr>
<tr>
<td>- There is no evidence of impending failure</td>
<td>One or more of the following:</td>
<td></td>
</tr>
<tr>
<td>- Opening voltage transformer or control power transformer compartments</td>
<td>The equipment is not properly installed</td>
<td>Yes</td>
</tr>
<tr>
<td>- Outdoor disconnect switch operation (hookstick operated) at 1 kV through 15 kV</td>
<td>The equipment is not properly maintained</td>
<td></td>
</tr>
<tr>
<td>- Outdoor disconnect switch operation (gang-operated, from grade) at 1 kV through 15 kV</td>
<td>Equipment doors are open or not secured</td>
<td></td>
</tr>
<tr>
<td>- There is evidence of impending failure</td>
<td>Equipment covers are off or not secured</td>
<td></td>
</tr>
<tr>
<td>- There is evidence of arcing, overheating, loose or bound equipment parts, visible damage, deterioration, or other damage</td>
<td>There is evidence of impending failure</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Note: Hazard identification is one component of risk assessment. Risk assessment involves a determination of the likelihood of occurrence of an incident, resulting from a hazard that could cause injury or damage to health. The assessment of the likelihood of occurrence contained in this table does not cover every possible condition or situation. Where this table indicates that arc flash PPE is not required, an arc flash is not likely to occur.

*The phrase properly installed, as used in this table, means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer's recommendations. The phrase properly maintained, as used in this table, means that the equipment has been maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards. The phrase evidence of impending failure, as used in this table, means that there is evidence of arcing, overheating, loose or bound equipment parts, visible damage, deterioration, or other damage.

Table 130.7(C)(15)(A)(b) Arc-Flash Hazard PPE Categories for Alternating Current (ac) Systems
<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panelboards or other equipment rated 240 V and below</td>
<td>1</td>
<td>485 mm</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td>(19 in.)</td>
</tr>
<tr>
<td>Panelboards or other equipment rated &gt;240 V and up to 600 V</td>
<td>2</td>
<td>900 mm</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td>(3 ft)</td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>2</td>
<td>1.5 m</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td>(5 ft)</td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>4</td>
<td>4.3 m</td>
</tr>
<tr>
<td>Parameters: Maximum of 42 kA short-circuit current available; maximum of 0.33 sec (20 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td>(14 ft)</td>
</tr>
<tr>
<td>600-V class switchgear (with power circuit breakers or fused switches) and 600 V class switchboards</td>
<td>4</td>
<td>6 m</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.5 sec (30 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td>(20 ft)</td>
</tr>
<tr>
<td>Other 600-V class (277 V through 600 V, nominal) equipment</td>
<td>2</td>
<td>1.5 m</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td>(5 ft)</td>
</tr>
<tr>
<td>NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV</td>
<td>4</td>
<td>12 m</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td>(40 ft)</td>
</tr>
<tr>
<td>Metal-clad switchgear, 1 kV through 15 kV</td>
<td>4</td>
<td>12 m</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td>(40 ft)</td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 [for clearing times of &lt; 0.5 sec (30 cycles) with a perspective 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, tested in accordance with IEEE C37.26.7, 1 kV through 15 kV</td>
<td>N/A (doors closed)</td>
<td>N/A (doors closed)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>4 (doors open)</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Other equipment 1 kV through 15 kV</td>
<td>4</td>
<td>12 m</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td>(40 ft)</td>
</tr>
</tbody>
</table>

Note: For equipment rated 600 volts and below, and protected by upstream current-limiting fuses or current-limiting 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.

**Statement of Problem and Substantiation for Public Input**

The suggestion contained in this table that there is not an arc flash hazard if the equipment meets the criteria listed is not accurate. If the electrical equipment contained within the enclosure has an arc flash incident energy of 1.2 cal/cm² or greater then there is the possibility of an arc flash hazard. Experience within the company that I work for, has shown that arcing events in equipment with an arc flash incident energies as low as 1.2 cal/cm² will cause the door of the enclosure to open. This in turn exposes the person, interacting with the electrical equipment, to potential injury. Other than arc venting equipment there is no testing on electrical equipment for containing an arcing fault. To have this criteria in the standard is misleading and gives people of false sense of safety. The arc flash hazard is a serious hazard which causes in excess of 4000 injuries per year. Recent testing has also shown that doors of electrical equipment do come open in arcing events.

**Submitter Information Verification**

Submitter Full Name: DANNY LIGGETT  
Organization: THE DUPONT COMPANY INC  
Affiliation: Self  
Street Address:  
City:  
State:  
Zip:  
Submittal Date: Sun Jul 05 16:21:51 EDT 2015
When selected in lieu of the incident energy analysis of 130.5(B)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(A)(b) shall be used to determine the arc flash PPE category. The estimated maximum available short-circuit current, maximum fault-clearing times, and minimum working distances for various ac equipment types or classifications are listed in Table 130.7(C)(15)(A)(b). An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Tasks not listed in Table 130.7(C)(15)(A)(a)
2. Power systems with greater than the estimated maximum available short-circuit current
3. Power systems with longer than the maximum fault clearing times
4. Tasks with less than the minimum working distance

### Arc Flash PPE Required

<table>
<thead>
<tr>
<th>Task</th>
<th>Equipment Condition</th>
<th>Is employee exposed to electric arc hazard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading a panel meter while operating a meter switch</td>
<td>Any</td>
<td>No</td>
</tr>
</tbody>
</table>
| Normal operation of a circuit breaker (CB), switch, contactor, or starter | All of the following:  
- The equipment is properly installed  
- The equipment is properly maintained  
- All equipment doors are closed and secured  
- All equipment covers are in place and secured  
- There is no evidence of impending failure | No                                       |
| For ac systems: Work on energized electrical conductors and circuit parts, including voltage testing | Any                 | Yes                                      |
| For dc systems: Work on energized electrical conductors and circuit parts of series-connected battery cells, including voltage testing | Any                 | Yes                                      |
| Voltage testing on individual battery cells or individual multi-cell units | All of the following:  
- The equipment is properly installed  
- The equipment is properly maintained  
- Covers for all other equipment are in place and secured  
- There is no evidence of impending failure | No                                       |
| Removal or installation of CBs or switches | Any                 | Yes                                      |
| Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare energized electrical conductors and circuit parts | Any                 | Yes                                      |
| Removal of bolted covers (to expose bare energized electrical conductors and circuit parts). For dc systems, this includes bolted covers, such as battery terminal covers. | Any                 | Yes                                      |
| Removal of battery intercell connector covers | All of the following:  
- The equipment is properly installed  
- The equipment is properly maintained | No                                       |
<table>
<thead>
<tr>
<th>Covers for all other equipment are in place and secured</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is no evidence of impending failure</td>
<td></td>
</tr>
</tbody>
</table>

One or more of the following:
- The equipment is not properly installed  
- The equipment is not properly maintained  
- Equipment doors are open or not secured  
- Equipment covers are off or not secured  
| There is evidence of impending failure              |     |

Opening hinged door(s) or cover(s) (to expose bare energized electrical conductors and circuit parts) | Any |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening hinged door(s) or cover(s) (to expose bare energized electrical conductors and circuit parts)</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Perform infrared thermography and other noncontact inspections outside the restricted approach boundary. This activity does not include opening of doors or covers. | Any |
| Perform infrared thermography and other noncontact inspections outside the restricted approach boundary. This activity does not include opening of doors or covers. | No |

Application of temporary protective grounding equipment after voltage test | Any |
| Application of temporary protective grounding equipment after voltage test | Yes |

Work on control circuits with exposed energized electrical conductors and circuit parts, 120 volts or below without any other exposed energized equipment over 120 V including opening of hinged covers to gain access | Any |
| Work on control circuits with exposed energized electrical conductors and circuit parts, 120 volts or below without any other exposed energized equipment over 120 V including opening of hinged covers to gain access | No |

Work on control circuits with exposed energized electrical conductors and circuit parts, greater than 120 V | Any |
| Work on control circuits with exposed energized electrical conductors and circuit parts, greater than 120 V | Yes |

Insertion or removal of individual starter buckets from motor control center (MCC) | Any |
| Insertion or removal of individual starter buckets from motor control center (MCC) | Yes |

Insertion or removal (racking) of CBs or starters from cubicles, doors open or closed | Any |
| Insertion or removal (racking) of CBs or starters from cubicles, doors open or closed | Yes |

Insertion or removal of plug-in devices into or from busways | Any |
| Insertion or removal of plug-in devices into or from busways | Yes |

Insulated cable examination with no manipulation of cable | Any |
| Insulated cable examination with no manipulation of cable | No |

Insulated cable examination with manipulation of cable | Any |
| Insulated cable examination with manipulation of cable | Yes |

Work on exposed energized electrical conductors and circuit parts of equipment directly supplied by a panelboard or motor control center | Any |
| Work on exposed energized electrical conductors and circuit parts of equipment directly supplied by a panelboard or motor control center | Yes |

Insertion and removal of revenue meters (kW-hour, at primary voltage and current) | Any |
| Insertion and removal of revenue meters (kW-hour, at primary voltage and current) | Yes |

For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an enclosure | Any |
| For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an enclosure | Yes |

For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an open rack | Any |
| For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an open rack | No |

For dc systems, maintenance on a single cell of a battery system or multi-cell units in an open rack | Any |
| For dc systems, maintenance on a single cell of a battery system or multi-cell units in an open rack | No |

For dc systems, work on exposed energized electrical conductors and circuit parts of utilization equipment directly supplied by a dc source | Any |
| For dc systems, work on exposed energized electrical conductors and circuit parts of utilization equipment directly supplied by a dc source | Yes |

Arc-resistant switchgear Type 1 or 2 (for clearing times of <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, tested in accordance | All of the following: |
| Arc-resistant switchgear Type 1 or 2 (for clearing times of <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, tested in accordance | No |
### Table 130.7(C)(15)(A)(b) Arc-Flash PPE Categories for Alternating Current (ac) Systems

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
</table>
| Panelboards or other equipment rated 240 V and below  
Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.) | 1                      | 485 mm (19 in.)    |
| Panelboards or other equipment rated >240 V and up to 600 V  
Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.) | 2                      | 900 mm (3 ft)      |
| 600-V class motor control centers (MCCs)  
Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.) | 2                      | 1.5 m (5 ft)       |
| 600-V class motor control centers (MCCs)  
Parameters: Maximum of 42 kA short-circuit current available; maximum of 0.33 sec (20 cycles) fault clearing time; working distance 455 mm (18 in.) | 4                      | 4.3 m (14 ft)      |
| 600-V class switchgear (with power circuit breakers or fused switches) and 600 V class switchboards  
Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.5 sec (30 cycles) fault clearing time; working distance 455 mm (18 in.) | 4                      | 6 m (20 ft)        |
| Other 600-V class (277 V through 600 V, nominal) equipment  
Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.) | 2                      | 1.5 m (5 ft)       |
| NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV  
Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.) | 4                      | 12 m (40 ft)       |
| Metal-clad switchgear, 1 kV through 15 kV  
Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.) | 4                      | 12 m (40 ft)       |
| Arc-resistant switchgear Type 1 or 2 (for clearing times of < 0.5 sec (30 cycles) with a perspective 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, tested in accordance with IEEE C37.20.7, 1 kV through 15 kV  
Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.) | N/A (doors closed)      | N/A (doors closed) |
| Other equipment 1 kV through 15 kV  
Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.) | 4                      | 12 m (40 ft)       |

Note: For equipment rated 600 volts and below, and protected by upstream current-limiting fuses or current-limiting 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.

Statement of Problem and Substantiation for Public Input

The wording in the last column has been changed to align with the wording used in new OSHA standard. 770E is a minimum standard and it is proper to say PPE is not required if all the conditions described are true. PPE may still be required as decided by the employer. The intent of the phrase normal operation has been added in the note below to ensure equipment is operated according to listing and labeling instructions and manufacturer’s recommendations. The wording for the phrases properly installed and maintained to align with OSHA wording including in the new OSHA standard.

Submitter Information Verification

Submitter Full Name: DALEEP MOHLA
Organization: DCM ELECTRICAL CONSULTING SERV
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Mon Jul 06 09:59:30 EDT 2015
When selected in lieu of the incident energy analysis of 130.5(B)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(A)(b) shall be used to determine the arc flash PPE category. The estimated maximum available short-circuit current, maximum fault-clearing times, and minimum working distances for various ac equipment types or classifications are listed in Table 130.7(C)(15)(A)(b). An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Tasks not listed in Table 130.7(C)(15)(A)(a)
2. Power systems with greater than the estimated maximum available short-circuit current
3. Power systems with longer than the maximum fault clearing times
4. Tasks with less than the minimum working distance

Table 130.7(C)(15)(A)(a) Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Task</th>
<th>Equipment Condition*</th>
<th>Arc Flash PPE Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading a panel meter while operating a meter switch</td>
<td>Any</td>
<td>No</td>
</tr>
</tbody>
</table>
| Normal operation of a circuit breaker (CB), switch, contactor, or starter | All of the following:  
- The equipment is properly installed  
- The equipment is properly maintained  
- All equipment doors are closed and secured  
- All equipment covers are in place and secured  
- There is no evidence of impending failure | No |
| | One or more of the following:  
- The equipment is not properly installed  
- The equipment is not properly maintained  
- Equipment doors are open or not secured  
- Equipment covers are off or not secured  
- There is evidence of impending failure | Yes |
| | For ac systems: Work on energized electrical conductors and circuit parts, including voltage testing | Any | Yes |
| | For dc systems: Work on energized electrical conductors and circuit parts of series-connected battery cells, including voltage testing | Any | Yes |
| Voltage testing on individual battery cells or individual multi-cell units | All of the following:  
- The equipment is properly installed  
- The equipment is properly maintained  
- Covers for all other equipment are in place and secured  
- There is no evidence of impending failure | No |
| | One or more of the following:  
- The equipment is not properly installed  
- The equipment is not properly maintained  
- Equipment doors are open or not secured  
- Equipment covers are off or not secured  
- There is evidence of impending failure | Yes |
| Removal or installation of CBs or switches | Any | Yes |
| Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare energized electrical conductors and circuit parts | All of the following:  
- The equipment is properly installed  
- The equipment is properly maintained  
- There is no evidence of impending failure | No |
| | Any of the following:  
- The equipment is not properly installed  
- The equipment is not properly maintained  
- There is evidence of impending failure | Yes |
| Removal of bolted covers (to expose bare energized electrical conductors and circuit parts). For dc systems, this includes bolted covers, such as battery terminal covers. | Any | Yes |
| Removal of battery intercell connector covers | All of the following:  
- The equipment is properly installed.  
- The equipment is properly maintained.  
- Covers for all other equipment are in place and secured  
- There is no evidence of impending failure | No |
| | One or more of the following:  
- The equipment is not properly installed  
- The equipment is not properly maintained  
- Equipment doors are open or not secured  
- Equipment covers are off or not secured  
- There is evidence of impending failure | Yes |
<table>
<thead>
<tr>
<th>Task Description</th>
<th>Any</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening hinged door(s) or cover(s) (to expose bare energized electrical conductors and circuit parts)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Perform infrared thermography and other noncontact inspections outside the restricted approach boundary. This activity does not include opening of doors or covers.</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Application of temporary protective grounding equipment after voltage test</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, 120 volts or below without any other exposed energized equipment over 120 V including opening of hinged covers to gain access</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, greater than 120 V</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal of individual starter buckets from motor control center (MCC)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal (racking) of CBs or starters from cubicles, doors open or closed</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal of plug-in devices into or from busways</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Insulated cable examination with no manipulation of cable</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insulated cable examination with manipulation of cable</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Work on exposed energized electrical conductors and circuit parts of equipment directly supplied by a panelboard or motor control center</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion and removal of revenue meters (kW-hour, at primary voltage and current)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an enclosure</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an open rack</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>For dc systems, maintenance on a single cell of a battery system or multi-cell units in an open rack</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>For dc systems, work on exposed energized electrical conductors and circuit parts of utilization equipment directly supplied by a dc source</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 (for clearing times of 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, tested in accordance with IEEE C37.20.7;</td>
<td>All of the following:</td>
<td>No</td>
</tr>
<tr>
<td>- Insertion or removal (racking) of CBs from cubicles</td>
<td>- The equipment is properly installed</td>
<td></td>
</tr>
<tr>
<td>- Insertion or removal (racking) of ground and test device</td>
<td>- The equipment is properly maintained</td>
<td></td>
</tr>
<tr>
<td>- Insertion or removal (racking) of voltage transformers on or off the bus</td>
<td>All equipment doors are closed and secured</td>
<td></td>
</tr>
<tr>
<td>- All equipment covers are in place and secured</td>
<td>There is no evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td>- One or more of the following:</td>
<td>The equipment is not properly installed</td>
<td></td>
</tr>
<tr>
<td>- The equipment is not properly maintained</td>
<td>Equipment doors are open or not secured</td>
<td></td>
</tr>
</tbody>
</table>
While it is next to impossible to list every evidence of impending failure, specifically listing water falling onto or coming out of equipment makes it clear that a failure is probably evident.

Note: Hazard identification is one component of risk assessment. Risk assessment involves a determination of the likelihood of occurrence of an incident, resulting from a hazard that could cause injury or damage to health. The assessment of the likelihood of occurrence contained in this table does not cover every possible condition or situation. Where this table indicates that arc flash PPE is not required, an arc flash is not likely to occur.

*The phrase properly installed, as used in this table, means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer's recommendations. The phrase properly maintained, as used in this table, means that the equipment has been maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards. The phrase evidence of impending failure, as used in this table, means that there is evidence of arcing, overheating, loose or bound equipment parts, visible damage, deterioration, water falling onto or coming out of the electrical equipment, or other damage.

Table 130.7(C)(15)(A)(b) Arc-Flash Hazard PPE Categories for Alternating Current (ac) Systems

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panelboards or other equipment rated 240 V and below</td>
<td>1</td>
<td>485 mm (19 in.)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td>2</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>Panelboards or other equipment rated &gt;240 V and up to 600 V</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td>4</td>
<td>4.3 m (14 ft)</td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>4</td>
<td>6 m (20 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.5 sec (30 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Other 600-V class (277 V through 600 V, nominal) equipment</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.33 sec (20 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV</td>
<td>N/A (doors closed)</td>
<td>N/A (doors closed)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>4 (doors open)</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Metal-clad switchgear, 1 kV through 15 kV</td>
<td>4 (doors open)</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>4 (doors open)</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Other equipment 1 kV through 15 kV</td>
<td>4 (doors open)</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>1</td>
<td>485 mm (19 in.)</td>
</tr>
</tbody>
</table>

Note: For equipment rated 600 volts and below, and protected by upstream current-limiting fuses or current-limiting 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.

Statement of Problem and Substantiation for Public Input

While it is next to impossible to list every evidence of impending failure, specifically listing water falling onto or coming out of equipment makes it clear that a failure is probably evident.

Submitter Information Verification

Submitter Full Name: ALVIN HAVENS
Organization: e-Hazard Management, LLC
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jul 06 10:43:41 EDT 2015
When selected in lieu of the incident energy analysis of 130.5(B)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(A)(b) shall be used to determine the arc flash PPE category. The estimated maximum available short-circuit current, maximum fault-clearing times, and minimum working distances for various ac equipment types or classifications are listed in Table 130.7(C)(15)(A)(b). An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Tasks not listed in Table 130.7(C)(15)(A)(a)
2. Power systems with greater than the estimated maximum available short-circuit current
3. Power systems with longer than the maximum fault clearing times
4. Tasks with less than the minimum working distance

<table>
<thead>
<tr>
<th>Task</th>
<th>Equipment Condition*</th>
<th>Arc Flash PPE Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading a panel meter while operating a meter switch</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Normal operation of a circuit breaker (CB), switch, contactor, or starter</td>
<td>All of the following: The equipment is properly installed, The equipment is properly maintained, All equipment doors are closed and secured, All equipment covers are in place and secured, There is no evidence of impending failure</td>
<td>No</td>
</tr>
<tr>
<td>One or more of the following: The equipment is not properly installed, The equipment is not properly maintained, Equipment doors are open or not secured, Equipment covers are off or not secured, There is evidence of impending failure</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>For ac systems: Work on energized electrical conductors and circuit parts, including voltage testing</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems: Work on energized electrical conductors and circuit parts of series-connected battery cells, including voltage testing</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Voltage testing on individual battery cells or individual multi-cell units</td>
<td>All of the following: The equipment is properly installed, The equipment is properly maintained, Covers for all other equipment are in place and secured, There is no evidence of impending failure</td>
<td>No</td>
</tr>
<tr>
<td>One or more of the following: The equipment is not properly installed, The equipment is not properly maintained, Equipment doors are open or not secured, Equipment covers are off or not secured, There is evidence of impending failure</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Removal or installation of CBs or switches</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare energized electrical conductors and circuit parts</td>
<td>All of the following: The equipment is properly installed, The equipment is properly maintained, There is no evidence of impending failure</td>
<td>No</td>
</tr>
<tr>
<td>Any of the following: The equipment is not properly installed, The equipment is not properly maintained, There is evidence of impending failure</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Removal of bolted covers (to expose bare energized electrical conductors and circuit parts). For dc systems, this includes bolted covers, such as battery terminal covers</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Removal of battery intercell connector covers</td>
<td>All of the following: The equipment is properly installed, The equipment is properly maintained, Covers for all other equipment are in place and secured, There is no evidence of impending failure</td>
<td>No</td>
</tr>
<tr>
<td>One or more of the following: The equipment is not properly installed, The equipment is not properly maintained, Equipment doors are open or not secured, Equipment covers are off or not secured, There is evidence of impending failure</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Activity Description</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------------</td>
<td>-----</td>
<td>------</td>
</tr>
<tr>
<td>Opening hinged door(s) or cover(s) (to expose bare energized electrical conductors and circuit parts)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Perform infrared thermography and other noncontact inspections outside the restricted approach boundary. This activity does not include opening of doors or covers.</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Application of temporary protective grounding equipment after voltage test</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, 120 volts or below without any other exposed energized equipment over 120 V including opening of hinged covers to gain access</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, greater than 120 V</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal of individual starter buckets from motor control center (MCC)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal (racking) of CBs or starters from cubicles, doors open or closed</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal of plug-in devices into or from busways</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insulated cable examination with no manipulation of cable</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Insulated cable examination with manipulation of cable</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Work on exposed energized electrical conductors and circuit parts of equipment directly supplied by a panelboard or motor control center</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion and removal of revenue meters (kW-hour, at primary voltage and current)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an enclosure</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an open rack</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>For dc systems, maintenance on a single cell of a battery system or multi-cell units in an open rack</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>For dc systems, work on exposed energized electrical conductors and circuit parts of utilization equipment directly supplied by a dc source</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 (for clearing times of &lt;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, tested in accordance with IEEE C37.20.7; Insertion or removal (racking) of CBs from cubicles Insertion or removal (racking) of ground and test device Insertion or removal (racking) of voltage transformers on or off the bus All of the following:</td>
<td>All of the following:</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>The equipment is properly installed</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>The equipment is properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All equipment doors are closed and secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All equipment covers are in place and secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is no evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td>One or more of the following:</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly installed</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly maintained</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Equipment doors are open or not secured</td>
<td>Yes</td>
</tr>
</tbody>
</table>
There is evidence of impending failure

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc-Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panelboards or other equipment rated 240 V and below</td>
<td>1</td>
<td>485 mm (19 in.)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panelboards or other equipment rated &gt;240 V and up to 600 V</td>
<td>2</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>500-V class motor control centers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class switchgear (with power circuit breakers or fused switches) and 600 V class switchboards</td>
<td>4</td>
<td>6 m (20 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.5 sec (30 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other 600-V class (277 V through 600 V, nominal) equipment</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metal-clad switchgear, 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 (for clearing times of &lt; 0.5 sec</td>
<td>N/A (doors closed)</td>
<td></td>
</tr>
</tbody>
</table>
## Statement of Problem and Substantiation for Public Input

The two different PPE categories for Motor Control Centers are confusing. Most people in the industry when working on switchboards or motor control centers use Cat 4 clothing. It is very difficult to explain the difference when teaching a class. Some people have inferred that the Category 2 refers to work performed on the load side of the motor control disconnect and the Category 4 refers to work on the line side. If this is the case then we should explain that in either an informational note or revise the actual equipment category text. But either way this needs to get fixed.

### Submitter Information Verification

<table>
<thead>
<tr>
<th>Submitter Full Name:</th>
<th>LAWRENCE AYER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization:</td>
<td>BIZ COM ELECTRIC INC</td>
</tr>
<tr>
<td>Affiliation:</td>
<td>IEC</td>
</tr>
<tr>
<td>Street Address:</td>
<td></td>
</tr>
<tr>
<td>City:</td>
<td></td>
</tr>
<tr>
<td>State:</td>
<td></td>
</tr>
<tr>
<td>Zip:</td>
<td></td>
</tr>
<tr>
<td>Submittal Date:</td>
<td>Mon Jul 06 14:17:33 EDT 2015</td>
</tr>
</tbody>
</table>
When selected in lieu of the incident energy analysis of 130.5(B)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(A)(b) shall be used to determine the arc flash PPE category. The maximum estimated maximum available short-circuit current, maximum fault-clearing times, and minimum working distances for various ac equipment types or classifications are listed in Table 130.7(C)(15)(A)(a). An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Tasks not listed in Table 130.7(C)(15)(A)(a)
2. Power systems with greater than the estimated maximum available short-circuit current listed in the associated parameters in Table 130.7(C)(15)(A)(a)
3. Power systems with longer than the maximum fault clearing times based on the maximum estimated available short-circuit current listed in the associated parameters in Table 130.7(C)(15)(A)(a)
4. Tasks with less than the associated minimum working distance

Table 130.7(C)(15)(A)(a) Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Task</th>
<th>Equipment Condition*</th>
<th>Arc Flash PPE Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading a panel meter while operating a meter switch</td>
<td>Any</td>
<td>No</td>
</tr>
</tbody>
</table>
| Normal operation of a circuit breaker (CB), switch, contactor, or starter | All of the following:  
- The equipment is properly installed  
- The equipment is properly maintained  
- All equipment doors are closed and secured  
- All equipment covers are in place and secured  
- There is no evidence of impending failure | No                     |
| One or more of the following:  
- The equipment is not properly installed  
- The equipment is not properly maintained  
- Equipment doors are open or not secured  
- Equipment covers are off or not secured  
- There is evidence of impending failure | Yes                     |
| For ac systems: Work on energized electrical conductors and circuit parts, including voltage testing | Any                                                                                 | Yes                    |
| For dc systems: Work on energized electrical conductors and circuit parts of series-connected battery cells, including voltage testing | Any                                                                                 | Yes                    |
| Voltage testing on individual battery cells or individual multi-cell units | All of the following:  
- The equipment is properly installed  
- The equipment is properly maintained  
- Covers for all other equipment are in place and secured  
- There is no evidence of impending failure | No                     |
| One or more of the following:  
- The equipment is not properly installed  
- The equipment is not properly maintained  
- Equipment doors are open or not secured  
- Equipment covers are off or not secured  
- There is evidence of impending failure | Yes                     |
| Removal or installation of CBs or switches                           | Any                                                                                 | Yes                    |
| Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare energized electrical conductors and circuit parts | All of the following:  
- The equipment is properly installed  
- The equipment is properly maintained  
- There is no evidence of impending failure | No                     |
| Any of the following:  
- The equipment is not properly installed  
- The equipment is not properly maintained  
- There is evidence of impending failure | Yes                     |
| Removal of bolted covers (to expose bare energized electrical conductors and circuit parts. For dc systems, this includes bolted covers, such as battery terminal covers.) | Any                                                                                 | Yes                    |
| Removal of battery intercell connector covers                        | All of the following:  
- The equipment is properly installed.  
- The equipment is properly maintained.  
- Covers for all other equipment are in place and secured  
- There is no evidence of impending failure | No                     |
| One or more of the following:  
- The equipment is not properly installed.  
- The equipment is not properly maintained.  
- Equipment doors are open or not secured | Yes                     |
<table>
<thead>
<tr>
<th>Equipment covers are off or not secured</th>
<th>Any</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is evidence of impending failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opening hinged door(s) or cover(s)</td>
<td>Any</td>
<td></td>
</tr>
<tr>
<td>(to expose bare energized electrical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>conductors and circuit parts)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perform infrared thermography and</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>other noncontact inspections outside</td>
<td></td>
<td></td>
</tr>
<tr>
<td>the restricted approach boundary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>This activity does not include opening</td>
<td></td>
<td></td>
</tr>
<tr>
<td>of doors or covers.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Application of temporary protective</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>grounding equipment after voltage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work on control circuits with exposed</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>energized electrical conductors and</td>
<td></td>
<td></td>
</tr>
<tr>
<td>circuit parts, 120 volts or below</td>
<td></td>
<td></td>
</tr>
<tr>
<td>without any other exposed energized</td>
<td></td>
<td></td>
</tr>
<tr>
<td>equipment over 120 V including</td>
<td></td>
<td></td>
</tr>
<tr>
<td>opening of hinged covers to gain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>access</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work on control circuits with exposed</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>energized electrical conductors and</td>
<td></td>
<td></td>
</tr>
<tr>
<td>circuit parts, greater than 120 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insertion or removal of individual</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>starter buckets from motor control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>center (MCC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insertion or removal (racking) of CBs</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>or starters from cubicles, doors open</td>
<td></td>
<td></td>
</tr>
<tr>
<td>or closed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insertion or removal of plug-in</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>devices into or from busways</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulated cable examination with no</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>manipulation of cable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulated cable examination with</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>manipulation of cable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work on exposed energized electrical</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>conductors and circuit parts of</td>
<td></td>
<td></td>
</tr>
<tr>
<td>equipment directly supplied by a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>panelboard or motor control center</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insertion and removal of revenue</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>meters (kW-hour, at primary voltage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>and current)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>For dc systems, insertion or removal</td>
<td>Any</td>
<td></td>
</tr>
<tr>
<td>of individual cells or multi-cell units of</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a battery system in an enclosure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>For dc systems, insertion or removal</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>of individual cells or multi-cell units of</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a battery system in an open rack</td>
<td></td>
<td></td>
</tr>
<tr>
<td>For dc systems, maintenance on a</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>single cell of a battery system or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>multi-cell units in an open rack</td>
<td></td>
<td></td>
</tr>
<tr>
<td>For dc systems, work on exposed</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>energized electrical conductors and</td>
<td></td>
<td></td>
</tr>
<tr>
<td>circuit parts of utilization equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>directly supplied by a dc source</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(for clearing times of &lt;0.5 sec with a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>prospective fault current not to</td>
<td></td>
<td></td>
</tr>
<tr>
<td>exceed the arc-resistant rating of the</td>
<td></td>
<td></td>
</tr>
<tr>
<td>equipment and metal enclosed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>interrupter switchgear, fused or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>unfused of arc resistant type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>construction, tested in accordance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>with IEEE C37.20.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insertion or removal (racking) of CBs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>from cubicles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insertion or removal (racking) of</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ground and test device</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insertion or removal (racking) of</td>
<td></td>
<td></td>
</tr>
<tr>
<td>voltage transformers in or off the bus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All of the following:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The equipment is properly installed</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>The equipment is properly maintained</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All equipment doors are closed and</td>
<td></td>
<td></td>
</tr>
<tr>
<td>secured</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All equipment covers are in place and</td>
<td></td>
<td></td>
</tr>
<tr>
<td>secured</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There is no evidence of impending</td>
<td></td>
<td></td>
</tr>
<tr>
<td>failure</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Submitter Information Verification

Submitter Full Name: PALMER HICKMAN
Organization: ELECTRICAL TRAINING ALLIANCE
Street Address:

---

**Statement of Problem and Substantiation for Public Input**

Editorial clarifications are proposed to improved clarity and usability. Although I believe this to clearly be the intent of the requirement, it is not necessarily clear from the present language in 130.7(C)(15)(A)(2) and (3) that the clearing time is to be based on the estimated maximum available short circuit current shown in the parameters in Table 130.7(C)(15)(A)(b).

---

Note: Hazard identification is one component of risk assessment. Risk assessment involves a determination of the likelihood of occurrence of an incident, resulting from a hazard that could cause injury or damage to health. The assessment of the likelihood of occurrence contained in this table does not cover every possible condition or situation. Where this table indicates that arc flash PPE is not required, an arc flash is not likely to occur.

*The phrase properly installed, as used in this table, means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer's recommendations. The phrase properly maintained, as used in this table, means that the equipment has been maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards. The phrase evidence of impending failure, as used in this table, means that there is evidence of arcing, overheating, loose or bound equipment parts, visible damage, deterioration, or other damage.*

---

Table 130.7(C)(15)(A)(b) Arc-Flash Hazard PPE Categories for Alternating Current (ac) Systems

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panelboards or other equipment rated 240 V and below</td>
<td>1</td>
<td>485 mm (19 in.)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td>2</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>Panelboards or other equipment rated &gt;240 V and up to 600 V</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td>4</td>
<td>4.3 m (14 ft)</td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>4</td>
<td>9 m (30 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 42 kA short-circuit current available; maximum of 0.33 sec (20 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td>4</td>
<td>6.3 m (20 ft)</td>
</tr>
<tr>
<td>Other 600-V class (277 V through 600 V, nominal) equipment</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Metal-clad switchgear, 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>N/A (doors closed)</td>
<td>N/A (doors closed)</td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 [for clearing times of &lt; 0.5 sec (30 cycles) with a perspective 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, tested in accordance with IEEE C37.20.7, 1 kV through 15 kV]</td>
<td>4 (doors open)</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>4 (doors open)</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Other equipment 1 kV through 15 kV</td>
<td>N/A (doors closed)</td>
<td>N/A (doors closed)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>4 (doors open)</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Other equipment 1 kV through 15 kV</td>
<td>4 (doors open)</td>
<td>12 m (40 ft)</td>
</tr>
</tbody>
</table>

Note: For equipment rated 600 volts and below, and protected by upstream current-limiting fuses or current-limiting 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.
When selected in lieu of the incident energy analysis of 130.5(B)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(A)(b) shall be used to determine the arc flash PPE category. The estimated maximum available short-circuit current, maximum fault-clearing times, and minimum working distances for various ac equipment types or classifications are listed in Table 130.7(C)(15)(A)(b). An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Tasks not listed in Table 130.7(C)(15)(A)(a)
2. Power systems with greater than the estimated maximum available short-circuit current
3. Power systems with longer than the maximum fault clearing times
4. Tasks with less than the minimum working distance

Table 130.7(C)(15)(A)(a) Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Task</th>
<th>Equipment Condition*</th>
<th>Arc Flash PPE Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading a panel meter while operating a meter switch</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Normal operation of a circuit breaker (CB), switch, contactor, or</td>
<td>All of the following:</td>
<td></td>
</tr>
<tr>
<td>starter</td>
<td>The equipment is properly installed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All equipment doors are closed and secured</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>All equipment covers are in place and secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is no evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td>For ac systems: Work on energized electrical conductors and circuit</td>
<td>All of the following:</td>
<td></td>
</tr>
<tr>
<td>parts, including voltage testing</td>
<td>The equipment is properly installed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Covers for all other equipment are in place and secured</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>There is no evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td>For dc systems: Work on energized electrical conductors and circuit</td>
<td>All of the following:</td>
<td></td>
</tr>
<tr>
<td>parts of series-connected battery cells, including voltage testing</td>
<td>The equipment is properly installed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Covers for all other equipment are in place and secured</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>There is no evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td>Voltage testing on individual battery cells or individual multi-cell</td>
<td>All of the following:</td>
<td></td>
</tr>
<tr>
<td>units</td>
<td>The equipment is properly installed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Covers for all other equipment are in place and secured</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>There is no evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td>Removal or installation of CBs or switches</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Removal or installation of covers for equipment such as wireways,</td>
<td>All of the following:</td>
<td></td>
</tr>
<tr>
<td>junction boxes, and cable trays that does not expose bare energized</td>
<td>The equipment is properly installed</td>
<td></td>
</tr>
<tr>
<td>electrical conductors and circuit parts</td>
<td>The equipment is properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is no evidence of impending failure</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Any of the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly installed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Equipment doors are open or not secured</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Equipment covers are off or not secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td>Removal or installation of covers for equipment such as wireways,</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>junction boxes, and cable trays that does not expose bare energized</td>
<td>All of the following:</td>
<td></td>
</tr>
<tr>
<td>electrical conductors and circuit parts</td>
<td>The equipment is properly installed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Covers for all other equipment are in place and secured</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>There is no evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td>Removal of bolted covers (to expose bare energized electrical</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>conductors and circuit parts). For dc systems, this includes bolted</td>
<td>All of the following:</td>
<td></td>
</tr>
<tr>
<td>covers, such as battery terminal covers.</td>
<td>The equipment is properly installed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Covers for all other equipment are in place and secured</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>There is no evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td>Removal of battery intercell connector covers</td>
<td>All of the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly installed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Covers for all other equipment are in place and secured</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>There is no evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>One or more of the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly installed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Equipment doors are open or not secured</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Equipment covers are off or not secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td>Activity</td>
<td>Condition</td>
<td>Result</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>----------------------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Opening hinged door(s) or cover(s) (to expose bare energized electrical conductors and circuit parts)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Perform infrared thermography and other noncontact inspections outside the restricted approach boundary (or through a listed and labeled inspection window). This activity does not include opening of doors or covers.</td>
<td>Any</td>
<td>There is no evidence of impending failure</td>
</tr>
<tr>
<td>Application of temporary protective grounding equipment after voltage test</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, 120 volts or below without any other exposed energized equipment over 120 V including opening of hinged covers to gain access</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, greater than 120 V</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal of individual starter buckets from motor control center (MCC)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal (racking) of CBs or starters from cubicles, doors open or closed</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal of plug-in devices into or from busways</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insulated cable examination with no manipulation of cable</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Insulated cable examination with manipulation of cable</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Work on exposed energized electrical conductors and circuit parts of equipment directly supplied by a panelboard or motor control center</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion and removal of revenue meters (kW-hour, at primary voltage and current)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an enclosure</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an open rack</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>For dc systems, maintenance on a single cell of a battery system or multi-cell units in an open rack</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>For dc systems, work on exposed energized electrical conductors and circuit parts of utilization equipment directly supplied by a dc source</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 (for clearing times of &lt;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, tested in accordance with IEEE C37.20.7: Insertion or removal (racking) of CBs from cubicles Insertion or removal (racking) of ground and test device Insertion or removal (racking) of voltage transformers on or off the bus</td>
<td>All of the following: The equipment is properly installed The equipment is properly maintained All equipment doors are closed and secured All equipment covers are in place and secured</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Clarify that using an inspection window is working outside the RAB, which is a very common question in the field. Performing non-contact inspections such as IR scans are also made it clear that regardless of how the inspection is being performed, if there is evidence of impending failure, the employee should utilize PPE for additional protection since the "impending failure" is a situation with inherent elevated risk.

**Related Input Relationship**

- **Statement of Problem and Substantiation for Public Input**

  Clarify that using an inspection window is working outside the RAB, which is a very common question in the field. Performing non-contact inspections such as IR scans are non-invasive and not increasing the risk of triggering an arc.

  Also, make it clear that regardless of how the inspection is being performed, if there is evidence of impending failure, the employee should utilize PPE for additional protection since the "impending failure" is a situation with inherent elevated risk.

**Related Public Inputs for This Document**

<table>
<thead>
<tr>
<th>Public Input No.</th>
<th>Relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td>407-NFPA 70E-2015 [Section No. 130.7(C)(15)(A)]</td>
<td>Related Input</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 130.7(C)(15)(A)(b) Arc-Flash Hazard PPE Categories for Alternating Current (ac) Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Equipment</strong></td>
</tr>
<tr>
<td>Panelboards or other equipment rated 240 V and below</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
</tr>
<tr>
<td>Panelboards or other equipment rated &gt;240 V and up to 600 V</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
</tr>
<tr>
<td>Parameters: Maximum of 42 kA short-circuit current available; maximum of 0.33 sec (20 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
</tr>
<tr>
<td>600-V class switchgear (with power circuit breakers or fused switches) and 600 V class switchboards</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.5 sec (30 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
</tr>
<tr>
<td>Other 600-V class (277 V through 600 V, nominal) equipment</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
</tr>
<tr>
<td>NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
</tr>
<tr>
<td>Metal-clad switchgear, 1 kV through 15 kV</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
</tr>
<tr>
<td>Arc-resistant switchgear Type I or 2 [for clearing times of &lt; 0.5 sec (30 cycles) with a perspective 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, tested in accordance with IEEE C37.20.7, 1 kV through 15 kV</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
</tr>
<tr>
<td>Other equipment 1 kV through 15 kV</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
</tr>
</tbody>
</table>

Note: Hazard identification is one component of risk assessment. Risk assessment involves a determination of the likelihood of occurrence of an incident, resulting from a hazard that could cause injury or damage to health. The assessment of the likelihood of occurrence contained in this table does not cover every possible condition or situation. Where this table indicates that arc flash PPE is not required, an arc flash is not likely to occur.

*The phrase properly installed, as used in this table, means that the equipment has been installed in accordance with the manufacturer’s recommendations and applicable industry codes and standards. The phrase evidence of impending failure, as used in this table, means that there is evidence of arcing, overheating, loose or bound equipment parts, visible damage, deterioration, or other damage.

**Related Public Inputs for This Document**

- **Related Input**

  Public Input No. 407-NFPA 70E-2015 [Section No. 130.7(C)(15)(A)]
When selected in lieu of the incident energy analysis of 130.5(B)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(A)(b) shall be used to determine the arc flash PPE category. The estimated maximum available short-circuit current, maximum fault-clearing times, and minimum working distances for various ac equipment types or classifications are listed in Table 130.7(C)(15)(A)(b). An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Tasks not listed in Table 130.7(C)(15)(A)(a)
2. Power systems with greater than the estimated maximum available short-circuit current
3. Power systems with longer than the maximum fault clearing times
4. Tasks with less than the minimum working distance

Table 130.7(C)(15)(A)(a) Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Task</th>
<th>Equipment Condition*</th>
<th>Arc Flash PPE Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading a panel meter while operating a meter switch</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Normal operation of a circuit breaker (CB), switch, contactor, or starter</td>
<td>All of the following;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly installed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All equipment doors are closed and secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All equipment covers are in place and secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is no evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>One or more of the following;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly installed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Equipment doors are open or not secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Equipment covers are off or not secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td>For ac systems: Work on energized electrical conductors and circuit parts, including voltage testing</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems: Work on energized electrical conductors and circuit parts of series-connected battery cells, including voltage testing</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Voltage testing on individual battery cells or individual multi-cell units</td>
<td>All of the following;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly installed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Covers for all other equipment are in place and secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is no evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>One or more of the following;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly installed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Equipment doors are open or not secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Equipment covers are off or not secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td>Removal or installation of CBs or switches</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare energized electrical conductors and circuit parts</td>
<td>All of the following;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly installed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is no evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Any of the following;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly installed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td>Removal of bolted covers (to expose bare energized electrical conductors and circuit parts). For dc systems, this includes bolted covers, such as battery terminal covers.</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Removal of battery intercell connector covers</td>
<td>All of the following;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly installed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Covers for all other equipment are in place and secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is no evidence of impending failure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>One or more of the following;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly installed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly maintained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Equipment doors are open or not secured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Equipment covers are off or not secured</td>
<td></td>
</tr>
<tr>
<td>Activity</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>Opening hinged door(s) or cover(s) (to expose bare energized electrical conductors and circuit parts)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Perform infrared thermography and other noncontact inspections outside the restricted approach boundary</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Application of temporary protective grounding equipment after voltage test</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, 120 volts or below without any other exposed energized equipment over 120 V including opening of hinged covers to gain access</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, greater than 120 V</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal of individual starter buckets from motor control center (MCC)</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal (racking) of CBs or starters from cubicles, doors open or closed</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal of plug-in devices into or from busways</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insulated cable examination with no manipulation of cable</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Insulated cable examination with manipulation of cable</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Work on exposed energized electrical conductors and circuit parts of equipment directly supplied by a panelboard or motor control center</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion and removal of voltage transformers on or off the bus</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 (for clearing times of &lt;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, tested in accordance with IEEE C37.20.7</td>
<td>All of the following:</td>
<td></td>
</tr>
<tr>
<td>The equipment is properly installed</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>The equipment is properly maintained</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>All equipment doors are closed and secured</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>All equipment covers are in place and secured</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>There is no evidence of impending failure</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>One or more of the following:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The equipment is not properly installed</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

There is evidence of impending failure
The equipment is not properly maintained

Equipment doors are open or not secured

Equipment covers are off or not secured

There is evidence of impending failure

Opening voltage transformer or control power transformer

Any

Outdoor disconnect switch operation

Any

Outdoor disconnect switch operation (hookstick operated) at 1 kV through 15 kV

Any

Note: Hazard identification is one component of risk assessment. Risk assessment involves a determination of the likelihood of occurrence of an incident, resulting from a hazard that could cause injury or damage to health. The assessment of the likelihood of occurrence contained in this table does not cover every possible condition or situation. Where this table indicates that arc flash PPE is not required, an arc flash is not likely to occur.

*The phrase properly installed, as used in this table, means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer's recommendations. The phrase properly maintained, as used in this table, means that the equipment has been maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards. The phrase evidence of impending failure, as used in this table, means that there is evidence of arcing, overheating, loose or bound equipment parts, visible damage, deterioration, or other damage.

Note: Hazard identification is one component of risk assessment. Risk assessment involves a determination of the likelihood of occurrence of an incident, resulting from a hazard that could cause injury or damage to health. The assessment of the likelihood of occurrence contained in this table does not cover every possible condition or situation. Where this table indicates that arc flash PPE is not required, an arc flash is not likely to occur.

**Table 130.7(C)(15)(A)(b) Arc-Flash Hazard PPE Categories for Alternating Current (ac) Systems**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panelboards or other equipment rated 240 V and below</td>
<td>1</td>
<td>485 mm</td>
</tr>
<tr>
<td>Fault clearing time; working distance</td>
<td></td>
<td>(19 in.)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panelboards or other equipment rated &gt;240 V and up to 600 V</td>
<td>2</td>
<td>900 mm</td>
</tr>
<tr>
<td>Fault clearing time; working distance</td>
<td></td>
<td>(3 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>2</td>
<td>1.5 m</td>
</tr>
<tr>
<td>Fault clearing time; working distance</td>
<td></td>
<td>(5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>4</td>
<td>4.3 m</td>
</tr>
<tr>
<td>Fault clearing time; working distance</td>
<td></td>
<td>(14 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 42 kA short-circuit current available; maximum of 0.33 sec (20 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class switchgear (with power circuit breakers or fused switches) and 600 V class switchboards</td>
<td>4</td>
<td>6 m</td>
</tr>
<tr>
<td>Fault clearing time; working distance</td>
<td></td>
<td>(20 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.5 sec (30 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other 600-V class (277 V through 600 V, nominal) equipment</td>
<td>2</td>
<td>1.5 m</td>
</tr>
<tr>
<td>Fault clearing time; working distance</td>
<td></td>
<td>(5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV</td>
<td>4</td>
<td>12 m</td>
</tr>
<tr>
<td>Fault clearing time; working distance</td>
<td></td>
<td>(40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metal-clad switchgear, 1 kV through 15 kV</td>
<td>4</td>
<td>12 m</td>
</tr>
<tr>
<td>Fault clearing time; working distance</td>
<td></td>
<td>(40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 for clearing times of &lt; 0.5 sec (30 cycles) with a perspective fault current not to exceed the arc-resistant rating of the equipment, and metal-enclosed interrupter switchgear, fused or unfused. Tested in accordance with IEEE C37.20.7, 1 kV through 15 kV</td>
<td>N/A (doors closed)</td>
<td>N/A (doors closed)</td>
</tr>
<tr>
<td>Fault clearing time; working distance</td>
<td>4</td>
<td>12 m</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td>(doors open)</td>
<td>(40 ft)</td>
</tr>
<tr>
<td>Other equipment 1 kV through 15 kV</td>
<td>4</td>
<td>12 m</td>
</tr>
<tr>
<td>Fault clearing time; working distance</td>
<td></td>
<td>(40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: For equipment rated 600 volts and below, and protected by upstream current-limiting fuses or current-limiting 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.

Note 2: The clearing time used in the tables is based upon equation ________________

Statement of Problem and Substantiation for Public Input

The clearing time calculated depends on the formula used to calculate the arcing current or short circuit current. For example, IEEE 1584 computes a different arcing current and subsequently different clearing time than the equations in Annex D.3. So if you use one equation you will be within the limits of the table and if you use a different you my not be.

In my example the arcing current in 1584 was 3.69 kA with a clearing time of .008 seconds on 480 volt equipment. The arcing current calculated using D.3 is 1.96 kA with a clearing time of .059 seconds. The maximum clearing time on the table for Other 600V class equipment is .03 sec.

Submitter Information Verification

Submitter Full Name: Dee Jones
Organization: AVO Training Institute
Street Address:
When selected in lieu of the incident energy analysis of 130.5(B)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(A)(b) shall be used to determine the arc flash PPE category. The estimated maximum available short-circuit current, maximum fault-clearing times, and minimum working distances for various ac equipment types or classifications are listed in Table 130.7(C)(15)(A)(b). An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Tasks not listed in Table 130.7(C)(15)(A)(a)
2. Power systems with greater than the estimated maximum available short-circuit current
3. Power systems with longer than the maximum fault clearing times
4. Tasks with less than the minimum working distance

Table 130.7(C)(15)(A)(a) Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Task</th>
<th>Equipment Condition*</th>
<th>Arc Flash PPE Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading a panel meter while operating a meter switch</td>
<td>Any</td>
<td>No</td>
</tr>
<tr>
<td>Normal operation of a circuit breaker (CB), switch,</td>
<td>All of the following:</td>
<td></td>
</tr>
<tr>
<td>contactor, or starter</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly installed</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>The equipment is properly maintained</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>All equipment doors are closed and secured</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>All equipment covers are in place and secured</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>There is no evidence of impending failure</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>One or more of the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly installed</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly maintained</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Equipment doors are open or not secured</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Equipment covers are off or not secured</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>There is evidence of impending failure</td>
<td>No</td>
</tr>
<tr>
<td>For ac systems: Work on energized electrical</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>conductors and circuit parts, including voltage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>testing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>For dc systems: Work on energized electrical</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>conductors and circuit parts of series-connected</td>
<td></td>
<td></td>
</tr>
<tr>
<td>battery cells, including voltage testing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage testing on individual battery cells or</td>
<td>All of the following:</td>
<td></td>
</tr>
<tr>
<td>individual multi-cell units</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly installed</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>The equipment is properly maintained</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Covers for all other equipment are in place and secured</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>There is no evidence of impending failure</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>One or more of the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly installed</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly maintained</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Equipment doors are open or not secured</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Equipment covers are off or not secured</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>There is evidence of impending failure</td>
<td>No</td>
</tr>
<tr>
<td>Removal or installation of CBs or switches</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>Removal or installation of covers for equipment</td>
<td>All of the following:</td>
<td></td>
</tr>
<tr>
<td>such as wireways, junction boxes, and cable trays</td>
<td></td>
<td></td>
</tr>
<tr>
<td>that does not expose bare energized electrical</td>
<td>The equipment is properly installed</td>
<td>No</td>
</tr>
<tr>
<td>conductors and circuit parts</td>
<td>The equipment is properly maintained</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>There is no evidence of impending failure</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Any of the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly installed</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>The equipment is not properly maintained</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>There is evidence of impending failure</td>
<td>No</td>
</tr>
<tr>
<td>Removal of bolted covers (to expose bare energized</td>
<td>Any</td>
<td>Yes</td>
</tr>
<tr>
<td>electrical conductors and circuit parts). For dc</td>
<td></td>
<td></td>
</tr>
<tr>
<td>systems, this includes bolted covers, such as</td>
<td></td>
<td></td>
</tr>
<tr>
<td>battery terminal covers.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Removal of battery intercell connector covers</td>
<td>All of the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The equipment is properly installed</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>The equipment is properly maintained</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Covers for all other equipment are in place and secured</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>There is no evidence of impending failure</td>
<td>No</td>
</tr>
</tbody>
</table>
### There is evidence of impending failure

<table>
<thead>
<tr>
<th>Activity Description</th>
<th>Any</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening hinged door(s) or cover(s) (to expose bare energized electrical conductors and circuit parts)</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Perform infrared thermography and other noncontact inspections outside the restricted approach boundary. This activity does not include opening of doors or covers.</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Application of temporary protective grounding equipment after voltage test</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, 120 volts or below without any other exposed energized equipment over 120 V including opening of hinged covers to gain access</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Work on control circuits with exposed energized electrical conductors and circuit parts, greater than 120 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insertion or removal of individual starter buckets from motor control center (MCC)</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal (racking) of CBs or starters from cubicles, doors open or closed</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion or removal of plug-in devices into or from busways</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Insulated cable examination with no manipulation of cable</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Insulated cable examination with manipulation of cable</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Work on exposed energized electrical conductors and circuit parts of equipment directly supplied by a panelboard or motor control center</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion and removal of revenue meters (kW-hour, at primary voltage and current)</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an enclosure</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an open rack</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>For dc systems, maintenance on a single cell of a battery system or multi-cell units in an open rack</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>For dc systems, work on exposed energized electrical conductors and circuit parts of utilization equipment directly supplied by a dc source</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 (for clearing times of &lt;0.5 sec with a prospective fault current not to exceed the arc-resistant rating of the equipment) and metal enclosed interupter switchgear, fused or unfused of arc resistant type construction, tested in accordance with IEEE C37.20.7:</td>
<td>All of the following:</td>
<td></td>
</tr>
<tr>
<td>- Insertion or removal (racking) of CBs from cubicles</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>- Insertion or removal (racking) of ground and test device</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Insertion or removal (racking) of voltage transformers on or off the bus</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Submitter Information Verification

Organization: NFPA Technical Committee on Electrical Safety in the Workplace

Statement of Problem and Substantiation for Public Input

NOTE: This Public Input appeared as "Reject but Hold" in Public Comment No. 231 of the A2014 Second Draft Report for NFPA 70E and per the Regs. at 4.4.8.3.1.

The proposed wording will provide the maximum protection and allow the maximum flexibility to the procedure.

Additional Proposed Changes

File Name Description Approved
PC_234.pdf 70E-PC234

Table 130.7(C)(15)(A)(b) Arc-Flash Hazard PPE Categories for Alternating Current (ac) Systems

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panelboards or other equipment rated 240 V and below</td>
<td>1</td>
<td>485 mm (19 in.)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panelboards or other equipment rated &gt;240 V and up to 600 V</td>
<td>2</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class motor control centers (MCCs)</td>
<td>4</td>
<td>4.3 m (14 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 42 kA short-circuit current available; maximum of 0.33 sec (20 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-V class switchgear (with power circuit breakers or fused switches) and 600 V class switchboards</td>
<td>4</td>
<td>6 m (20 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.5 sec (30 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other 600-V class (277 V through 600 V, nominal) equipment</td>
<td>2</td>
<td>1.5 m (5 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metal-clad switchgear, 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arc-resistant switchgear Type 1 or 2 [for clearing times of &lt; 0.5 sec (30 cycles) with a perspective 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, tested in accordance with IEEE C37.20.7, 1 kV through 15 kV</td>
<td>N/A (doors closed)</td>
<td>N/A (doors closed)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other equipment 1 kV through 15 kV</td>
<td>4</td>
<td>12 m (40 ft)</td>
</tr>
<tr>
<td>Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: For equipment rated 600 volts and below, and protected by upstream current-limiting fuses or current-limiting 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.

Note: Hazard identification is one component of risk assessment. Risk assessment involves a determination of the likelihood of occurrence of an incident, resulting from a hazard that could cause injury or damage to health. The assessment of the likelihood of occurrence contained in this table does not cover every possible condition or situation. Where this table indicates that arc flash PPE is not required, an arc flash is not likely to occur.

*The phrase properly installed, as used in this table, means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer's recommendations. The phrase properly maintained, as used in this table, means that the equipment has been maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards. The phrase evidence of impending failure, as used in this table, means that there is evidence of arcing, overheating, loose or bound equipment parts, visible damage, deterioration, or other damage.
Paragraphs:

Public Input No. 120-NFPA 70E-2015 [Section No. 130.7(C)(15)(B)]

(1) Tasks not listed in Table 130.7(C)(15)(A)(a)
(2) Power systems with greater than the estimated maximum available short circuit current
(3) Power systems with longer than the maximum fault clearing times
(4) Tasks with less than the minimum working distance

Informational Note No. 1: The arc flash PPE category, work tasks, and protective equipment provided in Table 130.7(C)(15)(A)(a), Table 130.7(C)(15)(A)(b), and Table 130.7(C)(15)(B) were identified and selected, based on the collective experience of the NFPA 70E Technical Committee. The arc flash PPE category of the protective clothing and equipment is generally based on determination of the estimated exposure level.

Informational Note No. 2: The collective experience of the NFPA 70E Technical Committee is that, in most cases, closed doors do not provide enough protection to eliminate the need for PPE in situations in which the state of the equipment is known to readily change (e.g., doors open or closed, rack in or rack out).

Informational Note No. 3: The premise used by the NFPA 70E Technical Committee 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 committee.

Table 130.7(C)(15)(B) Arc-Flash Hazard PPE Categories for Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 V &lt; Voltage &lt; 125 V</td>
<td>1</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>Voltage &lt; 125 V</td>
<td>2</td>
<td>1.2 m (4 ft)</td>
</tr>
<tr>
<td>Maximum arc duration and working distance: 2 sec @ 465 mm (18 in.)</td>
<td>3</td>
<td>1.8 m (6 ft)</td>
</tr>
<tr>
<td>Short-circuit current ≤ 4 kA</td>
<td>4</td>
<td>2.5 m (8 ft)</td>
</tr>
<tr>
<td>4 kA ≤ short-circuit current &lt; 7 kA</td>
<td>5</td>
<td>3.0 m (10 ft)</td>
</tr>
<tr>
<td>7 kA ≤ short-circuit current &lt; 15 kA</td>
<td>6</td>
<td>3.6 m (12 ft)</td>
</tr>
<tr>
<td>Storage batteries, dc switchboards, and other dc supply sources</td>
<td>7</td>
<td>4.2 m (14 ft)</td>
</tr>
<tr>
<td>Voltage: 130 V</td>
<td>8</td>
<td>4.8 m (16 ft)</td>
</tr>
<tr>
<td>Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)</td>
<td>9</td>
<td>5.4 m (18 ft)</td>
</tr>
<tr>
<td>Short-circuit current ≤ 1.5 kA</td>
<td>10</td>
<td>6.0 m (20 ft)</td>
</tr>
<tr>
<td>1.5 kA ≤ short-circuit current &lt; 3 kA</td>
<td>11</td>
<td>6.6 m (22 ft)</td>
</tr>
<tr>
<td>3 kA ≤ short-circuit current &lt; 7 kA</td>
<td>12</td>
<td>7.2 m (24 ft)</td>
</tr>
<tr>
<td>7 kA ≤ short-circuit current &lt; 10 kA</td>
<td>13</td>
<td>7.8 m (26 ft)</td>
</tr>
<tr>
<td>Storage batteries, dc switchboards, and other dc supply sources</td>
<td>14</td>
<td>8.4 m (28 ft)</td>
</tr>
<tr>
<td>Voltage: 250 V</td>
<td>15</td>
<td>9.0 m (30 ft)</td>
</tr>
<tr>
<td>Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)</td>
<td>16</td>
<td>9.6 m (32 ft)</td>
</tr>
<tr>
<td>Short-circuit current ≤ 1.5 kA</td>
<td>17</td>
<td>10.2 m (34 ft)</td>
</tr>
<tr>
<td>1.5 kA ≤ short-circuit current &lt; 3 kA</td>
<td>18</td>
<td>10.8 m (36 ft)</td>
</tr>
<tr>
<td>3 kA ≤ short-circuit current &lt; 7 kA</td>
<td>19</td>
<td>11.4 m (38 ft)</td>
</tr>
<tr>
<td>7 kA ≤ short-circuit current &lt; 10 kA</td>
<td>20</td>
<td>12.0 m (40 ft)</td>
</tr>
<tr>
<td>Storage batteries, dc switchboards, and other dc supply sources</td>
<td>21</td>
<td>12.6 m (42 ft)</td>
</tr>
<tr>
<td>Voltage: 600 V</td>
<td>22</td>
<td>13.2 m (44 ft)</td>
</tr>
</tbody>
</table>

Note: Apparel that can be expected to be exposed to electrolyte must meet both of the following conditions:

(1) Be evaluated for electrolyte protection in accordance with ASTM F1296, Standard Guide for Evaluating Chemical Protective Clothing
(2) Be arc-rated in accordance with ASTM F1891, Standard Specification for Arc Rated and Flame Resistant Rainwear, or equivalent

Informational Note No.1: The arc flash PPE category, work tasks, and protective equipment provided in this table, is determined from the dc power system maximum available short-circuit, including the effects of cables and any other impedances in the circuit. 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 collective experience of the NFPA 70E Technical Committee 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 committee.

Informational Note No.3: The premise used by the NFPA 70E Technical Committee 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 committee.

Table 130.7(C)(15)(B) Arc-Flash Hazard PPE Categories for Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 V &lt; Voltage &lt; 125 V</td>
<td>1</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>Voltage &lt; 125 V</td>
<td>2</td>
<td>1.2 m (4 ft)</td>
</tr>
<tr>
<td>Maximum arc duration and working distance: 2 sec @ 465 mm (18 in.)</td>
<td>3</td>
<td>1.8 m (6 ft)</td>
</tr>
<tr>
<td>Short-circuit current ≤ 4 kA</td>
<td>4</td>
<td>2.5 m (8 ft)</td>
</tr>
<tr>
<td>4 kA ≤ short-circuit current &lt; 7 kA</td>
<td>5</td>
<td>3.0 m (10 ft)</td>
</tr>
<tr>
<td>7 kA ≤ short-circuit current &lt; 15 kA</td>
<td>6</td>
<td>3.6 m (12 ft)</td>
</tr>
<tr>
<td>Storage batteries, dc switchboards, and other dc supply sources</td>
<td>7</td>
<td>4.2 m (14 ft)</td>
</tr>
<tr>
<td>Voltage: 130 V</td>
<td>8</td>
<td>4.8 m (16 ft)</td>
</tr>
<tr>
<td>Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)</td>
<td>9</td>
<td>5.4 m (18 ft)</td>
</tr>
<tr>
<td>Short-circuit current ≤ 1.5 kA</td>
<td>10</td>
<td>6.0 m (20 ft)</td>
</tr>
<tr>
<td>1.5 kA ≤ short-circuit current &lt; 3 kA</td>
<td>11</td>
<td>6.6 m (22 ft)</td>
</tr>
<tr>
<td>3 kA ≤ short-circuit current &lt; 7 kA</td>
<td>12</td>
<td>7.2 m (24 ft)</td>
</tr>
<tr>
<td>7 kA ≤ short-circuit current &lt; 10 kA</td>
<td>13</td>
<td>7.8 m (26 ft)</td>
</tr>
<tr>
<td>Storage batteries, dc switchboards, and other dc supply sources</td>
<td>14</td>
<td>8.4 m (28 ft)</td>
</tr>
<tr>
<td>Voltage: 250 V</td>
<td>15</td>
<td>9.0 m (30 ft)</td>
</tr>
<tr>
<td>Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)</td>
<td>16</td>
<td>9.6 m (32 ft)</td>
</tr>
<tr>
<td>Short-circuit current ≤ 1.5 kA</td>
<td>17</td>
<td>10.2 m (34 ft)</td>
</tr>
<tr>
<td>1.5 kA ≤ short-circuit current &lt; 3 kA</td>
<td>18</td>
<td>10.8 m (36 ft)</td>
</tr>
<tr>
<td>3 kA ≤ short-circuit current &lt; 7 kA</td>
<td>19</td>
<td>11.4 m (38 ft)</td>
</tr>
<tr>
<td>7 kA ≤ short-circuit current &lt; 10 kA</td>
<td>20</td>
<td>12.0 m (40 ft)</td>
</tr>
<tr>
<td>Storage batteries, dc switchboards, and other dc supply sources</td>
<td>21</td>
<td>12.6 m (42 ft)</td>
</tr>
<tr>
<td>Voltage: 600 V</td>
<td>22</td>
<td>13.2 m (44 ft)</td>
</tr>
</tbody>
</table>

Note: Apparel that can be expected to be exposed to electrolyte must meet both of the following conditions:

(1) Be evaluated for electrolyte protection in accordance with ASTM F1296, Standard Guide for Evaluating Chemical Protective Clothing
(2) Be arc-rated in accordance with ASTM F1891, Standard Specification for Arc Rated and Flame Resistant Rainwear, or equivalent

Informational Note No.1: The arc flash PPE category, work tasks, and protective equipment provided in this table, is determined from the dc power system maximum available short-circuit, including the effects of cables and any other impedances in the circuit. 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 collective experience of the NFPA 70E Technical Committee 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 committee.

Informational Note No.3: The premise used by the NFPA 70E Technical Committee 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 committee.

Statement of Problem and Substantiation for Public Input

Actual DC arcs are significantly overpredicted by existing arc flash calculations provided by Ammerman and Doan. As the voltage and/or current decreases, the discrepancy increases dramatically. At low voltages DC arcs tend are not self-sustaining and weak at best. Cantor, W., Zaklazic, P., and Spirina, M., “DC ARC FLASH. THE IMPLICATIONS OF NFPA 70E 2012 ON BATTERY MAINTENANCE”, Proceedings of Battcon 2012. This paper compares the theoretical methods of Doan and Ammerman against actual test data from the following Kinetics report:

http://submittals.nfpa.org/TerraViewWeb/ContentFetcher?commentPara...

Note that the Battcon paper has a serious technical error in that it gives incident energies from the Kinetics report that are normalized to 2 seconds and using a nonstandard 12" working distance in Table 3. While this is useful for comparing academic results, only the very shortest arc gaps were somewhat stable at 130 Volts in the Kinetics study and even then, the arc self-extinguished at 0.8 seconds. Using the actual results denormalized to an 18" working distance reveals that the incident energy for 20 kA does not exceed 1.2 cal/cm². Thus with DC the same situation exists as it does for utilities where IEEE C2 (NESC) has relied on equipment-specific testing in absence of calculations which provide realistic results.

This proposal extends the existing DC equipment table to incorporate the test data from Kinetics to reflect that an arc flash hazard exceeding a threshold of 1.2 cal/cm² does not exist for DC equipment below 130 Volts. Previously no guidance was given below 100 V and the guidance given for substation batteries and similar systems (125 VDC) is Level 1 PPE when in fact the incident energy does not exceed 1.2 cal/cm². This proposal extends the table to cover the vast majority of DC applications up to and including the most common substation battery strings with 60 cells.

Submitter Information Verification

Submitter Full Name: Paul Campbell
Organization: PotashCorp Aurora
Street Address:
City:
State:
Zip:
Submittal Date: Mon Apr 13 13:36:16 EDT 2015
Public Input No. 198-NFPA 70E-2015 [Section No. 130.7(C)(15)(B)]

(B) Direct Current (dc) Equipment.

When selected in lieu of the incident energy analysis of 130.5(C)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(B) shall be used to determine the arc flash PPE category. The estimated maximum available short circuit current, maximum arc duration and working distances for dc equipment are listed in 130.7(C)(15)(B). An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Tasks not listed in Table 130.7(C)(15)(A)(a)
2. Power systems with greater than the estimated maximum available short circuit current
3. Power systems with longer than the maximum fault clearing times
4. Tasks with less than the minimum working distance

Informational Note No.1: The arc flash PPE category, work tasks, and protective equipment provided in Table 130.7(C)(15)(A)(a), Table 130.7(C)(15)(A)(b), and Table 130.7(C)(15)(B) were identified and selected, based on the collective experience of the NFPA 70E Technical Committee. The arc flash PPE category of the protective clothing and equipment is generally based on determination of the estimated exposure level.

Informational Note No.2: The collective experience of the NFPA 70E Technical Committee is that, in most cases, closed doors do not provide enough protection to eliminate the need for PPE in situations in which the state of the equipment is known to readily change (e.g., doors open or closed, rack in or rack out).

Informational Note No.3: The premise used by the NFPA 70E Technical Committee 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 committee.

Table 130.7(C)(15)(B) Arc-Flash Hazard PPE Categories for Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage batteries, dc switchboards, and other dc supply sources</td>
<td>100 V &gt; Voltage &lt; 250 V</td>
<td>1</td>
</tr>
<tr>
<td>Voltage: 250, 249 V</td>
<td>Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>Short-circuit current &lt; 4 kA</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>4 kA ≤ short-circuit current &lt; 7 kA</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>7 kA ≤ short-circuit current &lt; 15 kA</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Storage batteries, dc switchboards, and other dc supply sources</td>
<td>Voltage: 250 V ≤ Voltage ≤ 600 V</td>
<td>1.8 m (6 ft)</td>
</tr>
<tr>
<td>Parameters: Voltage: 600 V</td>
<td>Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)</td>
<td>1.2 m (4 ft)</td>
</tr>
<tr>
<td>Short-circuit current 1.5 kA</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1.5 kA ≤ short-circuit current &lt; 3 kA</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3 kA ≤ short-circuit current &lt; 7 kA</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>7 kA ≤ short-circuit current &lt; 10 kA</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Note: Apparel that can be expected to be exposed to electrolyte must meet both of the following conditions:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Be evaluated for electrolyte protection in accordance with ASTM F1296, Standard Guide for Evaluating Chemical Protective Clothing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Be arc-rated in accordance with ASTM F1891, Standard Specification for Arc Rated and Flame Resistant Rainwear, or equivalent</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Informational Note No.1: "Short-circuit current," as used in this table, is determined from the dc power system maximum available short-circuit, including the effects of cables and any other impedances in the circuit. 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 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 3x for arc-in-a-box [508 mm (20 in.) cube] versus open air. Engineering judgment is required when reviewing the specific conditions of the equipment and task to be performed, including the dimensions of the enclosure and the working distance involved.

Statement of Problem and Substantiation for Public Input

If the limits of this section is greater than 100 V and less than 250 V, the parameter cannot be 250 V. It has to be less than 250 V, i.e., 249 V.

Submitter Information Verification

Submitter Full Name: ALVIN HAVENS
Organization: e-Hazard Management, LLC
Street Address: 
City: 
State: 
Zip: 
Submit Date: Fri Jun 19 12:14:10 EDT 2015
(B) Direct Current (dc) Equipment.

When selected in lieu of the incident energy analysis of 130.5(C)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(B) shall be used to determine the arc flash PPE category. The estimated maximum available short circuit current, maximum arc duration and working distances for dc equipment are listed in Table 130.7(C)(15)(B). An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Tasks not listed in Table 130.7(C)(15)(A)(a)
2. Power systems with greater than the estimated maximum available short circuit current
3. Power systems with longer than the maximum fault clearing times
4. Tasks with less than the minimum working distance

Informational Note No. 1: The arc flash PPE category, work tasks, and protective equipment provided in Table 130.7(C)(15)(A)(a), Table 130.7(C)(15)(A)(b), and Table 130.7(C)(15)(B) were identified and selected based on the collective experience of the NFPA 70E Technical Committee. The arc flash PPE category of the protective clothing and equipment is generally based on determination of the estimated exposure level.

Informational Note No. 2: The collective experience of the NFPA 70E Technical Committee is that, in most cases, closed doors do not provide enough protection to eliminate the need for PPE in situations in which the state of the equipment is known to readily change (e.g., doors open or closed, rack in or rack out).

Informational Note No. 3: The premise used by the NFPA 70E Technical Committee 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 committee.

Table 130.7(C)(15)(B) Arc-Flash Hazard PPE Categories for Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage batteries, dc switchboards, and other dc supply sources</td>
<td>1</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>Voltage: 250 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-circuit current ≤ 4 kA</td>
<td>1</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>4 kA ≤ short-circuit current &lt; 7 kA</td>
<td>2</td>
<td>1.2 m (4 ft)</td>
</tr>
<tr>
<td>7 kA ≤ short-circuit current ≤ 15 kA</td>
<td>3</td>
<td>1.8 m (6 ft)</td>
</tr>
<tr>
<td>Storage batteries, dc switchboards, and other dc supply sources</td>
<td>1</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>Voltage: 600 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-circuit current 1.5 kA</td>
<td>1</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>1.5 kA ≤ short-circuit current &lt; 3 kA</td>
<td>2</td>
<td>1.2 m (4 ft)</td>
</tr>
<tr>
<td>3 kA ≤ short-circuit current &lt; 7 kA</td>
<td>3</td>
<td>1.8 m (6 ft)</td>
</tr>
<tr>
<td>7 kA ≤ short-circuit current &lt; 10 kA</td>
<td>4</td>
<td>2.5 m (8 ft)</td>
</tr>
</tbody>
</table>

Note: Apparel that can be expected to be exposed to electrolyte must meet both of the following conditions:

1. Be evaluated for electrolyte protection in accordance with ASTM F1296, Standard Guide for Evaluating Chemical Protective Clothing
2. Be arc-rated in accordance with ASTM F1891, Standard Specification for Arc Rated and Flame Resistant Rainwear, or equivalent

Informational Note No. 1: “Short-circuit current,” as used in this table, is determined from the dc power system maximum available short-circuit, including the effects of cables and any other impedances in the circuit. 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 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. 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 3x for arc-in-a-box [508 mm (20 in.) cube] versus open air. Engineering judgment is required when reviewing the specific conditions of the equipment and task to be performed, including the dimensions of the enclosure and the working distance involved.

Statement of Problem and Substantiation for Public Input

Remove the word “hazard” from the title to the table to be consistent with related terminology used in NFPA 70E. The title to the table is the only location where “hazard” is used in the term “arc flash PPE category.” For example, see:

(B) Direct Current (dc) Equipment.

When selected in lieu of the incident energy analysis of 130.5(C)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(B) shall be used to determine the arc flash PPE category.

Submitter Information Verification

Submitter Full Name: Palmer Hickman
Organization: Electrical Training Alliance
Street Address:
Public Input No. 231-NFPA 70E-2015 [Section No. 130.7(C)(15)(B)]

(B) Direct Current (dc) Equipment.

When selected in lieu of the incident energy analysis of 130.5(C)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when there is an increased likelihood of initiating an arc flash event. When an increased likelihood of initiating an arc flash event exists, Table 130.7(C)(15)(B) shall be used to determine the arc flash PPE category. The estimated maximum available short circuit current, maximum arc duration and working distances for dc equipment are listed in 130.7(C)(15)(B). An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Tasks not listed in Table 130.7(C)(15)(A)(a)
2. Power systems with greater than the estimated maximum available short circuit current
3. Power systems with longer than the maximum fault clearing times
4. Tasks with less than the minimum working distance

Informational Note No. 1: The arc flash PPE category, work tasks, and protective equipment provided in Table 130.7(C)(15)(A)(a), Table 130.7(C)(15)(A)(b), and Table 130.7(C)(15)(B) were identified and selected, based on the collective experience of the NFPA 70E Technical Committee. The arc flash PPE category of the protective clothing and equipment is generally based on determination of the estimated exposure level.

Informational Note No. 2: The collective experience of the NFPA 70E Technical Committee is that, in most cases, closed doors do not provide enough protection to eliminate the need for PPE in situations in which the state of the equipment is known to readily change (e.g., doors open or closed, rack in or rack out).

Informational Note No. 3: The premise used by the NFPA 70E Technical Committee 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 committee.

Table 130.7(C)(15)(B) Arc-Flash Hazard PPE Categories for Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage batteries, dc switchboards, and other dc supply sources</td>
<td>100 V &gt; Voltage &lt; 250 V</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>Parameters:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage: 250 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-circuit current &lt; 4 kA</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>4 kA ≤ short-circuit current &lt; 7 kA</td>
<td>2</td>
<td>1.2 m (4 ft)</td>
</tr>
<tr>
<td>7 kA ≤ short-circuit current &lt; 15 kA</td>
<td>3</td>
<td>1.8 m (6 ft)</td>
</tr>
<tr>
<td>Storage batteries, dc switchboards, and other dc supply sources</td>
<td>250 V ≤ Voltage ≤ 600 V</td>
<td></td>
</tr>
<tr>
<td>Parameters:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage: 600 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-circuit current 1.5 kA</td>
<td>1</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>1.5 kA ≤ short-circuit current &lt; 3 kA</td>
<td>2</td>
<td>1.2 m (4 ft)</td>
</tr>
<tr>
<td>3 kA ≤ short-circuit current &lt; 7 kA</td>
<td>3</td>
<td>1.8 m (6 ft)</td>
</tr>
<tr>
<td>7 kA ≤ short-circuit current &lt; 10 kA</td>
<td>4</td>
<td>2.5 m (8 ft)</td>
</tr>
</tbody>
</table>

Note: Apparel that can be expected to be exposed to electrolyte must meet both of the following conditions:

1. Be evaluated for electrolyte protection in accordance with ASTM F1296, Standard Guide for Evaluating Chemical Protective Clothing
2. Be arc-rated in accordance with ASTM F1891, Standard Specification for Arc Rated and Flame Resistant Rainswear, or equivalent

Informational Note No. 1: “Short-circuit current,” as used in this table, is determined from the dc power system maximum available short-circuit, including the effects of cables and any other impedances in the circuit. 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 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 3x for arc-in-a-box [508 mm (20 in.) cube] versus open air. Engineering judgment is required when reviewing the specific conditions of the equipment and task to be performed, including the dimensions of the enclosure and the working distance involved.

Statement of Problem and Substantiation for Public Input

For equipment having an arc flash hazard, it is impossible to determine with 100% certainty that an arc flash event will not occur, and therefore no arc rated PPE is required, for all cases; for certain tasks listed in the tables. If the equipment has been energized, the likelihood of an event occurring and presenting risk of injury to personnel may be very low but it is not zero. This and companion PIs seek to revise the text and tables to reflect this.

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NFPA 70E - A2017 FD Meeting Agenda Page 448
### Public Input No. 314-NFPA 70E-2015 [ Section No. 130.7(C)(15)(B) ]

When selected in lieu of the incident energy analysis of 130.5(C)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(B) shall be used to determine the arc flash PPE category. The estimated maximum available short circuit current, maximum arc duration and working distances for dc equipment are listed in 130.7(C)(15)(B). An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Tasks not listed in Table 130.7(C)(15)(A)(a)
2. Power systems with greater than the estimated maximum available short circuit current
3. Power systems with longer than the maximum fault clearing times
4. Tasks with less than the minimum working distance

Informational Note No.1: The arc flash PPE category, work tasks, and protective equipment provided in Table 130.7(C)(15)(A)(a), Table 130.7(C)(15)(A)(b), and Table 130.7(C)(15)(B) were identified and selected, based on the collective experience of the NFPA 70E Technical Committee. The arc flash PPE category of the protective clothing and equipment is generally based on determination of the estimated exposure level. Informational Note No.2: The collective experience of the NFPA 70E Technical Committee is that, in most cases, closed doors do not provide enough protection to eliminate the need for PPE in situations in which the state of the equipment is known to readily change (e.g., doors open or closed, rack in or rack out).

Informational Note No.3: The premise used by the NFPA 70E Technical Committee 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 committee. The arc flash PPE category, work tasks, and protective equipment provided in Table 130.7(C)(15)(A)(a), Table 130.7(C)(15)(A)(b), and Table 130.7(C)(15)(B) were identified and selected, based on the collective experience of the NFPA 70E Technical Committee.

#### Table 130.7(C)(15)(B) Arc-Flash Hazard PPE Categories for Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage batteries, dc switchboards, and other dc supply sources</td>
<td>Shade in to distinguish sub-categories in table</td>
<td>Shade in to distinguish sub-categories in table</td>
</tr>
<tr>
<td>Voltage &lt; 250 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parameters:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage: 250 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)</td>
<td>1</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>Short-circuit current &lt; 4 kA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 kA ≤ short-circuit current &lt; 7 kA</td>
<td>2</td>
<td>1.2 m (4 ft)</td>
</tr>
<tr>
<td>7 kA ≤ short-circuit current &lt; 15 kA</td>
<td>3</td>
<td>1.8 m (6 ft)</td>
</tr>
<tr>
<td>Storage batteries, dc switchboards, and other dc supply sources</td>
<td>Shade in to distinguish sub-categories in table</td>
<td>Shade in to distinguish sub-categories in table</td>
</tr>
<tr>
<td>Voltage ≤ 600 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parameters:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage: 600 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)</td>
<td>1</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>Short-circuit current 1.5 kA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5 kA ≤ short-circuit current &lt; 3 kA</td>
<td>2</td>
<td>1.2 m (4 ft)</td>
</tr>
<tr>
<td>3 kA ≤ short-circuit current &lt; 7 kA</td>
<td>3</td>
<td>1.8 m (6 ft)</td>
</tr>
<tr>
<td>7 kA ≤ short-circuit current &lt; 10 kA</td>
<td>4</td>
<td>2.5 m (8 ft)</td>
</tr>
</tbody>
</table>

Note: Apparel that can be expected to be exposed to electrolyte must meet both of the following conditions:
1. Be evaluated for electrolyte protection in accordance with ASTM F1296, Standard Guide for Evaluating Chemical Protective Clothing
2. Be arc-rated in accordance with ASTM F1891, Standard Specification for Arc Rated and Flame Resistant Rainwear, or equivalent

Informational Note No.1: “Short-circuit current,” as used in this table, is determined from the dc power system maximum available short-circuit, including the effects of cables and any other impedances in the circuit. 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 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 arc flash has shown a multiplier of as much as 3x for arc-in-a-box (508 mm [20 in.] cube) versus open air. Engineering judgment is required when reviewing the specific conditions of the equipment and task to be performed, including the dimensions of the enclosure and the working distance involved.

### Statement of Problem and Substantiation for Public Input

This proposed change would add clarity in reading and interpreting the table found in NFPA 70E. Another method may be removing the vertical lines between the columns to show that this horizontal column is a sub-category found in the table.

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Zip:
Public Input No. 341-NFPA 70E-2015 [Section No. 130.7(C)(15)(B)]

(B) Direct Current (dc) Equipment.

When selected in lieu of the incident energy analysis of 130.5(C)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(B) shall be used to determine the arc flash PPE category. The estimated maximum available short circuit current, maximum arc duration and working distances for dc equipment are listed in 130.7(C)(15)(B). An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Tasks not listed in Table 130.7(C)(15)(A)(a)
2. Power systems with greater than the estimated maximum available short circuit current
3. Power systems with longer than the maximum fault clearing times
4. Tasks with less than the minimum working distance

Informational Note No.1: The arc flash PPE category, work tasks, and protective equipment provided in Table 130.7(C)(15)(A)(a), Table 130.7(C)(15)(A)(b), and Table 130.7(C)(15)(B) were identified and selected, based on the collective experience of the NFPA 70E Technical Committee. The arc flash PPE category of the protective clothing and equipment is generally based on determination of the estimated exposure level.

Informational Note No.2: The collective experience of the NFPA 70E Technical Committee is that, in most cases, closed doors do not provide enough protection to eliminate the need for PPE in situations in which the state of the equipment is known to readily change (e.g., doors open or closed, rack in or rack out).

Informational Note No.3: The premise used by the NFPA 70E Technical Committee 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 committee.

Table 130.7(C)(15)(B) Arc Flash Hazard PPE Categories for Direct Current (dc) Systems

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<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
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<tbody>
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<td>Storage batteries, dc switchboards, and other dc supply sources 100 V &gt; Voltage &lt; 250 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parameters:</td>
<td></td>
<td></td>
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<td>Voltage: 250 V</td>
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<td>Short-circuit current &lt; 4 kA</td>
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<td>4 kA ≤ short-circuit current &lt; 7 kA</td>
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<td>1.2 m (4 ft)</td>
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<tr>
<td>7 kA ≤ short-circuit current ≤ 15 kA</td>
<td>3</td>
<td>1.8 m (6 ft)</td>
</tr>
<tr>
<td>Storage batteries, dc switchboards, and other dc supply sources 250 V ≤ Voltage ≤ 600 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parameters:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage: 600 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-circuit current 1.5 kA</td>
<td>1</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>1.5 kA ≤ short-circuit current &lt; 3 kA</td>
<td>2</td>
<td>1.2 m (4 ft)</td>
</tr>
<tr>
<td>3 kA ≤ short-circuit current &lt; 7 kA</td>
<td>3</td>
<td>1.8 m (6 ft)</td>
</tr>
<tr>
<td>7 kA ≤ short-circuit current ≤ 10 kA</td>
<td>4</td>
<td>2.5 m (8 ft)</td>
</tr>
</tbody>
</table>

Note: Apparel that can be expected to be exposed to electrolyte must meet both of the following conditions:

1. Be evaluated for electrolyte protection in accordance with ASTM F1296, Standard Guide for Evaluating Chemical Protective Clothing
2. Be arc-rated in accordance with ASTM F1891, Standard Specification for Arc Rated and Flame Resistant Rainwear, or equivalent

Informational Note No.1: “Short-circuit current,” as used in this table, is determined from the dc power system maximum available short-circuit, including the effects of cables and any other impedances in the circuit. 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 Annex D5 for estimating short circuit current if manufacturer data is not available. 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 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 values shown in this table. Research with dc arc flash has shown a multiplier of as much as 3x for arc in a box [508 mm (20 in.) cube] versus open air. Engineering judgment is required when reviewing the specific conditions of the equipment and task to be performed, including the dimensions of the enclosure and the working distance involved.

Statement of Problem and Substantiation for Public Input

Informational Note 1 has been revised to add refer to Annex D5 for calculating available short circuit from a battery system if manufacturer data is not available. Note 2 has been revised to delete reference to a three times multiplier. It is infeasible to use a multiplier when using table for selection of PPE

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Public Input No. 360-NFPA 70E-2015 [ Section No. 130.7(C)(15)(B) ]

(B) Direct Current (dc) Equipment.

When selected in lieu of the incident energy analysis of 130.5(C)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(B) shall be used to determine the arc flash PPE category. The estimated maximum available short circuit current, maximum arc duration and working distances for dc equipment are listed in 130.7(C)(15)(B). An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Tasks not listed in Table 130.7(C)(15)(A)(a)
2. Power systems with greater than the estimated maximum available short circuit current
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4. Tasks with less than the minimum working distance

Informational Note No. 1: The arc flash PPE category, work tasks, and protective equipment provided in Table 130.7(C)(15)(A)(a), Table 130.7(C)(15)(A)(b), and Table 130.7(C)(15)(B) were identified and selected, based on the collective experience of the NFPA 70E Technical Committee. The arc flash PPE category of the protective clothing and equipment is generally based on determination of the estimated exposure level. Informational Note No. 2: The collective experience of the NFPA 70E Technical Committee is that, in most cases, closed doors do not provide enough protection to eliminate the need for PPE in situations in which the state of the equipment is known to readily change (e.g., doors open or closed, rack in or rack out).

Informational Note No. 3: The premise used by the NFPA 70E Technical Committee 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 committee.

Table 130.7(C)(15)(B) Arc-Flash Hazard PPE Categories for Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage batteries, dc switchboards, and other dc supply sources</td>
<td>1</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>100 V &gt; Voltage &lt; 250 V Parameters: Voltage: 250 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-circuit current &lt;4 kA</td>
<td>2</td>
<td>1.2 m (4 ft)</td>
</tr>
<tr>
<td>4 kA ≤ short-circuit current &lt; 7 kA</td>
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<td></td>
</tr>
<tr>
<td>7 kA ≤ short-circuit current &lt;15 kA</td>
<td>3</td>
<td>1.8 m (6 ft)</td>
</tr>
<tr>
<td>Storage batteries, dc switchboards, and other dc supply sources</td>
<td></td>
<td></td>
</tr>
<tr>
<td>250 V ≤ Voltage ≤ 600 V Parameters: Voltage: 600 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-circuit current 1.5 kA</td>
<td>1</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>1.5 kA ≤ short-circuit current &lt; 3 kA</td>
<td>2</td>
<td>1.2 m (4 ft)</td>
</tr>
<tr>
<td>3 kA ≤ short-circuit current &lt; 7 kA</td>
<td>3</td>
<td>1.8 m (6 ft)</td>
</tr>
<tr>
<td>7 kA ≤ short-circuit current &lt; 10 kA</td>
<td>4</td>
<td>2.5 m (8 ft)</td>
</tr>
</tbody>
</table>

Note: Apparel that can be expected to be exposed to electrolyte must meet both of the following conditions:

1. Be evaluated for electrolyte protection in accordance with ASTM F1296, Standard Guide for Evaluating Chemical Protective Clothing
2. Be arc-rated in accordance with ASTM F1891, Standard Specification for Arc Rated and Flame Resistant Rainwear, or equivalent

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Statement of Problem and Substantiation for Public Input

This information (attempting to justify the committee work) is unnecessary in the informational note text of NFPA 70E. It is only serving the user by providing the substantiation for the requirement. The consensus of the committee results in all the information in 70E. It is more appropriate for the public record.

Submitter Information Verification

Submitter Full Name: MICHAEL JOHNSTON
Organization: NATIONAL ELECTRICAL CONTRACTOR
Street Address: http://submittals.nfpa.org/TerraViewWeb/ContentFetcher?commentPara...
Public Input No. 370-NFPA 70E-2015 [Section No. 130.7(C)(15)(B)]

(B) Direct Current (dc) Equipment.
When selected in lieu of the incident energy analysis of 130.5(C)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(B) shall be used to determine the arc flash PPE category. The estimated maximum available short circuit current, maximum arc duration and working distances for dc equipment are listed in 130.7(C)(15)(B). An incident energy analysis shall be required in accordance with 130.5 for the following:

1. Tasks not listed in Table 130.7(C)(15)(A)(a)
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Informational Note No.1: The arc flash PPE category, work tasks, and protective equipment provided in Table 130.7(C)(15)(A)(a), Table 130.7(C)(15)(A)(b), and Table 130.7(C)(15)(B) were identified and selected, based on the collective experience of the NFPA 70E Technical Committee. The arc flash PPE category of the protective clothing and equipment is generally based on determination of the estimated exposure level.

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Table 130.7(C)(15)(B) Arc-Flash Hazard PPE Categories for Direct Current (dc) Systems

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<th>Equipment</th>
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<th>Arc-Flash Boundary</th>
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<tbody>
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<td>1</td>
<td>900 mm (3 ft)</td>
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<tr>
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<tr>
<td>4 kA ≤ short-circuit current &lt; 7 kA</td>
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</table>

Note: Apparel that can be expected to be exposed to electrolyte must meet both of the following conditions:

1. Be evaluated for electrolyte protection in accordance with ASTM F1296, Standard Guide for Evaluating Chemical Protective Clothing
2. Be arc-rated in accordance with ASTM F1891, Standard Specification for Arc Rated and Flame Resistant Rainwear, or equivalent

Informational Note No.1: “Short-circuit current,” as used in this table, is determined from the dc power system maximum available short circuit current, including the effects of cables and any other impedances in the circuit. 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 D5 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 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 3x for arc-in-a-box [508 mm (20 in.) cube] versus open air. Engineering judgment is required when reviewing the specific conditions of the equipment and task to be performed, including the dimensions of the enclosure and the working distance involved.

Informational Note No.3: A two second arc duration is assumed when there is no OCPD or when the fault clearing time is not known. If the fault clearing time is known and is less than two seconds, it is recommended that an incident energy analysis be performed.

Statement of Problem and Substantiation for Public Input
This table is based on a two second arc duration which is thought to be the maximum time for a person to remain in harm's way if there is no overcurrent protection device to interrupt the arc. Incident energy is directly related to the time of the arc and the values in this table are based on the theoretical maximum arc energy as described in annex D5. The calculation is known to be very conservative so if there is a fault clearing device, the arcing time will probably be reduced significantly which will probably reduce the required PPE to a more realistic level.

Submitter Information Verification
Submitter Full Name: WILLIAM CANTOR
Organization: TPI CORPORATION
Street Address: 

NFPA 70E - A2017 FD Meeting Agenda Page 452
When selected in lieu of the incident energy analysis of 130.5(C)(1), Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required. When arc flash PPE is required, Table 130.7(C)(15)(B) shall be used to determine the arc flash PPE category. The estimated maximum available short circuit current, maximum arc duration and working distances for dc equipment are listed in 130.7(C)(15)(B). Note: These tables are only applicable when all of the following conditions are met. An arc flash incident energy analysis shall be required in accordance with 130.5, for the following:

1. **Tasks not listed in Table 130.7(C)(15)(A)(a)**

2. **Power systems with greater than the estimated maximum available short circuit current**

3. **Power systems overcurrent protective devices clearing time is equal or less than the maximum fault clearing times**

4. **Tasks with less working distances equal or larger than the minimum working distance in Table 130.7(C)(15)(B) for the respective tasks**

   - **Informational Note No.1:** The arc flash PPE category, work tasks, and protective equipment provided in Table 130.7(C)(15)(A)(a), Table 130.7(C)(15)(A)(b), and Table 130.7(C)(15)(B) were identified and selected, based on the collective experience of the NFPA 70E Technical Committee. The arc flash PPE category of the protective clothing and equipment is generally based on determination of the estimated exposure level. Informational Note No.2: The collective experience of the NFPA 70E Technical Committee is that, in most cases, closed doors do not provide enough protection to eliminate the need for PPE in situations in which the state of the equipment is known to readily change (e.g., doors open or closed, rack in or rack out). Informational Note No.3: The premise used by the NFPA 70E Technical Committee 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 committee.

Table 130.7(C)(15)(B) Arc-Flash Hazard PPE Categories for Direct Current (dc) Systems

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage batteries, dc switchboards, and other dc supply sources</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 V &gt; Voltage &lt; 250 V Parameters:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage: 250 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-circuit current &lt;4 kA</td>
<td>1</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>4 kA ≤ short-circuit current &lt;7 kA</td>
<td>2</td>
<td>1.2 m (4 ft)</td>
</tr>
<tr>
<td>7 kA ≤ short-circuit current &lt;15 kA</td>
<td>3</td>
<td>1.8 m (6 ft)</td>
</tr>
<tr>
<td>Storage batteries, dc switchboards, and other dc supply sources</td>
<td></td>
<td></td>
</tr>
<tr>
<td>250 V ≤ Voltage ≤ 600 V Parameters:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage: 600 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-circuit current 1.5 kA</td>
<td>1</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>1.5 kA ≤ short-circuit current &lt;3 kA</td>
<td>2</td>
<td>1.2 m (4 ft)</td>
</tr>
<tr>
<td>3 kA ≤ short-circuit current &lt;7 kA</td>
<td>3</td>
<td>1.8 m (6 ft)</td>
</tr>
<tr>
<td>7 kA ≤ short-circuit current &lt;10 kA</td>
<td>4</td>
<td>2.5 m (8 ft)</td>
</tr>
</tbody>
</table>

Note: Apparel that can be expected to be exposed to electrolyte must meet both of the following conditions:

1. Be evaluated for electrolyte protection in accordance with ASTM F1296, Standard Guide for Evaluating Chemical Protective Clothing

2. Be arc-rated in accordance with ASTM F1891, Standard Specification for Arc Rated and Flame Resistant Rainwear, or equivalent

   - **Informational Note No.1:** "Short-circuit current," as used in this table, is determined from the dc power system maximum available short-circuit, including the effects of cables and any other impedances in the circuit. 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 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 arc flash has shown a multiplier of as much as 3x for arc-in-a-box [508 mm (20 in.) cube] versus open air. Engineering judgment is required when reviewing the specific conditions of the equipment and task to be performed, including the dimensions of the enclosure and the working distance involved.

Statement of Problem and Substantiation for Public Input

The wording has been revised for clarity to indicate when the tables can be used and when an incident energy analysis is required.

Submitter Information Verification

Submitter Full Name: DAELEEP MOHLA
### Public Input No. 525-NFPA 70E-2015 [ Section No. 130.7(C)(15)(B) ]

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Arc Flash PPE Category</th>
<th>Arc-Flash Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage batteries, dc switchboards, and other dc supply sources 100 V &gt; Voltage &lt; 250 V</td>
<td>1</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>Parameters: Voltage: 250 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-circuit current &lt; 4 kA</td>
<td>1</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>4 kA ≤ short-circuit current &lt; 7 kA</td>
<td>2</td>
<td>1.2 m (4 ft)</td>
</tr>
<tr>
<td>7 kA ≤ short-circuit current &lt; 15 kA</td>
<td>3</td>
<td>1.8 m (6 ft)</td>
</tr>
<tr>
<td>Storage batteries, dc switchboards, and other dc supply sources 250 V ≤ Voltage ≤ 600 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parameters: Voltage: 600 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-circuit current 1.5 kA</td>
<td>1</td>
<td>900 mm (3 ft)</td>
</tr>
<tr>
<td>1.5 kA ≤ short-circuit current &lt; 3 kA</td>
<td>2</td>
<td>1.2 m (4 ft)</td>
</tr>
<tr>
<td>3 kA ≤ short-circuit current &lt; 7 kA</td>
<td>3</td>
<td>1.8 m (6 ft)</td>
</tr>
<tr>
<td>7 kA ≤ short-circuit current &lt; 10 kA</td>
<td>4</td>
<td>2.5 m (8 ft)</td>
</tr>
</tbody>
</table>

Note: Apparel that can be expected to be exposed to electrolyte must meet both of the following conditions:

1. Be evaluated for electrolyte protection in accordance with ASTM F1296, Standard Specification for Arc Rated and Flame Resistant Rainwear, or equivalent

<table>
<thead>
<tr>
<th>Additional Proposed Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>FILE NAME</td>
</tr>
<tr>
<td>additional_input_for_table_130-7C15B.xlsx</td>
</tr>
</tbody>
</table>

Statement of Problem and Substantiation for Public Input

The second arc duration is atypical when working on the dc distribution system where there are OCPDs. The additional arcing times suggested for this table are typical clearing times for dc distribution fuses and circuit breakers. Since many users only utilize the table, this updated table will give users more applicable arc flash PPE requirements.

Submitter Information Verification

Submitter Full Name: WILLIAM CANTOR
Organization: TPI CORPORATION

524 of 693
7/7/2015 9:04 AM
TITLE OF NEW CONTENT

Type your content here ...

Delete the symbol => add only 1.2 to 12 cal/cm²

Arc-rated clothing and equipment with an arc rating equal to or greater than the determined incident energy (See Note 3.)

Other PPE

> 12 cal/cm²

Arc-rated clothing and equipment with an arc rating equal to or greater than the determined incident energy (See Note 3.)

Other PPE

Arc-rated long-sleeve shirt and arc-rated pants or arc-rated coverall or arc flash suit (SR). (See Note 3.)

Arc-rated face shield and arc-rated balaclava or arc flash suit hood (SR). (See Note 1.)

Arc-rated jacket, parka, or rainwear (AN)

Hard hat

Arc-rated hard hat liner (AN)

Safety glasses or safety goggles (SR) Hearing protection

Heavy-duty leather gloves or rubber insulating gloves with leather protectors (SR). (See Note 4.)

Leather footwear

ARC-RATED CLOTHING AND EQUIPMENT WITH AN ARC RATING

1.1.2 To add only 1.2 to 12 cal/cm²

Arc-rated clothing and equipment with an arc rating equal to or greater than the determined incident energy (See Note 3.)

Other PPE

> 12 cal/cm²

Arc-rated clothing and equipment with an arc rating equal to or greater than the determined incident energy (See Note 3.)

Other PPE

Arc-rated long-sleeve shirt and arc-rated pants or arc-rated coverall or arc flash suit (SR)

Arc-rated arc flash suit hood Arc-rated gloves incident energy (See Note 3.)

Arc-rated jacket, parka, or rainwear (AN)

Hard hat

Arc-rated hard hat liner (AN)

Safety glasses or safety goggles (SR) Hearing protection

Arc-rated gloves or rubber insulating gloves with leather protectors (SR). (See Note 4.)

Leather footwear

AN: As needed [in addition to the protective clothing and PPE required by 130.5(C)(1)]. SR: Selection of one in group is required by 130.5(C)(1).

Notes:

1. Face shields with a wrap-around guard to protect the face, chin, forehead, ears, and neck area are required by 130.7(C)(10)(c). For full head and neck protection, use a balaclava or an arc flash hood.

2. All items not designated "AN" are required by 130.7(C).

3. Arc ratings can be for a single layer, such as an arc-rated shirt and pants or a coverall, or for an arc flash suit or a multi-layer system consisting of a combination of arc-rated shirt and pants, coverall, and arc flash suit.

4. Rubber insulating gloves with leather protectors provide flash protection in addition to shock protection. Higher class rubber insulating gloves with leather protectors are required due to their increased material.

Statement of Problem and Substantiation for Public Input

See related PI 250

The information in table H.3(b) now exists in Annex H. Annexes in NFPA 70E are for information only and are not part of the requirements in NFPA 70E. The "Incident Energy Method" for selecting minimum arc flash clothing should be located in the requirements section of NFPA 70E (not in Annex H) the same way existing table 130.7(C)(16) exists in article 130.7 for the selection of arc flash PPE when the "Arc Flash PPE Category Method" is used to select arc flash PPE.

Existing table 130.7(C)(16) (recommendation is to rename this table 130.7(C)(17)) applies when the "Arc Flash PPE Category Method" in NFPA 70E is used to select arc flash PPE. The relocated table from H.3(b) (new table 130.7(C)(16)) applies when the "Incident Energy Method" is used to select minimum arc flash PPE.

Submitter Information Verification

Submitter Full Name: DARYLD CROW
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Affiliation: TG for article 13.4 and 130.5
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Fri Jun 26 11:24:31 EDT 2015
### Public Input No. 532-NFPA 70E-2015 [ New Section after 130.7(C)(16) ]

#### (16) Protective Clothing and Personal Protective Equipment (PPE)

(B) Incident Energy Analysis Method.

When the arc flash risk assessment has determined an arc flash hazard exists, Table 130.7(C)(B) shall be used to select arc rated clothing and other PPE to be used when working in the arc flash boundary.

#### TABLE 130.7(C)(16) (B) Selection of Arc-Rated Clothing and Other PPE for Use When Incident Energy Exposure is Determined.

<table>
<thead>
<tr>
<th>Incident Energy Exposure</th>
<th>Protective Clothing and PPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1.2 cal/cm²</td>
<td>Protective clothing, nonmelting (in accordance with ASTM F 1506) or untreated natural fiber</td>
</tr>
<tr>
<td></td>
<td>Face shield for projectile protection (AN)</td>
</tr>
<tr>
<td></td>
<td>Safety glasses or safety goggles (SR)</td>
</tr>
<tr>
<td></td>
<td>Hearing protection</td>
</tr>
<tr>
<td></td>
<td>Heavy-duty leather gloves or rubber insulating gloves with leather protectors (AN)</td>
</tr>
</tbody>
</table>

#### Other PPE

- Safety glasses or safety goggles (SR)
- Hearing protection
- Heavy-duty leather gloves or rubber insulating gloves with leather protectors (AN)

<table>
<thead>
<tr>
<th>&gt;1.2 to 12 cal/cm²</th>
<th>Arc-rated clothing and equipment with an arc rating equal to or greater than the determined incident energy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Arc-rated long-sleeve shirt and arc-rated pants or arc-rated coverall or arc flash suit (SR). (See Note 3.)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated face shield and arc-rated balaclava or arc flash suit hood (SR). (See Note 1.)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated jacket, parka, or rainwear (AN)</td>
</tr>
</tbody>
</table>

#### Other PPE

- Arc-rated hard hat (AN)
- Safety glasses or safety goggles (SR)
- Hearing protection
- Heavy-duty leather gloves or rubber insulating gloves with leather protectors (SR). (See Note 4.)
- Leather footwear

<table>
<thead>
<tr>
<th>&gt; 12 cal/cm²</th>
<th>Arc-rated clothing and equipment with an arc rating equal to or greater than the determined incident energy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Arc-rated long-sleeve shirt and arc-rated pants or arc-rated coverall and/or arc flash suit (SR)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated arc flash suit hood</td>
</tr>
<tr>
<td></td>
<td>Arc-rated gloves</td>
</tr>
<tr>
<td></td>
<td>Arc-rated jacket, parka, or rainwear (AN)</td>
</tr>
</tbody>
</table>

#### Other PPE

- Arc-rated hard hat (AN)
- Safety glasses or safety goggles (SR)
- Hearing protection
- Arc-rated gloves or rubber insulating gloves with leather protectors (SR). (See Note 4.)
- Leather footwear

AN: As needed [in addition to the protective clothing and PPE required by 130.5(C)(1)]

SR: Selection of one in group is required by 130.5(C)(1).

### Notes:

1. Face shields with a wrap-around guarding to protect the face, chin, forehead, ears, and neck area are required by 130.7(C)(10)(c). For full head and neck protection, use a balaclava or an arc flash hood.
2. All items not designated ‘AN’ are required by 130.7(C).
3. Arc ratings can be for a single layer, such as an arc-rated shirt and pants or a coverall, or for an arc flash suit or a multi-layer system consisting of a combination of arc-rated shirt and pants, coverall, and arc flash suit.
4. 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.

### Statement of Problem and Substantiation for Public Input

The NFPA 70E – 2015 edition does not contain a personal protective equipment table in the body of the standard. Table H.3(b) in Informative Annex H lists the required PPE to use when an incident energy analysis has been conducted. The requirements in Annex H are for informational purposes only, and thus not requirements. Information contained 130.7(C) Personal Protective Equipment (PPE) clearly states the PPE requirements. TableH.3(b) represents the requirements in 130.7(C), and by adding to the body of the standard, provides a quick and concise list of PPE for employers who have performed an incident energy analysis.

### Submitter Information Verification

**Submitter Full Name:** JASON WOLF
**Organization:** ESCO GROUP
Once the arc flash PPE category has been identified from Table 130.7(C)(15)(A)(b) or Table 130.7(C)(15)(B), Table 130.7(C)(16) shall be used to determine the required PPE for the task. Table 130.7(C)(16) 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.

Informational Note No. 1: See Informative Annex H for a suggested simplified approach to ensure adequate PPE for electrical workers within facilities with large and diverse electrical systems.

Informational Note No. 2: The PPE requirements of this section are intended to protect a person from arc flash hazards. While some situations could result in burns to the skin, even with the protection described in Table 130.7(C)(16), burn injury should be reduced and survivable. Due to the explosive effect of some arc events, physical trauma injuries could occur. The PPE requirements of this section do not address protection against physical trauma other than exposure to the thermal effects of an arc flash.

Informational Note No. 3: The arc rating for a particular clothing system can be obtained from the arc-rated clothing manufacturer.

### Table 130.7(C)(16) Personal Protective Equipment (PPE)

<table>
<thead>
<tr>
<th>PPE Category</th>
<th>PPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Arc-Rated Clothing, Minimum Arc Rating of 4 cal/cm²</strong> (see Note 1)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated long-sleeve shirt and pants or arc-rated coverall</td>
</tr>
<tr>
<td></td>
<td>Arc-rated face shield (see Note 2) or arc flash suit hood</td>
</tr>
<tr>
<td></td>
<td>Arc-rated jacket, parka, rainwear, or hard hat liner (AN)</td>
</tr>
<tr>
<td></td>
<td><strong>Protective Equipment</strong></td>
</tr>
<tr>
<td></td>
<td>Hard hat</td>
</tr>
<tr>
<td></td>
<td>Safety glasses or safety goggles (SR)</td>
</tr>
<tr>
<td></td>
<td>Hearing protection (ear canal inserts)</td>
</tr>
<tr>
<td></td>
<td>Heavy duty leather gloves (See Note 3)</td>
</tr>
<tr>
<td></td>
<td>Leather footwear (AN)</td>
</tr>
<tr>
<td>2</td>
<td><strong>Arc-Rated Clothing, Minimum Arc Rating of 8 cal/cm²</strong> (see Note 1)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated long-sleeve shirt and pants or arc-rated coverall</td>
</tr>
<tr>
<td></td>
<td>Arc-rated flash suit hood or arc-rated face shield (see Note 2) and arc-rated balaclava</td>
</tr>
<tr>
<td></td>
<td>Arc-rated jacket, parka, rainwear, or hard hat liner (AN)</td>
</tr>
<tr>
<td></td>
<td><strong>Protective Equipment</strong></td>
</tr>
<tr>
<td></td>
<td>Hard hat</td>
</tr>
<tr>
<td></td>
<td>Safety glasses or safety goggles (SR)</td>
</tr>
<tr>
<td></td>
<td>Hearing protection (ear canal inserts)</td>
</tr>
<tr>
<td></td>
<td>Heavy duty leather gloves (See Note 3)</td>
</tr>
<tr>
<td></td>
<td>Leather footwear</td>
</tr>
<tr>
<td>3</td>
<td><strong>Arc-Rated Clothing Selected so That the System Arc Rating Meets the Required Minimum Arc Rating of 25 cal/cm²</strong> (see Note 1)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated long-sleeve shirt (AR)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated pants (AR)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated coverall (AR)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated arc flash suit jacket (AR)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated arc flash suit pants (AR)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated arc flash suit hood</td>
</tr>
<tr>
<td></td>
<td>Arc-rated gloves (see Note 3)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated jacket, parka, rainwear, or hard hat liner (AN)</td>
</tr>
<tr>
<td>4</td>
<td><strong>Arc-Rated Clothing Selected so That the System Arc Rating Meets the Required Minimum Arc Rating of 40 cal/cm²</strong> (see Note 1)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated long-sleeve shirt (AR)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated pants (AR)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated coverall (AR)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated arc flash suit jacket (AR)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated arc flash suit pants (AR)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated arc flash suit hood</td>
</tr>
<tr>
<td></td>
<td>Arc-rated gloves (see Note 3)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated jacket, parka, rainwear, or hard hat liner (AN)</td>
</tr>
</tbody>
</table>
Safety glasses or safety goggles (SR)
Hearing protection (ear canal inserts)
Leather footwear

Notes:
AN: as needed (optional). AR: as required. SR: selection required.
(1) Arc rating is defined in Article 100.
(2) 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 hood is required to be worn.
(3) If rubber insulating gloves with leather protectors are used, additional leather or arc-rated gloves are not required. The combination of rubber insulating gloves with leather protectors satisfies the arc flash protection requirement.

Statement of Problem and Substantiation for Public Input
This PI seeks only to replace the reference to Note 1 with Note 3 in PPE Categories 3 and 4 relating to hand protection. This is errata that occurred when the notes were renumbered for the 2015 edition. Note 1 does not apply to hand protection.

Submitter Information Verification
Submitter Full Name: Bobby Gray
Organization: Hoydar/Buck, Inc.
Affiliation: None
Street Address:
City:
State:
Zip:
Submittal Date: Wed Apr 08 17:04:41 EDT 2015
Once the arc flash PPE category has been identified from Table 130.7(C)(15)(A)(b) or Table 130.7(C)(15)(B), Table 130.7(C)(16) shall be used to determine the required PPE for the task. Table 130.7(C)(16) 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.

Informational Note No. 1: See Informative Annex H for a suggested simplified approach to ensure adequate PPE for electrical workers within facilities with large and diverse electrical systems.

Informational Note No. 2: The PPE requirements of this section are intended to protect a person from arc flash hazards. While some situations could result in burns to the skin, even with the protection described in Table 130.7(C)(16), burn injury should be reduced and survivable. Due to the explosive effect of some arc events, physical trauma injuries could occur. The PPE requirements of this section do not address protection against physical trauma other than exposure to the thermal effects of an arc flash.

Informational Note No. 3: The arc rating for a particular clothing system can be obtained from the arc-rated clothing manufacturer.

Table 130.7(C)(16) Personal Protective Equipment (PPE)

<table>
<thead>
<tr>
<th>PPE Category</th>
<th>PPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Arc-Rated Clothing, Minimum Arc Rating of 4 cal/cm² (see Note 1)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated long-sleeve shirt and pants or arc-rated coverall</td>
</tr>
<tr>
<td></td>
<td>Arc-rated face shield (see Note 2) or arc flash suit hood</td>
</tr>
<tr>
<td></td>
<td>Arc-rated jacket, parka, rainwear, or hard hat liner (AN)</td>
</tr>
<tr>
<td></td>
<td>Protective Equipment</td>
</tr>
<tr>
<td></td>
<td>Hard hat</td>
</tr>
<tr>
<td></td>
<td>Safety glasses or safety goggles (SR)</td>
</tr>
<tr>
<td></td>
<td>Hearing protection (ear canal inserts)</td>
</tr>
<tr>
<td></td>
<td>Heavy duty leather gloves (See Note 3)</td>
</tr>
<tr>
<td></td>
<td>Leather footwear (AN)</td>
</tr>
</tbody>
</table>

| 2 | Arc-Rated Clothing, Minimum Arc Rating of 8 cal/cm² (see Note 1) |
| | Arc-rated long-sleeve shirt and pants or arc-rated coverall |
| | Arc-rated flash suit hood or arc-rated face shield (see Note 2) and arc-rated balaclava |
| | Arc-rated jacket, parka, rainwear, or hard hat liner (AN) |
| | Protective Equipment |
| | Hard hat |
| | Safety glasses or safety goggles (SR) |
| | Hearing protection (ear canal inserts) |
| | Heavy duty leather gloves (See Note 3) |
| | Leather footwear |

| 3 | Arc-Rated Clothing Selected so That the System Arc Rating Meets the Required Minimum Arc Rating of 25 cal/cm² (see Note 1) |
| | 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 (see Note 1, 2) |
| | Arc-rated jacket, parka, rainwear, or hard hat liner (AN) |
| | Protective Equipment |
| | Hard hat |
| | Safety glasses or safety goggles (SR) |
| | Hearing protection (ear canal inserts) |
| | Leather footwear |

| 4 | Arc-Rated Clothing Selected so That the System Arc Rating Meets the Required Minimum Arc Rating of 40 cal/cm² (see Note 1) |
| | 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 (see Note 1, 2) |
| | Arc-rated jacket, parka, rainwear, or hard hat liner (AN) |
| | Protective Equipment |
| | Hard hat |
| | Safety glasses or safety goggles (SR) |
| | Hearing protection (ear canal inserts) |
| | Leather footwear |

Notes:
AN: as needed (optional). AR: as required. SR: selection required.
(1) Arc rating is defined in Article 100.
(2) 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.
(3) If rubber insulating gloves with leather protectors are used, additional leather or arc-rated gloves are not required. The combination of rubber insulating gloves with leather protectors satisfies the arc flash protection requirement.

Statement of Problem and Substantiation for Public Input


Submitter Information Verification

Submitter Full Name: Drake Drobnick
Organization: [ Not Specified ]
Affiliation: N/A
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 28 21:49:01 EST 2015
Once the arc flash PPE category has been identified from Table 130.7(C)(15)(A)(b) or Table 130.7(C)(15)(B), Table 130.7(C)(16) shall be used to determine the required PPE for the task. Table 130.7(C)(16) 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.

Informational Note No. 1: See Informative Annex H for a suggested simplified approach to ensure adequate PPE for electrical workers within facilities with large and diverse electrical systems.

Informational Note No. 2: The PPE requirements of this section are intended to protect a person from arc flash hazards. While some situations could result in burns to the skin, even with the protection described in Table 130.7(C)(16), burn injury should be reduced and survivable. Due to the explosive effect of some arc events, physical trauma injuries could occur. The PPE requirements of this section do not address protection against physical trauma other than exposure to the thermal effects of an arc flash.

Informational Note No. 3: The arc rating for a particular clothing system can be obtained from the arc-rated clothing manufacturer.

Table 130.7(C)(16) | Personal Protective Equipment (PPE) 17) Selection of arc-rated clothing and other PPE for use when the Arc Flash PPE Category Method is used to select arc flash PPE

<table>
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<th>PPE Category</th>
<th>PPE</th>
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</table>
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Arc-rated long-sleeve shirt and pants or arc-rated coverall  
Arc-rated face shield (see Note 2) or arc flash suit hood  
Arc-rated jacket, parka, rainwear, or hard hat liner (AN)  
Protective Equipment  
Hard hat  
Safety glasses or safety goggles (SR)  
Hearing protection (ear canal inserts)  
Heavy duty leather gloves (See Note 3)  
Leather footwear (AN) |
| 2            | Arc-Rated Clothing, Minimum Arc Rating of 8 cal/cm² (see Note 1)  
Arc-rated long-sleeve shirt and pants or arc-rated coverall  
Arc-rated flash suit hood or arc-rated face shield (see Note 2) and arc-rated balaclava  
Arc-rated jacket, parka, rainwear, or hard hat liner (AN)  
Protective Equipment  
Hard hat  
Safety glasses or safety goggles (SR)  
Hearing protection (ear canal inserts)  
Heavy duty leather gloves (See Note 3)  
Leather footwear |
| 3            | Arc-Rated Clothing Selected so That the System Arc Rating Meets the Required Minimum Arc Rating of 25 cal/cm² (see Note 1)  
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 (see Note 1)  
Arc-rated jacket, parka, rainwear, or hard hat liner (AN)  
Protective Equipment  
Hard hat  
Safety glasses or safety goggles (SR)  
Hearing protection (ear canal inserts)  
Leather footwear |
| 4            | Arc-Rated Clothing Selected so That the System Arc Rating Meets the Required Minimum Arc Rating of 40 cal/cm² (see Note 1)  
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 (see Note 1)  
Arc-rated jacket, parka, rainwear, or hard hat liner (AN)  
Protective Equipment  
Hard hat  
Safety glasses or safety goggles (SR)  
Hearing protection (ear canal inserts)  
Leather footwear |

Notes:
(1) Arc rating is defined in Article 100.

(2) 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.

(3) If rubber insulating gloves with leather protectors are used, additional leather or arc-rated gloves are not required. The combination of rubber insulating gloves with leather protectors satisfies the arc flash protection requirement.

Statement of Problem and Substantiation for Public Input

Changing Table 130.7(C)(16) to table 130.7(C)(17) and revising the title to “Selection of arc-rated clothing and other PPE for use when the Arc Flash PPE Category Method is used to select arc flash PPE” will add clarity when parts of table H.3(b) are relocated to article 130.7 as new table 130.7(C)(16) with the title “Selection of minimum arc-rated clothing and other PPE for use when the incident energy method is used for the selection of arc flash PPE”.

Submitter Information Verification

Submitter Full Name: DARYLD CROW
Organization: DRC CONSULTING LTD
Affiliation: TG for article 130.4 and 130.5
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Fri Jun 26 13:02:43 EDT 2015
Once the arc flash PPE category has been identified from Table 130.7(C)(15)(A)(b) or Table 130.7(C)(15)(B), Table 130.7(C)(16) shall be used to determine the required PPE for the task. Table 130.7(C)(16) lists the requirements for PPE based on arc flash PPE categories through 4. This clothing and equipment shall be used when working within the arc flash boundary.

Informational Note No. 1: See Informative Annex H for a suggested simplified approach to ensure adequate PPE for electrical workers within facilities with large and diverse electrical systems.

Informational Note No. 2: The PPE requirements of this section are intended to protect a person from arc flash hazards. While some situations could result in burns to the skin, even with the protection described in Table 130.7(C)(16), burn injury should be reduced and survivable. Due to the explosive effect of some arc events, physical trauma injuries could occur. The PPE requirements of this section do not address protection against physical trauma other than exposure to the thermal effects of an arc flash.

Informational Note No. 3: The arc rating for a particular clothing system can be obtained from the arc-rated clothing manufacturer.

### Table 130.7(C)(16) Personal Protective Equipment (PPE)

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<thead>
<tr>
<th>Arc Flash, PPE Category</th>
<th>PPE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong></td>
<td>Arc-Rated Clothing, Minimum Arc Rating of 4 cal/cm² (see Note 1)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated long-sleeve shirt and pants or arc-rated coverall</td>
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<td>Arc-rated face shield (see Note 2) or arc flash suit hood</td>
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<td>Arc-rated jacket, parka, rainwear, or hard hat liner (AN)</td>
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<td><strong>Protective Equipment</strong></td>
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</tr>
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<td></td>
<td>Hard hat</td>
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</tr>
<tr>
<td></td>
<td>Leather footwear (AN)</td>
</tr>
<tr>
<td><strong>2</strong></td>
<td>Arc-Rated Clothing, Minimum Arc Rating of 8 cal/cm² (see Note 1)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated long-sleeve shirt and pants or arc-rated coverall</td>
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<td>Leather footwear</td>
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<td><strong>3</strong></td>
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</tr>
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<td>Arc-rated long-sleeve shirt (AR)</td>
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<td>Leather footwear</td>
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<tr>
<td><strong>4</strong></td>
<td>Arc-Rated Clothing Selected so That the System Arc Rating Meets the Required Minimum Arc Rating of 40 cal/cm² (see Note 1)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated long-sleeve shirt (AR)</td>
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**Notes:**
- AN: as needed (optional).
- AR: as required.
- SR: selection required.
(1) Arc rating is defined in Article 100.

(2) 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.

(3) If rubber insulating gloves with leather protectors are used, additional leather or arc-rated gloves are not required. The combination of rubber insulating gloves with leather protectors satisfies the arc flash protection requirement.

Statement of Problem and Substantiation for Public Input

The only change recommended in this Public Input is to add "Arc Flash" to the heading of the left column in Table 130.7(C)(16). This is an editorial change to be consistent with the terminology used elsewhere such as in the provisions of 130.7(C)(16).

Submitter Information Verification

Submitter Full Name: Palmer Hickman
Organization: Electrical Training Alliance
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jan 20 16:41:14 EST 2015
Once the arc flash PPE category has been identified from Table 130.7(C)(15)(A)(b) or Table 130.7(C)(15)(B), Table 130.7(C)(16) shall be used to determine the required PPE for the task. Table 130.7(C)(16) 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.

Informational Note No. 1: See Informative Annex H for a suggested simplified approach to ensure adequate PPE for electrical workers within facilities with large and diverse electrical systems.

Informational Note No. 2: The PPE requirements of this section are intended to protect a person from arc flash hazards. While some situations could result in burns to the skin, even with the protection described in Table 130.7(C)(16), burn injury should be reduced and survivable. Due to the explosive effect of some arc events, physical trauma injuries could occur. The PPE requirements of this section do not address protection against physical trauma other than exposure to the thermal effects of an arc flash.

Informational Note No. 3: The arc rating for a particular clothing system can be obtained from the arc-rated clothing manufacturer.

### Table 130.7(C)(16) Personal Protective Equipment (PPE)

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</table>

| 2 | Arc-Rated Clothing, Minimum Arc Rating of 8 cal/cm² (see Note 1) |
| | Arc-rated long-sleeve shirt and pants or arc-rated coverall |
| | Arc-rated flash suit hood or arc-rated face shield (see Note 2) and arc-rated balaclava |
| | Arc-rated jacket, parka, rainwear, or hard hat liner (AN) |
| | Protective Equipment |
| | Hard hat |
| | Safety glasses or safety goggles (SR) |
| | Hearing protection, (ear canal inserts) |
| | Heavy duty leather gloves (see Note 3) |
| | Leather footwear |

| 3 | Arc-Rated Clothing Selected so That the System Arc Rating Meets the Required Minimum Arc Rating of 25 cal/cm² (see Note 1) |
| | 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 (see Note 1) |
| | Arc-rated jacket, parka, rainwear, or hard hat liner (AN) |
| | Protective Equipment |
| | Hard hat |
| | Safety glasses or safety goggles (SR) |
| | Hearing protection, (ear canal inserts) |
| | Leather footwear |

| 4 | Arc-Rated Clothing Selected so That the System Arc Rating Meets the Required Minimum Arc Rating of 40 cal/cm² (see Note 1) |
| | Arc-rated long-sleeve shirt (AR) |
| | Arc-rated pants (AR) |
| | Arc-rated coverall (AR) |
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| | Arc-rated arc flash suit pants (AR) |
| | Arc-rated arc flash suit hood |
| | Arc-rated gloves (see Note 1) |
| | Arc-rated jacket, parka, rainwear, or hard hat liner (AN) |
| | Protective Equipment |
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| | Leather footwear |

Notes:

AN: as needed (optional). AR: as required. SR: selection required.
(1) Arc rating is defined in Article 100.

(2) 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.

(3) If rubber insulating gloves with leather protectors are used, additional leather or arc-rated gloves are not required. The combination of rubber insulating gloves with leather protectors satisfies the arc flash protection requirement.

Statement of Problem and Substantiation for Public Input

Other types or hearing protection can be necessary or preferred.

Submitter Information Verification

Submitter Full Name: PAUL DOBROWSKY
Organization: INNOVATIVE TECHNOLOGY SERVICES
Street Address: 
City:
State:
Zip:
Submittal Date: Mon Jul 06 15:20:43 EDT 2015
(A) Arc Flash PPE Categories Method. Once the arc flash PPE category has been identified from Table 130.7(C)(15)(A)(b) or Table 130.7(C)(15)(B), Table 130.7(C)(16)(A) shall be used to determine the required PPE for the task. Table 130.7(C)(16)(A) 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.

Informational Note No. 1: See Informative Annex H for a suggested simplified approach to ensure adequate PPE for electrical workers within facilities with large and diverse electrical systems.

Informational Note No. 2: The PPE requirements of this section are intended to protect a person from arc flash hazards. While some situations could result in burns to the skin, even with the protection described in Table 130.7(C)(16), burn injury should be reduced and survivable. Due to the explosive effect of some arc events, physical trauma injuries could occur. The PPE requirements of this section do not address protection against physical trauma other than exposure to the thermal effects of an arc flash.

Informational Note No. 3: The arc rating for a particular clothing system can be obtained from the arc-rated clothing manufacturer.

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<td></td>
<td>Leather footwear</td>
</tr>
<tr>
<td>4</td>
<td>Arc-Rated Clothing Selected so That the System Arc Rating Meets the Required Minimum Arc Rating of 40 cal/cm² (see Note 1)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated long-sleeve shirt (AR)</td>
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<tr>
<td></td>
<td>Arc-rated pants (AR)</td>
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<tr>
<td></td>
<td>Arc-rated coverall (AR)</td>
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<tr>
<td></td>
<td>Arc-rated arc flash suit jacket (AR)</td>
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<td></td>
<td>Arc-rated arc flash suit pants (AR)</td>
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<tr>
<td></td>
<td>Arc-rated arc flash suit hood</td>
</tr>
<tr>
<td></td>
<td>Arc-rated gloves (see Note 1)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated jacket, parka, rainwear, or hard hat liner (AN)</td>
</tr>
<tr>
<td></td>
<td>Protective Equipment</td>
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<tr>
<td></td>
<td>Hard hat</td>
</tr>
<tr>
<td></td>
<td>Safety glasses or safety goggles (SR)</td>
</tr>
<tr>
<td></td>
<td>Hearing protection (ear canal inserts)</td>
</tr>
<tr>
<td></td>
<td>Leather footwear</td>
</tr>
</tbody>
</table>

Notes:
AN: as needed (optional), AR: as required, SR: selection required.
(1) Arc rating is defined in Article 100.

(2) 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.

(3) If rubber insulating gloves with leather protectors are used, additional leather or arc-rated gloves are not required. The combination of rubber insulating gloves with leather protectors satisfies the arc flash protection requirement.

Statement of Problem and Substantiation for Public Input

Adding (A) Arc Flash PPE Categories Method this section and the Arc Flash PPE Categories table are more clearly linked together. This also allows for adding (B) Incident Energy Analysis and adding a table.

Submitter Information Verification

Submitter Full Name: JASON WOLF
Organization: ESCO GROUP
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jul 06 15:44:43 EDT 2015
Public Input No. 355-NFPA 70E-2015 [Section No. 130.7(D)]

(D) Other Protective Equipment.

(1) Insulated Tools and Equipment.

Employees shall use insulated tools or handling equipment, or both, when working inside the restricted approach boundary of exposed energized electrical conductors or circuit parts where tools or handling equipment might make accidental contact. Insulated tools shall be protected from damage to the insulating material.

Informational Note: See 130.4(B), Shock Protection Boundaries.

(a) Requirements for Insulated Tools. The following requirements shall apply to insulated tools:

(2) Insulated tools shall be rated for the voltages on which they are used.

(3) Insulated tools shall be designed and constructed for the environment to which they are exposed and the manner in which they are used.

(4) Insulated tools and equipment shall be inspected prior to each use. The inspection shall look for damage to the insulation or damage that can limit the tool from performing its intended function or could increase the potential for an incident (e.g., damaged tip on a screwdriver).

(e) Fuse or Fuseholder Handling Equipment. Fuse or fuseholder handling equipment, insulated for the circuit voltage, shall be used to remove or install a fuse if the fuse terminals are energized.

(f) Ropes and Handlines. Ropes and handlines used within the limited approach boundary of exposed energized electrical conductors or circuit parts operating at 50 volts or more, or where an electrical hazard exists, voltages equal to or greater than 50 Vac or 100 Vdc, shall be nonconductive.

(g) Fiberglass-Reinforced Plastic Rods. Fiberglass-reinforced plastic rod and tube used for live-line tools shall meet the requirements of applicable portions of electrical codes and standards dealing with electrical installation requirements.


(h) Portable Ladders. Portable ladders shall have nonconductive side rails if they are used where an employee or ladder could contact exposed energized electrical conductors or circuit parts operating at 50 volts or more or where an electrical hazard exists voltages equal to or greater than 50 Vac or 100 Vdc. Nonconductive ladders shall meet the requirements of ANSI standards for ladders listed in Table 130.7(F).

(i) Protective Shields. Protective shields, protective barriers, or insulating materials shall be used to protect each employee from shock, burns, or other electrically related injuries while an employee is working within the limited approach boundary of energized conductors or circuit parts that might be accidentally 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 be guarded to protect unqualified persons from contact with the energized conductors or circuit parts.

(j) Rubber Insulating Equipment. Rubber insulating equipment used for protection from accidental contact with energized conductors or circuit parts shall meet the requirements of the ASTM standards listed in Table 130.7(F).

(k) Voltage-Rated Plastic Guard Equipment. Plastic guard equipment for protection of employees from accidental contact with energized conductors or circuit parts, or for protection of employees or energized equipment or material from contact with ground, shall meet the requirements of the ASTM standards listed in Table 130.7(F).

(l) Physical or Mechanical Barriers. Physical or mechanical (field-fabricated) barriers shall be installed no closer than the restricted approach boundary distance given in Table 130.4(D)(a) and Table 130.4(D)(b). While the barrier is being installed, the restricted approach boundary distance specified in Table 130.4(D)(a) and Table 130.4(D)(b) shall be maintained, or the energized conductors or circuit parts shall be placed in an electrically safe work condition.

Statement of Problem and Substantiation for Public Input

This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.

This Public Input seeks to resolve the “dc gap” by consistently revising the phrase “50 V or more” to “voltages equal to or greater than 50 Vac or 100 Vdc.”

The phrase “or where an electrical hazard exists” is deleted as it does not add any value. As stated in 130.7(D)(1) the intent of the requirements of 130.7(D) are related to contact.

The word “accidentally” is deleted as it does not add any value to the requirement or intent.

Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS

Organization: SCHNEIDER ELECTRIC

Affiliation: This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.

Street Address:

City:

State:

Zip:

Submit Date: Wed Jul 01 17:29:12 EDT 2015
Public Input No. 273-NFPA 70E-2015 [Section No. 130.7(D)(1)]

1. Insulated Tools and Equipment.

Employees shall use insulated tools or handling equipment, or both, when working inside the restricted approach boundary of exposed energized electrical conductors or circuit parts where tools or handling equipment might make accidental contact. Insulated tools shall be protected from damage to the insulating material.

Informational Note: See 130.4(B), Shock Protection Boundaries.

(a) Requirements for Insulated Tools. The following requirements shall apply to insulated tools:

(2) Insulated tools shall be rated for the voltages on which they are used.

(3) Insulated tools shall be designed and constructed for the environment to which they are exposed and the manner in which they are used.

(4) Insulated tools and equipment shall be inspected prior to each use. The inspection shall look for damage to the insulation or damage that can limit the tool from performing its intended function or could increase the potential for an incident (e.g., damaged tip on a screwdriver).

(e) Fuse or Fuseholder Handling Equipment. Fuse or fuseholder handling equipment, insulated for the circuit voltage, shall be used to remove or install a fuse if the fuse terminals are energized.

(f) Ropes and Handlines. Ropes and handlines used within the limited approach boundary of exposed energized electrical conductors or circuit parts operating at 50 volts or more, or where an electrical hazard exists, shall be nonconductive.

(g) Fiberglass-Reinforced Plastic Rods. Fiberglass-reinforced plastic rod and tube used for live-line tools shall meet the requirements of applicable portions of electrical codes and standards dealing with electrical installation requirements.


(h) Portable Ladders. Portable ladders shall have nonconductive side rails if they are used where an employee or ladder could contact exposed energized electrical conductors or circuit parts operating at 50 volts or more or where an electrical hazard exists. Nonconductive ladders shall meet the requirements of ANSI standards for ladders listed in Table 130.7(F).

(i) Protective Shields. Protective shields, protective barriers, or insulating materials shall be used to protect each employee from shock, burns, or other electrically related injuries while an employee is working within the limited approach boundary of energized conductors or circuit parts that might be accidentally 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 be guarded to protect unqualified persons from contact with the energized conductors or circuit parts.

(j) Rubber Insulating Equipment. Rubber insulating equipment used for protection from accidental contact with energized, exposed energized, or circuit parts shall meet the requirements of the ASTM standards listed in Table 130.7(F).

(k) Voltage-Rated Plastic Guard Equipment. Plastic guard equipment for protection of employees from accidental contact with exposed energized conductors or circuit parts, or for protection of employees or energized equipment or material from contact with ground, shall meet the requirements of the ASTM standards listed in Table 130.7(F).

(l) Physical or Mechanical Barriers. Physical or mechanical (field-fabricated) barriers shall be installed no closer than the restricted approach boundary distance given in Table 130.4(D)(a) and Table 130.4(D)(b). While the barrier is being installed, the restricted approach boundary distance specified in Table 130.4(D)(a) and Table 130.4(D)(b) shall be maintained, or the energized conductors or circuit parts shall be placed in an electrically safe work condition.

Statement of Problem and Substantiation for Public Input

The term “exposed” deleted from 130.7(D)(1) and 130.7(D)(1)(c) as it is inferred by the context.

The term “exposed” is added to 130.7(D)(1)(g) and 130.7(D)(1)(h) as the reference is to shock hazards in general. The Task Group used the following principles when deciding whether or not to use “exposed” with “energized”:

1. Required when referring to shock hazards in general;
2. Not required when “exposed” is inferred (i.e. preceded by qualifier “within the limited approach boundary of...”);
3. Not required when referring to all electrical hazards or arc flash hazards.

This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the term “exposed” with the term “energized.”

Submitter Information Verification

<table>
<thead>
<tr>
<th>Name</th>
<th>DANIEL ROBERTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization</td>
<td>SCHNEIDER ELECTRIC</td>
</tr>
</tbody>
</table>

The Task Group used the following principles when deciding whether or not to use “exposed” with “energized”:

1. Required when referring to shock hazards in general;
2. Not required when “exposed” is inferred (i.e. preceded by qualifier “within the limited approach boundary of...”);
3. Not required when referring to all electrical hazards or arc flash hazards.

This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the term “exposed” with the term “energized.”

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Submitter Affiliation: SCHNEIDER ELECTRIC
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Submit Date: Fri Jun 26 14:50:21 EDT 2015

Submitter Full Name: SCHNEIDER ELECTRIC
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Submit Date: Fri Jun 26 14:50:21 EDT 2015
Public Input No. 112-NFPA 70E-2015 [ Section No. 130.7(E) ]

Point (E)  Alerting Techniques.
One or more of the methods (1), (2), or (3) shall be used to warn personnel of the likelihood of exposure to an electrical hazard within a work area. Method (4) shall be used to alert qualified persons of an electrical hazard.

1. Safety Signs and Tags.
Safety signs, safety symbols, or accident prevention tags shall be used where necessary to warn employees about electrical hazards that might endanger them. Such signs and tags shall meet the requirements of ANSI Z535, Series of Standards for Safety Signs and Tags, given in Table 130.7(F).

Informational Note: Safety signs, tags, and barricades used to identify energized "look-alike" equipment can be employed as an additional preventive measure.

2. Barricades.
Barricades shall be used to prevent or limit employee access to work areas containing energized conductors or circuit parts. Conductive barricades shall be placed no closer than the limited approach boundary given in Table 130.4(D)(a) and Table 130.4(D)(b). Where the arc flash boundary is greater than the limited approach boundary, barricades shall not be placed closer than the arc flash boundary.

3. Attendants.
If signs and barricades do not provide sufficient warning and protection from electrical hazards, an attendant shall be stationed where it is necessary to warn and protect employees. The primary duty and responsibility of an attendant providing manual signaling and alerting shall be to keep unqualified employees outside a work area where the unqualified employee might be exposed to electrical hazards. An attendant shall remain in the area as long as there is a potential for employees to be exposed to the electrical hazards.

4. Look-Alike Equipment.
Where work performed on equipment that is de-energized and placed in an electrically safe condition exists in a work area with other energized equipment that is similar in size, shape, and construction, one of the alerting methods in 130.7(E) (1), (2), or (3) shall be employed to prevent the employee from entering look-alike equipment.

Statement of Problem and Substantiation for Public Input

As written, the alerting techniques must be used in an ascending hierarchy. The user should be able to choose the proper alerting techniques based on the results of the risk assessment and specific conditions in workplace. There is no justification for preventing the use of an attendant without first using and testing the effectiveness of signs. The test could result in an exposure, which is not the intent of the rule.

Submitter Information Verification

Submitter Full Name: Bobby Gray
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Submittal Date: Wed Apr 08 17:13:21 EDT 2015

http://submittals.nfpa.org/TerraViewWeb/ContentFetcher?commentPara...
Public Input No. 313-NFPA 70E-2015 [ Section No. 130.7(E)(1) ]

(1) Safety Signs and Tags.
Safety signs, safety symbols, or accident prevention tags shall be used where necessary to warn employees about electrical hazards that might endanger them. Such signs and tags shall meet

Informational Note No. 1: Additional information about the requirements of Safety Signs can be found in ANSI Z535, Series of Standards for Safety Signs and Tags, given in Table 130.

Zulu.

Informational Note No. 2: Safety signs, tags, and barricades used to identify energized “look-alike” equipment can be employed as an additional preventive measure.

Statement of Problem and Substantiation for Public Input

Referencing other standards in the mandatory requirements of NFPA 70E is problematic and can raise issues if the reference standard is not available for public review. The use of this reference is also in conflict with the style manual and the move to make it an informational note will improve clarity and functionality of the 70E Standard.

Submitter Information Verification

Submitter Full Name: WESLEY WHEELER
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Affiliation: NECA
Street Address: 
City: 
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Zip: 
Submittal Date: Mon Jun 29 14:09:59 EDT 2015
Public Input No. 232-NFPA 70E-2015 [ Section No. 130.7(E)(3) ]

(3) Attendants.
If signs and barricades do not provide sufficient warning and protection from electrical hazards, an attendant, a Qualified Person, shall be stationed at all entrances to the work area and shall serve as an attendant to warn and protect unqualified employees. The primary duty and responsibility of an attendant shall be providing manual signaling and alerting to keep unqualified employees outside a work area where the unqualified employee might be exposed to electrical hazards. An attendant shall remain in the area as long as there is a potential for employees to be exposed to the electrical hazards.

Statement of Problem and Substantiation for Public Input

This revision clarifies that an attendant, if one is needed must be a qualified person. If an unqualified person serves as an attendant, they will not be able to recognize the hazards and take appropriate action to protect unqualified persons. The existing text states the attendant will protect unqualified persons. It makes no sense for the attendant to be an unqualified person as well.

Submitter Information Verification

Submitter Full Name: DAVID PACE
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Street Address:
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Zip:
Submittal Date: Mon Jun 22 18:11:03 EDT 2015
Public Input No. 363-NFPA 70E-2015 [ New Section after 130.7(E)(4) ]

(5) Removal or Rerouting of Conductors.
Where conductors are deenergized in order to remove or reroute them and conductor terminations are not within sight, such as where they are in a junction or pull box, additional steps to verify absence of voltage or identify the conductors shall be taken prior to cutting the conductors.

Informational Note. Additional methods would include but not be limited to; pulling the conductors to visually verify movement, non-shielded conductors could be additionally verified with a non contact test instrument and shielded conductors could be verified with devices to tone the cables for identification.

Statement of Problem and Substantiation for Public Input

The use of temporary power, renovation activity and upgrades to electrical systems regularly involve the deenergization of branch circuits and feeders to remove, relocate, or tap the conductors. Where this occurs, the act of cutting or tapping the conductors is typically not within sight of the source, as the conductors are in enclosures, junction boxes or pull boxes well out of sight of the equipment supplying the conductors. This proposed requirement would mandate that additional steps are taken to ensure the employees have identified the correct set of conductors before cutting or tapping into them. There are many ways to achieve this additional step. There are many documented occurrences of employees going into a pull box and choosing the wrong feeders or choosing the wrong junction box and cutting into energized conductors. This occurred in the spring of 2015 in the Philadelphia area and resulted in a fatality. NFPA 70E must address this issue to ensure employees are trained and directed to take additional steps to ensure the correct set of conductors have been identified before cutting into them.

Submitter Information Verification

Submitter Full Name: JAMES DOLLARD
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Street Address: 
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Submittal Date: Thu Jul 02 13:44:06 EDT 2015
205.3 General Maintenance Requirements. 
Electrical equipment shall be maintained in accordance with manufacturers' instructions or industry consensus standards to reduce the risk associated with failure. The equipment owner or the owner’s designated representative shall be responsible for maintenance of the electrical equipment and documentation.

Informational Note: Common industry practice is to apply test or calibration decals to equipment to indicate the test or calibration date and overall condition of equipment that has been tested and maintained in the field. These decals provide the employee immediate indication of last maintenance date and if the tested device or system was found acceptable on the date of test. This local information can assist the employee in the assessment of overall electrical equipment maintenance status.

Informational Note No. 2: Thermographic scans in addition to scheduled maintenance activities of electrical equipment can assist in identifying hot spots and minimize unscheduled maintenance outages. Installation of listed and labeled infrared windows assists in performing this task without opening the equipment doors.

Statement of Problem and Substantiation for Public Input

Infrared scans can assist in identifying hot spots between scheduled outages for maintenance. However, if performed this activity should be in addition to, and not in lieu of, scheduled maintenance activities.

Submitter Information Verification

Submitter Full Name: DALEEP MOHLA
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Street Address:
City: 
State:
Zip:
Submittal Date: Fri Jul 03 16:39:04 EDT 2015
Public Input No. 274-NFPA 70E-2015 [ Section No. 205.7 ]

205.7 Guarding of Energized Conductors and Circuit Parts.
Enclosures shall be maintained to guard against accidental contact with exposed energized conductors and circuit parts and other electrical hazards. Covers and doors shall be in place with all associated fasteners and latches secured.

Statement of Problem and Substantiation for Public Input

The term “exposed” is added as the reference is to shock hazards in general.
The Task Group used the following principles when deciding whether or not to use “exposed” with “energized”:
1. Required when referring to shock hazards in general;
2. Not required when “exposed” is inferred (i.e. preceded by qualifier “within the limited approach boundary of…”);
3. Not required when referring to all electrical hazards or arc flash hazards.
This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the term “exposed” with the term “energized.”

Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the term “exposed” with the term “energized.”
Street Address: 
City: 
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Submittal Date: Fri Jun 26 14:55:24 EDT 2015
Public Input No. 275-NFPA 70E-2015 [Section No. 220.2]

### 220.2 Protection and Control Circuitry
Protection and control circuitry used to guard against accidental contact with exposed energized conductors and circuit parts and to prevent other electrical or mechanical hazards shall be maintained.

#### Statement of Problem and Substantiation for Public Input

The term "exposed" is added as the reference is to shock hazards in general. The Task Group used the following principles when deciding whether or not to use "exposed" with "energized":

1. Required when referring to shock hazards in general;
2. Not required when "exposed" is inferred (i.e. preceded by qualifier "within the limited approach boundary of...");
3. Not required when referring to all electrical hazards or arc flash hazards.

This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the term "exposed" with the term "energized."

#### Submitter Information Verification

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<tr>
<th>Submitter Full Name</th>
<th>Organization</th>
<th>Affiliation</th>
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</thead>
<tbody>
<tr>
<td>DANIEL ROBERTS</td>
<td>SCHNEIDER ELECTRIC</td>
<td>This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the term &quot;exposed&quot; with the term &quot;energized.&quot;</td>
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<th>Zip</th>
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<td>Fri Jun 26 14:58:08 EDT 2015</td>
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Article 225  Fuses and Circuit Breakers

225.1  Fuses.
Fuses shall be maintained free of breaks or cracks in fuse cases, ferrules, and insulators. Fuse clips shall be maintained to provide adequate contact with fuses. Fuseholders for current-limiting fuses shall not be modified to allow the insertion of fuses that are not current-limiting. Non-current limiting fuses shall not be modified to allow their insertion into current-limiting fuseholders.

225.2  Molded-Case Circuit Breakers.
Molded-case circuit breakers shall be maintained free of cracks in cases and cracked or broken operating handles.

225.3  Circuit Breaker Testing After Electrical Faults.
Circuit breakers that interrupt faults approaching their interrupting ratings shall be inspected and tested in accordance with the manufacturer’s instructions.

225.11  Feeder and Branch-Circuit Conductors Entering, Exiting, or Attached to Buildings or Structures.
Feeder and branch-circuit conductors entering or exiting buildings or structures shall be installed in accordance with the requirements of 230.52. Overhead branch circuits and feeders attached to buildings or structures shall be installed in accordance with the requirements of 230.54.

Statement of Problem and Substantiation for Public Input

The preposition 'in' that is in bold font under 225.11 should be removed from the article. It is purely a grammatical error. Article 225.11 should read:

225.11  Feeder and Branch-Circuit Conductors Entering, Exiting, or Attached to Buildings or Structures.
Feeder and branch-circuit conductors entering or exiting buildings or structures shall be installed in accordance with the requirements of 230.52. Overhead branch circuits and feeders attached to buildings or structures shall be installed in accordance with the requirements of 230.54.

Submitter Information Verification

Submitter Full Name: kaitlyn muller
Organization: IBEW 48
Street Address:
City:
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Zip:
Submittal Date: Wed May 13 00:36:32 EDT 2015
Statement of Problem and Substantiation for Public Input

The term “exposed” is added as the reference is to shock hazards in general.

The Task Group used the following principles when deciding whether or not to use “exposed” with “energized”:

1. Required when referring to shock hazards in general;
2. Not required when “exposed” is inferred (i.e. preceded by qualifier “within the limited approach boundary of...”);
3. Not required when referring to all electrical hazards or arc flash hazards.

This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the term “exposed” with the term “energized.”

Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the term “exposed” with the term “energized.”
Street Address:
City:
State:
Zip:
Submittal Date: Fri Jun 26 14:59:41 EDT 2015
240.1 Ventilation.

Ventilation. When ventilation systems, forced or natural, are required and present, they shall be maintained to prevent buildup of explosive mixtures. This maintenance shall include a functional test of any associated detection and alarm systems.

Statement of Problem and Substantiation for Public Input

There are battery chemistries that do not require any ventilation. Although not explicitly stated, this section implies that ventilation systems are required for all batteries and battery room. This change makes it clear that ventilation systems may not be required.

Submitter Information Verification

Submitter Full Name: WILLIAM CANTOR
Organization: TPI CORPORATION
Street Address:
City:
State:
Zip:
Submittal Date: Fri Jul 03 09:08:18 EDT 2015
**240.2 Eye and Body Wash Apparatus.**

**Eye.** When eye and body wash apparatus are required and present, they shall be maintained in operable condition.

**Statement of Problem and Substantiation for Public Input**

There are battery chemistries that do not have liquid electrolyte and no eye/body wash are required. Although not explicitly stated, this section implies that eye and body wash apparatus are required for all batteries and battery room. This change makes it clear that eye and body wash apparatus may not be required.

**Submitter Information Verification**

Submitter Full Name: WILLIAM CANTOR  
Organization: TPI CORPORATION  
Street Address:  
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State:  
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Submittal Date: Fri Jul 03 09:14:20 EDT 2015
Public Input No. 277-NFPA 70E-2015 [ Section No. 310.4(A)(1) ]

(1) Training.
Qualified persons shall be trained and knowledgeable in the operation of cell line working zone equipment and specific work methods and shall be trained to avoid the electrical hazards that are present. Such persons shall be familiar with the proper use of precautionary techniques and PPE. Training for a qualified person shall include the following:

(1) Skills and techniques to avoid a shock hazard:

(2) Between exposed, energized surfaces, which might include temporarily insulating or guarding parts to permit the employee to work on exposed, energized parts

(3) Between exposed, energized surfaces and grounded equipment, other grounded objects, or the earth itself, that might include temporarily insulating or guarding parts to permit the employee to work on energized parts

(4) Method of determining the cell line working zone area boundaries

Statement of Problem and Substantiation for Public Input

The term "exposed" was added to "energized surfaces" for consistency with similar phrases in Chapter 3. See 310.5(A).
The Task Group used the following principles when deciding whether or not to use "exposed" with "energized":
1. Required when referring to shock hazards in general;
2. Not required when "exposed" is inferred (i.e. preceded by qualifier "within the limited approach boundary of...");
3. Not required when referring to all electrical hazards or arc flash hazards.
This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the term "exposed" with the term "energized."

Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the term "exposed" with the term "energized."
Street Address:
City:
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Zip:
Submittal Date: Fri Jun 26 15:03:19 EDT 2015
Public Input No. 299-NFPA 70E-2015 [Section No. 310.5(A)]

(A) General.
Operation and maintenance of electrolytic cell lines might require contact by employees with exposed energized surfaces such as buses, electrolytic cells, and their attachments. The approach distances referred to in Table 130.4(D)(a) and Table 130.4(D)(b) shall not apply to work performed by qualified persons in the cell line working zone. Safeguards such as safety-related work practices and other safeguards shall be used to protect employees from injury while working in the cell line working zone. These safeguards shall be consistent with the nature and extent of the related electrical hazards. Safeguards might be different for energized cell lines and de-energized cell lines. Hazardous battery effect voltages shall be dissipated to consider a cell line de-energized.

Informational Note No. 1: Exposed energized surfaces might not present an electrical hazard. Electrical hazards are related to current flow through the body, causing shock and arc flash burns and arc blasts. Shock is a function of many factors, including resistance through the body and the skin, return paths, paths in parallel with the body, and system voltages. Arc flash burns and arc blasts are a function of the current available at the point involved and the time of arc exposure.

Informational Note No. 2: A cell line or group of cell lines operated as a unit for the production of a particular metal, gas, or chemical compound might differ from other cell lines producing the same product because of variations in the particular raw materials used, output capacity, use of proprietary methods or process practices, or other modifying factors. Detailed standard electrical safety-related work practice requirements could become overly restrictive without accomplishing the stated purpose of Chapter 1.

Statement of Problem and Substantiation for Public Input
The term "process" was deleted as it did not add clarity to the requirement.
This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the terms "procedure," "practice," "program" and "process."
The Task Group recommendations regarding the use of the terms "practice," "procedure," "process" or "program" are based on:
1. The context in which the term was used;
2. The definition of each term as found in the Merriam-Webster on-line dictionary:
   Practice: to do something customarily (e.g. "work practice")
   Procedure: a series of steps followed in a regular definite order (e.g. "lockout/tagout procedure")
   Process: a series of actions or operations conducing to an end (e.g. "Risk Assessment – An overall process that...")
   Program: a plan or system under which action may be taken toward a goal (e.g. "electrical safety program")

Submitter Information Verification
Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the terms "procedure," "practice," "program" and "process."
Street Address:
City:
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Zip:
Submittal Date: Mon Jun 29 11:12:49 EDT 2015
Public Input No. 474-NFPA 70E-2015 [Section No. 310.5(A)]

(A) General.

Operation and maintenance of electrolytic cell lines might require contact by employees with exposed energized surfaces such as buses, electrolytic cells, and their attachments. The approach distances referred to in Table 130.4(D)(a) and Table 130.4(D)(b) shall not apply to work performed by qualified persons in the cell line working zone. Safeguards such as safety-related work practices and other safeguards shall be used to protect employees from injury while working in the cell line working zone. These safeguards shall be consistent with the nature and extent of the related electrical hazards. Safeguards might be different for energized cell lines and de-energized cell lines. Hazardous battery effect voltages shall be dissipated to consider a cell line de-energized.

Informational Note No. 1: Exposed energized surfaces might not present an electrical hazard. Electrical Shock hazards are related to current flow through the body, causing shock and thermal burns and arc blast. Shock current is a function of many factors, including resistance through the body and the skin, return paths, paths in parallel with the body, and system voltages. Arc flash burns and arc blast are a function of the arcing current available at the point involved and the time duration of arc exposure.

Informational Note No. 2: A cell line or group of cell lines operated as a unit for the production of a particular metal, gas, or chemical compound might differ from other cell lines producing the same product because of variations in the particular raw materials used, output capacity, use of proprietary methods or process practices, or other modifying factors. Detailed standard electrical safety-related work practice requirements could become overly restrictive without accomplishing the stated purpose of Chapter 1.

Statement of Problem and Substantiation for Public Input

The effects of shock and arc flash are placed into separate sentences and other editorial revisions are provided for clarity.

The effects of shock and arc flash are placed into separate sentences and other editorial revisions are provided for clarity.

Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: The effects of shock and arc flash are placed into separate sentences and other editorial revisions are provided for clarity
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jul 06 13:33:35 EDT 2015
(3) Nonroutine Tasks.

Before a nonroutine task is performed in the cell line working zone, an arc flash risk assessment shall be done. If an arc flash hazard is a possibility during nonroutine work, appropriate instructions shall be given to employees involved on how to use the risk control methods in the hierarchy of risk control to reduce the risk associated with arc flash.

Statement of Problem and Substantiation for Public Input

This Public Input is submitted by Daniel Roberts on behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.

The proposed revision creates consistency with the risk assessment principles found in the rest of the document.

Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This Public Input is submitted by Daniel Roberts on behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.
Street Address:
City:
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Zip:
Submittal Date: Mon Jul 06 13:39:47 EDT 2015
Public Input No. 278-NFPA 70E-2015 [ Section No. 310.5(D)(4) ]

(4) Voltage Equalization.
Voltage equalization shall be permitted by bonding a conductive surface to an electrically exposed energized surface, either directly or through a resistance, so that there is insufficient voltage to create an electrical hazard.

Statement of Problem and Substantiation for Public Input

The term “exposed” was added to “energized surfaces” for consistency with similar phrases in Chapter 3. See 310.5(A).
The term “electrically” is deleted as it is unnecessary.
The Task Group used the following principles when deciding whether or not to use “exposed” with “energized”:
1. Required when referring to shock hazards in general;
2. Not required when “exposed” is inferred (i.e. preceded by qualifier “within the limited approach boundary of…”);
3. Not required when referring to all electrical hazards or arc flash hazards.
This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the term “exposed” with the term “energized.”

Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the term “exposed” with the term “energized.”
Street Address:
City:
State:
Zip:
Submittal Date: Fri Jun 26 15:07:11 EDT 2015
Public Input No. 478-NFPA 70E-2015 [ Section No. 310.5(D)(5) ]

(5) Isolation.
Isolation shall be established by placing equipment or other items in locations such that employees are unable to simultaneously contact exposed conductive surfaces that could present an electrical hazard.

Statement of Problem and Substantiation for Public Input
This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.
The proposed editorial revision enhances clarity.

Submitter Information Verification
Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.
Street Address: City:
State:
Zip:
Submittal Date: Mon Jul 06 13:44:56 EDT 2015
(11) Pacemakers and Metallic Implants.
Employees with implanted pacemakers, ferromagnetic medical devices, or other electronic devices vital to life shall not be permitted in cell areas unless written permission is obtained from the employee’s physician.

Informational Note: The American Conference of Government Industrial Hygienists (ACGIH) recommends that persons with implanted pacemakers should not be exposed to magnetic flux densities above 10⁻⁸ gauss.

Statement of Problem and Substantiation for Public Input
Change is required to agree with information in IEEE 463 standard “Electrical Safety Practices in Electrolytic Cell Line working Zones”.

Submitter Information Verification
Submitter Full Name: DARYLD CROW
Organization: DRC CONSULTING LTD
Street Address:
City:
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Submittal Date: Wed Jun 17 11:26:57 EDT 2015
320.1 Scope. This article covers electrical safety requirements for the practical safeguarding of employees while working with exposed stationary storage batteries that exceed 50 volts, nominal.

Informational Note: For additional information on best practices for safely working on stationary batteries, see the following documents:

1. NFPA 1, Fire Code, Chapter 52, Stationary Storage Battery Systems, 2015
2. NFPA 70, National Electrical Code, Article 480, Storage Batteries, 2014
8. IEEE 1657, Recommended Practice for Personnel Qualifications for Installation and Maintenance of Stationary Batteries, 2009
10. OSHA 29 CFR 1926.441, “Batteries and battery charging”

Statement of Problem and Substantiation for Public Input

Maintenance of ventilations systems is critical for sites with batteries that vent explosive gas. IEEE 1635 provides all of the necessary calculations that can determine the rate of gas evolution. This PI also provides the dates for the latest versions of other referenced IEEE document.

Submitter Information Verification

Submitter Full Name: WILLIAM CANTOR
Organization: TPI CORPORATION
Street Address:
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Submittal Date: Fri Jul 03 09:18:02 EDT 2015
Prospective Short-Circuit Current.
The highest level of fault current that could theoretically occur at a point on a circuit. This is the fault current that can flow in the event of a zero impedance short circuit and if no protection devices operate.

Informational Note: Some battery chemistries have built in management devices to restrict maximum short circuit current. The determination of the prospective short-circuit current assumes that the internal battery management system protection devices are operable. These management devices are needed to ensure safe operation.

Statement of Problem and Substantiation for Public Input

Some battery chemistries, such as Li Ion, rely on internal battery management systems to safely operate. A failure of the system is rare, but a failure may cause a catastrophic event such as a fire. It would be very unlikely that a battery management system failure would occur at the same time as an external short circuit.

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Submittal Date: Fri Jul 03 09:30:27 EDT 2015
Public Input No. 481-NFPA 70E-2015 [Section No. 320.3(B)]

(B) Electrolyte Hazards.

1. Battery Activities That Include Handling of Liquid Electrolyte.
   The following protective equipment shall be available to employees performing any type of service on a battery with liquid electrolyte:
   
   1. Goggles and face shield appropriate for the electrical hazard and the chemical hazard
   2. Gloves and aprons appropriate for the chemical hazards
   3. Portable or stationary eye wash facilities and equipment within the work area that are capable of drenching or flushing of the eyes and body for the duration necessary to mitigate injury from the electrolyte hazard.

   Informational Note: Guidelines for the use and maintenance of eye wash facilities for vented batteries in nontelecom environments can be found in ANSI/ISEA Z358.1, American National Standard for Emergency Eye Wash and Shower Equipment.

   2. Activities That Do Not Include Handling of Electrolyte.

   Employees. The following protective equipment shall be available to employees, performing any activity not involving the handling of electrolyte, shall wear safety glasses:
   
   1. Eye and face protection appropriate for the electrical hazard;
   2. Gloves appropriate for the electrical hazards; and
   3. Protective clothing appropriate for electrical hazard.

   Informational Note: Battery maintenance activities usually do not involve handling electrolyte. Batteries with solid electrolyte (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.

Statement of Problem and Substantiation for Public Input

This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.

The proposed editorial revision to 320.3(B)(1)(3) enhances clarity.

The list of electrical PPE is added to 320.3(B)(2) as activities that do not involve the handling of electrolyte can involve electrical hazards of shock and arc flash.

Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.
Street Address:
City:
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Submittal Date: Mon Jul 06 13:52:02 EDT 2015
Public Input No. 375-NFPA 70E-2015 [ Sections 320.3(B)(1), 320.3(B)(2) ]

Sections 320.3(B)(1), 320.3(B)(2)

(1) Battery Activities That Include Handling of Liquid Electrolyte.

The following protective equipment shall be available to employees performing any type of service on a battery with liquid service that includes the handling of electrolyte:

(1) Goggles and face shield appropriate for the electrical hazard and the chemical hazard
(2) Gloves and aprons appropriate for the chemical hazards
(3) Portable For as long as the hazard exists, portable or stationary eye wash facilities within the work area that are capable of drenching or flushing of the eyes and body for the duration necessary to the hazard are required.

Informational Note: Guidelines for the use and maintenance of eye wash facilities for vented batteries in nontelecom environments can be found in ANSI/ISEA Z358.1, American National Standard for Emergency Eye Wash and Shower Equipment.

(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 (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. Handling of cell/units could be considered handling of electrolyte. In all cases, a battery risk assessment 320.3(A)(1) is required when performing battery installation and maintenance.

Statement of Problem and Substantiation for Public Input

As described by the title of this section, different PPE is required depending on if the technician is handling electrolyte or not. If there is no handling of electrolyte, regardless if the battery had liquid electrolyte or not, only safety glasses are needed at a minimum. An owner could always provide more electrolyte PPE if desired.

The problem is that there are many possible hazards from batteries including shock, arc flash and thermal. Traditionally the electrolyte hazard has been over-emphasized while the actual risk of a serious injury due to battery electrolyte is very low, especially if just performing normal battery maintenance. The most common battery available is lead-acid where the electrolyte is dilute sulfuric acid (~20-30%) and the majority of risk is splashing electrolyte in one’s eyes. If comprehensive electrolyte protection is required for all battery maintenance for chemistries with liquid electrolyte, it will be to the detriment of safety protection of the other hazards which are more likely to cause serious harm to the user. The changes to the wording recommend in this PI are consistent with industry practice and the titles of these sections.

Submitter Information Verification

Submitter Full Name: WILLIAM CANTOR
Organization: TPI CORPORATION
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Submittal Date: Fri Jul 03 09:46:01 EDT 2015
Public Input No. 233-NFPA 70E-2015 [ Section No. 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 (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.

Statement of Problem and Substantiation for Public Input

Delete Article 320.3(B)(2) in its entirety. It contains incorrect information and is providing incorrect guidance. Batteries not having what is considered to be traditional liquid electrolyte are not free from chemical hazards. I have seen firsthand failures of this type battery system and it is not pretty. There are plenty of chemical hazards and guidance in this standard should not include text that says there are not.

Submitter Information Verification

Submitter Full Name: DAVID PACE
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Street Address:
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Submittal Date: Mon Jun 22 18:14:48 EDT 2015
(1) Direct-Current Ground-Fault Detection.
For systems with voltages above where a dc shock hazard exists (see Table 130.4(D)(b)), shock PPE is required while working on batteries with type 2 or 4 grounded systems as described below. For type 1 and 3 grounded systems, shock PPE is only required if there is not an operational ground fault detection system or the ground fault detection system is indicating an inadvertent ground. The ground fault detector shall be tested prior to any battery work.

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:

(1) 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.

(2) 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.

(3) 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.

(4) 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.
Public Input No. 38-NFPA 70E-2015 [ Section No. 320.3(C)(2) ]

(2) Tools and Equipment.
   (a) Tools and equipment for work on batteries shall be equipped with handles listed as insulated for the maximum working voltage.
   (b) Battery terminals and all electrical conductors shall be kept clear of unintended contact with tools, test equipment, liquid containers, and other foreign objects.
   (c) Nonsparking tools shall be required when the risk assessment required by 110.1(F G) justifies their use.

Statement of Problem and Substantiation for Public Input

Document errata

Submitter Information Verification

Submitter Full Name: Drake Drobnick
Organization: [ Not Specified ]
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Street Address:
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Submittal Date: Sat Feb 07 07:58:27 EST 2015
Article 330 - Safety-Related Work Practices for Use of Lasers

330.1 - Scope.
The requirements of this article shall apply to the use of lasers in the laboratory and the workshop.

330.2 - Definitions.
For the purposes of this article, the definitions that follow shall apply.

Fail-safe.
The design consideration in which failure of a component does not create additional hazards or increased risk. In the failure mode, the system is rendered inoperative or nonhazardous.

Fail-Safe Safety Interlock.
An interlock that in the failure mode does not defeat the purpose of the interlock; for example, an interlock that is positively driven into the off position as soon as a hinged cover begins to open, or before a detachable cover is removed, and that is positively held in the off position until the hinged cover is closed or the detachable cover is locked in the closed position.

Laser.
Any device that can be made to produce or amplify electromagnetic radiation in the wavelength range from 100 nm to 1 mm primarily by the process of controlled stimulated emission.

Laser Energy Source.
Any device intended for use in conjunction with a laser to supply energy for the excitation of electrons, ions, or molecules. General energy sources, such as electrical supply services or batteries, shall not be considered to constitute laser energy sources.

Laser Product.
Any product or assembly of components that constitutes, incorporates, or is intended to incorporate a laser or laser system.

Laser Radiation.
All electromagnetic radiation emitted by a laser product between 100 nm and 1 mm that is produced as a result of a controlled stimulated emission.

Laser System.
A laser in combination with an appropriate laser energy source with or without additional incorporated components.

330.3 - Safety Training.
(A) Personnel to Be Trained.
Employers shall provide training for all operator and maintenance personnel.

(B) Scope of Training.
The training shall include, but is not limited to, the following:
(1) Familiarization with laser principles of operation, laser types, and laser emissions
(2) Laser safety, including the following:
(3) System operating procedures
(4) Risk assessment and risk control procedures
(5) Need for personal protection
(6) Accident reporting procedures
(7) Biological effects of the laser upon the eye and the skin
(8) Electrical and other hazards associated with the laser equipment, including the following:
(9) High voltages (>1 kV) and stored energy in the capacitor banks
(10) Circuit components, such as electron tubes, with anode voltages greater than 5 kV emitting X-rays
(11) Capacitor bank explosions
(12) Production of ionizing radiation
(13) Poisoning from the solvent or dye switching liquids or laser media
(14) High sound intensity levels from pulsed lasers

(C) Proof of Qualification.
Proof of qualification of the laser equipment operator shall be readily available.

(D) Safeguarding of Employees in the Laser Operating Area.

Eye Protection.
Employees shall be provided with eye protection as required by federal regulation.

Warning Signs.
Warning signs shall be posted at the entrances to areas or protective enclosures containing laser products.

Master Control.
High-power laser equipment shall include a key-operated master control.

High-Power Radiation Emission Warning.
High-power laser equipment shall include a fail-safe laser radiation emission audible and visible warning when it is switched on or if the capacitor banks are charged.

Beam Shutters or Caps shall be used, or the laser switched off, when laser transmission is not required. The laser shall be switched off when unattended for 30 minutes or more.

Aiming.
Laser beams shall not be aimed at employees.

Label.
Laser equipment shall bear a label indicating its maximum output.

Personal Protective Equipment (PPE).
PPE shall be provided for users and operators of high-power laser equipment.
330.5 Employee Responsibility

Employees shall be responsible for the following:

1. Obtaining authorization for laser use
2. Obtaining authorization for being in a laser operating area
3. Observing safety rules
4. Reporting laser equipment failures and accidents to the employer

DELETE IN ITS ENTIRETY

Statement of Problem and Substantiation for Public Input

Section 330 of NFPA 70E is related to laser hazards. Although it is part of the Electrical Safe Work Practices document most of the language is around non-electrical hazards, such as beam hazards. Existing, well established safety standards such as ANSI Z136.1 already include these requirements and more. The NFPA does not need to include redundant information in this standard that provide less safety than existing standards.

The hazard of electrical power supplies for lasers is an appropriate topic for this Standard, but is covered under general work safety rules already.

Submitter Information Verification

Submitter Full Name: Brian Primeau
Organization: MIT Lincoln Labs
Street Address:
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Zip:
Submittal Date: Wed Mar 18 09:28:23 EDT 2015
Article 330  Safety-Related Work Practices for Use of Lasers

330.1  Scope.
The requirements of this article shall apply to the use of lasers in the laboratory and the workshop.

330.2  Definitions.
For the purposes of this article, the definitions that follow shall apply.

Fail-Safe.
The design consideration in which failure of a component does not create additional hazards or increased risk. In the failure mode, the system is rendered inoperative or nonhazardous.

Fail-Safe Safety Interlock.
An interlock that in the failure mode does not defeat the purpose of the interlock; for example, an interlock that is positively driven into the off position as soon as a hinged cover begins to open, or before a detachable cover is removed, and that is positively held in the off position until the hinged cover is closed or the detachable cover is locked in the closed position.

Hazardous Laser.
Any laser that is a hazard to operators and/or nearby persons, such as ANSI/FDA Class 3B and 4 systems that are not eye- or skin-safe.

Laser.
Any device that can be made to produce or amplify electromagnetic radiation in the wavelength range from 100 nm to 1 mm primarily by the process of controlled stimulated emission.

Laser Energy Source.
Any device intended for use in conjunction with a laser to supply energy for the excitation of electrons, ions, or molecules. General energy sources, such as electrical supply services or batteries, shall not be considered to constitute laser energy sources.

Laser Product.
Any product or assembly of components that constitutes, incorporates, or is intended to incorporate a laser or laser system.

Laser Radiation.
All electromagnetic radiation emitted by a laser product between 100 nm and 1 mm that is produced as a result of a controlled stimulated emission.

Laser System.
A laser in combination with an appropriate laser energy source with or without additional incorporated components.

330.3  Safety Training.

(A)  Personnel to Be Trained.
Employers shall provide training for all operator and maintenance personnel working with or near Hazardous Laser Systems.

(B)  Scope of Training.
The training shall include, but is not limited to, the following:

1. Familiarization with laser principles of operation, laser types, and laser emissions
2. Laser safety, including the following:
   3. System operating procedures
   4. Risk assessment and risk control procedures
   5. Need for personnel protection
   6. Accident reporting procedures
   7. Biological effects of the laser upon the eye and the skin
   8. Electrical and other hazards associated with the laser equipment, including the following:
      9. High voltages (>1 kV) and stored energy in the capacitor banks
      10. Circuit components, such as electron tubes, with anode voltages greater than 5 kV emitting X-rays
      11. Capacitor bank explosions
      12. Production of ionizing radiation
      13. Poisoning from the solvent or dye switching liquids or laser media
      14. High sound intensity levels from pulsed lasers

(C)  Proof of Qualification.
Proof of qualification of the laser equipment operator shall be readily available.

330.4  Safeguarding of Employees in the Hazardous Laser Operating Area.

(A)  Eye Protection.
Employees shall be provided with eye protection as required by federal regulation.

(B)  Warning Signs.
Warning signs shall be posted at the entrances to areas or protective enclosures containing laser products.

(C)  Master Control.
High-power Hazardous laser equipment shall include a key-operated master control.

(D)  High-Power Radiation Emission Warning.
High-power Hazardous laser equipment shall include a fail-safe laser radiation emission audible and visible warning when it is switched on or if the capacitor banks are charged.

(E)  Beam Shutters or Caps.
Beam shutters or caps shall be used, or the laser switched off, when laser transmission is not required. The laser shall be switched off when unattended for 30 minutes or more.

(F)  Aiming.
Laser Hazardous laser beams shall not be aimed at employees.

(G)  Label.
Laser equipment shall bear a label indicating its maximum output.

(H)  Personal Protective Equipment (PPE).
PPE shall be provided for users and operators of high-power laser equipment.
330.5 Employee Responsibility.
   Employees working with hazardous lasers shall be responsible for the following:
   (1) Obtaining authorization for laser use
   (2) Obtaining authorization for being in a laser operating area
   (3) Observing safety rules
   (4) Reporting laser equipment failures and accidents to the employer

Statement of Problem and Substantiation for Public Input

Section 330.2 defines a laser as 'any' device that can emit laser radiation. Section 330.3 requires 'all operator and maintenance personnel' be trained. This, as written would require extensive training for persons such as grocery store checkout personnel operating an eye-safe Class 2 laser device. This would clearly add such a burden to employers as to make the standard unadoptable and unlikely to be utilized. It also conflicts with risk-based assessment and training under the widely adopted and excellent ANSI Z136 laser safety standards.

This revision defines a Hazardous Laser and requires training only when the laser is hazardous as defined in the ANSI and FDA standards.

Submitter Information Verification

Submitter Full Name: Brian Primeau
Organization: MIT Lincoln Labs
Street Address:
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Submittal Date: Wed Mar 18 11:08:06 EDT 2015
### Public Input No. 202-NFPA 70E-2015 [ Section No. 340.1 ]

**340.1 Scope.**
This article shall apply to safety-related work practices around power electronic equipment, including the following:

1. Electric arc welding equipment  
2. High-power radio, radar, and television transmitting towers and antennas  
3. Industrial dielectric and radio frequency (RF) induction heaters  
4. Shortwave or RF diathermy devices  
5. Process equipment that includes rectifiers and inverters such as the following:
   6. Motor drives  
   7. Uninterruptible power supply systems  
   8. Lighting controllers

### Statement of Problem and Substantiation for Public Input

Electric arc welding machines are covered in new Article 360

### Submitter Information Verification

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<thead>
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<tr>
<td>Zip:</td>
<td>Submittal Date: Sat Jun 20 08:16:28 EDT 2015</td>
</tr>
</tbody>
</table>
340.5, Effects of Electricity on the Human Body.

The employer and employees shall be aware of the following hazards associated with power electronic equipment.

1. Effects of Power Frequency Current:
   - At 0.5 mA, shock is perceptible.
   - At 10 mA, a person may not be able to voluntarily let go of an energized electrical conductor or circuit part.
   - At about 40 mA, the shock, if lasting for 1 second or longer, can be fatal due to ventricular fibrillation.
   - Further increasing current leads to burns and cardiac arrest.

2. Effects of Direct Current:
   - A dc current of 2 mA is perceptible.
   - A dc current of 40 mA is considered the threshold of the let-go current.

3. Effects of Voltage. A voltage of 30 V rms, or 60 V dc, is considered safe, except when the skin is broken. The internal body resistance can be as low as 500 ohms, so fatalities can occur.

4. Effects of Short Contact:
   - For contact less than 0.1 second and with currents just greater than 0.5 mA, ventricular fibrillation can occur only if the shock is during a vulnerable part of the cardiac cycle.
   - For contact of less than 0.1 second and with currents of several amperes, ventricular fibrillation can occur if the shock is during a vulnerable part of the cardiac cycle.
   - For contact of greater than 0.8 second and with currents just greater than 0.5 A, cardiac arrest (reversible) can occur.
   - For contact greater than 0.8 second and with currents of several amperes, burns and death are probable.

5. Effects of Alternating Current at Frequencies Above 100 Hz. When the threshold of perception increases from 10 kHz to 100 kHz, the threshold of let-go current increases from 10 mA to 100 mA.

6. Effects of Waveshape. Contact with voltages from phase controls usually causes effects between those of ac and dc sources.

7. Effects of Capacitive Discharge:
   - A circuit of capacitance of 1 μF having a 10 kV capacitor charge can cause ventricular fibrillation.
   - A circuit of capacitance of 20 μF having a 10 kV capacitor charge can be dangerous and probably will cause ventricular fibrillation.

Statement of Problem and Substantiation for Public Input

This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.

The content of 340.5 is primarily informational in nature it belongs in Annex K with similar content. A separate Public Input has been created to place this content in Annex K. The awareness requirement specified in the lead-in sentence is already covered by the training requirements in Article 110.2.

Related Public Inputs for This Document

<table>
<thead>
<tr>
<th>Related Input</th>
<th>Relationship</th>
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<tr>
<td>Public Input No. 485-NFPA 70E-2015 (Section No. K.2)</td>
<td></td>
</tr>
</tbody>
</table>

Submitter Information Verification

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Submittal Date: Mon Jul 06 13:58:35 EDT 2015
Public Input No. 484-NFPA 70E-2015 [ Section No. 340.7(B) ]

(B) Employee Responsibility.
The employee shall be 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 schemes.
5. Examining all documents provided by the employer relevant to the work, especially those documents indicating the location of components that present an electrical hazard.
6. Maintaining good housekeeping around the equipment and work space.
7. Reporting any incident that resulted in, or could have resulted in, injury or damage to health.
8. Using and appropriately maintaining the PPE and tools required to perform the work safely.

Statement of Problem and Substantiation for Public Input

This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.

The proposed revision clarifies what the employee is required to do with the documents provided by the employer. The term “especially” is deleted as it does not add any value to the requirement.

Submitter Information Verification

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Submittal Date: Mon Jul 06 14:00:45 EDT 2015
Section 350.10 Establishing an Electrically Safe Work Condition. An electrically safe work condition shall be achieved when performed in accordance with the procedures of 120.2 and verified by following the process identified in 120.1.

Exception: At the discretion of the Authority having Jurisdiction, alternative methods of ensuring worker safety may be employed for the following conditions:

1. Minor tool changes and adjustments, and other normal production operations that are routine, repetitive or sequential and integral to the use of the equipment for production;

2. Minor changes to the unit under test and other minor servicing activities, to include the activities listed under (1.), that take place during research and development;

3. Work on cord and plug connected equipment for which exposure to the hazards of unexpected energization or start up is controlled by:
   a. unplugging the equipment from the energy source and
   b. the employee performing the work maintains exclusive control of the plug.

Text Box: Substantiation – New section that will allow for the AHJ to allow for alternative methods for lockout/tagout requirements and application. These are defined in the OSHA standard and just allow for practical application the R&D environment.

Statement of Problem and Substantiation for Public Input

This PI is being submitted by the Article 350 task Group. This new section will allow the AHJ to evaluate and approve alternative to providing a safe working condition in lieu of lockout/tagout for unique research and development applications. These conditions are identified in the 1910 standard and just allow for practical application the R&D environment.

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TITLE OF NEW CONTENT

ARTICLE 360

Safety-Related Work Practices

Alternative Electrical Energy Sources

360.1 Scope. The requirements of this article shall apply to safeguarding employees during activities such as the installation, operation, inspection, servicing, and maintenance of equipment that supplies alternative electrical energy included in the scope of 90.2 and not addressed elsewhere in this standard. Examples of alternative electrical energy systems included in this article are photovoltaic and wind turbines.

Definitions. For the purposes of this article, the following definitions shall apply:

Fail Safe. The design consideration in which failure of a component does not increase the hazard. In the failure mode, the system is rendered inoperative or nonhazardous.

360.3 Safety Training.

(A) Personnel to Be Trained. Employers shall provide training for all operator and maintenance personnel.

(B) Scope of Training. The training shall include, but is not limited to, the following:

1. Familiarization with principles of operation,
2. Electrical safety principles, including the following:
   a. System operating procedures
   b. Hazard control procedures
   c. The need for personnel protection
   d. Accident reporting procedures
3. Electrical and other hazards associated with the equipment, including the following:
   a. High voltages (> 1 kV) and stored energy in capacitor banks
   b. Circuit components, such as inverters
   c. Electric shock
   d. Arc flash

360.4 Employee Responsibility.

Employees shall be responsible for the following:

1. Following safe electrical practices provided by the employer
2. Reporting observed unsafe conditions to the employer.

360.5 Safeguarding of Employees Working with Alternative Electrical Energy Systems.

(A) General. Operation and maintenance of alternative electrical energy systems and equipment shall be performed in an electrically safe work condition described in Chapter 1, unless the employer can provide justification for energized work.

(B) Signs. Permanent signs shall clearly designate electrical hazards.

(C) Electrical Arc Flash Hazard Analysis. The requirements of 130.3, Arc Flash Hazard Analysis, shall apply to alternative electrical energy systems.

1. Arc Flash Hazard Analysis Procedure. Each task performed on alternative electrical energy systems shall be analyzed for the risk of arc flash hazard injury. If there is risk of personal injury, appropriate measures shall be taken to protect persons exposed to the arc flash hazards. These measures shall include one or more of the following:

   (1) Provide appropriate personal protective equipment [see 310.5(D)(2)] to prevent injury from the arc flash hazard.
   (2) Alter work procedures to eliminate the possibility of the arc flash hazard.
   (3) Schedule the task so that work can be performed when the energy source is deenergized.

2. Routine Tasks. Arc flash hazard risk assessment shall be completed for all routine tasks performed on alternative electrical energy systems. The results of the arc flash hazard analysis shall be used in training employees in job procedures that minimize the possibility of arc flash hazards. The training shall be included in the requirements of 360.3.

3. Nonroutine Tasks. Before a nonroutine task is performed on alternative electrical energy systems, an arc flash hazard risk assessment shall be done. If an arc flash hazard is likely during nonroutine work, appropriate instructions shall be given to employees involved on how to minimize the possibility of a hazardous arc flash.

4. Safeguards. Safeguards shall include one or a combination of the following means:

   (1) Insulation. Insulation shall be suitable for the specific conditions, and its components shall be permitted to include: glass, porcelain, epoxy coating, rubber, fiberglass, plastic, and when dry, such materials as concrete, tile, brick, and wood. Insulation shall be permitted to be applied to energized or grounded surfaces.
   (2) Personal Protective Equipment. Personal protective equipment shall provide protection from hazardous electrical conditions. Personal protective equipment shall include one or more of the following as determined by authorized management:

      (i) Grounding equipment
      (ii) Hot sticks
      (iii) Rubber gloves, sleeves, and leather protectors
      (iv) Voltage test indicators
      (v) Blanket and similar insulating equipment
      (vi) Insulating mats and similar insulating equipment
      (vii) Protective barriers
      (viii) Externally circuit breaker rack-out devices
      (ix) Portable lighting units
      (x) Safety grounding equipment
      (xi) Dielectric footwear

| (12) Protective clothing |
| (13) Bypass jumpers |
| (14) Insulated and insulating hand tools |
| (a) Standards for Personal Protective Equipment. Personal and other protective equipment shall be appropriate for conditions, as determined by authorized management, and shall be required to meet the equipment standards in 130.7(C) and in Tables 130.7(C)(14) and 130.7(F). |
| (b) Testing of Personal Protective Equipment. Personal protective equipment shall be verified with regularity and by methods that are consistent with the exposure of employees to hazardous electrical conditions. |

| (3) Barriers. Barriers shall be devices that prevent contact with energized or grounded surfaces that could present a hazardous electrical condition. |
| (4) Voltage Equalization. Voltage equalization shall be permitted by bonding a conductive surface to an electrically energized surface, either directly or through a resistance, so that there is insufficient voltage to create an electrical hazard. |
| (5) Isolation. Isolation shall be the placement of equipment or items in locations such that employees are unable to simultaneously contact exposed conductive surfaces that could present a hazardous electrical condition. |

| (6) Safe Work Practices. Employees shall be trained in safe work practices. Employees shall comply with established safe work practices and the safe use of protective equipment. |
| (a) Attitude Awareness. Safe work practice training shall include attitude awareness instruction. |
| (b) Bypassing of Safety Equipment. Safe work practice training shall include techniques to prevent bypassing the protection of safety equipment. Jewelry and other metal accessories that may bypass protective equipment shall not be worn while working on energized alternative electrical energy systems. |

| (7) Tools. Tools and other devices used on energized alternative electrical energy systems shall be selected to prevent bridging between surfaces at hazardous potential difference. |
| (8) Testing. Equipment safeguards for employee protection shall be tested to ensure they are in a safe working condition. |

### 360.6 Portable Tools and Equipment

Portable tools and equipment shall be inspected for damage before use.

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**Statement of Problem and Substantiation for Public Input**

Currently there are no work practices provided in NFPA 70E for work on the expanding field of alternative energy. The purpose of this public input is to provide an outline and an opportunity to generate discussion regarding the benefit of providing a new article dedicated to safe work practices on alternative energy sources.

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Submittal Date: Mon Jul 06 17:59:41 EDT 2015
350.4 AHJ Structure and Responsibilities.
In R&D Laboratories, an organization (electrical safety committee or board) or official (electrical inspector, engineer, or equivalent qualified individual) may be designated as the electrical Authority Having Jurisdiction (AHJ). The AHJ shall possess such executive ability as is required for performance of the position, and shall have thorough knowledge of standard materials and work practices used in the installation, operation, construction, and maintenance of electrical equipment. The AHJ shall, through experience or education, be knowledgeable of the requirements contained in OSHA standards, the Institute of Electrical and Electronic Engineers' (IEEE) National Electrical Safety Code (NESC) (IEEE/ANSI C-2), NFPA 70, NFPA 70E, and other appropriate local, state, and national standards. The AHJ shall be responsible to interpret codes, regulations and standards, and approve, equipment, assemblies, or materials. If the AHJ needs to address items outside their electrical expertise, such as fire, confined space, fall protection, or like issues, the AHJ should consult with cognizant experts before a decision is reached. The AHJ may permit alternate methods when it is assured that equivalent objectives can be achieved by establishing and maintaining effective safety equal to, or exceeding, established codes, regulations, and standards.

This person may choose to delegate authority to an individual or organization within their control. The authority may reside within a safety or facilities department.

Statement of Problem and Substantiation for Public Input
Substantiation – This is being submitted on behalf of the NFPA 70E task team for article 350. This new section helps build the structure for the AHJ authority. In the R&D laboratory setting, having that authority figure, whether group or individual allows for the researchers to get help in working in areas that are not typical to the general industry. There are significant amounts of work activities and systems that do not practically fit into the general requirements. Having the AHJ and the defined authority significantly helps in applying the intent of NFPA 70E.

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Submittal Date: Mon Jul 06 16:40:57 EDT 2015
Public Input No. 540-NFPA 70E-2015 [ Section No. 350.4 ]

350.

5. Specific Measures and Controls for Personnel

Safety

Each laboratory or R&D system application shall be assigned a competent person and an AHJ - as defined in this article - to ensure the use of appropriate electrical safety-related work practices and controls.

(A) Job Briefings. Job briefings shall be performed as per 110.3(H).

Exception 1: 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.

Exception 2: The task and hazards are documented and the employee has reviewed applicable documentation and is qualified for the task.

(B) Personnel Protection. 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. For calibration and adjustment of equipment as it pertains to sensors, motor controllers, control hardware and other devices that need to be installed inside an equipment or control cabinet, surrounded by hazardous voltages, the AHJ shall define the required PPE based on the risk and exposure. Use of electrical insulating blankets, covers, or barriers should be used when practical to prevent inadvertent contact to exposed terminals and conductors. Insulated/non-conductive adjustment and alignment tools should be used where practical.

Statement of Problem and Substantiation for Public Input

Substantiation – This is being submitted on behalf of the NFPA 70E task team for article 350. Renumbered the section due to previous submission.

The new content makes the application of the job briefing better fit the R&D environment. Many of the research tasks are repetitive and the requirement to complete a job briefing for every job, is not practical. They may perform the same task every day for months. New job briefing each day, does not help to improve safety.

The new content in (B) allows for the AHJ to define the required PPE in unique work situations. This aligns with the new proposed section 350.4.

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Submittal Date: Mon Jul 06 16:46:13 EDT 2015
SAFETY RELATED WORK PRACTICES FOR USE WITH ELECTRIC ARC WELDERS

360.1 Scope. The requirements of this article shall apply to the electrical safety-related work practices used with electric arc welders.

360.2 Definitions. For the purposes of this article, the definitions that follow shall apply.

Electric Arc Welder. An electrical machine made up with either a gas engine, a motor generator, or a transformer, that converts either mechanical or electrical energy into suitable parameters, voltage and amperes, to perform electric arc welding in any form.

Electrode Lead. The electrical conductor used to carry current from the electric welder to the work that is to be welded. One end is usually made up with a connector that mates with a jack in the electric welder and the other end is usually made up with an insulated holder for the electrode used in the welding process.

Work Lead. The electrical conductor used to carry current from the welding work back to the electric welder completing the circuit. This lead’s function has been confused with the Ground Lead by function in the past. “Ground Lead” function is as defined in this section.

Ground Lead. An electrical conductor that connects the welding work with the surrounding electrically conductive elements such as welding tables, building columns, or other electrically conductive metal structural members presumably connected to the building’s earth ground. The Ground Lead’s function is to keep the welding work at ground potential and to prevent any potential difference between the welding work and the surrounding electrically conductive elements. This lead is never connected to the welder and does not carry any welding current. Both ends of this lead have appropriate clamps to effectively attach the welding work to the surrounding electrically conductive elements.

360.3 Application. The purpose of this article is to provide guidance for safety personnel in preparing specific safety related work practices within their industry when personnel use electric welders.

360.4 Specific Measures for Personnel Safety.

(A) Employer Responsibility. The employer shall be responsible for the following:

(1) Train employees who used electric arc welding machines to use three cables to accomplish the welding work.

(a) The Electrode Lead
This first lead is the lead that sends current, or power, from the electric welder to the electrode holder which contains the welding electrode.

(b) The Work Lead
The second lead connected to the electric welder is often designated the “ground” lead. The term in quotes because it is not really a “ground” lead. This term may have become popular because welding personnel typically connect this lead to the building steel, which is usually recognized as “ground” for the building electrical system.

The output of all electric welders is analogous to a separately derived system as defined by the NEC® that means there is no direct connection between the supply and the output of a particular system.

Therefore, the “ground” lead cannot actually be a “ground” lead because it is physically separated from any electrical ground system in the electrical welder by the welder machine’s insulation and physical construction.

This work lead is needed to complete the welding circuit from the electric welder, to the welding work, and back to the electric welder. Therefore, the proper term for this second lead is “work lead.”

This work lead shall be connected to the welding work as close as possible to the location of the electric arc doing the work. Doing this enables the electric welder machine’s current to be confined to the electrode lead, the welding work, and the work lead.

(c) The Ground Lead
The third welding is the Ground Lead. Its function is to keep the welding work at the surrounding ground potential and to prevent any potential difference between the welding work and the surrounding electrically conductive elements.

This lead is never connected to the welder and does not carry any welding current at any time during the welding task.

Both ends of this lead have appropriate clamps to effectively attach the welding work to the surrounding electrically conductive elements.

(2) Train employees to cease using the Work Lead as a Grounding Lead. The Work Lead shall not be used as a Grounding Lead. Using the Work Lead as a Grounding Lead.

(a) Permits welding current to flow from the welding work through all electrically conductive materials throughout the building, back to the welder. This includes, but it is not limited to, conduit, metal pipelines, structural steel, etc.

(b) Permits arcing to occur between the welding work and the metal surface on which the work is placed. There may be a poor electrical connection between the welding work and building steel.

(c) Permits welding current to heat up poor conduit connections attacking the insulation on the wires that are routed in the conduit pass the poor conduit connections.

(d) Permits electrical welding current to flow every possible path it can. That often includes electrical equipment ground conductors (EGC’s) that may be too small to adequately pass large welding currents. When this happens, EGC’s insulation often melts and the conductor may be destroyed. Destruction of an EGC makes the use of the device connected to the EGC unsafe because there is now no return path for any fault current that may occur in the device. A person touching that device while it is energized and a ground fault is present may be hurt, perhaps fatally.

Statement of Problem and Substantiation for Public Input

No other article covers safety work practices for arc welding equipment in any specific manner.

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<table>
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<th><strong>Public Input No. 542-NFPA 70E-2015 [ New Section after 350.5 ]</strong></th>
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<tr>
<td><strong>350.7 Custom Built, Unlisted Research Equipment, &lt;1000 V AC or DC:</strong></td>
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<tr>
<td><strong>(A) Labelling and Documentation</strong></td>
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<tr>
<td>(1) Labeling of equipment shall be required, but not limited to equipment fabricated, designed or developed for research testing and evaluation of electrical systems. Labeling shall sufficiently list all voltages entering and leaving control cabinets, enclosures and equipment. Warning or Danger labels shall be affixed to the exterior describing specific hazards and safety concerns.</td>
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<tr>
<td>(2) Documentation</td>
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<td>Sufficient documentation shall be provided that describes operation, shutdown, safety concerns and non-standard installation anomalies. Schematics and bill of materials describing power feeds, voltages, currents and parts used for construction, maintenance and operation of the equipment shall be provided.</td>
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<tr>
<td>(3) Safety requirements and emergency shutdown procedures of equipment, to include Lock Out Tag Out requirements. If equipment specific LOTO is required, then documentation outlining this procedure and PPE requirements shall be made available.</td>
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<td>(4) Specific hazards, other than electrical, associated with research equipment shall be documented. If existing hazards can be present even in a locked out state, they shall be labeled on the exterior of the equipment enclosure.</td>
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<tr>
<td>(5) Drawings, standard operational procedure and equipment shall be thoroughly inspected and approved by the AHJ on site before initial start up.</td>
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<tr>
<td>Informational Note: Equipment that does not meet the required standards will still be required to be approved by the AHJ. Proper safety shutdown procedures and PPE requirements must be considered in the absence of grounding and/or bonding.</td>
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<tr>
<td><strong>(B) Tools, Training and Maintenance</strong></td>
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<tr>
<td>(1) Documentation shall be provided if special tools, unusual PPE or other equipment is necessary for proper maintenance and operation of equipment.</td>
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<tr>
<td>(2) The AHJ shall make the determination of appropriate training and qualifications required to perform specific tasks.</td>
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**Statement of Problem and Substantiation for Public Input**

Substantiation – This is being submitted on behalf of the NFPA 70E task team for article 350. New section to help define the specific requirements for documenting, labeling, and maintaining custom built equipment that operates at less than 1000 volts. Custom built equipment is assembled often without any direction or safety precautions in mind. This gives general guidance to ensure some level of safe documentation, labeling, and maintenance for the workers.

**Submitter Information Verification**

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Public Input No. 544-NFPA 70E-2015 [ New Section after 350.5 ]

350.8 Custom Built, Unlisted Research Equipment, >1000 V AC or DC.

- Installations need to comply with all requirements of article 350.7, but PPE requirements may deviate substantially.
- In the event that research equipment requires PPE beyond what is commercially available, it shall be required that the AHJ determine safe work practices and PPE to be used.

Statement of Problem and Substantiation for Public Input

Substantiation – This is being submitted on behalf of the NFPA 70E task team for article 350.

New section to help define the specific requirements for documenting, labeling, and maintaining custom built equipment that operates over 1000 volts. Custom built equipment is assembled often without any direction or safety precautions in mind. This gives general guidance to ensure some level of safe documentation, labeling, and maintenance for the workers. Additionally, allows for the AHJ to determine the safe work practices for the higher voltages where no PPE is available. There are many systems that operate well beyond the Class 4 glove level.

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Public Input No. 545-NFPA 70E-2015 [ New Section after 350.5 ]

350.9 Hazardous Energy Thresholds.
Energy levels identified in the following list shall be considered hazardous:

(1) AC Electrical components and circuit parts operating at $\geq 50$-Volts and $\geq 5$ milliamperes.

(2) DC Electrical components and circuit parts operating at $\geq 100$-Volts and $\geq 40$ milliamps.

(3) Capacitive systems:

(4) Operating $\leq 100$-Volts and $\geq 100$ Joules of stored energy

(5) Operating 101 - 400-Volts and $\geq 1$ Joule of stored energy

(6) Operating $> 400$-Volts and $> 40$ Joules of stored energy

Statement of Problem and Substantiation for Public Input

Substantiation – This is being submitted on behalf of the NFPA 70E task team for article 350.

New section to help define the energy levels at which they become hazardous to the health of the worker. The voltage levels are from the shock tables that are already defined in this standard. These energy levels are based on the research and documented in the paper – A COMPLETE ELECTRICAL HAZARD CLASSIFICATION SYSTEM AND ITS APPLICATION – IEEE Paper No. ESW2009-23. This table more clearly defines that these levels are hazardous, and gives a threshold for applying safe work practices above these levels.

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350.  

The equipment or systems used in the R&D area or in the laboratory shall be listed or field evaluated prior to use.

Electrical conductors and equipment installed or used shall be listed, labeled, or acceptable if approved by the AHJ using the following criteria:

1. If it is accepted, certified, listed, labeled, or otherwise determined to be safe by an NRTL recognized pursuant to 29 CFR 1910.7;

2. With respect to an installation or equipment of a kind that no NRTL accepts, certifies, lists, labels, or determines to be safe, if it is inspected or tested by another federal agency, or by a state, municipal, or other local authority responsible for enforcing occupational safety provisions of the NEC, and found in compliance with the its provisions;

3. With respect to custom-made equipment or related installations that are designed, fabricated for, and intended for use by a particular customer, if it is determined to be safe for its intended use by its manufacturer on the basis of test data, and the AHJ approves.

Informational Note 1: Laboratory and R&D equipment or systems can pose unique electrical hazards that might require mitigation. Such hazards include ac and dc, low voltage and high amperage, high voltage and low current, large electromagnetic fields, induced voltages, pulsed power, multiple frequencies, and similar exposures.

Informational Note 2: All electrical equipment, components, and conductors shall be approved for their intended use, which means they are acceptable to the AHJ. There are several methods for determining acceptability to the AHJ, including: listing by a nationally recognized testing laboratory (NRTL), field evaluations by an NRTL, or inspection and approval by the AHJ or designee. Electrical utility generation, transmission, and distribution equipment built to nationally recognized standards is considered acceptable.

Statement of Problem and Substantiation for Public Input

Substantiation – This is being submitted on behalf of the NFPA 70E task team for article 350. Renumbered the section due to previous submission. Renamed the section to more clearly define the additional acceptance options. The new content more clearly defines the NRTL acceptance criteria as explained in the OSHA standard. One of the criteria is to allow for approval by the AHJ. This aligns with OSHA and just explains the options.

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A.3.1. ANSI Publications.
American National Standards Institute, Inc., 25 West 43rd Street, 4th Floor, New York, NY 10036.


A.3.2. ASTM Publications.
ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM D1048, Guide for Testing Metal-Enclosed Switchgear Rated up to 38 kV for Internal Arcing Faults
IEEE C37.20.7, Institute of Electrical and Electronics Engineers, IEEE Operations Center, 445 Hoes Lane, P. O. Box 1331, Piscataway, NJ 08855-1331.

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http://submittals.nfpa.org/TerraViewWeb/ContentFetcher?commentPara...
### Statement of Problem and Substantiation for Public Input

Referenced current SDO standard names, and editions.

### Related Public Inputs for This Document

<table>
<thead>
<tr>
<th>Related Input</th>
<th>Relationship</th>
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<tbody>
<tr>
<td>Public Input No. 46-NFPA 70E-2015 [Section No. B.1]</td>
<td></td>
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<tr>
<td>Public Input No. 47-NFPA 70E-2015 [Global Input]</td>
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</table>

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Public Input No. 331-NFPA 70E-2015 [Section No. A.3.2]

A.3.2  ASTM Publications.

Statement of Problem and Substantiation for Public Input

Update on date of a standard and addition of new standard (proposed for new informational note)

Related Public Inputs for This Document

<table>
<thead>
<tr>
<th>Related Input</th>
<th>Relationship</th>
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<tr>
<td>Public Input No. 330-NFPA 70E-2015 [Definition: Arc Rating.]</td>
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Public Input No. 46-NFPA 70E-2015 [Section No. B.1]

B.1 Referenced Publications.
The following documents or portions thereof are referenced within this standard for informational purposes only and are thus not part of the requirements of this document unless also listed in Informative Annex A.

B.1.1 NFPA Publications.
National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

B.1.2 ANSI Publications.
American National Standards Institute, Inc., 25 West 43rd Street, 4th Floor, New York, NY 10036.
ANSI C84.1, Electric Power Systems and Equipment — Voltage Ratings (60 Hz), 2011.

B.1.3 ASTM Publications.
ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.
ASTM F2413, Standard Specifications for Performance Requirements for Protective (Safety) Toe Cap Footwear, 2011.

B.1.4 British Standards Institute, Occupational Health and Safety Assessment Series (OHSAS) Project Group Publications.
British Standards Institute, American Headquarters, 12110 Sunset Hills Road, Suite 200, Reston VA 20190-5902.

B.1.5 CSA Publications.
Canadian Standards Association, 5060 Spectrum Way, Mississauga, ON L4W 5N6, Canada.

B.1.6 IEC Publications.
International Electrotechnical Commission, 3, rue de Varembe, P.O. Box 131, CH-1211 Geneva 20, Switzerland.
Statement of Problem and Substantiation for Public Input

Referenced current SDO names, addresses, standard names, and editions.

Related Public Inputs for This Document

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<thead>
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<th>Related Input</th>
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Submitter Full Name: Aaron Adamczyk
Public Input No. 180-NFPA 70E-2015 [ Section No. B.1.7 ]

<table>
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<th>IEEE Publications.</th>
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<tr>
<td>Institute of Electrical and Electronic Engineers, IEEE Operations Center, 445 Hoes Lane, P. O. Box 1331, Piscataway, NJ 08855-1331.</td>
<td></td>
</tr>
<tr>
<td>ANSI/IEEE C 37.20.6, Standard for 4.76 kV to 38 kV-Rated Ground and Test Devices Used in Enclosures, 2007.</td>
<td></td>
</tr>
<tr>
<td>IEEE 3001.5 Recommended Practice for the Application of Power Distribution Apparatus in Industrial and Commercial Power Systems</td>
<td></td>
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<tr>
<td>IEEE 3003.1, Recommended Practice for the System Grounding of Industrial and Commercial Power Systems.</td>
<td></td>
</tr>
<tr>
<td>IEEE 3002.3 Recommended Practice for Conducting Short-Circuit Studies of Industrial and Commercial Power Systems</td>
<td></td>
</tr>
</tbody>
</table>

Statement of Problem and Substantiation for Public Input

Replacement of the IEEE Industrial Applications Society color books continues. These 3 documents provide the best engineering guidance for safety-by-design principles. I will make arrangements with Lisa Perry at IEEE (lperry@ieee.org), Carey Cook (Carey.Cook@sandc.com) and Steve Townsend (steven.townsend@gm.com) of the Industrial and Commercial Power Systems Conference to get original copies for the committee to review.

Submitter Information Verification

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Submittal Date: Tue Jun 16 09:14:32 EDT 2015
C.1.2.3
To cross the restricted approach boundary and enter the restricted space, qualified persons should meet the following criteria:

1. **Clause.** As applicable, have an energized electrical work permit authorized by management.
2. Use personal protective equipment (PPE) that is rated for the voltage and energy level involved.
3. Minimize the likelihood of bodily contact with exposed energized conductors and circuit parts from inadvertent movement by keeping as much of the body out of the restricted space as possible and using only protected body parts in the space as necessary to accomplish the work.
4. Use insulated tools and equipment.

*(See Figure C.1.2.3.)*

**Figure C.1.2.3 Limits of Approach.**

---

**Statement of Problem and Substantiation for Public Input**

Document clarity

The current language can be misinterpreted to mean that an energized work permit is always required.

**Submitter Information Verification**

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### Public Input No. 160-NFPA 70E-2015 [Sections D.2, D.3]

**Sections D.2, D.3**

**D.2.1, Basic Equations for Calculating Arc Flash Boundary Distances.**

The short-circuit symmetrical ampacity, \( I_{sc} \), from a bolted three-phase fault at the transformer terminals is calculated with the following formula:

\[
I_{sc} = \left( \frac{\text{MVA Base} \times 10^9}{V} + [1.732 \times V] \right) \times [100 + \%Z]
\]

\[(D.2.1(a))\]

where \( I_{sc} \) is in amperes, \( V \) is in volts, and \( \%Z \) is based on the transformer MVA.

A typical value for the maximum power, \( P \), in MW, in a three-phase arc can be calculated using the following formula:

\[
P = \text{maximum bolted fault, in MVA} \times 0.707^2
\]

\[(D.2.1(b))\]

The arc flash boundary distance is calculated in accordance with the following formulae:

\[
D_c = \left[ \frac{2.65 \times \text{MVA}_{bf} \times t}{\text{MVA}} \right]^{1/3}
\]

\[(D.2.1(c))\]

\[
D_l = \left[ \frac{53 \times \text{MVA} \times t}{\text{MVA}_{bf}} \right]^{1/3}
\]

\[(D.2.1(d))\]

where:

- \( D_c \) = distance in feet of person from arc source for a just curable burn (that is, skin temperature remains less than 80°C).
- \( MVA_{bf} \) = bolted fault MVA at point involved.
- \( MVA \) = MVA rating of transformer. For transformers with MVA ratings below 0.75 MVA, multiply the transformer MVA rating by 1.25.
- \( t \) = time of arc exposure in seconds.

The clearing time for a current-limiting fuse is approximately \( \frac{1}{4} \) cycle or 0.004 second if the arcing fault current is in the fuse's current-limiting range. The clearing time of a 5-kV and 15-kV circuit breaker is approximately 0.1 second or 6 cycles if the instantaneous function is installed and operating. This can be broken down as follows: actual breaker time (approximately 2 cycles), plus relay operating time of approximately 1.74 cycles, plus an additional safety margin of 2 cycles, giving a total time of approximately 6 cycles. Additional time must be added if a time delay function is installed and operating.

The formulas used in this explanation are from Ralph Lee, "The Other Electrical Hazard: Electrical Arc Flash Burns," in *IEEE Trans. Industrial Applications*. The calculations are based on the worst-case arc impedance. (See Table D.2.1.)

**Table D.2.1 Flash Burn Hazard at Various Levels in a Large Petrochemical Plant**

| (1) Bus Nominal Voltage Levels System (MVA) Transformer MVA Rating (% Z) | Short-Circuit Symmetrical (A) Clearing Time of Fault (cycles) | Arc Flash Boundary Typical Distance \(^*\) | 13.8-kV buses 760 9.4 31,300 1.0 184 mm 6.1 ft | 13.8-kV bus 2.5 5.5 44,000 0.0–120.0 7.11–26.6 ft |
|---|---|---|---|---|---|
| 230 kV 9000 1.11 23,000 6.0 15 m 49.2 ft | 43.8 kV/250 9.4 31,300 1.0 1.6 m 5.2 ft | 43.8 kV/500 1.0 5.5 12,000 6.0 1.6 m 5.2 ft | 4.16 kV 5.0 5.5 12,000 6.0 1.6 m 4.6 ft | 4.16 kV fuse 2.5 5.5 14,000 0.0–120.0 7.11–26.6 ft |
| Load side of all 13.8-V fuses 760 9.4 31,300 1.0 184 mm 6.1 ft | 4.16 kV fuse 2.5 5.5 26,000 0.0 1.6 m 4.4 ft | 600-V fuse 1.0 5.5 12,000 6.0 1.6 m 4.4 ft | 600-V fuse 1.0 5.5 12,000 6.0 1.6 m 4.4 ft |

\(^*\) Distance from an open arc to limit skin damage to a curable second degree skin burn (less than 80°C or 176°F) on skin in free air.
D.2.2 Single-Line Diagram of a Typical Petrochemical Complex.

The single-line diagram (see Figure D.2.2) illustrates the complexity of a distribution system in a typical petrochemical plant. Figure D.2.2 Single-Line Diagram of a Typical Petrochemical Complex.

D.2.3 Sample Calculation.

Many of the electrical characteristics of the systems and equipment are provided in Table D.2.1. The sample calculation is made on the 4160-volt bus 4A or 4B. Table D.2.1 calculates the results of calculating the arc flash boundary for each part of the system. For this calculation, based on Table D.2.1, the following results are obtained:

1. Calculation is made on a 4160-volt bus.
2. Transformer MVA (and base MVA) = 10 MVA.
3. Transformer impedance on 10 MVA base = 5.5 percent.
4. Circuit breaker clearing time = 6 cycles.

Using Equation D.2.1(a), calculate the short-circuit current:

\[ I_s = \left( \frac{1,732 \times V}{\text{MVA Base}} \times 10^6 \right) \times \left( \frac{100 + \%Z}{1,732 \times 4160} \right) \times 100 = 25,000 \text{ amperes} \]

Using Equation D.2.1(b), calculate the power in the arc:

\[ P = 1,732 \times 4160 \times 25,000 \times 10^{-6} \times 0.707^2 = 91 \text{ MW} \]

Using Equation D.2.1(d), calculate the second degree burn distance:

\[ D_2 = \left( \frac{2.65 \times \left( 1,732 \times 25,000 \times 4160 \times 10^{-6} \right) \times 0.1}{1,732} \right)^{0.5} = 6.9 \text{ or } 7.00 \text{ ft} \]

Or, using Equation D.2.1(e), calculate the second degree burn distance using an alternative method:

\[ D_2 = \left[ \frac{53 \times 10 \times 0.1}{1,732} \right]^{0.5} = 7.28 \text{ ft} \]
D.2.4. Calculation of Incident Energy Exposure Greater Than 600 V for an Arc Flash Hazard Analysis.

The equation that follows can be used to predict the incident energy produced by a three-phase arc in open air on systems rated above 600 V. The parameters required to make the calculations follow.

(1) The maximum bolted fault, three-phase short-circuit current available at the equipment.

(2) The total protective device clearing time (upstream of the prospective arc location) at the maximum short-circuit current. If the total protective device clearing time is longer than 2 seconds, consider how long a person is likely to remain in the location of the arc flash. It is likely that a person exposed to an arc flash will move away quickly if it is physically possible, and 2 seconds is a reasonable maximum time for calculations. A person in a bucket truck or a person who has crawled into equipment will need more time to move away. Sound engineering judgment must be used in applying the 2-second maximum clearing time, since there could be circumstances where an employee’s egress is inhibited.

(3) The distance from the arc source.

(4) Rated phase-to-phase voltage of the system.

\[
E = \frac{793 \times F \times V \times t_A}{D^2} \quad \text{[D.2.4(4)]}
\]

where:

- \( E \) = incident energy, cal/cm²
- \( F \) = bolted fault short-circuit current, kA
- \( V \) = system phase-to-phase voltage, kV
- \( t_A \) = arc duration, sec
- \( D \) = distance from the arc source, in.


The following equations can be used to predict the incident energy produced by a three-phase arc on systems rated 600 V and below. The results of these equations might not represent the worst case in all situations. It is essential that the equations be used only within the limitations indicated in the definitions of the variables shown under the equations. The equations must be used only under qualified engineering supervision.

Informational Note: Experimental testing continues to be performed to validate existing incident energy calculations and to determine new formulas.

The parameters required to make the calculations follow.

(1) The maximum bolted fault, three-phase short-circuit current available at the equipment and the minimum fault level at which the arc will self-sustain. (Calculations should be made using the maximum value, and then at lowest fault level at which the arc is self-sustaining. For 480-volt systems, the industry accepted minimum level for a sustaining arcing fault is 38 percent of the available bolted fault, three-phase short-circuit current. The highest incident energy exposure could occur at these lower levels where the overcurrent device could take seconds or minutes to open.)

(2) The total protective device clearing time (upstream of the prospective arc location) at the maximum short-circuit current, and at the minimum fault level at which the arc will sustain itself.

(3) The distance of the worker from the prospective arc for the task to be performed.

Typical working distances used for incident energy calculations are as follows:

(1) Low voltage (600 V and below) MCC and panelboards — 455 mm (18 in.)
(2) Low voltage (600 V and below) switchgear — 610 mm (24 in.)
(3) Medium voltage (above 600 V) switchgear — 910 mm (36 in.)

D.3.2. Arc in Open Air.

The estimated incident energy for an arc in open air is as follows:

\[
E_{MA} = 5271 \cdot D_{A}^{-1.969} \cdot F_{A}^{-0.0016F^{2}} \cdot t_{A}^{-0.0076F} \cdot 0.8938 \quad \text{[D.3.2(a)]}
\]

where:

- \( E_{MA} \) = maximum open arc incident energy, cal/cm²
- \( D_{A} \) = distance from arc electrodes, in. (for distances 18 in. and greater)
- \( t_{A} \) = arc duration, sec
- \( F_{A} \) = short-circuit current, kA (for the range of 16 kA to 50 kA)

Sample Calculation: Using Equation D.3.2(a), calculate the maximum open arc incident energy, cal/cm², where \( D_{A} = 18 \text{ in.}, t_{A} = 0.2 \text{ second}, \) and \( F = 20 \text{ kA} \).

\[
E_{MA} = 5271 \cdot D_{A}^{-1.969} \cdot F_{A}^{-0.0016F^{2}} \cdot t_{A}^{-0.0076F} \cdot 0.8938
\]

\[
= 5271 \cdot 0.0035 \cdot 0.2 \cdot 0.0016 \cdot 0.0076 \cdot 0.8938
\]

\[
= 21.33 \text{ cal/cm}² (5.098 \text{ cal/cm}²)
\]
D.3.3  Arc in a Cubic Box.

The estimated incident energy for an arc in a cubic box (20 in. on each side, open on one end) is given in the equation that follows. This equation is applicable to arc
flashes emanating from within switchgear, motor control centers, or other electrical equipment enclosures.

\[
E_{MB} = 1038.7 D_B^{-1.478} t_A \left[ \frac{0.0093 F^2 - 0.3453 F}{5.9675} \right] \quad [D.3.3(a)]
\]

where:
- \(E_{MB}\) = maximum 20 in. cubic box incident energy, cal/cm\(^2\)
- \(D_B\) = distance from arc electrodes, in. (for distances 18 in. and greater)
- \(t_A\) = arc duration, sec
- \(F\) = short-circuit current, kA (for the range of 16 kA to 50 kA)

Sample Calculation: Using Equation D.3.3(a), calculate the maximum 20 in. cubic box incident energy, cal/cm\(^2\), using the following:

1. \(D_B = 18\) in.
2. \(t_A = 0.2\) sec
3. \(F = 20\) kA

\[
E_{MB} = 1038.7 D_B^{-1.478} t_A \left[ \frac{0.0093 F^2 - 0.3453 F}{5.9675} \right] \\
= 1038 \times 0.0141 \times 0.2 \left[ \frac{0.0093 \times 400 - 0.3453 \times 20}{5.9675} \right] \\
= 2.928 \times [2.7815] \\
= 34.1 \text{J/cm}^2 (8.144 \text{cal/cm}^2) \quad [D.3.3(b)]
\]

D.3.4  Reference.

The equations for this section were derived in the IEEE paper by R. L. Doughty, T. E. Neal, and H. L. Floyd, II, “Predicting Incident Energy to Better Manage the Electric
Arc Hazard on 600 V Power Distribution Systems.”

Statement of Problem and Substantiation for Public Input

At present, the most widely-accepted, conventional methods for determining the incident energy which may be potentially released during an arcing fault in commercial and
industrial power systems are those presented in IEEE 1584. The Ralph Lee method is theoretical. The Doughty, et al. method is based on limited 600-V testing. The 1584 data
set incorporated the Doughty test results. These methods are more outdated than the current 1584 standard, and should not be recommended.

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Submittal Date: Wed Jun 03 15:15:42 EDT 2015
Public Input No. 400-NFPA 70E-2015 [ Section No. D.4.1 [Excluding any Sub-Sections] ]

This section provides excerpts from IEEE 1584-2002, IEEE Guide for Performing Arc Flash Hazard Calculations, for estimating incident energy and arc flash boundaries based on statistical analysis and curve fitting of available test data. An IEEE working group produced the data from tests it performed to produce models of incident energy.

The complete data, including a spreadsheet calculator to solve the equations, can be found in the IEEE 1584-2002, IEEE Guide for Performing Arc Flash Hazard Calculations. This 2002 version is being revised and updated based on the new extensive testing performed by an IEEE/NFPA Collaborative project. Users are encouraged to consult the latest version of the complete document to understand the basis, limitation, rationale, and other pertinent information for proper application of the latest version of the standard. It can be ordered from the Institute of Electrical and Electronics Engineers, Inc., 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331.

Statement of Problem and Substantiation for Public Input

Excerpts included in 70E are based on IEEE 1584-2002. This edition is being revised by an IEEE Working Group. A statement has been added to inform users to use the latest version of the IEEE document when it is issued to avoid a conflict between the information contained in 70E and new IEEE 1584 document.

Submitter Information Verification

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Submittal Date: Sat Jul 04 12:52:11 EDT 2015
### D.5  Direct Current Incident Energy Calculations Calculation Method

#### D.5.1  Maximum Power Method.

The following method of estimating dc arc flash incident energy that follows was published in the *IEEE Transactions on Industry Applications* (see reference 2, which follows). This method is based on the concept that the maximum power possible in a dc arc will occur when the arcing voltage is one-half the system voltage. Testing completed for Bruce Power (see reference 3, which follows) has shown that this calculation is conservatively high in estimating the arc flash value. This method applies to dc systems rated up to 1000 V.

\[
I_{arc} = 0.5 \times I_{bf}
\]

\[
IE_{m} = 0.01 \times V_{sys} \times I_{arc} \times T_{arc} / D^2
\]

where:
- \(I_{arc}\) = arcing current amperes
- \(I_{bf}\) = system bolted fault current amperes
- \(IE_{m}\) = estimated dc arc flash incident energy at the maximum power point cal/cm²
- \(V_{sys}\) = system voltage volts
- \(T_{arc}\) = arcing time sec
- \(D\) = working distance cm

For exposures where the arc is in a box or enclosure, it would be prudent to use a multiplying factor of 3 for the resulting incident energy value.

#### D.5.2  Detailed Arcing Current and Energy Calculations Method.

A thorough theoretical review of dc arcing current and energy was published in the *IEEE Transactions on Industry Applications*. Readers are advised to refer to that paper (see reference 1) for those detailed calculations.

**References:**

#### D.5.3  Short Circuit Current.

The determination of short circuit current is necessary in order to use Table 130.7(C)(15)(B). The arcing current is calculated at 50 percent of the dc short-circuit value. The current that a battery will deliver depends on the total impedance of the short-circuit path. A conservative approach in determining the short-circuit current that the battery will deliver at 25°C is to assume that the maximum available short-circuit current is 10 times the 1 minute ampere rating (to 1.75 volts per cell at 25°C and the specific gravity of 1.215) of the battery. A more accurate value for the short-circuit current for the specific application can be obtained from the battery manufacturer.

**References:**

---

**Statement of Problem and Substantiation for Public Input**

This revision further recognized the source of the information and makes the title of D.5 consistent with the existing titles of D.2, D.3 and D.4.

**Submitter Information Verification**

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- **Zip:**
- **Submittal Date:** Mon Jun 22 18:16:32 EDT 2015
E.2 Typical Electrical Safety Program Controls.

Electrical safety program controls can include, but are not limited to, the following:

1. The employer develops programs, including training, and the employees apply them.
2. Employees are to be trained to be qualified for working in an environment influenced by the presence of electrical energy.
3. Procedures are to be used to identify the electrical hazards and to develop plans to eliminate those hazards or to control the associated risk for those hazards that cannot be eliminated.
4. Every electrical conductor or circuit part is considered energized until proved otherwise.
5. De-energizing an electrical conductor or circuit part and making it safe to work on is, in itself, a potentially hazardous task.
6. Tasks to be performed on or near, within the limited approach boundary of, exposed energized electrical conductors and circuit parts are to be identified and categorized.
7. Precautions appropriate to the working environment are to be determined and taken.
8. A logical approach is to be used to determine the associated risk of each task.

Statement of Problem and Substantiation for Public Input

Revised for consistency: the phrase "on or near" was replaced by "within the limited approach boundary" throughout the document in the 2009 edition as a result of work by the Words and Phrases Task Group.

The Task Group used the following principles when deciding whether or not to use "exposed" with "energized":
1. Required when referring to shock hazards in general;
2. Not required when "exposed" is inferred (i.e. preceded by qualifier "within the limited approach boundary of...");
3. Not required when referring to all electrical hazards or arc flash hazards.

This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the term "exposed" with the term "energized."

Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
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Affiliation: This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the term "exposed" with the term "energized."
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Submittal Date: Fri Jun 26 15:11:05 EDT 2015
Public Input No. 300-NFPA 70E-2015 [Section No. E.2]

E.2 Typical Electrical Safety Program Controls.

Electrical safety program controls can include, but are not limited to, the following:

(1) The employer develops programs and procedures, including training, and the employees apply them.

(2) Employees are to be trained to be qualified for working in an environment influenced by the presence of electrical energy.

(3) Procedures are to be used to identify the electrical hazards and to develop plans to eliminate those hazards or to control the associated risk for those hazards that cannot be eliminated.

(4) Every electrical conductor or circuit part is considered energized until proved otherwise.

(5) De-energizing an electrical conductor or circuit part and making it safe to work on is, in itself, a potentially hazardous task.

(6) Tasks to be performed on or near exposed energized electrical conductors and circuit parts are to be identified and categorized.

(7) Precautions appropriate to the working environment are to be determined and taken.

(8) A logical approach is to be used to determine the associated risk of each task.

Statement of Problem and Substantiation for Public Input

The phrase “and procedures” was added to correlate to the requirements in 120. An employer is required to develop both a lockout/tagout program and procedures.

This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the terms “procedure,” “practice,” “program” and “process.”

The Task Group recommendations regarding the use of the terms “practice,” “procedure,” “process” or “program” are based on:

1. The context in which the term was used;
2. The definitions of each term as found in the Merriam-Webster on-line dictionary:
   - Practice: to do something customarily (e.g. “work practice”)
   - Procedure: a series of steps followed in a regular definite order (e.g. “lockout/tagout procedure”)
   - Process: a series of actions or operations conducing to an end (e.g. “Risk Assessment – An overall process that...”)
   - Program: a plan or system under which action may be taken toward a goal (e.g. “electrical safety program”)

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Submittal Date: Mon Jun 29 11:14:37 EDT 2015
Annex F – Risk Assessment and Risk Control (Outline)

Risk Assessment

Overview of terminology and risk assessment principles

Relationship to OHSMS

Iterative nature of the management system

Where & how it fits into risk assessment

Risk Control

Hierarchy of risk control

Electrical safety examples

Risk Assessment at the Organizational Level

Purpose and methodology

Examples

Risk Assessment at the Field Level

Purpose and methodology

Examples
Annex F – Risk Assessment and Risk Control

F.1 Introduction to Risk Management

Risk management is the logical, systematic process used to manage the risk associated with any activity, process, function, or product including safety, the environment, quality, and finance. The risk management process and principles can be used by organizations of any type or size.

The following risk management principles can readily be applied to electrical safety. Risk management:

- Is an integral part of all organizational processes and decision making
- Is systematic, structured, and timely
- Is based on the best available information
- Takes human and cultural factors into account
- Is dynamic, iterative, and responsive to change
- Facilitates continual improvement of the organization

Informational Note: For more information on risk management principles see ISO 31000:2009 Risk Management – Principles and Guidelines.

The risk management process includes:

- Communication and consultation
- Establishing the risk assessment context and objectives
- Risk assessment
- Risk treatment
- Recording and reporting the risk assessment results and risk treatment decisions
- Monitoring and reviewing risks

Risk assessment is the part of risk management that involves:

- Identifying sources of risk;
- Analysing the sources of risk to estimate a level of risk; and
- Evaluating the level of risk to determine if risk treatment is required.

See Figure F.1 Risk Assessment Process

Figure F.1 Risk Management Process – Adapted from ISO 31000 figure 3
F.1.1 Occupational Health and Safety (OHS) Risk Management

The same logical, systematic process and the same principles apply to risk management in the OHS sphere of activity. However, it is more focussed and the terminology more narrowly defined:

- The OHS objective is freedom from harm (i.e. injury or damage to health)
- Sources of risk are referred to as hazards
- Analyzing and estimating The level of risk is a combination of the estimation of the likelihood of the occurrence of harm and the severity of that harm
- The level of risk is evaluated to determine if it is reasonable to conclude that freedom from harm can be achieved or if further risk treatment is required
- Risk treatment is referred to as risk control

Therefore, OHS risk assessment involves:

- Hazard identification: Find, list and characterize hazards.
- Risk analysis: Sources, causes and potential consequences are analyzed to determine:
  - The likelihood that harm might result;
  - The potential severity of that harm; and
  - Estimate the level of risk
- Risk evaluation: The level of risk is evaluated to determine if the objective of freedom from harm can reasonably be met by the risk control that is in place or is further risk control required?

F.2 Relationship to Occupational Health and Safety Management System (OHSMS)

As discussed in Annex P, the most effective application of the requirements of this standard can be achieved within the framework of an OHSMS. Using a management system provides a businesslike approach to health and safety by means of goal setting, planning, and performance measurement.

Risk management shares the six management system process elements of:

1. Leadership. If any venture is to succeed it needs to be sponsored at the highest levels of the organization.
2. Policy. The organization should articulate their vision and establish relevant, attainable goals.
3. Plan. A plan is developed in line with the organization’s vision and to achieve their goals. The plan must include mechanisms to measure and monitor the success of the plan.
4. Do. The plan is executed.
5. Check (Monitor). The success of the plan in achieving the organization’s goals is continuously monitored.
6. Act (Review). The measuring and monitoring results are compared to the organization’s goals for the purposes of reviewing and revising goals and plans to improve performance.

As noted in F.1, risk management is iterative. The repeating nature of the management system plan-do-check-act (PDCA) cycle is intended to promote continuous improvement in health and safety performance.

Risk assessment fits into the “plan” and “do” stages of the PDCA cycle:

- Planning – Information used during the planning stage comes from sources that can include workplace inspections; incident reports and risk assessments.
- Do – Risk assessment is an ongoing activity.

F.3 Hierarchy of Risk Control

The purpose of specifying and adhering to a hierarchy of risk control methods is to identify the most effective individual or combination of preventive or protective measures to reduce the risk associated with
a hazard. Each risk control method is considered less effective than the one before it. Table F.3 lists the hierarchy of risk control identified in this and other safety standards and provides examples of each.

**Table F.3 The hierarchy of risk control methods**

<table>
<thead>
<tr>
<th>Risk control method</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Elimination</td>
<td>Conductors and circuit parts in an electrically safe working condition</td>
</tr>
<tr>
<td>(2) Substitution</td>
<td>Reduce energy by replacing 120 V control circuitry with 24 Vac or Vdc control circuitry</td>
</tr>
<tr>
<td>(3) Engineering controls</td>
<td>Guard energized electrical conductors and circuit parts to reduce the likelihood of electrical contact or arcing faults</td>
</tr>
<tr>
<td>(4) Awareness</td>
<td>Signs alerting of the potential presence of hazards</td>
</tr>
<tr>
<td>(5) Administrative controls</td>
<td>Procedures and job planning tools</td>
</tr>
<tr>
<td>(6) PPE</td>
<td>Shock and arc flash PPE</td>
</tr>
</tbody>
</table>

**F.4 Hazard Based Risk Assessment**

In a hazard-based risk assessment workplace hazards are identified and characterized for materials, processes, the worksite and the environment. Activities that might be affected by those hazards are identified. The risk associated with each activity is analyzed for likelihood of harm and severity of harm. An organization uses this information to prioritize risk reduction decisions.

The information from hazard-based risk assessments is useful to organization when designing, specifying and purchasing electrical distribution equipment. Risk control is much more effective when it is applied at the beginning of the equipment or process lifecycle. Risk can be reduced by specifying ‘substitution’ and ‘engineering’ risk control methods that affect the likelihood of occurrence of harm or severity of harm.

**F.5 Task Based Risk Assessment**

In a task-based risk assessment a job is broken down into discrete tasks. Hazards are identified for each task (often referred to as task-hazard pairs). The risk associated with each hazard is analyzed and evaluated.

The task-based risk assessment is the most commonly used when performing a field level risk assessment.

**F.6 Risk Assessment Methods**

There are many risk assessment methods. The method or combination of methods should be chosen based on:

- The application
- The desired result
- The skill level of the persons performing the assessment

Some risk assessment methods include:

- Brainstorming. An open group discussion regarding hazards, the associated risk and risk control methods can be used as part of pre-job planning and during a job briefing session.
- Check-lists. A list of common hazards and possible control methods is a useful tool for pre-job planning and for job briefing purposes. See Annex I for an example of a job briefing and planning checklist.
Risk assessment matrix. A risk assessment matrix is commonly used to quantify levels of risk. The matrix can be in a multilevel or a simple two-by-two format. See figure F.6 for an example of a risk assessment matrix.

**Figure F.6 Example of a Qualitative Two-By-Two Risk Assessment Matrix**

<table>
<thead>
<tr>
<th>Likelihood of Occurrence of Harm</th>
<th>Severity of Harm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Energy ≤ [Selected Threshold]</td>
</tr>
<tr>
<td>Improbable</td>
<td>Low</td>
</tr>
<tr>
<td>Possible</td>
<td>Low</td>
</tr>
</tbody>
</table>

**Legend**

<table>
<thead>
<tr>
<th>Likelihood of Occurrence of Harm</th>
<th>Severity of Harm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improbable: Source of harm adequately guarded such that contact with source is improbable</td>
<td>Energy ≤ [Selected Threshold]: Level of hazardous energy insufficient to cause harm</td>
</tr>
<tr>
<td>Possible: Source of harm inadequately guarded such that contact with source is possible</td>
<td>Energy &gt; [Selected Threshold]: Level of hazardous energy sufficient to cause harm</td>
</tr>
</tbody>
</table>

**Risk evaluation**

Identify the risk controls in place and evaluate the effectiveness of the controls. Prioritize actions taken to control risk based on the level of risk as follows:

- Low: Risk Acceptable – Further risk control discretionary
- High: Risk Unacceptable – Further risk control required before proceeding

Public Input No. 301-NFPA 70E-2015 [Annex G]

Informative Annex G Sample Lockout/Tagout Procedure Program

This informative annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

Lockout is the preferred method of controlling personnel exposure to electrical energy hazards. Tagout is an alternative method that is available to employers. The sample program and procedures that follow are provided to assist employers in developing a procedure that meets the requirements of NFPA 70E. The sample program and procedures can be used for a simple lockout/tagout, or as part of a complex lockout/tagout. A more comprehensive plan procedure will need to be developed, documented, and used for the complex lockout/tagout.

**LOCKOUT/TAGOUT PROCEDURE PROGRAM**

FOR [COMPANY NAME]

OR

TAGOUT PROCEDURE PROGRAM FOR [COMPANY NAME]

1.0 Purpose.

This procedure establishes the minimum requirements for lockout/tagout of electrical energy sources. It is to be used to ensure that conductors and circuit parts are disconnected from sources of electrical energy, locked (tagged), and tested before work begins where employees could be exposed to dangerous conditions. Sources of stored energy, such as capacitors or springs, shall be relieved of their energy, and a mechanism shall be engaged to prevent the reaccumulation of energy.

2.0 Responsibility.

All employees shall be instructed in the safety significance of the employer’s lockout/tagout procedure. All new or transferred employees and all other persons whose work operations are or might be in the area shall be instructed in the purpose and use of the employer’s lockout/tagout procedures. The employees shall be notified that a lockout/tagout system is going to be implemented and the reason for it. The qualified employee implementing the lockout/tagout procedure shall ensure that appropriate personnel receive instructions on their roles and responsibilities. All persons installing a lockout/tagout device shall sign their names and the date on the tag [or state how the name of the individual or person in charge will be available].

3.0 Preparation for Lockout/Tagout.

3.1 Review current diagrammatic drawings (or their equivalent), tags, labels, and signs to identify and locate all disconnecting means to determine that power is interrupted by a physical break and not de-energized by a circuit interlock. Make a list of disconnecting means to be locked (tagged).

3.2 Review disconnecting means to determine adequacy of their interrupting ability. Determine if it will be possible to verify a visible open point, or if other precautions will be necessary.

3.3 Review other work activity to identify where and how other personnel might be exposed to electrical hazards. Review other energy sources in the physical area to determine employee exposure to those sources of other types of energy. Establish energy control methods for control of other hazardous energy sources in the area.

3.4 Provide an adequately rated test instrument to test each phase conductor or circuit part to verify that they are de-energized (see Section 11.3). Provide a method to determine that the test instrument is operating satisfactorily.

3.5 Where the possibility of induced voltages or stored electrical energy exists, call for grounding the phase conductors or circuit parts before touching them. Where it could be reasonably anticipated that contact with other exposed energized conductors or circuit parts is possible, call for applying ground connecting devices.

4.0 Simple Lockout/Tagout.

The simple lockout/tagout procedure will involve 1.0 through 3.0, 5.0 through 9.0, and 11.0 through 13.0.

5.0 Sequence of Lockout/Tagout System Procedures.

5.1 The employees shall be notified that a lockout/tagout system is going to be implemented and the reason for it. The qualified employee implementing the lockout/tagout shall know the disconnecting means location for all sources of electrical energy and the location of all sources of stored energy. The qualified person shall be knowledgeable of hazards associated with electrical energy.

5.2 If the electrical supply is energized, the qualified person shall de-energize and disconnect the electric supply and relieve all stored energy.

5.3 Wherever possible, the blades of disconnecting devices should be visually verified to be fully opened, or draw-out type circuit breakers should be verified to be completely withdrawn to the fully disconnected position.

5.4 Lockout/tagout all disconnecting means with lockout/tagout devices.

Informational Note: For tagout, one additional safety measure must be employed, such as opening, blocking, or removing an additional circuit element.

5.5 Attempt to operate the disconnecting means to determine that operation is prohibited.

5.6 A test instrument shall be used. (See 11.3.) Inspect the instrument for visible damage. Do not proceed if there is an indication of damage to the instrument until an undamaged device is available.

5.7 Verify proper instrument operation and then test for absence of voltage.

5.8 Verify proper instrument operation after testing for absence of voltage.

5.9 Where required, install a grounding equipment/conductor device on the phase conductors or circuit parts, to eliminate induced voltage or stored energy, before touching them. Where it has been determined that contact with other exposed energized conductors or circuit parts is possible, apply ground connecting devices rated for the available fault duty.

5.10 The equipment, electrical source, or both are now locked out (tagged out).

6.0 Restoring the Equipment, Electrical Supply, or Both to Normal Condition.

6.1 After the job or task is complete, visually verify that the job or task is complete.

6.2 Remove all tools, equipment, and unused materials and perform appropriate housekeeping.

6.3 Remove all grounding equipment/conductors/devices.
6.4 Notify all personnel involved with the job or task that the lockout/tagout is complete, that the electrical supply is being restored, and that they are to remain clear of the equipment and electrical supply.

6.5 Perform any quality control tests or checks on the repaired or replaced equipment, electrical supply, or both.

6.6 Remove lockout/tagout devices. The person who installed the devices is to remove them.

6.7 Notify the owner of the equipment, electrical supply, or both, that the equipment, electrical supply, or both are ready to be returned to normal operation.

6.8 Return the disconnecting means to their normal condition.

7.0 Procedure Involving More Than One Person.
For a simple lockout/tagout and where more than one person is involved in the job or task, each person shall install his or her own personal lockout/tagout device.

8.0 Procedure Involving More Than One Shift.
When the lockout/tagout extends for more than one day, it shall be verified that the lockout/tagout is still in place at the beginning of the next day. When the lockout/tagout is continued on successive shifts, the lockout/tagout is considered to be a complex lockout/tagout.

For a complex lockout/tagout, the person in charge shall identify the method for transfer of the lockout/tagout and of communication with all employees.

9.0 Complex Lockout/Tagout.
A complex lockout/tagout plan is required where one or more of the following exist:

1. Multiple energy sources (more than one)
2. Multiple crews
3. Multiple crafts
4. Multiple locations
5. Multiple employers
6. Unique disconnecting means
7. Complex or particular switching sequences
8. Lockout/tagout for more than one shift; that is, new shift workers

9.1 All complex lockout/tagout procedures shall require a written plan of execution. The plan shall include the requirements in 1.0 through 3.0, 5.0, 6.0, and 8.0 through 12.0.

9.2 A person in charge shall be involved with a complex lockout/tagout procedure. The person in charge shall be at the procedure location.

9.3 The person in charge shall develop a written plan of execution and communicate that plan to all persons engaged in the job or task. The person in charge shall be held accountable for safe execution of the complex lockout/tagout plan. The complex lockout/tagout plan must address all the concerns of employees who might be exposed, and they must understand how electrical energy is controlled. The person in charge shall ensure that each person understands the electrical hazards to which they are exposed and the safety-related work practices they are to use.

9.4 All complex lockout/tagout plans identify the method to account for all persons who might be exposed to electrical hazards in the course of the lockout/tagout. One of the following methods is to be used:

1. Each individual shall install his or her own personal lockout or tagout device.
2. The person in charge shall lock his/her key in a lock box.
3. The person in charge shall maintain a sign-in/sign-out log for all personnel entering the area.
4. Another equally effective methodology shall be used.

9.5 The person in charge can install locks/tags or direct their installation on behalf of other employees.

9.6 The person in charge can remove locks/tags or direct their removal on behalf of other employees, only after all personnel are accounted for and ensured to be clear of potential electrical hazards.

9.7 Where the complex lockout/tagout is continued on successive shifts, the person in charge shall identify the method for transfer of the lockout and the method of communication with all employees.

10.0 Discipline.

10.1 Knowingly violating the requirements of this procedure program will result in [state disciplinary actions that will be taken].

10.2 Knowingly operating a disconnecting means with an installed lockout device (tagout device) will result in [state disciplinary actions to be taken].

11.0 Equipment.

11.1 Locks shall be [state type and model of selected locks].

11.2 Tags shall be [state type and model to be used].

11.3 The test instrument(s) to be used shall be [state type and model].

12.0 Review.
This procedure program was last reviewed on [date] and is scheduled to be reviewed again on [date] (not more than 1 year from the last review).
### 13.0 Lockout/Tagout Training.
Recommended training can include, but is not limited to, the following:

1. Recognition of lockout/tagout devices
2. Installation of lockout/tagout devices
3. Duty of employer in writing procedures
4. Duty of employee in executing procedures
5. Duty of person in charge
6. Authorized and unauthorized removal of locks/tags
7. Enforcement of execution of lockout/tagout procedures
8. Simple lockout/tagout
9. Complex lockout/tagout
10. Use of single-line and diagrammatic drawings to identify sources of energy
11. Alerting techniques
12. Release of stored energy
13. Personnel accounting methods
14. Temporary protective grounding equipment needs and requirements
15. Safe use of test instruments

### Statement of Problem and Substantiation for Public Input
Annex G is more than a procedure: it contains two separate procedures (simple and complex lockout/tagout) and various administrative requirements. Accordingly, the term "procedure" was revised to "program" throughout Annex G whenever the context indicated that it was the overall program that was being referred to vs. a specific procedure.

In G.2 the word "employer’s" was added to the phrase "lockout/tagout procedures" for clarity.
In G.10.1, in addition to revising "procedure" to "program" as explained above, the phrase "the requirements of" was added for clarity.
In G.12.0 the term "procedure" was revised to "program" as explained above.

The Task Group recommendations regarding the use of the terms “practice,” “procedure,” “process” or “program” are based on:

1. The context in which the term was used;
2. The definitions of each term as found in the Merriam-Webster on-line dictionary:
   - Practice: to do something customarily (e.g. “work practice”)
   - Procedure: a series of steps followed in a regular definite order (e.g. “lockout/tagout procedure”)
   - Process: a series of actions or operations conducing to an end (e.g. “Risk Assessment – An overall process that...”
   - Program: a plan or system under which action may be taken toward a goal (e.g. “electrical safety program”)

### Submitter Information Verification
**Submitter Full Name:** DANIEL ROBERTS  
**Organization:** SCHNEIDER ELECTRIC  
**Affiliation:** This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the terms “procedure,” “practice,” “program” and “process.”  
**Street Address:**  
**City:**  
**State:**  
**Zip:**  
**Submittal Date:** Mon Jun 29 11:17:50 EDT 2015
Sections G.5.7, G.5.8

5.7 Verify proper instrument operation on a known source of voltage and then test for absence of voltage.

5.8 Verify proper instrument operation on a known source of voltage, after testing for absence of voltage.

Statement of Problem and Substantiation for Public Input

known source of voltage" is added to be consistent with other text of the standard.

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Organization: OLIN CORPORATION
Affiliation: Self
Street Address: 
City: 
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Zip: 
Submittal Date: Mon Jun 22 18:19:17 EDT 2015
### Public Input No. 447-NFPA 70E-2015 [ New Section after H.3 ]

**H.4 Conformity Assessment of Personal Protective Equipment (PPE)**

**H.4.1 Article 130.7(C)(17)** requires that all PPE referenced in Table 130.7(C)(14) not only comply with the appropriate referenced performance standard, but also undergo conformity assessment in accordance with ANSI/ISEA 125, American National Standard for Conformity Assessment of Safety and Personal Protective Equipment. ANSI/ISEA 125 establishes criteria for conformity assessment of safety and personal protective equipment which is sold with claims of compliance with product performance standards. ANSI/ISEA 125 contains provisions for data collection; product verification; conformation of quality and manufacturing production control; and roles and responsibilities of suppliers, testing organizations, and third party certification organizations.

**H.4.2 ANSI/ISEA 125 provides for 3 different levels of conformity assessment: Level 1, Level 2, and Level 3. Article 130.7(C)(17)(2) allows for the manufacturer or supplier to choose any of the 3 levels of conformity assessment.**

- **Level 1 conformity** is where the supplier or manufacturer is making a self-declaration that a product meets all of the requirements of the standard(s) to which the product is marked with the CO’s mark or label.

- **Level 2 conformity** is where the supplier or manufacturer is making a self-declaration that a product meets all of the requirements of the standard(s) to which conformity is claimed. A supplier Declaration of Conformity for each product is required to be made available for examination upon request.

- **Level 3 conformity** is where the products are certified by an ISO 17025 accredited independent third party certification organization (CO). All product testing is directed by the CO, and all changes to the product must be reviewed and retested if necessary. Compliant products are issued a Declaration of Conformity by the CO and products are marked with the CO’s mark or label.

**H.4.3 While there are three levels of conformity assessment described ANSI/ISEA 125, the levels are not to be considered as equivalent. Article 130.7(C)(17) does not assign a level of conformity assessment to any particular product. Users are cautioned that the level of rigor required to demonstrate conformity should be based on the potential safety and health consequence of using a product that does not meet a stated performance standard. A higher potential safety and health consequence associated with the use of a non-compliant product should necessitate a higher level of conformity assessment.**

- **H.4.4 It should be noted that the individual PPE standards referenced in Table 130.7(C)(14) may contain requirements for conformity assessment. Article 130.7(C)(17) should not be construed as allowing a lesser level of conformity than is required by the PPE end product standard.**

- **H.4.5 ANSI/ISEA contains detailed information and guidance on the application of the different conformity assessment levels. Copies of ANSI/ISEA 125 are available free of charge by e-mailing the International Safety Equipment Association at: ISEA@Safetyequipment.org and requesting a complimentary copy.**

### Statement of Problem and Substantiation for Public Input

A task group was formed at the request of the NFPA 70E subcommittee to review third party clothing certification. The task group consisted of Larry Ayer chair, Jim Dollard co-chair, Ron Widup, Rod West, Steve Corrado, Mark McNellis, and Mike Doherty.

NFPA 70E currently references performance standards for items of personal protective equipment (PPE). Conformance to these standards is intended to provide the user with appropriate PPE to ensure that any residual risk associated with their duties remains at the desired level. The proposed language will add a system of conformity assessment that can add substance or credibility to claims that the specified requirements are fulfilled, giving the users greater confidence in such claims.

Under the proposed language, the level of conformity assessment for any particular piece of PPE is determined by the manufacturer or can be mandated by the purchaser. ANSI/ISEA 125 is referenced as the standard for the conformity assessment methodology and allows for three levels of conformity assessment ranging from supplier self-declaration to independent third party certification. ANSI/ISEA 125 also requires that a Supplier Declaration of Conformity be supplied to users and purchasers upon request. This gives the users a clear indication of the conformance of the products, and documents the manufacturers or sellers chosen level of conformity assessment.

Due to the level of conformity assessment being left to the discretion of the manufacturer, proposed language requires that the conforming PPE be marked with the level of conformity per ANSI/ISEA 125. This will clarify to the purchasers as to what level of conformity assessment the product has been subjected to.

Additionally, language is proposed to allow for a label to show conformance with NFPA 70E. There are currently in the marketplace numerous claims of compliance to NFPA 70E – but no direction in NFPA 70E as to what this actually entails.

Explanatory language for Annex H is also being proposed to give the users of NFPA 70E guidance and background information.

### Submitter Information Verification

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**Submittal Date:** Mon Jul 06 10:35:14 EDT 2015
Table H.3(a) provides a summary of specific sections within the NFPA 70E standard describing PPE for electrical hazards. Table H.3(b) provides guidance on the selection of arc-rated and other PPE for users who determine the incident energy exposure (in cal/cm²).

<table>
<thead>
<tr>
<th>Shock Hazard PPE</th>
<th>Applicable Section(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rubber insulating gloves and leather protectors (unless the requirements of ASTM F 496 are met)</td>
<td>130.7(C)(7)(a)</td>
</tr>
<tr>
<td>Rubber insulating sleeves (as needed)</td>
<td>130.7(C)(7)(a)</td>
</tr>
<tr>
<td>Class G or E hard hat (as needed)</td>
<td>130.7(C)(3)</td>
</tr>
<tr>
<td>Safety glasses or goggles (as needed)</td>
<td>130.7(C)(4)</td>
</tr>
<tr>
<td>Dielectric overshoes (as needed)</td>
<td>130.7(C)(8)</td>
</tr>
</tbody>
</table>

**Arc Flash Hazard PPE**

Incident energy exposures up to 1.2 cal/cm²

<table>
<thead>
<tr>
<th>Protective clothing and PPE</th>
<th>Applicable Section(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clothing: nonmelting or untreated natural fiber long-sleeve shirt and long pants or coverall</td>
<td>130.7(C)(1); 130.7(C)(9)(d)</td>
</tr>
<tr>
<td>Gloves: heavy-duty leather</td>
<td>130.7(C)(7)(b), 130.7(C)(9)(d)</td>
</tr>
<tr>
<td>Hard hat: class G or E</td>
<td>130.7(C)(3)</td>
</tr>
<tr>
<td>Face shield: covers the face, neck, and chin (as needed)</td>
<td>130.7(C)(3)</td>
</tr>
<tr>
<td>Safety glasses or goggles</td>
<td>130.7(C)(4); 130.7(C)(10)(c)</td>
</tr>
<tr>
<td>Hearing protection</td>
<td>130.7(C)(5)</td>
</tr>
<tr>
<td>Footwear: heavy-duty leather (as needed)</td>
<td>130.7(C)(10)(e)</td>
</tr>
</tbody>
</table>

Incident Energy Exposures ≥ 1.2 cal/cm²

<table>
<thead>
<tr>
<th>Protective clothing and PPE</th>
<th>Applicable Section(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clothing underlayers (when used): arc-rated or nonmelting untreated natural fiber</td>
<td>130.7(C)(9)(c); 130.7(C)(11); 130.7(C)(12)</td>
</tr>
<tr>
<td>Gloves:</td>
<td>130.7(C)(7)(b); 130.7(C)(10)(d)</td>
</tr>
<tr>
<td>Exposures ≤ 4 cal/cm²</td>
<td>130.7(C)(1); 130.7(C)(3); 130.7(C)(10)(a); 130.7(C)(10)(b); 130.7(C)(10)(c)</td>
</tr>
<tr>
<td>Exposures &gt; 4 cal/cm²</td>
<td>130.7(C)(5)</td>
</tr>
<tr>
<td>Face shield:</td>
<td>130.7(C)(10)(e)</td>
</tr>
<tr>
<td>Other PPE</td>
<td>130.7(C)(10)(e)</td>
</tr>
</tbody>
</table>

Table H.3(b) Guidance on Selection of Arc-Rated Clothing and Other PPE for Use When Incident Energy Exposure Is Determined

<table>
<thead>
<tr>
<th>Incident Energy Exposure</th>
<th>Protective PPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1.2 cal/cm²</td>
<td>Safety glasses or safety goggles (SR)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated face shield and arc-rated balaclava or arc flash suit hood (SR) (See Note 1.)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated jacket, parka, or rainwear (AN)</td>
</tr>
<tr>
<td></td>
<td>Heavy-duty leather gloves or rubber insulating gloves with leather protectors (AN)</td>
</tr>
<tr>
<td></td>
<td>Hearing protection: Heavy-duty leather gloves or rubber insulating gloves with leather protectors (SR) (See Note 4.)</td>
</tr>
<tr>
<td></td>
<td>Hard hat</td>
</tr>
<tr>
<td></td>
<td>Arc-rated hard hat liner (AN)</td>
</tr>
<tr>
<td></td>
<td>Arc-rated hard hat liner (AN)</td>
</tr>
</tbody>
</table>

| > 1.2 to 12 cal/cm²      | Arc-rated long-sleeve shirt and arc-rated pants or arc-rated coverall or arc flash suit (SR) (See Note 3.) |
|                          | Arc-rated face shield and arc-rated balaclava or arc flash suit hood (SR) (See Note 1.) |
|                          | Arc-rated jacket, parka, or rainwear (AN) |
|                          | Hearing protection: Heavy-duty leather gloves or rubber insulating gloves with leather protectors (SR) (See Note 4.) |
|                          | Hard hat |
|                          | Arc-rated hard hat liner (AN) |
|                          | Safety glasses or safety goggles (SR) |

| > 12 cal/cm²             | Arc-rated long-sleeve shirt and arc-rated pants or arc-rated coverall and/or arc flash suit (SR) |
|                          | Arc-rated arc flash suit hood |
|                          | Arc-rated gloves |
|                          | Arc-rated jacket, parka, or rainwear (AN) |
|                          | Hard hat |
|                          | Arc-rated hard hat liner (AN) |
Safety glasses or safety goggles (SR)
Hearing protection
Arc-rated gloves or rubber insulating gloves with leather protectors (SR)
(See Note 4)
Leather footwear

AN: As needed [in addition to the protective clothing and PPE required by 130.5(C)(1)].
SR: Selection of one in group is required by 130.5(C)(1).

Notes:
(1) Face shields with a wrap-around guarding to protect the face, chin, forehead, ears, and neck area are required by 130.7(C)(10)(c). For full head and neck protection, use a balaclava or an arc flash hood.
(2) All items not designated ‘AN’ are required by 130.7(C).
(3) Arc ratings can be for a single layer, such as an arc-rated shirt and pants or a coverall, or for an arc flash suit or a multi-layer system consisting of a combination of arc-rated shirt and pants, coverall, and arc flash suit.
(4) 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.

Statement of Problem and Substantiation for Public Input
Removing hearing protection from Table H.3(b) for less than or equal to 1.2 cal/cm² corrects an inconsistency. 130.7(C)(5) states that employees shall wear hearing protection when within the arc flash boundary. If the incident energy is less than or equal to 1.2 cal/cm², the worker is outside the arc flash boundary so hearing protection is not required. Additionally wearing hearing protection when not necessary can increase the overall hazards to employees when it unnecessarily interferes with communications.

Submitter Information Verification
Submitter Full Name: JOSEPH KILAR
Organization:
Street Address:
City:
State:
Zip:
Submittal Date: Fri Jun 19 08:11:57 EDT 2015
H.3 Arc-Rated Clothing and Other Personal Protective Equipment (PPE) for Use with Risk Assessment of Electrical Hazards.

Table H.3(a) provides a summary of specific sections within the NFPA 70E standard describing PPE for electrical hazards. Table H.3(b) provides guidance on the selection of arc-rated and other PPE for users who determine the incident energy exposure (in cal/cm²).

Table H.3(a) Summary of Specific Sections Describing PPE for Electrical Hazards

<table>
<thead>
<tr>
<th>Protectives</th>
<th>Applicable Section(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gloves:</td>
<td>130.7(C)(7)(a)</td>
</tr>
<tr>
<td>Hard hat:</td>
<td>130.7(C)(3)</td>
</tr>
<tr>
<td>Safety glasses or goggles</td>
<td>130.7(C)(4)</td>
</tr>
<tr>
<td>Footwear:</td>
<td>130.7(C)(8)</td>
</tr>
</tbody>
</table>

Incident energy exposures up to 1.2 cal/cm²

- **Clothing**: nonmelting or untreated natural fiber long-sleeve shirt and long pants or coverall
- **Gloves**: heavy-duty leather
- **Hard hat**: class G or E
- **Face shield**: covers the face, neck, and chin (as needed)
- **Safety glasses or goggles**: as needed
- **Footwear**: heavy-duty leather (as needed)

Incident energy exposures > 1.2 cal/cm²

- **Clothing**: arc-rated clothing system with an arc rating appropriate to the anticipated incident energy exposure
- **Gloves**: as needed
- **Hard hat**: class G or E
- **Face shield**: as needed
- **Footwear**: as needed

Shock Hazard PPE

- Rubber insulating gloves and leather protectors (unless the requirements of ASTM F 496 are met)
- Rubber insulating sleeves (as needed)
- Class G or E hard hat (as needed)
- Safety glasses or goggles (as needed)
- Dielectric overshoes (as needed)

Arc Flash Hazard PPE

- Incident energy exposures up to 1.2 cal/cm²
  - **Clothing**: nonmelting or untreated natural fiber long-sleeve shirt and long pants or coverall
  - **Gloves**: heavy-duty leather
  - **Face shield**: covers the face, neck, and chin (as needed)
  - **Safety glasses or goggles**: as needed
  - **Footwear**: heavy-duty leather (as needed)

- Incident energy exposures > 1.2 cal/cm²
  - **Clothing**: arc-rated clothing system with an arc rating equal to or greater than the determined incident energy exposure
  - **Gloves**: as needed
  - **Hard hat**: class G or E
  - **Face shield**: as needed
  - **Footwear**: as needed

<table>
<thead>
<tr>
<th>Notes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Face shields with a wrap-around guard to protect the face, chin, forehead, ears, and neck area are required by 130.7(C)(10)(c). For full head and neck protection, use a balaclava or an arc flash suit hood.</td>
</tr>
<tr>
<td>(2) All items not designated “AN” are required by 130.7(C).</td>
</tr>
<tr>
<td>(3) Arc ratings can be for a single layer, such as an arc-rated shirt and pants or a coverall, or for an arc flash suit or a multi-layer system consisting of a combination of arc-rated shirt and pants, coverall, and arc flash suit.</td>
</tr>
<tr>
<td>(4) 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.</td>
</tr>
</tbody>
</table>

Statement of Problem and Substantiation for Public Input

Table H.3(a) Summary of Specific Sections Describing PPE for Electrical Hazards

1. There is no protective clothing for this range of incident energy exposure. Non-melting, natural fiber clothing is not PPE or protective clothing. It is just clothing.
2. This proposal will conform the table to the concept that there is no arc flash hazard outside of the Arc Flash Boundary (AFB) as inferred in Chapter 1. The AFB is determined by the distance from a prospective arc source within which a person could receive a second degree burn if an electrical arc flash were to occur. A second degree burn is possible by an exposure of unprotected skin to an electric arc flash above the incident energy level of 1.2 cal/cm². So, any distance outside of the AFB is inherently less than 1.2 cal/cm². It is understood that a person walking near or past a barricade indicating the AFB is not required to wear any protective clothing or PPE, and is not required to wear non-melting, natural fiber clothing. Since that is the case, allowing any type of clothing when the incident energy exposure less than 1.2 cal/cm² is permitted.

3. If there was an arc flash hazard up to 1.2 cal/cm², for everyone who would come near a barricade tape demarking the AFB, this table recommends PPE that is essentially Category 1 save the clothing description. That does not comply with the requirements of Chapter 1 and therefore it does not conform to the concept listed above under item 2.

Table H.3(b)
1. There is no protective clothing for this range of incident energy exposure. Non-melting, natural fiber clothing is not PPE or protective clothing. It is just clothing.
2. This proposal will conform the table to the concept that there is no arc flash hazard outside of the Arc Flash Boundary (AFB). The AFB is determined by the distance from a prospective arc source within which a person could receive a second degree burn if an electrical arc flash were to occur. A second degree burn is possible by an exposure of unprotected skin to an electric arc flash above the incident energy level of 1.2 cal/cm². So, any distance outside of the AFB is inherently less than 1.2 cal/cm². It is understood that a person walking near or past a barricade indicating the AFB is not required to wear any protective clothing or PPE, and is not required to wear non-melting, natural fiber clothing. Since that is the case, allowing any type of clothing when the incident energy exposure less than 1.2 cal/cm² is permitted.
3. Deleting Table H.3(b) and relabeling it as Table 130.5(C)(1)(a) removes the table from an informative recommendation to a mandatory requirement.
4. Re-labeling Table H.3(b) to Table 130.5(C)(1)(a) positions the table in its proper place right after Article 130.5(C)(1)
5. Having PPE Categories and Selection of Arc-Rated Clothing and Other PPE for Use When Incident Energy Exposure Is Determined both in Chapter One makes the issue of wearing appropriate AR PPE consistent, regardless of the method used for PPE selection.
Table H.3(a) provides a summary of specific sections within the NFPA 70E standard describing PPE for electrical hazards. Table H.3(b) provides guidance on the selection of arc-rated and other PPE for users who determine the incident energy exposure (in cal/cm²).

### Shock Hazard PPE

<table>
<thead>
<tr>
<th>PPE Description</th>
<th>Applicable Section(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rubber insulating gloves and leather protectors</td>
<td>130.7(C)(7)(a)</td>
</tr>
<tr>
<td>Rubber insulating sleeves (as needed)</td>
<td>130.7(C)(7)(a)</td>
</tr>
<tr>
<td>Class G or E hard hat (as needed)</td>
<td>130.7(C)(3)</td>
</tr>
<tr>
<td>Safety glasses or goggles (as needed)</td>
<td>130.7(C)(4)</td>
</tr>
<tr>
<td>Dielectric overshoes (as needed)</td>
<td>130.7(C)(8)</td>
</tr>
</tbody>
</table>

### Arc Flash Hazard PPE

**Incident energy exposures up to 1.2 cal/cm²**

- Clothing: nonmelting or untreated natural fiber long-sleeve shirt and long pants or coverall
  - 130.7(C)(1); 130.7(C)(9)(d)
- Gloves: heavy-duty leather
  - 130.7(C)(7)(b); 130.7(C)(10)(d)
- Hard hat: class G or E
  - 130.7(C)(3)
- Face shield: covers the face, neck, and chin (as needed)
  - 130.7(C)(3)
- Safety glasses or goggles
  - 130.7(C)(4); 130.7(C)(10)(c)
- Hearing protection
  - 130.7(C)(5)
- Footwear: heavy-duty leather (as needed)
  - 130.7(C)(10)(e)

**Incident Energy Exposures ≥ 1.2 cal/cm²**

- Clothing: arc-rated clothing system with an arc rating appropriate to the anticipated incident energy exposure
  - 130.7(C)(1); 130.7(C)(2); 130.7(C)(6); 130.7(C)(9)(d)
- Clothing underlayers (when used): arc-rated or nonmelting untreated natural fiber
  - 130.7(C)(9)(c); 130.7(C)(11); 130.7(C)(12)
- Gloves:
  - Exposures ≥ 1.2 cal/cm² and ≤ 8 cal/cm²: heavy-duty leather gloves
    - 130.7(C)(7)(b); 130.7(C)(10)(d)
- Hard hat: class G or E
  - 130.7(C)(3)
- Face shield:
  - Exposures ≥ 1.2 cal/cm² and ≤ 12 cal/cm²: arc-rated face shield that covers the face, neck, and chin and an arc-rated balaclava or an arc-rated arc flash suit hood
    - 130.7(C)(1); 130.7(C)(3); 130.7(C)(10)(a); 130.7(C)(10)(b); 130.7(C)(10)(c)
- Safety glasses or goggles
  - 130.7(C)(4); 130.7(C)(10)(c)
- Hearing protection
  - 130.7(C)(5)
- Footwear:
  - Exposures ≥ 8 cal/cm²: heavy-duty leather footwear
  - 130.7(C)(10)(e)
  - Exposures > 8 cal/cm²: rubber insulating gloves with their leather protectors; or arc-rated gloves

**Incident Energy Exposures ≥ 1.2 cal/cm² and ≤ 8 cal/cm²**

- Clothing: arc-rated long-sleeve shirt and arc-rated pants or arc-rated coverall or arc flash suit hood
  - (See Note 1.)
- Arc-rated face shield and arc-rated balaclava or arc flash suit hood (SR)
  - (See Note 1.)
- Arc-rated jacket, parka, or rainwear (AN)
- Arc-rated hard hat (AN)
- Safety glasses or safety goggles (SR)
- Hearing protection

**Incident Energy Exposures > 8 cal/cm²**

- Clothing: arc-rated long-sleeve shirt and arc-rated pants or arc-rated coverall or arc flash suit hood
  - (See Note 1.)
- Arc-rated jacket, parka, or rainwear (AN)
- Arc-rated hard hat (AN)
- Safety glasses or safety goggles (SR)
- Hearing protection

**Footwear**

<table>
<thead>
<tr>
<th>Exposure Level</th>
<th>Protective Clothing and PPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 4 cal/cm²</td>
<td>Heavy-duty leather footwear (as needed)</td>
</tr>
<tr>
<td>&gt; 4 cal/cm²</td>
<td>Heavy-duty leather footwear</td>
</tr>
</tbody>
</table>

---

**Table H.3(b) Guidance on Selection of Arc-Rated Clothing and Other PPE for Use When Incident Energy Exposure Is Determined**

**Incident Energy Exposure**

- Protective clothing, nonmelting (in accordance with ASTM F1506) or untreated natural fiber
  - Shirt (long sleeve) and pants (long) or coverall
- Other PPE
  - Heavy-duty leather gloves or rubber insulating gloves with leather protectors (AN)
  - Face shield for projectile protection (AN)

**≥ 1.2 to 12 cal/cm²**

- Arc-rated clothing and equipment with an arc rating equal to or greater than the determined incident energy (See Note 3.)
- Arc-rated long-sleeve shirt and arc-rated pants or arc-rated coverall or arc flash suit hood
- Arc-rated face shield and arc-rated balaclava or arc flash suit hood (SR) (See Note 1.)
- Arc-rated jacket, parka, or rainwear (AN)
- Arc-rated hard hat (AN)
- Safety glasses or safety goggles (SR)
- Hearing protection

**Footwear**

- Informational Note: see table 130.7(C)(16) in article 130.7 for information on arc-rated clothing and other PPE required when the incident energy method is used.
### Incident Energy Exposure

<table>
<thead>
<tr>
<th>Protective Clothing and PPE</th>
<th>Arc-rated gloves or rubber insulating gloves with leather protectors (SR)</th>
<th>Leather footwear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hearing protection</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**AA:** As needed [in addition to the protective clothing and PPE required by 130.5(C)(1)].

**SR:** Selection of one in group is required by 130.5(C)(1).

**Notes:**

1. Face shields with a wrap-around guard to protect the face, chin, forehead, ears, and neck area are required by 130.7(C)(10)(c). For full head and neck protection, use a balaclava or an arc flash hood.
2. All items not designated “AN” are required by 130.7(C).
3. Arc ratings can be for a single layer, such as an arc-rated shirt and pants or a coverall, or for an arc flash suit or a multi-layer system consisting of a combination of arc-rated shirt and pants, coverall, and arc flash suit.
4. 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.

### Statement of Problem and Substantiation for Public Input

Annexes in NFPA are not requirements of NFPA 70E and provide information only. The information in table H.3(b) now exists in Annex H. Annexes in NFPA 70E are for information only and are not part of the requirements in NFPA 70E. The “Incident Energy Method” for selecting arc flash clothing should be located in the requirements section of NFPA 70E (not in Annex H), the same way existing table 130.7(C)(16) exists in article 130.7 for the selection of arc flash PPE when the “Arc Flash PPE Category Method” is used to select arc flash PPE.

This PI will coordinate with PIs 250, 252, and 253.

### Submitter Information Verification

**Submitter Full Name:** DARYLD CROW  
**Organization:** DRC CONSULTING LTD  
**Affiliation:** TG for articles 130.4 and 130.5  
**Street Address:**  
**City:**  
**State:**  
**Zip:**  
**Submittal Date:** Fri Jun 26 13:12:29 EDT 2015
Table H.3(a) provides a summary of specific sections within the NFPA 70E standard describing PPE for electrical hazards. Table H.3(b) provides guidance on the selection of arc-rated and other PPE for users who determine the incident energy exposure (in cal/cm²).

### Table H.3(a) Summary of Specific Sections Describing PPE for Electrical Hazards

<table>
<thead>
<tr>
<th><strong>Shock Hazard PPE</strong></th>
<th><strong>Applicable Section(s)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rubber insulating gloves and leather protectors (unless the requirements of ASTM F 496 are met)</td>
<td>130.7(C)(7)(a)</td>
</tr>
<tr>
<td>Rubber insulating sleeves (as needed)</td>
<td>130.7(C)(7)(a)</td>
</tr>
<tr>
<td>Class G or E hard hat (as needed)</td>
<td>130.7(C)(3)</td>
</tr>
<tr>
<td>Safety glasses or goggles (as needed)</td>
<td>130.7(C)(4)</td>
</tr>
<tr>
<td>Dielectric overshoes (as needed)</td>
<td>130.7(C)(8)</td>
</tr>
</tbody>
</table>

**Arc Flash Hazard PPE**

- **Incident energy exposures up to 1.2 cal/cm²**
  - Clothing: nonmelting or untreated natural fiber long-sleeve shirt and long pants or coverall
  - Gloves: heavy-duty leather
  - Hard hat: class G or E
  - Face shield: covers the face, neck, and chin (as needed)
  - Safety glasses or goggles
  - Hearing protection (ear canal inserts)
  - Footwear: heavy-duty leather (as needed)

<table>
<thead>
<tr>
<th><strong>Applicable Section(s)</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>130.7(C)(7)(a); 130.7(C)(9)(d)</td>
<td></td>
</tr>
</tbody>
</table>

- **Incident Energy Exposures \(\geq 1.2 \text{ cal/cm}^2\)**
  - Clothing: arc-rated clothing system with an arc rating appropriate to the anticipated incident energy exposure
  - Clothing underlayers (when used): arc-rated or nonmelting untreated natural fiber
  - Gloves:
    - Exposures \(\geq 1.2 \text{ cal/cm}^2\) and \(\leq 8 \text{ cal/cm}^2\): heavy-duty leather gloves
    - Exposures > 8 cal/cm²: rubber insulating gloves with their leather protectors; or arc-rated gloves
  - Hard hat: class G or E
  - Face shield:
    - Exposures \(\geq 1.2 \text{ cal/cm}^2\) and 12 cal/cm²: arc-rated face shield that covers the face, neck, and chin and an arc-rated balaclava or an arc-rated arc flash suit hood
    - Exposures >12 cal/cm²: arc-rated arc flash suit hood
  - Safety glasses or goggles
  - Hearing protection (ear canal inserts)
  - Footwear:
    - Exposures \(\leq 4 \text{ cal/cm}^2\): heavy-duty leather footwear (as needed)
    - Exposures > 4 cal/cm²: heavy-duty leather footwear

<table>
<thead>
<tr>
<th><strong>Applicable Section(s)</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>130.7(C)(1); 130.7(C)(2); 130.7(C)(6); 130.7(C)(9)(d)</td>
<td></td>
</tr>
</tbody>
</table>

### Table H.3(b) Guidance on Selection of Arc-Rated Clothing and Other PPE for Use When Incident Energy Exposure Is Determined

<table>
<thead>
<tr>
<th><strong>Incident Energy Exposure</strong></th>
<th><strong>Protective Clothing and PPE</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1.2 cal/cm²</td>
<td>Protective clothing, nonmelting (in accordance with ASTM F1506) or untreated natural fiber</td>
</tr>
</tbody>
</table>
  - Shirt (long sleeve) and pants (long) or coverall |
  - Other PPE: Face shield for projectile protection (AN) Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Heavy-duty leather gloves or rubber insulating gloves with leather protectors (AN) |

<table>
<thead>
<tr>
<th>(\geq 1.2 \text{ to } 12 \text{ cal/cm}^2)</th>
<th>Arc-rated clothing and equipment with an arc rating equal to or greater than the determined incident energy (See Note 3.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arc-rated long-sleeve shirt and arc-rated pants or arc-rated coverall or arc flash suit (SR) (See Note 3.)</td>
<td>Arc-rated face shield and arc-rated balaclava or arc flash suit hood (SR) (See Note 1.)</td>
</tr>
<tr>
<td>Arc-rated jacket, parka, or rainwear (AN)</td>
<td>Arc-rated jacket, parka, or rainwear (AN)</td>
</tr>
</tbody>
</table>

| \(\geq 12 \text{ cal/cm}^2\) | Arc-rated clothing and equipment with an arc rating equal to or greater than the determined incident energy (See Note 3.) |
| Arc-rated long-sleeve shirt and arc-rated pants or arc-rated coverall and/or arc flash suit (SR) | Arc-rated arc flash suit hood Arc-rated gloves Arc-rated jacket, parka, or rainwear (AN) |

<table>
<thead>
<tr>
<th>Other PPE</th>
<th>Hard hat Arc-rated hard hat liner (AN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incident Energy Exposure</td>
<td>Protective Clothing and PPE</td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>Safety glasses or safety goggles (SR)</td>
<td>Arc-rated gloves or rubber insulating gloves with leather protectors (SR)</td>
</tr>
<tr>
<td>Hearing protection (ear canal inserts)</td>
<td>(See Note 4)</td>
</tr>
<tr>
<td>Arc-rated gloves or rubber insulating gloves with leather protectors (SR)</td>
<td>Leather footwear</td>
</tr>
</tbody>
</table>

AN: As needed [in addition to the protective clothing and PPE required by 130.5(C)(1)].

SR: Selection of one in group is required by 130.5(C)(1).

Notes:
(1) Face shields with a wrap-around guarding to protect the face, chin, forehead, ears, and neck area are required by 130.7(C)(10)(c). For full head and neck protection, use a balaclava or an arc flash hood.
(2) All items not designated "AN" are required by 130.7(C).
(3) Arc ratings can be for a single layer, such as an arc-rated shirt and pants or a coverall, or for an arc flash suit or a multi-layer system consisting of a combination of arc-rated shirt and pants, coverall, and arc flash suit.
(4) 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.

Statement of Problem and Substantiation for Public Input

Correct document inconsistency

Either remove the term "ear canal inserts" from Table 130.7 (C)(16) describing Hearing Protection or insert the same description here.

Submitter Information Verification

Submitter Full Name: Drake Drobnick
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Affiliation: N/A
Street Address:
City:
State:
Zip:
Submittal Date: Sat Feb 07 10:35:46 EST 2015
Table H.3(a) provides a summary of specific sections within the NFPA 70E standard describing PPE for electrical hazards. Table H.3(b) provides guidance on the selection of arc-rated and other PPE for users who determine the incident energy exposure (in cal/cm²).

### Table H.3(a) Summary of Specific Sections Describing PPE for Electrical Hazards

<table>
<thead>
<tr>
<th>Shock Hazard PPE</th>
<th>Applicable Section(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rubber insulating gloves and leather protectors (unless the requirements of ASTM F 496 are met)</td>
<td>130.7(C)(7)(a)</td>
</tr>
<tr>
<td>Rubber insulating sleeves (as needed)</td>
<td>130.7(C)(7)(a)</td>
</tr>
<tr>
<td>Class G or E hard hat (as needed)</td>
<td>130.7(C)(3)</td>
</tr>
<tr>
<td>Safety glasses or goggles (as needed)</td>
<td>130.7(C)(4)</td>
</tr>
<tr>
<td>Dielectric overshoes (as needed)</td>
<td>130.7(C)(8)</td>
</tr>
</tbody>
</table>

### Arc Flash Hazard PPE

#### Incident energy exposures up to 1.2 cal/cm²

| Clothing: nonmelting or untreated natural fiber long-sleeve shirt and long pants or coverall | 130.7(C)(1); 130.7(C)(9)(d) |
| Gloves: heavy-duty leather | 130.7(C)(7)(b); 130.7(C)(10)(d) |
| Hard hat: class G or E | 130.7(C)(3) |
| Face shield: covers the face, neck, and chin (as needed) | 130.7(C)(3) |
| Safety glasses or goggles | 130.7(C)(4); 130.7(C)(10)(c) |
| Hearing protection | 130.7(C)(5) |
| Footwear: heavy-duty leather (as needed) | 130.7(C)(10)(e) |

#### Incident Energy Exposures ≥ 1.2 cal/cm²

| Clothing: arc-rated clothing system with an arc rating appropriate to the anticipated incident energy exposure | 130.7(C)(1); 130.7(C)(2); 130.7(C)(6); 130.7(C)(9)(d) |
| Clothing underlayers (when used): arc-rated or nonmelting untreated natural fiber | 130.7(C)(9)(c); 130.7(C)(11); 130.7(C)(12) |
| Gloves: | 130.7(C)(7)(b); 130.7(C)(10)(d) |
| Exposures > 1.2 cal/cm² and ≤ 8 cal/cm²: heavy-duty leather gloves | 130.7(C)(1); 130.7(C)(3) |
| Exposures > 8 cal/cm²: rubber insulating gloves with their leather protectors; or arc-rated gloves | 130.7(C)(7)(b); 130.7(C)(10)(d) |
| Hard hat: class G or E | 130.7(C)(3) |
| Face shield: | 130.7(C)(4); 130.7(C)(10)(c) |
| Exposures > 12 cal/cm²: arc-rated arc flash suit hood | 130.7(C)(1)(a); 130.7(C)(10)(b); 130.7(C)(10)(c) |
| Safety glasses or goggles | 130.7(C)(5) |
| Hearing protection | 130.7(C)(10)(e) |
| Footwear: heavy-duty leather footwear (as needed) | 130.7(C)(10)(e) |

### Table H.3(b) Guidance on Selection of Arc-Rated Clothing and Other PPE for Use When Incident Energy Exposure Is Determined

<table>
<thead>
<tr>
<th>Incident Energy Exposure</th>
<th>Protective Clothing and PPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1.2 cal/cm²</td>
<td>Protective clothing: nonmelting (in accordance with ASTM F1506) or untreated natural fiber</td>
</tr>
<tr>
<td>Other PPE</td>
<td>Face shield for projectile protection (AN)</td>
</tr>
<tr>
<td>Safety glasses or safety goggles (SR)</td>
<td>Hearing protection</td>
</tr>
<tr>
<td>Heavy-duty leather gloves or rubber insulating gloves with leather protectors (AN)</td>
<td>≥ 1.2 to 12 cal/cm²</td>
</tr>
</tbody>
</table>

| Arc-rated clothing and equipment with an arc rating equal to or greater than the determined incident energy (See Note 3.) | Arc-rated long-sleeve shirt and arc-rated pants or arc-rated coverall or arc flash suit (SR) (See Note 3.) |
| | Arc-rated arc flash suit hood (SR) (See Note 1.) |
| Arc-rated jacket, parka, or rainwear (AN) |
| Other PPE | Hard hat |
| Arc-rated hard hat liner (AN) | Safety glasses or safety goggles (SR) |
| Hearing protection | Heavy-duty leather gloves or rubber insulating gloves with leather protectors (SR) (See Note 4.) |
| Leather footwear |

| > 12 cal/cm² | Arc-rated clothing and equipment with an arc rating equal to or greater than the determined incident energy (See Note 3.) |
| | Arc-rated long-sleeve shirt and arc-rated pants or arc-rated coverall and/or arc flash suit (SR) |
| Arc-rated ar flash suit hood | Arc-rated jacket, parka, or rainwear (AN) |
| Other PPE | Hard hat |
| Arc-rated hard hat liner (AN) | Safety glasses or safety goggles (SR) |
### Incident Energy Exposure

- Hearing protection
- Arc-rated gloves or rubber insulating gloves with leather protectors (SR)
- Leather footwear

### Protective Clothing and PPE

- As needed [in addition to the protective clothing and PPE required by 130.5(C)(1)].
- SR: Selection of one in group is required by 130.5(C)(1).

#### Notes:

1. Face shields with a wrap-around guarding to protect the face, chin, forehead, ears, and neck area are required by 130.7(C)(10)(c). For full head and neck protection, use a balaclava or an arc flash hood.
2. All items not designated 'AN' are required by 130.7(C).
3. Arc ratings can be for a single layer, such as an arc-rated shirt and pants or a coverall, or for an arc flash suit or a multi-layer system consisting of a combination of arc-rated shirt and pants, coverall, and arc flash suit.
4. 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.

### Statement of Problem and Substantiation for Public Input

Delete less than 1.2. Section 130.7(C)(6) does not require wearing PPE at 1.2 calories/cm² or below. Removing this information will simplify the use of Annex H.3(b).

### Submitter Information Verification

- **Submitter Full Name:** PAUL DOBROWSKY
- **Organization:** INNOVATIVE TECHNOLOGY SERVICES
- **Street Address:**
- **City:**
- **State:**
- **Zip:**
- **Submittal Date:** Mon Jul 06 15:28:31 EDT 2015
Informative Annex I Job Briefing and Planning Checklist

This informative annex is not a part of the requirements of this NFPA document but is included for informational purposes only.
Figure I.1 illustrates considerations for a job briefing and planning checklist.

<table>
<thead>
<tr>
<th>Identify</th>
<th>Ask</th>
<th>Check</th>
<th>Know</th>
<th>Think</th>
<th>Prepare for an emergency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[ ] Hazards</td>
<td>[ ] Can the equipment be de-energized?</td>
<td>[ ] Job plans</td>
<td>[ ] What the job is</td>
<td>[ ] About the unexpected event . . . What if?</td>
<td></td>
</tr>
<tr>
<td>[ ] Voltage levels involved</td>
<td>[ ] Are backfeeds of the circuits to be worked on possible?</td>
<td>[ ] Single-line diagrams and vendor prints</td>
<td>[ ] Who else needs to know — Communicate!</td>
<td>[ ] Lock — Tag — Test — Try</td>
<td></td>
</tr>
<tr>
<td>[ ] Skills required</td>
<td>[ ] Safety procedures</td>
<td>[ ] Status board</td>
<td>[ ] Who is in charge</td>
<td>[ ] Test for voltage — FIRST</td>
<td></td>
</tr>
<tr>
<td>[ ] Any “foreign” (secondary source) voltage source</td>
<td>[ ] install and remove temporary protective grounding equipment</td>
<td>[ ] Information on plant and vendor resources is up to date</td>
<td>[ ] Install barriers and barricades</td>
<td>[ ] What else . . . ?</td>
<td></td>
</tr>
<tr>
<td>[ ] Any unusual work conditions</td>
<td>[ ] Individuals are familiar with the facility</td>
<td></td>
<td></td>
<td>[ ] Install and remove temporary protective grounding equipment</td>
<td></td>
</tr>
<tr>
<td>[ ] Number of people needed to do the job</td>
<td>[ ] Is a standby person required?</td>
<td></td>
<td></td>
<td>[ ] Install barriers and barricades</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[ ] Shock protection boundaries</td>
<td>[ ] Safety procedures</td>
<td></td>
<td></td>
<td>[ ] What else . . . ?</td>
</tr>
<tr>
<td></td>
<td>[ ] Available incident energy</td>
<td>[ ] Vendor information</td>
<td></td>
<td></td>
<td>[ ] Install and remove temporary protective grounding equipment</td>
</tr>
<tr>
<td></td>
<td>[ ] Potential for arc flash (Conduct an arc flash hazard analysis.)</td>
<td>[ ] Individuals are familiar with the facility</td>
<td></td>
<td></td>
<td>[ ] Install barriers and barricades</td>
</tr>
<tr>
<td></td>
<td>[ ] Arc flash boundary</td>
<td>[ ] Any evidence of impending failure?</td>
<td></td>
<td></td>
<td>[ ] What else . . . ?</td>
</tr>
</tbody>
</table>

NFPA 70E - A2017 FD Meeting Agenda
Statement of Problem and Substantiation for Public Input

With the addition of Normal Operation 130.2(A)(4) and Maintenance 110.1(B) to the 2015 standard, the emphasis on proper installation and maintenance is clear. Employers should be encouraged to add this to any job planning or risk assessment procedures.

Adding AED to planning checklist is consistent with emergency response training outlined in 110.2(C)(2). AEDs are common in the work place, and when present, must be part of preparing for an emergency. Consideration must also be given to mobile crews and shift work, where an AED may not always be accessible.

Submitter Information Verification

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Street Address:
City:
State:
Zip:
Submittal Date: Wed Jun 24 10:19:04 EDT 2015
Public Input No. 26-NFPA 70E-2015 [ New Section after J.1 ]

TITLE OF NEW CONTENT
Type your content here ...
PART I
add new (2) Scope of work, increment others

Statement of Problem and Substantiation for Public Input

Document clarity

Submitter Information Verification

Submitter Full Name: Drake Drobnick
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Affiliation: N/A
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Submittal Date: Sun Feb 01 18:50:42 EST 2015
J.1 Energized Electrical Work Permit Sample.

Figure J.1 illustrates considerations for an energized electrical work permit.

Statement of Problem and Substantiation for Public Input

Note to NFPA Staff: the figure cannot be modified so this revision is shown below.

Revise Figure J.1 (Part II section) as follows:

(1) Detailed description of the job procedures to be used in performing the above detailed work:

Rationale:

The sentence was restructured and the term "procedure" was pluralized for clarity.

This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the terms "procedure," "practice," "program" and "process."

The Task Group recommendations regarding the use of the terms "practice," "procedure," "process" or "program" are based on:

1. The context in which the term was used;
2. The definitions of each term as found in the Merriam-Webster on-line dictionary:
   - Practice: to do something customarily (e.g. "work practice")
   - Procedure: a series of steps followed in a regular definite order (e.g. 'lockout/tagout procedure")
   - Process: a series of actions or operations conducing to an end (e.g. "Risk Assessment – An overall process that...")
   - Program: a plan or system under which action may be taken toward a goal (e.g. "electrical safety program")

Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This PI is submitted by Daniel Roberts in behalf of the Ad Hoc Risk Assessment Task Group appointed by the Chair of the NFPA 70E Technical Committee to review the use of the terms “procedure,” “practice,” “program” and “process.”
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Zip: 
Submittal Date: Mon Jun 29 11:31:48 EDT 2015
J.2 Energized Electrical Work Permit.

Figure J.2 illustrates items to consider when determining the need for an energized electrical work permit.

Figure J.2 Energized Electrical Work Permit Flow Chart.

Statement of Problem and Substantiation for Public Input

Revise the text "50 volts" where it appears in the graphic to read as follows:

"50 volts ac / 60 volts dc"

The graphic infers that 50 volts is a demarcation for the shock boundary for all ac and dc systems when in actuality it would be 50 volts ac and 100 volts dc. A proposal has also been submitted to change 100 volts to 60 volts dc. In either case the graphic should be updated to reflect the correct boundary voltage for both ac and dc electrical systems.

Submitter Information Verification

Submitter Full Name: LAWRENCE AYER
Organization: BIZ COM ELECTRIC INC
Affiliation: IEC
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Zip:
Submittal Date: Mon Jul 06 14:41:27 EDT 2015

NFPA 70E - A2017 FD Meeting Agenda

Informative Annex K, General Categories of Electrical Hazards

K.1 General Categories.
There are three general categories of electrical hazards: electrical shock, arc flash, and arc blast.

K.2 Electric Shock.
Approximately 30,000 nonfatal electrical shock accidents occur each year. The National Safety Council estimates that about 1000 fatalities each year are due to electrocution, more than half of them while servicing energized systems of less than 600 volts.

Electrocution is the fourth leading cause of industrial fatalities, after traffic, homicide, and construction accidents. The current required to light a 7 1/2-watt, 120-volt lamp, if passed across the chest, is enough to cause a fatality. The most damaging paths through the body are through the lungs, heart, and brain.

K.3 Arc Flash.
When an electric current passes through air between ungrounded conductors or between ungrounded conductors and grounded conductors, the temperatures can reach 35,000°F. Exposure to these extreme temperatures both burns the skin directly and causes ignition of clothing, which adds to the burn injury. The majority of hospital admissions due to electrical accidents are from arc flash burns, not from shocks. Each year more than 3000 people are admitted to burn centers with severe arc flash burns. Arc flashes can and do kill at distances of 3 m (10 ft).

K.4 Arc Blast.
The tremendous temperatures of the arc cause the explosive expansion of both the surrounding air and the metal in the arc path. For example, copper expands by a factor of 67,000 times when it turns from a solid to a vapor. The danger associated with this expansion is one of high pressures, sound, and shrapnel. The high pressures can easily exceed hundreds or even thousands of pounds per square foot, knocking workers off ladders, rupturing pumper, and collapsing lungs. The sounds associated with these pressures can exceed 160 dB. Finally, material and molten metal are expelled away from the arc at speeds exceeding 1120 km/hr (700 mph), fast enough for shrapnel to completely penetrate the human body.

See attached document for suggested material to replace present Annex K

Additional Proposed Changes

<table>
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<th>File Name</th>
<th>Description</th>
<th>Approved</th>
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<tbody>
<tr>
<td>PC_185.pdf</td>
<td>70E-PC185</td>
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</tr>
<tr>
<td>PC_185_Attachment.pdf</td>
<td>Proposed Annex K</td>
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Statement of Problem and Substantiation for Public Input

NOTE: This Public Input appeared as “Reject but Hold” in Public Comment No. 185 of the A2014 Second Draft Report for NFPA 70E and per the Regs. at 4.4.6.3.1.

Annex K needs to be updated. The present version of Annex K does not adequately cover the range of shock and arc-related injuries or provide a good perspective on arc-related injuries. I have provided suggested material to replace Annex K. Please consider my suggestions. I strongly feel that improvements need to be made to Annex K.

Submitter Information Verification

Submitter Full Name: TC on EEW-AAA
Organization: NFPA Technical Committee on Electrical Safety in the Workplace
Street Address: City:
State: Zip:
Submittal Date: Thu Mar 26 15:46:13 EDT 2015
K.1 General Categories.

There are three general categories of electrical hazards: electrical shock, arc flash, and arc blast.

Electrical injuries represent a serious workplace health and safety issue to electrical and non-electrical workers. Data from the U.S. Bureau of Labor Statistics (BLS) indicate that there were nearly 6,000 fatal electrical injuries to workers in the U.S. between 1992 and 2013. BLS data also indicates that there were 24,100 non-fatal electrical injuries from 2003 through 2012. From 1992 to 2013 the number of fatal workplace electrical injuries has fallen steadily and dramatically, from 334 in 1992 to 139 in 2013. However, the trend with non-fatal electrical injuries is less consistent. Between 2003 and 2009, non-fatal injury totals ranged from 2,390 in 2003 to 2,620 in 2009, with a high of 2,950 injuries in 2005. Non-fatal injury totals between 2010 through 2012 were the lowest over this 10-year period, with 1,890 non-fatal injuries in 2010, 2,250 in 2011, and 1,700 in 2012.

There are two general categories of electrical injury - electrical shock and electrical burns. Electrical burns can be further subdivided into burns caused by radiant energy (arc burns), burns caused by exposure to ejected hot gases and materials (thermal burns), and burns caused by the conduction of electrical current through body parts (conduction burns). In addition, hearing damage can occur from acoustic energy, and traumatic injury can be caused by toxic gases and pressure waves associated with an arcing event.

About 98% of fatal occupational electrical injuries are electrical shock injuries.

A corporate case study examining electrical injury reporting and safety practices found that 40% of electrical incidents involved 250 volts or less and were indicative of a misperception of electrical safety as a high-voltage issue. In addition, electrical incidents once again were found to involve a large share of non-electrical workers, with approximately one-half of incidents involving workers from outside electrical crafts. Research of electrical fatalities in construction found that the highest proportion of fatalities occurred in establishments with 10 or fewer employers and pointed out that smaller employers may have fewer formal training requirements and less structured training in safety practices.

Statement of Problem and Substantiation for Public Input

Annex K has been revised to reflect the current data. The updated data reflects data included in Occupational Injuries From Electrical Shock and Arc Flash Events Prepared by: Richard B. Campbell, ScD. of Fire Analysis and Research Division or National Fire Protection Association and David A. Dini, P.E. of Commercial and Industrial R&D UL LLC. The update also includes information available from NIOSH provided by James Cawley. The update was coordinated by TG appointed by 70E Chair. The TG included Daleep Mohla, James Cawley, Lanny Floyd and David Wallis.

Submitter Information Verification

Submitter Full Name: DALEEP MOHLA
Organization: DCM ELECTRICAL CONSULTING SERV
Street Address:
City:
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Submittal Date: Mon Jun 29 15:53:50 EDT 2015
### Public Input No. 76-NFPA 70E-2015 [Section No. K.1]

**K.1 General Categories.**  
There are **three** general categories of electrical hazards: electrical shock, arc flash, **and** arc blast, **and** thermal injury.

### Statement of Problem and Substantiation for Public Input

would make definition of electrical hazard in 100 and annex K, consistent.

### Related Public Inputs for This Document

<table>
<thead>
<tr>
<th>Related Input</th>
<th>Relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Input No. 73-NFPA 70E-2015 [Definition: Electrical Hazard]</td>
<td>consistency with 100 electrical hazard and annex K</td>
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<tr>
<td>Public Input No. 75-NFPA 70E-2015 [New Section after K.4]</td>
<td>consistency with 100 electrical hazard and annex K</td>
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</tbody>
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### Submitter Information Verification

- **Submitter Full Name:** ZANE MEVEY  
- **Organization:** CITY OF WICHITA  
- **Street Address:**  
- **City:**  
- **State:**  
- **Zip:**  
- **Submittal Date:** Wed Mar 18 23:19:06 EDT 2015
Public Input No. 326-NFPA 70E-2015 [ Section No. K.2 ]

K.2 Electric Shock.

Approximately 30,000 nonfatal electrical shock accidents occur each year. The National Safety Council estimates that about 1,000 fatalities each year are due to electrocution, more than half of them while servicing energized systems of less than 600 volts.

Electrocution is the fourth leading cause of industrial fatalities, after traffic, homicide, and construction accidents. The current required to light a 7.1/2-watt, 120-volt lamp, if passed across the chest, is enough to cause a fatality. The most damaging paths through the body are through the lungs, heart, and brain.

Contact Injuries

Electrical fatalities ranked seventh, making up about 4% of all occupational fatalities.

Over 40% of all electrical fatalities involved overhead power line contact. This includes overhead power line fatalities from direct contact by a worker, contact through hand-carried objects, and contact through machines and vehicles. Comparing the ratio of total electrical fatalities to total electrical accidents plus fatalities, it was noticed that electrical accidents are more often fatal than many other accident categories. For example, from 2003-2009 there were 20,033 electrical injuries (accidents plus fatalities), which resulted in 1,573 fatalities. For every 13 (actually 12.74) electrical injuries, one worker died. For the same period there were 1,718,219 fall injuries that resulted in 5,279 fatalities – one worker died for every 325 injuries.

* Of those, 1,573 were electrical fatalities. A more detailed look at the demographics for 168 electrical fatalities in 2009 showed that:

- 99% died of electrocution;
- 70% were performing a constructing, repairing or cleaning work activity at the time of death;

Statement of Problem and Substantiation for Public Input

Annex K has been revised to reflect the current data. The updated data reflects data included in Occupational Injuries From Electrical Shock and Arc Flash Events Prepared by: Richard B. Campbell, ScD. of Fire Analysis and Research Division or National Fire Protection Association and David A. Dini, P.E. of Commercial and Industrial R&D UL LLC. The update also includes information available from NIOSH provided by James Cawley. The update was coordinated by TG appointed by 70E Chair. The TG included Daleep Mohla, James Cawley, Lanny Floyd and David Wallis.

Submitter Information Verification

Submitter Full Name: DALEEP MOHLA
Organization: DCM ELECTRICAL CONSULTING SERV
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jun 29 16:12:05 EDT 2015
K.2 Electric Shock.

Approximately 30,000 nonfatal electrical shock accidents occur each year. The National Safety Council estimates that about 1000 fatalities each year are due to electrocution, more than half of them while servicing energized systems of less than 600 volts.

Electrocution is the fourth leading cause of industrial fatalities, after traffic, homicide, and construction accidents. The current required to light a 7 1/2-watt, 120-volt lamp, if passed across the chest, is enough to cause a fatality. The most damaging paths through the body are through the lungs, heart, and brain.

The employer and employees should be aware of the following hazards associated with power electronic equipment.

(1) Effects of Power Frequency Current:
   a. At 0.5 mA, shock is perceptible.
   b. At 10 mA, a person may not be able to voluntarily let go of an energized electrical conductor or circuit part.
   c. At about 40 mA, the shock, if lasting for 1 second or longer, can be fatal due to ventricular fibrillation.
   d. Further increasing current leads to burns and cardiac arrest.

(2) Effects of Direct Current:
   a. A dc current of 2 mA is perceptible.
   b. A dc current of 40 mA is considered the threshold of the let-go current.

(3) Effects of Voltage. A voltage of 30 V rms, or 60 V dc, is considered safe, except when the skin is broken. The internal body resistance can be as low as 500 ohms, so fatalities can occur.

(4) Effects of Short Contact:
   a. For contact less than 0.1 second and with currents just greater than 0.5 mA, ventricular fibrillation can occur only if the shock is during a vulnerable part of the cardiac cycle.
   b. For contact of less than 0.1 second and with currents of several amperes, ventricular fibrillation can occur if the shock is during a vulnerable part of the cardiac cycle.
   c. For contact of greater than 0.8 second and with currents just greater than 0.5 A, cardiac arrest (reversible) can occur.
   d. For contact greater than 0.8 second and with currents of several amperes, burns and death are probable.

(5) Effects of Alternating Current at Frequencies Above 100 Hz. When the threshold of perception increases from 10 kHz to 100 kHz, the threshold of let-go current increases from 10 mA to 100 mA.

(6) Effects of Waveshape. Contact with voltages from phase controls usually causes effects between those of ac and dc sources.

(7) Effects of Capacitive Discharge:
   a. A circuit of capacitance of 1 μF having a 10 kV capacitor charge can cause ventricular fibrillation.
   b. A circuit of capacitance of 20 μF having a 10 kV capacitor charge can be dangerous and probably will cause ventricular fibrillation.

Statement of Problem and Substantiation for Public Input

This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.

The inserted text is relocated from 340.5 as it is primarily informational in nature and therefore belongs in Annex K with similar content. A separate Public Input has been created to delete 340.5.

Related Public Inputs for This Document

<table>
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<tr>
<td>Public Input No. 483-NFPA 70E-2015 [Section No. 340.5]</td>
<td>Deleted content from 340.5 is relocated to Annex K.2</td>
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Submitter Information Verification

Submitter Full Name: DANIEL ROBERTS
Organization: SCHNEIDER ELECTRIC
Affiliation: This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.
Street Address: City: State: Zip:
Submittal Date: Mon Jul 06 14:04:31 EDT 2015
K.3 Arc Flash.

When an electric current passes through air between ungrounded conductors or between ungrounded conductors and grounded conductors, the temperatures can reach 35,000°F. Exposure to these extreme temperatures both burns the skin directly and causes ignition of clothing, which adds to the burn injury. The majority of hospital admissions due to electrical accidents are from arc flash burns, not from shocks. Each year more than 2000 people are admitted to burn centers with severe arc flash burns. Arc flashes can and do kill at distances of 3 m (10 ft).

In the recent issued Sub part V, OSHA identified 99 accidents that involved burns from arcs from energized equipment faults or failures, resulting in 21 fatalities and 94 hospitalized injuries for the period January 1991 through December 1998.

Based on this data, OSHA estimated that an average of at least 8 burn accidents occur each year involving employees doing work covered by OSHA rules leading to 12 nonfatal injuries and 2 fatalities per year. Of the reports indicating the extent of the burn injury, 75 percent reported third-degree burns.

During the period involved, Federal OSHA only required nonfatal accidents to be reported when there were three or more workers hospitalized. OSHA found that there were six injuries for every fatality in California, which requires the reporting of every hospitalized injury. Using that data, OSHA estimated that would be at least 36 injuries to every fatality, and probably much more. Also, many nonfatal electric shocks involve burns from associated electric arcs.

Starting January 1, 2015, Federal OSHA requires every hospitalized injury to be reported.

In addition, the “arc flash” can be a serious light hazard known to cause temporary blindness for several days, even for extremely short duration arcs, without additional injury. Permanent visual loss sometimes can also occur, as well as cataracts, perhaps due to UV or infrared radiation or even thermal energy.

Statement of Problem and Substantiation for Public Input

Annex K has been revised to reflect the current data. The updated data reflects data included in Occupational Injuries From Electrical Shock and Arc Flash Events Prepared by: Richard B. Campbell, ScD. of Fire Analysis and Research Division or National Fire Protection Association and David A. Dini, P.E. of Commercial and Industrial R&D UL LLC. The update also includes information available from NIOSH provided by James Cawley. The update was coordinated by TG appointed by 70E Chair. The TG included Daleep Mohla, James Cawley, Lanny Floyd and David Wallis.

Submitter Information Verification

Submitter Full Name: DALEEP MOHLA
Organization: DCM ELECTRICAL CONSULTING SERV
Street Address:
City: State: Zip: Submittal Date: Sat Jul 04 11:22:01 EDT 2015
Public Input No. 378-NFPA 70E-2015 [ New Section after K.4 ]

References

For additional information, readers are advised to the following documents:

- Occupational Injuries From Electrical Shock and Arc Flash Events
  Final Report by Richard Campbell, and David Dini
  Sponsored by The Fire Protection Research Foundation, Quincy, MA
- Occupational Electrical Injuries in the US, 2003-2009
  by James Cawley and Brett C. Banner, ESFI
  Technical paper ESW 2012-24 presented at IEEE ESW conference
- Arc Flash* Hazards, Incident Energy, PPE Ratings and Thermal Burn Injury – A Deeper Look
  by Tammy Gammon, Wei-Jen Lee, and Ben Johnson
  Technical Paper ESW2015-17 presented at IEEE ESW Conference
- OSHA Subpart V: Electric Power and Distribution APRIL 11, 2014

Statement of Problem and Substantiation for Public Input

The references include documents where additional information on these hazards can be found by the readers.

Submitter Information Verification

Submitter Full Name: DALEEP MOHLA
Organization: DCM ELECTRICAL CONSULTING SERV
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Fri Jul 03 17:31:37 EDT 2015
Title of New Content
K.5 Thermal burns.

Statement of Problem and Substantiation for Public Input
This needs expanding. But it would make the definition of electrical hazard and the information in annex K, consistent.

Related Public Inputs for This Document

<table>
<thead>
<tr>
<th>Related Public Input</th>
<th>Relationship</th>
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<tbody>
<tr>
<td>Public Input No. 73-NFPA 70E-2015 [Definition: Electrical Hazard]</td>
<td>making it consistent with annex K</td>
</tr>
<tr>
<td>Public Input No. 76-NFPA 70E-2015 [Section No. K.1]</td>
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Submitter Information Verification
Submitter Full Name: ZANE MEVEY
Organization: CITY OF WICHITA
Street Address: City: State: Zip:
Submittal Date: Wed Mar 18 22:28:34 EDT 2015
Public Input No. 392-NFPA 70E-2015 [ Section No. K.4 ]

K.4 Arc Blast.

The tremendous temperatures of the arc cause the explosive expansion of both the surrounding air
and the metal in the arc path. For example, copper expands by a factor of 67,000 times when it turns from a solid to a vapor. The danger associated with this
expansion is one of high pressures, sound, and shrapnel. The high pressures can easily exceed hundreds or even thousands of pounds per square foot, knocking
workers off ladders, rupturing eardrums, and collapsing lungs.

The sounds associated with these pressures can exceed 160 dB.

Based on a staged test conducted under controlled conditions, a three phase bolted fault of 22.6 KA and a clearing time of 6 cycles, a pressure greater than 2160
pounds per square foot and a sound level of over 140dB were measured at a distance of 455 mm (18 inches) away.

Finally, material and molten metal are expelled away from the arc at speeds exceeding 1120 km/hr (700 mph), fast enough for shrapnel to completely penetrate the
human body.

Statement of Problem and Substantiation for Public Input

Annex K has been revised to reflect the current data. The updated data reflects data included in Occupational Injuries From Electrical Shock and Arc Flash Events Prepared by:
Richard B. Campbell, ScD. of Fire Analysis and Research Division or National Fire Protection Association and David A. Dini, P.E. of Commercial and Industrial R&D UL LLC. The
update also includes information available from NIOSH provided by James Cawley. The update was coordinated by TG appointed by 70E Chair. The TG included Daleep Mohla,
James Cawley, Lanny Floyd and David Wallis

Submitter Information Verification

Submitter Full Name: DALEEP MOHLA
Organization: DCM ELECTRICAL CONSULTING SERV
Street Address:
City:
State:
Zip:
Submittal Date: Sat Jul 04 11:33:06 EDT 2015
M.1.2
The total system of protective clothing can be selected to take credit for the protection provided by all the layers of clothing that are worn. For example, to achieve an arc rating of 40 cal/cm², an arc flash suit with an arc rating of 40 cal/cm² could be worn over a cotton shirt and cotton pants. Alternatively, an arc flash suit with a 25 cal/cm² arc rating could be worn over an arc-rated shirt and arc-rated pants with an arc rating of 8 cal/cm² to achieve a total system arc rating of 40 cal/cm². This latter approach provides the required arc rating at a lower weight and with fewer total layers of fabric and, consequently, would provide the required protection with a higher level of worker comfort. Natural fibre clothing under arc-rated clothing does not add to the rating.

Statement of Problem and Substantiation for Public Input
Does not make sense without further clarification. Yes, 40 cal is equal to 40 cal....

Submitter Information Verification
Submitter Full Name: JIM HAZELWOOD
Organization: REVERE CONTROL SYSTEMS
Street Address:
City:
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Submittal Date: Mon Apr 20 12:01:53 EDT 2015
Public Input No. 430-NFPA 70E-2015 [Section No. O.1 [Excluding any Sub-Sections]]

This informative annex addresses the responsibilities of the facility owner or manager or the employer having responsibility for facility ownership or operations management to perform a risk assessment during the design of electrical systems and installations. ANSI/ASSE Z590.3-2011 Prevention through Design Guidelines for Addressing Occupational Hazards and Risks in Design and Redesign Processes provides a framework for addressing risk elimination and reduction in design processes. IEEE 1683-2014 IEEE Guide for Motor Control Centers Rated up to and including 600 V AC or 1000 V DC with Recommendations Intended to Help Reduce Electrical Hazards provides guidance for evaluating risk reduction design options for motor control centers.

Statement of Problem and Substantiation for Public Input

This proposal provides reference to two relevant industry standards that were published after Annex O was added in the 2009 revision to NFPA 70E. These references can aid in effective use of this annex.

Submitter Information Verification

Submitter Full Name: Lanny Floyd
Organization: Electrical Safety Group Inc
Street Address: 
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Submittal Date: Sun Jul 05 17:48:09 EDT 2015
O.2 General Design Considerations.

O.2.1 Employers, facility owners, and managers who have responsibility for facilities and installations having electrical energy as a potential hazard to employees and other personnel should ensure that electrical hazards risk assessments are performed during the design of electrical systems and installations.

O.2.2 Design option decisions should facilitate the ability to eliminate hazards or reduce risk by doing the following:

1. Reducing the likelihood of exposure
2. Reducing the magnitude or severity of exposure
3. Enabling achievement of an electrically safe work condition

O.2.3 Incident Energy Reduction Methods.

The following methods have proved to be effective in reducing incident energy:

1. Zone-selective interlocking. A method that allows two or more circuit breakers to communicate with each other so that a short circuit or ground fault will be cleared by the breaker closest to the fault with no intentional delay. Clearing the fault in the shortest time aids in reducing the incident energy.

2. Differential relaying. The concept of this protection method is that current flowing into protected equipment must equal the current out of the equipment. If these two currents are not equal, a fault must exist within the equipment, and the relaying can be set to operate for a fast interruption. Differential relaying uses current transformers located on the line and load sides of the protected equipment and fast acting relay.

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 work is complete.

O.2.4 Other Methods.

1. Energy-reducing active arc flash mitigation system. This system can reduce the arcing duration by creating a low impedance current path, located within a controlled compartment, to cause the arcing fault to transfer to the new current path, while the upstream breaker clears the circuit. The system works without compromising existing selective coordination in the electrical distribution system.

2. Arc flash relay. An arc flash relay typically uses light sensors to detect the light produced by an arc flash event. Once a certain level of light is detected the relay will issue a trip signal to an upstream overcurrent device.

3. High-resistance grounding. A great majority of electrical faults are of the phase-to-ground type. High-resistance grounding will insert an impedance in the ground return path and will typically limit the fault current to 10 amperes and below (at 5 kV nominal or below), leaving insufficient fault energy and thereby helping reduce the arc flash hazard level. High-resistance grounding will not affect arc flash energy for line-to-line or line-to-line-to-line arcs.


Statement of Problem and Substantiation for Public Input

The risk reduction examples provided in this annex are currently focused on incident energy reduction and arc flash burn risk reduction. This proposal is intended to make this annex more comprehensive by including electric shock risk reduction examples.

Submitter Information Verification

Submitter Full Name: Lanny Floyd
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Submittal Date: Sun Jul 05 18:04:33 EDT 2015
O.2.2
Design option decisions should facilitate the ability to eliminate hazards or reduce risk by doing the following:

(1) Reducing the likelihood of exposure
(2) Reducing the magnitude or severity of exposure
(3) Enabling achievement of an electrically safe work condition

Within the context of Hierarchy of Risk Control methods, design options that eliminate or reduce risk are in the category of Elimination, Substitution and Engineering Controls.

Statement of Problem and Substantiation for Public Input

This proposal is intended to enhance clarity in how this annex links to the requirements in NFPA 70e-2015 article 110.1(G) Risk Assessment Procedure.

Submitter Information Verification

Submitter Full Name: Lanny Floyd
Organization: Electrical Safety Group Inc
Street Address:
City: 
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Zip: 
Submittal Date: Sun Jul 05 17:53:21 EDT 2015
O.2.4 Other Methods.

(1) Energy-reducing active arc flash mitigation system. This system can reduce the arcing duration by creating a low impedance current path, located within a controlled compartment, to cause the arcing fault to transfer to the new current path, while the upstream breaker clears the circuit. The system works without compromising existing selective coordination in the electrical distribution system.

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(4) Current-limiting devices. Current-limiting protective devices reduce incident energy by clearing the fault faster and by reducing the current seen at the arc source. The energy reduction becomes effective for current above the current-limiting threshold of the current-limiting fuse or current limiting circuit breaker.

(5) Shunt-trip. Adding a shunt-trip that is signaled to open from an open-fuse relay to switches 800 amperes and greater, reduces incident energy by opening the switch immediately when the first fuse opens. The reduced clearing time reduces incident energy. This is especially helpful for arcing currents that are not within the current-limiting threshold of the three current-limiting fuses.

Statement of Problem and Substantiation for Public Input

When the arcing current is less than the current limiting threshold of the three fuses, one fuse will likely open first. At that point the circuit is not cleared until another fuse opens. The use of a shunt-trip on the switch that opens all three switch poles immediately when the first fuse opens will reduce clearing time for these lower level arcing currents, and therefore reduce the incident energy.

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Submittal Date: Wed Jul 01 12:38:21 EDT 2015
Public Input No. 379-NFPA 70E-2015 [ Section No. O.2.4 ]

<table>
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<tr>
<th>O.2.4</th>
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<tr>
<td>(1)</td>
<td>Energy-reducing active arc flash mitigation system. This system can reduce the arcing duration by creating a low impedance current path, located within a controlled compartment, to cause the arcing fault to transfer to the new current path, while the upstream breaker clears the circuit. The system works without compromising existing selective coordination in the electrical distribution system.</td>
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<tr>
<td>(5)</td>
<td>Type 2 motor controller protection. The current-limitation necessary to obtain Type 2 “no damage” protection of motor controllers under short-circuit conditions also reduces incident energy whenever the arcing current is within the current limiting threshold of the current-limiting fuse or current-limiting circuit breaker.</td>
</tr>
</tbody>
</table>

Statement of Problem and Substantiation for Public Input

In order to achieve Type 2 “no damage” protection of a motor controller, it is generally necessary to utilize overcurrent devices with the highest degrees of current limitation. For example, most motor controllers cannot achieve Type 2 protection with Class RK5 fuses. It takes Class RK1, Class J, or Class CC fuses. This very high degree of current limitation then is also able to reduce incident energy during an arc-flash event, as long as the arcing current is large enough to be within the overcurrent protective device’s current-limiting threshold.

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Submittal Date: Sat Jul 04 07:57:36 EDT 2015
### Public Input No. 380-NFPA 70E-2015 [ Section No. O.2.4 ]

#### O.2.4 Other Methods.

1. **Energy-reducing active arc flash mitigation system.** This system can reduce the arcing duration by creating a low impedance current path, located within a controlled compartment, to cause the arcing fault to transfer to the new current path, while the upstream breaker clears the circuit. The system works without compromising existing selective coordination in the electrical distribution system.

2. **Arc flash relay.** An arc flash relay typically uses light sensors to detect the light produced by an arc flash event. Once a certain level of light is detected the relay will issue a trip signal to an upstream overcurrent device.

3. **High-resistance grounding.** A great majority of electrical faults are of the phase-to-ground type. High-resistance grounding will insert an impedance in the ground return path and will typically limit the fault current to 10 amperes and below (at 5 kV nominal or below), leaving insufficient fault energy and thereby helping reduce the arc flash hazard level. High-resistance grounding will not affect arc flash energy for line-to-line or line-to-line-to-line arcs.

4. **Current-limiting devices.** Current-limiting protective devices reduce incident energy by clearing the fault faster and by reducing the current seen at the arc source. The energy reduction becomes effective for current above the current-limiting threshold of the current-limiting fuse or current limiting circuit breaker.

5. **Finger-safe components.** Installing finger-safe components, covers, and insulating barriers helps minimize exposure to energized parts, reducing the chances of contacting an energized part or initiating an arc-flash event.

### Statement of Problem and Substantiation for Public Input

Finger-safe components, often called IP-20 components, make it more difficult to accidentally contact an energized part, reducing the chances of shock, and reducing the chances of creating an arcing fault.

### Submitter Information Verification

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<tr>
<td>Organization: Eaton Bussmann Division</td>
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<td>Street Address:</td>
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<td>Submittal Date: Sat Jul 04 08:19:45 EDT 2015</td>
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Public Input No. 381-NFPA 70E-2015 [ Section No. O.2.4 ]

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<td>Current-limiting devices. Current-limiting protective devices reduce incident energy by clearing the fault faster and by reducing the current seen at the arc source. The energy reduction becomes effective for current above the current-limiting threshold of the current-limiting fuse or current limiting circuit breaker.</td>
</tr>
<tr>
<td>(5)</td>
<td>At the motor disconnects. Installing at-the-motor HP-rated disconnects within sight of every motor or driven machine, even where not required, improves the chances that the equipment will be put into an electrically safe work condition before being worked upon.</td>
</tr>
</tbody>
</table>

Statement of Problem and Substantiation for Public Input

Exceptions in the NEC sometimes allow for the avoidance of a disconnecting means within sight of every motor. By assuring that there is a disconnecting means available, whenever possible, the odds are greater that it will be utilized to put the equipment into an electrically safe work condition.

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Submittal Date: Sat Jul 04 08:31:02 EDT 2015
Other Methods.

(1) Energy-reducing active arc flash mitigation system. This system can reduce the arcing duration by creating a low impedance current path, located within a controlled compartment, to cause the arcing fault to transfer to the new current path, while the upstream breaker clears the circuit. The system works without compromising existing selective coordination in the electrical distribution system.

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(4) Current-limiting devices. Current-limiting protective devices reduce incident energy by clearing the fault faster and by reducing the current seen at the arc source. The energy reduction becomes effective for current above the current-limiting threshold of the current-limiting fuse or current limiting circuit breaker.

(5) Installing selectively coordinated overcurrent protective devices. Isolating overcurrent conditions to only the one overcurrent device immediately ahead of the overcurrent eliminates unnecessary power outages and enhances personnel safety because the electrical worker is exposed only at the problem circuit.

Statement of Problem and Substantiation for Public Input

In a selectively coordinated system, overcurrents are isolated to only the nearest upstream devices. Where not selectively coordinated, additional upstream devices can unnecessarily open. When that happens, the worker will normally begin trouble shooting at the upstream device, where incident energy is generally higher. The worker is exposed to fewer energized circuits while trouble-shooting and the circuits to which he or she is exposed, will normally have lower levels of incident energy.

Submitter Information Verification

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Submittal Date: Sat Jul 04 08:44:58 EDT 2015
O.2.4 Other Methods.

1. Energy-reducing active arc flash mitigation system. This system can reduce the arcing duration by creating a low impedance current path, located within a controlled compartment, to cause the arcing fault to transfer to the new current path, while the upstream breaker clears the circuit. The system works without compromising existing selective coordination in the electrical distribution system.

2. Arc flash relay. An arc flash relay typically uses light sensors to detect the light produced by an arc flash event. Once a certain level of light is detected the relay will issue a trip signal to an upstream overcurrent device.

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5. Cable limiters. Cable limiters are optionally used on services between the transformer and the service disconnecting means, on conductors that are "unprotected", and in an area that typically has extremely high incident energy. The current limiting cable limiters can help reduce the incident energy in these areas of high incident energy. Additionally, cable limiters can be utilized to provide short-circuit protection (and therefore incident energy reduction) for feeder tap conductors that are protected at up to ten times their ampacity, a situation where the tap conductor can easily vaporize.

Statement of Problem and Substantiation for Public Input

Unprotected service conductors and underprotected feeder tap conductors can allow for extremely high incident energies. The installation of current-limiting cable limiters can help to significantly reduce that incident energy by providing short-circuit protection for the conductors.

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Submittal Date: Sat Jul 04 09:02:40 EDT 2015
Other Methods.

(1) Energy-reducing active arc flash mitigation system. This system can reduce the arcing duration by creating a low impedance current path, located within a controlled compartment, to cause the arcing fault to transfer to the new current path, while the upstream breaker clears the circuit. The system works without compromising existing selective coordination in the electrical distribution system.

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(4) Current-limiting devices. Current-limiting protective devices reduce incident energy by clearing the fault faster and by reducing the current seen at the arc source. The energy reduction becomes effective for current above the current-limiting threshold of the current-limiting fuse or current limiting circuit breaker.

(5) Breaking larger branch circuits and feeders into smaller ones. Reducing the size of a branch circuit or feeder circuit typically reduces the incident energy. For example, the incident energy for two 800 ampere MCCs will be less than the incident energy for one 1600 ampere MCC.

Statement of Problem and Substantiation for Public Input

The smaller the overcurrent protective device, the lower the incident energy. Wherever possible, the reduction in the size of a feeder or branch circuit will result in lower incident energies. For example, a 1600 ampere MCC with 28,000 amperes available might have an incident energy of 22.7 calories, while two 800 ampere MCCs with 28,000 amperes available might have an incident energy of 1.2 calories, a very significant reduction.

Submitter Information Verification

Submitter Full Name: VINCENT SAPORITA
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Street Address: 
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Submittal Date: Sat Jul 04 09:22:39 EDT 2015
<table>
<thead>
<tr>
<th>Public Input No. 387-NFPA 70E-2015 [ Section No. O.2.4 ]</th>
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</thead>
<tbody>
<tr>
<td><strong>O.2.4 Other Methods.</strong></td>
</tr>
<tr>
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</tr>
<tr>
<td>(5) Lowering adjustable instantaneous trip settings. Where inrush currents allow, an adjustable instantaneous trip can often be lowered, allowing for reduced incident energy.</td>
</tr>
</tbody>
</table>

**Statement of Problem and Substantiation for Public Input**

Incident energy can be quite high for arcing currents that are less than the instantaneous trip of the circuit breaker. If inrush currents are not too high, the instantaneous trip can often be lowered, significantly improving the incident energy for the lower level arcing currents.

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Submittal Date: Sat Jul 04 09:39:07 EDT 2015
Public Input No. 389-NFPA 70E-2015 [Section No. O.2.4]

O.2.4 Other Methods.

1. Energy-reducing active arc flash mitigation system. This system can reduce the arcing duration by creating a low impedance current path, located within a controlled compartment, to cause the arcing fault to transfer to the new current path, while the upstream breaker clears the circuit. The system works without compromising existing selective coordination in the electrical distribution system.

2. Arc flash relay. An arc flash relay typically uses light sensors to detect the light produced by an arc flash event. Once a certain level of light is detected the relay will issue a trip signal to an upstream overcurrent device.

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5. Viewing windows. Installing windows, for infrared viewing or for viewing equipment ratings to perform a 130.5 incident energy analysis, reduces the need to open doors or remove covers, reducing the chances for accidental contact with energized parts and reducing the chances for initiating an arc-flash incident.

Statement of Problem and Substantiation for Public Input

When viewing windows are installed, exposure for the worker is greatly reduced, because enclosure doors do not have to be opened and covers do not have to be removed.

Submitter Information Verification

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Submittal Date: Sat Jul 04 09:50:42 EDT 2015
Public Input No. 409-NFPA 70E-2015 [ Section No. O.2.4 ]

O.2.4   Other Methods.
(1)   Energy-reducing active arc flash mitigation system. This system can reduce the arcing duration by creating a low impedance current path, located within a controlled compartment, to cause the arcing fault to transfer to the new current path, while the upstream breaker clears the circuit. The system works without compromising existing selective coordination in the electrical distribution system.
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(4)   Current-limiting devices. Current-limiting protective devices reduce incident energy by clearing the fault faster and by reducing the current seen at the arc source. The energy reduction becomes effective for current above the current-limiting threshold of the current-limiting fuse or current limiting circuit breaker.
(5)   Main disconnecting means with overcurrent protection. A main disconnecting means allows a worker to easily place the equipment into an electrically safe work condition. A main overcurrent device provides protection for bus that would be unprotected if the six-disconnect rule were utilized.

Statement of Problem and Substantiation for Public Input

The use of the six-disconnect rule can leave unprotected, energized bus, increasing the chance to accidentally contact an energized bus or initiate an arc-flash event. A main disconnecting means provides an easy method to de-energize all but the incoming terminals, while the overcurrent protection is needed to keep incident energy to a manageable level.

Submitter Information Verification

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Submittal Date: Sun Jul 05 09:22:44 EDT 2015
## O.2.4 Other Methods.

1. Energy-reducing active arc flash mitigation system. This system can reduce the arcing duration by creating a low impedance current path, located within a controlled compartment, to cause the arcing fault to transfer to the new current path, while the upstream breaker clears the circuit. The system works without compromising existing selective coordination in the electrical distribution system.

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5. Remote monitoring. Remote monitoring of voltage and current levels reduces exposure to electrical hazards by placing the worker further away from the hazard.

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### Statement of Problem and Substantiation for Public Input

Voltage and current can be displayed on enclosure exteriors, computers and other means that are able to put distance between the hazard and the worker, reducing the chance that the worker will contact an energized conductor or initiate an arc-flash event.

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### Submitter Information Verification

<table>
<thead>
<tr>
<th>Submitter Full Name: VINCENT SAPORITA</th>
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<tbody>
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<td>Organization: Eaton Bussmann Division</td>
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### Public Input No. 412-NFPA 70E-2015 [Section No. O.2.4]

**O.2.4 Other Methods.**

1. Energy-reducing active arc flash mitigation system. This system can reduce the arcing duration by creating a low impedance current path, located within a controlled compartment, to cause the arcing fault to transfer to the new current path, while the upstream breaker clears the circuit. The system works without compromising existing selective coordination in the electrical distribution system.

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5. Arc-resistant switchgear. Arc-resistant equipment is designed with features that divert hot gases, plasma, and other products of an arc flash out of the enclosure so that a worker is not exposed when standing in front of the equipment with all doors and covers closed and latched.

### Statement of Problem and Substantiation for Public Input

Arc-resistant switchgear provides protection for a worker that is energizing or de-energizing the equipment, when the doors and covers are closed and latched. Products of the arc are diverted out of the enclosure, away from the worker. Arc-resistant equipment does not protect the worker when the doors and covers are not properly closed and latched.

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<td>Zip:</td>
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<tr>
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<td>Sun Jul 05 10:17:11 EDT 2015</td>
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Public Input No. 413-NFPA 70E-2015 [ Section No. O.2.4 ]

O.2.4 Other Methods.

(1) Energy-reducing active arc flash mitigation system. This system can reduce the arcing duration by creating a low impedance current path, located within a controlled compartment, to cause the arcing fault to transfer to the new current path, while the upstream breaker clears the circuit. The system works without compromising existing selective coordination in the electrical distribution system.

(2) Arc flash relay. An arc flash relay typically uses light sensors to detect the light produced by an arc flash event. Once a certain level of light is detected the relay will issue a trip signal to an upstream overcurrent device.

(3) High-resistance grounding. A great majority of electrical faults are of the phase-to-ground type. High-resistance grounding will insert an impedance in the ground return path and will typically limit the fault current to 10 amperes and below (at 5 kV nominal or below), leaving insufficient fault energy and thereby helping reduce the arc flash hazard level. High-resistance grounding will not affect arc flash energy for line-to-line or line-to-line-to-line arcs.

(4) Current-limiting devices. Current-limiting protective devices reduce incident energy by clearing the fault faster and by reducing the current seen at the arc source. The energy reduction becomes effective for current above the current-limiting threshold of the current-limiting fuse or current limiting circuit breaker.

(5) Remote racking. Remote racking of equipment, such as remote-controlled motorized remote racking of a circuit breaker or an MCC bucket, moves the worker outside the arc-flash boundary. An extended length hand-operated racking tool also adds distance between the worker and the equipment, reducing the worker's exposure.

Statement of Problem and Substantiation for Public Input

Moving a worker away from the source of the exposure to a location outside the arc-flash boundary can be accomplished through the use of a remote-controlled motorized racking device or through the use of an extended length hand-operated racking tool.

Submitter Information Verification

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Other Methods.

(1) Energy-reducing active arc flash mitigation system. This system can reduce the arcing duration by creating a low impedance current path, located within a controlled compartment, to cause the arcing fault to transfer to the new current path, while the upstream breaker clears the circuit. The system works without compromising existing selective coordination in the electrical distribution system.

(2) Arc flash relay. An arc flash relay typically uses light sensors to detect the light produced by an arc flash event. Once a certain level of light is detected the relay will issue a trip signal to an upstream overcurrent device.

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(4) Current-limiting devices. Current-limiting protective devices reduce incident energy by clearing the fault faster and by reducing the current seen at the arc source. The energy reduction becomes effective for current above the current-limiting threshold of the current-limiting fuse or current limiting circuit breaker.

(5) Remote opening and closing. The remote opening and closing of circuit breakers and switches permits workers to operate the equipment from a safe distance outside the arc-flash boundary.

Statement of Problem and Substantiation for Public Input

Motor-operated circuit breakers and switches are available that allow for a worker to remotely open and close the circuit breaker or switch. Moving the worker outside the arc-flash boundary reduces the hazards to which the worker is exposed.

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Public Input No. 432-NFPA 70E-2015 [Section No. O.2.4]

O.2.4., Other Methods.

(4) Energy-reducing active arc flash mitigation system. This system can reduce the arcing duration by creating a low impedance current path, located within a controlled compartment, to cause the arcing fault to transfer to the new current path, while the upstream breaker clears the circuit. The system works without compromising existing selective coordination in the electrical distribution system.

(5) Arc flash relay. An arc flash relay typically uses light sensors to detect the light produced by an arc flash event. Once a certain level of light is detected the relay will issue a trip signal to an upstream overcurrent device.

(6) High-resistance grounding. A great majority of electrical faults are of the phase-to-ground type. High-resistance grounding will insert an impedance in the ground return path and will typically limit the fault current to 10 amperes and below (at 5 kV nominal or below), leaving insufficient fault energy and thereby helping reduce the arc flash hazard level. High-resistance grounding will not affect arc flash energy for line-to-line or line-to-line-to-line arcs.

(7) Current-limiting devices. Current-limiting protective devices reduce incident energy by clearing the fault faster and by reducing the current seen at the arc source. The energy reduction becomes effective for current above the current-limiting threshold of the current-limiting fuse or current limiting circuit breaker.

Statement of Problem and Substantiation for Public Input

The title of existing clause O.2.4 does not add value by separating the examples in this clause from the examples in clause O.2.3. This proposal is intended to reduce confusion by combining clauses O.2.3 and O.2.4.

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State:
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Submittal Date: Sun Jul 05 17:57:44 EDT 2015
Appendix Q

Note: Add the arc flash tables (available in PDF) after formatting and reviewing. These tables are just as accurate as provided with software. It has been recommended that the tables be marketed for commercial use only, but this is up to the team. So far the results in industrial facilities has been the same 99% of the time to an ERM study. For more information go to www.arcflashtables.com. A validation tool (Excel file) can also be provided. Murphy & Nicole LLC owns the IP and copyright to these tables at this time. The PDF document is not attached, because I am not willing to give up copyright unless an agreement is reached. However, I can send them to you via another method.

The arc flash tables and information provided below is based on IEEE 1584 equations and provides similar results to other industry methods. The tables are a one-step process to be utilized along with pre-printed labels or a portables printer. The validation tool provides the method in full and inputs can be manipulated for non-standard installations. The arc flash tables can be utilized in commercial applications. The arc flash tables do not accomplish protective device coordination, short circuit, voltage drop or load flow analysis, but code violations should be logged during the labeling process.

REQUEST PDF FOR REVIEW

Statement of Problem and Substantiation for Public Input

Commercial compliance is very low in the United States. These tables can also be used in standard design industrial facilities, and the validation tool can be manipulated for non-standard industrial facilities. To date, we have labeled over 1000 points and 99% of the labels match (in PPE) the existing labels that were part of a study done 5 years ago with leading software. This also puts safety in the hands of electricians or field engineers.

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Submittal Date: Mon Apr 13 21:28:59 EDT 2015
Informative Annex Q Example of Equipment Labeling

This informative annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

Q.1 Equipment Labeling Sample. Figure Q.1 illustrates the information on an equipment label required per 130.5(D), when an incident energy analysis has been performed.

(insert picture of label here)

Figure Q.1 Sample Equipment Label

Notes:
(1) Nominal Voltage listed as Alternating or Direct Current; required per 130.5(D)(1)
(2) Arc flash protection boundary, listed in inches; required per 130.5(D)(2)
(3) Incident energy listed in calories per centimeter squared (cal/cm²); required per 130.5(D)(3)(a)
(4) Working distance listed in inches; required per 130.5(D)(3)(a)
(5) Site specific PPE required; required per 130.5(D)(3)(c)

Additional Proposed Changes

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<td>Sample_label_picture.pdf</td>
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Statement of Problem and Substantiation for Public Input

Creating an annex with a sample label will provide guidance on what an arc flash label should look like, and standardize across industry.

Related Public Inputs for This Document

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Submitter Information Verification

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X.1 Introduction

This Annex introduces the concept of human performance and how this concept can be applied to workplace electrical safety.

Human performance is an aspect of risk management that addresses organizational, leader and individual performance as factors that either lead to or prevent errors and their events. The objective of human performance is to identify and address human error and its negative consequences on people, programs, processes, the work environment, an organization, or equipment.

Studies by high risk industries indicate that human error is often a root cause of incidents. The premise of this Annex is that human error is similarly a frequent root cause of electrical incidents. In occupational health and safety terms, an incident is an occurrence arising in the course of work that resulted in or could have resulted in an injury, illness, damage to health, or a fatality (see ANSI/AHA Z10-2012 Definition of Incident).

The hierarchy of risk control methods identified in this and other CSA Standards is:

(a) Eliminating the hazard;
(b) Substituting other materials, processes, or equipment;
(c) Engineering controls;
(d) Systems that increase awareness of potential hazards;
(e) Administrative controls, e.g., training and procedures, instructions, and scheduling; and
(f) PPE, including measures to ensure its appropriate selection, use, and maintenance.

The purpose of these controls is to either reduce the likelihood of an incident occurring or to prevent or mitigate the severity of consequence if an incident occurs. No control is infallible. All of the controls are subject to errors in human performance, whether at the design, implementation, or use phase.

Human performance addresses managing human error as a unique control that is complementary to the hierarchy of risk control methods.

X.2 Principles of human performance

The following are basic principles of human performance:

(a) People are fallible, and even the best people make mistakes.
(b) Error-likely situations and conditions are predictable, manageable, and preventable.
(c) Individual performance is influenced by organizational processes and values.
(d) People achieve high levels of performance largely because of the encouragement and reinforcement received from leaders, peers, and subordinates.
(e) Incidents can be avoided through an understanding of the reasons mistakes occur and application of the lessons learned from past incidents.

X.3 Information processing and attention

The brain processes information in a series of interactive stages:

(a) Attention – where and to what we intentionally or unintentionally direct our concentration.
(b) Sensing – sensory inputs (hearing, seeing, touching, smelling, etc.) receive and transfer information.
(c) Encoding, Storage, Thinking – incoming information is encoded and stored for later use in decision making (i.e., what to do with information). This stage of information processing involves interaction between the working memory and long-term memory (capabilities, knowledge, past experiences, opinions, and perspectives).
(d) Retrieval, Acting – taking physical human action based on the synthesis of attention, sensation, encoded information, thinking, and decision-making. In a workplace environment, this would include changing the state of a component using controls, tools, and computers, including verbal statements to inform or direct others.

According to Rasmussen’s model used to classify human error, workers operate in one or more of three human performance modes: rule-based mode, skill-based mode, and knowledge-based mode.

Note: See Rasmussen, J. (1980); Skills, rules, and knowledge; signals, signs, and symbols, and other distinctions in human performance models. IEEE Transactions on Systems, Man, and Cybernetics, (3), 257-266.

Reason’s Human Performance Generic Error Modeling System is an extension of Rasmussen’s model. An individual consciously or subconsciously selects a human performance mode based on his or her perception of the situation. This perception is usually a function of the individual’s familiarity with a specific task and the level of attention (information processing) applied to accomplish the activity.


Most cognitive psychologists agree that humans have a limited pool of attentional resources available to divide up among tasks. This pool of shared attentional resources enables the mind to process information while performing one or sometimes multiple tasks. Some tasks require more attentional resources than others. The amount of attentional resource required to perform a task satisfactorily defines the mental workload for an individual and is inversely proportional to the individual’s familiarity with the task. An increase in knowledge, skill, and experience with a task decrease the level of attentional resources required to perform that task and therefore decrease the level of attentional resource allocated to that task.

Critical points in activities when risk is higher (increased likelihood of harm or increased severity of harm, or both) require an increased allocation of attentional resources. Allocation at these critical points can be improved by training, procedures, equipment design, and teamwork.

Each human performance mode has associated errors. Awareness of which human performance mode the individual might be in helps identify the kind of errors that could be made and which error prevention techniques would be the most effective.

X.4 Human performance modes and associated errors

X.4.1 Rule-based human performance mode

X.4.1.1 General

An individual operates in rule-based human performance mode when the work situation is likely to be one that he or she has encountered before or has been trained to deal with, or which is covered by a procedure. It is called the rule-based mode because the individual applies memorized or written rules. These rules might have been learned as a result of interaction at the workplace, through formal training, or by working with experienced workers.

The level of required attentional resources when in the rule-based mode fits between that of the knowledge- and skill-based modes. The time devoted to processing the information (reaction time) to select an appropriate response to the work situation is in the order of seconds.

The rule-based level follows an IF (symptom X), THEN (situation Y) logic. The individual operates by matching the signs and symptoms of the situation to some stored knowledge structure, and will usually react in a predictable manner.

In human performance theory, rule-based is the most desirable performance mode. The individual can use conscious thinking to challenge whether or not the proposed solution is appropriate. This can result in additional error prevention being integrated into the solution.

Not all activities guided by a procedure are necessarily executed in rule-based mode. An experienced worker might unconsciously default to the skill-based mode when executing a procedure that is normally done in the rule-based mode.

X.4.1.2 Rule-based human performance mode errors
Since the rule-based human performance mode requires interpretation using an "if-then" logic, misinterpretation is the prevalent type error mode. Errors involve deviating from an approved procedure, applying the wrong response to a work situation, or applying the correct procedure to the wrong situation.

X.4.2 Knowledge-based human performance mode

X.4.2.1 General
A worker operates in knowledge-based human performance mode when there is uncertainty about what to do, no skill or rule is readily identifiable. The individual relies on their understanding and knowledge of the situation and related scientific principles and fundamental theory to develop an appropriate response. Uncertainty creates a need for information. To gather information more effectively, the individual's attentional resources become more focused. Thinking takes more effort and energy, and the time devoted to processing the information to select an appropriate response to the situation can be in the order of minutes to hours.

X.4.2.2 Knowledge-based human performance mode errors
The prevalent error when operating in knowledge-based mode is that decisions are often based on an inaccurate mental picture of the work situation. Knowledge-based activities require decision making based on diagnosis and problem-solving. Humans do not usually perform optimally in high stress, unfamiliar situations where they are required to "think on their feet" in the absence of rules, routines, and procedures to handle the situation. The tendency is to use only information that is readily available to evaluate the situation and to become enmeshed in one aspect of the problem to the exclusion of all other considerations. Decision-making is erroneous if problem-solving is based on incomplete or inaccurate information.

X.4.3 Skill-based human performance mode

X.4.3.1 General
A person is in skill-based mode when executing a task that involves practiced actions in a very familiar and common situation. Human performance is governed by mental instructions developed by either practice or experience and is less dependent on external conditions. The time devoted to processing the information is in the order of milliseconds. Writing one's signature is an example of skill-based performance mode. A familiar workplace procedure is typically performed in skill-based performance mode, such as the operation of a low-voltage molded case circuit breaker.

X.4.3.2 Skill-based human performance mode errors
The relatively low demand on attentional resources required when an individual is in skill-based human performance mode can create the following errors:
(a) Inattention: Skill-based performance mode errors are primarily execution errors involving omissions triggered by human variability, or not recognizing changes in task requirements or work conditions related to the task.
(b) Perceived reduction in risk: As familiarity with a task increases, the individual's perception of the associated risk is less likely to match actual risk. A perceived reduction in risk can create "inattentional blindness" and insensitivity to the presence of hazards.

5 Error precursors
Error precursors are situations when the demands of the task and the environment it is performed in exceed the capabilities of the individual(s) or the limitations of human nature. Error precursors can also be unfavorable conditions that increase the probability for error during a specific action. Error precursors can be grouped into four broad categories.
(a) Task demands – when specific mental, physical, or team requirements to perform a task either exceed the capabilities or challenge the limitations of the individual assigned to the task.
(b) Work environment – when general influences of the workplace, organizational, and cultural conditions affect individual performance.
(c) Individual capabilities – when an individual's unique mental, physical, and emotional characteristics do not match the demands of the specific task.
(d) Human nature – when traits, dispositions, and limitations common to all persons incline an individual to err under unfavorable conditions.

Table X.1 provides a list of specific examples for each category.
When error precursors are identified and addressed then the likelihood of human error is reduced.

6 Human performance tools

6.1 Application
Human performance tools reduce the likelihood of error when applied to error precursors. Consistent use of human performance tools by an organization will facilitate the incorporation of best practice work. The following are some human performance tools. See Table X.1 for a list of these tools.

6.2 Job planning and pre-job briefing tool (See 110.1(H))
Creating a job plan and conducting the pre-job briefing assists personnel to focus on the performance of the tasks and to understand their role in the execution of the tasks. The following is a graded approach that can be used when job planning to identify error precursors and select an appropriate human performance tool, or combination of tools, proportionate to the potential consequences of error:
1. Summarize the critical steps of the job that, if performed improperly, will cause irreversible harm to persons or equipment, or will significantly impact operation of a process.
2. Anticipate error precursors for each critical step.
3. Foresee probable and worst-case consequences if an error occurs during each critical step.
4. Evaluate controls or contingencies at each critical step to prevent, catch, and recover from errors and to reduce their consequences.
5. Review previous experience and lessons learned relevant to the specific task and critical steps.

If one or more human performance tools are identified, then each tool should be discussed regarding its advantages, disadvantages, and when and how it should be applied.

6.3 Job site review tool
Incorporating a job site review into job planning facilitates the identification of hazards and potential barriers and delays. A job site review can be performed any time prior or during work.

6.4 Post-job review tool
A Post-job review is a positive opportunity to capture feedback and lessons learned from the job that can be applied to future jobs. The use of or lack of use of human performance tools should be incorporated into the review.

6.5 Procedure use and adherence tool
Adhering to a written step-by-step sequential procedure is a human performance tool. The worker should proactively read and understand the purpose, scope, and intent of all actions as written and in the sequence specified.
An accurate and current account of progress should be kept by marking each step in the procedure as it is completed. This ensures that if the procedure is interrupted before all the steps are completed:
(1) The job site or activity can be left in a safe state; and
(2) The procedure can be resumed at the point it was interrupted.

If the procedure cannot be used as written, or if the expected result cannot be accurately predicted, then the activity should be stopped and the issues resolved before continuing.
An example of adhering to a written step-by-step sequential procedure is a "switching sequence", wherein the sequential order of operation of electrical distribution equipment is identified and documented for the purposes of de-energizing and re-energizing.

6.6.6 Self-check with verbalization tool
The self-check with verbalization tool is also known by the acronym STAR – Stop, Think, Act, and Review. Before, during, and after performing a task that cannot be reversed the worker should stop, think, and openly verbalize their actions. Verbalization permits the individual’s brain to slow down to their body speed. It has the effect of keeping the individual focused, thus enabling them to act and then review their actions.

Example: A worker has one more routine task to complete before the end of shift – to approach a group of motor control panels and close a circuit breaker in one of those panels. The error precursors are task demands (in a hurry) and human nature (complacency). If the worker verbalizes each step in the task and the expected outcome of each step, he or she is less likely to operate the wrong circuit breaker and will be prepared in the event that the outcome of an action does not match the expectation. For example, the worker self checks and verbalizes:

1. “I am at Panel 12 Bravo (12B);”
2. “I am about to close Circuit Breaker 4 Bravo (4B);”
3. The pump motor heater indicator light will engage bright red on Panel 10 Bravo (10B);
4. The pump motor should not start;
5. If the pump motor starts then I will open Circuit Breaker 4 Bravo;
6. I am now closing Circuit Breaker 4 Bravo”.

X.6.7 Three-way communication tool

The three-way communication tool facilitates a mutual understanding of the message between the sender and receiver. After a directive or statement is made by the sender, it is repeated back by the receiver to confirm the accuracy of the message.

When the message includes the use of letters then whenever possible the letters should be communicated using the phonetic alphabet.

Example: A sender issues a directive over a radio communication device: “Close circuit breaker 4 Bravo.” The receiver repeats the message: “I understand, close circuit breaker 4 Bravo.” The sender validates that the proper response was understood: “That is correct” or “Affirmative.”

X.6.8 Stop when unsure tool

When a worker is unable to follow a procedure or process step, if something unexpected occurs or if the worker has a “gut feeling” that something is not right, then the worker should stop and obtain further direction. The “stop when unsure” tool requires that the worker maintains a questioning attitude at all times.

Phrases such as “I think” or “I’m pretty sure,” whether verbalized or not, are an indication that the worker is in knowledge-based mode and needs to transition to rule-based mode. This transition should be communicated to co-workers.

X.6.9 Flagging and blocking tools (See 130.7(E))

Flagging is a method to ensure the correct component is manipulated or worked on at the required time under the required conditions. It could be a marker, label, or device.

It should be used when an error-likely situation or condition is present, such as

1. Similar or “look-alike” equipment;
2. Working on multiple components;
3. Frequent operations performed in a short period of time; or
4. Interruption of process critical equipment

Blocking is a method of physical preventing access to an area or equipment controls.

Hinged covers on control buttons or switches, barricades, fences or other physical barriers, whether temporary or permanent, are examples of blocking tools.

Blocking can be used in conjunction with flagging.

X.7 Human performance warning flags

X.7.1 General

There are common process, organizational, supervisory, and worker performance weaknesses that serve as human performance warning flags. These warning flags should be identified by the organization and action taken to address the root cause.

X.7.2 Program or process

The following are program or process human performance warning flags

(a) Risk management processes are over-relied on, instead of personal ownership and accountability for managing risk,
(b) Risk management processes are inefficient or cumbersome (“more” is often not better).

X.7.3 Organizational performance

The following are organizational human performance warning flags

(a) Personnel in the organization tend to engage in consensus or group thinking, without encouraging counterview points,
(b) Personnel overly defer to managers and perceived experts,
(c) Activities with high risk are not assigned clear owners,
(d) Past success without adverse outcomes becomes the basis for continuing current practices,
(e) The organization assumes that risk management is healthy because a program or process was established (i.e., complacency exists).

X.7.4 Supervisory performance

The following are supervisory human performance warning flags

(a) Delegation is lacking, with a few individuals relied on to make major decisions,
(b) Supervision is physically or mentally separated from the job site and is insufficiently aware of current conditions and attitudes,
(c) Personnel in the organization do not understand how risk is perceived and managed at the worker level,
(d) Past success without adverse outcomes becomes the basis for continuing current practices,
(e) Performance indicators are used to justify existing risk management strategies.

X.7.5 Worker performance

The following are worker human performance warning flags

(a) Individuals or groups exhibit self-imposed production pressure,
(b) Work activities are considered routine,
(c) Individuals are quick to make risk judgments without taking the time to fully understand the situation,
(d) Past success without adverse outcomes becomes the basis for continuing current practices,
(e) Personnel take pride in their ability to work through or with levels of risk that could have been mitigated or eliminated,
(f) Risk is not communicated effectively up the company. Individuals assume that the next level of supervision knows or understands the risk involved or that there are insufficient resources to manage the risk,
(g) Problem reporting is not transparent. Individuals are not willing to report high risk conditions.
X.8 Workplace culture

X.8.1 General
The reduction or elimination of electrical incidents requires that all members at the workplace cultivate and consistently exhibit a culture that supports the use of human performance tools and principles. Workers, supervisors and managers must all work together to implement strong human performance practices.

X.8.2 Workers
The safe performance of activities by workers is a product of mental processes influenced by factors related to the work environment, the task demands, and the capabilities of the worker. All need to take responsibility for their actions and strive to improve themselves, the task at hand, and the work environment. Five general practices that should be consistently demonstrated by workers include
(a) Communication to support a consistent understanding;
(b) Anticipation of error-likely situations and conditions;
(c) Desire to improve personal capabilities;
(d) Reporting all incidents (including "near-miss" incidents); and
(e) A commitment to utilize human performance tools and principles.

X.8.3 Supervisors and managers
Through their actions, supervisors focus worker and team efforts in order to accomplish a task. To be effective, supervisors must understand what influences worker performance. Supervisors promote positive outcomes into the workplace environment to encourage desired performance and results. Supervisors must demonstrate a passion for identifying and preventing human performance errors. They influence both individual and company performance in order to achieve high levels of workplace electrical safety. Five general practices that should be consistently demonstrated by supervisors include
(a) Promote open communication;
(b) Encourage teamwork to eliminate error-likely situations and conditions;
(c) Seek out and eliminate broader company weaknesses that may create opportunity for error;
(d) Reinforce desired workplace culture; and
(e) Recognize the value in preventing errors, reporting of near-miss incidents and the utilization of human performance tools and principles.

X.8.4 The organization
It is important that an organization’s procedures, processes, and values recognize and accept that people make mistakes. The policies and goals of an organization influence worker and supervisor performance. Five general practices that should be consistently demonstrated by an organization include
(a) Promote open communication;
(b) Foster a culture that values error prevention and the use of human performance tools;
(c) Identify and prevent the formation of error-likely situations and conditions;
(d) Support continuous improvement and learning across the entire organization; and
(e) Establish a blame-free culture that supports incident reporting and proactively identifies and reacts appropriately to risk.

Table X.1
Error precursor identification and human performance tool selection (See X.5 and X.6.1)

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<th>Human performance tools</th>
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<td>Time pressure (in a hurry)</td>
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<td>Increased situational awareness</td>
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<td><strong>3 Post-job review</strong></td>
<td>Identify ways to improve and best practices</td>
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<td><strong>4 Procedure use and adherence</strong></td>
<td>Peer check</td>
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<td>Step-by-step procedure read, outcome understood</td>
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<td><strong>6 Three-way communication</strong></td>
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<td><strong>7 Stop when unsure</strong></td>
<td>Directives are repeated by receiver back to sender; receiver is acknowledged by sender</td>
</tr>
<tr>
<td>Lack of or unclear standards</td>
<td><strong>8 Flagging and blocking</strong></td>
<td>Use of the phonetic alphabet for clarity</td>
</tr>
<tr>
<td><strong>Work Environment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distractions/interruptions</td>
<td><strong>9 Stop when unsure</strong></td>
<td>Maintain a questioning attitude</td>
</tr>
<tr>
<td>Changes/departures from routine</td>
<td><strong>10 Stop when unsure</strong></td>
<td>Identify (flag) equipment and controls that will be operated; prevent access (block) equipment and controls that should not be operated</td>
</tr>
<tr>
<td>Confusing displays or controls</td>
<td><strong>11 Stop when unsure</strong></td>
<td></td>
</tr>
<tr>
<td>Workarounds/out of service instrumentation</td>
<td><strong>12 Stop when unsure</strong></td>
<td></td>
</tr>
<tr>
<td>Obscure electrical supplies or configurations</td>
<td><strong>13 Stop when unsure</strong></td>
<td></td>
</tr>
<tr>
<td>Unexpected equipment conditions</td>
<td><strong>14 Stop when unsure</strong></td>
<td></td>
</tr>
<tr>
<td>Lack of alternative indication</td>
<td><strong>15 Stop when unsure</strong></td>
<td></td>
</tr>
<tr>
<td>Personality conflicts</td>
<td><strong>16 Stop when unsure</strong></td>
<td></td>
</tr>
<tr>
<td>Individual Capabilities</td>
<td><strong>17 Stop when unsure</strong></td>
<td></td>
</tr>
<tr>
<td>Unfamiliar with, or first time performing task</td>
<td><strong>18 Stop when unsure</strong></td>
<td></td>
</tr>
<tr>
<td>Lack of knowledge (faulty mental model)</td>
<td><strong>19 Stop when unsure</strong></td>
<td></td>
</tr>
<tr>
<td>New technique not used before</td>
<td><strong>20 Stop when unsure</strong></td>
<td></td>
</tr>
<tr>
<td>Imprecise communication habits</td>
<td><strong>21 Stop when unsure</strong></td>
<td></td>
</tr>
<tr>
<td>Lack of proficiency or experience</td>
<td><strong>22 Stop when unsure</strong></td>
<td></td>
</tr>
</tbody>
</table>
### Notes:
This Table may be utilized when identifying workplace hazards. Identify the error precursors in the left-hand column. Select the optimal human performance tool or combination of tools from the right-hand column. List the selected tool(s) in the centre column beside the associated error.

This Table does not include all possible human performance tools; however, all tools listed can be applied to each error precursor.

### Additional Proposed Changes

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description Approved</th>
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<tbody>
<tr>
<td>CSA_Z462_Technical_Committee_Public_Input_Annex_X__Human_Performance_and_Worplace_Electrical_Safety_Clean.docx</td>
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</tr>
</tbody>
</table>

### Statement of Problem and Substantiation for Public Input

This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.

This material for this proposed Annex is taken directly from Annex U of CSA Z462 – 2015 Workplace Electrical Safety. The cross references have been revised from the CSA Clause numbers to the NFPA Article and Section numbers to match NFPA 70E.

Rationale for adding the new annex:
The purpose of the Annex is to introduce to users of 70E the concept of human performance – human error – and to demonstrate how it can be applied to workplace electrical safety.

The basic principle of human performance is that humans are fallible. Even the best intentioned person errs. The objective of human performance is to identify and address human error and its negative consequences on people, programs, processes, the work environment, an organization, or equipment.

Risk assessment is now a fundamental part of this Standard. If it is to be comprehensive it needs to include organizational, leader and individual human performance factors that can either lead to or prevent errors and their events.

A related Public Input has been submitted to reference this new Annex in Article 130.5.

### Related Public Inputs for This Document

<table>
<thead>
<tr>
<th>Related Input</th>
<th>Relationship</th>
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<tbody>
<tr>
<td>Public Input No. 340-NFPA 70E-2015 [Section No. 130.5]</td>
<td>PI 340 includes a proposal to reference the new annex</td>
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### Submitter Information Verification

<table>
<thead>
<tr>
<th>Submitter Full Name</th>
<th>Organization</th>
<th>Affiliation</th>
<th>Street Address</th>
<th>City</th>
<th>State</th>
<th>Zip</th>
<th>Submittal Date</th>
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</thead>
<tbody>
<tr>
<td>DANIEL ROBERTS</td>
<td>SCHNEIDER ELECTRIC</td>
<td>This Public Input is submitted by Daniel Roberts in behalf of the Canadian Standards Association (CSA) Z462 Workplace Electrical Safety Technical Committee.</td>
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<td></td>
<td>Mon Jul 06 14:32:30 EDT 2015</td>
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