AGENDA

NEC Code-Making Panel 9

Report on Proposal Meeting

January 9-11, 2012

Hilton Head, SC

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9-1 Log #1170h NEC-P09

(Entire Document)

Submitter: Russell LeBlanc, The Peterson School

Recommendation: In articles 90 through 830, if the wording is not already there, then add the words (or other structure(s)) after the word BUILDING(S) wherever the intent of the requirement is to also include STRUCTURES as well as buildings.

Substantiation: There is a flaw in the NEC. The term "building" is used over 1000 times in the NEC, and in most of the cases the words "or other structure" should follow and apply the same requirements to bridges, billboards, towers, tanks, and other structures that are by definition NOT BUILDINGS. One specific example I can use is section 225.10 Wiring on Buildings. I believe that this section is also intended to be applied structures, but the wording "or other structures" is not in the heading or the paragraph. There are literally thousands of other instances throughout the code that this same problem exists. This can easily be seen by doing an electronic search for the word "building". In some cases the words "or other structure" (or similar wording) are present, but in the vast majority where the requirements should also be applied to structures other than buildings, the wording is not there.

9-2 Log #921h NEC-P09

(Entire Document)

Submitter: Joe Tedesco, Boston, MA

Recommendation: The term "adequate" and "adequately" and "inadequately" and "inadequate" should be replaced with terms that can be properly enforced and understood.

Substantiation: Terms are not defined and are considered vague and unenforceable per Table 3.2.1 in the NEC Style Manual. They are all "incorrect" 148 times in the NEC.

9-3 Log #1180 NEC-P09

(100.Askarel)

Submitter: Marcelo M. Hirschler, GBH International

Recommendation: Revise text to read as follows:

Askarel. A generic term for a group of nonflammable synthetic chlorinated hydrocarbons used as electrical insulating media. Askarels of various compositional types are used. Under arcing conditions, the gases produced, while consisting predominantly of noncombustible hydrogen chloride, can include varying amounts of combustible gases, depending on the askarel type.

Informational Note: Askarels of various compositional types are used. Under arcing conditions, the gases produced, while consisting predominantly of noncombustible hydrogen chloride, can include varying amounts of combustible gases, depending on the askarel type.

Substantiation: The NFPA Manual of Style requires definitions to be in single sentences. The information provided in the subsequent sentences is not really a part of the definition; it is further information that is best placed in an informational note.
Submitter: Marcelo M. Hirschler, GBH International
Recommendation: Revise text to read as follows:
Conduit Body. A separate portion of a conduit or tubing system that provides access through a removable cover(s) to the interior of the system at a junction of two or more sections of the system or at a terminal point of the system. Boxes such as FS and FD or larger cast or sheet metal boxes are not classified as conduit bodies.

Informational Note: Boxes such as FS and FD or larger cast or sheet metal boxes are not classified as conduit bodies.

Substantiation: The NFPA Manual of Style requires definitions to be in single sentences. The information provided in the subsequent sentences is not really a part of the definition; it is further information that is best placed in an informational note.

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Submitter: Steve Carle, Advanced Currents Corp.
Recommendation: Add text to read as follows:

Article 100 Definitions
I. General

Connector Fitting. A specialized component that provides both electrical terminations and mechanical strain relief. It must be used in conjunction with an incorporated box that is designed and approved for use with it.

Substantiation: This companion proposal for 300.15 introduces a new component that combines the features of a fitting and a connector into one part. This proposal is needed to clearly define what a “connector fitting” is so there is no ambiguity.

Note: This is a companion proposal to 300.15, 334.30 and 314.16.

Note: Supporting material is available for review at NFPA Headquarters.
Enclosed Switch. An enclosure for a switch design for surface or flush mounting, that has a swinging door or attachable cover that is or can be secured to the wall of the enclosure.

Cutout Box. An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the box proper.

I propose that the present definition for cutout box be deleted from the Code, and that the term cutout box be replaced by the term "enclosed switch ".

In Section 110.28, of the 2011 NEC, the term "enclosed switches" is used.

The phrase 'enclosures for switches' was added to the 2011 NEC in 312.8. (Proposal by Mr. Pauley - ROP 9-34 (Log #3758)) by a unanimous vote.

Switch and Overcurrent Device Enclosures with Splices, Taps, and Feed-Through Conductors.

The wiring space of enclosures for switches or overcurrent devices shall be permitted for conductors feeding through, spliced, or tapping off to other enclosures, switches, or overcurrent devices where all of the following conditions are met:

Enclosures are defined, and switches are and defined.

A companion proposal has been sent to Code Panel 9 for Article 312 toward this end.

It is well understood what a switch does, and six types of switches are presently defined in Article 100. Enclosures are also defined in Article 100.

However, the present Code definition of cutout box - shown below - does not include any reference to switching, but only to the enclosure.

"Cutout Box. An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the box proper."

In addition, I'm thinking that the use of the term cutout box may be outdated.

Over 70 years ago, electrical workers were probably more familiar with the term cutout box.

In my experience, today's electrical workers use the words 'switch' or 'disconnect' instead of the term 'cutout '.

The only use of the term cutout that I am familiar with or being generally referred to is for switching of customer owned or utility type pole top electrical distribution of medium and high voltage circuits or systems.

The term cutout box is a holdover from decades ago when the first switches were open type knife switches with exposed live parts.

Eventually, these open knife switches were placed in wood cabinets, then later in metal enclosures.

As a wireman, electrical contractor, and electrical inspector, I have seen 1940 vintage switch enclosures (commonly known today as a fused disconnect or safety switch), which had an orange and yellow colored circular UL label that read "UL Listed Cut Out Box".

I have drawn the conclusion, after talking to many electrical professionals, that a cutout box is really what we refer to today as a fused disconnect or safety switch.

Combining the two already NEC defined terms of 'switch' and 'enclosure' into the new term 'enclosed switch', seems to me to be useable, understandable, and enforceable. It might even make sense.

An alternate idea is to use the phrase 'Switch enclosure '.

As a Code user, I appreciate and support the Chairman of the NEC correlating committee's stated goal of 'making the NEC say what it means, and mean what it says'.

Respectfully,

A companion proposal has been submitted to Article 312 to replace the term cutout box with enclosed switch throughout Article 312.
Revise the definition to read as follows:

**Metal-Enclosed Power Switchgear.** A switchgear assembly completely enclosed on all sides and top with sheet metal (except for ventilating openings and inspection windows) and containing primary power circuit switching, interrupting devices, or both, with buses and connections. The assembly may include control and auxiliary devices. Access to the interior of the enclosure is provided by doors, removable covers, or both. Metal-enclosed power switchgear is available in non-arc-resistant or arc-resistant constructions.

**Substantiation:** Metal-enclosed power switchgear is not listed by UL only metal-enclosed switchgear is so the definition should reflect the real equipment. All listings appear to be over 600 volts only.

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Revise text to read as follows:

**Metal-Enclosed Power Switchgear.** A switchgear assembly completely enclosed on all sides and top with sheet metal (except for ventilating openings and inspection windows) and containing primary power circuit switching, interrupting devices, or both, with buses and connections. The assembly may include control and auxiliary devices. Access to the interior of the enclosure is provided by doors, removable covers, or both. Metal-enclosed power switchgear is available in non-arc-resistant or arc-resistant constructions.

**Informational Note:** The assembly may include control and auxiliary devices. Access to the interior of the enclosure is provided by doors, removable covers, or both. Metal-enclosed power switchgear is available in non-arc-resistant or arc-resistant constructions.

**Substantiation:** The NFPA Manual of Style requires definitions to be in single sentences. The information provided in the subsequent sentences is not really a part of the definition; it is further information that is best placed in an informational note.
Switch Enclosure. An enclosure for a switch designed for surface or flush mounting, that has a swinging door or attachable cover that is or can be secured to the wall of the enclosure.

Cutout Box. An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the box proper.

I propose that the present definition for cutout box be deleted from the Code, and that the term cutout box be replaced by the term "switch enclosure".

A companion proposal has been sent to Code Panel 9 for Article 312 toward this end.

It is well understood what a switch does, and six types of switches are presently defined in NEC Article 100. Enclosures are also defined in NEC Article 100.

However, the present Code definition of cutout box - shown below - does not include any reference to switching, but only to the enclosure.

"Cutout Box. An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the box proper."

In addition, I'm thinking that the use of the term cutout box may be outdated.

Over 70 years ago, electrical workers were probably more familiar with the term cutout box.

In my experience, today's electrical workers use the words 'switch' or 'disconnect' instead of the term 'cutout'.

The only use of the term cutout that I am familiar with or being generally referred to is for switching of customer owned or utility type pole top electrical distribution of medium and high voltage circuits or systems.

The term cutout box is a holdover from decades ago when the first switches were open type knife switches with exposed live parts.

Eventually, these open knife switches were placed in wood cabinets, then later in metal enclosures.

As a wireman, electrical contractor, and electrical inspector, I have seen 1940 vintage switch enclosures (commonly known today as a fused disconnect or safety switch), which had an orange and yellow colored circular UL label that read "UL Listed Cut Out Box".

I have drawn the conclusion, after talking to many electrical professionals, that a cutout box is really what we refer to today as a fused disconnect or safety switch.

Combining the two already NEC defined terms of 'switch' and 'enclosure' into the new term 'switch enclosure', seems to me to be useable, understandable, and enforceable. It might even make sense.

As a Code user, I appreciate and support the Chairman of the NEC correlating committee's stated goal of 'making the NEC say what it means, and mean what it says'.

Respectfully,

A companion proposal has been submitted to Section Article 312 to replace the term cutout box with switch enclosure throughout Article 312.
Report on Proposals – June 2013

Submitter: Mike Weitzel, Bechtel
Recommendation: Add new text to read as follows:

Switch, Enclosed. A switch that is surrounded by a case, housing, fence, or wall(s) that prevents persons from accidentally contacting energized parts.

Substantiation: This is a companion proposal to Article 312, where the term enclosed switches is proposed to be added to the entire article.

Enclosed switches is a term that is presently used in the Code.
For the 2011 NEC Cycle, CMP 1 added "enclosed switches" to Section 110.28, and CMP 9 added "enclosures for switches" to Section 312.8 by a unanimous vote.

We know what an enclosed switch is by use, and by common sense.
It would help to have a clear definition of an enclosed switch in the NEC.
The Code has terms such as 'cutout box', which is an antiquated term that is still in the Code and the UL Product Standards, but electrical workers, engineers, and inspectors generally don't use the term, and only a small number of them could not give you a definition of it if asked.

However, this proposal leaves the term 'cutout box' exactly as it is in the NEC.

There has been an emphasis in the NEC overall to make the Code 'say what it means, and mean what it says'. An example of this is Code Making Panel 5 for grounding and bonding in the last two Code cycles. The definition for "Ground" in the 2005 NEC took 28 words to define the term.

For the 2008 Cycle, the definition became simply "Ground. The Earth." The same thing happened with the term "Grounded Conductor", which is mostly used as a neutral. For instance, say an electrical worker would remove a 120-volt flush-mounted wall receptacle outlet to work on it.

If asked what the 'white wire' on the receptacle was, he would not say "well, it's the grounded conductor", instead he would call it the "neutral".

The point is that the terms "Neutral conductor", and "Neutral Point" were added to improve communication and understanding of the NEC.

This should not to be considered as 'dumbing down' the document, far from it.
Rather, the goal is to provide technically correct and understandable terms for all to use, in order to assure understanding in communication, and proper installation.

If we don't propose a change, CMP 1 don't have a change to work with.

Submitter: Marcelo M. Hirschler, GBH International
Recommendation: Revise text to read as follows:

Switch, Isolating. A switch intended for isolating an electrical circuit from the source of power. It has no interrupting rating, and it is intended to be operated only after the circuit has been opened by some other means.

Informational Note: It has no interrupting rating, and it is intended to be operated only after the circuit has been opened by some other means.

Substantiation: The NFPA Manual of Style requires definitions to be in single sentences. The information provided in the subsequent sentences is not really a part of the definition; it is further information that is best placed in an informational note.
### 9-12 Log #422 NEC-P09 (100.Switchboard)

**Final Action:**

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<th>Submitter: Joel A. Rencsok, Scottsdale, AZ</th>
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<td><strong>Recommendation:</strong> Revise text to read as follows: Switchboard. A large single panel, frame, or assembly of panels on which are mounted on the face, back, or both, switches, overcurrent and other protective devices, buses, and usually instruments. Switchboards are generally accessible from the rear as well as from the front. and are not intended to be installed in cabinets. Substantiation: Switchboards cannot be purchased unless enclosed in a metal enclosure so the definition should reflect the change. See also NEC 408.2 for additional requirements.</td>
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### 9-13 Log #1200 NEC-P09 (100.Switchboard)

**Final Action:**

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<td><strong>Recommendation:</strong> Revise text to read as follows: Switchboard. A large single panel, frame, or assembly of panels on which are mounted on the face, back, or both, switches, overcurrent and other protective devices, buses, and usually instruments. Switchboards are generally accessible from the rear as well as from the front and are not intended to be installed in cabinets. Informational Note: Switchboards are generally accessible from the rear as well as from the front and are not intended to be installed in cabinets. Substantiation: The NFPA Manual of Style requires definitions to be in single sentences. The information provided in the subsequent sentences is not really a part of the definition; it is further information that is best placed in an informational note.</td>
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### 9-14 Log #615 NEC-P09 (100.Switchboard, Metal Enclosed (New))

**Final Action:**

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<td><strong>Recommendation:</strong> Add a new definition for Metal Enclosed Switchboard to read as follows: Switchboard, Metal Enclosed. A large single panel, frame, or assembly of panels on which are mounted on the face, back, or both, switches, overcurrent and other protective devices, buses, and usually instruments. Metal enclosed switchboards are generally accessible from the front and are designed to be placed in a floor-standing enclosure. Substantiation: There is no definition in the NEC for Metal Enclosed Switchboards. I think the code should have a better definition for this type of installation. Many areas of the NEC refer to metal enclosed switchboards.</td>
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### 9-15 Log #255a NEC-P09 (240.83(D) and 404.11)

**Final Action:**

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<td><strong>Recommendation:</strong> Delete text as follows: 240.83(D) Used as Switches. Circuit breakers used as switches in 120-volt and 277-volt fluorescent lighting circuits shall be listed and shall be marked SWD or HID. Circuit breakers used as switches in high intensity discharge lighting circuits shall be listed and shall be marked as HID. Substantiation: Do not allow circuit breakers to be used as switches. In the 2009 edition of Electrical Safety in the Workplace (NFPA 70E Table 130.7(C)(9)) you have the hazard class as 0 for &gt;240v and up. To many office persons are not using the protection needed when turning on 277v lighting breakers as they are only aware that the NFPA 70 says it is okay to use a breaker as a switch.</td>
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Recommendation: Revise text to read as follows:

I. General  312.1 no change.
II. Installation  312.2 through 312.9 no change.
III. Construction Specifications  312.10 and 312.11 no change.

Substantiation: This is an editorial change to bring the parts numbering that appears in most of Chapter Three into a consistent usage. The style manual, in 2.4.1, suggests that, where possible, the same part numbers are to be used for the same purposes within articles covering similar subjects. Most of the articles in Chapter Three are similar and use the same format. Having taught code related classes to apprentices and journeymen for the past 13 years, I have heard students complain about such inconsistencies. Hence, this change goes to improving usability.
This article covers the installation and construction specifications of cabinets, switch enclosures, cutout boxes, and meter socket enclosures.

312.1 Scope. This article covers the installation and construction specifications of cabinets, switch enclosures, cutout boxes, and meter socket enclosures.

1. Installation

312.2 Damp and Wet Locations. In damp or wet locations, surface-type enclosures within the scope of this article shall be placed or equipped so as to prevent moisture or water from entering and accumulating within the cabinet or cutout box, and shall be mounted so there is at least 6-mm (1/4-in.) airspace between the enclosure and the wall or other supporting surface. Enclosures installed in wet locations shall be weatherproof. For enclosures in wet locations, raceways or cables entering above the level of uninsulated live parts shall use fittings listed for wet locations.

Exception: Nonmetallic enclosures shall be permitted to be installed without the airspace on a concrete, masonry, tile, or similar surface.

Informational Note: For protection against corrosion, see 300.6.

312.3 Position in Wall. In walls of concrete, tile, or other noncombustible material, cabinets and switch enclosures shall be installed so that the front edge of the cabinet is not set back of the finished surface more than 6 mm (1/4 in.). In walls constructed of wood or other combustible material, cabinets shall be flush with the finished surface or project therefrom.

312.4 Repairing Noncombustible Surfaces. Noncombustible surfaces that are broken or incomplete shall be repaired so there will be no gaps or open spaces greater than 3 mm (1/8 in.) at the edge of the cabinet or switch enclosure, cutout box employing a flush-type cover.

312.5 Cabinets, Switch Enclosures, Cutout Boxes, and Meter Socket Enclosures. Conductors entering enclosures within the scope of this article shall be protected from abrasion and shall comply with 312.5(A) through (C).

(A) Openings to Be Closed. Openings through which conductors enter shall be adequately closed.

(B) Metal Cabinets, Switch Enclosures, Cutout Boxes, and Meter Socket Enclosures. Where metal enclosures within the scope of this article are installed with messenger-supported wiring, open wiring on insulators, or concealed knob-and-tube wiring, conductors shall enter through insulating bushings or, in dry locations, through flexible tubing extending from the last insulating support and firmly secured to the enclosure.

(C) Cables. Where cable is used, each cable shall be secured to the cabinet, switch, cutout box, or meter socket enclosure.

Exception: Cables with entirely nonmetallic sheaths shall be permitted to enter the top of a surface-mounted enclosure through one or more nonflexible raceways not less than 450 11/16 in. (18 in.) and not more than 3.0 m (10 ft) in length, provided all of the following conditions are met:

(a) Each cable is fastened within 300 mm (12 in.), measured along the sheath, of the outer end of the raceway.

(b) The raceway extends directly above the enclosure and does not penetrate a structural ceiling.

(c) A fitting is provided on each end of the raceway to protect the cable(s) from abrasion and the fittings remain accessible after installation.

(d) The raceway is sealed or plugged at the outer end using approved means so as to prevent access to the enclosure through the raceway.

(e) The cable sheath is continuous through the raceway and extends into the enclosure beyond the fitting not less than 6 mm (1/4 in.).

(f) The raceway is fastened at its outer end and at other points in accordance with the applicable article.

(g) Where installed as conduit or tubing, the allowable cable fill does not exceed that permitted for complete conduit or tubing systems by Table 1 of Chapter 9 of this Code and all applicable notes thereto.

Informational Note: See Table 1 in Chapter 9, including Note 9, for allowable cable fill in circular raceways. See 310.15(B)(3)(a) for required ampacity reductions for multiple cables installed in a common raceway.

Table 312.6(A) Minimum Wire-Bending Space at Terminals and Minimum Width of Wiring Gutters
- NO CHANGES TO THIS TABLE -

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312.6 Deflection of Conductors. Conductors at terminals or conductors entering or leaving cabinets, switch enclosures, or cutout boxes and the like shall comply with 312.6(A) through (C).

Exception: Wire-bending space in enclosures for motor controllers with provisions for one or two wires per terminal shall comply with 430.10(B).

(A) Width of Wiring Gutters. Conductors shall not be deflected within a cabinet switch enclosure, or cutout box, unless a gutter having a width in accordance with Table 312.6(A) is provided, Conductors in parallel in accordance with 310.10(H) shall be judged on the basis of the number of conductors in parallel.

(B) Wire-Bending Space at Terminals. Wire-bending space at each terminal shall be provided in accordance with 312.6(B)(1) or (B)(2).

1. Conductors Not Entering or Leaving Opposite Wall. Table 312.6(A) shall apply where the conductor does not enter or leave the enclosure through the wall opposite its terminal.

2. Conductors Entering or Leaving Opposite Wall. Table 312.6(B) shall apply where the conductor does enter or leave the enclosure through the wall opposite its terminal.

Exception No. 1: Where the distance between the wall and its terminal is in accordance with Table 312.6(A), a conductor shall be permitted to enter or leave an enclosure through the wall opposite its terminal, provided the conductor enters or leaves the enclosure where the gutter joins an adjacent gutter that has a width that conforms to Table 312.6(B) for the conductor.

Exception No. 2: A conductor not larger than 350 kmil shall be permitted to enter or leave an enclosure containing only a meter socket(s) through the wall opposite its terminal, provided the distance between the terminal and the opposite wall is not less than that specified in Table 312.6(A) and the terminal is a lay-in type, where the terminal is either of the following:

(a) Directed toward the opening in the enclosure and within a 45 degree angle of directly facing the enclosure wall
(b) Directly facing the enclosure wall and offset not greater than 50 percent of the bending space specified in Table 312.6(A).

Informational Note: Offset is the distance measured along the enclosure wall from the axis of the centerline of the terminal to a line passing through the center of the opening in the enclosure.

(C) Conductors 4 AWG or Larger. Installation shall comply with 300.4(G).

312.7 Space in Enclosures. Cabinets and switch enclosures cutout boxes shall have sufficient space to accommodate all conductors installed in them without crowding.

312.8 Switch and Overcurrent Device Enclosures with Splices, Taps, and Feed-Through Conductors. The wiring space of enclosures for switches or overcurrent devices shall be permitted for conductors feeding through, spliced, or tapping off to other enclosures, switches, or overcurrent devices where all of the following conditions are met:

1. The total of all conductors installed at any cross section of the wiring space does not exceed 40 percent of the cross-sectional area of that space.

2. The total area of all conductors, splices, and taps installed at any cross section of the wiring space does not exceed 75 percent of the cross-sectional area of that space.

3. A warning label is applied to the enclosure that identifies the closest disconnecting means for any feedthrough conductors.

312.9 Side or Back Wiring Spaces or Gutters. Cabinets and switch enclosures cutout boxes shall be provided with back-wiring spaces, gutters, or wiring compartments as required by 312.11(C) and (D).

II. Construction Specifications

312.10 Material. Cabinets, cutout boxes, and meter socket enclosures shall comply with 312.10(A) through (C).

(A) Metal Cabinets and Cutout Boxes. Metal enclosures within the scope of this article shall be protected both inside and outside against corrosion.

Informational Note: For information on protection against corrosion, see 300.6.

Table 312.6(A) Minimum Wire-Bending Space at Terminals and Minimum Width of Wiring Gutters Wires per Terminal

- NO CHANGES TO THIS TABLE -

(B) Strength. The design and construction of enclosures within the scope of this article shall be such as to secure ample strength and rigidity. If constructed of sheet steel, the metal thickness shall not be less than 1.35 mm (0.053 in.) uncoated.

(C) Nonmetallic Cabinets and Switch Enclosures. Nonmetallic cabinets and switch enclosures shall be listed, or they shall be submitted for approval prior to installation.

312.11 Spacing. The spacing within cabinets and cutout boxes shall comply with 312.11(A) through (D).

(A) General. Spacing within cabinets and switch enclosures cutout boxes shall be sufficient to provide ample room for
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the distribution of wires and cables placed in them and for a separation between metal parts of devices and apparatus mounted within them in accordance with (A)(1), (A)(2), and (A)(3).

(1) Base. Other than at points of support, there shall be an airspace of at least 1.59 mm (0.0625 in.) between the base of the device and the wall of any metal cabinet or cutout box in which the device is mounted.

(2) Doors. There shall be an airspace of at least 25.4 mm (1.00 in.) between any live metal part, including live metal parts of enclosed fuses, and the door.

Exception: Where the door is lined with an approved insulating material or is of a thickness of metal not less than 2.36 mm (0.093 in.) uncoated, the airspace shall not be less than 12.7 mm (0.500 in.).

(3) Live Parts. There shall be an airspace of at least 12.7 mm (0.500 in.) between the walls, back, gutter partition, if of metal, or door of any cabinet or switch enclosure cutout boxes and the nearest exposed current-carrying part of devices mounted within the cabinet or switch enclosure where the voltage does not exceed 250. This spacing shall be increased to at least 25.4 mm (1.00 in.) for voltages of 251 to 600, nominal.

Exception: Where the conditions in 312.11(A)(2). Exception, are met, the airspace for nominal voltages from 251 to 600 shall be permitted to be not less than 12.7 mm (0.500 in.).

(B) Switch Clearance. Cabinets and switch enclosures cutout boxes shall be deep enough to allow the closing of the doors when 30-ampere branch-circuit panel board switches are in any position, when combination cutout switches are in any position, or when other single-throw switches are opened as far as their construction permits.

(C) Wiring Space. Cabinets and switch enclosures cutout boxes that contain devices or apparatus connected within the cabinet or enclosure box to more than eight conductors, including those of branch circuits, meter loops, feeder circuits, power circuits, and similar circuits, but not including the supply circuit or a continuation thereof, shall have back-wiring spaces or one or more side-wiring spaces, side gutters, or wiring compartments.

(D) Wiring Space - Enclosure. Side-wiring spaces, side gutters, or side-wiring compartments of cabinets and switch enclosures cutout boxes shall be made tight enclosures by means of covers, barriers, or partitions extending from the bases of the devices contained in the cabinet or switch enclosure, to the door, frame, or sides of the cabinet or switch enclosure.

Exception: Side-wiring spaces, side gutters, and side-wiring compartments of cabinets shall not be required to be made tight enclosures where those side spaces contain only conductors that enter the cabinet or switch enclosure directly opposite to the devices where they terminate.

Partially enclosed back-wiring spaces shall be provided with covers to complete the enclosure. Wiring spaces that are required by 312.11(C) and are exposed when doors are open shall be provided with covers to complete the enclosure.

Where adequate space is provided for feed-through conductors and for splices as required in 312.8, additional barriers shall not be required.

Substantiation: I propose that the present definition for cutout box be deleted from the Code, and that the term cutout box be replaced by the term "switch enclosure". I will present a companion proposal to Panel I and Article 100 toward this end.

It is well understood what a switch does, and six types of switches are presently defined in NEC Article 100.

Enclosures are also defined in NEC Article 100.

However, the present Code definition of cutout box - shown below - does not include any reference to switching, but only to the enclosure.

"Cutout Box. An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the box proper."

Also, I'm thinking that the use of the term cutout box may be outdated.

Over 70 years ago, electrical workers were probably more familiar with the term cutout box.

In my experience, today's electrical workers use the words 'switch ' or 'disconnect ' instead of the term 'cutout '.

The only use of the term cutout that I am familiar with or being generally referred to is for switching of customer owned or utility type pole top electrical distribution of medium and high voltage circuits or systems.

The term cutout box is a holdover from decades ago when the first switches were open type knife switches with exposed live parts.

Eventually, these open knife switches were placed in wood cabinets, then later in metal enclosures.

As a wireman and electrical inspector, I have seen 1940 vintage switch enclosures (commonly known today as a fused disconnect or safety switch), which had an orange and yellow colored circular UL label that read "UL Listed Cut out Box".

I have drawn the conclusion, after talking to many electrical professionals, that a cutout box is really what we refer to today as a fused disconnect or safety switch.

Combining the two already NEC defined terms of 'switch' and 'enclosure' into the new term 'switch enclosure', seems to me to be usable, understandable, and enforceable. It might even make sense.

As a Code user, I appreciate and support the Chairman of the NEC correlating committee's stated goal of 'making the
NEC say what it means, and mean what it says.
This article covers the installation and construction specifications of cabinets, enclosed switches, cutout boxes, and meter socket enclosures.

312.2 Damp and Wet Locations. In damp or wet locations, surface-type enclosures within the scope of this article shall be placed or equipped so as to prevent moisture or water from entering and accumulating within the cabinet or cutout box, and shall be mounted so there is at least 6-mm (\(\frac{1}{4}\) in.) airspace between the enclosure and the wall or other supporting surface. Enclosures installed in wet locations shall be weatherproof. For enclosures in wet locations, raceways or cables entering above the level of uninsulated live parts shall use fittings listed for wet locations.

Exception: Nonmetallic enclosures shall be permitted to be installed without the airspace on a concrete, masonry, tile, or similar surface.

Informational Note: For protection against corrosion, see 300.6.

312.3 Position in Wall. In walls of concrete, tile, or other noncombustible material, cabinets and enclosed switches shall be installed so that the front edge of the cabinet is not set back of the finished surface more than 6 nun (\(\frac{1}{4}\) in.). In walls constructed of wood or other combustible material, cabinets shall be flush with the finished surface or project therefrom.

312.4 Repairing Noncombustible Surfaces. Noncombustible surfaces that are broken or incomplete shall be repaired so there will be no gaps or open spaces greater than 3 mm (\(\frac{1}{8}\) in.) at the edge of the cabinet or enclosed switches employing a flush-type cover.

312.5 Cabinets, Enclosed Switches, Cutout Boxes, and Meter Socket Enclosures. Conductors entering enclosures within the scope of this article shall be protected from abrasion and shall comply with 312.5(A) through (C).

(A) Openings to Be Closed. Openings through which conductors enter shall be adequately closed.

(B) Metal Cabinets, Enclosed Switches, Cutout Boxes, and Meter Socket Enclosures. Where metal enclosures within the scope of this article are installed with messenger-supported wiring, open wiring on insulators, or concealed knob-and-tube wiring, conductors shall enter through insulating bushings or, in dry locations, through flexible tubing extending from the last insulating support and firmly secured to the enclosure.

(C) Cables. Where cable is used, each cable shall be secured to the cabinet, enclosed switch, cutout or meter socket enclosure.

Exception: Cables with entirely nonmetallic sheaths shall be permitted to enter the top of a surface-mounted enclosure through one or more nonflexible raceways not less than 450 mm (18 in.) and not more than 3.0 m (10 ft) in length, provided all of the following conditions are met:

(a) Each cable is fastened within 300 mm (12 in.) measured along the sheath, of the outer end of the raceway.

(b) The raceway extends directly above the enclosure and does not penetrate a structural ceiling.

(c) A fitting is provided on each end of the raceway to protect the cable(s) from abrasion and the fittings remain accessible after installation.

(d) The raceway is seated or plugged at the outer end using approved means so as to prevent access to the enclosure through the raceway.

(e) The cable sheath is continuous through the raceway and extends into the enclosure beyond the fitting not less than 6 mm (\(\frac{1}{4}\) in.).

(f) The raceway is fastened at its outer end and at other points in accordance with the applicable article.

(g) Where installed as conduit or tubing, the allowable cable fill does not exceed that permitted for complete conduit or tubing systems by Table 1 of Chapter 9 of this Code and all applicable notes there to.

Informational Note: See Table 1 in Chapter 9, including Note 9, for allowable cable fill in circular raceways. See 310.15(B)(3)(a) for required ampacity reductions for multiple cables installed in a common raceway.

Table 312.6(A) Minimum Wire-Bending Space at Terminals and Minimum Width of Wiring Gutters - NO

Changes to this Table - 312.6 Deflection of Conductors. Conductors at terminals or conductors entering or leaving cabinets, enclosed.
switches or cutout boxes and the like shall comply with 312.6(A) through (C).

Exception: Wire-bending space in enclosures for motor controllers with provisions for one or two wires per terminal shall comply with 430.10(B).

(A) Width of Wiring Gutters. Conductor shall not be deflected within a cabinet, enclosed switch, or cutout box, unless a gutter having a width in accordance with Table 312.6(A) is provided. Conductors in parallel in accordance with 310.10(H) shall be judged on the basis of the number of conductors in parallel.

(B) Wire-Bending Space at Terminals. Wire-bending space at each terminal shall be provided in accordance with 312.6(B)(1) or (8)(2).

(1) Conductors Not Entering or leaving Opposite Wall. Table 312.6(A) shall apply where the conductor does not enter or leave the enclosure through the wall opposite its terminal.

(2) Conductors Entering or Leaving Opposite Wall. Table 312.6(B) shall apply where the conductor does enter or leave the enclosure through the wall opposite its terminal.

Exception No. 1: Where the distance between the wall and its terminal is in accordance with Table 312.6(A), a conductor shall be permitted to enter or leave an enclosure through the wall opposite its terminal, provided the conductor enters or leaves the enclosure where the gutter joins an adjacent gutter that has a width that conforms to Table 312.6(B) for the conductor.

Exception No. 2: A conductor not larger than 350 kcmil shall be permitted to enter or leave an enclosure containing only a meter socket(s) through the wall opposite its terminal, provided the distance between the terminal and the opposite wall is not less than that specified in Table 312.6(A) and the terminal is a lay-in type, where the terminal is either of the following:

(a) Directed toward the opening in the enclosure and within a 45 degree angle of directly facing the enclosure wall

(b) Directly facing the enclosure wall and offset not greater than 50 percent of the bending space specified in Table 312.6(A).

Informational Note: Offset is the distance measured along the enclosure wall from the axis of the centerline of the terminal to a line passing through the center of the opening in the enclosure.

(C) Conductors 4 AWG or Larger. Installation shall comply with 300.4(0).

312.7 Space in Enclosures. Cabinets, switch enclosures, and cutout boxes shall have sufficient space to accommodate all conductors installed in them without crowding.

312.8 Switch and Overcurrent Device Enclosures with Splices, Taps, and Feed-Through Conductors. The wiring space of enclosures for switches or overcurrent devices shall be permitted for conductors feeding through, spliced, or tapping off to other enclosures, switches, or overcurrent devices where all of the following conditions are met:

(1) The total of all conductors installed at any cross section of the wiring space does not exceed 40 percent of the cross-sectional area of that space.

(2) The total area of all conductors, splices, and taps installed at any cross section of the wiring space does not exceed 75 percent of the cross-sectional area of that space.

(3) A warning label is applied to the enclosure that identifies the closest disconnecting means for any feed through conductors.

312.9 Side or Back Wiring Spaces or Gutters. Cabinets and enclosed switches, and cutout boxes shall be provided with back-wiring spaces, gutters, or wiring compartments as required by 312.11(C) and (0).

II. Construction Specifications

312.10 Material. Cabinets, cutout boxes, and meter socket enclosures shall comply with 312.10(A) through (C).

(A) Metal Cabinets and Enclosed Switches - and Cutout Boxes. Metal enclosures within the scope of this article shall be protected both inside and outside against corrosion.

Informational Note: For information on protection against corrosion, see 300.6.

Table 312.6(A) Minimum Wire-Bending Space at Terminals and Minimum Width of Wiring Gutters Wires per Terminal- NO CHANGES TO THIS TABLE

(B) Strength. The design and construction of enclosures within the scope of this article shall be such as to secure ample strength and rigidity. If constructed of sheet steel, the metal thickness shall not be less than 1.35 mm (0.053 in.) uncoated.

(C) Nonmetallic Cabinets and Enclosed Switches. Nonmetallic cabinets and enclosed switches shall be listed, or they shall be submitted for approval prior to installation.

312.11 Spacing. The spacing within cabinets and cutout boxes shall comply with 312.11(A) through (D).

(A) General. Spacing within cabinets and switch enclosures and cut out boxes shall be sufficient to provide ample
room for the distribution of wires and cables placed in them and for a separation between metal parts of devices and apparatus mounted within them in accordance with (A)(1), (A)(2), and (A)(3).

(1) **Base.** Other than at points of support, there shall be an airspace of at least 1.59 mm (0.0625 in.) between the base of the device and the wall of any metal cabinet or cutout box in which the device is mounted.

(2) **Doors.** There shall be an airspace of at least 25.4 mm (1.00 in.) between any live metal part, including live metal parts of enclosed fuses, and the door.

Exception: Where the door is lined with an approved insulating material or is of a thickness of metal not less than 2.36 mm (0.093 in.) uncoated, the airspace shall not be less than 12.7 mm (0.500 in.).

(3) **Live Parts.** There shall be an airspace of at least 12.7 mm (0.500 in.) between the walls, back, gutter partition, if of metal, or door of any cabinet, enclosed switch, or cutout box and the nearest exposed current-carrying part of devices mounted within the cabinet or enclosed switch where the voltage does not exceed 250. This spacing shall be increased to at least 25.4 mm (1.00 in.) for voltages of 251 to 600, nominal.

Exception: Where the conditions in 312.11 (A)(2). Exception, are met, the airspace for nominal voltages from 251 to 600 shall be permitted to be not less than 12.7 mm (0.500 in.).

(B) **Switch Clearance.** Cabinets and enclosed switches, and cutout boxes shall be deep enough to allow the closing of the doors when 30-ampere branch-circuit panelboard switches are in any position, when combination cutout switches are in any position, or when other single-throw switches are opened as far as their construction permits.

(C) **Wiring Space.** Cabinets and enclosed switches, and cutout boxes that contain devices or apparatus connected within the cabinet, enclosure or box to more than eight conductors, including those of branch circuits, feeder circuits, power circuits, and similar circuits, but not including the supply circuit or a continuation thereof, shall have back-wiring spaces or one or more side-wiring spaces, side gutters, or wiring compartments.

(D) **Wiring Space - Enclosure.** Side-wiring spaces, side gutters, or side-wiring compartments of cabinets enclosed switches and cutout boxes shall be made tight enclosures by means of covers, barriers, or partitions extending from the bases of the devices contained in the cabinet or enclosed switch to the door, frame, or sides of the cabinet or enclosed switch.

Exception: Side-wiring spaces, side gutters, and side-wiring compartments of cabinets shall not be required to be made tight enclosures where those side spaces contain only conductors that enter the cabinet or enclosed switch directly opposite to the devices where they terminate.

Partially enclosed back-wiring spaces shall be provided with covers to complete the enclosure. Wiring spaces that are required by 312.11 (C) and are exposed when doors are open shall be provided with covers to complete the enclosure. Where adequate space is provided for feed-through conductors and for splices as required in 312.8, additional barriers shall not be required.

**Substantiation:** I propose that the term "enclosed switch" be added to Article 312.

I have submitted a companion proposal to Panel I and Article 100 toward this end.

Code Panel 9 added the term "enclosed switches" in Section 312.8 during the 2011 NEC Code Cycle.

Code Panel I also added the term "enclosed switches" to NEC Section 110.28 relating to the selection of enclosures for the 2011 NEC Code Cycle.

Enclosures are defined in NEC Article 100.

It is well understood what a switch does, and six types of switches are presently defined in NEC Article 100.

The term Cutout Box, even though defined in NEC Article 100, used in Article 100 in the Definition of a Panel board and in Article 312, is not a term that electrical workers are familiar with.

"Enclosed switch is better understood by today's electrical industry, as evidenced by its recent additions in the 2011 NEC."

I'm thinking that the use of the term cutout box may be outdated.

Over 70 years ago, electrical workers were probably more familiar with the term cutout box.

The term cutout box is a holdover from decades ago when the first switches were open type knife switches with exposed live parts.

Eventually, these open knife switches were placed in wood cabinets, then later in metal enclosures.

As a wireman and electrical inspector, I have seen 1940 vintage switch enclosures ( commonly known today as a fused disconnect or safety switch ), which had an orange and yellow colored circular UL label that read "UL Listed Cutout Box".

Also, it is unclear how a 'cutout box' is used in a panel board cabinet - or if this is a holdover from days gone by.

In my experience, today's electrical workers use the words 'switch' or 'disconnect' instead of the term 'cutout'.

The only use of the term cutout that I am familiar with or being generally referred to is for switching of customer owned or utility type pole top electrical distribution of medium and high voltage circuits or systems.
I have drawn the conclusion, after talking to many electrical professionals, that a cutout box is really what we refer to today as a fused disconnect or safety switch.

Combining the two already NEC defined terms of 'enclosure' and 'switch' into the new term 'enclosed switch', which has been recently been used in Article 312, and Section 110.28, and adding it into the definitions in Article 100, and in Article 312, helps the Code to be better useable, understandable, and enforceable.

This line of thought also appears to be consistent with NEC processes, such as when the term luminaire was added, there were still references for at least one code cycle to the existing term - light fixture. Example: Enclosed Switch (Cutout Box).

I have approached this proposal from a few different directions in order to provide CMP 9 input for their decision.
Cabinets, Enclosed Switches, Cutout Boxes, and Meter Socket Enclosures

312.1 Scope. This article covers the installation and construction specifications of cabinets, enclosed switches, cutout boxes, and meter socket enclosures.

1. Installation

312.2 Damp and Wet Locations. In damp or wet locations, surface-type enclosures within the scope of this article shall be placed or equipped so as to prevent moisture or water from entering and accumulating within the cabinet or cutout box, and shall be mounted so there is at least 6-mm (\(\frac{1}{4}\)-in.) airspace between the enclosure and the wall or other supporting surface. Enclosures installed in wet locations shall be weatherproof. For enclosures in wet locations, raceways or cables entering above the level of uninsulated live parts shall use fittings listed for wet locations.

Exception: Nonmetallic enclosures shall be permitted to be installed without the airspace on a concrete, masonry, tile, or similar surface.

Informational Note: For protection against corrosion, see 300.6.

312.3 Position in Wall. In walls of concrete, tile, or other noncombustible material, cabinets and enclosed switches shall be installed so that the front edge of the cabinet is not set back of the finished surface more than 6 nun (\(\frac{1}{4}\) in.). In walls constructed of wood or other combustible material, cabinets shall be flush with the finished surface or project therefrom.

312.4 Repairing Noncombustible Surfaces. Noncombustible surfaces that are broken or incomplete shall be repaired so there will be no gaps or open spaces greater than 3 mm (\(\frac{1}{8}\) in.) at the edge of the cabinet or enclosed switches cutout box employing a flush-type cover.

312.5 Cabinets, Enclosed Switches, Cutout Boxes, and Meter Socket Enclosures. Conductors entering enclosures within the scope of this article shall be protected from abrasion and shall comply with 312.5(A) through (C).

(A) Openings to Be Closed. Openings through which conductors enter shall be adequately closed.

(B) Metal Cabinets, Enclosed Switches, Cutout Boxes, and Meter Socket Enclosures. Where metal enclosures within the scope of this article are installed with messenger-supported wiring, open wiring on insulators, or concealed knob-and-tube wiring, conductors shall enter through insulating bushings or, in dry locations, through flexible tubing extending from the last insulating support and firmly secured to the enclosure.

(C) Cables. Where cable is used, each cable shall be secured to the cabinet, switch, cutoutbox or meter socket enclosure.

Exception: Cables with entirely nonmetallic sheaths shall be permitted to enter the top of a surface-mounted enclosure through one or more nonmetallic raceways not less than 450 mm (18 in.) and not more than 3.0 m (10 ft) in length, provided all of the following conditions are met:

(a) Each cable is fastened within 300 mm (12 in.) measured along the sheath, of the outer end of the raceway.

(b) The raceway extends directly above the enclosure and does not penetrate a structural ceiling.

(c) A fitting is provided on each end of the raceway to protect the cable(s) from abrasion and the fittings remain accessible after installation.

(d) The raceway is seated or plugged at the outer end using approved means so as to prevent access to the enclosure through the raceway.

(e) The cable sheath is continuous through the raceway and extends into the enclosure beyond the fitting not less than 6 mm (\(\frac{1}{4}\) in.).

(f) The raceway is fastened at its outer end and at other points in accordance with the applicable article.

(g) Where installed as conduit or tubing, the allowable cable fill does not exceed that permitted for complete conduit or tubing systems by Table 1 of Chapter 9 of this Code and all applicable notes thereon.

Informational Note: See Table 1 in Chapter 9, including Note 9, for allowable cable fill in circular raceways. See 310.15(B)(3)(a) for required ampacity reductions for multiple cables installed in a common raceway.

Table 312.6(A) Minimum Wire-Bending Space at Terminals and Minimum Width of Wiring Gutters - NO CHANGES TO THIS TABLE-312.6 Deflection of Conductors. Conductors at terminals or conductors entering or leaving cabinets, enclosed
switches or cutout boxes and the like shall comply with 312.6(A) through (C).

Exception: Wire-bending space in enclosures for motor controllers with provisions for one or two wires per terminal shall comply with 430.10 (B).

(A) Width of Wiring Gutter. Conductors shall not be deflected within a cabinet, enclosed switch, or cutout box, unless a gutter having a width in accordance with Table 312.6(A) is provided. Conductors in parallel in accordance with 310.10 (H) shall be judged on the basis of the number of conductors in parallel.

(B) Wire-Bending Space at Terminals. Wire-bending space at each terminal shall be provided in accordance with 312.6(B)(1) or (B)(2).

(1) Conductors Not Entering or Leaving Opposite Wall. Table 312.6(A) shall apply where the conductor does not enter or leave the enclosure through the wall opposite its terminal.

(2) Conductors Entering or Leaving Opposite Wall. Table 312.6(B) shall apply where the conductor does enter or leave the enclosure through the wall opposite its terminal.

Exception No. 1: Where the distance between the wall and its terminal is in accordance with Table 312.6(A), a conductor shall be permitted to enter or leave an enclosure through the wall opposite its terminal, provided the conductor enters or leaves the enclosure where the gutter joins an adjacent gutter that has a width that conforms to Table 312.6(B) for the conductor.

Exception No. 2: A conductor not larger than 350 kcmil shall be permitted to enter or leave an enclosure containing only a meter socket(s) through the wall opposite its terminal, provided the distance between the terminal and the opposite wall is not less than that specified in Table 312.6(A) and the terminal is a lay-in type, where the terminal is either of the following:

(a) Directed toward the opening in the enclosure and within a 45 degree angle of directly facing the enclosure wall

(b) Directly facing the enclosure wall and offset not greater than 50 percent of the bending space specified in Table 312.6(A).

Informational Note: Offset is the distance measured along the enclosure wall from the axis of the centerline of the terminal to a line passing through the center of the opening in the enclosure.

(C) Conductors 4 AWG or Larger. Installation shall comply with 300.4(0).

312.7 Space in Enclosures. Cabinets and enclosed switches, cutout boxes shall have sufficient space to accommodate all conductors installed in them without crowding.

312.8 Switch and Overcurrent Device Enclosures with Splices, Taps, and Feed-Through Conductors. The wiring space of enclosures for switches or overcurrent devices shall be permitted for conductors feeding through, spliced, or tapping off to other enclosures, switches, or overcurrent devices where all of the following conditions are met:

(1) The total of all conductors installed at any cross section of the wiring space does not exceed 40 percent of the cross-sectional area of that space.

(2) The total area of all conductors, splices, and taps installed at any cross section of the wiring space does not exceed 75 percent of the cross-sectional area of that space.

(3) A warning label is applied to the enclosure that identifies the closest disconnecting means for any feed through conductors.

312.9 Side or Back Wiring Spaces or Gutters. Cabinets and enclosed switches, cutout boxes shall be provided with back-wiring spaces, gutters, or wiring compartments as required by 312.11(C) and (O).

II. Construction Specifications

312.10 Material. Cabinets, cutout boxes, and meter socket enclosures shall comply with 312.10(A) through (C).

(A) Metal Cabinets and Enclosed Switches - Cutout Boxes. Metal enclosures within the scope of this article shall be protected both inside and outside against corrosion.

Informational Note: For information on protection against corrosion, see 300.6.

Table 312.6(A) Minimum Wire-Bending Space at Terminals and Minimum Width of Wiring Gutters Wires per Terminal - NO CHANGES TO THIS TABLE

(B) Strength. The design and construction of enclosures within the scope of this article shall be such as to secure ample strength and rigidity. If constructed of sheet steel, the metal thickness shall not be less than 1.35 mm (0.053 in.) uncoated.

(C) Nonmetallic Cabinets and Enclosed Switches. Nonmetallic cabinets and enclosed switches shall be listed, or they shall be submitted for approval prior to installation.

312.11 Spacing. The spacing within cabinets and cutout boxes shall comply with 312.11 (A) through (D).

(A) General. Spacing within cabinets and switch enclosures, cutout boxes shall be sufficient to provide ample room for the
distribution of wires and cables placed in them and for a separation between metal parts of devices and apparatus mounted within them in accordance with (A)(1), (A)(2), and (A)(3).

(1) **Base.** Other than at points of support, there shall be an airspace of at least 1.59 mm (0.0625 in.) between the base of the device and the wall of any metal cabinet or cutout box in which the device is mounted.

(2) **Doors.** There shall be an airspace of at least 25.4 mm (1.00 in.) between any live metal part, including live metal parts of enclosed fuses, and the door.

Exception: Where the door is lined with an approved insulating material or is of a thickness of metal not less than 2.36 mm (0.093 in.) uncoated, the airspace shall not be less than 12.7 mm (0.500 in.).

(3) **Live Parts.** There shall be an airspace of at least 12.7 mm (0.500 in.) between the walls, back, gutter partition, if of metal, or door of any cabinet or enclosed switch, cutout box and the nearest exposed current-carrying part of devices mounted within the cabinet or enclosed switch where the voltage does not exceed 250. This spacing shall be increased to at least 25.4 nun (1.00 in.) for voltages of 251 to 600, nominal.

Exception: Where the conditions in 312.11 (A)(2). Exception, are met, the airspace for nominal voltages from 251 to 600 shall be permitted to be not less than 12.7 mm (0.500 in.).

(B) **Switch Clearance.** Cabinets and enclosed switches, cutout boxes shall be deep enough to allow the closing of the doors when 30-ampere branch-circuit panelboard switches are in any position, when combination cutout switches are in any position, or when other single-throw switches are opened as far as their construction permits.

(C) **Wiring Space.** Cabinets and enclosed switches, cutout boxes that contain devices or apparatus connected within the cabinet or enclosure box to more than eight conductors, including those of branch circuits, meter loops, feeder circuits, power circuits, and similar circuits, but not including the supply circuit or a continuation thereof, shall have back-wiring spaces or one or more side-wiring spaces, side gutters, or wiring compartments.

(D) **Wiring Space - Enclosure.** Side-wiring spaces, side gutters, or side-wiring compartments of cabinets and switch enclosures cutout boxes shall be made tight enclosures by means of covers, barriers, or partitions extending from the bases of the devices contained in the cabinet or enclosed switch to the door, frame, or sides of the cabinet or enclosed switch.

Exception: Side-wiring spaces, side gutters, and side-wiring compartments of cabinets shall not be required to be made tight enclosures where those side spaces contain only conductors that enter the cabinet or enclosed switch directly opposite to the devices where they terminate.

Partially enclosed back-wiring spaces shall be provided with covers to complete the enclosure. Wiring spaces that are required by 312.11 (C) and are exposed when doors are open shall be provided with covers to complete the enclosure. Where adequate space is provided for feed-through conductors and for splices as required in 312.8, additional barriers shall not be required.

Substantiation: I propose that the present definition for cutout box be deleted from the Code, and that the term cutout box be replaced by the term "enclosed switches". The term "Enclosed Switch" is already used in the NEC in Section 110.28 for selection of enclosure types.

I will present a companion proposal to Panel I (Article 100) toward this end.

**This phrase using the term "enclosures for switches" was added to the 2011 NEC:**

"312.8 Switch and Overcurrent Device Enclosures with Splices, Taps, and Feed-Through Conductors."

The wiring space of enclosures for switches or overcurrent devices shall be permitted for conductors feeding through, spliced, or tapping off to other enclosures, switches, or overcurrent devices where all of the following conditions are met:

"It is well understood what a switch does, and six types of switches are presently defined in NEC Article 100. Enclosures are also defined in NEC Article 100. However, the present Code definition of cutout box - shown below - does not include any reference to switching, but only to the enclosure."

"Cutout Box. An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the box proper."

Also, I'm thinking that the use of the term cutout box may be outdated.

Over 70 years ago, electrical workers were probably more familiar with the term cutout box.

In my experience, today's electrical workers use the words 'switch' or 'disconnect' instead of the term 'cutout'.

The only use of the term cutout that I am familiar with or being generally referred to is for switching of customer owned or utility type pole top electrical distribution of medium and high voltage circuits or systems.

The term cutout box is a holdover from decades ago when the first switches were open type knife switches with exposed live parts.

Eventually, these open knife switches were placed in wood cabinets, then later in metal enclosures.
As a wireman and electrical inspector, I have seen 1940 vintage switch enclosures (commonly known today as a fused disconnect or safety switch), which had an orange and yellow colored circular UL label that read "UL Listed Cut out Box".

I have drawn the conclusion, after talking to many electrical professionals, that a cutout box is really what we refer to today as a fused disconnect or safety switch.

Combining the two already NEC defined terms of 'switch' and 'enclosure' into the new term 'enclosed switch' seems to me to be useable, understandable, and enforceable. It might even make sense.

The alternate term 'switch enclosure' could also be considered by the Code Making Panel.

As a Code user, I appreciate and support the Chairman of the NEC correlating committee's stated goal of 'making the NEC say what it means, and mean what it says'.
This article covers the installation and construction specifications of cabinets, enclosed switches, cutout boxes, and meter socket enclosures.

312.2 Damp and Wet Locations. In damp or wet locations, surface-type enclosures within the scope of this article shall be placed or equipped so as to prevent moisture or water from entering and accumulating within the cabinet or cutout box, and shall be mounted so there is at least 6-mm (1/4-in.) airspace between the enclosure and the wall or other supporting surface. Enclosures installed in wet locations shall be weatherproof. For enclosures in wet locations, raceways or cables entering above the level of uninsulated live parts shall use fittings listed for wet locations.

Exception: Nonmetallic enclosures shall be permitted to be installed without the airspace on a concrete, masonry, tile, or similar surface.

Informational Note: For protection against corrosion, see 300.6.

312.3 Position in Wall. In walls of concrete, tile, or other noncombustible material, cabinets and enclosed switches shall be installed so that the front edge of the cabinet is not set back of the finished surface more than 6 mm (1/4 in.). In walls constructed of wood or other combustible material, cabinets shall be flush with the finished surface or project therefrom.

312.4 Repairing Noncombustible Surfaces. Noncombustible surfaces that are broken or incomplete shall be repaired so there will be no gaps or open spaces greater than 3 mm (1/8 in.) at the edge of the cabinets, enclosed switches, or cutout boxes employing a flush-type cover.

312.5 Cabinets, Enclosed Switches, Cutout Boxes, and Meter Socket Enclosures. Conductors entering enclosures within the scope of this article shall be protected from abrasion and shall comply with 312.5(A) through (C).

(A) Openings to be closed. Openings through which conductors enter shall be adequately closed.

(B) Metal Cabinets, Enclosed Switches, Cutout Boxes, and Meter Socket Enclosures. Where metal enclosures within the scope of this article are installed with messenger-supported wiring, open wiring on insulators, or concealed knob-and-tube wiring, conductors shall enter through insulating bushings or, in dry locations, through flexible tubing extending from the last insulating support and firmly secured to the enclosure.

(C) Cables. Where cables is used, each cable shall be secured to the cabinet, enclosed switch, cutout box, or meter socket enclosure.

Exception: Cables with entirely nonmetallic sheaths shall be permitted to enter the top of a surface-mounted enclosure through one or more nonflexible raceways not less than 450 mm (18 in.) and not more than 3.0 m (10 ft) in length, provided all of the following conditions are met:

(a) Each cable is fastened within 300 mm (12 in.), measured along the sheath, of the outer end of the raceway.

(b) The raceway extends directly above the enclosure and does not penetrate a structural ceiling.

(c) A fitting is provided on each end of the raceway to protect the cable(s) from abrasion and the fittings remain accessible after installation.

(d) The raceway is sealed or plugged at the outer end using approved means so as to prevent access to the enclosure through the raceway.

(e) The cable sheath is continuous through the raceway and extends into the enclosure beyond the fitting not less than 6 mm (1/4 in.).

(f) The raceway is fastened at its outer end and at other points in accordance with the applicable article.

(g) Where installed as conduit or tubing, the allowable cable fill does not exceed that permitted for complete conduit or tubing systems by Table 1 or Chapter 9 of this Code and all applicable notes thereto.

Informational Note: See Table 1 in Chapter 9, including Note 9, for allowable cable fill in circular raceways. See 310.15(B)(3)(a) for required ampacity reductions for multiple cables installed in a common raceway.

Table 312.6(A) Minimum Wire-Bending Space at Terminals and Minimum Width of Wiring Gutters -NO CHANGES TO THIS TABLE-

312.6 Deflection of Conductors. Conductors at terminals or conductors entering or leaving cabinets, switch enclosures, or cutout boxes and the like shall comply with 312.6(A) through (C).
Exception: Wire-bending space in enclosures for motor controllers with provisions for one or two wires per terminal shall comply with 430.10(B).

(A) Width of Wiring Gutters. Conductors shall not be deflected within a cabinet, switch enclosure, or cutout box unless a gutter having a width in accordance with Table 312.6(A) is provided. Conductors in parallel in accordance with Table 310.10(H) shall be judged on the basis of the number of conductors in parallel.

(B) Wire-Bending Space at Terminals. Wire-bending space at each terminal shall be provided in accordance with 312.6(B)(1) or (B)(2).

1. Conductors Not Entering or Leaving Opposite Wall.  Table 312.6(A) shall apply where the conductor does not enter or leave the enclosure through the wall opposite its terminal.

2. Conductors Entering or Leaving Opposite Wall.  Table 312.6(B) shall apply where the conductor does enter or leave the enclosure through the wall opposite its terminal.

Exception No. 1: Where the distance between the wall and its terminal is in accordance with Table 312.6(A), a conductor shall be permitted to enter or leave an enclosure through the wall opposite its terminal, provided the conductor enters or leaves the enclosure where the gutter joins an adjacent gutter that has a width that conforms to Table 312.6(B) for the conductor.

Exception No. 2: A conductor not larger than 350 kcmil shall be permitted to enter or leave an enclosure containing only a meter socket(s) through the wall opposite its terminal, provided the distance between the terminal and the opposite wall is not less than that specified in Table 312.6(A) and the terminal is a lay-in type, where the terminal is either of the following:

(a) Directed toward the opening in the enclosure and within a 45 degree angle of directly facing the enclosure wall

(b) Directly facing the enclosure wall and offset not greater than 50 percent of the bending space specified in Table 312.6(A).

Informational Note: Offset is the distance measured along the enclosure wall from the axis of the centerline of the terminal to a line passing through the center of the opening in the enclosure.

3. Conductors 4 AWG or Larger.  Installation shall comply with 300.4(G).

312.7 Space in Enclosures.  Cabinets, switch enclosures, and cutout boxes shall have sufficient space to accommodate all conductors installed in them without crowding.

312.8 Switch and Overcurrent Device Enclosures with Splices, Taps, and Feed-Through Conductors.  The wiring space of enclosures for switches or overcurrent devices shall be permitted for conductors feeding through, spliced, or tapping off to other enclosures, switches, or overcurrent devices where all of the following conditions are met:

1. The total of all conductors installed at any cross section of the wiring space does not exceed 40 percent of the cross-sectional area of that space.

2. The total area of all conductors, splices, and taps installed at any cross section of the wiring space does not exceed 75 percent of the cross-sectional area of that space.

3. A warning label is applied to the enclosure that identifies the closest disconnecting means for any feedthrough conductors.

312.9 Side or Back Wiring Spaces or Gutters.  Cabinets, enclosed switches, and cutout boxes shall be provided with back-wiring spaces, gutters, or wiring compartments as required by 312.11(C) and (D).

II, Construction Specifications

312.10 Material.  Cabinets, enclosed switches, cutout boxes, and meter socket enclosures shall comply with 312.10(A) through (C).

A. Metal Cabinets, Enclosed Switches, and Cutout Boxes.  Metal enclosures within the scope of this article shall be protected both inside and outside against corrosion.

Informational Note: For information on protection against corrosion, see 300.6.

Table 312.6(A) Minimum Wire-Bending Space at Terminals and Minimum Width of Wiring Gutters Wires per Terminal - NO CHANGES TO THIS TABLE

B. Strength.  The design and construction of enclosures within the scope of this article shall be such as to secure ample strength and rigidity. If constructed of sheet steel, the metal thickness shall not be less than 1.35 mm (0.053 in.) uncoated.

C. Nonmetallic Cabinets and Enclosed Switches.

Nonmetallic cabinets and enclosed switches shall be listed, or they shall be submitted for approval prior to installation.

312.11 Spacing.  The spacing within cabinets and cutout boxes shall comply with 312.11(A) through (D).

A. General.  Spacing within cabinets switch enclosures and cutout boxes shall be sufficient to provide ample room for the distribution of wires and cables placed in them and for a separation between metal parts of devices and apparatus mounted within them in accordance with (A)(1), (A)(2), and (A)(3).

1. Base.  Other than at points of support, there shall be an airspace of at least 1.59 mm (0.0625 in.) between the base...
of the device and the wall of any metal cabinet or cutout box in which the device is mounted.

(2) Doors. There shall be an airspace of at least 25.4 mm (1.00 in.) between any live metal part, including live metal parts of enclosed fuses, and the door.

Exception: Where the door is lined with an approved insulating material or is of a thickness of metal not less than 2.36 mm (0.093 in.) uncoated, the airspace shall not be less than 12.7 mm (0.500 in.).

(3) Live Parts. There shall be an airspace of at least 12.7 mm (0.500 in.) between the walls, back, gutter partition, if of metal, or door of any cabinet, enclosed switch, or cutout box and the nearest exposed current-carrying part of devices mounted within the cabinet or enclosed switch where the voltage does not exceed 250. This spacing shall be increased to at least 25.4 mm (1.00 in.) for voltages of 251 to 600, nominal.

Exception: Where the conditions in 312.11(A)(2), Exception, are met, the airspace for nominal voltages from 251 to 600 shall be permitted to be not less than 12.7 mm (0.500 in.).

(B) Switch Clearance. Cabinets, enclosed switches, and cutout boxes shall be deep enough to allow the closing of the doors when 30-ampere branch-circuit panelboard switches are in any position, when combination cutouts or cutout switches are in any position, or when other single-throw switches are opened as far as their construction permits.

(C) Wiring Space. Cabinets, enclosed switches, and cutout boxes that contain devices or apparatus connected within the cabinet, enclosure, or box to more than eight conductors, including those of branch circuits, meter loops, feeder circuits, power circuits, and similar circuits, but not including the supply circuit or a continuation thereof, shall have back-wiring spaces or one or more side-wiring spaces, side gutters, or wiring compartments.

(D) Wiring Space - Enclosure. Side-wiring spaces, side gutters, or side-wiring compartments of cabinets, enclosed switches, and cutout boxes shall be made tight enclosures by means of covers, barriers, or partitions extending from the bases of the devices contained in the cabinet or enclosed switch, to the door, frame or sides of the cabinet or enclosed switch.

Exception: Side-wiring spaces, side gutters, and side-wiring compartments of cabinets shall not be required to be made tight enclosures where those side spaces contain only conductors that enter the cabinet or enclosed switch directly opposite to the devices where they terminate.

Partially enclosed back-wiring spaces shall be provided with covers to complete the enclosure. Wiring spaces that are required by 312.11(C) and are exposed when doors are open shall be provided with covers to complete the enclosure. Where adequate space is provided for feed-through conductors and for splices as required in 312.8, additional barriers shall not be required.

Substantiation: I propose that the term "enclosed switch" be added to Article 312.

I have submitted a companion proposal to Panel 1 and Article 100 toward this end.

Code Panel 9 added the term "enclosed switches" in Section 312.8 during the 2011 NEC Code Cycle.

Code Panel 1 also added the term "enclosed switches" to NEC Section 110.28 relating to the selection of enclosures for the 2011 NEC Code Cycle.

Enclosures are defined in NEC Article 100.

It is well understood what a switch does, and six types of switches are presently defined in NEC Article 100. The term Cutout Box, even though defined in NEC Article 100, used in Article 100 in the Definition of a Panelboard, and in Article 312, is not a term that electrical workers are familiar with.

Enclosed switch is better understood by today's electrical industry, as evidenced by its recent additions in the 2011 NEC.

I'm thinking that the use of the term cutout box may be outdated.

Over 70 years ago, electrical workers were probably more familiar with the term cutout box. The term cutout box is a holdover from decades ago when the first switches were open type knife switches with exposed live parts.

Eventually, these open knife switches were places in wood cabinets, then later in metal enclosures.

As a wireman and electrical inspector, I have seen 1940 vintage switch enclosures (commonly known today as a fussed disconnect or safety switch), which had an orange and yellow colored circular UL label that read "UL Listed Cutout Box".

Also, it is unclear how a "cutout box" is used in a panelboard cabinet - or if this is a holdover from days gone by.

In my experience, today's electrical workers use the words "switch" or "disconnect" instead of the term "cutout". The only use of the term cutout that I am familiar with or being generally referred to is for switching of customer owned or utility type pole top electrical distribution of medium and high voltage circuits or systems.

I have drawn the conclusion, after talking to many electrical professionals, that a cutout box is really what we refer to today as a fused disconnect or safety switch.

Combining the two already NEC defined terms of "enclosure" and "switch" into the new term "enclosed switch", which has been recently been used in Article 312, and Section 110.28, and adding it into the definitions in Article 100, and in Article 312, helps the Code to be better useable, understandable, and enforceable.

Printed on 11/25/2011
This line of thought also appears to be consistent with NEC processes, such as when the term luminaire was added, there were still references for at least one code cycle to the existing term - light fixture. Example: Enclosed Switch (Cutout Box).

I have approached this proposal from a few different directions in order to provide CMP 9 input for their decision.

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9-21 Log #1768 NEC-P09
(312)

Submitter: Mike Weitzel, Central Washington Electrical Education

Recommendation:

***INCLUDE NEC_L1768_R HERE***

Substantiation: I propose that the term "enclosed switch" be added to Article 312.
I have submitted a companion proposal to Panel I and Article 100 toward this end.
Code Panel 9 added the term "enclosed switches" in 312.8 during the 2011 NEC Code Cycle.
Code Panel 1 also added the term "enclosed switches" to NEC 110.28 relating to the selection of enclosures for the 2011 NEC Code Cycle.
Enclosures are defined in NEC Article 100.
It is well understood what a switch does, and six types of switches are presently defined in NEC Article 100.
The term Cutout Box, even though defined in NEC Article 100, used in Article 100 in the Definition of a Panel board, and in Article 312, is not a term that electrical workers are familiar with.
"Enclosed switch" is better understood by today’s electrical industry, as evidenced by its recent additions in the 2011 NEC.
I'm thinking that the use of the term cutout box may be outdated.
Over 70 years ago, electrical workers were probably more familiar with the term cutout box.
The term cutout box is a holdover from decades ago when the first switches were open type knife switches with exposed live parts.
Eventually, these open knife switches were placed in wood cabinets, then later in metal enclosures.
As a wireman and electrical inspector, I have seen 1940 vintage switch enclosures (commonly known today as a fused disconnect or safety switch), which had an orange and yellow colored circular UL label that read "UL Listed Cut out Box".
Also, it is unclear how a 'cutout box' is used in a panel board cabinet - or if this is a holdover from days gone by.
In my experience, today’s electrical workers use the words 'switch' or 'disconnect' instead of the term 'cutout.'
The only use of the term cutout that I am familiar with or being generally referred to is for switching of customer owned or utility type pole top electrical distribution of medium and high voltage circuits or systems.
I have drawn the conclusion, after talking to many electrical professionals, that a cutout box is really what we refer to today as a fused disconnect or safety switch.
Combining the two already NEC defined terms of 'enclosure' and 'switch' into the new term 'enclosed switch', which has been recently used in Article 312, and Section 110.28, and adding it into the definitions in Article 100, and in Article 312, helps the Code to be better useable, understandable, and enforceable.
This line of thought also appears to be consistent with NEC processes, such as when the term luminaire was added, there were still references for at least one code cycle to the existing term - light fixture. Example: Enclosed Switch (Cutout Box).
I have approached this proposal from a few different directions in order to provide CMP 9 input for their decision.
ARTICLE 312
Cabinets, Enclosed Switches, Cutout Boxes, and Meter Socket Enclosures

312.1 Scope. This article covers the installation and construction specifications of cabinets, enclosed switches, cutout boxes, and meter socket enclosures.

I. Installation

312.2 Damp and Wet Locations. In damp or wet locations, surface-type enclosures within the scope of this article shall be placed or equipped so as to prevent moisture or water from entering and accumulating within the cabinet or cutout box, and shall be mounted so there is at least 6-mm (¼ in.) airspace between the enclosure and the wall or other supporting surface. Enclosures installed in wet locations shall be weatherproof. For enclosures in wet locations, raceways or cables entering above the level of uninsulated live parts shall use fittings listed for wet locations.

Exception: Nonmetallic enclosures shall be permitted to be installed without the airspace on a concrete, masonry, tile, or similar surface.

Informational Note: For protection against corrosion, see 300.6.

312.3 Position in Wall. In walls of concrete, tile, or other noncombustible material, cabinets and enclosed switches shall be installed so that the front edge of the cabinet is not set back of the finished surface more than 6 mm (1/4 in.). In walls constructed of wood or other combustible material, cabinets shall be flush with the finished surface or project there from.

312.4 Repairing Noncombustible Surfaces. Noncombustible surfaces that are broken or incomplete shall be repaired so there will be no gaps or open spaces greater than 3 mm (1/8 in.) at the edge of the cabinets, enclosed switches, or cutout boxes employing a flush-type cover.

312.5 Cabinets, Enclosed Switches, Cutout Boxes, and Meter Socket Enclosures.

Conductors entering enclosures within the scope of this article shall be protected from abrasion and shall comply with 312.5(A) through (C).

(A) Openings to Be Closed. Openings through which conductors enter shall be adequately closed.

(B) Metal Cabinets, Enclosed Switches, Cutout Boxes, and Meter Socket Enclosures. Where metal enclosures within the scope of this article are installed with messenger-supported wiring, open wiring on insulators, or concealed knob-and-tube wiring, conductors shall enter through insulating bushings or, in dry locations, through flexible tubing extending from the last insulating support and firmly secured to the enclosure.

(C) Cables. Where cable is used, each cable shall be secured to the cabinet, enclosed switch, cutout box, or meter socket enclosure.

Exception: Cables with entirely nonmetallic sheaths shall be permitted to enter the top of a surface-mounted enclosure through one or more nonflexible raceways not less than 450 mm (18 in.) and not more than 3.0 m (10 ft) in length, provided all of the following conditions are met:

(a) Each cable is fastened within 300 mm (12 in.), measured along the sheath, of the outer end of the raceway.

(b) The raceway extends directly above the enclosure and does not penetrate a structural ceiling.

(c) A fitting is provided on each end of the raceway to protect the cable(s) from abrasion and the fittings remain accessible after installation.

(d) The raceway is sealed or plugged at the outer end using approved means so as to prevent access to the enclosure through the raceway.
(e) The cable sheath is continuous through the raceway and extends into the enclosure beyond the fitting not less than 6 mm (1 1/4 in.).

(f) The raceway is fastened at its outer end and at other points in accordance with the applicable article.

(g) Where installed as conduit or tubing, the allowable cable fill does not exceed that permitted for complete conduit or tubing systems by Table 1 of Chapter 9 of this Code and all applicable notes thereto.

Informational Note: See Table I in Chapter 9, including Note 9, for allowable cable fill in circular raceways. See 310.15(B)(3)(a) for required ampacity reductions for multiple cables installed in a common raceway.

Table 312.6(A) Minimum Wire-Bending Space at Terminals and Minimum Width of Wiring Gutters

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312.6 Deflection of Conductors. Conductors at terminals or conductors entering or leaving cabinets, switch enclosures, or cutout boxes and the like shall comply with 312.6(A) through (C).

Exception: Wire-bending space in enclosures for motor controllers with provisions for one or two wires per terminal shall comply with 430.10(B).

(A) Width of Wiring Gutters. Conductors shall not be deflected within a cabinet, switch enclosure, or cutout box unless a gutter having a width in accordance with Table 312.6(A) is provided. Conductors in parallel in accordance with 310.10(H) shall be judged on the basis of the number of conductors in parallel.

(B) Wire-Bending Space at Terminals. Wire-bending space at each terminal shall be provided in accordance with 312.6(B)(1) or (B)(2).

1) Conductors Not Entering or Leaving Opposite Wall. Table 312.6(A) shall apply where the conductor does not enter or leave the enclosure through the wall opposite its terminal.

2) Conductors Entering or Leaving Opposite Wall. Table 312.6(B) shall apply where the conductor does enter or leave the enclosure through the wall opposite its terminal.

Exception No. 1: Where the distance between the wall and its terminal is in accordance with Table 312.6(A), a conductor shall be permitted to enter or leave an enclosure through the wall opposite its terminal, provided the conductor enters or leaves the enclosure where the gutter joins an adjacent gutter that has a width that conforms to Table 312.6(B) for the conductor.

Exception No. 2: A conductor not larger than 350 kcmil shall be permitted to enter or leave an enclosure containing only a meter socket(s) through the wall opposite its terminal, provided the distance between the terminal and the opposite wall is not less than that specified in Table 312.6(A) and the terminal is a lay-in type, where the terminal is either of the following:

(a) Directed toward the opening in the enclosure and within a 45 degree angle of directly facing the enclosure wall.

(b) Directly facing the enclosure wall and offset not greater than 50 percent of the bending space specified in Table 312.6(A).

Informational Note: Offset is the distance measured along the enclosure wall from the axis of the centerline of the terminal to a line passing through the center of the opening in the enclosure.

(C) Conductors 4 AWG or Larger. Installation shall comply with 300.4(G).

312.7 Space in Enclosures. Cabinets, switch enclosures, and cutout boxes shall have sufficient space to accommodate all conductors installed in them without crowding.

312.8 Switch and Overcurrent Device Enclosures with Splices, Taps, and Feed-Through Conductors. The wiring space of enclosures for switches or overcurrent devices shall be
permitted for conductors feeding through, spliced, or tapping off to other enclosures, switches, or overcurrent devices where all of the following conditions are met:

1. The total of all conductors installed at any cross section of the wiring space does not exceed 40 percent of the cross-sectional area of that space.
2. The total area of all conductors, splices, and taps installed at any cross section of the wiring space does not exceed 75 percent of the cross-sectional area of that space.
3. A warning label is applied to the enclosure that identifies the closest disconnecting means for any feedthrough conductors.

312.9 Side or Back Wiring Spaces or Gutters. Cabinets, enclosed switches, and cutout boxes shall be provided with back-wiring spaces, gutters, or wiring compartments as required by 312.11 (C) and (D).

II. Construction Specifications

312.10 Material. Cabinets, enclosed switches, cutout boxes, and meter socket enclosures shall comply with 312.10(A) through (C).

(A) Metal Cabinets, Enclosed Switches, and Cutout Boxes. Metal enclosures within the scope of this article shall be protected both inside and outside against corrosion.

Informational Note: For information on protection against corrosion, see 300.6.

Table 312.6(A) Minimum Wire-Bending Space at Terminals and Minimum Width of Wiring Gutters Wires per Terminal - NO CHANGES TO THIS TABLE

(B) Strength. The design and construction of enclosures within the scope of this article shall be such as to secure ample strength and rigidity. If constructed of sheet steel, the metal thickness shall not be less than 1.35 mm (0.053 in.) uncoated.

(C) Nonmetallic Cabinets and Enclosed Switches. Nonmetallic cabinets and enclosed switches shall be listed, or they shall be submitted for approval prior to installation.

312.11 Spacing. The spacing within cabinets and cutout boxes shall comply with 312.11(A) through (D).

(A) General. Spacing within cabinets, switch enclosures and cutout boxes shall be sufficient to provide ample room for the distribution of wires and cables placed in them and for a separation between metal parts of devices and apparatus mounted within them in accordance with (A)(1), (A)(2), and (A)(3).

1. Base. Other than at points of support, there shall be an airspace of at least 1.59 mm (0.0625 in.) between the base of the device and the wall of any metal cabinet or cutout box in which the device is mounted.

2. Doors. There shall be an airspace of at least 25.4 mm (1.00 in.) between any live metal part, including live metal parts of enclosed fuses, and the door.

Exception: Where the door is lined with an approved insulating material or is of a thickness of metal not less than 2.36 mm (0.093 in.) uncoated, the airspace shall not be less than 12.7 mm (0.500 in.).

3. Live Parts. There shall be an airspace of at least 12.7 mm (0.500 in.) between the walls, back, gutter partition, if of metal, or door of any cabinet, enclosed switch, or cutout box and the nearest exposed current-carrying part of devices mounted within the cabinet or enclosed switch where the voltage does not exceed 250. This spacing shall be increased to at least 25.4 mm (1.00 in.) for voltages of 251 to 600, nominal.

Exception: Where the conditions in 312.11(A)(2), Exception, are met, the airspace for nominal voltages from 251 to 600 shall be permitted to be not less than 12.7 mm (0.500 in.).
(B) **Switch Clearance.** Cabinets, enclosed switches, and cutout boxes shall be deep enough to allow the closing of the doors when 30-ampere branch-circuit panelboard switches are in any position, when combination cutouts or cutout switches are in any position, or when other single-throw switches are opened as far as their construction permits.

(C) **Wiring Space.** Cabinets, enclosed switches, and cutout boxes that contain devices or apparatus connected within the cabinet, enclosure, or box to more than eight conductors, including those of branch circuits, meter loops, feeder circuits, power circuits, and similar circuits, but not including the supply circuit or a continuation thereof, shall have back-wiring spaces or one or more side-wiring spaces, side gutters, or wiring compartments.

(D) **Wiring Space - Enclosure.** Side-wiring spaces, side gutters, or side-wiring compartments of cabinets, enclosed switches, and cutout boxes shall be made tight enclosures by means of covers, barriers, or partitions extending from the bases of the devices contained in the cabinet or enclosed switch, to the door, frame, or sides of the cabinet or enclosed switch.

*Exception: Side-wiring spaces, side gutters, and side-wiring compartments of cabinets shall not be required to be made tight enclosures where those side spaces contain only conductors that enter the cabinet or enclosed switch directly opposite to the devices where they terminate.*

Partially enclosed back-wiring spaces shall be provided with covers to complete the enclosure. Wiring spaces that are required by 312.11(C) and are exposed when doors are open shall be provided with covers to complete the enclosure.

Where adequate space is provided for feed-through conductors and for splices as required in 312.8, additional barriers shall not be required.
9-22  Log #3429  NEC-P09  Final Action: (312.4)

Submitter: Marvin Taylor, Student at Metropolitan Community College; Omaha, Nebraska
Recommendation:  Revise text to read as follows:

312.4 Repairing Noncombustible or Combustible Surfaces. Noncombustible or combustible surfaces that are broken or incomplete shall be repaired so there will...

<OR> 312.4 Repairing Noncombustible Surfaces. Noncombustible. Surfaces that are broken or incomplete shall be repaired so there will...

Substantiation: Cabinets, cutout boxes, and meter socket enclosures may be installed in combustible or noncombustible surfaces. Yet only noncombustible surfaces are required to be repaired. The CODE is silent on combustible surfaces. I propose the CODE require combustible surfaces be repaired to the 1/8 in gap also. This edition improvement will close the Code omission of not requiring repair of combustible surfaces.

9-23  Log #1847  NEC-P09  Final Action: (312.5(C))

Submitter: James F. Williams, Fairmont, WV
Recommendation:  Revise text to read as follows:

312.5(C) Exception: Cables with entirely nonmetallic sheaths (NM) shall be permitted to enter the top of a surface-mounted enclosure through one or more nonflexible raceways not less than 450 mm (18 in.) and not more than 3.0 m (10 ft) in length, provided all of the following conditions are met:

Substantiation: "nonmetallic sheathed cable" is referred to in several ways: "nonmetallic sheathed cable", "type NM" "type MNC" "type NMS" "NM" ....

Nonmetallic sheathed also appears to be used for other than NM cable in some cases.
Suggest that "NM" be added to all references. This will make finding all references to "nonmetallic sheathed cable" easier and more reliable.

9-24  Log #122  NEC-P09  Final Action: (312.5(C) Exception (g))

Submitter: Dennis Alwon, Alwon Electric Inc.
Recommendation:  Revise text to read as follows:

(g) Where installed as conduit or tubing, the allowable cable fill does not exceed that permitted for complete conduit or tubing systems by Table 1 of Chapter 9 of this Code and all applicable notes thereto except Note 2.

Substantiation: As written, this exception makes no sense since it takes us to Table 1 of Chapter 9 Note 2 which states that for sleeves Table 1 is not applicable. Section 312.5(C) is about sleeving NM cables into a panel. So we are told to use Table 1 then we are given exemption from using Table 1. If the intent is to consider conduit fill then Note 2 should be excluded otherwise the entire section (g) should be excluded.
9-25  Log #2536  NEC-P09  (312.8)  Final Action: 

**Submitter:** William Gross, Electric Service of Clinton  
**Recommendation:** Revise text to read as follows:

312.8 Switch and Overcurrent Device Enclosures with Splices, Taps, and Feed-Through Conductors. The wiring space of enclosures for switches or overcurrent devices shall not be used as junction boxes, auxiliary gutters or raceways be permitted for conductors feeding through, spliced, or tapping off to other enclosures, switches, or overcurrent devices where unless all of the following conditions are met: (1) The total of all conductors installed at any cross section of the wiring space does not exceed 40 percent of the cross-sectional area of that space. (2) The total area of all conductors, splices, and taps installed at any cross section of the wiring space does not exceed 75 percent of the cross-sectional area of that space. (3) A warning label is applied to the enclosure that identifies the closest disconnecting means for any feedthrough conductors.

**Substantiation:** The general rule of not using enclosures for splicing conductors should remain. Enclosures containing overcurrent devices should only contain splices under the conditions listed. The present wording seems to indicate that splicing is allowed first and subject to conditions secondly. The section as rewritten indicates that splicing shall not be performed in these enclosures unless certain conditions are present.

9-26  Log #853  NEC-P09  (312.8(3))  Final Action: 

**Submitter:** Michael J. Johnston, National Electrical Contractors Association  
**Recommendation:** Revise as follows:

(3) A warning label complying with 110.21(B) is applied to the enclosure that identifies the closest disconnecting means for any feedthrough conductors.

**Substantiation:** This proposal is one of several coordinated companion proposals to provide consistency of danger, caution, and warning sign or markings as required in the NEC. The proposed revision will correlate this warning marking requirement with proposed 110.21(B) and the requirements in ANSI Z 535.4.

9-27  Log #967  NEC-P09  (312.11(A)(3))  Final Action: 

**Submitter:** James T. Dollard, Jr., IBEW Local 98  
**Recommendation:** Change (3) from 600 to 1000V and do not change exception.  
**Substantiation:** This proposal is the work of the “High Voltage Task Group” appointed by the Technical Correlating Committee. The task group consisted of the following members: Alan Peterson, Paul Barnhart, Lanny Floyd, Alan Manche, Donny Cook, Vince Saporita, Roger McDaniel, Stan Folz, Eddie Guidry, Tom Adams, Jim Rogers and Jim Dollard.

The Task Group identified the demand for increasing voltage levels used in wind generation and photovoltaic systems as an area for consideration to enhance existing NEC requirements to address these new common voltage levels. The task group recognized that general requirements in Chapters 1 through 4 need to be modified before identifying and generating proposals to articles such as 690 specific for PV systems. These systems have moved above 600V and are reaching 1000V due to standard configurations and increases in efficiency and performance. The committee reviewed Chapters 1 through 8 and identified areas where the task group agreed that the increase in voltage was of minimal or no impact to the system installation. Additionally, there were requirements that would have had a serious impact and the task group chose not to submit a proposal for changing the voltage. See table (supporting material) that summarizes all sections considered by the TG.

**Note:** Supporting material is available for review at NFPA Headquarters.
Recommendation: Replace 600V with 1000V.

Substantiation: This proposal is the work of the “High Voltage Task Group” appointed by the Technical Correlating Committee. The task group consisted of the following members: Alan Peterson, Paul Barnhart, Lanny Floyd, Alan Manche, Donny Cook, Vince Saporita, Roger McDaniel, Stan Folz, Eddie Guidry, Tom Adams, Jim Rogers and Jim Dollard.

The Task Group identified the demand for increasing voltage levels used in wind generation and photovoltaic systems as an area for consideration to enhance existing NEC requirements to address these new common voltage levels. The task group recognized that general requirements in Chapters 1 through 4 need to be modified before identifying and generating proposals to articles such as 690 specific for PV systems. These systems have moved above 600V and are reaching 1000V due to standard configurations and increases in efficiency and performance. The committee reviewed Chapters 1 through 8 and identified areas where the task group agreed that the increase in voltage was of minimal or no impact to the system installation. Additionally, there were requirements that would have had a serious impact and the task group chose not to submit a proposal for changing the voltage. See table (supporting material) that summarizes all sections considered by the TG.

Note: Supporting material is available for review at NFPA Headquarters.
Elliot Rappaport, Coconut Creek, FL

**Recommendation:** Replace the phrase “equipment grounding conductor” with the phrase “equipment bonding conductor” in the Articles and Sections as identified below. Replacement of “grounding” or “ground” when used separately is covered in separate proposals.

- **Article 314:** 314.16(B)(1) Exc.; 314.16(B)(5); 314.40(D)
- **Article 404:** 404.9(B); 404.9(B)(1) & (2); 404.9(B) Exc. 1, 2, & 3
- **Article 408:** 408.3(D)
- **Article 490:** 490.36; 490.37; 490.55; 490.72(D)

**Substantiation:** This proposal is one of a series of proposals to replace, throughout the Code, the term “grounding” with “bonding” where appropriate.

As used in the Code, “grounding” is a well defined term and refers to connecting to the earth or ground for any one of a number of reasons. Similarly, “bonding” is the connection of two bodies together to form a continuous electrical path. The term “equipment grounding conductor” has a definite purpose that is not uniquely expressed in the term. As a result, there is a misconception that “grounding” will make a system safe. On the contrary, connecting equipment to ground without providing the bonding connection back to the source can make the equipment less safe.

The purpose of the “equipment grounding conductor (EGC)” is to provide a low impedance path from a fault at equipment “likely to become energized” to the source of the electrical current (transformer, generator, etc.). If it is argued that the purpose is to connect the equipment to ground, then the requirement of 250.4(A)(5) that “the earth shall not be considered as an effective ground path” would no longer be valid because fault current would then be intended to flow to the ground (earth).

From the conductor sizing requirements of 250.122, and specifically 250.122(B), it is apparent that the purpose of the EGC is related to connection (bonding) to the source of power rather than connection to ground. If the principle purpose was the connection to ground, then the sizing requirements would be less important since near equipotential conditions can be achieved with much smaller conductors.

The fundamentals of these proposals are to clearly state that “systems” are “grounded” and “equipment” is “bonded”. The fact that the bonding conductor may be grounded also is secondary to the primary function of bonding.

This proposal proposes changing the word “grounding” to “bonding”, where appropriate, throughout the Code. It is clear that there are many places where “grounding” is used to identify the connection to earth (grounding electrode conductor) and “grounding” should remain. Additionally, the expression “EGC” should be changed to “EBC”, “equipment bonding conductor” for consistency.
Nonmetallic boxes shall be permitted only with open wiring on insulators, concealed knob-and-tube wiring, cabled wiring methods with entirely nonmetallic sheaths (NM), flexible cords, and nonmetallic raceways.

**314.17(C) Exception:** Where nonmetallic-sheathed cable (NM) or multiconductor Type UF cable is used with single gang boxes not larger than a nominal size 57 mm x 100 mm (2 1/4 in. x 4 in.) mounted in walls or ceilings, and where the cable is fastened within 200 mm (8 in.) of the box measured along the sheath and where the sheath extends through a cable knockout not less than 6 mm (1/4 in.), securing the cable to the box shall not be required. Multiple cable entries shall be permitted in a single cable knockout opening.

**Substantiation:** "nonmetallic sheathed cable" is referred to in several ways: "nonmetallic sheathed cable", "type NM", "type MNC" "type NMS" "NM" ....

Nonmetallic sheathed also appears to be used for other than NM cable in some cases.

Suggest that "NM" be added to all references. This will make finding all references to "nonmetallic sheathed cable" easier and more reliable.

**Armored Cable**

"armored cable" is referred to in several ways: "armored cable" & "type AC"

Suggest that "Type AC" be added to all references. This will make finding all references to "armored cable" easier and more reliable.

[The files that propose this change include AC_250, AC_314, AC_392, AC_404, & AC_668]

"In damp or wet locations, boxes, conduit bodies, and fittings shall be placed or equipped so as to prevent moisture from entering or accumulating within the box, conduit body, or fitting. Boxes, conduit bodies, and fittings installed in wet locations shall be listed for use in wet locations.

**Substantiation:** The first sentence is redundant because the requirement "listed for use in wet locations" in the second sentence accomplishes what is stated in the first sentence.
**9-33  Log #1527  NEC-P09**

**Final Action:**

**Submitter:** Vince Baclawski, National Electrical Manufacturers Association (NEMA)

**Recommendation:** Add the following new text in Section 314.15:

**314.15 Damp or Wet Locations.** In damp or wet locations, boxes, conduit bodies, and fittings shall be placed or equipped so as to prevent moisture from entering or accumulating within the box, conduit body, or fitting. Boxes, conduit bodies, 
**outlet box hoods**, and fittings installed in wet locations shall be listed for use in wet locations.

**Substantiation:** The 2011 NEC, in Section 406.9(B)(1), requires “extra duty” outlet box hoods installed in a wet location to be listed. All outlet box hoods should be required to be listed when installed in a wet location as they are relied upon to provide protection for enclosed devices. Outlet box hoods are also used as a component of a weatherproof enclosure to protect other wiring devices that are not covered by the requirements in Section 406.9(B)(1).

**9-34  Log #2136  NEC-P09**

**Final Action:**

**Submitter:** Robert A. Jones, IEC Texas Gulf Coast

**Recommendation:** Revise text to read as follows:

In damp or wet locations, boxes, conduit bodies, and fittings shall be placed or equipped so as to prevent moisture 
**water** from entering or accumulating within the box, conduit body, or fitting. Boxes, conduit bodies, and fittings installed in wet locations shall be listed for use in wet locations.

**Substantiation:** The definition for raintight states "...beating rain will not result in the entrance of water...". Watertight is defined as "Constructed so that moisture will not enter the enclosure...". If the intent of CMP 9 is to have a damp or wet location installation meet the requirement for raintight then the word "water" would bring the requirement in line with the definition for raintight.
Revise as follows:

In damp or wet locations, boxes, conduit bodies, and fittings shall be placed or equipped so as to prevent moisture from entering or accumulating within the box, conduit body, or fitting. Drainage openings not larger than 6 mm (¼ in.) shall be permitted to be installed in the field. Boxes, conduit bodies, and fittings installed in wet locations shall be listed for use in wet locations.

Substantiation: Electricians have added weep holes in the field since electrical enclosures were first used in wet locations, and will continue to do so. Their use improves the safety and durability of electrical installations. How many times have we seen the inside of cast aluminum boxes thoroughly degraded over time when moisture condensed within the enclosure; experienced electricians routinely provide weep holes in the underside that provide enough ventilation to avoid such damage. The rule in 230.53 requiring service raceways to be arranged to drain is merely one example, albeit one with an express code mandate. The Code should say what it means and mean what it says.

As noted in the comment on Proposal 1-142 in the prior cycle, this provision was originally within the scope of CMP 9. In the 1996 code cycle (Proposal 9-33) CMP 9 limited the unused opening provision to cable and raceway openings precisely to accommodate weep holes. The submitter of that proposal, the late Creighton Schwan, was one of the greatest participants in the code process in the history of the document. He correctly pointed out that such openings should be clearly permitted.

Since the field orientation of cast aluminum or other such enclosures cannot be known at the time of manufacture, it would be impossible for such openings to be provided in advance and therefore “as part of the design for listed equipment”. The panel statement from CMP 1 in rejecting this change as a generic action in the comment period expressed concern that the original proposal had no upper limit on the size of permitted drainage openings applied in the field. This wording adequately addresses that concern.

Revise text to read as follows:

In damp or wet locations, boxes, conduit bodies, and fittings shall be placed or equipped so as to prevent moisture from entering or accumulating within the box, conduit body, or fitting. Boxes, conduit bodies, and fittings in wet locations shall be listed for use in wet locations. The interior of such box, conduit body, or fitting shall be considered to be a wet location.

Substantiation: As an inspector of solar photovoltaic systems, I encounter many outdoor enclosures that contain indoor twist-on wire connectors. These connectors after several weeks will show signs of rust and corrosion, thus compromising the integrity of the splice. The new addition to 314.15 would coincide with Article 300.9 states “Where raceways installed in wet locations abovegrade, the interior of these raceways shall be considered to be a wet location...”
Boxes and conduit bodies shall be of sufficient size to provide free space for all enclosed conductors. In no case shall the volume of the box, as calculated in 314.16(A), be less than the fill calculation as calculated in 314.16(B). The minimum volume for conduit bodies shall be as calculated in 314.16(C).

The volume of a wiring enclosure (box) shall be the total volume of the assembled sections, including connector fittings, if applicable, and, where used, the space provided by plaster rings, domed covers, extension rings, and so forth, that are marked with their volume or are made from boxes the dimensions of which are listed in Table 314.16(A)

(B) Box Fill Calculations
The volumes in paragraphs 314.16(B)(1) through (B)(5), as applicable, shall be added together. No allowance shall be required for small fittings such as locknuts and bushings.

(6) Connector Fittings. Only conductors on the side of the connector fitting that are inside the wiring enclosure (box) when assembled shall be counted. Conductors on the side of the connector fitting external of the wiring enclosure (box) shall not be counted.

Substantiation: The connector fitting introduced in the companion proposals is not addressed in the current box volume and conductor fill calculations. This proposal would give clarity as to how to calculate volume and fill when using connector fittings to maintain product safety.

Note: This is a companion proposal to 100, 300.15 and 334.30
Note: Supporting material is available for review at NFPA Headquarters.
For each yoke or strap containing one or more devices or equipment, a double volume allowance in accordance with Table 314.16(B) shall be made for each yoke or strap based on the largest conductor connected to a device(s) or equipment supported by that yoke or strap. The volume of the device(s) or equipment shall be deducted from the box volume. The box shall not be filled with device(s) or equipment to greater than 35% of the box volume. A device or utilization equipment wider than a single 50 mm (2 in.) device box as described in Table 314.16(A) shall have double volume allowances provided for each gang required for mounting.

Substantiation: The same basic proposal was submitted and rejected during the 2005 NEC proposal cycle. It is not my intent to waste the committee's valuable time by submitting the same proposal; however, most recently another manufacturer, as well as other committee members, recommended I should resubmit.

The committee's response to require 1/4 in. of space from the inside back of a box to the back of a device has had little impact resolving the basic issue of overcrowding in outlet boxes. Therefore, with great esteem for the collective intelligence of this committee I am respectfully submitting this proposal for your consideration.

Observation
The proposed Code changes are necessary to meet the intent of NEC Article 314.16 where it states: Boxes shall be of sufficient size to provide free space for all enclosed conductors.
It has been observed repeatedly during 12 years tracking many projects that for many modern devices, the required free-air space is not available for conductors in the device box.

Goal
Demonstrate mathematically that a Code change is necessary and essential to meet the intent of the Code for box fill when using modern devices and equipment.

Problem and Solution
The volume allowance for device(s) and equipment in electrical boxes that is based upon the largest size of conductor terminated to the device(s) or equipment does not achieve the conductor free-air space required in Table 314.16(B) when modern device(s) and equipment that are larger than traditional receptacles and switches are installed.

The proposed method is based upon the actual device and equipment volume. Research indicates 35% of box fill for device(s) and equipment provides adequate free-air for conductors.

To calculate box fill using this proposed method:
1. Check the volume of the device or equipment and deduct that volume from the box volume and verify it is no more than 35% of the box volume.
2. The remaining volume is then used to determine the maximum number of conductors allowable per Table 314.16(B).

Mathematical Demonstration
The representative few examples below are actual and commonly used in industry today.
Example A: Sensor, Timer and Dimmer Devices
1. Current Code: When a 9 in³ device is installed in a 16 in³ box it fills 56% of the box volume and leaves 7 in³ of space for conductors. Per existing Code 8 #14 AWG conductors may be installed in this box less 2 conductors for a double volume allowance terminated on the device. Thus 6 conductors (required by the device) in 7 in³ of free space yields a ratio of 1.17 in³ of free air space per conductor. This is only 59% of the free space required by Table 314.16(B).
2. Proposed Code: A 9 in³ device would require a minimum of 26 in³ at 35% fill. 26 less 9 equals 17 in³ free air space available for up to 12 #14 AWG conductors with 2.125 in³ of free air space for each conductor, thus meeting the requirement of Table 314.16(B).

Example B - Fire Alarm Device
1. Current Code: When a 13 in³ device is installed in a 21 in³ box as specified by the manufacturer the device fills 62% of the box by volume and leaves only 8 in³ of space for conductors. Per existing Code 10 #14 AWG conductors may be installed in this box less 2 conductors for a double volume allowance terminated on the device per 314.16(B)(4). Thus 8 conductors (required by the device) in 8 in³ of free space yields a ratio of 1.0 in³ of free space per conductor. This is only 50% of the free space required by Table 314.16(B).
2. Proposed Code: A 13 in³ device would require a minimum of 37 in³ at 35% fill. 37 less 13 equals 24 in³ free air space available for up to 12 #14 AWG conductors with 2.0 in³ free air space per conductor, this meeting a 2.0 in³ free air space for each conductor, thus meeting the requirements of Table 314.16(B).

Example C - Fire Alarm Device
1. Current Code: When a 14 in$^3$ device is installed in a 30 in$^3$ box as specified by the manufacturer the device fills 47% of the box by volume and leaves only 16 in$^3$ of free air space for conductors. Per existing code 15 #14 AWG conductors may be installed in this box less 2 conductors for a double volume allowance terminated on the device per 314.16(B)(4). Thus 13 conductors in 16 in$^3$ of free space yields a ratio of 1.23 in$^3$ of free air space per conductor. This is only 62% of the free air space required by Table 314.16(B)(4).

2. Proposed Code: A 14 in$^3$ device would require a minimum of 40 in$^3$ at 35% fill. 40 less 14 equals 26 in$^3$ free air space available for up to 13 #14 AWG conductors with 2.0 in$^3$ requirement of Table 314.16(B).

Example D - Fire Alarm Device

1. Current Code: When a 27 in$^3$ device is installed in a 51 in$^3$ box it consumes 53% of the box volume and leaves 24 in$^3$ of free air space for conductors. Per existing Code 25 #14 Awg conductors may be installed in this box less 2 conductors for a double volume allowance terminated on the device per 314.16(B)(4). Thus 23 conductors in 24 in$^3$ of free air space yields a ratio of 1.04 in$^3$ of free air space per conductor. This is only 52% of the free air space required by Table 314.16(B).

2. Proposed Code: A 27 in$^3$ device would require a minimum of 78 in$^3$ at 35% fill. 78 less 27 equals 51 in$^3$ free air space available for up to 25 #14 AWG conductors with 2.04 in$^3$ free air space per conductor, thus meeting the 2.0 in$^3$ free air requirement of Table 314.16(B).

Response to Alternative:

1. If a box has conductors only and the maximum fill by actual volume of those conductors never exceeds over 5%, why would we then allow a device to fill 65% the box volume and yet only reduce the number of conductors by two? Why not fill a conductor only box up to 65%? The hazards become very obvious and so should the hazards of allowing device(s) and equipment with this same level of fill.

2. Some suggest a quadruple conductor allowance to resolve this problem. If we install a 27 in$^3$ device in a 51 in$^3$ box existing code allows 25 # 14 Wag conductors less 4 conductors, still leaving 21 conductors. The device only requires 8 conductors, therefore a quadruple deduction has no realistic impact. The only thing that does alleviate these problems is limiting the volume that a device or equipment may consume in a box.

Impact of Proposed Code Change

A previous cycle of the Code-making panel expressed concern that manufacturers may be forced to stop making some products and be forced out of business. Our research indicates that this is unlikely because a larger box size is all that will be required for a product to meet the revised Code. More importantly, these products will be installed more safely and with fewer wiring problems. As a result, even with the marginal cost increase for larger boxes, the overall costs will be less due to reduced installation and troubleshooting time.

It is our contention that if implemented the industry will see a marked decrease in the number of box related fires and fire related injuries and equipment damage.

Conclusions

The mathematical calculations using actual modern device volumes and the existing Code fill allowances demonstrate unequivocally that the proposed Code change is necessary to meet the spirit and safety intent of the Code.

Note: Supporting material is available for review at NFPA Headquarters.
I propose the following change to NEC Article 314.16(B)(5), to wit:

Where one or more equipment grounding conductors or equipment bonding jumpers enter a box:

(a) A single volume allowance in accordance with Table 314.16(B) shall be made based on the largest equipment grounding conductor or equipment bonding jumper present in the box; and

(b) Where an additional set of equipment grounding conductors, as permitted by 250.146(D), is present in the box, an additional volume allowance shall be made based on the largest equipment grounding conductor in the additional set. The size of the largest equipment grounding conductor in the additional set shall be used to determine the volume allowance in (a) of this section.

Article 314.16(B)(5) of the NEC, as it is, can be interpreted in two different ways. One interpretation assigns a separate volume allowance for only an additional set of equipment grounding conductors. The other interpretation assigns a single volume allowance for all equipment grounding conductors present in a box, based upon the size of an additional set of equipment grounding conductors. A question can arise, therefore, as to whether the size of the largest equipment grounding conductor, of those permitted by 250.146(D), should be considered in the volume allowance that is calculated for those equipment grounding conductors existing in a box prior to the installation of the additional set. Breaking the paragraph into levels (a) and (b) would clarify this article by eliminating the possibility of there being two different interpretations of it.

Note: Supporting material is available for review at NFPA Headquarters.

Conductors entering boxes, conduit bodies, or fittings shall be protected from abrasion and shall comply with 314.17(A) through (D). Openings through which conductors enter shall be adequately closed. Where openings are closed to comply with energy requirements, the closing method shall be approved or part of a listed box, conduit body or fitting.

In an effort to seal outlet boxes, there are several reports of field modifications to products that can environmentally seal the box, but can add fuel to a fire, or have compatibility problems with the box material or conductors material. I have provided an example of what has been done in the field, using silicone sealant plastered around a box. This change requires listed products to be used when sealing for energy efficiency purposes or other approved means as allowed by the AHJ.

Note: Supporting Material is available for review at NFPA headquarters.
Add a new Section (E) as follows:

(E) Protection During Construction. Where outlet or device boxes are secured in place prior to the application of the surface finish and arranged for flush mounting in drywall, the open fronts shall be covered with protective plates identified for this purpose to prevent conductor damage during surface application activities.

The requirement for "the protection of conductors within boxes" is addressed in 300.4(E) for boxes installed under roof-decking. However, conductor damage within outlet or device boxes happens much more frequently during surface application activities.

The Code Making Panel makes a reference to the text of 110.12(B), indicating that 110.12(B) provides adequate protection. Yet the text of 110.12(B) only describes "What" damage to electrical equipment should be avoided; this Proposal describes "How" to avoid that damage.

The requirement of protective plates will assure that exposed and vulnerable conductors within device boxes are safe from being cut, damaged, or contaminated during construction form knives, power routers, saws, drills, plaster-filled boxes, overspray from paint guns, spray foam insulation guns and mastic materials.

In addition, these protective plates will offer protection to so-called "snap-in" devices that are installed during the rough-in period, including switches, receptacles and control and protective devices of electronic design.

These protective plates are a cost-effective solution to a costly problem as they are inexpensive, reusable and designed simply. Quite possibly, there is not an electrical inspector in the country who cannot relate to witnessing costly damage to a conductor that could have been prevented by a protective plate.

Finally, the use of protective plates does not require an additional inspection by the Authority Having Jurisdiction ("AHJ") as the protective plates are easily removed and replaced during the rough inspection.
314.17 Conductors Entering Boxes, Conduit Bodies, or Fittings.

(E) Conductors Inside Electrical Boxes. Conductors, inside electrical boxes, subject to physical damage from router bits, sheetrock saws, and knives, and nonconductive coatings; such as drywall mud, paint, lacquer and enamel, shall be protected during the construction process by means of a rigid cover, plate, or insert of a thickness and strength as to prohibit penetration by the above mentioned items.

Substantiation: I have been an electrician for over 30 years. During this time, I have encountered thousands of wires inside the electrical box damaged by sheetrock routers, knives, saws, mud, paint, enamel, and lacquer.

Furthermore, I have received many calls from homeowners complaining of “the smell of burning wires” or “a receptacle or switch that doesn’t work”. What I inevitably find are damaged wires inside the electrical box. The insulation on the wires has melted due to excessive heat because the amperage rating of the wires has been compromised or lessened as a result of a nick or cut in the wires. If the homeowner hadn’t noticed the “smell of burning wires” or “that the switch or receptacle was not operational”, the damaged wire would have eventually caused a fire.

Per the US Home Product Report, Appliances & Equipment, 01/02 issued by the NFPA’s Fire Analysis & research, Quincy, MA:

The number one cause of an “Electrical Distribution Equipment: fire is a short circuit or a ground fault. Damaged conductors cause short circuits and ground faults. When the conductors are damaged the amperage rating of the conductor is compromised or lessened. This results in overheating, which results in the fire.

The form of material first ignited from an “Electrical Distribution Equipment” fire is the electrical wire or cable insulation.

There are codes in place that provide for the Integrity of Electrical Equipment and Connections 110.12 (C) and 314.17 Conductors Entering Boxes, Conduit Bodies, or Fittings. These codes specifically protect the wire at all points of vulnerability from the distribution panel up to, but not including, the point where the wires are inserted into the electrical box.

There is no code that specifically ensures the protection of the conductors after they are inserted in the electrical box. Once the conductors are inserted in the electrical box, they are extremely vulnerable to the inevitable damage caused by sheetrock routers, sheetrock saws and knives, and nonconductive coatings; such as drywall mud, paint, lacquer and enamel.

It may be assumed that an inspection will detect damaged wires and the electrician will be required to re-run the wires. That is not always true. An inspector may not always see a damaged wire hidden in the wall or spliced. The plug in tester used during the inspection will confirm that the outlet or receptacle is working even though the amperage rating of the conductor is compromised or lessened due to damage.

It may also be assumed that electricians will re-run a damaged wire that violates code 300.14 “Length of Free Conductors at Outlets, Junctions, and Switch Panels”. However, from my experience and from conversations I’ve had with many electricians, that is not what is occurring.

Please see attached results of a Survey of Electricians.

As members of the NFPA, I feel that we have a responsibility to ensure that the wires are explicitly protected by a specific code at every point of vulnerability during construction from the distribution panel to inside the electrical box. This is especially true of the conductors once they are inside the electrical box as they are extremely vulnerable to the inevitable damage from sheetrock routers, sheetrock saws and knives, and nonconductive coatings; such as drywall mud, paint, lacquer and enamel.

The addition of Code 314.17(E) is a vital fire safety preventative targeted directly at reducing the number of deaths and injuries from home fires.

Printed on 11/25/2011
process by means of a rigid cover, plate, or insert of a thickness and strength as to prohibit penetration by the above mentioned items.

Similar proposals have been presented to the code making panel many times in the past. In 2008 this proposal was passed by panel 3 and rejected by panel 9 due to a disagreement of where it belonged in the code. It was put on hold and as a result was killed in the process. The IBEW & the IAEI was in favor of this code. Facts from fire analysis reports, statements from electricians gathered in surveys, and pictures substantiate the problem. A damaged conductor inside the electrical box loses its current carrying capacity, if gone undetected the over current protection device will not protect the conductor from overheating (without an arc to trip the arc fault breaker), causing the wire and cable insulation to heat up and catch on fire. This is still the material first ignited as shown in all reports I have found since 1994 to present. There may be arguments as to where this belongs in the code. The point is it does belong in the code. The point of the NEC is as stated in 90.1 A and 90.1 B.  

90.1 A- Practical Safeguarding. The purpose of this Code is the practical safeguarding of persons and property from hazards arising from the use of electricity.

90.1 B- Adequacy. This Code contains provisions that are considered necessary for safety. Compliance therewith and proper maintenance results in an installation that is essentially free from hazard, but not necessarily efficient, convenient, or adequate for good service or future expansion of electrical use.

Note: Supporting material is available for review at NFPA Headquarters.

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9-43  Log #3430  NEC-P09  Final Action:

(314.21)

Submitter: Marvin Taylor, Student at Metropolitan Community College; Omaha, Nebraska
Recommendation: Revise text to read as follows:

314.21 Repairing Noncombustible or Combustible Surfaces. Noncombustible or combustible surfaces that are broken or incomplete around...

<OR>

314.21 Repairing Noncombustible Surfaces. Noncombustible Surfaces that are broken or incomplete around...

Substantiation: Outlet, Device, Pull, and Junction Boxes; Conduit Bodies; Fittings; and Handhole Enclosures may be installed in combustible or noncombustible surfaces. Yet only noncombustible surfaces are required to be repaired. The CODE is silent on combustible surfaces. I propose The CODE require combustible surfaces be repaired to the 1/8 in. gap also. This editing improvement will close the CODE omission of not requiring repair of combustible surfaces.

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9-44  Log #562  NEC-P09  Final Action:

(314.22)

Submitter: Ronald Bethea, Memphis and Shelby County Code Enforcement
Recommendation: Revise text to read as follows:

314.22 Surface Extensions. Surface extensions from an outlet, device, junction, or pull box shall be made by mounting and mechanically securing an extension ring over the box. Equipment grounding shall be in accordance with Part VI of Article 250.

Substantiation: This proposal limits the applicability of surface extensions to boxes used specifically for the purposes listed in the revised text. It also restores the language similarly to that of 370.12 of the 1990 Code. Although not specifically included in the scope of Article 314, panelboard enclosures are required to comply with Article 314 by Section 408.2. Because of this, the exception to Section 314.22 could be interpreted to apply to panelboard covers. The revised text will clarify the specific applications of boxes and covers that are permitted to be used to transition from a concealed wiring method to a surface wiring method without adversely affecting common practice in the field.
Submitter: Stanley J. Folz, Morse Electric Company
Recommendation: Revise text to read as follows:

314.23(D)(2) The enclosure shall be secured, using identified methods identified for the purpose, to ceiling support wire(s), including any additional wire(s) installed for ceiling support.

Substantiation: The TCC Usability Task Group is comprised of Stanley Folz, James Dollard, Bill Fiske and David Hittinger. This task group was assigned by the TCC Chair to review the use of the phrase “identified for the purpose” throughout the NEC.

The word “Identified” is defined in Art. 100 as “Recognizable as suitable for the specific purpose . . .”. The addition of “for the purpose” after the word identified is unnecessary and does not add clarity to the rule.

This is not original material; its reference/source is as follows:

This proposal was developed by the TCC Usability Task Group.
Enclosures within the scope of this article shall be supported in accordance with one or more of the provisions in 314.23(A) through (H).

314.23 Supports. Enclosures within the scope of this article shall be supported in accordance with one or more of the provisions in 314.23(A) through (H).

(E) Raceway-Supported Enclosures, Without Devices, Luminaires, or Lampholders. An enclosure that does not contain a device(s) other than splicing devices or support a luminaire(s), lampholder, or other equipment and is supported by entering raceways shall not exceed $1650 \text{ cm}^3$ (100 in.$^3$) in size. It shall have threaded entries or have hubs identified for the purpose. It shall be supported by two or more conduits threaded wrenchtight into the enclosure or hubs. Each conduit shall be secured within 900 mm (3 ft) of the enclosure, or within 450 mm (18 in.) of the enclosure if all conduit entries are on the same side.

Exception No. 1: The following wiring methods shall be permitted to support a conduit body of any size, including a conduit body constructed with only one conduit entry, if provided the trade size of the conduit body is not larger than the largest trade size of the conduit or tubing:

1. Intermediate metal conduit, Type IMC
2. Rigid metal conduit, Type RMC
3. Rigid polyvinyl chloride conduit, Type PVC
4. Reinforced thermosetting resin conduit, Type RTRC
5. Electrical metallic tubing, Type EMT

Exception No. 2: An enclosure that is listed as a raceway fitting for the following wiring methods shall be supported in accordance with the manufacturer's installation instructions and shall not be required to be supported by means of conduit entries or hubs.

1. Surface metal raceways
2. Surface nonmetallic raceways
3. Underfloor raceways

[The remainder of 314.23 unchanged by this Proposal]

Substantiation: The existing content of this “Raceway Supported” requirement addresses generally those enclosures supported solely by conduit (i.e., conduit being “raceway” in the general sense, as defined in Article 100). Installations of surface raceways and underfloor raceways may provide negligible mechanical connection for the purpose of adequate support beyond each raceway section to raceway fittings. Support of enclosures (raceway fittings) consequently is achieved by mechanical means (other than conduit) addressed in manufacturer’s installation instructions. Standards ANSI/UL 5, ANSI/UL 5A and ANSI/UL 884 for these specific raceway methods and their associated fittings include evaluations for adequacy of mounting, mechanical loading, heat deflection (nonmetallic), and associated manufacturer’s installation instructions. Also for correlation with 386.30 and 388.30.

This Exception No. 2 proposal may also apply to listed fittings (enclosures and boxes) associated with Cellular Concrete Floor Raceways (Article 372), Cellular Metal Floor Raceways (Article 374), and surface-mount Strut-Type Channel Raceways (Article 384). I defer to those on the Code-Making Panel and those in the Comment (ROC) stage having more specialized knowledge of those particular wiring methods to provide information as appropriate.

The editorial changes of “Raceway Supported Enclosure” to “Raceway-Supported Enclosures” (in the title) and of “if” to “provided” (in Exception No. 1) are for consistency with existing wording of 314.23(F).
Submitter: Stanley J. Folz, Morse Electric Company
Recommendation: Revise text to read as follows:
   It shall have threaded entries or have identified hubs identified for the purpose.
Substantiation: The TCC Usability Task Group is comprised of Stanley Folz, James Dollard, Bill Fiske and David Hittinger. This task group was assigned by the TCC Chair to review the use of the phrase “identified for the purpose” throughout the NEC.
   The word “Identified” is defined in Art. 100 as “Recognizable as suitable for the specific purpose . . .”. The addition of “for the purpose” after the word identified is unnecessary and does not add clarity to the rule.
This is not original material; its reference/source is as follows:
This proposal was developed by the TCC Usability Task Group.
9-48 Log #340 NEC-P09
(314.23(F))

Final Action:

Submitter: Brian E. Rock, Hubbell Incorporated

Recommendation: Revise text to read as follows:

314.23 Supports. Enclosures within the scope of this article shall be supported in accordance with one or more of the provisions in 314.23(A) through (H).

[314.23(A) through 314.23(E) unchanged by this Proposal]

(F) Raceway-Supported Enclosures, with Devices, Luminaire(s), or Lampholder(s). An enclosure that contains a device(s), other than splicing devices, or support a luminaire(s), lampholder, or other equipment and is supported by entering raceways shall not exceed 1650 cm$^3$ (100 in.$^3$) in size. It shall have threaded entries or have hubs identified for the purpose. It shall be supported by two or more conduits threaded wrenchtight into the enclosure or hubs. Each conduit shall be secured within 900 mm (3 ft) of the enclosure, or within 450 mm (18 in.) of the enclosure if all conduit entries are on the same side.

Exception No. 1: Rigid metal or intermediate metal conduit shall be permitted to support a conduit body of any size, including a conduit body constructed with only one conduit entry, provided the trade size of the conduit body is not larger than the largest trade size of the conduit.

Exception No. 2: An unbroken length(s) of rigid or intermediate metal conduit shall be permitted to support a box used for luminaire or lampholder support, or to support a wiring enclosure that is an integral part of a luminaire and used in lieu of a box in accordance with 300.15(B), where all of the following conditions are met:

(a) The conduit is securely fastened at a point so that the length of conduit beyond the last point of conduit support does not exceed 900 mm (3 ft).

(b) The unbroken conduit length before the last point of conduit support is 300 mm (12 in.) or greater, and that portion of the conduit is securely fastened at some point not less than 300 mm (12 in.) from its last point of support.

(c) Where accessible to unqualified persons, the luminaire or lampholder, measured to its lowest point, is at least 2.5 m (8 ft) above grade or standing area and at least 900 mm (3 ft) measured horizontally to the 2.5 m (8 ft) elevation from windows, doors, porches, fire escapes, or similar locations.

(d) A luminaire supported by a single conduit does not exceed 300 mm (12 in.) in any direction from the point of conduit entry.

(e) The weight supported by any single conduit does not exceed 9 kg (20 lb).

(f) At the luminaire or lampholder end, the conduit(s) is threaded wrenchtight into the box, conduit body, or integral wiring enclosure, or into hubs identified for the purpose. Where a box or conduit body is used for support, the luminaire shall be secured directly to the box or conduit body, or through a threaded conduit nipple not over 75 mm (3 in.) long.

Exception No. 3: An enclosure that is listed as a raceway fitting for the following wiring methods shall be supported in accordance with the manufacturer's installation instructions and shall not be required to be supported by means of conduit entries or hubs.

(1) Surface metal raceways

(2) Surface nonmetallic raceways

(3) Underfloor raceways

[The remainder of 314.23 unchanged by this Proposal]

Substantiation: The existing content of this “Raceway-Supported” requirement addresses generally those enclosures supported solely by conduit (i.e., conduit being “raceway” in the general sense, as defined in Article 100). Installations of surface raceways and underfloor raceways (Articles 386, 388 and 390) at enclosures and boxes (listed as raceway fittings) however typically incorporate no conduit whatsoever. Adjacent sections of surface raceway and underfloor raceway may provide negligible mechanical connection for the purpose of adequate support beyond each raceway section to raceway fittings. Support of enclosures (raceway fittings) consequently is achieved by mechanical means (other than conduit) addressed in manufacturer’s installation instructions. Standards ANSI/UL 5, ANSI/UL 54 and ANSI/UL 884 for these specific raceway methods and their associated fittings include evaluations for adequacy of mounting, mechanical loading, heat deflection (nonmetallic), and associated manufacturer’s installation instructions. Also for correlation with 386.30 and 388.30.

This Exception No. 3 proposal may also apply to listed fittings (enclosures and boxes) associated with Cellular Concrete Floor Raceways (Article 372), Cellular Metal Floor Raceways (Article 374), and surface-mount Strut-Type Channel Raceways (Article 384). I defer to those on the Code-Making Panel and those in the Comment (ROC) stage having more specialized knowledge of those particular wiring methods to provide information as appropriate.
9-49  Log #350  NEC-P09  
(314.23(F))  

Submitter: Stanley J. Folz, Morse Electric Company  
Recommendation: Revise text to read as follows:  
It shall have threaded entries or have identified hubs identified for the purpose.  
Substantiation: The TCC Usability Task Group is comprised of Stanley Folz, James Dollard, Bill Fiske and David Hittinger. This task group was assigned by the TCC Chair to review the use of the phrase "identified for the purpose" throughout the NEC.  
The word "Identified" is defined in Art. 100 as "Recognizable as suitable for the specific purpose . . .". The addition of "for the purpose" after the word identified is unnecessary and does not add clarity to the rule.  
This is not original material; its reference/source is as follows:  
This proposal was developed by the TCC Usability Task Group.

9-50  Log #2360  NEC-P09  
(314.23(F) and 314.23(H))  

Submitter: James F. Williams, Fairmont, WV  
Recommendation: Add text to read as follows:  
314.23(F)  
Exception No. 1: Rigid metal (RMC) or intermediate metal conduit shall be permitted to support a conduit body of any size, including a conduit body constructed with only one conduit entry, provided the trade size of the conduit body is not larger than the largest trade size of the conduit.  
Exception No. 2: An unbroken length(s) of rigid (RMC) or intermediate metal conduit shall be permitted to support a box used for luminaire or lampholder support, or to support a wiring enclosure that is an integral part of a luminaire and used in lieu of a box in accordance with 300.15(B), where all of the following conditions are met:  
314.23(H)  
(2) Conduit. A box supporting lampholders or luminaires, or wiring enclosures within luminaires used in lieu of boxes in accordance with 300.15(B), shall be supported by rigid (RMC) or intermediate metal conduit stems. For stems longer than 450 mm (18 in.), the stems shall be connected to the wiring system with flexible fittings suitable for the location. At the luminaire end, the conduit(s) shall be threaded wrenchtight into the box or wiring enclosure, or into hubs identified for the purpose.  
Substantiation: "Rigid Metal Conduit" is also referred to as "RMC" "Metallic Conduit"  
Suggest that "RMC" be added to all references. This will make finding all references to "Rigid Metal Conduit" easier and more reliable.
Add new text to 314.23(F) to read as follows:

314.23 Supports

(F) Raceway-Supported Enclosures, with Devices, Luminaires, or Lampholders. An enclosure that contains a device(s), other than splicing devices, or supports a luminaire(s), lampholder, or other equipment and is supported by entering raceways shall not exceed 1650 cm$^3$ (100 in.$^3$) in size. It shall have threaded entries or have hubs identified for the purpose. It shall be supported by two or more conduits threaded wrenchtight into the enclosure or hubs. Each conduit shall be secured within 450 mm (18 in.) of the enclosure. An outdoor, raceway-supported enclosure within 600 mm (2 ft) vertically of grade level and adjacent to a paved surface intended for perpendicular or angled parking of automotive-type vehicles shall be located no closer horizontally than 450 mm (18 in.) to the farthest of the parking space pavement or of the vehicle-side surface of the curbing, a permanent parking chock (wheel stop), or a single permanent bollard.

(Exception Nos. 1 and 2 to 314.23(F) are unchanged by this Proposal)

Exception No. 3: An outdoor, raceway-supported enclosure adjacent to a paved surface intended for perpendicular or angled parking of automotive-type vehicles and protected by two or more permanent bollards shall be permitted to be located no closer horizontally than 100 mm (4 in.) of the vehicle-side surfaces of the bollards.

(The remainder of 314.23 is unchanged by this Proposal)

Substantiation: This Proposal addresses damage and unsafe exposure of energized components resulting from mitigateable low-speed automotive impact.

Accompanying photos are views of the same raceway-supported enclosure installation, typical of those frequently encountered adjacent to vehicular parking areas. This wet location outlet box installation was located approximately 10 inches from the curbing of a parking lot having no concrete parking chocks at perpendicular parking spaces. (The electrical enclosure may not be visible to drivers backing into the parking space.) This was the condition of nearly all raceway-supported boxes adjacent to parking spaces at that new facility (hotel) approximately 8 months after its 2010 opening. The square channel supporting this box appeared to be an unsuccessful reinforcement remedial attempt to preventing recurring damage and was not yet present at all damaged enclosures in this parking area. [NEC® 406.9(B) noncompliance also evident appeared to be possibly the result of replacement of originally-installed components by unqualified repairers. Wet location outlet boxes located much farther from parking spaces and as yet undamaged were 406.9(B)-compliant, pre-2011 “extra-duty” revisions.]

Unpaved parking spaces are not addressed by this Proposal since enforceable measurement is unlikely to be repeatably achievable.

Note: Supporting material is available for review at NFPA Headquarters.
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9-52 Log #2460 NEC-P09
(314.23(F) Exception No. 1 and No. 2 and 314.23(H)(2))

Final Action:

Submitter: James F. Williams, Fairmont, WV
Recommendation: Revise text to read as follows:

314.23(F)

Exception No. 1: Rigid metal or intermediate metal conduit (IMC) shall be permitted to support a conduit body of any size, including a conduit body constructed with only one conduit entry, provided the trade size of the conduit body is not larger than the largest trade size of the conduit.

Exception No. 2: An unbroken length(s) of rigid or intermediate metal conduit (IMC) shall be permitted to support a box used for luminaire or lampholder support, or to support a wiring enclosure that is an integral part of a luminaire and used in lieu of a box in accordance with 300.15(B), where all of the following conditions are met:

314.23(H)(2) Conduit. A box supporting lampholders or luminaires, or wiring enclosures within luminaires used in lieu of boxes in accordance with 300.15(B), shall be supported by rigid or intermediate metal conduit (IMC) stems. For stems longer than 450 mm (18 in.), the stems shall be connected to the wiring system with flexible fittings suitable for the location. At the luminaire end, the conduit(s) shall be threaded wrench tight into the box or wiring enclosure, or into hubs identified for the purpose.

Substantiation: "Intermediate Metal Conduit" is also referred to as “IMC” “Metallic Conduit” “IOMC” be added to all references. This make finding all references to “Intermediate Metal Conduit” easier and more reliable.

9-53 Log #349 NEC-P09
(314.23(F) Exception No. 2 (f))

Final Action:

Submitter: Stanley J. Folz, Morse Electric Company
Recommendation: Revise text to read as follows:

(f) At the luminaire or lampholder end, the conduit(s) is threaded wrench tight into the box, conduit body, or integral wiring enclosure, or into identified hubs identified for the purpose.

Substantiation: The TCC Usability Task Group is comprised of Stanley Folz, James Dollard, Bill Fiske and David Hittinger. This task group was assigned by the TCC Chair to review the use of the phrase "identified for the purpose" throughout the NEC.

The word “Identified” is defined in Art. 100 as “Recognizable as suitable for the specific purpose . . .”. The addition of “for the purpose” after the word identified is unnecessary and does not add clarity to the rule.

This is not original material; its reference/source is as follows:

This proposal was developed by the TCC Usability Task Group.

9-54 Log #351 NEC-P09
(314.23(H)(2))

Final Action:

Submitter: Stanley J. Folz, Morse Electric Company
Recommendation: Revise text to read as follows:

At the luminaire end, the conduit(s) shall be threaded wrench tight into the box or wiring enclosure, or into identified hubs identified for the purpose.

Substantiation: The TCC Usability Task Group is comprised of Stanley Folz, James Dollard, Bill Fiske and David Hittinger. This task group was assigned by the TCC Chair to review the use of the phrase “identified for the purpose” throughout the NEC.

The word “Identified” is defined in Art. 100 as “Recognizable as suitable for the specific purpose . . .”. The addition of “for the purpose” after the word identified is unnecessary and does not add clarity to the rule.

This is not original material; its reference/source is as follows:

This proposal was developed by the TCC Usability Task Group.
9-55     Log #830 NEC-P09
(314.25)

Submitter: Michael J. Johnston, National Electrical Contractors Association

Recommendation: Include an additional sentence as follows:

Screws installed for the covers, or other equipment fastened to the box, shall be machine screws matching the thread gage or size that is integral to the box.

Substantiation: Use of drywall screws for fastening luminaires or other equipment to boxes is not acceptable and can result in damage to the box and inadequate support of the equipment can result. It is recognized that installers should follow the manufacturer’s installation instructions, but having the additional text will help clarify this requirement. A similar proposal is also being submitted to Articles 404 and 406 restricting use of drywall screws for installing receptacles and switches to boxes.

Note: Supporting material is available for review at NFPA Headquarters.

This is not original material; its reference/source is as follows:

See support letter written to NECA from John E. Newton. NFPA has my permission to include the letter for the CMP.

9-56     Log #270 NEC-P09
(314.25(C))

Submitter: Stanley J. Folz, Morse Electric Company

Recommendation: Revise text to read as follows:

(C) Flexible Cord Pendants. Covers of outlet boxes and conduit bodies having holes through which flexible cord pendants pass shall be provided with identified bushings designed for the purpose or shall have smooth, well rounded surfaces on which the cords may bear. So called hard rubber or composition bushings shall not be used.

Substantiation: The TCC Usability Task Group is comprised of Stanley Folz, James Dollard, Bill Fiske and David Hittinger. This task group was assigned by the TCC Chair to review the use of the phrase “designed for the purpose” throughout the NEC. There are twelve instances of its use.

By definition, identified equipment is suitable for its intended purpose (see definition of Identified in Article 100). Many things not defined for a specific purpose are nonetheless suitable for that purpose, and are thus "identified." Substituting "identified" for the word(s) to be replaced conforms to 3.2.4 of the NEC Style Manual, that says, "recognized or defined terms are to be used in preference to similar terms that do not have such recognition."

This is not original material; its reference/source is as follows:

This proposal was developed by the TCC Usability Task Group.
9-57     Log #46 NEC-P09
(314.27)   Final Action:

NOTE: This Proposal appeared as Comment 9-30 (Log #1680) on Proposal 9-77 in the 2010 Annual Meeting National Electrical Code Committee Report on Proposals. This comment was held for further study during the processing of the 2011 NATIONAL ELECTRICAL CODE. The Recommendation in Proposal 9-77 was: Revise text as follows:

(A) Boxes at Luminaire Outlets. Outlet boxes or fittings designed for the support of luminaires and installed as required by 314.23 shall be permitted to support a luminaire weighing 23 kg (50 lb) or less. Boxes used at luminaire or lampholder outlets in a ceiling shall be designed for the purpose and shall be required to support a luminaire—weighing a minimum of 23 kg (50 lb).

(1) Luminaire Outlets in the Wall. Boxes used at luminaire or lampholder outlets in a wall shall be designed for the purpose and shall be marked to indicate the maximum weight of the luminaire that is permitted to be supported by the box in the wall, if other than 23 kg (50 lb). At every outlet used exclusively for lighting, the box shall be designed or installed so that a luminaire may be attached.

Exception: A wall-mounted luminaire weighing not more than 3 kg (6 lb) shall be permitted to be supported on other boxes or plaster rings that are secured to other boxes provided the luminaire or its supporting yoke is secured to the box with no fewer than two No. 6 or larger screws.

(2) Luminaire Outlets in the Ceiling. At every outlet used exclusively for lighting, the box shall be designed or installed so that a luminaire may be attached. Boxes used at luminaire or lampholder outlets in a ceiling shall be designed for the purpose and shall be required to support a luminaire weighing a minimum of 23 kg (50 lb). A luminaire that weighs more than 23 kg (50 lb) shall be supported independently of the outlet box unless the outlet box is listed and marked for the maximum weight to be supported.

(B) Maximum Luminaire Weight. Outlet boxes or fittings designed for the support of luminaires and installed as required by 314.23 shall be permitted to support a luminaire weighing 23 kg (50 lb) or less. A luminaire that weighs more than 23 kg (50 lb) shall be supported independently of the outlet box unless the outlet box is listed and marked for the maximum weight to be supported.

Submitter: Dan Leaf, Seneca, SC

Recommendation: Accept the proposal with the following revision:

(A) Boxes and fittings identified for the support of luminaires, lampholders, cameras, television sets, electric signs, or other electrical equipment and installed in accordance with 314.23 shall be permitted to support such equipment.

(1) Boxes or Fittings Supported on Vertical Structures. Boxes or fittings supported on vertical structures shall be identified for the purpose and marked on the exterior of the box to indicate the maximum weight to be supported if greater than 23 kg (50 lbs).

Exception: Other boxes, with or without extension rings or plaster rings, and mounted on a vertical support member or surface and supporting equipment specified in (A) shall be permitted to support such equipment weighing not more than 3 kg (6 lbs) if the equipment is secured to the box, extension ring, or plaster ring by not less than two No. 6 or larger machine screws.

Substantiation: Lampholders, TV receivers and cameras, and other equipment should be noted. Support members may not always be a wall or ceiling. Support boxes may not always be an "outlet", e.g., an end-to-end row of fluorescent fixtures suspended by fixture stems from boxes where only one box is an "outlet."

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Boxes used at luminaire or lampholder outlets in or on a vertical surface shall be identified for the purpose and marked on the interior of the box to indicate the maximum weight of the luminaire that is permitted to be supported by the box in the wall, if other than 23 kg (50 lb).

**Exception:** A wall-mounted luminaire or lampholder weighing not more than 3 kg (6 lb) shall be permitted to be supported on other boxes or plaster rings that are secured to other boxes, provided the luminaire or its supporting yoke, or the lampholder, is secured to the box with no fewer than two No. 6 or larger screws.

**Substantiation:** Outlet boxes used to support luminaires and lampholders are often mounted on vertical surfaces. Current requirement only addresses boxes mounted in the walls.

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Wall Outlets. Boxes used at luminaire or lampholder outlets in a wall shall be marked on the interior of the box to indicate the maximum weight of the luminaire or lampholder that is permitted to be supported by the box in the wall, if other than 23 kg (50 lb).

**Exception No. 1:** A wall-mounted luminaire or lampholder weighing not more than 3 kg (6 lb) shall be permitted to be supported on other boxes or plaster rings that are secured to other boxes, provided the luminaire or its supporting yoke, or the lampholder, is secured to the box with no fewer than two No. 6 or larger screws.

**Substantiation:** The word "other" is incorrect because it implies a weight both greater than or less than 50 lbs. This proposal clarifies that any box used at luminaire or lampholder outlets that is permitted a maximum weight greater than 50 lbs will be marked to indicate that maximum weight. The UL certification is attached to this proposal. The highlighted section indicates how the boxes are to be marked. Also, the words "or lampholder" were added for inclusiveness.

**Note:** Supporting material is available for review at NFPA Headquarters.

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Boxes identified in 314.27(A)(2) shall be permitted to support luminaries weighing 23 kg (50 lb) or less in the wall.

**Substantiation:** 314.27(A)(1) was new to 2011 NEC to address boxes used in the wall to support luminaires. This proposal adds a new Exception No. 2 to clarify that boxes used in the ceiling for luminaires weighing 23 kg (50 lb) or less shall be permitted to be used in the wall for luminaire support.
9-61     Log #2324  NEC-P09
(314.27(A)(2))

Submitter: Eric Kench, Kench Engineering Consultant
Recommendation: Revise text to read as follows:

(2) Ceiling Outlets. At every outlet used exclusively for lighting, the box shall be designed or installed so that a luminaire or lampholder may be attached. Boxes shall be required to support a luminaire weighing a minimum maximum of 23 kg (50 lb) and shall be marked with the words FOR FIXTURE SUPPORT.

Substantiation: The problem is the use of the word "minimum". This is incorrect. Using this word implies that a box must be designed to support a luminaire/lampholder weighing more than 50 lbs. Example: a box able to support a luminaire/lampholder weighing 100 lbs is unlikely. Also, the words "shall be required" is inappropriate because it sets a definite minimum (or maximum) for boxes. In accordance with UL certification the requirement for proper marking of boxes used for fixture supports is affirmed.

9-62     Log #3231  NEC-P09
(314.27(A)(2))

Submitter: Mark C. Ode, Underwriters Laboratories Inc.
Recommendation: Revise the text in 314.27(A)(2) as follows:

314.27 Outlet Boxes
(A) Boxes at Luminaire or Lampholder Outlets.
(2) Ceiling Outlets. At every outlet used exclusively for lighting, the box shall be designed or installed so that a luminaire or lampholder may be attached. Boxes shall be required to support a luminaire weighing a minimum of 23 kg (50 lb). A luminaire that weighs more than 23 kg (50 lb) shall be supported independently of the outlet box, unless the outlet box is listed and marked for the maximum weight to be supported on the interior of the box to indicate the maximum weight the box shall be permitted to support.

Substantiation: The interior of a box designed to support a luminaire that weighs more than 50 lb should be required to be marked on the interior of the box what the maximum weight of the luminaire that can be supported from the box is so the installer of the luminaire will have access to the maximum weight value.

9-63     Log #541  NEC-P09
(314.27(C))

Submitter: Martin Lin, Underwriters Laboratories Taiwan Co., Ltd.
Recommendation: Revise text to read as follows:

(C) Boxes at Ceiling-Suspended (Paddle) Fan Outlets. Outlet boxes or outlet box systems used as the sole support of a ceiling-suspended (paddle) fan shall be listed, shall be marked by their manufacturer as suitable for this purpose, and shall not support ceiling-suspended (paddle) fans that weigh more than 32 kg (70 lb). For outlet boxes or outlet box systems designed to support ceiling-suspended (paddle) fans that weigh more than 16 kg (35 lb), the required marking shall include the maximum weight to be supported.

Where spare, separately switched, ungrounded conductors are provided to a ceiling mounted outlet box, in a location acceptable for a ceiling-suspended (paddle) fan in single family, two family or multi-family dwellings, the outlet box or outlet box system shall be listed for sole support of a ceiling-suspended (paddle) fan.

Substantiation: Adding "two family" into the text in the second paragraph will ensure the requirement for a ceiling fan outlet box will be apply to all dwellings. Article 100 shows a definition for a single family dwelling, a two family dwelling and a multifamily dwelling. By leaving off a two family dwelling, ceiling boxes installed in a two family dwelling where spare separately switched ungrounded conductors are supplied would not require a listed ceiling fan box. This change will ensure that box is a listed ceiling fan box.
9-64  Log #544  NEC-P09  
(314.27(C))  
Submitter: Thomas B. Leonard, Hartland, VT  
Recommendation: Delete last paragraph.  
Substantiation: This is a design issue and is catering to non-professionals. The code has been lacking in complying with 90.1(C) and should focus on standards for electrical safety.

9-65  Log #1861  NEC-P09  
(314.27(C))  
Submitter: Robert Clukey, Robert Clukey Electrical Contractor  
Recommendation: Revise text to read as follows:  
In any location acceptable for a ceiling-suspended (paddle) fan in single or multi-family dwellings, the outlet box or outlet box system shall be listed for sole support of a ceiling suspended (paddle) fan.  
Substantiation: Currently, the section states, (Where spare, separately switched, ungrounded conductors are provided to a ceiling mounted outlet box,) This wording does not take into consideration, the following fact, that a ceiling paddle fan can be installed and controlled by having present just 2 wires or 1 switch, by utilizing a remote control hand held or wall mounted controller.

9-66  Log #2320  NEC-P09  
(314.28(3))  
Submitter: Eric Kench, Kench Engineering Consultant  
Recommendation: Revise text to read as follows:  
(3) Separation of Entries. Where there are angles or U Pulls, the distance between raceway entries enclosing the same conductors shall not be less than six times the metric designator (trade size) of the larger raceway.  
When transposing cable size into raceway size in 314.28(A)(1), 314.28(A)(2) and 314.28(A)(3), the minimum metric designator (trade size) raceway required for the number and size of conductors in the cable shall be used.  
(9) (4) Smaller Dimensions.  
Substantiation: When the proposal to add the words "or splices" was accepted for the 2008 NEC it created an additional problem in that wherever there were splices used the raceway entries had to be separated by six times the diameter of the larger raceway. This would put pressure on the splice thus causing it to pull apart and become separated. My proposal corrects the problem by breaking 314.28(A)(2) into two parts and redesignating them along with some additional text.
Add new text to read as follows:

314.28 (A)(3) Smaller Dimensions. Boxes or conduit bodies of dimensions less than those required in 314.28(A)(1) and (A)(2) shall be permitted for installations of combinations of conductors that are less than the maximum conduit or tubing fill (of conduits or tubing being used) permitted by Table 1 of Chapter 9, provided the box or conduit body has been listed for, and is permanently marked with, the maximum number and maximum size of conductors permitted.

Listed conduit bodies of dimensions less than those required in 314.28(A)(1) and (A)(2) having a radius of the curve to the centerline not less than as indicated in Table 2, Chapter 9 shall be permitted for installations of combinations of conductors of the maximum conduit or tubing wire fill (of conduit or tubing being used) permitted by Table 1 of Chapter 9. These conduit bodies are not required to be marked with, the maximum number and maximum size of conductors permitted.

Listed conduit bodies having a radius of the curve to the centerline not less than as indicated in Table 2, Chapter 9 are already on the market. This is the same minimum radius of curve required for field bends in IMC, RMC and EMT in Sections 342.24, 344.24 and 358.24 respectively. These are therefore suitable for installations of combinations of conductors of the maximum conduit or tubing wire fill (of conduit or tubing being used) permitted by Table 1 in Chapter 9.

These designs greatly simplify wire fill calculations for conduit bodies for both design and inspection and should require no conductor size markings. The present text in Section 314.28 (A)(3) is restrictive for these designs as it technically does not permit installation of the full table 1, chapter 9 wire fill for the conduit or tubing being used. In fact, these designs effectively negate the concern for wire jamming addressed in Informational Note No. 2 to Tables in Chapter 9 by providing significantly more space for bending than the diameter of the conduit or tubing being used.

Replace 600V with 1000V.

This proposal is the work of the “High Voltage Task Group” appointed by the Technical Correlating Committee. The task group consisted of the following members: Alan Peterson, Paul Barnhart, Lanny Floyd, Alan Manche, Donny Cook, Vince Saporita, Roger McDaniel, Stan Folz, Eddie Guidry, Tom Adams, Jim Rogers and Jim Dollard.

The Task Group identified the demand for increasing voltage levels used in wind generation and photovoltaic systems as an area for consideration to enhance existing NEC requirements to address these new common voltage levels. The task group recognized that general requirements in Chapters 1 through 4 need to be modified before identifying and generating proposals to articles such as 690 specific for PV systems. These systems have moved above 600V and are reaching 1000V due to standard configurations and increases in efficiency and performance. The committee reviewed Chapters 1 through 8 and identified areas where the task group agreed that the increase in voltage was of minimal or no impact to the system installation. Additionally, there were requirements that would have had a serious impact and the task group chose not to submit a proposal for changing the voltage. See table (supporting material) that summarizes all sections considered by the TG.

Note: Supporting material is available for review at NFPA Headquarters.
9-69  Log #3338  NEC-P09  
(314.40(B) Exception No. 1)  

**Submitter:** Mahran Ayrton, Hubbell-Raco  
**Recommendation:** Delete text as follows:  

Exception 1: Listed boxex and conduit bodies shown to have equivalent strength and characteristics shall be permitted to be made of thinner and/or other metals.  

**Substantiation:** Ground screw requires two threads for adequate grounding in cases of thinner material used in boxes, screw hole may be extruded in order to provide two threads. The wall of the extruded feature is thin. The residual torque from the ground screw install may break over time.  

Note: Supporting material is available for review at NFPA Headquarters.

9-70  Log #969  NEC-P09  
(314.70(A))  

**Submitter:** James T. Dollard, Jr., IBEW Local 98  
**Recommendation:** Replace 600V with 1000V.  
**Substantiation:** This proposal is the work of the “High Voltage Task Group” appointed by the Technical Correlating Committee. The task group consisted of the following members: Alan Peterson, Paul Barnhart, Lanny Floyd, Alan Manche, Donny Cook, Vince Saporita, Roger McDaniel, Stan Folz, Eddie Guidry, Tom Adams, Jim Rogers and Jim Dollard.  

The Task Group identified the demand for increasing voltage levels used in wind generation and photovoltaic systems as an area for consideration to enhance existing NEC requirements to address these new common voltage levels. The task group recognized that general requirements in Chapters 1 through 4 need to be modified before identifying and generating proposals to articles such as 690 specific for PV systems. These systems have moved above 600V and are reaching 1000V due to standard configurations and increases in efficiency and performance. The committee reviewed Chapters 1 through 8 and identified areas where the task group agreed that the increase in voltage was of minimal or no impact to the system installation. Additionally, there were requirements that would have had a serious impact and the task group chose not to submit a proposal for changing the voltage. See table (supporting material) that summarizes all sections considered by the TG.  

Note: Supporting material is available for review at NFPA Headquarters.

9-71  Log #970  NEC-P09  
(314.70(B))  

**Submitter:** James T. Dollard, Jr., IBEW Local 98  
**Recommendation:** Replace 600V with 1000V.  
**Substantiation:** This proposal is the work of the “High Voltage Task Group” appointed by the Technical Correlating Committee. The task group consisted of the following members: Alan Peterson, Paul Barnhart, Lanny Floyd, Alan Manche, Donny Cook, Vince Saporita, Roger McDaniel, Stan Folz, Eddie Guidry, Tom Adams, Jim Rogers and Jim Dollard.  

The Task Group identified the demand for increasing voltage levels used in wind generation and photovoltaic systems as an area for consideration to enhance existing NEC requirements to address these new common voltage levels. The task group recognized that general requirements in Chapters 1 through 4 need to be modified before identifying and generating proposals to articles such as 690 specific for PV systems. These systems have moved above 600V and are reaching 1000V due to standard configurations and increases in efficiency and performance. The committee reviewed Chapters 1 through 8 and identified areas where the task group agreed that the increase in voltage was of minimal or no impact to the system installation. Additionally, there were requirements that would have had a serious impact and the task group chose not to submit a proposal for changing the voltage. See table (supporting material) that summarizes all sections considered by the TG.  

Note: Supporting material is available for review at NFPA Headquarters.
This proposal is the work of the “High Voltage Task Group” appointed by the Technical Correlating Committee. The task group consisted of the following members: Alan Peterson, Paul Barnhart, Lanny Floyd, Alan Manche, Donny Cook, Vince Saporita, Roger McDaniel, Stan Folz, Eddie Guidry, Tom Adams, Jim Rogers and Jim Dollard.

The Task Group identified the demand for increasing voltage levels used in wind generation and photovoltaic systems as an area for consideration to enhance existing NEC requirements to address these new common voltage levels. The task group recognized that general requirements in Chapters 1 through 4 need to be modified before identifying and generating proposals to articles such as 690 specific for PV systems. These systems have moved above 600V and are reaching 1000V due to standard configurations and increases in efficiency and performance. The committee reviewed Chapters 1 through 8 and identified areas where the task group agreed that the increase in voltage was of minimal or no impact to the system installation. Additionally, there were requirements that would have had a serious impact and the task group chose not to submit a proposal for changing the voltage. See table (supporting material) that summarizes all sections considered by the TG.

Note: Supporting material is available for review at NFPA Headquarters.

Submitter: Michael J. Johnston, National Electrical Contractors Association
Recommendation: Revise the last sentence as follows:

The marking shall meet the requirements in 110.21(B), be on the outside of the box cover, and shall be readily visible. Letters shall be block type and at least 13 mm (1/2 in.) in height.

Substantiation: This proposal is one of several coordinated companion proposals to provide consistency of danger, caution, and warning sign or markings as required in the NEC. The proposed revision will correlate this danger marking requirement with proposed 110.21(B) and the requirements in ANSI Z 535.4.

Submitter: James T. Dollard, Jr., IBEW Local Union 98
Recommendation: Replace 600V with 1000V.
Substantiation: This proposal is the work of the “High Voltage Task Group” appointed by the Technical Correlating Committee. The task group consisted of the following members: Alan Peterson, Paul Barnhart, Lanny Floyd, Alan Manche, Donny Cook, Vince Saporita, Roger McDaniel, Stan Folz, Eddie Guidry, Tom Adams, Jim Rogers and Jim Dollard.

The Task Group identified the demand for increasing voltage levels used in wind generation and photovoltaic systems as an area for consideration to enhance existing NEC requirements to address these new common voltage levels. The task group recognized that general requirements in Chapters 1 through 4 need to be modified before identifying and generating proposals to articles such as 690 specific for PV systems. These systems have moved above 600V and are reaching 1000V due to standard configurations and increases in efficiency and performance. The committee reviewed Chapters 1 through 8 and identified areas where the task group agreed that the increase in voltage was of minimal or no impact to the system installation. Additionally, there were requirements that would have had a serious impact and the task group chose not to submit a proposal for changing the voltage. See table (supporting material) that summarizes all sections considered by the TG.

Note: Supporting material is available for review at NFPA Headquarters.
Submitter: Jarred Bolognan, Whitingham, VT
Recommendation: Delete text as follows (Note: move text to become 404.10 as noted in Substantiation):

404.2 Switch Connections

(A) Three Way and Four Way Switches. Three way and four way switches shall be wired so that all switching is done only in the ungrounded circuit conductor. Where in metal raceways or metal armored cables, wiring between switches and outlets shall be in accordance with 300.20(A).

Exception: Switch loops shall not require a grounded conductor.

(B) Grounded Conductors. Switches or circuit breakers shall not disconnect the grounded conductor of a circuit.

Exception: A switch or circuit breaker shall be permitted to disconnect a grounded circuit conductor where all circuit conductors are disconnected simultaneously, or where the device is arranged so that the grounded conductor cannot be disconnected until all the ungrounded conductors of the circuit have been disconnected.

(C) Switches Controlling Lighting Loads. Where switches control lighting loads supplied by a grounded general purpose branch circuit, the grounded circuit conductor for the controlled lighting circuit shall be provided at the switch location.

Exception: The grounded circuit conductor shall be permitted to be omitted from the switch enclosure where either of the following conditions in (1) or (2) apply:

(1) Conductors for switches controlling lighting loads enter the box through a raceway. The raceway shall have sufficient cross-sectional area to accommodate the extension of the grounded circuit conductor of the lighting circuit to the switch location whether or not the conductors in the raceway are required to be increased in size to comply with 310.1(B)(9)(a).

(2) Cable assemblies for switches controlling lighting loads enter the box through a framing cavity that is open at the top or bottom on the same floor level, or through a wall, floor, or ceiling that is unfinished on one side.

Substantiation: The .2 of any article should be reserved for definitions as in the way that the rest of the code book uses it. Therefore, all of 404.2 A, B, and C should be moved to 404.10 and be under uses permitted which would also follow the style of the code.

Submitter: Roy Gillespie, Jr., Ranken Technical College
Recommendation: Revise text to read as follows:

Three-way and four-way switches shall be wired so that all switching is done only in the ungrounded circuit conductor.

Switch loop circuits shall not contain three-ways or four-ways. Where in metal raceways or metal-armored cables, wiring between switches and outlets shall be in accordance with 300.20(A).

Exception: Switch loops shall not require a grounded conductor.

Substantiation: This is to follow with 404.2(C) to stop the use of the grounding conductor to carry current for occupancy sensors.
Switches Controlling Lighting Loads. Where switches control lighting loads supplied by a grounded general purpose branch circuit, the grounded circuit conductor for the controlled lighting circuit shall be provided at the switch location.

Exception: The grounded circuit conductor shall be permitted to be omitted from the switch enclosure where either of the following conditions in (1) or (2) apply:

(1) Conductor for switches controlling lighting loads enter the box through one or more raceways.
   (a) The raceway(s) shall have sufficient cross-sectional area to accommodate the extension of the grounded circuit conductor(s) for each of the lighting branch circuit(s) to the switch location whether or not the conductors in the raceway are required to be increased in size to comply with 310.15(B)(3)(a).
   (b) The box containing the switch(es) shall have sufficient volume to accommodate the additional grounded circuit conductors.

Substantiation: The point of 404.2(C) exception is to provide the ability to add a neutral conductor for an electronic lighting control device as explained in the informational note. 404.2(C) should be written so that the neutral conductor(s) can be provided (in the future) without creating a code violation. The elements that need to be taken into account are the following:

1. Space in the switch box for the additional conductor(s).
2. The ability to run additional conductor(s) in the raceway(s) entering the switch box without reducing the adjusted ampacity of the conductors below what is required.
3. Avoidance of using a neutral conductor for than one (multiwire) branch circuit.

Note: This does not address the requirements for raceways and junction boxes back to the nearest appearance of the required neutral(s).

Three-way and four-way switches shall be wired so that all switching is done only in the ungrounded circuit conductor. Where in metal raceways or metal-armored cables Type AC, wiring between switches and outlets shall be in accordance with 300.20(A).

Metal enclosures for switches or circuit breakers shall be connected to an equipment grounding conductor as specified in Part IV of Article 250. Metal enclosures for switches or circuit breakers used as service equipment shall comply with the provisions of Part V of Article 250. Where nonmetallic enclosures are used with metal raceways or metal-armored cables Type AC, provision shall be made for connecting the equipment grounding conductor(s).

Substantiation: “armored cable” is referred to in several ways: “armored cable” & “type AC”
Suggest that “Type AC” be added to all references. This will make finding all references to “armored cable” easier and more reliable.

[The files that propose this change include AC_250, AC_314, AC_392, AC_404, & AC_668]
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9-79 Log #109 NEC-P09
(404.2(C))

Final Action:

Submitter: Stephen L. Herman, Pittsburg, TX
Recommendation: Change requirement from all switch locations to single-pole switch locations only.
Substantiation: This provision requires that a grounded or neutral conductor be provided to any switch that controls lighting loads. The rationale for this provision is that some electronic devices, such as motion sensors, require a stand-by current for operation. It is my opinion that this provision, as written, causes more confusion than clarification. I have several reasons for this opinion.

- As far as I am aware, there are no electronic switching devices that can be used on a 3-way or 4-way switch.
- This provision, as written, will require a grounded conductor be supplied to any switch location even if a sensor cannot be installed in that location such as the case with 3-way and 4-way switches.
- In many instances, the power is brought to a 3-way switch, and the switch leg is run from the second 3-way switch to the light. In this instance, the grounded conductor is provided at both 3-way switches and possibly to one or more 4-way switches connected between the travelers. This would meet the requirement of 404.2(C), but there is still no way to install an electronic sensing device in any switch location, except the switch where power entered the switch box, and that is provided that a sensor for use in a 3-way switch location can be obtained. The other switches would have a grounded conductor, but no ungrounded conductor that can supply continuous power.
- The National Electrical Code provides requirements for new installations. If a contractor knows that an electronic device is to be used at a particular location they would supply the proper power during the rough-in wiring.
- A major concern of the panel is that there have been instances where electronic sensors were installed in existing locations and the grounding conductor was used to complete the circuit back to ground. This is, of course, a very poor practice. However, this probably occurs in less than 0.1% of the switch locations throughout the United States. Also, these electronic sensors require only milliamperes of current for operation.
- I think 404.2(C) should be amended to require a grounded conductor at single-pole switch locations only, since these are the only locations where an electronic sensor can be used. I believe that this would make more sense than requiring a grounded conductor at all switch locations. However, I don't think there is a way to do this before the 2014 code, so we are stuck with it.

9-80 Log #175 NEC-P09
(404.2(C))

Final Action:

Submitter: Thomas B. Leonard, Hartland, VT
Recommendation: Delete in its entirety.
Substantiation: This is a "design" consideration and is contrary to 90.1(C). It is a waste of resources. Should it be desired to utilize a device requiring a grounded conductor, "trained" persons would not install such a device if the G C is not available. An outlet without a G C is not less safe if utilized as installed. Precedence for numerous other requirements to prevent untrained persons from creating violations should not be established.
Submitter: Keith M. Whitesel, Whitesel Electric
Recommendation: Delete entirely.
Substantiation: 1. It is in direct conflict with 404.2(A) exception which allows a switch loop without a grounded conductor.
   2. It is in direct conflict with 200.7 which clearly allows the white wire to be used in single-pole, 3-way and 4-way switch-loops. If a grounded conductor is required at each switch, then 200.7 would no longer be allowed.
   3. The Informational Note after 404.2(C) states that this is for possible future wiring which directly conflicts with 90.1(B) which states that the code is NOT necessarily adequate for future expansion. You cannot predict what will happen in the future and prepare for every eventuality. But, this requirement appears to be trying. Let the designer do his/her job correctly and that will take care of the problem. Or, better yet, make the manufacturer's equipment meet the NEC rather than the NEC meeting their designs.
   4. 90.1(C) clearly states that the NEC is NOT intended as a design specification. But, once again, you are trying to dictate the design of all circuit layouts. By requiring a grounded conductor at each and every switch location, there would be one and only one possible way to run the cables when using non-metallic sheathed cable or armored cable, both of which are typical wiring methods used in residential construction.
   5. 110.26(D) clearly states that illumination for service equipment etc. shall NOT be controlled by automatic means only. So providing a grounded conductor at these locations would be unnecessary, would increase the cost at these locations, and could be misleading to someone in the future.
   6. What is the possibility that each and every switch in a building would ever be replaced by these types of switches that require a grounded conductor to operate? The answer is never. So, why are you trying to force wiring that provides for this?

While a walk in clothes closet might be a good place to replace with automatic/specialty switch a non-walk-in-closet would not since the light switch would most likely be placed in the room rather than in a closet.

Respectfully, this is one of the dumbest code requirements that I have ever seen. By writing this requirement, you have made 1 and only 1 possible routing of wire for switching. In a remodel situation, you would now have to get into existing wiring and reroute the existing wire to include a grounded wire in each switch location rather than rewire within a box and add the new wiring.

Submitter: Ron Beers, Wisconsin Homes
Recommendation: Add new text to read as follows:

Exempt 4-way switches.

Substantiation: A 4-way switch doesn't have an ungrounded or grounded conductor. It consists of travelers. I haven't seen a device requiring a grounded conductor in a 4-way configuration. This also adds more wire to make it difficult to make wire work in a single gear box.

Submitter: Ron Beers, Wisconsin Homes
Recommendation: Add a new (3) to the Exception to read as follows:

In one and two family dwelling - switches that control under cabinet lighting and switches that control lighting in closet less than 36 in. in depth jamb switches.

Substantiation: The under cabinet lighting is likely to be used for tasks at that specific spot and would not be lighting that a person would want to be controlled by a motion detector from someone walking by. Closet lights - in closets that do not have enough room for someone to walk into.
9-84  Log #1552  NEC-P09
(404.2(C))

Submitter: David Clements, International Association of Electrical Inspectors

Recommendation: Revise Section 404.2(C) as follows:

(C) Switches Controlling Lighting Loads. Where switches control lighting loads supplied by a grounded general purpose branch circuit, the grounded circuit conductor for the controlled lighting circuit shall be provided at the switch location.

Exception: The grounded circuit conductor shall be permitted to be omitted from the switch enclosure where either of the following conditions in (1) or (2) apply:

1) the conductors for switches controlling lighting loads enter the box through a raceway. The raceway shall have sufficient cross-sectional area to accommodate the extension of the grounded circuit conductor of the lighting circuit to the switch location whether or not the conductors in the raceway are required to be increased in size to comply with 310.15(B)(3)(a).

2) Cable assemblies for switches controlling lighting loads enter the box through a framing cavity that is open at the top or bottom on the same floor level, or through a wall, floor, or ceiling that is unfinished on one side.

Substantiation: This revision eliminates option (2) in the existing exception and retains option (1) as remaining text. Option (2) is deleted because the grounded conductor cannot be an individual conductor fished into the switch location and shall be from the same branch circuit as the lighting load. The existing wording does not require either one of the conditions. The existing verbiage for the exception does not require the grounded conductor to be installed when an unfinished area is finished at a later date.

9-85  Log #1642  NEC-P09
(404.2(C))

Submitter: Charles Palmieri, Cohasset, MA

Recommendation: Edit the current text as indicated (C) Switches Controlling Lighting Loads. For other than dwelling units, in buildings more than 465/m² or 5000/ft² where switches control lighting loads supplied by a grounded general purpose branch circuit, the grounded circuit conductor for the controlled lighting circuit shall be provided at the switch location.

Substantiation: This present language applies to all occupancies regardless of size. The original proposal by Mr. Baclawski cites the need to provide occupancy sensors in commercial occupancies. He is correct. The 2009 IECC is the document that appears to drive this issue. In Chapter 5 section 505.2.2.2 of that document titled Automatic lighting shutoff there is a requirement to automatically shutoff the lighting. List item 2 of that section recognizes an occupancy sensor as one method of accomplishing such automatic switching. It is important to note that this section is focused to buildings with an area larger than 5000 square feet. Additionally exception 1 to this section does not require sleeping areas (of said commercial occupancies) to comply with this automatic switching. Chapter-5 of the IECC is titled Commercial Energy Efficiency. It is Chapter 4 that addresses Residential Energy Efficiency. Section 404 is titled “Electrical Power and Lighting Systems” and it only has one paragraph 404.1 Lighting Equipment (Prescriptive). 404.1 states; “ A minimum of 50 percent of the lamps in permanently installed lighting fixtures shall have high efficiency lamps. This section is silent regarding the need to provide occupancy sensors. I propose that the code panel modify the existing language to reflect these requirements (IECC). The IECC only requires automatic switching for commercial buildings and then only in those buildings, which exceed 5000 square feet. It seems counter intuitive to apply chapter 5 requirements to chapter 4 occupancies. I do not see a large demand for the installation of these sensors in living rooms, kitchens, great rooms or any normally occupied area of a dwelling. For that matter it is less likely to see these devices installed in dwelling units. In the case of dwellings I am convinced that the use of occupancy sensors are in deed a design issue and the installer certainly can plan for a grounded circuit conductor at a switch location if the design criteria requires.

This is not original material; its reference/source is as follows:

IECC 2009 and 2011 NEC
9-86  Log #136  NEC-P09  
(404.2(C) Exception No. 2)  

9-87  Log #343  NEC-P09  
(404.2(C) Exception No. 2)  

Sub-mitter: Dennis Alwon, Alwon Electric Inc.  
Recommandation: Delete text as follows:  
(2) Cable assemblies for switches controlling lighting loads enter the box through a framing cavity that is open at the top or bottom on the same floor level, or through a wall, floor, or ceiling that is unfinished on one side.  
Substantiation: Since the NEC has taken steps, with this new section, to be a bit of a design manual to prevent problems down the road then this exception should be deleted. If a wall is open that doesn’t mean that a neutral from the same circuit will be available. This will effective defeat the purpose of this rule. Also it is very likely that if the neutral is available then the neutral will not necessarily be run with the ungrounded conductor creating unwanted electromagnetic fields.

Sub-mitter: Brian E. Rock, Hubbell Incorporated  
Recommandation: Revise text to read as follows:  
404.2 Switch Connections.  
[404.2(A) and 404.2(B) unchanged by this Proposal]  
(C) Switches Controlling Lighting Loads. Where switches control lighting loads supplied by a grounded general purpose branch circuit, the grounded circuit conductor for the controlled lighting circuit shall be provided at the switch location.  
Exception No. 1: The grounded circuit conductor shall be permitted to be omitted from the switch enclosure where either of the following conditions in (1) and (2) apply:  
(1) Conductors for switches controlling lighting loads enter the box through a raceway. The raceway shall have sufficient cross-sectional area to accommodate the extension of the grounded circuit conductor of the lighting circuit to the switch location whether or not the conductors in the raceway are required to be increased in size to comply with 310.15(B)(3)(a).  
(2) Cable assemblies for switches controlling lighting loads enter the box through a framing cavity that is open at the top or bottom on the same floor level, or through a wall, floor, or ceiling that is unfinished on one side.  
Exception No. 2: The grounded circuit conductor shall not be required to be provided at switch locations where snap switches with integral enclosures complying with 300.15(E) control the lighting loads.  
Informational Note: The provision for a (future) grounded conductor is to complete the circuit path for electronic lighting control devices.  
Substantiation: In accordance with the main requirement of 300.15, switches are required to be installed in a box or conduit body, except as permitted in 300.15(A) through (L). 300.15(E) permits switches with integral enclosures “in lieu of a box or conduit body”.  
These “Self-Contained Switches for Use Without a Separate Outlet Box”, listed in accordance with Standard ANSI/UL 20, have NO separate boxes and are restricted to nonmetallic-sheathed cables (Type NM series) containing copper conductors. As part of the listing, a special tool forms the nonmetallic-sheathed cables (sheath partially removed) and accomplishes guided closure of self-contained switches on nonmetallic-sheathed cables as terminations. These self-contained switches are NOT able to accommodate extra unused conductors, splices, or other connections normally allowed in an outlet box or conduit body.  
These self-contained switches (see figure provided) are specifically designed for efficient installation on Type NM cables and are targeted primarily at the markets for mobile homes, recreational vehicles, manufactured housing, manufactured buildings, and park trailers permitted by 545.10, 550.15(I) Exception, 551.47(E) Exception No. 1, and 552.48(E) Exception No. 1 [per 300.15(E) Informational Note]. These self-contained switches provide a very fast, efficient, cost-effective installation method for these types of construction, but their boxless design inherently limits flexibility.  
Note: Supporting material is available for review at NFPA Headquarters.  
This is not original material; its reference/source is as follows:  
Images in the Substantiation: © Hubbell Incorporated (Wirecon Division), used with permission.
9-88  Log #1960  NEC-P09
(404.2(C) Exception No. 2 (New )

**Submitter:** Jonathan  R. Althouse, Michigan State University

**Recommendation:** Add a new Exception No. 2 as follows:

*Exception No. 2:* Where lighting loads supplied by a grounded general purpose circuit and controlled by 3-way or 3-way and 4-way switches, the grounded neutral conductor is required to be supplied to only one switch location.

**Substantiation:** Based upon lighting control devices available on the market, a neutral wire would only be required at one location to achieve the desired results intended. Having to run an additional wire between switching points would result in a waste in limited resource materials.

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9-89  Log #3086  NEC-P09
(404.2(C) Exception No. 2 (New )

**Submitter:** Frederic P. Hartwell, Hartwell Electrical Services, Inc.

**Recommendation:** Insert a new exception as follows:

*Exception No. 2:* Where multiple switch locations control the same lighting load in an interior room or space, a grounded conductor of the lighting circuit shall not be required at each such location if one has been provided at one or more switching points that is (are) visible from most areas within the room including all principal entry points. Where a switch controls a receptacle load or a lighting load that does not serve a habitable room or bathroom, or where automatic control of lighting has been provided or the switch is not within the lit area, a grounded circuit conductor shall not be required.

**Substantiation:** The 2011 NEC did a good job of framing what is in effect a wiring method exception, which avoids the neutral provision requirement in instances where it can be easily added in the future. However, this provision is sorely lacking an application exception addressing instances where an occupancy sensor would be redundant, excessive, or impossible to install. Unfortunately, this question was not addressed by CMP 9, largely because no public comments mentioned it.

If a three-way switch loop controls the lighting in a space, and the switches both see the room, why force a grounded conductor into every switch location? Very frequently three-way switches will be arranged in a two-gang arrangement where one of them will be on the opposite side of a wall from the illuminated space it controls; how could that switch ever be replaced by an occupancy detector? Note that 210.70 requires switch control of lighting loads in a space, but the switch does not need to be in that space.

In addition, although 210.70 (A)(1) Exception No. 1 clearly allows switch-controlled receptacles to substitute for luminaire outlets in dwellings, and this substitution is entirely unregulated in other occupancies, no occupancy sensor will ever likely be listed for use with receptacle outlets because the character of the connected load is inherently uncontrollable in many aspects. Some switches, such as closet door-jamb switches, control loads for which occupancy sensors are not appropriate. Some wiring designs use conventional snap switches wired to turn lights off if needed, but in series with an occupancy sensor in the ceiling. This allows for automatic lighting control, but also a means to force the lights off in an occupied room in order to show slides on a screen. The proposal completes the action CMP 9 took for the 2011 cycle by addressing these issues.

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9-90  Log #173  NEC-P09
(404.2(C) Exception No. 3 (New )

**Submitter:** Thomas B. Leonard, Hartland, VT

**Recommendation:** New a new Exception No. 3 as follows:

*Exception No. 3:* Motorized door jamb switch assemblies.

**Substantiation:** These assemblies, typically used for closet luminaires, are designed for use only with the manufacturer's pressure activated switching device and will not accept electronic control devices.
9-91 Log #329 NEC-P09 (404.2(C) Exception No. 3) Final Action:

Submitter: Dennis Alwon, Alwon Electric Inc.
Recommendation: Add new text to read as follows:
404.2(C)(3) Boxes used for lights controlled by a door jamb switch.
Substantiation: These door jamb switches are very tiny and adding another wire will make it more difficult for wire fill. It also is unnecessary as an electronic controller cannot be used in jamb switch boxes anyway.

9-92 Log #404 NEC-P09 (404.3(C) (New)) Final Action:

Submitter: Kenneth G. Horak, Montgomery County Dept. of Permitting Services
Recommendation: Add new text to read as follows:
All switches and circuit breakers supplied by a feeder in other than one- and two-family dwellings shall be marked to indicate the source where the power supply originates unless located and arranged so that the source is evident.
Substantiation: 110.22 already requires disconnecting means to be marked to indicate its purpose.
408.4(B) requires all switchboards and panelboards supplied by a feeder to be marked to indicate where the power source originates.
It only seems proper to require switches and circuit breakers supplied by a feeder to also require the marking for the source as well.
There are numerous instances where a switch and/or a circuit breaker are used as a disconnecting means for pieces of equipment, transformers, machinery, and HVAC units. By requiring these disconnecting means to be marked to indicate where the power supply originates it will only increase the safety of those working on these switches. By having the switches marked as to where the power supply originates it would also simplify the lock out/tag out process by eliminating the guess work often involved.

9-93 Log #1381 NEC-P09 (404.3(C)) Final Action:

Submitter: John Powell, JPETC
Recommendation: Delete the following text:
(G) Switches Controlling Lighting Loads. Where switches control lighting loads supplied by a grounded general purpose branch circuit, the grounded circuit conductor for the controlled lighting circuit shall be provided at the switch location:

Exception: The grounded circuit conductor shall be permitted to be omitted from the switch enclosure where either of the following conditions in (1) or (2) apply:
(1) Conductors for switches controlling lighting loads enter the box through a raceway. The raceway shall have sufficient cross-sectional area to accommodate the extension of the grounded circuit conductor of the lighting circuit to the switch location whether or not the conductors in the raceway are required to be increased in size to comply with 316.15(B)(3)(a).
(2) Cable assemblies for switches controlling lighting loads enter the box through a framing cavity that is open at the top or bottom or on the same floor level, or through a wall, floor, or ceiling that is unfinished on one side.

Informational Note: The provision for a (future) grounded conductor is to complete a circuit path for electronic lighting control devices.
Substantiation: This requirement is based upon a "what-if" situation and has no place in a document that is based upon safety. Many installations of switches that control lighting do not have nor will they have occupancy sensors or dimmers. To make code requirements based upon "what-ifs" rather than what the inspector is currently looking at or what may happen down the road, sets a bad precedent.
9-94  Log #860  NEC-P09  
(404.6(C) Exception)  

Submitter: Michael J. Johnston, National Electrical Contractors Association  
Recommendation: Add a new last sentence to the exception as follows:  
For such installations, a permanent sign shall be installed on the switch enclosure or immediately adjacent to open switches with the following words or equivalent: WARNING — LOAD SIDE TERMINALS MAY BE ENERGIZED BY BACKFEED. The warning sign or label shall comply with 110.21(B).  
Substantiation: This proposal is one of several coordinated companion proposals to provide consistency of danger, caution, and warning sign or markings as required in the NEC. The proposed revision will correlate this warning marking requirement with proposed 110.21(B) and the requirements in ANSI Z 535.4.

9-95  Log #2983  NEC-P09  
(404.6(D) (New) )  

Submitter: Thomas J. Baker, Puget Sound Electrical Training  
Recommendation: Add new text to read as follows:  
404.6(D) Source of Supply.  
All fused switches, non-fused switches and enclosed circuit breakers supplied by a feeder in other than one- or two-family dwellings shall be marked to indicate the device or equipment where the power supply originates.  
Substantiation: The 2008 NEC added the requirement in Section 408.4(B) for switchboards and panelboards to be marked to indicate the device or equipment where the power supply originates. This proposal is to extend this requirement to other equipment where the same hazard exists, fused switches, non-fused switches and enclosed circuit breakers. This proposal will assist in worker safety as to the identification of the circuit source.
Submitter: Brian E. Rock, Hubbell Incorporated

Recommendation: Add new text and Exceptions to read as follows:

404.7 Indicating

General-use and motor-circuit switches, and circuit breakers; and molded case switches; where mounted in an enclosure as described in 404.3, shall clearly indicate whether they are in the open (off) or closed (on) position. Where these switch or circuit breaker handles are operated vertically rather than rotationally or horizontally, the up position shall be the closed (on) position.

Exception No. 1: Vertically operated double-throw switches shall be permitted to be in the closed (on) position with the handle in either the up or down position.

Exception No. 2: On busway installations, tap switches employing a center-pivoting handle shall be permitted to be open or closed with either end of the handle in the up or down position. The switch position shall be clearly indicating and shall be visible from the floor or point of operation.

Exception No. 3: Vertically operated three-way and four-way general-use switches shall be permitted to be in the closed (on) position with the handle in either the up or down position and shall not be required to indicate the open (off) and closed (on) positions.

Exception No. 4: Vertically operated emergency-call single-pole general-use switches shall be permitted to be in the closed (on) position with the handle in either the up or down position.

Informational Note: Many types of emergency-call switches are actuated by pulling a mechanically-guided cord or chain and serve to notify attendant personnel of the need for assistance.

Substantiation: Substantive revisions:

New Exception No. 3: Three-way switches (SPDT) are used in pairs and four-way switches (DPDT) are used in conjunction with at least one pair of three-way switches. The actuation of any one three-way switch (or four-way switch) in the circuit alternates the closed (on) position of the remaining switches in the circuit from the up position to the down position, or vice versa. Consequently, the open (off) and closed (on) positions cannot be indicated, nor can the up position of the handle always be the closed (on) position.

New Exception No. 4: Emergency-call general-use switches are used in health care facilities and in commercial and public facilities complying with the Americans with Disabilities Act of 1990 and with sections 205.1 and 309 of the 2010 Standards for Accessible Design published by the U.S. Department of Justice. Such emergency-call switches are actuated by a guided cord or chain applied to the switch handle. Often the guides for the cord or chain redirect the actuation direction of the switch handle. Depending on the user’s elevation and the switch mounting height, gravity on the cord or chain may dictate that the single-pole general-use switch be mounted with the closed (off) position in the down position, rather than the up position, to serve its function properly.

Editorial revisions:

Main requirement, first paragraph: “Where mounted in an enclosure as described in 404.3” is ambiguous as to which items in the preceding series it specifically applies. Addition of “and” before “circuit breakers” and deletion of the commas after “circuit breakers” and “molded case switches” clarify that the NEC® 404.3 enclosure allowance applies specifically to circuit breakers and molded case switches.

Main requirement, second paragraph: The parentheses surrounding “on” provide no implicit reference without the omitted word “closed” preceding. The omission of “closed” before “(on)” is inconsistent with usage elsewhere in this section and throughout the Code.
Vince Baclawski, National Electrical Manufacturers Association (NEMA)

Continue to accept the proposal but revise 404.8(C) as follows:

(C) Multipole Snap Switches. A multipole, general-use snap switch shall not be permitted to be fed from more than a single circuit unless it is listed and marked as a two-circuit or three-circuit switch. or unless its voltage rating is not less than the nominal line to line voltage of the system supplying the circuits.

The addition of the FPN provides important information for the safe use of 2 and 3 circuit switches. However, there is an additional safety concern that needs to be recognized. 404.8(C) as currently written allows for a potentially unsafe installation. If the deleted text shown above remains in the code, a general use multipole snap switch is permitted to be used for multicircuit applications. Listed two and three pole general use snap switches have not been evaluated for use in multicircuit applications. UL guide information, WJQR, states: "Multi-pole, general-use snap switches have not been investigated for more than single-circuit operation unless marked "2-circuit" or "3-circuit."

The reason that this statement appears in the guide information is that there are different test requirements for 2 and 3 pole snap switches and 2 and 3 circuit switches. It is true that some 2 and 3 pole switches on the market today can safely be used in 2 and 3 circuit applications. This is due to the robust design of many of these switches. However, there is no certainty that all 2 and 3 pole snap switches are suitable for use in 2 and 3 circuit applications, unless the switches have been specifically tested and marked in accordance with the ANSI/UL20, the Standard for General Use Snap Switches. The wiring device industry and UL are currently reviewing ANSI/UL20 to insure that the testing and marking of these switches clearly defines and differentiates the intended use of multipole and multi-circuit switches.

Michael J. Johnston, National Electrical Contractors Association

Include an additional sentence as follows:

Screws installed for the snap switches fastened to the box, shall be machine screws matching the thread gage or size that is integral to the box.

Use of drywall screws for fastening snap switches to boxes is not acceptable and can result in damage to the box and inadequate support of the device can result. It is recognized that installers should follow the manufacturer’s installation instructions, but having the additional text will help clarify this requirement. A similar proposal is also being submitted to Articles 406 restricting use of drywall screws for installing receptacles to boxes.
Replace 600V with 1000V.

This proposal is the work of the “High Voltage Task Group” appointed by the Technical Correlating Committee. The task group consisted of the following members: Alan Peterson, Paul Barnhart, Lanny Floyd, Alan Manche, Donny Cook, Vince Saporita, Roger McDaniel, Stan Folz, Eddie Guidry, Tom Adams, Jim Rogers and Jim Dollard.

The Task Group identified the demand for increasing voltage levels used in wind generation and photovoltaic systems as an area for consideration to enhance existing NEC requirements to address these new common voltage levels. The task group recognized that general requirements in Chapters 1 through 4 need to be modified before identifying and generating proposals to articles such as 690 specific for PV systems. These systems have moved above 600V and are reaching 1000V due to standard configurations and increases in efficiency and performance. The committee reviewed Chapters 1 through 8 and identified areas where the task group agreed that the increase in voltage was of minimal or no impact to the system installation. Additionally, there were requirements that would have had a serious impact and the task group chose not to submit a proposal for changing the voltage. See table (supporting material) that summarizes all sections considered by the TG.

Note: Supporting material is available for review at NFPA Headquarters.

Revise text to read as follows:

Resistive and inductive loads not exceeding the ampere rating of the switch at the voltage involved applied.

See: 404.14 (B)(1)(2) The term voltage applied is used for both subsections in reference to switched loads. Reference to voltage in association with switches should be consistent. Note also there is no period at the end of subsections 404.14(A)(1)(2)(3) as seen elsewhere in the NEC.

Exception: Outlets supplying lighting over stairs meeting the requirements of article 210.70(A)(2)(c) shall not be controlled by a dimmer switch or other voltage drop device unless specifically listed for the use.

Interior stairs with six or more risers are required for lighting to be controlled at each end by a wall switch. There are dimmer switches available that are three and four way type devices. When the dimmer is turned all the way down at one end, the switch cannot be operated at the other end. This leaves the stair lighting nonfunctional and out of code compliance since it will no longer be a switched outlet supplying lighting over stairs.
9-102   Log #3087  NEC-P09
(404.14(F))

Submitter: Frederic P. Hartwell, Hartwell Electrical Services, Inc.
Recommendation: Delete this provision in its entirety, including the exception and the informational note.
Substantiation: When this was proposed for the 2011 NEC it seemed excessively theoretical but probably harmless. It has turned out not to be harmless. It has removed all Despard-style (interchangeable device) switches and multiple switch configurations on a single yoke (customarily matching the profile of a duplex receptacle) from any possible use on 20-ampere branch circuits used to control receptacle outlets. No such devices are available in a 20-ampere configuration. If there were a realistic possibility of harm, then so be it, but that is not the case.

The reason is 210.21(B)(2), which limits the cord-and-plug connected load connected to a 20-ampere receptacle to 16 amperes on any receptacle. That is only one ampere above the switch rating, and in practice is seldom seen on switch-controlled devices. It is true that combinations of loads on a 20-amp multi-outlet branch circuit could approach the switch rating, but that is very unusual. This may be the reason that the original proposal submitter did not offer any loss experience to support his proposal. Note also that multiple lighting outlets, if not policed, can also exceed the switch ratings. If the industry made multiple switch combinations in 20-ampere configurations this change would go back to being harmless, but that does not seem to be at hand. CMP 9 should have insisted on more than theoretical arguments to have made this change.

9-103   Log #989  NEC-P09
(404.16)

Submitter: James T. Dollard, Jr., IBEW Local Union 98
Recommendation: Change Title to rated "600V or more" and change 600V to "600V or more" in the text.
Substantiation: This proposal is the work of the “High Voltage Task Group” appointed by the Technical Correlating Committee. The task group consisted of the following members: Alan Peterson, Paul Barnhart, Lanny Floyd, Alan Manche, Donny Cook, Vince Saporita, Roger McDaniel, Stan Folz, Eddie Guidry, Tom Adams, Jim Rogers and Jim Dollard.

The Task Group identified the demand for increasing voltage levels used in wind generation and photovoltaic systems as an area for consideration to enhance existing NEC requirements to address these new common voltage levels. The task group recognized that general requirements in Chapters 1 through 4 need to be modified before identifying and generating proposals to articles such as 690 specific for PV systems. These systems have moved above 600V and are reaching 1000V due to standard configurations and increases in efficiency and performance. The committee reviewed Chapters 1 through 8 and identified areas where the task group agreed that the increase in voltage was of minimal or no impact to the system installation. Additionally, there were requirements that would have had a serious impact and the task group chose not to submit a proposal for changing the voltage. See table (supporting material) that summarizes all sections considered by the TG.

Note: Supporting material is available for review at NFPA Headquarters.

9-104   Log #504  NEC-P09
(408)

Submitter: Joel A. Rencsok, Scottsdale, AZ
Recommendation: Change title to read "Metal-Enclosed Switchgears, Switchboards and Panelboards”.
Substantiation: There is no Article in the NEC as to how Metal-Enclosed Switchgear is to be installed. Only open face Switchboards are included. See definitions.
This article covers metal-enclosed switchgears, switchboards and panelboards. It does not apply to equipment operating at over 600 volts. Part I and Part II applies to all voltages and Part III applies to equipment operating at less than 600 volts, except as specifically referenced elsewhere in the Code.

408.2 Other Articles. Switches, circuit breakers, and overcurrent devices used on metal-enclosed switchgears, switchboards and panelboards and their enclosures shall comply with this article and also with the requirements of Articles 240, 250, 312, 314, 404, and other articles that apply. Switchboards, metal-enclosed switchgears and panelboards in hazardous (classified) locations shall comply with the applicable provisions of Articles 500 through 517.

408.3 Support and Arrangement of Busbars and Conductors.

(A) Conductors and Busbars on a Switchboard or Panelboard. Conductors and busbars on a switchboard or panelboard shall comply with 408.3(A)(1), (A)(2), and (A)(3) as applicable.

1) Location. Conductors and busbars shall be located so as to be free from physical damage and shall be held firmly in place.

2) Service Switchboards. Barriers shall be placed in all service metal-enclosed switchgears and switchboards such that no uninsulated, ungrounded service busbar or service terminal is exposed to inadvertent contact by persons or maintenance equipment while servicing load terminations.

3) Same Vertical Section. Other than the required interconnections and control wiring, only those conductors that are intended for termination in a vertical section of a metal-enclosed switchgear and switchboard shall be located in that section.

Exception: Conductors shall be permitted to travel horizontally through vertical sections of switchboards and metal-enclosed switchgear where such conductors are isolated from busbars by a barrier.

(B) Overheating and Inductive Effects. The arrangement of bus bars and conductors shall be such as to avoid overheating due to inductive effects.

(C) Used as Service Equipment. Each metal-enclosed switchgear and switchboards or panelboard, if used as service equipment, shall be provided with a main bonding jumper size in accordance with 250.28(D) or the equivalent placed within the panelboard or one of the sections of the metal-enclosed switchgear and switchboard for connecting the grounded service conductor on its supply side to the metal-enclosed switchgear, switchboard or panelboard frame. All sections of a metal-enclosed switchgear and switchboard shall be bonded together using an equipment bonding conductor sized in accordance with Table 250.122 or Table 250.66 as appropriate.

Exception: Switchboards, metal-enclosed switchgears and panelboards used as service equipment on high-impedance grounded-neutral systems in accordance with 250.36 shall not be required to be provided with a main bonding jumper.

(D) Terminals. In metal-enclosed switchgears, switchboards and panelboards, load terminals for field wiring, including grounded circuit conductor load terminals and connections to the equipment grounding conductor bus for load equipment grounding conductors, shall be so located that it is not necessary to reach across or beyond an uninsulated ungrounded line bus in order to make connections.

(E) Phase Arrangement. The phase arrangement on 3-phase buses shall be A, B, C from front to back, top to bottom, or left to right, as viewed from the front of the metal-enclosed switchgear, switchboard or panelboard. The B phase shall be the phase having the higher voltage to ground on 3-phase, 4-wire, delta-connected systems.

Other busbar arrangements shall be permitted for additions to existing installations and shall be marked.

Exception: Equipment within the same single section or multisection metal-enclosed switchgear, switchboard or panelboard as the meter on 3-phase, 4-wire, delta-connected systems shall be permitted to have the same phase configuration as the metering equipment.

Informational Note: See 110.15 for requirements on marking the busbar or phase conductor having the higher voltage to ground where supplied from a 4-wire, delta-connected system.

(F) Metal-Enclosed Switchgear, Switchboard or Panelboard Identification.

1) High-Leg Identification. A metal-enclosed switchgear, switchboard or panelboard containing a 4-wire, delta-connected system where the midpoint of one phase winding is grounded shall be legibly and permanently field marked as follows:

"Caution __ Phase Has __ Volts to Ground"

2) Ungrounded Systems. A metal-enclosed switchgear, switchboard or panelboard containing an ungrounded electrical system as permitted in 250.21 shall be legibly and permanently field marked as follows:
“Caution Ungrounded System Operating — _____ Volts Between Conductors”

(G) Minimum wire-Bending Space. The minimum wire bending space at terminals and minimum gutter space provided in panelboards and switchboards shall be as required in 312.6. See also section 300.34 for additional requirements.

408.4 field Identification Required.

(A) Circuit Directory or Circuit Identification. Every circuit and circuit modification shall be legibly identified as to its clear, evident, and specific purpose or use. The identification shall include sufficient detail to allow each circuit to be distinguished from all others. Spare positions that contain unused overcurrent devices or switches shall be described accordingly. The identification shall be included in a circuit directory that is located on the face or inside of the panel door in the case of a panelboard, and located at each switch or circuit breaker in a switchboard or metal-enclosed switchgear. No circuit shall be described in a manner that depends on transient conditions of occupancy.

(B) Source of Supply. All metal-enclosed switchgears, switchboards and panelboards supplied by a feeder in other than one- or two-family dwellings shall be marked to indicate the device or equipment where the power supply originates.

408.5 Clearance for Conductor Entering Bus Enclosures.

Where conduit or other raceways enter a metal-enclosed switchgear, switchboard, floor-standing panelboard, or similar enclosure at the bottom, sufficient space shall be provided to permit installation of conductors in the enclosure. The wiring space shall not be less than shown in Table 408.5 for 600 volts or less where the conduit or raceways enter or leave the enclosure below the busbars, their supports, or other obstructions. The conduit or raceways, including their end fittings, shall not rise more than 75 mm (3 in.) above the bottom of the enclosure.

Information Note: See Article 490 for requirements on voltages over 600 volts.

408.7 Unused Openings. Unused openings for circuit breakers and switches shall be closed using identified closures, or other approved means that provide protection substantially equivalent to the wall of the enclosure.

Substantiation: It appears that metal-enclosed switchgear was inadvertently left out when this was included in the NEC.

See also Article 100 definitions.
See also Part VIII Section 230.200 for additional requirements.
Switchboards by definition are not intended to be enclosed. See definition.
Article 490 Part VII does not include installation requirements.

9-106 Log #990 NEC-P09 Final Action:

(408.1)

Submitter: James T. Dollard, Jr., IBEW Local Union 98
Recommendation: Replace 600V with 1000V.
Substantiation: This proposal is the work of the “High Voltage Task Group” appointed by the Technical Correlating Committee. The task group consisted of the following members: Alan Peterson, Paul Barnhart, Lanny Floyd, Alan Manche, Donny Cook, Vince Saporita, Roger McDaniel, Stan Folz, Eddie Guidry, Tom Adams, Jim Rogers and Jim Dollard.

The Task Group identified the demand for increasing voltage levels used in wind generation and photovoltaic systems as an area for consideration to enhance existing NEC requirements to address these new common voltage levels. The task group recognized that general requirements in Chapters 1 through 4 need to be modified before identifying and generating proposals to articles such as 690 specific for PV systems. These systems have moved above 600V and are reaching 1000V due to standard configurations and increases in efficiency and performance. The committee reviewed Chapters 1 through 8 and identified areas where the task group agreed that the increase in voltage was of minimal or no impact to the system installation. Additionally, there were requirements that would have had a serious impact and the task group chose not to submit a proposal for changing the voltage. See table (supporting material) that summarizes all sections considered by the TG.

Note: Supporting material is available for review at NFPA Headquarters.
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<th>9-107</th>
<th>Log #556 NEC-P09</th>
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<td>(408.2)</td>
<td>Submitter: Ronald Bethea, Memphis and Shelby County Code Enforcement</td>
<td>Recommendation: Delete text as follows:</td>
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<td><strong>408.2 Other Articles.</strong> Switches, circuit breakers, and overcurrent devices used on switchboards and panelboards and their enclosures shall comply with this article and also with the requirements of Articles 240, 250, 312, 314, 404 and other articles that apply.</td>
<td><strong>Substantiation:</strong> Delete the reference to Article 314 in Section 408.2. Panelboard enclosures do not fall within the scope of Article 314. The blanket reference to Article 314 in 408.2 could be construed to permit surface extensions (314.22, Exception) to be run from flush-mounted panelboard covers. It could also be construed to require the volume of the box to be marked by the manufacturer on some smaller panelboard enclosures (314.16(A)(2)).</td>
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<td>(408.3(A)(2))</td>
<td>Submitter: Donald A. Ganiere, Ottawa, IL</td>
<td><strong>Recommendation:</strong> Add new text to read as follows:</td>
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<td><strong>(2) Service Switchboards and Panelboards.</strong> Barriers shall be placed in all service switchboards and panelboards such that no uninsulated, ungrounded service busbar or service terminal is exposed to inadvertent contact by persons or maintenance equipment while servicing load terminations. The barrier shall provide shock and arc flash protection equivalent to that provided by the switchboard or panelboard enclosure.</td>
<td><strong>Substantiation:</strong> With the current design of panelboards used as service equipment, it is not possible to comply with the electrical safe work rules required by OSHA and NFPA 70E, unless the utility disconnects the line side power any time the service equipment enclosure cover is opened or removed. This code change will make it possible to do work in the service equipment without having the utility disconnect the line side power, by removing the (unacceptable) exposure to the unprotected line side connections. This requirement has been in place for Canadian service equipment for many years. There is no reason why we can’t have the same protection for the electrical workers here in the US. Canadian Standards Association Standard C22.2 No. 29, Clause 7.4.1.2 states: “The main switch or circuit breaker shall be located in a separate section of the enclosure with a sheet-metal barrier or the equivalent, of the same thickness as the walls of the enclosure, having bushed holes or the equivalent, for the necessary wiring between compartments”. The major manufacturers of switchboards and panelboards currently make products that are in compliance with the CSA Standard so it will not be a hardship on them to comply with this safety rule.</td>
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<tr>
<td></td>
<td>I made this same proposal last cycle and it was rejected. The panel statement included the following: “Alternative methods exist to provide shock and arc flash protection equivalent to that provided by an enclosure.” This statement implies to me that the panel believes that you can work on energized equipment if you use PPE for the hazard level. This same misconception is held by many who work in the field. The fact is that there is no provision in the OSHA rules or those found in NFPA 70E that will let a worker work in service equipment in residential or commercial occupancies with the line side of the service OCPD energized. In many cases it would be impossible or very impractical to have the utility disconnect the service so that a new circuit could be installed. The acceptance of this proposal would go a long way in making it much safer to work in the service panel.</td>
<td></td>
</tr>
</tbody>
</table>
9-109 Log #251 NEC-P09
(408.3(C)(1) (New) )

Submitter: Jerry L. Sweeney, Campbell County Public Works
Recommendation: Add New text to read as follows:

408.3(C)(1) Intersystem Bonding Termination. Each switchboard or panelboard, listed as service equipment, shall be provided, from the manufacturer, an intersystem bonding termination, required by 250.94. It shall be provided with the equipment.

Substantiation: Since 250.94 requires the intersystem bonding termination, it should be provided with the service equipment.

9-110 Log #297 NEC-P09
(408.3(E))

Submitter: Ben Hartman, Nextek Power Systems, Inc.
Recommendation: Revise text to read as follows:

(E) Phase Arrangement. The phase arrangement on 3-phase buses shall be A, B, C from front to back, top to bottom, or left to right, as viewed from the front of the switchboard or panelboard. The B phase shall be that phase having the higher voltage to ground on 3-phase, 4-wire, delta-connected systems. Other busbar arrangements shall be permitted for additions to existing installations and shall be marked.

(E) Ungrounded Bus Arrangement.
(1) AC phase arrangement on 3-phase buses shall be A, B, C from front to back, top to bottom, or left to right, as viewed from the front of the switchboard or panelboard. The B phase shall be that phase having the higher voltage to ground on 3-phase, 4-wire, delta-connected systems. Other busbar arrangements shall be permitted for additions to existing installations and shall be marked.

(2) There shall be no specific bus arrangement required of DC ungrounded buses. Arrangement of DC buses shall be labeled as to polarity, grounding system and nominal voltage.

Substantiation: This proposal was developed by a subgroup of the NEC DC Task Force of the Technical Correlating Committee. The Task Force is chaired by John R. Kovacik, Underwriters Laboratories, and the subgroup members are Ben Hartman, Nextek Power Systems, subgroup lead, Ed Byaliy, Rockwell Automation, Brian Rock, Hubbell Incorporated, and Rob Wills, Intergrid, LLC.

The specific requirements for AC bus arrangements leaves ambiguous whether there is a proper arrangement in DC systems. It is our opinion that there is not a specific reason to have an arrangement, but labeling is crucial.
Revise text to read as follows:

(F) Switchboard or Panelboard Identification.

(2) Ungrounded AC Systems. A switchboard or panelboard containing an ungrounded AC electrical system as permitted in 250.21 shall be legibly and permanently field marked as follows:

"Caution Ungrounded System Operating — _____ Volts Between Conductors" or resistively grounded

(3) Ungrounded DC Systems. A switchboard or panelboard containing an ungrounded DC electrical system shall be legibly and permanently field marked as follows:

"Caution Ungrounded DC System Operating — _____ Volts Between Conductors"

(4) Resistively Grounded DC Systems. A switchboard or panelboard containing a resistive connection between current carrying conductors and the equipment grounding system to stabilize voltage to ground shall be legibly and permanently field marked as follows:

"Caution Ungrounded DC System Operating. Conductors Resistively Connected To Equipment Ground — _____ Volts Between Conductors And ± _____ Volts Referenced to Ground"

Substantiation: This proposal was developed by a subgroup of the NEC DC Task Force of the Technical Correlating Committee. The Task Force is chaired by John R. Kovacik, Underwriters Laboratories, and the subgroup members are Ben Hartman, Nextek Power Systems, subgroup lead, Ed Byaliy, Rockwell Automation, Brian Rock, Hubbell Incorporated, and Rob Wills, Intergrid LLC.

Addition of this language allow for explicit acceptance of DC systems and their grounding schema.

There is a related proposal from Rob Wills, Intergrid, LLC for Direct Current Microgrids in Chapter 7 of the code.

Language should be harmonized here if the new section is accepted.

The caution sign(s) or label(s) shall comply with 110.21(B).

This proposal is one of several coordinated companion proposals to provide consistency of danger, caution, and warning sign or markings as required in the NEC. The proposed revision will correlate this caution marking requirement with proposed 110.21(B) and the requirements in ANSI Z 535.4.

Delete the labeling requirement "Caution_____Phase has_____Volts to Ground" and replace with the labeling requirement "B-Phase, 208 Volts to Ground" to read as follows:

(1) High-Leg Identification. A switchboard or panelboard containing a 4-wire, delta-connected system where the midpoint of one phase winding is grounded, shall be legibly and permanently field marked as follows:

"Caution_____Phase has_____Volts to Ground"

"B-Phase, 208 Volts to Ground"

Substantiation: The word “caution” is an overstatement which if place on this type of system should also be placed on all systems. In all my years of working across the country I have never experienced a 4-wire delta system with a high leg that was not a nominal 208 volts to ground, so why not just require that voltage in the label? Also the NEC requires the high leg of a 4-wire delta to be the B-phase.
9-114  Log #1962  NEC-P09  Final Action:
(408.3(F)(2))

Submitter: Jonathan R. Althouse, Michigan State University
Recommendation: Delete the required label “Caution Ungrounded System operating - ____ Volts Between Conductors” and replace with the marking “Ungrounded System”.
Substantiation: This section and 250.21(C) each address the same situation, but require different markings. The word “caution” is an overstatement and marking the voltage is unnecessary.

9-115  Log #2984  NEC-P09  Final Action:
(408.3(F)(2))

Submitter: Thomas J. Baker, Puget Sound Electrical Training
Recommendation: Revise text to read as follows:
408.3(F)(2) Ungrounded Systems. A switchboard or panelboard containing an ungrounded electrical system as permitted in 250.21 shall be legibly and permanently field marked as follows:
“Caution Ungrounded System Operating — ____ Volts Between Conductors”
Substantiation: This is a companion proposal to a new definition “Marking”. The definition of marking includes the term legibly. Legibly can be deleted, simplifying the NEC.

9-116  Log #2745  NEC-P09  Final Action:
(408.4(B))

Submitter: Bill McGovern, City of Plano
Recommendation: Add text to read as follows:
(B) Source of Supply. All switchboards and panelboards supplied by a feeder in other than one- or two-family dwellings shall be marked to indicate the device or equipment where the power supply(s) originates.

Substantiation: It is very common today to utilize optional standby systems in the scheme of the electrical distribution network for commercial and industrial facilities. Other facilities may have legally required standby systems or emergency systems for buildings such as hospitals and high rise office buildings. The one thing all these systems have in common is an additional source of electrical energy whether it is a generator, storage batteries, or a second electrical service. While the vast majority of switchboards and panelboards are only supplied from one source, there are many that have multiple sources of power. It should be clear that switchboards and panelboards that have more than one source of power be clearly marked to indicate not only where the normal source of power originates, but any additional sources.
Throughout its history, the NEC® has mandated the practical safeguarding of persons and property from hazards arising from the use of electricity. However, one of the hazards that is often overlooked is damage to property, such as fire, or the destruction of appliances and electronic equipment, due to surges caused by (1) the starting and stopping of power electronic equipment, (2) direct or indirect lightning strikes, and (3) imposition of a higher voltage on a lower voltage system. While NFPA 70 has long recognized the practical application of surge protective devices as evidenced by several NEC® Articles, including but not limited to, 285, 694 and 708, the vast majority of equipment is not required to be protected from damage by surges. This lack of required protection results in, as the State Farm Insurance Company notes on their web site, "... power surges are responsible for hundreds of millions of dollars of property damage every year ... Over time, surges can also cause cumulative damage to your property, incrementally decreasing the lifespan of televisions, computers, stereo equipment, and anything else plugged into the wall."

This proposal is intended to expand protection against damaging surges through the use of listed surge protective devices. While progress has been made in this area, it is evident that expanded use of listed surge protective devices will be a step function improvement to the practical safeguarding of persons and property.

Some very recent specific examples of events that call attention to this need include the documented destruction of a house due to electrical surge as a result of a transformer fire. This occurred in Kings County California in October of 2011.

In the UK in 2010, 71 incidents were caused by electrical power surges according to the fire inspector. In fact, the cause of the surge was related to the theft of a copper component in a substation. Of the 71 incidents, 48 resulted in damage to electrical equipment, including 36 panelboards, a number of televisions, washing machines and other electrical appliances.

In Dallas, Texas, a utility electric crew repairing a transformer in front of a residence caused a significant surge. The transformer was seen to be arcing with the subsequent destruction of equipment in nearby homes. This included Central Heat and Air units, refrigerators, washers, dryers .... and the like. Another recent event in Carthage, MO, occurred in October of 2011. Lightning hit the Jasper County Jail and the resultant surge knocked out the security system as well as fire alarms, locks and other key systems. The same event also resulted in a small fire at a Carthage home. Only because of an alert homeowner and quick response by the local fire department was extensive damage and possible loss of life prevented.

Studies by recognized authorities including NEMA, IEEE, and UL, all substantiate the fact that surges can and do cause significant damage. Nationwide Insurance recognizes the need for effective surge protection as well and has published recommendations that include point-of-use surge protectors and installation of main service panel suppressors.

Unprotected surges do cause catastrophic damage to industrial, commercial and residential electronic equipment and residential appliances, sometimes resulting in fire and loss of life. Surge protective devices are readily available to protect against these common surges, but have simply not been required in most applications. This Code Making Panel has the opportunity to take a significant step toward better protection of persons and property by accepting this proposal.
Metal-enclosed switchgears and switchboards in damp or wet locations shall be installed in accordance with 312.2.

Metal-enclosed switchgears and switchboards shall be placed so as to reduce to a minimum the probability of communicating fire to adjacent combustible materials. Where installed over a combustible floor, suitable protection thereto shall be provided.

For other than a totally enclosed metal-enclosed switchgear and switchboard, a space not less than 900 mm (3 ft) shall be provided between the top of the switchboard and any combustible ceiling, unless a noncombustible shield is provided between the metal-enclosed switchgear and switchboard and the ceiling.

Clearance around metal-enclosed switchgears and switchboards shall comply with the provisions of 110.26.

An insulated conductor used within a metal-enclosed switchgears and switchboard shall be listed, shall be flame retardant, and shall be rated not less than the voltage applied to it and not less than the voltage applied to other conductors or busbars with which it may come in contact.

Switchboards that have any exposed live parts shall be located in permanently dry locations and then only where under competent supervision and accessible only to qualified persons. Switchboards shall be located such that the probability of damage from equipment or processes is reduced to a minimum.

Instruments, relays, meters, and instrument transformers located on metal-enclosed switchboards shall be grounded as specified in Chapters 250.170 through 250.178.

Substantiation: It appears that metal-enclosed switchgear was inadvertently left out when this was included in the NEC.

See also Article 100 definitions.

Switchboards by definition are not intended to be enclosed. See definition.
Add "metal-enclosed power switchgears," to section to read as follows:

II. Switchboards.

408.16 Metal-Enclosed Power Switchgear and Switchboards in Damp or Wet Locations. Metal-enclosed power switchgears and switchboards in damp or wet locations shall be installed in accordance with 312.2.

408.17 Location Relative to Easily Ignitable Material. Metal-enclosed power switchgears and switchboards shall be placed so as to reduce to a minimum the probability of communicating fire to adjacent combustible materials. Where installed over a combustible floor, suitable protection thereto shall be provided.

408.18 Clearances.
(A) From Ceiling. For other than a totally enclosed metal-enclosed power switchgear and switchboard, a space not less than 900 mm (3 ft) shall be provided between the top of the switchboard and any combustible ceiling, unless a noncombustible shield is provided between the metal-enclosed power switchgear and switchboard and the ceiling.

(B) Around Metal-Enclosed Power Switchgears and Switchboards. Clearances around metal-enclosed power switchgears and switchboards shall comply with the provisions of Section 110.26.

408.19 Conductor Insulation. An insulated conductor used within a metal-enclosed power switchgear and switchboard shall be listed, shall be flame retardant, and shall be rated not less than the voltage applied to it and not less than the voltage applied to other conductors or busbars with which it may come in contact.

408.20 Location of Switchboards. Switchboards that have any exposed live parts shall be located in permanently dry locations and then only where under competent supervision and accessible only to qualified persons. Switchboards shall be located such that the probability of damage from equipment or processes is reduced to a minimum.

408.22 Grounding of Instruments, Relays, Meters, and Instrument Transformers on Switchboards. Instruments, relays, meters, and instrument transformers located on metal-enclosed power switchgears and switchboards shall be grounded as specified in 250.170 through 250.178.

Substantiation: It appears that metal-enclosed power switchgear was inadvertently left out when this was included in the NEC.

See also Article 100 definitions.

Switchboards by definition are not intended to be enclosed. See definition.

The Panel may want to recheck the spelling of "ignitable" in the Title of 408.17.

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Revise text to read as follows:

Clearances around switchboards shall comply with the provisions of 110.26: for 0-600 volts, and section 110.32 for over 600 volts.

Substantiation: The present wording in 408.18(B) seems to imply that 110.32 can be ignored. I do not believe that is the intent for switchboards rated over 600 volts, which may require larger work spaces than 110.26 dimensions. The proposed new wording will clarify the intent.
9-121 Log #3432 NEC-P09  
(408.18(C))

Final Action:

Submitter: Hector Bello, Houston I.S.D.  
Recommendation: Add new text to read as follows:  
Section 408.18(C) The switchboard shall be installed that all sides and back be maintained at least 3 ft clearance for maintaining, calibrating, adjusting and replacement.  
Substantiation: This new section shall be implemented so as to provide access for adjustment, replacing parts and perform preventive maintenance. This allows easy access to the sides and back.

9-122 Log #2321 NEC-P09  
(408.36)

Final Action:

Submitter: Eric Kench, Kench Engineering Consultant  
Recommendation: Revise text to read as follows:  
†(B) (A) Supplied Through a Transformer.  
(B) (B) Delta Breakers.  
(C) (C) Back-fed Devices  
Substantiation: A 30 amp snap switch cannot be protected by a 200 amp OCPD. Though it is possible to have a 200 amp panel with branch circuits having 30 amp snap switches in series with 30 amp fuses, this particular NEC section does not indicate this configuration in anyway.

9-123 Log #566 NEC-P09  
(408.36(C))

Final Action:

Submitter: Roy Gillespie, Jr., Ranken Technical College  
Recommendation: Identify what a Delta breaker is before the article.  
Substantiation: The wording can confuse some to believe that you cannot have a Delta panelboard. Where the article is stating don't use a single phase panel for a 3 phase system.

9-124 Log #467 NEC-P09  
(408.36(E) (New))

Final Action:

Submitter: Mario L. Mumfrey, Inspection Bureau Inc.  
Recommendation: Add new text to read as follows:  
(E) Mounting Height Outdoors. Panelboard enclosures with overcurrent devices shall be installed not less than 600 mm (2 ft) above finish grade or working platform. The maximum height of circuit breakers center grip used as switches or disconnecting means are not to exceed 2.0 m (6 ft 7 in.) as per 404.8(A) applies.  
Substantiation: This new text mirrors a long standing code article for mobile and manufactured homes in 550.32(F). The same concerns exist for other installations outdoors. A panelboard can be installed without regard for mounting height and while in direct contact with conductive properties of the earth a shock hazard is imminent. Simply and for no other reason than the panelboard with overcurrent devices were mounted too low to safely service this equipment. This is becoming more of an issue with swimming pool installers who try to keep the pool loadcenters and other equipment as low to the ground as possible for cosmetic reasons. This code change will enable a concise enforcement to address a safety concern.
Panelboards shall be mounted in cabinets, cutout boxes, or identified enclosures designed for the purpose and shall be dead-front.

The TCC Usability Task Group is comprised of Stanley Folz, James Dollard, Bill Fiske and David Hittinger. This task group was assigned by the TCC Chair to review the use of the phrase “designed for the purpose” throughout the NEC. There are twelve instances of its use.

By definition, identified equipment is suitable for its intended purpose (see definition of Identified in Article 100). Many things not defined for a specific purpose are nonetheless suitable for that purpose, and are thus "identified.” Substituting "identified" for the word(s) to be replaced conforms to 3.2.4 of the NEC Style Manual, that says, "recognized or defined terms are to be used in preference to similar terms that do not have such recognition."

This is not original material; its reference/source is as follows:
This proposal was developed by the TCC Usability Task Group.

Panelboards shall be mounted in cabinets, cutout boxes, or enclosures designed for the purpose and shall be dead-front.

Cabinets and cut-out boxes are enclosures and it is not necessary to list them.

Panelboards shall be mounted in cabinets, cutout boxes, or enclosures designed for the purpose and shall be dead-front.

Cabinets and cut-out boxes are enclosures and it is not necessary to list them.

Section 408.51 - Insulated or bare bus bars shall be rigidly mounted. The end portion of each bus bars in the switchboard shall be provided with an insulated end cap and fireboard to prevent in contact to exposed live parts. Most switchboards that are built by manufacturers have a clearance of 2 in. at the end part. If some bump the covered bend this will make contact to live bus bars and create explosion or electrocution to a person.
Instruments, pilot lights, voltage (potential) transformers, and other switchboard devices with potential coils shall be supplied by a circuit that is protected by standard overcurrent devices rated 15 amperes or less.

Substantiation: Provides consistency with editorial change proposed for 450.3(C). Voltage transformer and potential transformer are used interchangeably in many segments of the electrical industry.

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Teri Dwyer, Wells Fargo

Recommendation: Revise text to read as follows:

408.55 Wire-Bending Space Within an Enclosure Containing a Panelboard.

(A) Top and Bottom Wire-Bending Space. The enclosure for a panelboard shall have the top and bottom wire-bending space sized in accordance with Table 312.6(B) for the largest conductor entering or leaving the enclosure. Side wire-bending space shall be in accordance with Table 312.6(A) for the largest conductor to be terminated in that space.

Exception No. 1: Either the top or bottom wire-bending space shall be permitted to be sized in accordance with Table 312.6(A) for a panelboard rated 225 amperes or less and designed to contain not over 42 overcurrent devices. For the purposes of this exception, a 2-pole or a 3-pole circuit breaker shall be considered as two or three overcurrent devices, respectively.

Exception No. 2: Either the top or bottom wire-bending space for any panelboard shall be permitted to be sized in accordance with Table 312.6(B) where at least one side wire-bending space is sized in accordance with Table 312.6(B) for the largest conductor to be terminated in any side wire-bending space.

Exception No. 3: The top and bottom wire-bending space shall be permitted to be sized in accordance with Table 312.6(A) spacings if the panelboard is designed and constructed for wiring using only a single 90 degree bend for each conductor, including the grounded circuit conductor, and the wiring diagram shows and specifies the method of wiring that shall be used.

Exception No. 4: Either the top or the bottom wire-bending space, but not both, shall be permitted to be sized in accordance with Table 312.6(A) where there are no conductors terminated in that space.

(B) Back Wire-Bending Space. Where a raceway or cable entry is in the wall of the enclosure opposite a removable cover, the distance from that wall to the cover shall be permitted to comply with the distance required for one wire per terminal in Table 312.6(A).

Substantiation: Currently, section 408.55 requires the enclosure for a panelboard to have the top wire bending space to be sized in accordance with Table 312.6(B) and the side wire-bending space in accordance with Table 312.6(A). However, when conductors entering the back of a panelboard enclosure it is silent. This new language would ensure a minimum required bending space similar to that required by section 314.28(A)(2). There are also requirements for conductor deflection within wireways that reference the dimensions corresponding to one wire per terminal in Table 312.6(A) shall apply.

Note: Supporting material is available for review at NFPA Headquarters.
408.55 Wire-Bending Space Within an Enclosure Containing a Panelboard.

(A) Top and Bottom Wire-Bending Space. The enclosure for a panelboard shall have the top and bottom wire-bending space sized in accordance with Table 312.6(B) for the largest conductor entering or leaving the enclosure. Side wire-bending space shall be in accordance with Table 312.6(A) for the largest conductor to be terminated in that space.

Exception No. 1: Either the top or bottom wire-bending space shall be permitted to be sized in accordance with Table 312.6(A) for a panelboard rated 225 amperes or less and designed to contain not over 42 overcurrent devices. For the purpose of this exception, a 2-pole or a 3-pole circuit breaker shall be considered as two or three overcurrent devices, respectively.

Exception No. 2: Either the top or bottom wire-bending space for any panelboard shall be permitted to be sized in accordance with Table 312.6(A) where at least one side wire-bending space is sized in accordance with Table 312.6(B) for the largest conductor to be terminated in any side wire-bending space.

Exception No. 3: The top and bottom wire-bending space shall be permitted to be sized in accordance with Table 312.6(A) spacings if the panelboard is designed and constructed for wiring using only a single 90 degree bend for each conductor, including the grounded circuit conductor, and the wiring diagram shows and specifies the method of wiring that shall be used.

Exception No. 4: Either the top or the bottom wire-bending space, but not both, shall be permitted to be sized in accordance with Table 312.6(A) where there are no conductors terminated in that space.

(B) Back Wire-Bending Space. Where a raceway or cable entry is in the wall of the enclosure opposite a removable cover, the distance from that wall to the cover shall be permitted to comply with the distance required for one wire per terminal in Table 312.6(A).

Substantiation: Currently, section 408.55 requires the enclosure for a panelboard to have the top wire bending space to be sized in accordance with Table 312.6(B) and the side wire-bending space in accordance with Table 312.6(A). However when conductors entering the back of a panelboard enclosure it is not clear what requirements are needed. This new language would ensure a minimum required bending space similar to that required by 314.28(A)(2).

Enclosures for overcurrent devices shall be used for junction boxes, auxiliary gutters or raceways, if adequate space is provided, so why not have same requirements as 314.28(A)(2) apply.

Note: Supporting material is available for review at NFPA Headquarters.

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This proposal is the work of the “High Voltage Task Group” appointed by the Technical Correlating Committee. The task group consisted of the following members: Alan Peterson, Paul Barnhart, Lanny Floyd, Alan Manche, Donny Cook, Vince Saporita, Roger McDaniel, Stan Folz, Eddie Guidry, Tom Adams, Jim Rogers and Jim Dollard.

The Task Group identified the demand for increasing voltage levels used in wind generation and photovoltaic systems as an area for consideration to enhance existing NEC requirements to address these new common voltage levels. The task group recognized that general requirements in Chapters 1 through 4 need to be modified before identifying and generating proposals to articles such as 690 specific for PV systems. These systems have moved above 600V and are reaching 1000V due to standard configurations and increases in efficiency and performance. The committee reviewed Chapters 1 through 8 and identified areas where the task group agreed that the increase in voltage was of minimal or no impact to the system installation. Additionally, there were requirements that would have had a serious impact and the task group chose not to submit a proposal for changing the voltage. See table (supporting material) that summarizes all sections considered by the TG.

Note: Supporting material is available for review at NFPA Headquarters.
9-133 Log #2975 NEC-P09

(Table 408.56)

Submitter: Ben Hartman, Nextek Power Systems, Inc.

Recommendation: Revise Table as shown below:

****Insert Table 408.56 Here****

Substantiation: This proposal was developed by a subgroup of the NEC DC Task Force of the Technical Correlating Committee. The Task Force is chaired by John R. Kovacik, Underwriters Laboratories, and the subgroup members are Ben Hartman, Nextek Power Systems, subgroup lead, Ed Byaliy, Rockwell Automation, Brian Rock, Hubbell Incorporated, and Rob Wills, Intergrid, LLC.

To reduce ambiguity in the leftmost column heading, the text “AC or DC” is prepended to the original, “Voltage.” Although the existing text could be assumed to apply to AC or DC implicitly, some readers interpret higher voltages to mean AC.

9-134 Log #2972 NEC-P09

(408.58)

Submitter: Ben Hartman, Nextek Power Systems, Inc.

Recommendation: Revise text to read as follows:

408.58 Panelboard Marking.

Panelboards shall be durably marked by the manufacturer with the voltage and the current rating and the number of AC phases or DC buses for which they are designed and with the manufacturer's name or trademark in such a manner so as to be visible after installation, without disturbing the interior parts or wiring.

Substantiation: This proposal was developed by a subgroup of the NEC DC Task Force of the Technical Correlating Committee. The Task Force is chaired by John R. Kovacik, Underwriters Laboratories, and the subgroup members are Ben Hartman, Nextek Power Systems, subgroup lead, Ed Byaliy, Rockwell Automation, Brian Rock, Hubbell Incorporated, and Rob Wills, Intergrid, LLC.

The addition of DC marking requirements reduces ambiguity for panelboard/switchboard manufacturers, safety listing agencies and AHJs.
Table 408.56 Minimum Spacings Between Bare Metal Parts

<table>
<thead>
<tr>
<th>AC or DC Voltage</th>
<th>Opposite Polarity Where Mounted on the Same Surface</th>
<th>Opposite Polarity Where Held Free in Air</th>
<th>Live Parts to Ground*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mm</td>
<td>in.</td>
<td>mm</td>
</tr>
<tr>
<td>Not over 125 volts, nominal</td>
<td>19.1</td>
<td>¾</td>
<td>12.7</td>
</tr>
<tr>
<td>Not over 250 volts, nominal</td>
<td>31.8</td>
<td>1¼</td>
<td>19.1</td>
</tr>
<tr>
<td>Not over 600 volts, nominal</td>
<td>50.8</td>
<td>2</td>
<td>25.4</td>
</tr>
</tbody>
</table>

*For spacing between live parts and doors of cabinets, see 312.11(A)(1), (2), and (3).
Report on Proposals – June 2013

9-135 Log #1034 NEC-P09
(450) Final Action:

Submitter: James T. Dollard, Jr., IBEW Local Union 98
Recommendation: Replace 600V with 1000V.
Substantiation: This proposal is the work of the “High Voltage Task Group” appointed by the Technical Correlating Committee. The task group consisted of the following members: Alan Peterson, Paul Barnhart, Lanny Floyd, Alan Manche, Donny Cook, Vince Saporita, Roger McDaniel, Stan Folz, Eddie Guidry, Tom Adams, Jim Rogers and Jim Dollard.

The Task Group identified the demand for increasing voltage levels used in wind generation and photovoltaic systems as an area for consideration to enhance existing NEC requirements to address these new common voltage levels. The task group recognized that general requirements in Chapters 1 through 4 need to be modified before identifying and generating proposals to articles such as 690 specific for PV systems. These systems have moved above 600V and are reaching 1000V due to standard configurations and increases in efficiency and performance. The committee reviewed Chapters 1 through 8 and identified areas where the task group agreed that the increase in voltage was of minimal or no impact to the system installation. Additionally, there were requirements that would have had a serious impact and the task group chose not to submit a proposal for changing the voltage. See table (supporting material) that summarizes all sections considered by the TG.

Note: Supporting material is available for review at NFPA Headquarters.

9-136 Log #1880 NEC-P09
(450.3 (New)) Final Action:

Submitter: Gaylan Bishop, The University of North Carolina - Chapter Hill
Recommendation: Add new design-permissive language as shown below:

450.3+ Capacity. As an alternative to the feeder and service load calculations required by Parts III and IV of Article 220, transformer capacity shall be permitted to be based upon historical demand information if the determination of capacity is made by a registered professional engineer or an individual under their supervision.

Substantiation: The University of North Carolina supports the effort by the APPA.ORG Code Advocacy Task Force (CATF) to bring the 2014 NEC in step with rapidly evolving energy codes by reducing the size of building services which have shown themselves to be significantly oversized for decades.

Our energy workgroups have submitted electrical data to the CATF for use in preparing proposals to several committees. Across a broad variety of occupancy classes, we find that average loads on medium substations are about 43 percent of transformer ambient kVA ratings and peak loads are about 54 percent of transformer ambient kVA ratings. We are willing to turn over our data to the NFPA Fire Protection Research Foundation as part of a comprehensive study to harmonize parts of the NEC with energy codes.

Since the committee that covers Article 220 feeder and service calculations has historically rejected proposals that would have the practical effect of reducing the overcapacity of service transformers and related switchgear, we would like the Article 450 committee to permit open-ended engineering methods to “right-size” transformers and related service switchgear in the interest of reconciling the competing objectives of fire safety, flash hazard reduction, and energy conservation. We believe that trusting trained and licensed professional engineering consultants with open-ended approaches in Article 450 will be quicker to the goal.

This is not original material; its reference/source is as follows:
APPA.ORG - Leadership in Education Code Advocacy Task Force (Issue 11-6 Proposal 45)

Printed on 11/25/2011
9-137  Log #269  NEC-P09  Final Action:

Submitter: Fred M. Perilstein, Springfield, NJ
Recommendation: A new column should be added to Table 450.3(A) entitled “Primary Protection 600 Volts or Below”, similar to the present column labeled “Primary Protection Over 600 Volts”.
Substantiation: NFPA 70-2011 Table 450.3(A) has no "overcurrent protection" column for "step-up" transformers whose primaries are 600 volts or less and whose secondaries are over 600 volts. This format is used at facilities where the generators' output voltage is 600 volts or less, but they must connect into power systems rated at more than 600 volts.

9-138  Log #3375  NEC-P09  Final Action:

Submitter: Timothy Crnko, Cooper Bussmann
Recommendation: Revise text to read as follows:
1. Where the required fuse rating or circuit breaker setting does not correspond to a standard rating or setting, a higher rating or setting that does not exceed
   (1) the next higher standard rating or setting for fuses and circuit breakers 600 volts and below or
   (2) the next higher commercially available rating or setting for fuses and circuit breakers above 600 volts shall be permitted.
Substantiation: The standard ampere ratings in 240.6 are applicable for fuses and circuit breakers 600V or less. The NEC does not have standard ampere ratings or settings for circuit breakers or fuses rated over 600V. Table 450.3(A) Note 1 is also applicable to fuses and circuit breakers over 600V. This revision allows the next standard ampere rating or setting that a manufacturer provides as a product offering.

9-139  Log #433  NEC-P09  Final Action:

Submitter: Jay Brunetto, Burris Engineers, Inc.
Recommendation: Add subdivision 1 under 450.3(B) to read as follows:
Where the transformer secondary conductors are terminated in the main circuit breaker of a panelboard, this shall be considered Primary only Protection.
Substantiation: Currently there is confusion as to whether a main circuit breaker in a panelboard connected to the secondary conductors of a transformer acts as secondary overcurrent protection of the transformer or not. Exhibit 450.4 shows this scenario and indicates that this is Primary Overcurrent Protection Only. However I've read in a Mike Holt article as well as discussed with several Engineers that this would constitute secondary overcurrent protection and therefore the primary overcurrent could be sized at 250% of the transformer rated current instead of 125%.
9-140  Log #1867  NEC-P09  
(Table 450.3(B))

Submitter: Christopher P. Brown, Ewing Cole  
Recommendation: Revise Table 450.3(B) to read as follows:

***Insert Table 450.3(B) Here***

Substantiation: This proposal is intended to provide additional guidance for the overcurrent protection requirements on the secondary side of transformers. I have seen many installations where primary protection on transformers meeting the description of Table 450.3 is set to 125% and no secondary protection is provided although the secondary side conductors may run more than 100 ft. This proposal should be included to provide additional guidance that although overcurrent protection on the secondary side of a transformer with primary protection is not required to protect the transformer, there are other requirements for conductors connected to the transformer’s secondary side which must be considered.

9-141  Log #1704  NEC-P09  
(450.3(C))

Submitter: David Bredhold, Eaton Corporation  
Recommendation: Revise text to read as follows:

Voltage (Potential) Transformers.

Substantiation: Provides consistency with editorial change proposed for 408.52. Voltage transformer and potential transformer are used interchangeably in many segments of the electrical industry.

9-142  Log #3344  NEC-P09  
(450.5 Exception No. 1 (New))

Submitter: Tony Hoevenaars, Mirus International Inc.  
Recommendation: Add new text to read as follows:

Exception No. 1: A special grounding autotransformer that provides low zero phase sequence impedance at its load side (<1.0%) and high zero phase sequence impedance at its line side (>30%) is allowed to be installed on the load side of a system grounding connection without requiring that the autotransformer be electrically connected to the grounded conductor of the system supplying the autotransformer provided the neutral of the autotransformer is grounded.  

Substantiation: Present restrictions in NEC Section 450.5 do not allow the use of a special grounding autotransformer configuration with low zero phase sequence impedance at its load side (<1.0%) and high zero phase sequence impedance at its line side (>20%) on a grounded system. The reason this is not allowed for standard grounding transformers is that they are typically parallel connections that present low zero phase sequence impedance to both the line side and load side of their connection to the power system. This can cause the current from a line-to-ground fault to be shared through the supply system transformer and the zigzag transformer. The high line side zero phase sequence impedance of the special grounding autotransformer blocks the ground fault return path through the supply system transformer. An autotransformer used in this application would be smaller, lower cost and significantly more energy efficient than the isolation transformers which are presently used.
<table>
<thead>
<tr>
<th>Protection Method</th>
<th>Primary Protection</th>
<th>Secondary Protection (see Note 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Currents of 9 Amperes or More</td>
<td>Currents Less Than 9 Amperes</td>
</tr>
<tr>
<td>Primary only protection</td>
<td>125% (See Note 1)</td>
<td>167%</td>
</tr>
<tr>
<td>Primary and secondary protection</td>
<td>250% (See Note 3)</td>
<td>250% (See Note 3)</td>
</tr>
</tbody>
</table>

Notes:
1....
2....
3....
4. For conductors connected to the secondary side of the transformer, see Articles 240.4(F) and 240.21(C) 1-6 for conductor over current protection requirements.
9-143  Log #2887 NEC-P09
(450.9)

Submitter: James F. Williams, Fairmont, WV
Recommendation: Revise text to read as follows:

450.9 Ventilation. The ventilation shall be adequate to dispose of the heat from the transformer full-load losses without creating a temperature rise that is in excess of the transformer rating.
Substantiation: You cannot dispose of “full-load losses” you can only dispose of the heat the losses create.

9-144  Log #3446 NEC-P09
(450.10(A) (New))

Submitter: Michael J. Johnston, National Electrical Contractors Association
Recommendation: Add new text to read as follows:

(A) Dry-Type Transformer Enclosures. Where separate equipment grounding conductors and supply-side bonding jumpers are installed, a terminal bar for all grounding and bonding conductor connections shall be secured inside the transformer enclosure. The terminal bar shall be bonded to the enclosure in accordance with 250.12 and shall not be installed on or over any vented portion of the enclosure.

Exception. Where a dry-type transformers is equipped with wire-type connections (leads), the grounding and bonding connections shall be permitted to be connected together using any of the methods in 250.8 and shall be bonded to the enclosure, if of metal.

Include the current text of this section as Subdivision (B) and new title as follows:

(B) Other Metal Parts. Insert current text of this section unchanged.

Substantiation: The connections of grounding and bonding conductors in dry-type transformer enclosures continue to be problematic and inconsistently made without clear requirements in the NEC. It is very common to see grounding and bonding conductors connected to the enclosure at or over the venting openings in the bottom of the transformer, resulting in less than effective connections. I don’t believe these enclosures have been evaluated as grounding and bonding equipment and should not be depended upon to serve as effective ground fault current paths. The requirement for a terminal bar eliminates the inconsistencies and provides needed direction for installers.
Each transformer shall be provided with a nameplate giving the following information:

1. The name of the manufacturer;
2. Rated kilovolt-amperes;
3. Frequency;
4. Primary and secondary voltage;
5. For dry type transformers, if the transformer is permitted to be connected in either direction, it shall be marked as "Bi-Directional". Installation instructions shall be provided by the manufacturer detailing how the transformer should be connected when the primary and secondary are reversed.
6. The impedance of transformers 25kVA and larger;
7. Required clearances for transformers with ventilating openings;
8. The amount and kind of insulating liquid where used.

In addition, the nameplate of each dry-type transformer shall include the temperature class for the insulation system.

Although it is common industry practice to reverse wire dry-type transformers, the marking requirements in the current NEC do not make the installer aware of the fact that UL 1561 does not support this practice. UL 1561 provides that the testing of these transformers includes "step up, step down, and autotransformer type..." with the supply being connected to the primary and the load being connected to the secondary, thus, making connections in any other manner a violation of 110.3(B). Changing the marking requirements of 450.11 will provide clarification and enhance electrical safety.

Transformers, other than Class 2 or Class 3 transformers, shall have a disconnecting means located either in sight of the transformer or in a remote location. Where located in a remote location, the disconnecting means shall be lockable in accordance with 110.25 and its location shall be field marked on the transformer.

This proposal has been developed by the Usability Task Group assigned by the Technical Correlating Committee. The committee members were Stanley Folz, James Dollard, William Fiske, David Hittinger, Andy Juhasz, Amos Lowrance, Susan Newman-Scearce, Marc Bernsen and Vincent Zinnante. Requirements for a disconnecting means to be lockable in the open position exist in numerous locations in the NEC. A new section has been proposed in Article 110 to consolidate the requirements for a disconnecting means required to be "capable of being locked in the open position" in a single section for clarity. It is understood that this requirement includes more than disconnecting and locking electrical power sources.

This proposal is intended to facilitate a lockout/tagout scenario. It is equally important to ensure that the means for placing the lock remain in place. The concept suggested by this proposal is necessary to provide correlation throughout the NEC with respect to the capability of placing a lock on a disconnecting means to secure it in the open position.

This is not original material; its reference/source is as follows:

This proposal was the result of work by TCC Usability Task Group.
In section 450.14 Disconnecting Means, strike the existing text as indicated and relocate to a new exception. Transformers, other than Class 2 or Class 3 transformers, shall have a disconnecting means located either in sight of the transformer, or in a remote location. Where located in a remote location, the disconnecting means shall be lockable, and the location shall be field marked on the transformer.

**Exception** The disconnecting means shall not be required to be of sight of the transformer where all of the following conditions are met:

(a) Locating the disconnecting means within sight is impracticable or introduces additional or increased hazards to persons or property.

(b) The remotely located disconnect is capable of being locked in the open position, and the provision for locking or adding a lock to the disconnecting means shall be installed on or at the switch or circuit breaker and shall remain in place with or without the lock installed.

(c) The location of the disconnect is permanently field marked on the transformer and the means of marking is suitable for the environment.

**Substantiation:** This section has important requirements but it does not provide specific instructions on the conditions of use. The present text allows discretion on the part of the installer in regards to determining if a transformers disconnect shall be located in sight of the transformer or if the disconnect is located in a remote location. The present text recognizes a remote disconnect but it does not apply the usual requirement that the disconnect provide a means to lock it out with or without a lock installed. I have suggested language simply stating the general rule. Transformers shall have a disconnecting means in sight of the transformer. Admittedly these requirements are not always practicable. This proposed exception to the general rule provides a list of conditions that include the existing text and a requirement that the means to lock a remote switch or circuit breaker open remain with the lock in place or not. Similar language is in use else where in this code. When ever lockout tag out rules are employed throughout the NEC the provisions to lock the disconnect in the open position is almost always required to remain place. Proposal 9-176 A2010 –ROP by Mr. Rogers included the lockable requirement. It seems that the language was edited to resolve run on sentences. There was also a proposal 1-63 by Mr. Folz to clarify the locking means requirements with a new definition. Code Making Panel 1 rejected that proposal based on the content (multiple requirements within the definition). Beyond Mr. Folz’s definition there seems to be a few other requirements that should be met in order to allow a disconnecting means which is provided to enhance the safety of the installation to be located out of sight of the equipment in question. I believe those conditions are addressed in the proposed exception.

Add text to read as follows:

**Disconnection Means.** Transformers, other than Class 2 or Class 3 transformers, shall have a disconnecting means located either in sight of the transformer or in a remote location. Where located in a remote location, the disconnecting means shall be lockable, and the location shall be field marked on the on the transformer. The provision for locking or adding a lock to the disconnecting means shall be installed on or at the switch or circuit breaker and shall remain in place with or without the lock installed.

**Substantiation:** The provisions for locking out electrical equipment should remain with the equipment and not rely on a portable device for the safety of the worker or installer. The Code has no way in insure that a portable device will remain with the equipment once that device has been removed.
9-149 Log #679 NEC-P09 (450.14 Exception (New))

Submitter: Andy Juhasz, Kone, Inc.
Recommendation: Add new exception as follows:

Exception: Where the equipment is within the scope of Article 620 the disconnecting means shall comply with 620.51.
Substantiation: Many elevator and other conveyance controls have a main transformer ahead of them for voltage matching or isolation. This conveyance equipment is already required to have a disconnecting means, see 620.51, to disconnect all ungrounded main power supply conductors which would include such a transformer. The location of this disconnect is also already specified in 620.51(C) and is equipment type dependent. These provisions in Article 620 should supersede those in 450.14 (see 90.3, Code Arrangement). This may not be obvious to the user of the Code with regards to 450.14.

9-150 Log #2171 NEC-P09 (450.21, Informational Note)

Submitter: Marcelo M. Hirschler, GBH International
Recommendation: Revise text to read as follows:

450.21 Dry-Type Transformers Installed Indoors.
Substantiation: NFPA 251 has been withdrawn – ASTM E119 is equivalent to NFPA 251 throughout the NFPA system and has an updated date.

9-151 Log #2268 NEC-P09 (450.42)

Submitter: Leo F. Martin, Sr., Martin Electrical Consulting
Recommendation: Revise text to read as follows:

For the purpose of this section, studs and wallboard construction shall not be acceptable. For the purposes of this section, studs and wallboard construction shall not be permitted.
Substantiation: To comply with the requirements of 90.5(A) Mandatory rules and the NEC Style Manual.

9-152 Log #2172 NEC-P09 (450.42, Informational Note)

Submitter: Marcelo M. Hirschler, GBH International
Recommendation: Revise text to read as follows:

450.42 Walls, Roofs and Floors.
Substantiation: NFPA 251 has been withdrawn – ASTM E119 is equivalent to NFPA 251 throughout the NFPA system and has an updated date.
Replace 600V with 1000V.

This proposal is the work of the “High Voltage Task Group” appointed by the Technical Correlating Committee. The task group consisted of the following members: Alan Peterson, Paul Barnhart, Lanny Floyd, Alan Manche, Donny Cook, Vince Saporita, Roger McDaniel, Stan Folz, Eddie Guidry, Tom Adams, Jim Rogers and Jim Dollard.

The Task Group identified the demand for increasing voltage levels used in wind generation and photovoltaic systems as an area for consideration to enhance existing NEC requirements to address these new common voltage levels. The task group recognized that general requirements in Chapters 1 through 4 need to be modified before identifying and generating proposals to articles such as 690 specific for PV systems. These systems have moved above 600V and are reaching 1000V due to standard configurations and increases in efficiency and performance. The committee reviewed Chapters 1 through 8 and identified areas where the task group agreed that the increase in voltage was of minimal or no impact to the system installation. Additionally, there were requirements that would have had a serious impact and the task group chose not to submit a proposal for changing the voltage. See table (supporting material) that summarizes all sections considered by the TG.

Note: Supporting material is available for review at NFPA Headquarters.

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Add new text to read as follows:

940.5 Clearances from Fire Hydrants. Supporting structures, pad mounted and other above-ground equipment and pedestals shall have a clearance of not less than 1.22 m (4 ft) from fire hydrants.

Exception: Where conditions do not permit, a clearance of not less than 900 mm (3 ft) shall be permitted.

Substantiation: Clearances from fire hydrants are needed to provide room for the installation of fire hoses. The 4 ft clearance allows the firefighters to install a gate valve unit to one side of a fire hydrant so a second truck can attach without water being turned off to the first truck. The 3 ft clearance allows the attachment of a valve unit, but not with the same capability. Both the 4 ft and 3 ft numbers were taken from a similar requirement in the NESC.
Add new design-permissive language as shown below:

490.20 Service or Feeder Load. As an alternative to the feeder and service load calculations required by Parts III and IV of Article 220, alternative service load calculations that are based upon historical demand information shall be permitted to be performed by registered professional engineers or individuals under their supervision.

Substantiation: The University of North Carolina supports the effort by the APPA.ORG Code Advocacy Task Force (CATF) to bring the 2014 NEC in step with rapidly evolving energy codes by reducing the size of building services which have shown themselves to be significantly oversized for decades.

Our energy workgroups have submitted electrical data to the CATF for use in preparing proposals to several committees. Across a broad variety of occupancy classes, we find that average loads on medium substations are about 43 percent of transformer ambient kVA ratings and peak loads are about 54 percent of transformer ambient kVA ratings.

Since the committee that covers Article 220 feeder and service calculations has historically rejected proposals that would have the practical effect of reducing the overcapacity of service transformers and related switchgear, we would like the Article 490 committee to permit open-ended engineering methods to "right-size" medium voltage services in the interest of reconciling the competing objectives of fire safety, flash hazard reduction, and energy conservation. We believe that trusting trained and licensed professional engineering consultants with open-ended approaches in Article 490 will be quicker to the goal.

This is not original material; its reference/source is as follows:
APPAN.ORG - Leadership in Education Code Advocacy Task Force (Issue 11-6 Proposal 36)

Revise text to read as follows:

(7) High-Voltage Fuses. Metal-enclosed power switchgear and substations that utilize high-voltage fuses shall be provided with a gang-operated disconnecting switch. Isolation of the fuses from the circuit shall be provided by either connecting a switch between the source and the fuses or providing roll-out switch and fuse-type construction. The switch shall be of the load-interrupter type, unless mechanically or electrically interlocked with a load-interrupting device arranged to reduce the load to the interrupting capability of the switch.

Substantiation: It appears that the word "power" was inadvertently left out when this was included in the NEC. See also Article 100 definitions.

Fuseholders shall be designed or installed so that they are de-energized while a fuse is being replaced. A permanent and legible sign shall be installed immediately adjacent to the fuseholders worded:

DISCONNECT CIRCUIT BEFORE REPLACING FUSES.

Substantiation: This provision, editorially improved, is currently in the NEC as 225.70(A)(3). This is one of six companion proposals to another that deletes 225.70 because none of its contents are within the scope of Article 225. This proposal wording is prescriptive and less ambiguous than that in the current NEC.
9-158     Log #276  NEC-P09
(490.21(B)(6) Exception)

Submitter: Stanley J. Folz, Morse Electric Company
Recommendation: Revise text to read as follows:
Exception: Fuses and fuseholders designed to permit fuse replacement by qualified persons using identified equipment designed for the purpose without de-energizing the fuseholder shall be permitted.
Substantiation: The TCC Usability Task Group is comprised of Stanley Folz, James Dollard, Bill Fiske and David Hittinger. This task group was assigned by the TCC Chair to review the use of the phrase “designed for the purpose” throughout the NEC. There are twelve instances of its use.
By definition, identified equipment is suitable for its intended purpose (see definition of Identified in Article 100). Many things not defined for a specific purpose are nonetheless suitable for that purpose, and are thus “identified.” Substituting “identified” for the word(s) to be replaced conforms to 3.2.4 of the NEC Style Manual, that says, "recognized or defined terms are to be used in preference to similar terms that do not have such recognition."
This is not original material; its reference/source is as follows:
This proposal was developed by the TCC Usability Task Group.

9-159     Log #2912  NEC-P09
(490.21(E) (New) )

Submitter: Michael A. Anthony, University of Michigan / Rep. APPA.ORG - Leadership in Education
Recommendation: Add text:
(NEW) 490.21(E)  Low Resistance Grounding. In multi-building, campus-style power distribution systems operating above 600V, low resistance grounding regimes shall be permitted.
Substantiation: Low Resistance Grounding (LRG) regimes have significant benefits:
1. Limits phase-to-ground currents to 200-400A.
2. Reduces arcing current and, to some extent, limits arc-flash hazards associated with phase-to-ground arcing current conditions.
3. May limit the mechanical damage and thermal damage to shorted transformer and rotating machinery windings.
4. Do not prevent operation of overcurrent devices.
5. Do not require ground fault detection systems.
These advantages require conductor insulation and surge arrestors to be rated based on the line-to-line voltage and, phase-to-neutral loads (if any) would have to be supplied through an isolation transformer.
Users of the NEC are accustomed to solidly grounded systems. This proposal is intended to open up a discussion on the safety and economic features non-solid grounding regimes offer to large non-utility medium voltage distribution systems such as those on many college and university campuses.
Add new first level subdivision 490.21(F) as follows:

490.21(F) Reclosers. Automatic closing of circuit breakers or other devices after opening due to a fault condition shall not be permitted.

This proposal is the work of the "High Voltage Task Group" appointed by the Technical Correlating Committee. The task group consisted of the following members: Alan Peterson, Paul Barnhart, Lanny Floyd, Alan Manche, Donny Cook, Vince Saporita, Roger McDaniel, Stan Folz, Eddie Guidry, Tom Adams, Jim Rogers and Jim Dollard.

While reclosing of devices in a utility distribution system is common, utilization of reclosing devices in premises wiring may create serious safety concerns. The OSHA General Industry Standard does not permit the manual reclosing of overcurrent protective devices due to potential safety concerns unless the cause of the automatic opening is determined. Permitting automatic reclosing would create an even greater concern. The OSHA requirement 1910.334(b)(2) is provided below:

1910.334(b)(2) Reclosing circuits after protective device operation. After a circuit is deenergized by a circuit protective device, the circuit may 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 is prohibited.

Note: When it can be 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, no examination of the circuit or connected equipment is needed before the circuit is reenergized.

NOTE: This Proposal appeared as Comment 9-89 (Log #145) on Proposal 9-196 in the 2010 Annual Meeting National Electrical Code Committee Report on Proposals. This comment was held for further study during the processing of the 2011 NATIONAL ELECTRICAL CODE. The Recommendation in Proposal 9-196 was: Revise first sentence: Means shall be provided to completely isolate an item of equipment from supply conductors, including grounded conductors.

Submitter: Technical Correlating Committee on National Electrical Code®,

Recommendation: The Technical Correlating Committee directs that the panel clarify the panel action on this proposal by providing specific text on “designed for the purpose” in the last sentence of this section.

This action will be considered by the panel as a public comment.

Substantiation: This is a direction from the National Electrical Code Technical Correlating Committee in accordance with 3.4.2 and 3.4.3 of the Regulations Governing Committee Projects.
An identified fuseholder and fuse, designed for the purpose, shall be permitted as an isolating switch.

The TCC Usability Task Group is comprised of Stanley Folz, James Dollard, Bill Fiske and David Hittinger. This task group was assigned by the TCC Chair to review the use of the phrase “designed for the purpose” throughout the NEC. There are twelve instances of its use.

By definition, identified equipment is suitable for its intended purpose (see definition of Identified in Article 100). Many things not defined for a specific purpose are nonetheless suitable for that purpose, and are thus "identified." Substituting "identified" for the word(s) to be replaced conforms to 3.2.4 of the NEC Style Manual, that says, "recognized or defined terms are to be used in preference to similar terms that do not have such recognition."

This is not original material; its reference/source is as follows:
This proposal was developed by the TCC Usability Task Group.

Means shall be provided to completely isolate an item of equipment from all ungrounded conductors. The use of isolating switches shall not be required where there are other ways of de-energizing the equipment for inspection and repairs, such as draw-out-type metal-enclosed power switchgear units and removable truck panels. Isolating switches not interlocked with an approved circuit-interrupting device shall be provided with a sign warning against opening them under load.

A fuseholder and fuse, designed for the purpose, shall be permitted as an isolating switch.

It appears that the word "power" was inadvertently left out when this was included in the NEC. See also Article 100 definitions.

Isolating switches not interlocked with an approved circuit-interrupting device shall be provided with a sign warning against opening them under load. The warning sign(s) or label(s) shall comply with 110.21(B).

This proposal is one of several coordinated companion proposals to provide consistency of danger, caution, and warning sign or markings as required in the NEC. The proposed revision will correlate this warning marking requirement with proposed 110.21(B) and the requirements in ANSI Z 535.4.
9-165     Log #3093 NEC-P09  (490.25 (New) )  Final Action:

**Submitter:** Frederic P. Hartwell, Hartwell Electrical Services, Inc.

**Recommendation:** Insert a new section as follows:

490.25. Backfeed. Installations where the possibility of backfeed exists shall comply with (a) and (b).

(a) A permanent sign shall be installed on the switch enclosure or immediately adjacent to open switches with the following words or equivalent: “WARNING — CONTACTS ON EITHER SIDE OF THIS DEVICE MAY BE ENERGIZED BY BACKFEED.”

(b) A permanent and legible single-line diagram of the local switching arrangement, clearly identifying each point of connection to the high-voltage section, shall be provided where it is within view and not more than 1.8 m (6 ft) of each point of connection.

**Substantiation:** This provision, editorially improved, is currently in the NEC as 225.70(A)(4). This is one of six companion proposals to another that deletes 225.70 because none of its contents are within the scope of Article 225. The NEC is an installation code, not a work practice, and its provisions should stipulate installation requirements rather than a work sequence. The format in this proposal [e.g. “shall comply with (a) and (b)”] is more consistent with NEC practice for that reason. The warning in (a) is prescriptive, definitive, and familiar, being based on 404.6(C) Exception. The positioning rule in (b) is also less ambiguous, and avoids a misuse of the defined terminology “within sight” because a warning label 50 ft away is unlikely to accomplish its intended purpose. The terminology “station switching arrangement” was changed to “local switching arrangement” because the provision should be applied to other equipment that may not qualify as a substation.

9-166     Log #421 NEC-P09  (490.30)  Final Action:

**Submitter:** Joel A. Rencsok, Scottsdale, AZ

**Recommendation:** Revise text to read as follows:

490.30 General. This part covers assemblies of metal-enclosed power switchgear and industrial control assemblies, including but not limited to switches, interrupting devices and their control, metering, protection and regulating equipment, where an integral part of the assembly, with associated interconnections and supporting structures. This part also includes metal-enclosed power switchgear assemblies that form a part of unit substations, power centers, or similar equipment.

**Substantiation:** It appears that the word “assemblies” was inadvertently left out when this was included in the NEC.

9-167     Log #1555 NEC-P09  (490.30)  Final Action:

**Submitter:** David Clements, International Association of Electrical Inspectors

**Recommendation:** Revise text to read as follows:

490.30 General. This part covers assemblies of metal-enclosed power switchgear and industrial control assemblies, including but not limited to switches, interrupting devices and their control, metering, protection and regulating equipment, where an integral part of the assembly, with associated interconnections and supporting structures. This part also includes metal-enclosed power switchgear assemblies that form a part of unit substations, power centers, or similar equipment.

**Substantiation:** It appears the word “assemblies” was inadvertently left out of this section. The addition of the word “assemblies” adds clarity to the section and correlates with the title of Part III.
Kathy Richards, Northern Michigan University

**Recommendation:** Add new design-permissive language as shown below:

`490.30+ Transformer Capacity. For the purpose of limiting flash hazard associated with equipment covered in this article, the feeder and service load calculations required by Parts III and IV of Article 220 that determine the size of transformer shall be permitted to be modified if they are based upon historical demand information and performed by registered professional engineers or individuals under their supervision.`

**Substantiation:** Northern Michigan University supports the effort by the APPA.ORG Code Advocacy Task Force (CATF) to bring the 2014 NEC in step with rapidly evolving energy codes and to reduce flash hazard by reducing the size of building services. We urge the NEC Technical Correlating Committee to assign a Task Force to discover ways of accomplishing this goal. We urge the NFPA Fire Protection Research Foundation to develop a research project to support the Task Force. In both cases, we would be happy to turn over our electrical demand information for further study.

Northern Michigan University is observing the same electrical demand as all of its peer institutions who also conform to the NEC. Across a broad variety of occupancy classes, we find that average loads on medium substations are about 21 percent of transformer ambient kVA ratings with average watts per square foot of 1.53. The oversizing of transformers that result from the design-prescriptive requirements of Article 220 causes us to bring in far more energy into a building than is necessary. An explicit exception to the Article 220 requirements in Article 490 will help us reduce flash hazard as well as contribute significantly NMU sustainability objectives.

Since the committee that covers Article 220 feeder and service calculations has historically rejected proposals that would have the practical effect of reducing the overcapacity of service transformers and related switchgear, we would like the Article 490 committee to permit open-ended engineering methods to "right-size" medium voltage services in the interest of reconciling the competing objectives of fire safety, flash hazard reduction, and energy conservation. We believe that trusting trained and licensed professional engineers with open-ended approaches in Article 490 will be quicker to the goal.

**Note:** Supporting material is available for review at NFPA Headquarters.

**This is not original material; its reference/source is as follows:**

APPA.ORG - Leadership in Education Code Advocacy Task Force (Issue 11-6 Proposal 47)
Add new section:

As an alternative to the feeder and service load calculations required in Article 220, rating and capacity for equipment covered in this Article shall be permitted to be determined from historical demand data by a registered professional engineer or a qualified person under their supervision.

Substantiation: [Note to NFPA Staff: A PDF with 2 pages of a flash study is part of this proposal]

A straight line exists between the rating and capacity of medium voltage equipment and electrical safety. When Article 220 load calculations result in over 50% un-used transformation capacity that over-capacity presents a permanent electrical hazard. Transformer changeout has long been recognized as a method for reducing flash hazard. (See reference to an IEEE Industrial Applications Society paper below). The attachments show the effect on electrical safety when a 1000 kVA transformer is replaced with a 500 kVA transformer.

We believe significant improvements can be made in building power systems worldwide if registered professional engineers are part of early planning stages of projects and are unbound from the Article 220 methods. In the right context, each of the following features may not be affordable stand-alone but as part of a comprehensive electrical service upgrade, all of them could be afforded together:

1. Transformer changeout. Large, old lossy transformers can be replaced with transformers half their size. Except in rare cases, the cost of the logistic barriers to this may be greater than the recovery of waste heat cost, however. Reduction in flash energy may not be enough of a driver either.

2. Medium voltage service removal. Because so many general commercial buildings only need 3-4 watts per square foot, medium voltage transformers can simply be removed and replaced with low voltage services at 400-800A if medium voltage sources are consolidated and reconfigured for 480V feeder run-outs -- particularly in a multi-building campus environment. An 800A, 480V service gets you 5 watts of power to every square foot in a 100,000 square foot building.

3. Enterprise space recovery. The footprint of a radially fed 1000 kVA medium voltage substation delivering 500 kW is about 18'L x 6'D x 8'H and requires medium voltage clearances around it. The footprint of an 800A service switchboard delivering the same 500 kW is about 8'L x 2'D x 7'H that can be placed against an outer foundation wall.

4. Smart metering and real-time measurement of incident energy. An broad effort to upgrade service equipment could be topped off with the installation of metering technology for interactive sources, energy management, and real-time measure of incident energy present at the service.

All these benefits accrue to the organization that permits its electrical engineers to use industry-specific electrical consumption data with his or her judgment. That might mean not bringing in medium voltage into the building to begin with but concentrating larger medium voltage sources farther apart in more supervised, industrial locations where the flash risk can be managed with specialty equipment that permits live work to be performed more safely.

At the moment, because AHJ’s, insurance companies, and professional engineers are skittish about taking exemptions to the NEC and our industry is losing about $1 billion a year in waste heat, loss of enterprise space, and material excess as a result of over-sized switchgear and service transformers.

A reference for the convenience of the committee:

70E-150 Log #270 EEW-AAA Final Action: Reject
(110.10 (New) )

Submitter: Michael A. Anthony, University of Michigan / Rep. APPA.ORG - Association of Education Facility Executives

Recommendation: New text to read as follows:

110.10 (NEW) Reduction of Incident Energy. It shall be permitted to reduce incident energy by modifying an existing power delivery system with a combination of product application and system design methods that can include, but not be limited, by the following:

a) reduction of transformer kVA
b) addition of impedance elements
c) change out of protective devices

Substantiation: This proposal conforms to the explicit purpose and scope of NFPA 70E as written in Sections 90.1 and 90.2 and is an extension of installation safety concepts that appear in NFPA 70, the National Electrical Code. Substantiation for each of the recommended methods is as follows:

a. Reduction of transformer kVA. Over several NEC update cycles, knowledgeable industries such as the chemical and educational facilities industry, have observed that the branch circuit, feeder and service sizing rules of NEC Chapter 2 result in significant oversizing of service transformers. Although these proposals have been rejected for lack of technical substantiation that was satisfactory to the committees, our industry stands behind its “anecdotal” evidence that a significant number of service transformers, under a variety of ownership arrangements, are significantly oversized. Under engineering supervision these service transformers could be changed out -- not only for energy conservation reasons, but to reduce hazard risk category at the point where the system requires live work. It is understood that transformer changeout, where possible and economically feasible, may present a set of new problems that would have to be evaluated against the benefits of incident energy reduction (e.g. -- motor starting, arc flash increases because the protective device takes excessive time to operate, etc).

b. Addition of impedance elements. The addition of impedance elements (resistors to accomplish low resistance grounding (at medium voltage) and high resistance grounding (at low voltage) will increase electrician safety by reducing ground fault current.

c. Changeout of protective devices. Depending upon the fault current minimum and maximums -- owing to the dynamic nature of fault impedances, the reduction of clearing times and reduction of hazard risk category could be accomplished with carefully selected fuses and/or breakers. All of the foregoing cost money and it is highly likely that this approach would not be cost effective in most cases. But NFPA technical committees attempt to be agnostic about cost in service of safety. This proposal is crafted in non-mandatory language intended to alert the management of employee workplaces that in a limited number of situations, a reduction in energy loss and an increase in electrician safety may be simultaneously accomplished. Inclusion of this proposal into the 2012 version of NFPA 70E may provide a brighter path for designing safer systems than the National Electrical Code.

Portions of this proposal were derived from an October 2009 IEEE Industry Applications Society paper authored by David D. Shipp & David M. Wood, “Innovative Techniques for Mitigating Arc Flash Exposure” – as presented at the IEEE IAS conference in Houston, 110/09 (IEEE #IAS16P3)

Committee Meeting Action: Reject

Committee Statement: The concept introduced by the recommendation is not prohibited by the standard. The recommendation may be more suitable for inclusion in Annex O.

Number Eligible to Vote: 25
Ballot Results: Affirmative: 23 Abstain: 1

Ballot Not Returned: 1 Selk, A.
Explanation of Abstention:
WALLIS, D.: I am abstaining in accordance with Agency policy against
voting on technical issues.

Comment on Affirmative:
HICKMAN, P.: We agree that the concepts in this recommendation are not prohibited. However, we support safe design and are not convinced that recommendations such as these must be placed in an Annex.

This proposal was prepared with the assistance of Glenn Keates of Dymax Engineering, Ann Arbor, Michigan, a full-service electrical engineering firm that provides service to world markets.

Note: Supporting material is available for review at NFPA Headquarters.

This is not original material; its reference/source is as follows:
Glenn Keates, P.E. Dymax Engineering

Submitter: Joel A. Rencsok, Scottsdale, AZ
Recommendation: Revise text to read as follows:

9-170 Log #411 NEC-P09
(490.34) Final Action:

490.34 Clearance for Cable Conductors Entering Enclosure. The unobstructed space opposite terminals or opposite raceways or cables entering a metal-enclosed power switchgear or industrial control assembly shall be adequate for the type of conductor and method of termination.

Substantiation: It appears that the word "switchgear" was not included in the NEC Article 100 definitions, but switchboard was, as was Metal-Enclosed Power Switchgear. Part III applies to industrial control assemblies and not all control assemblies.

Submitter: Frederic P. Hartwell, Hartwell Electrical Services, Inc.
Recommendation: Revise as follows:

9-171 Log #3094 NEC-P09
(490.35(A)) Final Action:

(A) High-Voltage Equipment. Doors that would provide unqualified persons access to high-voltage energized parts shall be locked. Permanent, legible signs shall be installed on panels or doors that give access to live parts over 600 volts carrying the wording “DANGER — HIGH VOLTAGE — KEEP OUT.”

Substantiation: This provision, editorially improved, is currently in the NEC as 225.70(A)(5)(b). This is one of six companion proposals to another that deletes 225.70 because none of its contents are within the scope of Article 225. The addition of the words “KEEP OUT” to the warning sign is because it has been established over the course of extensive litigation that warning signs must include a command so the viewer knows what he or she is supposed to do or not do. This is the reason that all such warnings throughout the NEC were converted in the 1990s to add a command in the wording. See, for example, 110.34(C).

Submitter: Joel A. Rencsok, Scottsdale, AZ
Recommendation: Revise text to read as follows:

9-172 Log #410 NEC-P09
(490.36) Final Action:

490.36 Grounding. Frames of metal-enclosed power switchgear and industrial control assemblies shall be connected to an equipment grounding conductor or, where permitted, the grounded conductor.

Substantiation: It appears that the word "switchgear" was not included in the NEC Article 100 definitions, but switchboard was, as was Metal-Enclosed Power Switchgear. Part III applies to industrial control assemblies and not all control assemblies.
9-173 Log #409 NEC-P09 (490.37)

Final Action:

Submitter: Joel A. Rencsok, Scottsdale, AZ
Recommendation: Revise text to read as follows:

490.37 Grounding of Devices. The metal cases or frames, or both, such as instruments, relays, meters, and instrument and control transformers, located in or on metal-enclosed power switchgear or industrial control assemblies, shall be connected to an equipment grounding conductor or, where permitted, the grounded conductor.

Substantiation: It appears that the word "switchgear" was not included in the NEC Article 100 definitions, but switchboard was, as was Metal-Enclosed Power Switchgear. Part III applies to industrial control assemblies and not all control assemblies.

9-174 Log #55 NEC-P09 (490.44(C))

Final Action:

NOTE: This Proposal appeared as Comment 9-91 (Log #2618) on Proposal 9-201 in the 2010 Annual Meeting National Electrical Code Committee Report on Proposals. This comment was held for further study during the processing of the 2011 NATIONAL ELECTRICAL CODE. The Recommendation in Proposal 9-201 was: Revise text to read as follows:

(C) Switching Mechanism. The switching mechanism shall be arranged to be operated from a location outside the enclosure where the operator is not exposed to energized parts and shall be arranged to open all ungrounded conductors of the circuit simultaneously with one operation. Switches shall be a lockable disconnecting means capable of being locked in the open position. The provisions for locking shall remain in place with or without the lock installed.

Submitter: Frederic P. Hartwell, Hartwell Electrical Services, Inc.
Recommendation: Continue to accept the proposal, contingent on the companion comment to this being accepted by CMP 1.

Substantiation: The concept of a central location for the characteristics of a locking disconnect is sound, although the original proposal to place the wording in Article 100 failed because rules were included in a definition. The companion comment will place the following requirement in Article 110:

“Disconnecting Means, Lockable. Where a disconnecting means with provisions for being locked in the open position is required by a provision in the NEC, unless otherwise modified by that provision, the disconnecting function shall be accomplished by either a keyed or combination lockout device in which the provision for applying the lockout device remains in place on the disconnecting means and the disconnecting means remains operable until the lockout device is applied.”
Submitter: Stanley J. Folz, Morse Electric Company
Recommendation: Revise text to read as follows:

(C) **Switching Mechanism.** The switching mechanism shall be arranged to be operated from a location outside the enclosure where the operator is not exposed to energized parts and shall be arranged to open all ungrounded conductors of the circuit simultaneously with one operation. Switches shall be **lockable in accordance with 110.25** capable of being locked in the open position. The provisions for locking shall remain in place with or without the lock installed.

Substantiation: This proposal has been developed by the Usability Task Group assigned by the Technical Correlating Committee. The committee members were Stanley Folz, James Dollard, William Fiske, David Hittinger, Andy Juhasz, Amos Lowrance, Susan Newman-Scearce, Marc Bernsen and Vincent Zinnante. Requirements for a disconnecting means to be lockable in the open position exist in numerous locations in the NEC. A new section has been proposed in Article 110 to consolidate the requirements for a disconnecting means required to be "capable of being locked in the open position" in a single section for clarity. It is understood that this requirement includes more than disconnecting and locking electrical power sources.

This proposal is intended to facilitate a lockout/tagout scenario. It is equally important to ensure that the means for placing the lock remain in place. The concept suggested by this proposal is necessary to provide correlation throughout the NEC with respect to the capability of placing a lock on a disconnecting means to secure it in the open position.

This proposal was the result of work by TCC Usability Task Group.

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9-175 Log #298 NEC-P09 (490.44(C)) Final Action:

Submitter: Stanley J. Folz, Morse Electric Company
Recommendation: Revise text to read as follows:

490.46 **Circuit Breaker Locking.** Circuit breakers shall be capable of being locked in the open position or, if they are installed in a drawout mechanism, that mechanism shall be capable of being locked in such a position that the mechanism cannot be moved into the connected position. In either case, the provision shall be lockable in accordance with 110.25, for locking shall remain in place with or without the lock installed.

Substantiation: This proposal has been developed by the Usability Task Group assigned by the Technical Correlating Committee. The committee members were Stanley Folz, James Dollard, William Fiske, David Hittinger, Andy Juhasz, Amos Lowrance, Susan Newman-Scearce, Marc Bernsen and Vincent Zinnante. Requirements for a disconnecting means to be lockable in the open position exist in numerous locations in the NEC. A new section has been proposed in Article 110 to consolidate the requirements for a disconnecting means required to be "capable of being locked in the open position" in a single section for clarity. It is understood that this requirement includes more than disconnecting and locking electrical power sources.

This proposal is intended to facilitate a lockout/tagout scenario. It is equally important to ensure that the means for placing the lock remain in place. The concept suggested by this proposal is necessary to provide correlation throughout the NEC with respect to the capability of placing a lock on a disconnecting means to secure it in the open position.

This proposal was the result of work by TCC Usability Task Group.
Metal-enclosed and metal-clad power switchgear installed as high-voltage service equipment shall include a ground bus for the connection of service cable shields and to facilitate the attachment of safety grounds for personnel protection. This bus shall be extended into the compartment where the service conductors are terminated.

It appears that the word "Metal Clad" was not included in the NEC Article 100 definitions, but switchboard was, as was Metal-Enclosed Power Switchgear. The Title needs to change to reflect this change also. The intent of the section does not change.

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Metal-enclosed and metal-clad switchgear installed as high-voltage service equipment shall include a ground bus for the connection of service cable shields and to facilitate the attachment of safety grounds for personnel protection. This bus shall be extended into the compartment where the service conductors are terminated. Where the compartment door or panel gives access to parts that can only be de-energized and visibly isolated by the serving utility, the warning sign required by 490.35(A) shall include notice that access is limited to the serving utility or following an authorization of the serving utility.

This provision, editorially improved, is currently in the NEC as 225.70(A)(5)(c). This is one of six companion proposals to another that deletes 225.70 because none of its contents are within the scope of Article 225. The application has been broadened from the word "panel" to "door or panel" because the hazard applies equally to a panel or to a door, and the language should apply to both. It is proposed to be located here because it addresses utility access, which necessarily is limited to service conductors and related equipment. This is the only section that uniquely covers service gear.

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A permanent, legible, single-line diagram of the switchgear shall be provided in a readily visible location within sight of the switchgear and this diagram shall clearly identify interlocks, isolation means, and all possible sources of voltage to the installation under normal or emergency conditions, including all equipment contained in each cubicle, and the marking on the switchgear shall cross-reference the diagram.

Exception: Where the equipment consists solely of a single cubicle or metal-enclosed unit substation containing only one set of high-voltage switching devices, diagrams are not required.

This provision, editorially improved, is currently in the NEC as 225.70(A)(5)(a). This is one of six companion proposals to another that deletes 225.70 because none of its contents are within the scope of Article 225.
Add a new sentence as follows:

All energized switching and control parts shall be enclosed in grounded metal cabinets or enclosures. These cabinets or enclosures shall be marked “DANGER — HIGH VOLTAGE — KEEP OUT” and shall be locked so that only authorized and qualified persons can enter. The danger marking(s) or labels shall comply with 110.21(B). Circuit breakers and protective equipment shall have the operating means projecting through the metal cabinet or enclosure so these units can be reset without opening locked doors. With doors closed, reasonable safe access for normal operation of these units shall be provided.

Substantiation: This proposal is one of several coordinated companion proposals to provide consistency of danger, caution, and warning sign or markings as required in the NEC. The proposed revision will correlate this danger marking requirement with proposed 110.21(B) and the requirements in ANSI Z 535.4.

Add a new last sentence as follows:

"...The enclosure shall have provision for locking so that only authorized and qualified persons may open it and shall be marked as follows: DANGER — HIGH VOLTAGE — KEEP OUT. The danger marking(s) or labels shall comply with 110.21(B).

Substantiation: This proposal is one of several coordinated companion proposals to provide consistency of danger, caution, and warning sign or markings as required in the NEC. The proposed revision will correlate this danger marking requirement with proposed 110.21(B) and the requirements in ANSI Z 535.4.