AGENDA

NEC Code-Making Panel 10

Report on Proposal Meeting

January 12-14, 2012

Hilton Head, SC

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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.

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

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.

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Delete the following text:

Controlled Vented Power Fuse. A fuse with provision for controlling discharge circuit interruption such that no solid material may be exhausted into the surrounding atmosphere.

Informational Note: The fuse is designed so that discharged gases will not ignite or damage insulation in the path of the discharge or propagate a flashover to or between grounded members or conduction members in the path of the discharge where the distance between the vent and such insulation or conduction members conforms to manufacturer's recommendations.

Substantiation: Remove archaic language.

NEC style manual: 3.3.4 Word Clarity. Words and terms used in the NEC shall be specific and clear in meaning, and shall avoid jargon, trade terminology, industry-specific terms, or colloquial language that is difficult to understand. NEC language shall be brief, clear, and emphatic. The following are examples of old-fashioned expressions and word uses that shall not be permitted: "...and such...".
10-4 Log #2264 NEC-P10 (100.Coordination (New))

Submitter: Patrick Murphy, City of Richmond

Recommendation: Add to definition of Coordination: Coordination shall mean no overlap of overcurrent device curves at any point above the X axis.

Substantiation: Engineers often design protection systems where there is overlap among the device curves so that one, two, three or four devices may trip. This clarification will make it clear that curves must not overlap so there is little chance the wrong overcurrent device will trip.

Final Action:

10-5 Log #2721 NEC-P10 (100.Coordination (Selective))

Submitter: Bob Herzig, Bob Herzig and Associates, Inc. dBa Herzig Engineering

Recommendation: Revise text to read as follows:

Coordination (Selective). Localization of an overcurrent condition to restrict outages to the circuit or equipment affected, accomplished by the choice installation of overcurrent protective devices and their ratings or settings for the full range of available overcurrents, from overload to the maximum available fault current, and for the full range of overcurrent protective device opening times associated with those overcurrents.

Substantiation: The word "choice" is replaced by the word "installation" because it is not a "choice" that provides for a selectively coordinated system, but rather an "installation". Choosing the right settings is only part of the job. It is installing the devices with the correct settings and sizes that counts. The last phrases about the full range of overcurrents and full range of opening times is added to clarify the definition. There has been some confusion, initiated by those that are opposed to selective coordination, about what levels of overcurrents are covered by the definition of coordination (selective). As a professional consulting engineer, I was taught, and have never had a doubt, that selective coordination was for the full range of overcurrents that the overcurrent protective devices could "see" and for whatever opening times it takes for the overcurrent protective devices to open at those overcurrent levels.

The NEC® needs to remain the lead dog for this electrical system safety issue, and while the existing definition has served us well for many years, it is now necessary to clarify the definition, or other standards will do it for us. This revision is necessary to clarify the definition. not change the meaning. The proposed changes add the specific clarity that is needed.

Final Action:

10-6 Log #1319 NEC-P10 (100.Current-Limiting Overcurrent Protective Device (New) and 240.2)

Submitter: James F. Williams, Fairmont, WV

Recommendation: Revise text to read as follows:

Current-Limiting Overcurrent Protective Device. A device that, when interrupting currents in its current-limiting range, reduces the current flowing in the faulted circuit to a magnitude substantially less than that obtainable in the same circuit if the device were replaced with a solid conductor having comparable impedance.

240.2

Current-Limiting Overcurrent Protective Device. A device that, when interrupting currents in its current-limiting range, reduces the current flowing in the faulted circuit to a magnitude substantially less than that obtainable in the same circuit if the device were replaced with a solid conductor having comparable impedance.


NEC Style Manual: 2.2.2.1 Article 100. In general, Article 100 shall contain definitions of terms that appear in two or more other articles of the NEC.
10-7 Log #1184 NEC-P10

(100. Electronically Actuated Fuse)

Final Action:

Submitter: Marcelo M. Hirschler, GBH International

Recommendation: Revise text to read as follows:

**Electronically Actuated Fuse.** An overcurrent protective device that generally consists of a control module that provides current sensing, electronically derived time–current characteristics, energy to initiate tripping, and an interrupting module that interrupts current when an overcurrent occurs. Electronically actuated fuses may or may not operate in a current-limiting fashion, depending on the type of control selected.

*Informational Note:* Electronically actuated fuses may or may not operate in a current-limiting fashion, depending on the type of control selected.

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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10-8 Log #1192 NEC-P10

(100. Overcurrent)

Final Action:

Submitter: Marcelo M. Hirschler, GBH International

Recommendation: Revise text to read as follows:

**Overcurrent.** Any current in excess of the rated current of equipment or the ampacity of a conductor. It may result from overload, short circuit, or ground fault.

*Informational Note 1:* It may result from overload, short circuit, or ground fault.

*Informational Note 2:* A current in excess of rating may be accommodated by certain equipment and conductors for a given set of conditions. Therefore, the rules for overcurrent protection are specific for particular situations.

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.
10-9  Log #16  NEC-P10
(100.Overcurrent Protective Device, Branch-Circuit)

Final Action:

NOTE: This Proposal appeared as Comment 10-1 (Log #1324) on Proposal 10-2a 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 10-2a was: Revise
text to read as follows:

Branch-Circuit Overcurrent Protective Device, Branch-Circuit. A device capable of providing protection for service,
feeder, and branch circuits and equipment over the full range of overcurrents between its rated current and its
interrupting rating. Branch-circuit overcurrent protective devices are provided with interrupting ratings appropriate
for the intended use but no less than 5,000 amperes.

Submitter: Glossary of Terms Technical Advisory Committee,
Recommendation: Revise text to read as follows:

Overcurrent Protective Device, Branch-Circuit. A device capable of providing protection for service, feeder, and
branch circuits and equipment over the full range of overcurrents between its rated current and its interrupting rating.
Branch-circuit overcurrent protective devices are provided with interrupting ratings appropriate for the intended use but
no less than 5,000 amperes.

Informational Note: Branch-circuit overcurrent protective devices are provided with interrupting ratings appropriate for
the intended use but no less than 5,000 amperes.

Substantiation: The NFPA Technical Advisory Committee on Glossary of Terminology (GOT) was formed by
Standards Council to ensure consistency in definitions within the NFPA system.
The Manual of Style requires that definitions be in single sentences and that they not contain requirements. The
second sentence of this definition is further clarification or discussion but should not be part of the definition. Moreover it
contains a requirement which should not be included in the definition.

CMP 10 might consider revising the definition to make it into a single sentence while eliminating requirements.
It is understood by the commenter that the Technical Correlating Committee changed the designation of “FPN” to
“Informational Note”.

10-10  Log #1190  NEC-P10
(100.Overcurrent Protective Device, Branch-Circuit)

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

Overcurrent Protective Device, Branch-Circuit. A device capable of providing protection for service, feeder, and
branch circuits and equipment over the full range of overcurrents between its rated current and its interrupting rating.
Branch-circuit overcurrent protective devices are provided with interrupting ratings appropriate for the intended use but
no less than 5000 amperes.

Informational Note: Branch-circuit overcurrent protective devices are provided with interrupting ratings appropriate for
the intended use but no less than 5000 amperes.

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.
Glossary of Terms

Technical Advisory Committee, Revise text to read as follows:

**A device intended to provide limited overcurrent protection for specific applications and utilization equipment such as luminaires and appliances.** This limited protection is in addition to the protection provided in the required branch circuit by the branch circuit overcurrent protective device.

**Informational Note:** This limited protection is in addition to the protection provided in the required branch circuit by the branch circuit overcurrent protective device.

**Submittal:** The NFPA Technical Advisory Committee on Glossary of Terminology (GOT) was formed by Standards Council to ensure consistency in definitions within the NFPA system.

The Manual of Style requires that definitions be in single sentences and that they not contain requirements. The second sentence of this definition is further clarification or discussion but should not be part of the definition. Moreover it contains a requirement which should not be included in the definition.

CMP 10 might consider revising the definition to make it into a single sentence while eliminating requirements. An example follows:

**A device intended to provide limited overcurrent protection, beyond that provided by the branch circuit overcurrent protection device, for specific applications and utilization equipment such as luminaires and appliances.**

It is understood by the commenter that the Technical Correlating Committee changed the designation of “FPN” to “Informational Note.”
### 10-13 Log #1321 NEC-P10

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

100 1

**Restricted access.** Located behind one of the following:

1. Removable and sealable covers over the adjusting means
2. Bolted equipment enclosure doors
3. Locked doors accessible only to qualified personnel

**240.6(C) Restricted Access Adjustable-Trip Circuit Breakers.**

A circuit breaker(s) that has restricted access to the adjusting means shall be permitted to have an ampere rating(s) that is equal to the adjusted current setting (long-time pickup setting). *Restricted access shall be defined as located behind one of the following:*

1. Removable and sealable covers over the adjusting means
2. Bolted equipment enclosure doors
3. Locked doors accessible only to qualified personnel

**Substantiation:** The defined term is referenced in several articles of the NEC: 240.6, 504.30(A)(2)(4), & 708.5(B).

**NEC Style Manual:** 2.2.2.1 Article 100. In general, Article 100 shall contain definitions of terms that appear in two or more articles of the *NEC.*

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### 10-14 Log #2297 NEC-P10

**Recommendation:** Article 100 should have the definition of a "Tap Conductor."

**Substantiation:** The definition of Tap Conductor is in the grounding and bonding section but difficult to find and is not a term known very well.

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### 10-15 Log #1320 NEC-P10

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

100 1

**Tap Conductors.** A tap conductor is defined as a conductor, other than a service conductor, that has overcurrent protection ahead of its point of supply that exceeds the value permitted for non-tap conductors.

**Substantiation:** The defined term is referenced in several articles of the NEC: 210.19(A)(3), 210.19(A)(4), 210.19(A)(4)(b), 240.2 Tap Conductors, 240, 250.30(A)(6), 250.30(A)(6)(b), 250.64(D)(1), 250.122(G), 350.30(A), 356.30(2), 410.117(C), 430.28, 430.28(1), 430.28(1), 430.28(2), 430.28(3), 430.28(4), 430.28(5), 430.28(6), 430.28(7), 430.53(D)(3), 430.53(H)(4)(7), 551.43(B), 610.42(B)(1), 690.47(B) & 725.45(B).

**NEC Style Manual:** 2.2.2.1 Article 100. In general, Article 100 shall contain definitions of terms that appear in two or more other articles of the *NEC.*
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.

Relocate definition of Supervised Industrial Installation to Article 100.

The industrial portions of a facility where all of the following conditions are met:
(1) Conditions of maintenance and engineering supervision ensure that only qualified persons monitor and service the system.
(2) The premises wiring system has 2500 kVA or greater of load used in industrial process(es), manufacturing activities, or both, as calculated in accordance with Article 220.
(3) The premises has at least one service or feeder that is more than 150 volts to ground and more than 300 volts phase-to-phase.

This definition excludes installations in buildings used by the industrial facility for offices, warehouses, garages, machine shops, and recreational facilities that are not an integral part of the industrial plant, substation, or control center.

In several locations throughout the NEC the terms industrial installation, industrial occupancy, industrial premises or industrial establishment are used. These terms are typically accompanied by the qualifier that only qualified persons will monitor and service the installation. In most instances, the term is used in the form of an exception to relax the more stringent requirements of the NEC, examples of which may be found in the following sections: 110.24(B) Exc., 110.70 Exc., 210.3 Exc., 210.9 Exc. 2. However, there is no clear language to help the user determine what qualifies as an industrial installation.

By relocating this definition to Article 100 from it’s current location in 240.2, the definition will then be able to be applied throughout the NEC for the application of other sections. It will then be possible to correlate this definition for references to industrial installations or occupancies that are currently found in the code (such as those referenced above) and re-categorize them as supervised industrial installations. It is not intended for this change to alter how supervised industrial installations relate to Article 240. It will potentially provide better clarity and consistency for the user of the NEC in determining whether or not a particular section of code applies to an installation. I realize that this proposal may need to be re-directed to CMP-1 for consideration, but since it is currently a definition under the jurisdiction of CMP-10 I felt it was proper to start with your panel.
Revise text to read as follows:
Add the following sentence to the end of 240.4: Where circuit conductors are increased in size for any reason, such as voltage drop or de-rating, they shall be marked or tagged with: Maximum circuit ampacity xxx amps.

When an installer uses larger conductors for a circuit because of voltage drop or de-rating factors there is no indication for follow up installers or owners of the intended circuit size. Persons could look at the conductor size and install larger overcurrent protection based on the size of the conductor and inadvertently cause the circuit to be over loaded.

Delete 240.4(C) in its entirety.

Add text to read as follows:
Motors and motor-control circuit conductors 430, Parts II, III, IV, V, VI, VII

The table intends to list specific code articles and parts that are exempt from the small conductor rule; however, Part II of Article 430 is not listed and it is the part for motor branch circuit conductors.
240.12 Electrical System Coordination. Where an orderly shutdown is required to minimize the hazard(s) to personnel and equipment, the electrical system shall be designed, installed, and maintained to be selectively coordinated. A system of coordination based on the following two conditions shall be permitted: (1) Coordinated short circuit protection (2) Overload indication based on monitoring systems or devices.

(A) Overload Indication. In supervised installations where conditions of maintenance and engineering supervision ensure that only qualified persons monitor and service the system, it shall be permitted to omit overload protection where the overload condition initiates an alarm, requiring corrective action.

(B) Selection of Overcurrent Protective Devices. Where selective coordination is required, the overcurrent protective device types, ratings or settings shall be chosen by a licensed professional engineer or other qualified person engaged primarily in the design and installation of electrical systems. The selection shall be documented and made available to those authorized to design, install, inspect, maintain, and operate the system.

Informational Note: The monitoring system may cause the condition to go to alarm, allowing corrective action or an orderly shutdown, thereby minimizing personnel hazard and equipment damage.

Substantiation: This proposed change clarifies the existing requirement that permits overload indication as part of the means to achieve an orderly shutdown.

(1) "(A) Overload Indication" is added because overload indication instead of overcurrent device operation due to an overload, is a serious trade-off. Such a trade-off must not be taken lightly. If qualified persons are not nearby to respond to an alarm, fire and equipment damage will easily occur.

(2) "(B) Selection of Overcurrent Protective Devices" is added because there has been some confusion as to who is responsible for assuring that there is an orderly shutdown when it is required to minimize the hazard(s) to personnel and equipment. This added requirement clarifies who is responsible for choosing or determining the selectively coordinated system. It also makes clear that documentation must be made available. This documentation is especially helpful to electrical inspectors who may need to rely upon the documentation to determine compliance with the Code.

(3) The Informational Note is removed because it is replaced by the changes made to "(A) Overload Indication"
Circuits supplied by current-limited sources shall be protected at the source of currents that can damage those circuits.

When there are external sources of current that can damage these circuits such as parallel-connected strings of PV modules or external batteries or other devices, the overcurrent protection should located at the source of those overcurrents.

Photovoltaic (PV) modules and PV utility-interactive inverters are current-limited, current sources of energy that cannot provide the high values of fault current that the typical ac voltage source or battery source can provide. The circuits and conductors that carry current from these PV sources are sized to have an ampacity of 125% of the rated maximum current from the source. See Section 690.8. Overcurrent devices for these circuits are required to be rated also at 125% of the rated short-circuit current from these sources.

Because of these required ratings, the circuit conductors are not subject to damage from fault currents originating from the source (the PV module). For PV systems, it is not correct to provide overcurrent protection at the PV Module source as required by the location requirements of 240.21.

This addition to the Code is necessary, because electricians and even professional engineers frequently interpret Section 240.21 literally and place overcurrent protection for these circuits at the PV module source. With a required rating of 1.56 times the rated short-circuit current, an overcurrent device located here, provides little or no overcurrent protection for the circuit.

240.13 Ground-Fault Protection of Equipment.

(A) General: Ground-fault protection of equipment shall be provided in accordance with the provisions of 230.95 for solidly grounded wye electrical systems of more than 150 volts to ground but not exceeding 600 volts phase-to-phase for each individual device used as a building or structure main disconnecting means rated 1000 amperes or more. The provisions of this section shall not apply to the disconnecting means for the following:

(1) Continuous industrial processes where a non-orderly shutdown will introduce additional or increased hazards
(2) Installations where ground-fault protection is provided by other requirements for services or feeders
(3) Fire pumps

(B) Feeder. Where two or more levels of ground-fault protection are provided for operation of the feeder disconnecting means as specified by 230.95 or 215.10, such protection shall consist of overcurrent devices and current transformers or other equivalent protective equipment that shall cause the feeder disconnecting means to open and comply with 240.13(C) and (D).

(C) Selectivity. Ground-fault protection for two or more levels of operation shall be fully selective such that the feeder device closest to the load shall open on ground faults. Separation of ground-fault protection time-current characteristics shall conform to manufacturer's recommendations and shall consider all required tolerances and disconnect operating time to achieve 100 percent selectivity.

Informational Note: See 230.95, fine print note, for transfer of alternate source where ground-fault protection is applied.

(D) Testing. When equipment ground-fault protection is first installed, each level shall be performance tested to ensure compliance with 240.13(C).

Substantiation: There are no requirements in the code for how to install two or more ground fault protection devices in series. Only Article 517 has any requirements. By adding this requirement, it will help the electrical industry installers and designers better understand installation of ground fault protection selectivity requirements for a safer installation.
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.

(A) Ground-Fault Circuit-Interrupters. Ground-fault circuit-interrupter overcurrent devices shall be provided where previous circuit breakers are shown to be GFCI type at time of replacement.

Exception: Where ground-fault protection is required elsewhere in this Code such as swimming pool pump motors and not installed due to code enforcement change only, GFCI protection is now required at time of replacement.

(B) Arc-Fault Circuit-Interrupters. Arc-fault circuit-interrupter overcurrent devices shall be provided where previous circuit breakers are shown to be AFCI type at time of placement per 210.12 and 210.18.

Exception: Where arc-fault protection is required elsewhere in this Code and not installed due to code enforcement change only, such as post 2004, AFCI protection is now required at time of replacement.

This not a requirement for GFCI or AFCI automatic protection on existing installations. It is for replacing these existing devices only where they were once required to be installed per code compliance. By the 2014 NEC cycle, the AFCI requirement will be almost 10 years old. It is apparent these devices may start to fail and require to be replaced. With the introduction of GFCI “receptacles”, the use of these types of circuit breakers are limited, however, AFCI type circuit breakers may still be the only form available for some time. Due to changes in code enforcement, there are additional areas of protection required for dwelling units between code cycles. This would be the time to include those additional areas for AFCI protection of new designs built after 2004. These changes also mirror the requirement for GFCI and AFCI protection of receptacles in 406.4(D)(3 ) and (4) where required to be so protected elsewhere in this Code. Although this proposal is not about swimming pools, as the CMP is aware Article 680 has gone through many changes over the last four code cycles. One in particular has been the 1999 NEC requirement for GFCI protection of pool pump motors, then removed in the 2002 NEC and re-instated in the 2005 NEC. This proposed code change will ensure the safety intent will remain intact and most alterations will not be affected by this change.
Informational Note No. 2  Ungrounded systems may necessitate the evaluation of overcorrect devices based upon their single-pole short-circuit interrupting rating, which may be less than their normal interrupting rating. If a second ground-fault occurs on an opposite phase before the first ground-fault is cleared, the full phase-to-phase voltage (480V, 600V, or 240V), would appear across only one pole of the affected overcurrent device. This may result in a fault current that exceeds the single-pole interrupting capability.

Most of the tap rules have limits on the sizing of the overcurrent device protecting the feeder. For example in 240.21 (B)(2)(1) the overcurrent device protecting the feeder can be no larger than three times the ampacity of the tap conductor. And in 240.21(B)(3)(1) the conductors supplying the primary of a transformer must have an ampacity of at least one-third the rating of the overcurrent device protecting the feeder conductors. But there is no limit on the size of the feeder overcurrent device for 240.21(B)(1) for factory-made taps or in 240.21(B)(5). Without a limit, the tap conductor could be very significantly undersized. For example it would be possible to tap a 14 AWG conductor to a feeder protected by a 6000 ampere feeder overcurrent protective device, per 240.21 (B)(1). If an electrical worker were trouble-shooting in the equipment when the 14 AWG shorted, the electrical worker would face a horrific explosion as the 14 AWG conductor vaporized. With this proposed wording, the 14AWG conductor would be protected from shortcircuit damage, averting the horrific explosion. See Table 240.92(B) Tap Conductor Short-Circuit Current Ratings which states “Tap conductors are considered to be protected under short-circuit conditions when their short-circuit temperature limit is not exceeded. ”

(B) Feeder Taps. Conductors shall be permitted to be tapped, without overcurrent protection at the tap, to a feeder as specified in 240.21(B)(1) through (B)(5). The provisions of 240.4(B) shall not be permitted for tap conductors. For feeders with additional supply from utility-interactive inverters, tap conductor sizing shall be based on the sum of inverter output current rating and the rating of the overcurrent device protecting the feeder conductors in accordance with 705.12(D)(2).

This proposal coordinates with a proposal to 705.12(D)(2) that requires that a feeder that contains both utility-interactive inverters and taps must account for the additional current available from the inverters to the taps. A very conservation approach to the size requirements for the taps is to add 125% of the inverter output circuit current to the rating of the overcurrent device protecting the feeder, increasing the minimum required size of the tap conductor. This is a conservative approach since the fault current characteristics of utility-interactive inverters is no more than twice the operating current of the inverter. The fault current of the overcurrent device protecting the feeder is normally about 100 times the rating of the device.
Accept this proposal in principle as follows:

240.21(B)(1)(1)(b) should be revised as follows:

"b. Not less than the rating of the switchboard, panelboard, disconnecting means, or control device supplied by the tap conductors or not less than the rating of the overcurrent protective device at the termination of the tap conductors."

The submitter is correct, the use of the word "device" in 240.21(B)(1)(1)(b) is incorrect. The word "device" is defined in Article 100 as follows:

"Device. A unit of an electrical system that carries or controls electric energy as its principal function."

During the discussion on this proposal, it was clear that the panel intends for these "tap conductors" to be provided with overload protection. As presently written, the text permits termination in a device as defined above. The intent of the panel is not met in the present text of this section. The submitter is correct the existing text is confusing and should be clarified.

The present text of 240.21(B)(1)(2) includes more prescriptive text and limits termination of these "tap conductors" to "switchboard, panelboard, disconnecting means, or control devices." The same level of clarity is necessary in 240.21(B)(1)(1)(b). The panel statement refers to the present permission of this section. The submitter seeks only to clarify what is permitted. Clarification is needed.
Phil Simmons, Simmons Electrical Services

Revise the text of the 2011 NEC ROP Draft as follows:

If the length of the tap conductors does not exceed 3 m (10 ft) and the tap conductors comply with all of the following:

1. The ampacity of the tap conductors is:
   a. Not less than the combined calculated loads on the circuits supplied by the tap conductors, and
   b. Not less than the rating of the switchboard or other distribution equipment device supplied by the tap conductors or not less than the rating of the overcurrent protective device at the termination of the tap conductors.

2. The tap conductors do not extend beyond the switchboard, panelboard, disconnecting means, or control devices they supply.

3. Except at the point of connection to the feeder, the tap conductors are enclosed in a raceway, which shall extend from the tap to the enclosure of an enclosed switchboard, panelboard, or control devices, or to the back of an open switchboard.

4. For field installations if the tap conductors leave the enclosure or vault in which the tap is made, the rating of the overcurrent device on the line side of the tap conductors shall not exceed 10 times the ampacity of the tap conductor.

FPN: For overcurrent protection requirements for panelboards, see 408.36.

Submitter: Phil Simmons, Simmons Electrical Services

Recommendation: Revise the text of the 2011 NEC ROP Draft as follows:

1. Taps Not over 3 m (10 ft) Long. If the length of the tap conductors does not exceed 3 m (10 ft) and the tap conductors comply with all of the following:

   a. Not less than the combined calculated loads on the circuits supplied by the tap conductors, and
   b. Not less than the rating of the switchboard or other equipment providing overload protection device supplied by the tap conductors, or
   c. Not less than the rating of the overcurrent protective device at the termination of the tap conductors.

   2. The tap conductors do not extend beyond the switchboard, panelboard, disconnecting means, or control devices they supply.

   3. Except at the point of connection to the feeder, the tap conductors are enclosed in a raceway, which shall extend from the tap to the enclosure of an enclosed switchboard, panelboard, or control devices, or to the back of an open switchboard.

   4. For field installations if the tap conductors leave the enclosure or vault in which the tap is made, the ampacity of the tap conductors is not less than one-tenth of the rating of the overcurrent device protecting the feeder conductors.

Substantiation: The conditions under which 10-ft tap conductors are permitted to be installed without overcurrent protection appropriate to the ampacity of the tapped conductors where the conductors originate needs to be clarified.

The present word “device” must be replaced with more descriptive terms since the definition of “device in Article 100 is, “A unit of an electrical system that carries or controls electric energy as its principal function.” Though not intended by 240.24(B)(1)(b), the broad definition of device includes wire and other conductors such as busway.

Article 408 permits switchboards to be used without overcurrent protection on their supply side. The phrase “Other equipment providing overload protection” in the Comment might include “A combination of a current transformer and overcurrent relay shall be considered equivalent to an overcurrent trip unit” as stated in 240.15(A).

Panelboards are required to have overcurrent protection on their supply side in 408.36 as are motor control centers in 430.94 and industrial control panels in 409.21. So, it does not appear this equipment can be used for termination of tap conductors unless the conductors terminate in overcurrent protection as provided in 240.21(B)(1)(1)b.

It is recommended that the list below 240.21(B)(1)(1) include a (c) to separate the items in the list.
NOTE: This Proposal appeared as Comment 10-18 (Log #2865) on Proposal 10-46 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 10-46 was: Revise text to read as follows:

1) Taps Not over 3 m (10 ft) Long. Where the length of the tap conductors does not exceed 3 m (10 ft) and the tap conductors comply with all of the following:
   a. Not less than the combined calculated loads on the circuits supplied by the tap conductors, and
   b. Not less than the rating of the switchboard or other distribution equipment device supplied by the tap conductors or not less than the rating of the overcurrent protective device at the termination of the tap conductors.
2) The tap conductors do not extend beyond the switchboard, panelboard, disconnecting means, or control devices they supply.
3) Except at the point of connection to the feeder, the tap conductors are enclosed in a raceway, which shall extend from the tap to the enclosure of an enclosed switchboard, panelboard, or control devices, or to the back of an open switchboard.
4) For field installations where the tap conductors leave the enclosure or vault in which the tap is made, the rating of the overcurrent device on the line side of the tap conductors shall not exceed 10 times the ampacity of the tap conductor.

FPN: For overcurrent protection requirements for panelboards, see 408.36.

Submitter: Don Ganiere, Ottawa, IL

Recommendation: Accept in principle and revise as shown below:

240.21(B)(1)(b) should be revised as follows:
"b. Not less than the rating of the device switchboard, panelboard, disconnecting means, or controller supplied by the tap conductors or not less than the rating of the overcurrent-protective device at the termination of the tap conductors.

Substantiation: The submitter is correct that the use of the word device in the existing text is not correct. The word is much too broad in scope to be used in this code section. Looking at the definition of device in Article 100, we see that it can mean just about anything. The code rule needs to tell the code user exactly what the tap conductor is permitted to be terminated on. The proposed wording of the submitter was a good start, but it needs to be expanded upon a bit. The panel statement says that the removal of the word device and its replacement with specific equipment that the tap conductor can be terminated on narrows the use of the section beyond what the current rule say is correct, however this "narrowing" is exactly what this section needs. This change will give the section some much needed clarity.
10-32 Log #2151 NEC-P10

Final Action:

Submitter: Phil Simmons, Simmons Electrical Services
Recommendation: Revise text to read as follows:

(1) Taps Not over 3 m (10 ft) Long. If the length of the tap conductors does not exceed 3 m (10 ft) and the tap conductors comply with all of the following:

(1) The ampacity of the tap conductors is
   a. Not less than the combined calculated loads on the circuits supplied by the tap conductors, and
   b. Not less than the rating of the equipment containing an overcurrent device(s) supplied by the tap conductors or not less than the rating of the overcurrent protective device at the termination of the tap conductors.

(2) The tap conductors do not extend beyond the switchboard, panelboard, disconnecting means, or control devices they supply.

(3) Except at the point of connection to the feeder, the tap conductors are enclosed in a raceway, which shall extend from the tap to the enclosure of an enclosed switchboard, panelboard, or control devices, or to the back of an open switchboard.

Substantiation: This proposal is intended to clarify the application of the existing requirement and state the specific type of device as an overcurrent device. This clarification is needed since a conductor fits within the definition of “device” in Article 100. The submitter is quite confident such an application or interpretation would not meet the intention of the Code Panel who is responsible for this Article.

The term “equipment containing an overcurrent device(s)” could be a main-lug panelboard, a fusible switch, a switchboard or a motor control center.

10-33 Log #3372 NEC-P10

Final Action:

Submitter: Timothy Crnko, Cooper Bussmann
Recommendation: Revise text to read as follows:

(2) The tap conductors terminate in a single circuit breaker, fused disconnect switch, or a single set of fuses that limit the load to the ampacity of the tap conductors. This device shall be permitted to supply any number of additional overcurrent devices on its load side.

Substantiation: A fused disconnect switch is a suitable device used for this application and should be included.

10-34 Log #3373 NEC-P10

Final Action:

Submitter: Timothy Crnko, Cooper Bussmann
Recommendation: Revise text to read as follows:

(5) The secondary conductors terminate in a single circuit breaker, fused disconnect switch, or set of fuses that limit the load current to not more than the conductor ampacity that is permitted by 310.15.

Substantiation: A fused disconnect switch is a suitable device used for this application and should be included.
10-35  Log #3368 NEC-P10
(240.21(B)(4)(4))

**Final Action:**

**Submitter:** Timothy Crnko, Cooper Bussmann

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

(4) The tap conductors terminate at a single circuit breaker, fused disconnect switch, or a single set of fuses that limit the load to the ampacity of the tap conductors. This single overcurrent device shall be permitted to supply any number of additional overcurrent devices on its load side.

**Substantiation:** A fused disconnect switch is a suitable device used for this application and should be included.

10-36  Log #665 NEC-P10
(240.21(B)(5))

**Final Action:**

**Submitter:** Richard A. Janoski, Finleyville, PA

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

(5) Outside Taps of Unlimited Length. Where the conductors are located outdoors of a building or structure, except at the point of load termination and comply with all of the following conditions:

(1) The tap conductors are protected from physical damage in an approved manner.

(2) The tap conductors terminate at a single circuit breaker or single set of fuses that limit the load to the ampacity of the tap conductors. This single overcurrent device shall be permitted to supply any number of additional overcurrent devices on its load side.

(3) The overcurrent device for the tap conductors is an integral part of a disconnecting means or shall be located immediately adjacent thereto.

(4) The disconnecting means for the tap conductors is installed at a readily accessible location complying with one of the following:
   a. Outside of a building or structure
   b. Inside, nearest the point of entrance of the conductors
   c. Where installed in accordance with 230.6, nearest the point of entrance of the conductors

**Substantiation:** All of the subsections under 240.21(B) are specific in regards to naming the "tap" conductors except for 240.21(B)(5).

The addition of the word "tap" in 240.21(B)(5)(1) through(4) will add more specific language to the section in regards to which conductors are being referred to and will also add consistency throughout the section. No technical change is intended; only editorial.
Revise text to read as follows:

10-37  Log #1714  NEC-P10
(240.21(B)(5)(4), 240.21(C)(4)(4), and 240.92(D)(5))

Submitter: James F. Williams, Fairmont, WV

Recommendation:  Revise text to read as follows:

240.21(B)(5)(4)
  b. Inside, nearest the service point of entrance of the conductors

240.21(C)(4)(4)
  b. Inside, nearest the service point of entrance of the conductors

240.92(D)(5)
  b. Inside, nearest the service point of entrance of the conductors

Substantiation:  This proposal is part of a set of proposals that:
  a. remove the Point of Entrance definitions from articles 770.2, 800.2, 820.2, and 830.2, replacing them with a single definition in 100 I;
  b. provide a definition of service point of entrance in 100 for the currently undefined point of entrance concept used in articles 90, 100, 225, 230, & 240;
  c. do nothing with the use of point of entrance concerning water pipes, mobile homes, park trailers, and trucks.

10-38  Log #3369  NEC-P10
(240.21(B)(5)(2))

Submitter: Timothy Crnko, Cooper Bussmann

Recommendation:  Revise text to read as follows:

(2) The conductors terminate at a single circuit breaker, fused disconnect switch, or a single set of fuses that limit the load to the ampacity of the conductors. This single overcurrent device shall be permitted to supply any number of additional overcurrent devices on its load side.

Substantiation:  A fused disconnect switch is a suitable device used for this application and should be included.
This proposal should be accepted in principle by retaining the part accepted in the ROP and by revising 240.21(C)(2) as follows:

(1) The ampacity of the secondary conductors is
a. Not less than the combined calculated loads on the circuits supplied by the secondary conductors, and
b. Not less than the rating of the switchboard or other distribution equipment device supplied by the secondary conductors or not less than the rating of the overcurrent-protective device at the termination of the secondary conductors.

(2) The secondary conductors do not extend beyond the switchboard, panelboard, disconnecting means, or control devices they supply.

(3) The secondary conductors are enclosed in a raceway, which shall extend from the transformer to the enclosure of an enclosed switchboard, panelboard, or control devices or to the back of an open switchboard.

(4) For field installations where the secondary conductors leave the enclosure or vault in which the supply connection is made, the rating of the overcurrent device protecting the primary of the transformer, multiplied by the primary to secondary transformer voltage ratio, shall not exceed 10 times the ampacity of the secondary conductor.

FPN: For overcurrent protection requirements for panelboards, see 408.36.

Submitter: James T. Dollard, Jr., IBEW Local 98

Recommendation: This proposal should be accepted in principle by retaining the part accepted in the ROP and by revising 240.21(C)(2) as follows:

240.21(C)(2)(1)(b) should be revised as follows:

“b. Not less than the rating of the switchboard, panelboard, disconnecting means, or control device supplied by the secondary conductors or not less than the rating of the overcurrent-protective device at the termination of the secondary conductors.”

Substantiation: The submitter is correct, the use of the word “device” in 240.21(C)(2)(1)(b) is incorrect. The word “device” is defined in Article 100 as follows:

“Device. A unit of an electrical system that carries or controls electric energy as its principal function.”

During the discussion on this proposal, it was clear that the panel intends for these “tap conductors” to be provided with overload protection. As presently written, the text permits termination in a device as defined above. The intent of the panel is not met in the present text of this section. The submitter is correct the existing text is confusing and should be clarified.

The present text of 240.21(C)(2)(2) includes more prescriptive text and limits termination of these “tap conductors” to “switchboard, panelboard, disconnecting means, or control devices.” The same level of clarity is necessary in 240.21(C)(2)(1)(b). The panel statement refers to the present permission of this section. The submitter seeks only to clarify what is permitted. Clarification is needed.
Phil Simmons, Simmons Electrical Services

Revise the text of the 2011 NEC ROP Draft as follows:

(2) Transformer Secondary Conductors Not over 3 m (10 ft) Long. If the length of secondary conductor does not exceed 3 m (10 ft) and comply with all of the following:

(1) The ampacity of the secondary conductors is
   a. Not less than the combined calculated loads on the circuits supplied by the secondary conductors, and
   b. Not less than the rating of the switchboard or other distribution equipment supplied by the secondary conductors or not less than the rating of the overcurrent-protective device at the termination of the secondary conductors

(2) The secondary conductors do not extend beyond the switchboard, panelboard, disconnecting means, or control devices they supply.

(3) The secondary conductors are enclosed in a raceway, which shall extend from the transformer to the enclosure of an enclosed switchboard, panelboard, or control devices.

(4) For field installations where the secondary conductors leave the enclosure or vault in which the supply connection is made, the rating of the overcurrent device protecting the primary of the transformer, multiplied by the primary to secondary transformer voltage ratio, shall not exceed 10 times the ampacity of the secondary conductor.

FPN: For overcurrent protection requirements for panelboards, see 408.36.

Submitter: Phil Simmons, Simmons Electrical Services

Recommendation: Revise the text of the 2011 NEC ROP Draft as follows:

(2) Transformer Secondary Conductors Not over 3 m (10 ft) Long. If the length of secondary conductor does not exceed 3 m (10 ft) and comply with all of the following:

(1) The ampacity of the secondary conductors is
   a. Not less than the combined calculated loads on the circuits supplied by the secondary conductors, and
   b. Not less than the rating of the switchboard or other distribution equipment supplied by the secondary conductors, or
   c. not less than the rating of the overcurrent-protective device at the termination of the secondary conductors

(2) The secondary conductors do not extend beyond the switchboard, panelboard, disconnecting means, or control devices they supply.

(3) The secondary conductors are enclosed in a raceway, which shall extend from the transformer to the enclosure of an enclosed switchboard, panelboard, or control devices.

(4) For field installations where the secondary conductors leave the enclosure or vault in which the supply connection is made, the rating of the overcurrent device protecting the primary of the transformer, multiplied by the primary to secondary transformer voltage ratio, shall not exceed 10 times the ampacity of the secondary conductor.

Retain the informational Note.

Substantiation: The conditions under which 10-ft transformer secondary conductors are permitted to be installed without overcurrent protection appropriate to the ampacity of the secondary conductors where the conductors originate needs to be clarified. The present word "device" must be replaced with more descriptive terms since the definition of "device in Article 100 is, "A unit of an electrical system that carries or controls electric energy as its principal function."

Though not intended by 240.24(C)(2)(1)b, the broad definition of device includes wire and other conductors such as busway.

Article 408 permits switchboards to be used without overcurrent protection on their supply side. The phrase "Other equipment providing overload protection" in the Comment might include "A combination of a current transformer and overcurrent relay shall be considered equivalent to an overcurrent trip unit" as stated in 240.15(A).

Panelboards are required to have overcurrent protection on their supply side in 408.36 as are motor control centers in 430.94 and industrial control panels in 409.21. So, it does not appear this equipment can be used for termination of tap conductors unless the conductors terminate in overcurrent protection as provided in 240.21(C)(2)(1)b.

It is recommended that the list below 240.21(C)(2)(1) include a (c) to separate the items in the list.
This proposal should be accepted in principle by retaining the part accepted in the ROP and by revising 240.21(C)(2) as follows:

240.21(C)(2)(b) should be revised as follows:

"b. Not less than the rating of the device switchboard, panelboard, disconnecting means, or controller supplied by the secondary conductors or not less than the rating of the overcurrent-protective device at the termination of the secondary conductors."

The submitter is correct that the use of the word device is not suitable for this section as a "device" can be almost anything per its Article 100 definition. The section needs clarification and the replacement of the word device with a specific list of equipment that a tap conductor is permitted to be terminated on would provide the clarity that this section requires.
10-42 Log #3073 NEC-P10 (240.21(C)(3)) Final Action:

Submitter: Frederic P. Hartwell, Hartwell Electrical Services, Inc.
Recommendation: Revise the opening paragraph as follows:

(3) Industrial Installation Secondary Conductors Not over 7.5 m (25 ft) Long. For the supply of switchboards in industrial installations only, where the length of the secondary conductors does not exceed 7.5 m (25 ft) and complies with all of the following:

Substantiation: This is a resubmittal of Proposal 10-53 and its supporting Comment 10-22 in the 2011 cycle. As a practical matter this provision is limited to tap conductors arriving at the main lugs of a switchboard. A motor control center could not qualify, because overcurrent protection in the form of a singular device is required in accordance with the rating of the common power bus, as covered in 430.94. Power panels no longer comply because all panelboards now require individual overcurrent protection, with exceptions that would not apply here (see 408.36). If the tap arrived at a wireway or auxiliary gutter over the collection of loads intended to be supplied, the individual taps to each of the loads would violate the prohibition against tapping taps, certainly so if they were reduced in size to meet the likely termination limitations of the smaller equipment.

This rule is routinely being applied improperly because past practice allowed for other arrangements. The procedure entered the NEC as 240.21 Exception No. 11 in the 1987 NEC, long before the prohibition on tapping a tap entered the NEC (1999 edition) and even longer before the individual protection rule applied to all panelboards (2008 NEC). At this time the switchboard is the only permissible application. CMP 11 objected to the omission of other equipment such as “switchgear” in its panel statement. This terminology is generally applied to medium voltage applications, or at least to applications such as substations where at least some of the connections are for medium voltage conductors. However, any connections operating at 600 volts or less and that are potentially covered by this rule can only take place at equipment that will qualify as a switchboard, and this proposal will clear up a great deal of field confusion regarding its proper application.

10-43 Log #3370 NEC-P10 (240.21(C)(4)(2)) Final Action:

Submitter: Timothy Crnko, Cooper Bussmann
Recommendation: Revise text to read as follows:

(2) The conductors terminate at a single circuit breaker, fused disconnect switch, or a single set of fuses that limit the load to the ampacity of the conductors. This single overcurrent device shall be permitted to supply any number of additional overcurrent devices on its load side.

Substantiation: A fused disconnect switch is a suitable device used for this application and should be included.

10-44 Log #3371 NEC-P10 (240.21(C)(6)(2)) Final Action:

Submitter: Timothy Crnko, Cooper Bussmann
Recommendation: Revise text to read as follows:

(2) The secondary conductors terminate in a single circuit breaker, fused disconnect switch, or set of fuses that limit the load current to not more than the conductor ampacity that is permitted by 310.15.

Substantiation: A fused disconnect switch is a suitable device used for this application and should be included.
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10-45 Log #537 NEC-P10

**Final Action:**

**Submitter:** Patrick Murphy, City of Richmond  
**Recommendation:** Add new text to read as follows:

1. **Taps Not Over 3 m (10 ft) Long.** Where the length of the tap conductors does not exceed 3 m (10 ft) and the tap conductors comply with all of the following:
   
   a. The ampacity of the tap conductors is not less than the combined computed loads on the circuits supplied by the tap conductors, and
   
   b. Not less than the rating of the device supplied by the tap conductors or not less than the rating of the overcurrent-protective device at the termination of the tap conductors.

2. The tap conductors do not extend beyond the switchboard, panelboard, disconnecting means, or control devices they supply.

3. Except at the point of connection to the feeder, the tap conductors are enclosed in a raceway, which shall extend from the tap to the enclosure of an enclosed switchboard, panelboard, or control devices, or to the back of an open switchboard.

4. For field installations where the tap conductors leave the enclosure or vault in which the tap is made, the rating of the overcurrent device on the line side of the tap conductors shall not exceed 10 times the ampacity of the tap conductor.

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10-46 Log #2113 NEC-P10

**Final Action:**

**Submitter:** Darryl Hill, Wichita Electrical JATC  
**Recommendation:** Revise text to read as follows:

240.24(D) Not in Vicinity of Easily Ignitable Material Located in Clothes Closet. Overcurrent devices shall not be located in clothes closet or in the vicinity of easily ignitable material, such as in clothes closets.

**Substantiation:** With the definition of clothes closet in Article 100 now, it states that this space is primarily intended for the storage of garments and apparel. With this statement in the definition it is apparent that this room will have easily ignitable material and should not have OCPD’s located within it. It seems there could be confusion on the wording “such as” and the intent of this phrase. This would help in clarification that it is prohibited from putting these devices in a clothes closet.

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10-47  Log #2276 NEC-P10 (240.24(E))

Submitter: Jay Mendoza, Denver, CO

Recommendation: Revise text to read as follows:
In dwelling units, dormitories, and guest rooms or guest suites, commercial locations, overcurrent devices, other than supplementary overcurrent protection, shall not be located in bathrooms.

Substantiation: Prevent commercial locations such as restaurants placing overcurrent devices in or near bathroom

10-48  Log #3493 NEC-P10 (240.24(E))

Submitter: Tom Watson, Los Altos, CA

Recommendation: Not Located in Bathrooms Bathing Facilities. In dwelling units, dormitories, and guest rooms or guest suites, overcurrent devices, other than supplementary overcurrent protection, shall not be located in bathrooms bathing facilities.

Additional definition (Article 100):
Bathing Facility: A room where a human body has a substantial portion exposed to water or water vapor when the facility is in normal use.

Informational note: Tubs, showers, saunas, spas, or similar, but not basins.

Substantiation: As currently written, the definition of bathroom does not includes a room with only a shower and a toilet. These are frequently paired in a separate room away from basins. The current text and definition allow for this combination with panelboards, which I consider dangerous. It is possible that water vapor can infiltrate into panelboards causing faults. The need for a basin (sink) to meet the definition IN THIS USE is poor, thus the need for a new definition, in this case “bathing facility”. A shower (which meets the requirements) can also produce water vapor, as well as a sauna when in use. A sauna typically does not have fixed plumbing, but often a water ladle is used to produce vapor. The informational note is to set some examples of bathing facilities to give an inspector guidance and latitude.
Submitter: James Brozek, Acton, MA
Recommendation: Insert the following as a new requirement.

240.35 Available Fault Current.

(A) Marking. To ensure that equipment interrupting and short-circuit current ratings are sufficient for the maximum available fault current at the line terminals of the equipment, electrical equipment in other than dwelling units, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers shall be legibly marked in the field with the maximum available fault current. The field markings shall include the date the fault current calculation was performed and be of sufficient durability to withstand the environment involved.

(B) Modifications. When modifications to the electrical installation occur, that affect the maximum available fault current at the equipment the maximum available fault current shall be verified or recalculated as necessary to ensure the equipment interrupting and short-circuit current ratings are sufficient for the maximum available fault current at the line terminals of the equipment. The required field marking(s) in (A) above shall be adjusted to reflect the new level of maximum available fault current.

(C) Installation. Electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers shall not be installed where the available fault current exceeds its short-circuit current rating as marked in accordance with 240.35(A) and 240.35(B).

Exception No. 1: The field marking requirements in (A) and (B) shall not be required for service equipment already marked in accordance with 110.24.

Exception No. 2: The field marking requirements in (A) and (B) shall not be required in industrial installations where conditions of maintenance and supervision ensure that only qualified persons service the equipment.

Substantiation: This proposal is a modified version of 110.24 which covers only service entrance equipment. While 110.24 is adequate to cover the need for proper interrupting rating of the service equipment, the remainder of the electrical system is in need of a similar requirement. Almost all electrical equipment has either an interrupting rating or a short-circuit current rating. These ratings are quite frequently overlooked during the design and installation process, but they are every bit as SAFETY-CRITICAL as the interrupting rating for the service equipment. The calculations are already required and are supposed to be completed in order to comply with 110.9, 110.10, 409.110(4), 430.8, 440.4(B), and 670.3, so there should be no complaints about extra time to calculate the available fault current. This is simply a matter of marking the equipment with the fault current value after it is determined.
James T. Dollard, Jr., IBEW Local 98

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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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 >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.

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NOTE: This Proposal appeared as Comment 10-36 (Log #1611) on Proposal 10-82 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 10-82 was: Add new text to read as follows:

240.87 Short-time Delay. Where short-time delay is utilized on a circuit breaker, one of the following shall be provided:

(A) Zone-selective interlocking

(B) Differential relaying

(C) Energy-reducing maintenance switching

FPN: An energy-reducing maintenance switch allows a worker to set a circuit breaker trip unit to instantaneous while the worker is working within an arc-flash boundary as defined in NFPA 70E, and then to set the trip unit back to a short-time delay setting after the potentially hazardous work is complete.

Submitter: Christopher G. Walker, Eaton Corp.

Recommendation: Modify the Panel’s accepted text to read as follows:

240.87 Non-instantaneous Trip Arc Energy Reduction: Where a circuit breaker without an instantaneous trip rated for, or can be adjusted to, 1,000 Amperes or more is utilized, one of the following or approved equivalent means shall be provided:

(1) Zone-selective interlocking

(2) Differential relaying

(3) Energy-reducing maintenance switching with a local status indicator

Informational Note: An energy-reducing maintenance switch allows a worker to set a circuit breaker trip unit to operate faster while the worker is working within an arc flash boundary as defined in NFPA 70E, and then to set the circuit breaker back to normal setting after the potentially hazardous work is complete.

Substantiation: The Panel Action recognizes the importance of having electrical circuits open without delay in order to minimize arc flash hazards. This comment is focused on requiring the use of either currently available or future devices, technologies or design approaches that may be incorporated to further minimize arc flash hazards, regardless of the circuit breaker’s Instantaneous or Short-Delay capabilities. The Panel’s action focuses on only Non-Instantaneous circuit breakers may exclude certain circuit breakers that have an instantaneous trip, yet may have a higher amount of let-through energy. This comment also addresses Mr. Cook’s Comment on the Affirmative: “As an enforcement representative I have some concern about the difficulty of identifying non-instantaneous trip circuit breakers in the field.” These devices and technologies would be used to further enhance existing design and operational safety options such as the use of PPE and other arc resistant equipment per NFPA 70E. This comment is focused on requiring the use of these devices and technologies of circuit breakers rated for, or can be adjusted to, 1,000 Amperes or more. This aligns with the rating established for Ground-Fault Protection of Equipment per NEC 230.95.
Where a circuit breaker is utilized without an instantaneous trip, one of the following or approved equivalent means shall be provided permitted.

**Substantiation:** There are a number of things that need to be considered before this requirement becomes mandatory; therefore, as an interim solution, the wording was changed from “shall be provided” (mandatory) to “shall be permitted” (permissive).

The informational notes talks about incident energy; therefore, it is assumed the reason for this requirement was to provide a means for faster tripping in order to reduce the incident energy. ROP 10-82 also discusses the reduction in incident energy using one of the three options provided in this section.

As mentioned by some of the code panel members who voted in the negative, these methods may reduce (for some faults), but not eliminate the hazard. Also, the use of an instantaneous trip circuit breaker or one of the options shown does not always reduce the incident energy below 40 cal/cm². (Sometimes the service provided by the utility is smaller than the service used to design a main switchboard. In those cases, an instantaneous may be provided for the main breaker, but it can be set above the available fault current. Some circuit breakers with an instantaneous trip may have a high range instantaneous or an instantaneous override setting (if the instantaneous is turned off) which results in a higher than normal instantaneous pickup. Finally, an arc flash study may indicate the protective device operating time for the incident energy calculation was based on the short-time delay or long-time delay of the circuit breaker instead of the instantaneous trip due to the trip unit settings and the magnitude of the expected arcing fault current.)

The only time a low voltage (600 volts and below) circuit breaker may exclude an instantaneous trip function is for power circuit breakers applied in switchgear or a switchboard. (Insulated-case circuit breakers and molded-case circuit breakers are required to have an instantaneous trip function.) One of the coordination “benefits” of switchgear or using power circuit breakers is the ability to exclude the instantaneous trip function for selectivity.

(Note: in the discussion below, a main breaker for a switchgear line-up is the main disconnect for that piece of equipment.)

Each of the options provided will be discussed below:

1.) Zone-selective interlocking. Equipment manufacturers who include a zone-selective interlocking feature include it with one or more of the following trip functions: short-time delay, ground-fault delay, and instantaneous. For purposes of this discussion, only the short-time delay zone-selective interlocking will be considered.

Problem – if a line-up with switchgear has a main and several feeder breakers without instantaneous trips, does adding zone-selective interlocking to this equipment meet the requirements of this section? (For this case, the main and feeder breakers are part of a zone-selective interlocking scheme.) If yes, what is the “benefit” to any loads fed by the NFPA 70 2011 Page 3 Toth Proposal 240.87 feeder breakers? The trip characteristic of the feeder breakers will be based on the short-time delay setting of the trip unit. For a fault in a main lug only panelboard fed by this feeder breaker, what was the benefit of including the feeder breaker in a zone-selective interlocking scheme?

For the main breaker, there is a partial “benefit”. For example, if the feeder breakers had a short-time delay setting of 0.1 seconds and the main breaker had a short-time delay setting of 0.3 seconds (for selectivity), the main breaker will use the 0.3 second delay band if a fault is downstream of a feeder breaker in the switchgear and the feeder breaker sends a signal to the main breaker that it detected a fault downstream. If the fault is in the switchgear, none of the feeder breakers will see the fault, so the main breaker will not receive a signal from the feeder breakers. This will allow the main breaker to change its short-time delay band from the 0.3 second setting to a default setting of 0.1 seconds (the minimum delay band setting). (This would reduce the incident energy for a fault in the switchgear between the main and feeder breakers.) However; if you were going to work in the switchgear, and there were exposed electrical conductors or parts on the line side of the main breaker, the arc fault clearing time of a protective upstream should be used to determine your potential incident energy exposure. Was this the level of benefit you were expecting (reduce energy for some faults but not for others) for using zone-selective interlocking? (If this is a main service switchboard or switchgear fed by the utility, it would not be unusual to have an incident energy in excess of 40 cal/cm² due to the long operating time of the utility transformer primary fuse. The results of an arc flash study may indicate the equipment was not safe to work on energized.)

2.) Differential relaying. This relay scheme provides fast fault clearing for faults within the differential zone of protection. This type of relay scheme can only be used in switchgear. It would not be practical to try to include this in a switchboard or to include a downstream panelboard in a feeder differential scheme.
Problem – if selectivity is desired, complete selectivity is not possible because a fault between a feeder breaker and the current transformer will cause all circuit breakers to trip. Although the probability of a fault in that small area is small, it is still a possibility. Therefore, this scheme cannot be used where selectivity is required by the NEC (e.g., Article 700 and Article 701).

Similar to the zone-selective interlocking discussion, if a line-up with switchgear has a main and several feeder breakers without instantaneous trips, does adding differential relaying to this equipment meet the requirements of this section? If yes, what is the “benefit” to any loads fed by the feeder breakers? If a fault occurs downstream of the differential relaying zone of protection, the trip characteristic of the feeder breakers will be based on the short-time delay setting of the trip unit. For a fault in a main lug only panelboard fed by this feeder breaker, what was the benefit of including the differential relaying around this feeder breaker in the switchgear line-up?

For the main breaker, there is a partial “benefit”. For example, if there is a fault on the main horizontal bus or the vertical bus fed by the main breaker in the switchgear, there will be an instantaneous trip (this would reduce the incident energy for a fault in the switchgear between the main and feeder breakers in the differential zone of protection); however, if you were going to work in the switchgear, and there were exposed electrical conductors or parts on the line side of the main breaker current transformer, the arc fault clearing time of a protective upstream should be used to determine your potential incident energy exposure. Was this the level of benefit you were expecting (reduce energy for some faults but not for others) for using differential relaying? (See additional comments previously shown under zone-selective interlocking.)

3.) Energy-reducing maintenance switching with local status indicator. This option allows the temporary inclusion of an instantaneous trip setting. This will provide a benefit for loads fed by a feeder breaker with this option.

Problem 1 – this temporary instantaneous will also provide a partial benefit for the main breaker. As in the two previous discussions, if there is a fault on the main horizontal bus or the vertical bus fed by the main breaker in the switchgear, there will be an instantaneous trip; however, if you were going to work in the switchgear, and there were exposed electrical conductors or parts on the line side of the main breaker, the arc fault clearing time of a protective upstream should be used to determine your potential incident energy exposure. Was this the level of benefit you were expecting (reduce energy for some faults but not for others) for using the temporary instantaneous setting? (See additional comments previously shown under zone-selective interlocking.)

Problem 2 – can this be used where selectivity is required by the NEC (e.g., Article 700 and Article 701)? If the temporary instantaneous is not selective with emergency system overcurrent devices or legally required standby system overcurrent devices, can you use the temporary setting? If you can’t, what was the reason for adding this option if it can’t be used?
Where a circuit breaker is utilized without an instantaneous trip function, one of the following or approved equivalent means shall be provided:

1. Zone-selective interlocking
2. Differential relaying
3. Energy-reducing maintenance switching with local status indicator
4. Energy-reducing active arc flash mitigation system

Informational Note #1: An energy-reducing maintenance switch allows a worker to set a circuit breaker trip unit to “no intentional delay” to reduce the clearing time while the worker is working within an arc-flash boundary as defined in NFPA 70E-2009, Standard for Electrical Safety in the Workplace, and then to set the trip unit back to a normal setting after the potentially hazardous work is complete.

Informational Note #2: An energy-reducing active arc flash mitigation system helps in reducing arcing duration without compromising existing selective coordination in the electrical distribution system. No change in circuit breaker or the settings of other devices is required during maintenance when a worker is working within an arc-flash boundary as defined in NFPA 70E-2012, Standard for Electrical Safety in the Workplace.

Substantiation: Understanding how to apply the 240.87 is difficult without also understanding what the various instantaneous trip functions are in low voltage circuit breakers, how they work, and what the Panel stated in the 2011 ROC. There can be as many as three instantaneous trip functions in low voltage circuit breakers; four if a special energy-reducing maintenance switch instantaneous trip function is provided. Understanding what these functions are and whether or not they can be used to reduce the arc flash hazard in a given application is important.

Electronic trip Molded Case Circuit Breakers (MCCBs) and Insulated Case Circuit Breakers (ICCBs) are often equipped with two different instantaneous trip functions; a field adjustable instantaneous trip function and a fixed high level instantaneous trip function called an instantaneous override. The field adjustable instantaneous trip function allows the user to adjust the trip setting to optimize protection and coordination. If the setting is lower than the prospective arcing fault current, low levels of incident energy let-through may be achieved.

The fixed instantaneous override trip function is provided for the self-protection of the circuit breaker. If its factory setting is lower than the prospective arcing fault current, it will reduce the incident energy let-through in the event of an arcing fault.

Low Voltage Power Circuit Breakers (LVPCBs) are typically equipped with a field adjustable instantaneous trip function and may also be equipped with a fixed instantaneous override trip function. Additionally, they may have a making current release, provided for self-protection of the circuit breaker when closing in on a high level fault. Whether or not an LVPCB is equipped with an instantaneous override trip function or a making current release depends on the short-time withstand, interrupting and close and latch ratings of the circuit breaker.

Most of the LSI/G electronic trip units on the market today have an OFF position on the field adjustable instantaneous trip function (LSI/G refers to the Long-time, Short-time, Instantaneous and Ground-fault trip functions). The OFF position allows the user to achieve higher levels of selective coordination.

Whether or not a circuit breaker will reduce the incident energy let-through should an arc flash event occur is dependent on where the instantaneous trip function is set with respect to the prospective arcing fault current, not whether or not an instantaneous trip function is present. This can be likened to seat belts in cars. The presence of seat belts alone will not reduce injuries in the event of a crash, only the proper use of them will.

Unfortunately, 240.87 does not state whether it is referring to the absence of an instantaneous trip function or an instantaneous trip setting, nor does it state if it is referring to a field adjustable instantaneous trip function or a fixed instantaneous trip function.

2011 Comment 10-41 attempted in part to clarify the meaning of the text by proposing that the Section begin with the words, “Where a power circuit breaker is utilized without an instantaneous trip, or the instantaneous trip can be turned off, one of the following or approved equivalent means shall be provided:”. The comment went on to propose additional text, “Where power circuit breakers are utilized, documentation shall be available to those authorized to design, install, inspect, or operate the device notifying field personnel the breaker does not or may not include an instantaneous trip.
function.” The substantiation stated in part, “While many breakers include an ‘Off’ position for the instantaneous setting, they also include positions where the instantaneous protection is on. Those devices are not WITHOUT an instantaneous trip.” In accepting this comment in principle, the Panel stated, “The panel deleted the text ‘instantaneous trip can be turned off’ because the requirement addresses circuit breakers utilized without an instantaneous trip.” It would seem that what the Panel meant is that 240.87 applies only when there is no instantaneous trip function present on the circuit breaker. In an attempt to reduce the arc flash hazard, a worker could change a field adjustable instantaneous trip setting to a setting other than OFF just as easily as activating an energy reducing maintenance switch, achieving the same end result.

Taking into account how circuit breakers work and the Panel Statement on ROC 10-41, it would seem that 240.87 only applies when a circuit breaker does not have an instantaneous trip function, not when the field adjustable instantaneous trip function is set to OFF.

This proposal clarifies the text to better align with how circuit breakers work and the seeming intent of the Panel as stated in 2011 ROC 10-41.

Subsection (4) has been added, along with a second Informational Note to recognize that there is another arc flash mitigation method that is available to reduce the arc flash hazard during periods of live work.

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**Submitter:** Carl Fredericks, American Chemistry Council

**Recommendation:** Revise the second paragraph of 240.87 as follows:

Where a circuit breaker is shall be permitted to be used without an instantaneous trip in either a Supervised Industrial Installation in accordance with 240.2, or where one of the following or approved equivalent means is provided:

**Substantiation:** The 240.87 text as adopted for the 2011 NEC was broader than the substantiation justified.

There was no substantiation of a field problem or worker injuries for Supervised Industrial Installations as covered by this proposed exception.

Where available incident energy levels are within the recognized capabilities of PPE, circuit breakers may be safely applied without an instantaneous trip. A non-coordinated instantaneous trip can in some cases create greater personnel hazards than a non-instantaneous trip.

Further the adoption of the 240.87 text may not have contemplated cases where small panelboard molded case circuit breakers are applied without instantaneous trips, for coordination purposes. Available incident energy in many of these cases will be very low, well within the proven capabilities of PPE and in some cases even within HRC-0 levels, despite no instantaneous trip upstream.

Also, in just addressing certain circuit breaker applications, the adopted 240.87 text selectively requires design changes for one type of equipment while not addressing other types. Consider the following examples:

- For a motor control center with a 3-phase fault available of 20 kA at 480 volts, calculated current for an arcing fault is 11.86 kA per IEEE 1584.

  - If the motor control center feeder is protected by one manufacturer's 1200 ampere, Class L fuse, the nominal clearing time at 11.86 kA is about 0.2 seconds, considerably longer than the 0.05 second or shorter clearing time that would be associated with an instantaneous trip on a circuit breaker. This is effectively a “non-instantaneous trip” with a fuse in this situation.

  - For a 1200 amp insulated case circuit breaker with a 15x instantaneous override, the breaker will not trip instantaneously for this arcing fault current, and depending on the short time setting, could take as long as 0.25 seconds or longer to trip. This is a non-instantaneous trip with an insulated case circuit breaker in this situation, even though the breaker has an instantaneous trip that is always enabled.

  - A 1200 amp molded case circuit breaker with an instantaneous set at 10x may not trip instantaneously for this arcing fault current, and certainly would not for fault currents that were a bit lower. Trip time for this situation could be by a thermal element and considerably longer than 0.25 seconds. This would be a non-instantaneous trip with a molded-case circuit breaker in this situation, even though the breaker has an instantaneous trip that is always enabled.

For all of these applications which are allowable per the existing 240.87 text, there will be no instantaneous trip for an arcing fault, and the user must provide adequate PPE or make other changes or accommodations to protect the workers. Personnel responsible for supervised industrial installations are familiar with such issues and can provide safety for those situations and others where an instantaneous trip will not be available.
240.87 Noninstantaneous Trip. Where a power circuit breaker is used without an instantaneous trip, and calculated arc flash energy exceeds those values that can safely be protected with available personal protective equipment, documentation shall be available to those authorized to design, install, operate, or inspect the installation as to the location of the circuit breaker(s). Where such a circuit breaker is utilized without an instantaneous trip, one of the following or approved equivalent means shall be provided:

1. Zone-selective interlocking
2. Differential relaying
3. Energy-reducing maintenance switching with local status indicator local to the energy reducing switch

Exception - Where a greater hazard is created by potential miscoordination, instantaneous settings shall not be required.

Informational Note: An energy-reducing maintenance switch allows a worker to set a circuit breaker trip unit to “no intentional delay” to reduce the clearing time while the worker is working within an arc-flash boundary as defined in NFPA 70E-2009, Standard for Electrical Safety in the Workplace, and then to set the trip unit back to a normal setting after the potentially hazardous work is complete.

Substantiation: This section should be qualified based on the Arc Flash energy involved. There is no reason to require the use if instantaneous trip if the arc flash energy is below that which can safely be protected with available personal protective equipment, especially when the consequence of a potential miscoordination may result in a more hazardous condition. While this section is not retroactive, it also presents legal problems should an injury occur, regardless of the arc flash energy level present. Finally, what is meant by the term “local indication”? I presume this is meant to be local to the substation breaker where the instantaneous trip is or is not present, but this needs to be so specified. The above language is an attempt to make this section meaningful and meet the original intent of the insertion in the 2011 NEC®.

Exception: If the load served is a chemical (or other potentially hazardous material) manufacturing plant where sudden loss of electrical power may result in an increased hazard, and the available incident energy level when short-time protection is utilized is within manageable levels of commonly available personal protective equipment, the additional requirements of 240.87(1), (2), or (3) are not required.

Substantiation: Utilizing modern substation equipment and appropriate overcurrent long-time and short-time settings it is common to have calculated energy levels in the mid 20’s cal/cm². Protection for electrical workers at this level is manageable with commonly available flash protection. While the addition of zone selective interlocking, differential relaying or “maintenance mode” switching will further reduce the arc flash level that electrical workers are exposed to, they increase the likelihood of a larger scale unplanned interruption of service to the load served. In the case of a chemical (or other potentially hazardous material) manufacturing facility, this unplanned service interruption may introduce additional safety hazards of a non-electrical nature. This “increased hazard” concept is currently recognized by NFPA within NFPA-70E; Reference 70E 2012 130.2(A)(1) Greater Hazard. These additional hazards have the potential of affecting other personnel, facilities, the environment, and possibly the public.
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Note: Supporting material is available for review at NFPA Headquarters.