4-1 Log #4917c NEC-P04
(Entire Document) Final Action: Reject

Submitter: Caleb M. Ferris, Chadwick Electric
Recommendation: Add a diagram table after the scope of each article similar to the one in Article 430.
Substantiation: For NEC user cost make the table layout diagram in 430.8 standard throughout the code.
Panel Meeting Action: Reject
Panel Statement: The proposal does not meet the requirements of 4.3.3(b) of the Regulations Governing Committee Projects.

4-2 Log #614b NEC-P04
(Entire Document) Final Action: Reject

Submitter: Paul Guidry, Fluor Enterprises, Inc.
Recommendation: Change terms "high voltage" and "medium voltage" to correlate with new proposed definitions in Article 100.
   This is a companion proposal to a proposal to add definitions for low voltage, medium voltage, and high voltage to Article 100.
Substantiation: If the proposal for adding the definitions in Article 100 is accepted, this proposal must be accepted as well to correlate between all chapters of the NEC.
Panel Meeting Action: Reject
Panel Statement: The proposal does not contain any actual proposed language and lacks any specific requirement and thus does not comply with the NEC Style Manual. These terms are not used in the Articles under CMP 4.

4-3 Log #3502 NEC-P04
(100.Overhead Service Conductors (New) ) Final Action: Accept in Principle

Submitter: James J. Rogers, Bay State Inspectional Agency
Recommendation: Add text to read as follows:
   (Overhead Service conductors.) The overhead service conductors between the service point and the first point of connection to the service-entrance conductors at the building or other structure.
Substantiation: This proposal is being submitted by a task group that has been formed by Panel Chair, Ronald Toomer, in response to instructions that were presented to Code-Making Panel 4 by the Technical Correlating Committee as a result of some proposals that were submitted in the last cycle. These proposals spurred some discussion that resulted in differing opinions relative to the use of the term "Service Lateral". The members of the task group are as follows: Larry D. Cogburn, Chair, Robert J. Deaton, James J. Rogers, John A. Sigmund, and John W. Young.
Panel Meeting Action: Accept in Principle
Panel Statement: The panel defined the overhead conductors provided between the service point and the service entrance conductors.
4-4 Log #2006 NEC-P04 Final Action: Reject
(100.Service Cable)

Submitter: Dan Leaf, Seneca, SC
Recommendation: Revise text as follows: Service conductors made up in multiconductor the form of multiconductor cable or individual conductors.
Substantiation: Edit. "Cable" (not defined) may be single conductor or multiconductor. Service conductors by definition include service laterals and service –entrance conductors which may be individual conductors. Proposal clarifies that "cable" is not intended to be limited to multiconductor types as may be inferred by "form of a cable". Present definition uses the term being defined (cable) in the definition.
Panel Meeting Action: Reject
Panel Statement: The submitter is not correct in the assumption that the current definition does not include all cable types, even those made up of individual single conductors the current definition covers all conductors that are placed together to be used as service cables whether they are single conductors, preformed unjacketed cable assemblies, or jacketed cable assemblies.

4-5 Log #447 NEC-P04 Final Action: Accept in Principle
(100.Service Drop)

Submitter: Rod Mutch, Selah, WA
Recommendation: Revise text to read as follows: Service Drop. The overhead service conductors from the last pole or other aerial support to and including the splices, if any, connecting to the service-entrance conductors at the building or other structure.
Substantiation: The current definition of Service Drop refers to overhead "service conductors". Because "service conductors" is also a defined term, ("The conductors from the service point to the service disconnecting means"), there can be no NEC defined service drop conductors on the utility side of the service point. This creates a conflict when applying the definitions to the requirements of various code sections that refer to service drops. 230.40 states: "Each service drop or lateral shall supply only one set of service-entrance conductors". With the current definition, for example, there is no "service drop" on an overhead service where the service point is at the point of connection to the service entrance conductors at the weather head, and therefore, the requirements of 230.40 do not apply. The same problem exists when trying to enforce the point of attachment and support requirements of 230.26 thru 29. The current definition is also in conflict with 90.2(B)(5)a. This section refers to a service drop that is under the exclusive control of an electric utility. Removing the word "service" from the definition of service drop would include the conductors on the utility side of the service point in the definition of service drop, thus allowing us to recognize these conductors as service drop conductors for application of other code requirements. This change would not affect the scope of enforcement of these conductors because 90.2 is very clear that conductors under the exclusive control of an electric utility are not covered by the NEC.
A similar change is being proposed to the definition of "service lateral".
Panel Meeting Action: Accept in Principle
Panel Statement: See panel action and statement on Proposal 4-8.

Printed on 2/4/2009
Submitter: Brian J. Dolan, IBEW/NECA Technical Institute
Recommendation: Revise as follows:

Service Drop: The overhead service conductors from the last pole...

Substantiation: The use of the phrase "service conductors" in the definition of "service drop" is misleading because service conductors, by definition, are on the customer side of the service point. The conductors that extend from the last pole to the weatherhead on a building may or may not be on customer side of the service point.

Panel Meeting Action: Accept in Principle

Panel Statement: See panel action and statement on Proposal 4-8.

Submitter: Neil F. LaBrake, Jr., National Grid USA
Recommendation: Revise the definition of service drop and add the following new fine print note in Article 100 as follows.

Service Drop. The overhead service conductors between the electric supply or communication line and the building or structure being served from the last pole or other aerial support to and including the splices, if any, connecting to the service entrance conductors at the building or other structure.

FPN Service drops are typically on the line side of the service point provided by the serving utility's conditions of service. See Figure 90.2 for a general illustration of where utility electric supply and premises wiring meet for what is covered by this Code and what is not covered.

Substantiation: As the Edison Electric Institute NESC & NEC representative in meetings of the NESC and NEC Committees' Ad Hoc Task Group on July 10th and Sep. 30th, 2008, I am submitting this proposal based upon discussions in those meetings to mitigate conflicts between the NESC and NEC documents. Several companion proposals regarding this subject are submitted to 90.1(C), 90.2, 90.2(A), 90.2(A)(3), 90.2(A)FPN new, 90.2(B)FPN new, 90.2(B)(5), 90.2(B)FPN to (4) & (5), and Article 100 Definitions for Exclusive Control (new), Restricted Access (new), Service Lateral, Service Point, and Utilization Equipment.

This is one action along with the companion proposals to resolve the ongoing conflict in 90.2(B)(5)b contained in the 2008 NEC caused by the removal of the words "or by other agreements".

Refer to the NFPA Standards Council Appeals Hearings on the 2008 NEC adoption in July 2007 in Final Decision on Appeal numbers #07-24 (SC# 07-7-39) and #07-7 (SC# 07-7-5-m) in the NFPA archives (http://www.nfpa.org/itemDetail.asp?categoryID=837&itemID=35006 and http://www.nfpa.org/assets/files/PDF/Standards%20Council/TranscriptSCMeetingJuly07.pdf).

Specifically, the rationale for this change is to provide clarity where the NEC applies to premises wiring meeting the supply facilities under exclusive control of utilities at the service point and to separately derived systems that are not connected to a service point. This proposal correlates the definition of “service drop” with the 2007 NESC same defined term. The service drop is overhead conductors provided by the governmental or regulated serving utility’s local requirements or those of a private utility under conditions of service (e.g. tariffs with service applications). As such, premises wiring attaches to a service drop at a service point.

Panel Meeting Action: Accept in Principle
Panel Statement: See panel action and statement on Proposal 4-8. The FPN is not necessary.
Report on Proposals – June 2010

4-8 Log #3503 NEC-P04 Final Action: Accept in Part
(100. Service Drop)

Submitter: James J. Rogers, Bay State Inspectional Agency
Recommendation: Revise text to read as follows:
Service Drop. (The overhead service conductors between the utility distribution system and the service point for the premises wiring system).
Substantiation: This proposal is being submitted by a task group that has been formed by Panel Chair, Ronald Toomer, in response to instructions that were presented to Code-Making Panel 4 by the Technical Correlating Committee as a result of some proposals that were submitted in the last cycle. These proposals spurred some discussion that resulted in differing opinions relative to the use of the term “Service Lateral”. The members of the task group are as follows: Larry D. Cogburn, Chair, Robert J. Deaton, James J. Rogers, John A. Sigmund, and John W. Young.
Panel Meeting Action: Accept in Part
Delete the word “service” between overhead and conductors and omit “for the premises wiring system”.
Panel Statement: The definition of service drop is being revised to clearly identify these overhead conductors as being under the exclusive control of a serving utility. The word "service" was removed to harmonize with the definition of service conductors. The remainder of the words after service point were removed for clarity.

4-9 Log #3525 NEC-P04 Final Action: Accept in Principle
(100. Service Drop)

Submitter: Phil Simmons, Olympia, WA
Recommendation: Revise the existing text of the 2008 NEC as follows:
Service Drop. The overhead service conductors from the service point last pole or other aerial support to and including the splices, if any, connecting to the point of connection to service-entrance conductors at the building or other structure.
FPN: If the service point is at the weatherhead or other point of connection to service-entrance conductors, there may not be a service drop that is covered by the NEC.
Substantiation: This proposed change recognizes that the definition of Service Conductors in Article 100 states “The conductors from the service point to the service disconnecting means.” Thus, service drops, if provided, controlled, and maintained by the electric utility, are on the supply side of the “service point” as defined in Article 100 and are not covered by the Code as stated in 90.2(B)(5).
The proposed Fine Print Note will assist the user of the NEC to understand the concepts included in the definition of “service drop.”
Panel Meeting Action: Accept in Principle

Panel Statement: See panel action and statement on Proposal 4-8. The FPN is not necessary.
The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main control and cutoff of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of “service drops” and “service laterals”. Those, too, are utility installed extensions of the services. What comes after the “point of delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.

It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground) need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of “Service Drop” and “Service Lateral” are “by current definitions and code requirements, not limited to the ‘utility company side of the service point.’” This revised definition, as well as a corresponding proposed change to the definitions of “Service Cable” to “Service-Entrance Cable” and “Service Conductors” to “Service-Entrance Conductors” (and corresponding changes to related NEC Sections that use these terms as well as “Service Drop” and “Service Lateral”) will clarify the application of NEC requirements.

By changing this definition (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

Common misunderstandings are that service entrance equipment is manufactured with special bracing and that breakers for service entrance equipment are especially listed for use in service entrance equipment. In UL 869A, fourth edition, one learns in Section 14.2, Insulated neutral, Paragraph 14.2.1, that, “Equipment having a neutral insulated from the enclosure, intended for use as service equipment, and that can accommodate not more than six main disconnecting means shall be marked “Suitable for use as service equipment.”

The requirements for equipment to be marked and identified as suitable for use as service equipment are in the product standards. If the equipment is listed and marked then it can be used as service equipment, which is defined.
Service Lateral. The underground service conductors between the street main, including any risers at a pole or other structure or from transformers, and the first point of connection to the service-entrance conductors in a terminal box or meter or other enclosure, inside or outside the building wall. Where there is no terminal box, meter, or other enclosure, the point of connection is considered to be the point of entrance of the service conductors into the building.

Substantiation: The current definition of Service Lateral refers to underground "service conductors". Because "service conductors" is also a defined term, ("The conductors from the service point to the service disconnecting means"), there can be no NEC defined service lateral conductors on the utility side of the service point. This creates a conflict when applying the definitions to the requirements of other code sections that refer to service laterals. 230.40 states: "Each service drop or lateral shall supply only one set of service-entrance conductors". With the current definition, for example, there is no "service lateral" on an underground service where the service point is at the point of connection to the service entrance conductors in a terminal box or meter or other enclosure, and therefore, the requirements of 230.40 do not apply. The current definition is also in conflict with 90.2(B)(5)a. This section refers to a service lateral that is under the exclusive control of an electric utility. Removing the word "service" from the definition of service lateral would include the conductors on the utility side of the service point in the definition of service lateral, thus allowing us to recognize these conductors as service lateral conductors for application of other code requirements. This change would not affect the scope of enforcement of these conductors because 90.2 is very clear that conductors under the exclusive control of an electric utility are not covered by the NEC.

A similar change is being proposed to the definition of "service drop".

Panel Meeting Action: Accept in Principle
Panel Statement: See panel action and statement on proposal 4-15 and 4-16.

Recommendation: Revise text to read as follows:

Service Lateral. The underground service conductors between the street main, including any risers at a pole or other structure or from transformers, and the first point of connection to the service-entrance conductors in a terminal box or meter or other enclosure, inside or outside at the building wall. Where there is no terminal box, meter or other enclosure, the point of connection is considered to be the point of entrance of the service conductors into the building.

Substantiation: The existing definition has been misinterpreted when a remote meter or terminal box has been installed. It implies that at the remote meter or terminal box the service lateral ends because this is the "first" point of connection. This change would clarify that the service lateral ends at the building or structure where the service equipment is located.

Panel Meeting Action: Accept in Principle
Panel Statement: See panel action and statement on proposal 4-15 and 4-16.
Revise the definition of service lateral and add the following new fine print note in Article 100 as follows.

Service Lateral. The underground service conductors between the utility source of supply, street main, including any risers at a pole or other structure or from transformers, and the first point of connection to the service-entrance conductors in a terminal box or meter socket or other enclosure, inside or outside the building wall. Where there is no terminal box, meter socket, or other enclosure, the point of connection is considered to be the point of entrance of the service conductors into the building.

FPN. Service laterals are typically on the line side of the service point provided by the serving utility’s conditions of service. See Figure 90.2 for a general illustration of where utility electric supply and premises wiring meet for what is covered by this Code and what is not covered.

Substantiation: As the Edison Electric Institute NESC & NEC representative in meetings of the NESC and NEC Committees’ Ad Hoc Task Group on July 10th and Sep. 30th, 2008, I am submitting this proposal based upon discussions in those meetings to mitigate conflicts between the NESC and NEC documents. Several companion proposals regarding this subject are submitted to 90.1(C), 90.2, 90.2(A), 90.2(A)(3), 90.2(A)FPN new, 90.2(B)FPN new, 90.2(B)(5), 90.2(B)FPN to (4) & (5), and Article 100 Definitions for Exclusive Control (new), Restricted Access (new), Service Drop, Service Point, and Utilization Equipment.

This is one action along with the companion proposals to resolve the ongoing conflict in 90.2(B)(5)b contained in the 2008 NEC caused by the removal of the words “or by other agreements”.

Refer to the NFPA Standards Council Appeals Hearings on the 2008 NEC adoption in July 2007 in Final Decision on Appeal numbers #07-24 (SC# 07-7-39) and #07-7 (SC# 07-7-5-m) in the NFPA archives (http://www.nfpa.org/itemDetail.asp?categoryID=837&itemID=35006 and http://www.nfpa.org/assets/files/PDF/Standards%20Council/TranscriptSCMeetingJuly07.pdf).

Specifically, the rationale for this change is to provide clarity where the NEC applies to premises wiring meeting the supply facilities under exclusive control of utilities at the service point and to separately derived systems that are not connected to a service point. The service lateral consists of underground conductors provided by the governmental or regulated serving utility’s local requirements or those of a private utility under conditions of service (e.g. tariffs with service applications). As such, premises wiring attaches to a service lateral at a service point.

Panel Meeting Action: Accept in Principle
Panel Statement: See panel action and statement on Proposals 4-15 and 4-16. The FPN is not necessary.
Service Lateral. The underground service conductors between the (service point) street main, including any risers at a pole or other structure or from transformers, and the first point of connection to the service-entrance conductors in a terminal box or meter or other enclosure, inside or outside the building wall. Where there is no terminal box, meter, or other enclosure, the point of connection is considered to be the point of entrance of the service conductors into the building.

Substantiation: This proposal is being submitted by a task group that has been formed by Panel Chair, Ronald Toomer, in response to instructions that were presented to CMP 4 by the TCC as a result of some proposals that were submitted in the last cycle. These proposals spurred some discussion that resulted in differing opinions relative to the use of the term "Service Lateral". This proposal is intended to clarify where the underground service conductors begin and end in reference to the NEC as installed by other than electric utility companies. If these conductors are installed by electric service utility companies by established agreements or easements, then the NEC does not apply and the utility can define these conductors as they see fit. The members of the task group are as follows: Larry D. Cogburn, Chair, Robert J. Deaton, James J. Rogers, John A. Sigmund, and John W. Young.

Panel Meeting Action: Accept in Principle

New Definition: Service Conductors, Underground. The underground conductors between the service point and the first point of connection to the service-entrance conductors in a terminal box, meter or other enclosure, inside or outside the building wall. Where there is no terminal box, meter, or other enclosure, the point of connection is considered to be the point of entrance of the service conductors into the building.

Panel Statement: To define the conductors provided between the service point and the service entrance conductors.

Service Lateral. The underground conductors between the utility distribution system and the service point.

Substantiation: This proposal is being submitted by a task group that has been formed by Panel Chair, Ronald Toomer, in response to instructions that were presented to CMP 4 by the TCC as a result of some proposals that were submitted in the last cycle. These proposals spurred some discussion that resulted in differing opinions relative to the use of the term "Service Lateral". This proposal is intended to clarify where service lateral conductors begin and end in reference to the NEC as installed by electric utility companies. If these conductors are installed by electric service utility companies by established agreements or easements, then the NEC does not apply and the utility can define these conductors as they see fit. The members of the task group are as follows: Larry D. Cogburn, Chair, Robert J. Deaton, James J. Rogers, John A. Sigmund, and John W. Young.

Panel Meeting Action: Accept
Phil Simmons, Olympia, WA

Revise the existing text of the 2008 NEC as follows:

Service Lateral. The underground service conductors, on the load side of the service point, between the utility supply street main, including any risers at a pole or other structure or from transformers, and the first point of connection to the service-entrance conductors in a terminal box or meter or other enclosure, inside or outside the building wall. This includes conductors from the street main, any risers at a pole or other structure, or from transformers. If there is no terminal box, meter, or other enclosure at the load end of the conductors, the point of connection is considered to be the point of entrance of the service conductors into the building.

Relocating the phrase on risers at a pole, etc., is for simplicity and clarity. Other changes are for clarity.

Section 3.3.4 of the NEC Style Manual states that “where” should not be used to mean “when” or “if.” This proposal intends to use the word “if” where appropriate.

Panel Meeting Action: Accept in Principle

Panel Statement: The definition of service lateral has been clarified See panel action and statement on Proposals 4-15 and 4-16.
Neil F. LaBrake, Jr., National Grid USA

Add the following new text for line and load sides of the service point and fine print notes to the definition of service point in Article 100 as follows. The defined term is reprinted for clarity.

**Service Point.** The point of connection between the facilities of the serving utility and the premises wiring.

*See definition for “service”.*

*See ANSI C2-2007, National Electrical Safety Code for definitions of “lines”, “electric supply station”, and “electric supply equipment” that further describe a utility supply.*

**Load Side of Service Point.** See definitions of “premises wiring (systems)” and “utilization equipment”.

**Substantiation:** As the Edison Electric Institute NESC & NEC representative in meetings of the NESC and NEC Committees’ Ad Hoc Task Group on July 10th and Sep. 30th, 2008, I am submitting this proposal based upon discussions in those meetings to mitigate conflicts between the NESC and NEC documents primarily with the location of utility facilities on private property under “other agreements”. I facilitated sub-task group teleconference sessions on July 29th, 2008 and September 9th & 15th, 2008 that included Messrs. J. Dollard, IBEW (member of the NESC-NEC Ad Hoc Task Group); P. Hickman, IBEW; and T. Adams, EEI. Subsequently, NESC members of the NESC-NEC Ad Hoc Task Group provided input to this proposal. Several companion proposals regarding this subject are submitted to 90.1(C), 90.2, 90.2(A), 90.2(A)(3), 90.2(A)FPN new, 90.2(B)FPN new, 90.2(B)(5), 90.2(B)FPN to (4) & (5), and Article 100 Definitions for Exclusive Control (new), Restricted Access (new), Service Drop, Service Lateral, and Utilization Equipment.

This is one action along with the companion proposals to resolve the ongoing conflict in 90.2(B)(5)b contained in the 2008 NEC caused by the removal of the words “or by other agreements” as encountered in the NFPA Standards Council Appeals Hearings on the 2008 NEC adoption in July 2007 *

* Refer to Final Decision on Appeal numbers #07-24 (SC# 07-7-39) and #07-7 (SC# 07-7-5-m) in the NFPA archives (http://www.nfpa.org/itemDetail.asp?categoryID=837&itemID=35006 and http://www.nfpa.org/assets/files/PDF/Standards%20Council/TranscriptSCMeetingJuly07.pdf) pertaining to this issue.

Specifically, the rationale for this change is to provide clarity where the NEC applies to premises wiring meeting the supply facilities under exclusive control of utilities at the service point and to separately derived systems that are not connected to a service point. The location of the service point and utility equipment to provide electric service to premises wiring is dependent upon the governmental or regulated serving utility’s local requirements or those of a private utility under conditions of service (e.g. tariffs with service applications). This revised term is also proposed in the NESC at this time and intended to correlate the purpose and scope of both documents.

**Panel Meeting Action:** Accept in Part

Accept the first two sentences of the FPN. Reject the remainder of the proposal.

**Panel Statement:** The first two lines of the proposed FPN adds sufficient clarity. The remainder of the proposal is not needed.
Service-entrance conductors made up in the form of a cable.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of “service drops” and “service laterals”. Those, too, are utility installed extensions of the services. What comes after the “point of delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.

It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground) need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of “Service Drop” and “Service Lateral” are “by current definitions and code requirements, not limited to the 'utility company side of the service point'.” This revised definition, as well as a corresponding proposed change to the definition of “Service Conductors” to “Service-Entrance Conductors” (and corresponding changes to related NEC Sections that use these terms as well as “Service Drop” and “Service Lateral”) will clarify the application of NEC requirements.

By changing this definition (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

Panel Meeting Action: Reject
Panel Statement: Not all service cables are service-entrance cables.

The conductors from the service point to the service disconnecting means.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of “service drops” and “service laterals”. Those, too, are utility installed extensions of the services. What comes after the “point of delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.

It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground) need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of “Service Drop” and “Service Lateral” are “by current definitions and code requirements, not limited to the 'utility company side of the service point'.” This revised definition, as well as a corresponding proposed change to the definition of “Service Cable” to “Service-Entrance Cable” and corresponding changes to related NEC Sections that use these terms as well as “Service Drop” and “Service Lateral”) will clarify the application of NEC requirements.

By changing this definition (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

Panel Meeting Action: Reject
Panel Statement: The existing definition for service-entrance conductors is correct.
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**Submitter:** Code-Making Panel 4,  
**Recommendation:** Change the definition of Service-Entrance Conductors, Overhead System to read as follows: The service conductors between the terminals of the service equipment and a point usually outside the building, clear of building walls, where joined by tap or splice to the service drop or overhead service conductors.

**Substantiation:** The panel is submitting this proposal to harmonize these definitions with the remainder of the changes made to the terms service drop and service lateral.  
**Panel Meeting Action:** Accept

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**Submitter:** Code-Making Panel 4,  
**Recommendation:** Change the definition of Service-Entrance Conductors, Underground System to read as follows: The service conductors between the terminals of the service equipment and the point of connection to the service lateral or underground service conductors.

**Substantiation:** The panel is submitting this proposal to harmonize these definitions with the remainder of the changes made to the terms service drop and service lateral.  
**Panel Meeting Action:** Accept
Any building, room, or separate space within which electric supply equipment is located and the interior of which is accessible only to qualified persons. This includes generating stations and substations, including their associated generator, storage battery, transformer, and switchgear rooms or enclosures, but does not include facilities such as pad-mounted equipment and installations in manholes and vaults.

1. Generating Station. A plant wherein electric energy is produced by conversion from some other form of energy (e.g., chemical, nuclear, solar, mechanical, or hydraulic) by means of suitable apparatus. This includes all generating station auxiliaries and other associated equipment required for the operation of the plant. Not included are stations producing power exclusively for use with communications systems.

2. Substation. An enclosed assemblage of equipment, e.g., switches, circuitbreakers, busses, and transformers, under the control of qualified persons, through which electric energy is passed for the purpose of switching or modifying its characteristics.

225.32 Other Articles.
Editorially relocate 225.2 to 225.3 to create a new 225.2.

225.89 Calculation of Loads 600 Volts, Nominal, or Less.
Editorially relocate 225.3 to 225.8 to create a new 225.2.

III. Over 600 Volts
225.50 Sizing of Conductors. The sizing of conductors over 600 volts shall be in accordance with 210.19(B) for branch circuits and 215.2(B) for feeders.

225.51 Isolating Switches. Where oil switches or air, oil, vacuum, or sulfur hexafluoride circuit breakers constitute a building disconnecting means, an isolating switch with visible break contacts and meeting the requirements of 230.204(B), (C), and (D) shall be installed on the supply side of the disconnecting means and all associated equipment. Exception: The isolating switch shall not be required where the disconnecting means is mounted on removable truck panels or metal-enclosed switchgear units that cannot be opened unless the circuit is disconnected and that, when removed from the normal operating position, automatically disconnect the circuit breaker or switch from all energized parts.

225.52 Disconnecting Means
(A) Location. A building or structure disconnecting means shall be located in accordance with 225.32, or it shall be electrically operated by a similarly located remote control device.

(B) 225.59 Type. Each building or structure disconnect shall simultaneously disconnect all ungrounded supply conductors it controls and shall have a fault-closing rating not less than the maximum available short-circuit current available at its supply terminals.

Exception: Where the individual disconnecting means consist of fused cutouts, the simultaneous disconnection of all ungrounded supply conductors is not required provided that there is a means to disconnect the load before opening the cutouts. A permanent legible sign shall be installed adjacent to the fused cutouts indicating the above requirement.

Where fused switches or separately mounted fuses are installed, the fuse characteristics shall be permitted to contribute to the fault closing rating of the disconnecting means.

(C) Locking
Disconnecting means shall be capable of being locked in the open position. The provisions for locking shall remain in place with or without the lock installed.

Exception: Where an individual disconnecting means consist of fused cutouts, a suitable enclosure, capable of being locked and sized to contain all cutout fuse holders shall be installed at a convenient location to the fused cutouts.

(D) Indicating
Disconnecting means shall clearly indicate whether they are in the open “off” or closed “on” position.

(E) Uniform Position
Where disconnecting means handles are operated vertically the “up” position of the handle shall be the “on” position.

Exception: A switching device having more than one “on” position, such as a double throw switch, need not comply with this requirement.

(F) Identification. Where a building or structure has any combination of feeders, branch circuits, or services passing through it or supplying it, a permanent plaque or directory shall be installed at each feeder and branch circuit disconnect
location denoting all other services, feeders, or branch circuits supplying that building or structure or passing through that building or structure and the area served by each.

225.56 Inspections and Tests.

(A) Pre-Energization and Operating Tests. The complete electrical system shall be performance tested when first installed on site. Each protective, switching, and control circuit shall be adjusted in accordance with recommendations of the protective device study and tested by actual operation using current injection or equivalent methods as necessary to ensure that each and every such circuit operates correctly to the satisfaction of the authority having jurisdiction.

(1) Instrument Transformers. All instrument transformers shall be tested to verify correct polarity and burden.

(2) Protective Relays. Each protective relay will be demonstrated to operate by injecting current (and/or voltage) at the associated instrument transformer output terminal and observing that the associated switching and signaling functions occur correctly and in proper time and sequence to accomplish the protective function intended.

(3) Switching Circuits. Each switching circuit will be observed to operate the associated equipment being switched.

(4) Control and Signal Circuits. Each control or signal circuit will be observed to perform it’s proper control function or produce a correct signal output.

(5) Metering Circuits. All metering circuits will be verified to operate correctly from potential and current sources similarly to protective relay circuits.

(6) Acceptance Tests. Complete acceptance tests shall be performed after the station installation is completed, on all assemblies, equipments, conductors, control and protective systems as applicable to verify the integrity of all the systems.

(7) Relays and Metering Utilizing Phase Differences. All relays and metering which use phase differences for operation shall be verified by measuring phase angles at the relay under actual load conditions after operation commences, which may be at a later date than Pre-energization tests.

(B) Test Report. A test report covering the results of the tests required in 225.56(A) shall be delivered to the authority having jurisdiction prior to energization.


225.60 Clearances over Roadways, Walkways, Rail, Water, and Open Land.

(A) 22 kV, Nominal, to Ground or Less. The clearances over roadways, walkways, rail, water, and open land for conductors and live parts up to 22 kV, nominal, to ground or less shall be not less than the values shown in Table 225.60.

Table 225.60 Clearances over Roadways, Walkways, Rail, Water, and Open Land

***Insert Table Here***

(B) Over 22 kV Nominal to Ground. Clearances for the categories shown in Table 225.60 shall be increased by 10 mm (0.4 in.) per kV above 22,000 volts.

(C) Special Cases. For special cases, such as where crossings will be made over lakes, rivers, or areas using large vehicles such as mining operations, specific designs shall be engineered considering the special circumstances and shall be approved by the authority having jurisdiction.

FPN: For additional information, see ANSI C2-2007, National Electrical Safety Code.

225.61 Clearances over Buildings and Other Structures.

(A) 22 kV Nominal to Ground. The clearances over buildings and other structures for conductors and live parts up to 22 kV, nominal, to ground or less shall be not less than the values shown in Table 225.61.

Table 225.61 Clearances over Buildings and Other Structures

***Insert Table 225.61 Here***

(B) Over 22 kV Nominal to Ground. Clearances for the categories shown in Table 225.61 shall be increased by 10 mm (0.4 in.) per kV above 22,000 volts.

FPN: For additional information, see ANSI C2-2007, National Electrical Safety Code.

225.70 Substations

(A) Warning Signs.

(1) General. A permanent, legible warning notice carrying the wording “DANGER — HIGH VOLTAGE” shall be placed in a conspicuous position in the following areas:

(a) At all entrances to electrical equipment vaults, electrical equipment rooms, areas, or enclosures; and

(b) At points of access to conductors on all high voltage conduit systems and cable systems; and

(c) On all cable trays containing high-voltage conductors with the maximum spacing of warning notices not to exceed 3
m (10 ft.); and

(2) Isolating Equipment. Permanent legible signs shall be installed at isolating equipment warning against operating it while carrying current, unless the equipment is interlocked so that it cannot be operated under load.

(3) Fuse Locations. Suitable warning signs shall be erected in a conspicuous place adjacent to fuses, warning operators not to replace fuses while the circuit is energized.

(4) Backfeed. The following steps shall be taken where the possibility of backfeed exists:
   (a) Each group-operated isolating switch or disconnecting means shall bear a warning notice to the effect that contacts on either side of the device may be energized; and
   (b) A permanent, legible, single-line diagram of the station switching arrangement, clearly identifying each point of connection to the high-voltage section, shall be provided in a conspicuous location within sight of each point of connection.

(5) Metal Enclosed and Metal Clad Switchgear. Where metal enclosed switchgear is installed the following steps shall be taken:
   (a) 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 to (a): 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.

   (b) 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” to warn of the danger of opening while energized.

   (c) Where the panel gives access to parts that can only be de-energized and visibly isolated by the serving utility, the warning shall add that access is limited to the serving utility or following an authorization of the serving utility.

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, and Jim Dollard.

The following substantiation is separated to provide clarity:

225.2
A new .2 section is created for definitions in accordance with the NEC Manual of Style. The term “Electric Supply Station” is defined with a definition in ANSI/IEEE C2-2007, National Electrical Safety Code.

225.3 & 225.8
In order to add a new 225.2 for definitions, it is necessary to editorially relocate 225.2 to 225.3 and 225.3 to 225.8.

225.52
The existing text of this section is editorially separated into two new first level subdivisions for clarity and usability. The text is separated into (A) Location and (B) Type to logically separate the information in accordance with the NEC Manual of Style.

A new first level subdivision “(C) Locking”, is added to require that the disconnecting means addressed in 225.52 be capable of being locked in the open position for safety. This text mirrors the text that presently exists in 490.44(C) and is necessary in Part III of Article 225. A high voltage substation may rely on different types of disconnects as well as isolation switches for the purposes of this section and this requirement is necessary in Article 225.

A new first level subdivision “(D) Indicating”, is added to require that the disconnecting means addressed in 225.52 clearly indicate whether they are in the open “off” or closed “on” position. This text mirrors the text that presently exists in 240.81 and is necessary in Part III of Article 225. The requirements of 240.81 exist in Part VII of Article 240 and apply only to circuit breakers. The requirement in 404.7 does not adequately address indication requirements for high voltage disconnecting means.

A new first level subdivision “(E) Uniform Position”, is added to require that the disconnecting means handles addressed in 225.52 are operated vertically so that the “up” position of the handle shall be the “on” position. This text mirrors the text that presently exists in 240.81 and is necessary in Part III of Article 225. The requirements of 240.81 exist in Part VII of Article 240 and apply only to circuit breakers.

225.56
The installation of substations requires that the overcurrent protection be provided with a designed system consisting of instrument transformers, protective relays, switching circuits, conrol circuits, signal circuits, metering circuits, as well as relays and metering utilizing phase differences. This type of installation requires pre-energization and operating tests to verify proper operation and for the submission of acceptance test criteria to the AHJ. The FPN refers the code user to the industry standard, NETA ATS-2007 for acceptance testing.
The text in this section is derived primarily from the Ontario Code, Section 36 High-Voltage Installations. This document is attached to the proposal for your information.

First level subdivision “(A) Warning Signs”, provides prescriptive requirements for signage in different areas of a substation as outlined below:

1. General. This second level subdivision provides general signage requirements throughout the substation.
2. Isolating Equipment. This signage requirement is intended to prevent someone from opening an isolation switch under load.
3. Fuse Locations. This signage requirement is intended to prevent the replacement of fuses while the supply circuit is energized.
4. Backfeed. This signage requirement is intended to prevent injury and damage to equipment where a potential backfeed situation exists.
5. Metal Enclosed Switchgear. This signage requirement is intended to provide installer/maintainers with necessary information including, single line diagram, interlocks, isolation means, all possible sources of voltage and signs on equipment which allow access to energized parts.

Panel Meeting Action: Accept in Principle

Revise 225.56(A)(2) of the submitter's text as follows: (2) Protective Relays. Each protective relay will be demonstrated to operate by injecting current (and/or voltage) at the associated instrument transformer output terminal (or test switch) and observing that the associated switching and signaling functions occur correctly and in proper time and sequence to accomplish the protective function intended.

Panel Statement: The general practice is to inject current at the test switch to prove protective relay connections and functions.

The panel accepts the remainder of the recommendation as submitted.
Submitter: Donald W. Zipse, Electrical Forensics, LLC

Recommendation: Delete the following words from Section 225.4, Exception, “and grounded circuit conductors.”

Substantiation: By continuing to allow the “grounded circuit conductors”, commonly referred to as the neutral to be installed bare allows the neutral current to flow uncontrolled over the earth. This uncontrolled flow of “stray current” results in the potential to harm not only humans but to cows and pigs.

“In order to have and maintain an electrical installation safe from electrical shocks and to prevent electrocution from stray current: All continuously, flowing man made electric current shall be contained within a conductor, insulated from earth, except at one place within the system and only one place can the neutral be connected to earth.”

This is accomplished within industrial facilities since they do not make the bastardized electrical transformer connection between the primary neutral and the secondary neutral, which allows the continuous flow of dangerous and hazardous high voltage neutral current over the earth and ground conductors. The industrial facilities keep the neutral insulated and carry the ground conductor with the phase conductors. (See IEEE Standard 141, “Electrical Power Distribution”, The Red Book.)

Within the past three years 4 young people were injured due to the uncontrolled flow of neutral current in the earth. Two suffered permanent brain damage and another was declared dead due to electrocution from neutral current (Bryan K. Fitzpatrick ("Bryan") and Diana J. Fitzpatrick ("Diana"), individually, and Timothy Sean Fitzpatrick ("Timothy"), a minor, by and through his Next Friend Bryan K. Fitzpatrick).

Over thirty years ago the Code Making Panel charged with trailers realized persons were being killed by neutral current flowing uncontrolled on the trailers and the over the earth. That panel required an insulated neutral conductor run to all trailers. The next code cycle the panel responsible for marinas adopted the same requirement for insulated neutrals. For 21 years code proposals were submitted to a third panel to make the neutral insulated, which after seven (7) code cycles they did.

Am I going to have to submit this code proposal multiple times until this code panel follows the actions of three previous Code Making Panels making the neutral an insulated conductor, based on safety to the public? I hope NOT.

Panel Meeting Action: Reject

Panel Statement: The conductors are outdoor overhead conductors. They are not installed in the earth and as such they can be bare.

The exception that the submitter has referenced refers to overhead conductors and only if such an installation is specifically permitted elsewhere in the NEC. Installations in existing facilities commonly utilize this exception where feeders are run between buildings and overhead cables are installed that utilize a bare support conductor that also serves for feeder circuit neutral and grounding purposes. The new requirements found in Section 250.32 limit installations such as this to existing installations only, and this exception is required for these existing installations.

Submitter: James M. Daly, Upper Saddle River, NJ

Recommendation: Change “computed” to “calculated”.

Substantiation: The term “calculated” more accurately describes the operation. It is not necessary to have a computer to do the calculations, they can also be done manually.

This is one of a series of proposals to provide consistent terminology throughout the code.

Panel Meeting Action: Accept
Frederic P. Hartwell, Hartwell Electrical Services, Inc.

Delete the clause “where the luminaires are not less than 900 mm (3 ft) from windows, platforms, fire escapes, and the like.”

With current luminaire construction and grounding requirements the continuing presence of this rule is very difficult to defend. Consider, for example, the conventional bollard-style luminaires operating at 277 volts that mount on grade. Any two-year old can toddle up to one of those and hug it with no code objection. There are no branch-circuit limitations in 210.6(C) that correlate with this rule, so there are no placement limitations for these luminaires indoors, even in environmentally challenging areas such as commercial locker rooms. However, woe betides an installer who places such a luminaire near a fire escape landing, or even near a window.

This proposal is a modest step; a more comprehensive step (not proposed at this time) would be to delete both this paragraph and also (D) in their entirety on the grounds that 210.6 adequately covers the topic. Certainly 210.6(D) does not leave much for 225.7(D) to do, and 210.6(C) covers 225.7(C) except for a spacing limit for certain locations that is very difficult to explain. This section carried a minimum height above grade limitation until the 1987 NEC, however, that has now been gone over two decades and these limits should keep it company.

Panel Meeting Action: Accept

Dan Leaf, Seneca, SC

Delete text and substitute: Wiring methods on the exterior of buildings and structures shall be identified as suitable for the use.

Present listed wiring methods do not include other suitable methods such as raceways, cable trays, auxiliary gutters, structures other than “buildings” should be included.

The submitter has not provided sufficient documentation as to what text is recommended for deletion. He also has not submitted any documented problem with the existing requirement.

Panel Meeting Action: Reject

Jerry Feagans, City of St. Louis

Revise text to read as follows:

As open wiring on insulators, as multi conductor, as Type MC cable as Type UF cable, as type MI Cable, as messenger-supported wiring in rigid metal conduit, in intermediate metal conduit, in rigid nonmetallic PVC conduit

Conforming to style manual Article 352.

Panel Meeting Action: Accept in Principle

See the panel action and statement in Proposal 4-28.
4-28     Log #4728  NEC-P04
(225.10) Final Action: Accept in Principle

Submitter: James M. Imlah, City of Hillsboro
Recommendation: Revise text to read as follows:

225.10 Wiring on Buildings.

The installation of outside wiring on surfaces of buildings shall be permitted for circuits of not over 600 volts, nominal, as open wiring on insulators, as multiconductor cable, as Type MC cable, as Type UF cable, as Type MI cable, as messenger-supported wiring, in rigid metal conduit, in intermediate metal conduit, in rigid polyvinyl chloride Conduit (PVC), reinforced thermosetting resin conduit (RTRC), in cable trays, as cablebus, in wireways, in auxiliary gutters, in electrical metallic tubing, in liquidtight flexible metal conduit, in liquidtight flexible nonmetallic conduit, and in busways. Circuits of over 600 volts, nominal, shall be installed as provided in 300.37.

Substantiation: This is an addition from the result of the 2008 adding of new code sections for specific nonmetallic raceways and the conditions for their intended use. Both rigid polyvinyl chloride conduit (PVC) and reinforced thermosetting resin conduit (RTRC) are now separate articles are allowed to be installed on buildings as permitted uses.

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

NFPA-70 2008 NEC

Panel Meeting Action: Accept in Principle

Panel Statement: The panel revised the text for clarification.

4-29     Log #4738  NEC-P04
(225.10) Final Action: Accept in Principle

Submitter: James M. Imlah, City of Hillsboro
Recommendation: Revise text to read as follows:

225.10 Wiring on Buildings.

The installation of outside wiring on surfaces of buildings shall be permitted for circuits of not over 600 volts, nominal, as open wiring on insulators, as multiconductor cable, as Type MC cable, as Type UF cable, as Type MI cable, as messenger-supported wiring, in rigid metal conduit, in intermediate metal conduit, in rigid polyvinyl chloride Conduit (PVC), reinforced thermosetting resin conduit (RTRC), in cable trays, as cablebus, in wireways, in auxiliary gutters, in electrical metallic tubing, in liquidtight flexible metal conduit, in liquidtight flexible nonmetallic conduit, and in busways. Circuits of over 600 volts, nominal, shall be installed as provided in 300.37.

Substantiation: This is an addition from the result of the 2008 adding of new code sections for specific nonmetallic raceways and the conditions for their intended use. Both rigid polyvinyl chloride conduit (PVC) and reinforced thermosetting resin conduit (RTRC) are now separate articles are allowed to be installed on buildings as permitted uses.

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

NFPA 70, 2008 NEC

Panel Meeting Action: Accept in Principle

Panel Statement: See the panel action and statement in Proposal 4-28.
Submitter: Allen L. Clapp, Power & Communication Utility Training Center

Recommendation: Revise text to read as follows:

225.18 Clearance for Overhead Conductors and Cables.

Overhead spans of open conductors and open multicore cables of not over 600 volts, nominal, shall have a clearance of not less than the following when at maximum final sag resulting from ice load or thermal load losses, whichever is greater:

FPN: New, unstretched wires are installed at initial sag conditions. Over time, the weight, wind, and ice loading received in service will cause inelastic (non-recoverable) deformation (permanent stretching) in the wire. Final sag conditions occur when further inelastic deformation is reduced to a negligible amount. Maximum sag occurs when the combination of (a) elastic deformation due to thermal or ice loading and (b) inelastic deformation is the greatest. Rule 230A4, Rule 232A, and Appendix B of the National Electrical Safety Code ANSI C2-2007 contain information on (a) calculating the inelastic deformation due to conductor/cable weight, ice loading, and wind loading that is appropriate for various loading areas and useful in calculating maximum final sag and (b) appropriate conductor temperatures and ice loading useful in determining conditions that will produce maximum final sag, respectively.

(1) 3.0 m (10 ft) — above finished grade, sidewalks, or from any platform or projection from which they might be reached where (a) the voltage does not exceed 150 volts to ground and (b) the area is accessible to pedestrians only

(2) 3.7 m (12.0 ft) 3.8 m (12.5 ft) — over portions of residential property and residential driveways, and those commercial areas where (a) such portions are not subject to truck traffic and where (b) the voltage does not exceed 300 volts to ground

EXCEPTION: This clearance may be reduced to 3.7 m (12.0 ft) for cables with insulated conductors cabled together with an effectively grounded, bare neutral or messenger; this exception does not apply for cables having an insulated neutral or messenger

(3) 4.5 m (15 ft) — for those areas listed in the 3.7-m (12-ft) classification where the voltage exceeds 300 volts to ground

(4) 5.5 m (18 ft) — over public streets, alleys, roads, parking areas subject to truck traffic, driveways on other than residential property, portions of driveways on residential property subject to truck traffic, and other land traversed by vehicles, such as cultivated, grazing, forest, and orchard.

Substantiation: This proposal contains three types of changes. The first addresses the need to assure that the conductors will not sag enough after installation to produce vertical clearances less than those required by this NEC section. The second addresses the need to recognize that the front portions of most residential driveways are general-use driveways and subject to truck traffic. The third prohibits use of the reduced clearance of 12 ft for service drops to commercial buildings.

To assure that conductors and cables are installed high enough to maintain the required clearance throughout their life, and not just at installation, consideration of sag changes due to their own weight, ice loading, and thermal loading is necessary. The National Electrical Safety Code contains appropriate information for use in calculating maximum final sags to assure that vertical clearances are met and is, therefore, a good reference.

Many portions of residential property are subject to truck traffic. In particular, the front portion of most residential driveways is subject to moving vans, delivery trucks, and ambulances. As a result of hundreds of service drops being torn down in the 1980s, the NESC raised the clearances required for service drops above driveways and limited the application of the reduced clearance of 12 ft (applicable only to service drops) to only those residential buildings where the height of the building did not allow achieving the full clearance value of 16.0 ft required by NESC Table 232-1. Some of the service-drop teardown accidents reviewed had serious safety consequences. In some cases, service drops torn down by moving vans and delivery trucks (which often exceed 12 ft in height) were touched in a damaged area by personnel trying to move them out of the way. In others, ambulances cut off the lights and power to houses to which they were making an emergency response call. Since this NEC section does not cover service drops, there is no reason to allow less than the normal line clearances.

The NESC clearances to ground are based upon review of more than twenty years of accident data, as well as the general history of above-ground clearances. Clearances for open wire (whether bare or covered) are required to be greater than those for multiplex cable (duplex, triplex, and quadruplex) with an effectively grounded bare neutral or messenger. Those NESC Table 232-1, Category 5 clearances are 12.0 ft for multiplex cable with bare neutrals/messengers and 12.5 ft for open wire (bare or covered wire) above areas not subject to trucks (vehicles defined as being greater than 8 ft in height), riders on horseback or other large animals, etc. Where subject to trucks, riders on
horseback, etc., NESC clearances are 16.0 ft and 16.5 ft, respectively. It is recommended that, at a minimum, the NEC match the NESC clearances. Thus, the clearances in 225.18(2) should be increased for open wire to match those of NESC Table 232-1, Category 5.

The above proposal was worded in a manner to make the least changes to the existing language as practical. However, you may find that the following language may be preferable for subpart 4:

4) 5.5 m (18 ft) — over public streets, alleys, roads, parking areas, driveways (excluding portions of driveways on residential property not subject to truck traffic), and other lands (such as cultivated, grazing, forest, and orchard lands) subject to truck traffic, driveways on other than residential property, and other land such as cultivated, grazing, forest, and orchard.

I am a licensed Professional Engineer with over 400 electric and communication utilities and large industrial complexes as clients. I am a member of NFPA, IEEE, and IAEI. I have used both the National Electrical Code and the National Electrical Safety Code in my work since 1964. I have been a member of NESC subcommittees since 1971 and have served several times over the years on NESC/NEC coordination task forces. I have reviewed over 20 years of electrical accident data in that capacity. I have also been involved in over 600 accident investigation and litigation assignments over the years. The above proposal is made to (a) improve safety and (b) harmonize certain requirements of the NEC with those of the NESC to limit the opportunity for confusion.

Panel Meeting Action: Reject
Panel Statement: The submitter has submitted a proposal whereby the only calculation formula is defined in a different ANSI Standard, the National Electrical Safety Code. This additional standard is not uniformly adopted and it would be impossible for local AHJs to enforce this requirement and installers to comply with it. Article 225 applies to outside feeders and branch circuits, both are clearly premises wiring systems and are on the customer side of the “Service Point,” and these particular installations have nothing to do with service drops at the interface of residential driveways and streets as referenced by the submitter. In addition these conductors have to have properly sized short circuit, ground fault, and overload protection at their point of supply and thus are not as susceptible to personnel hazard as utility supply conductors would be. The submitter has not defined any documented problems with the existing requirements.
Add the following to 225.18 Clearance from Grade:

"(5) 7.5 m (24.5 ft) - over track rails of railroads."

There is currently no specified height for these conductors above a railroad. We have many industrial facilities where rail is used throughout the facility and the conductors are owned and maintained by the facility. The height requirements are from tables found in ANSI C2, National Electrical Safety Code, which we have used since there is no mention in the NEC.

Panel Meeting Action: Accept in Part

Add the following text:

The panel accepts the addition of text "(5) 7.5 m (24.5 ft) - over track rails of railroads." and rejects the title change. The title already was changed in the 2008 code.

Panel Statement: The panel accepts the addition of text "(5) 7.5 m (24.5 ft) - over track rails of railroads" and rejects the title change. The title already was changed in the 2008 code.
225.19 Clearances from Buildings for Conductors of Not over 600 Volts, Nominal, Passing but Not Attaching To Buildings or Other Nonbridge Installations

The following clearances apply to conductors and cables passing but not attaching to buildings.

FPN: For service drop clearances, see 230.24.

Horizontal clearances shall be not less than the following values when at rest without wind deflection. Vertical clearances shall be not less than the following values when at maximum final sag resulting from ice loading or thermal line losses, whichever is greater:

FPN: New, unstretched wires are installed at initial sag conditions. Over time, the weight, wind, and ice loading received in service will cause inelastic (nonrecoverable) deformation (permanent stretching) in the wire. Final sag conditions occur when further inelastic deformation is reduced to a negligible amount. Maximum sag occurs when the combination of (a) elastic (recoverable) deformation due to thermal or ice loading and (b) inelastic deformation is the greatest. Rule 230A4, Rule 232A, and Appendix B of the National Electrical Safety Code ANSI C2-2007 contain information on (a) calculating the inelastic deformation due to conductor/cable weight, ice loading, and wind loading that is appropriate for various loading areas and useful in calculating maximum final sag and (b) appropriate conductor temperatures and ice loading useful in determining conditions that will produce maximum final sag, respectively.

(A) Vertical Clearances Above Building Roofs. Overhead spans of open conductors and open multiconductor cables shall have a vertical clearance of not less than 2.5 m (8 ft) 3.0 m (10 ft) above the roof surface (if the surface is not readily accessible to pedestrians) or 3.4 m (11 ft) above the roof surface (if the surface is readily accessible to pedestrians). The vertical clearance above the roof level shall be maintained for a distance not less than 900 mm (3 ft) as a diagonal arc from the edge of the roof over to a vertical extension of the horizontal clearance required by (B) below.

Exception No. 1: The area above a roof surface subject to pedestrian or vehicular traffic shall have a vertical clearance from the roof surface in accordance with the clearance requirements of 225.18.

Exception No. 2: Where the voltage between conductors does not exceed 300, and the roof has a slope of 100 mm in 300 mm (4 in. in 12 in.) or greater, a reduction in clearance to 900 mm (3 ft) shall be permitted:

Exception No. 3: Where the voltage between conductors does not exceed 300, a reduction in clearance above only the overhanging portion of the roof to not less than 450 mm (18 in.) shall be permitted if (1) not more than 1.8 m (6 ft) of the conductors, 1.2 m (4 ft) horizontally, pass above the roof overhang and (2) they are terminated at a through-the-roof raceway or approved support.

Exception No. 4: The requirement for maintaining the vertical clearance 900 mm (3 ft) from the edge of the roof shall not apply to the final conductor span where the conductors are attached to the side of a building.

(B) Clearances From Nonbuilding or Nonbridge Structures. From signs, chimneys, radio and television antennas, tanks, and other nonbuilding or nonbridge structures, clearances — vertical, diagonal, and horizontal — shall not be less than 900 mm (3 ft); the following. The diagonal clearance in the transition zone between vertical and horizontal clearances shall be not less than the vertical clearance requirement.

***Insert Table Here***

(C) Horizontal Clearances from Buildings. Clearances shall not be less than 900 mm (3 ft) 1.5 m (5.0 ft).

Substantiation: Exceptions 2, 3, and 4 apply only to service drops, which are covered in 230.24 and should not be duplicated here. Having the duplicate here causes confusion, in that some think that ordinary secondary wires or cable passing by a building can have the lower clearances.

I have also proposed adding language relative to final sag at this location similar to that recommended in separate proposals for 225.18 and 230.24(B). Wires must be installed high enough at installation to allow the required clearances to be met under all conditions of expected loading. The effect of both inelastic deformation and elastic deformation must be considered.

The remainder of this proposal is to harmonize the NEC clearance values with those of the NESC.

As a part of my NESC Clearances Subcommittee work, I led the review of electrical accidents relating to construction and maintenance of buildings and other installations adjacent to energized power lines in the 1970s and again in the 1980s. In each case, we had a solid 10 years of accident data gathered from state public service commissions and
electric utilities across the nation, with the outlying and overlapping information spanning approximately 24 years. The review was performed by a special task force of utility engineers, consulting engineers, and public service commission engineers familiar with both building construction and maintenance and utility line construction.

This work was done as a part of a complete coordination of NESC line clearances to assure that appropriate amounts of clearance were required in each type of area. Several NESC clearances to buildings and other installations were adjusted at that time to match the accident data. The history of these changes is written up in the NESC Handbook at the discussion of Rule 234C. The basis for the 1990 and later NESC clearances, including the electrical and mechanical components of clearance and the dimensions of expected conflicting activity, can be found in Appendix A of the NESC.

The above proposals are made to adjust NEC clearances to match the accident data that was available to us and assure that appropriate clearances are required by the NEC, based upon both the expected activity in the area over which or beside which the conductor exists and the relative voltage of the conductor.

The values that are not adjusted either match or exceed those required by the NESC and are not proposed to be changed. The values for portions of signs, etc., upon which personnel walk are new to the NEC. The changes in other values are necessary to limit contact by those working or playing on the surfaces of the buildings, signs, etc., as applicable.

I am a licensed Professional Engineer with over 400 electric and communication utilities and large industrial complexes as clients. I am a member of NFPA, IEEE, and IAEI. I have used both the National Electrical Code and the National Electrical Safety Code in my work since 1964. I have been a member of NESC subcommittees since 1971 and have served several times over the years on NESC/NEC coordination task forces. I have also been involved in over 600 accident investigation and litigation assignments over the years. The above proposal is made to (a) improve safety and (b) harmonize certain requirements of the NEC with those of the NESC to limit the opportunity for confusion.

Panel Meeting Action: Reject
Panel Statement: The submitter has submitted a proposal whereby the only calculation formula is defined in a different ANSI Standard, the National Electrical Safety Code. This additional standard is not uniformly adopted and it would be impossible for local AHJs to enforce this requirement and installers to comply with it. Article 225 applies to outside feeders and branch circuits, both are clearly premises wiring systems and are on the customer side of the “Service Point,” and these particular installations have nothing to do with service drops at the interface of residential driveways and streets as referenced by the submitter. In addition these conductors have to have properly sized short circuit, ground fault and overload protection at their point of supply and thus are not as susceptible to personnel hazard as utility supply conductors would be. The submitter has not defined any documented problems with the existing requirements.

Final Action: Reject

Submitter: Leo F. Martin, Jr., Martin Electrical & Technical Training Services
Recommendation: Revise text as follows:
225.31 Multiconductor Cables on Exterior Surfaces of Buildings. Supports for multiconductor cables on exterior surfaces of buildings shall be as provided in 230.51.
225.21 Support of Multiconductor Cables and Raceways. Multiconductor cables and raceways mounted on or attached to the exterior surface of a building or structure shall be supported under the conditions described in their respective articles and sections.
Substantiation: Branch circuits and feeders located in areas covered by the scope of article 225 may be installed using any of the wiring methods appropriate for the location. These wiring methods include both cables and raceways. The revised text addresses both cables and raceways, as well as buildings and structures.

Panel Meeting Action: Reject
Panel Statement: The panel agrees that all required information is not in Chapter 3.
4-34 Log #3703 NEC-P04 (225.22) Final Action: Accept

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

Recommendation: Revise 225.22 as follows:

225.22 Raceways on Exterior Surfaces of Buildings or Other Structures.
Raceways on exteriors of buildings or other structures shall be arranged to drain and shall be raintight suitable for use in wet locations.

Substantiation: Acceptance of this proposal would correlate with the Panel’s action on 230.53 during the 2008 NEC cycle. With respect to the raceways specified in the wiring methods in 225.10, the individual articles identify such raceways for their suitability for use in “wet locations.” The word “raintight” in 225.22 is overridden, or introduces confusion as to which is the true requirement.

The definition of “raceway” in Article 100 does not include fittings. Section 314.15(A) requires that “… fittings installed in wet locations shall be listed for use in wet locations,” not “raintight”. The definition of “raintight” in Article 100 contains unenforceable language “…will not result in entrance of water under specified test conditions” verifiable only for listed raceways. Raceways suitable for use in wet locations are listed for use in wet locations, not “raintight”.

Panel Meeting Action: Accept

4-35 Log #307 NEC-P04 (225.27 (New)) Final Action: Accept

Submitter: Joel A. Rencsok, Scottsdale, AZ

Recommendation: Add a new section to Article 225 which states:

225.X Raceway Seal. Where a feeder raceway enters a building or structure from an underground distribution system, it shall be sealed in accordance with 300.5(G). Spare or unused raceways shall also be sealed. Sealants shall be identified for use with the cable insulation, shield or other components.

Substantiation: Feeders entering buildings or other structures are no different than services. The requirements should be the same. See NEC 230.8.

I have provided a few photos of what can happen when an underground metal mole damaged a feeder trying to install a cable for digital cable. The sustaining arc generated hydrogen gas and the 600-ampere fuses did not blow.

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

Panel Meeting Action: Accept
Henry A. Jenkins, Wake County, Inspections Development   / Rep. N.C. Ellis Cannady Chapter of I.A.E.I

The Panel should have Accepted in Principle. We suggest the addition of a new second paragraph to read as follows:

"Where a branch circuit or feeder originates in these additional buildings or other structures, only one feeder circuit shall be permitted to supply power back to the original building or structure, unless permitted in 225.30(A) through (E)."

Insert it between the existing first sentence and the last sentence. Making the existing sentence into a separate third paragraph. The new text to read as follows:

225.30 Number of Supplies. Where more than one building or other structure is on the same property and under single management, each additional building or other structure that is served by a branch circuit or feeder on the load side of the service disconnecting means shall be supplied by only one feeder or branch circuit. A building or other structure shall be permitted to be supplied by one set of feeder conductors or by one set of branch circuit conductors unless otherwise permitted in 225.30(A) through (E). For the purpose of this section, a multiwire branch circuit shall be considered a single circuit. Feeders or branch circuits shall be permitted to run from one building or other structure to another building or other structure where the buildings or other structures are on the same property and under single management.


Recommendation: The Panel should have Accepted in Principle. We suggest the addition of a new second paragraph to read as follows:

"Where a branch circuit or feeder originates in these additional buildings or other structures, only one feeder circuit shall be permitted to supply power back to the original building or structure, unless permitted in 225.30(A) through (E)."

Insert it between the existing first sentence and the last sentence. Making the existing sentence into a separate third paragraph. The new text to read as follows:

225.30 Number of Supplies. Where more than one building or other structure is on the same property and under single management, each additional building or other structure that is served by a branch circuit or feeder on the load side of the service disconnecting means shall be supplied by only one feeder or branch circuit unless permitted in 225.30(A) through (E).

Where a branch circuit or feeder originates in these additional buildings or other structures, only one feeder or branch circuit shall be permitted to supply power back to the original building or structure, unless permitted in 225.30(A) through (E).

Substantiation: The existing text only covers one feeder or branch circuit to supplying an additional building or structure where there is more than one building on the same property and under single management. The text does not address bringing more than one feeder or branch circuit from one of these peripheral buildings back to the original building. The present text would permit an unlimited number of feeders or branch circuits to be brought back to the original building. For example, a generator could provide power for an emergency branch circuit panel in building No. 2 and any number of branch circuits could be fed from that emergency panel back to the original building to supply any number of emergency loads. The same would hold true for a feeder distribution panel.

Panel Meeting Action: Accept

Panel Statement: The panel recognizes that the new text is to be inserted between the first sentence and the last sentence. The result will be that the last sentence will become a third paragraph.
James W. Carpenter, International Association of Electrical Inspectors

Panel should have Accepted in Principle in Part. We suggest the adding of a new second paragraph to read as follows:

"Where a branch circuit or feeder originates in these additional buildings or other structures, only one feeder circuit shall be permitted to supply power back to the original building or structure, unless permitted in 225.30(A) through (E)."

Insert it between the existing first sentence and the last sentence making the existing sentence into a separate third paragraph. The new text to read as follows:

225.30 Number of Supplies. Where more than one building or other structure is on the same property and under single management, each additional building or other structure that is served by a branch circuit or feeder on the load side of the service disconnecting means shall be supplied by only one feeder or branch circuit unless permitted in 225.30(A) through (E). Where a branch circuit or feeder originates in these additional buildings or other structures, only one feeder or branch circuit shall be permitted to supply power back to the original building or structure, unless permitted in 225.30(A) through (E).

Substantiation: The existing text only covers one feeder or branch circuit to supplying an additional building or structure where there is more than one building on the same property and under single management. The text does not address bringing more than one feeder or branch circuit from one of these peripheral buildings back to the original building. The present text would permit an unlimited number of feeders or branch circuits to be brought back to the original building.

For example, a generator could provide power for an emergency branch circuit panel in Building No. 2 and any number of branch circuits could be fed from that emergency panel back to the original building to supply any number of emergency loads. The same would hold true for a feeder distribution panel.

Panel Meeting Action: Accept
Panel Statement: See the panel statement on Proposal 4-36.
Submitter: Jim Pauley, Square D Company/Schneider Electric
Recommendation: Revise the title of Part II to Article 225 to read as follows:

II. More than One Building or Other Structure Buildings or Other Supplied by a Feeder(s) or Branch Circuit(s)

In addition, revise the text of 225.30 to read as shown:

225.30 Number of Supplies. Where more than one building or other structure is on the same property and under single management, each additional building or other structure that is served by a branch circuit or feeder on the load side of the service disconnecting means shall be supplied by only one feeder or branch circuit unless permitted in 225.30(A) through (E). For the purpose of this section, a multiwire branch circuit shall be considered a single circuit.

Substantiation: The overall intent of Part II of Article 225 needs to be clarified. The present wording is leading to a significant amount of time being spent arguing over whether or not a building is supplied from another building or from a structure or from something else. It would appear that the ultimate intent of these provisions in Article 225 is to require that we have appropriate disconnecting means at any building or structure that is supplied by a branch circuit or feeder. If that is the case, why not simply revise the language to make that clear.

For example, take a building that has the service disconnect located away from the building by some distance (i.e. determined by the AHJ to not be at the building itself). The conductors from the service disconnect to the building are an outside feeder. We would expect that the provisions of Part II apply to that feeder when it gets to the building. The problem is with the present wording that says “each additional building or structure”. If the service disconnect is a pad mounted single switchboard section, the only way you can argue that Part II of 225 applies is to argue that the switchboard is a “structure”. I believe that it only adds confusion to say that a piece of electrical equipment is a structure.

The proposed revision to both the Part II title and to 225.30 would simplify the text to simply say that if you have a building supplied by a feeder or branch circuit, you have to comply with Part II. Note that the proposed title for Part II is identical to the title used by CMP 5 for 250.32. The use of the same terminology in both parts of the code would greatly benefit users in applying the proper rules.

The suggested revision to 225.30 that changes “…of the service disconnecting…” to “…of a service disconnecting… is to simply recognize that there may be more than one service disconnecting means on the premises.

Panel Meeting Action: Accept in Principle

Revise the title as follows: Buildings or Other Structures Supplied by a Feeder(s) or Branch Circuit(s).

The panel accepts the changes to the first sentence of Section 225.30.

Panel Statement: The panel accepted in principle the title change but revised the wording. The panel accepted the remainder of the proposal.
(F) Modular temporary school rooms or offices that consist of a single disconnecting means for each module shall be permitted to be served by a separate feeder for each module. The documented switching procedures required in section (E) shall apply when two or modules are combined to make a single structure.

Many schools and construction sites are now using modular school and office buildings for temporary classroom and office space. These modules often can be combined to make large office or classroom space. Each module typically comes with a separate disconnecting means because the manufacturer does not know how they will be combined at the time of manufacture. The current requirements of the NEC often times require the installer to remove the single disconnect or make the installation of multiple modules work. This change would allow multiple feeds, one to each module, for a temporary office or classroom were multiple modules are installed without decreasing safety or increasing cost to the customer.

The submitter has not presented any technical or factual data to support the requested reduction in safety requirements. The concerns expressed by the submitter are really design and installation concerns and these issues are no different when feeders are the source of supply than they are if a service is the source of supply.

Location. The disconnecting means shall be installed either inside or outside of the building or structure served or where the raceway, cable or conductors pass through the building or structure. The disconnecting means shall be at a readily accessible location nearest the point of entrance of the raceway, cable or conductors. For the purpose of this section, the requirements in 230.6 shall be utilized.

This is a companion proposal to a proposal to 230.70(A)(1) submitted in June 2008. As stated, the nearest point of entrance of these conductors is where the conductors exit the raceway or cable. A legal argument can be made that a disconnect could be installed 20, 30, or even 50 ft inside a building or structure because it would still be installed at the nearest point of entrance of the conductors as stated.

Adding the wording "raceway, cable, or" ahead of the word "conductors" clarifies the code's intent that the disconnect be at the nearest point of entrance to the building or structure.

The existing language mandates what the submitter is requesting. The term conductors is used and this generic term applies to all conductors entering a building or structure regardless of the wiring method that has been selected to contain the conductors.
Where the disconnecting means is located outside the building and is within sight of the building, an additional disconnecting means shall not be required where conductors enter the building.

Substantiation: This addition would permit the disconnect to be located up to fifty feet away from the building. Under current wording, if the disconnect is located outside and not mounted on the building, then the rules in Article 225 would require an additional disconnecting means inside the building where the conductors enter. This would seem needlessly restrictive in my opinion. This proposal also parallels the existing requirements in 700.12(B)(6), 701.11(B)(5), and 702.11 which allow the disconnecting means for a feeder to be remote from the building.

Panel Meeting Action: Reject
Panel Statement: Over the past several code cycles, CMP 4 has had to grapple with this issue of what distance from a building or structure is a safe distance for locating a disconnecting means whether it be for service conductors or feeder conductors and no agreeable distance has been found. The submitter has not presented and documented technical rationale for changing this opinion.

Submitter: Paul Guidry, Fluor Enterprises, Inc.
Recommendation: Add the following FPN under main paragraph:
FPN: For corresponding grounding requirements, see 250.32(D).

Substantiation: It's been my experience that 250.32(D) grounding requirements are missed often. Adding this FPN may aid the user by alerting them to the fact that there is more to consider when utilizing 225.32.

Panel Meeting Action: Reject
Panel Statement: Section 225.2 and its table already provide a generic reference to Article 250. Section 225.32 provides requirements for the location of a disconnecting means and would not be an appropriate area to reference grounding and bonding requirements.

Submitter: James M. Daly, Upper Saddle River, NJ
Recommendation: Revise text to read as follows:
Change “per” to “for each”.

Substantiation: This revision will comply with the recommendations in the NEC Style Manual and the Manual of Style for NFPA Technical Committee Documents and provide consistency throughout the Code. “Per” is not an appropriate term for a standard.
Submitter: Jim Davis, Electrical Education Services, LLC

Recommendation: Revise text to read as follows:

**(B) Additional Disconnecting Means.** The one or more additional disconnecting means for fire pumps or for the emergency or legally required or optional standby system permitted by 225.30 shall be installed sufficiently remote from the one to six disconnecting means for normal supply to minimize the possibility of simultaneous interruption of supply.

Substantiation: For the purpose of “locating” the disconnecting means for “optional standby systems” remote from other disconnecting means, the treatment of optional standby systems as though they were critical loads to be maintained in the ON condition in all possible cases is unnecessary. In fact, safety would be INCREASED if the disconnecting means for “optional loads” was grouped with the other “normal load” disconnecting means where fire incidences are concerned. Electrical feeders (or services) that do NOT supply life safety equipment or other legally required loads should be capable of being quickly de-energized during emergency events by locating all of the disconnecting means in close proximity. Added words are for grammatical accuracy.

Panel Meeting Action: Reject

Panel Statement: The submitter has not presented any technical rationale to support his assumption that locating the disconnects adjacent to one another enhances safety. Even though the systems he references are not legally required, these optional systems could provide assistance to building occupants or responding emergency personnel. There are requirements for proper labeling of these disconnects as to where other disconnects are located this should provide the additional safety the submitter has mentioned.

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Submitter: Dan Leaf, Seneca, SC

Recommendation: Delete and substitute:

The supply conductors and disconnecting means for circuits permitted in 225.30(A) for fire pumps, emergency systems, and legally required or optional standby systems shall be installed remote from all other supply systems to minimize the likelihood of an occurrence in one system affecting the supply of another system.

Substantiation: Edit. the supply wiring system, including supply conductors, not just disconnecting means should be separated for reliability. "Sufficiently" is subjective and a term to be avoided per the Style Manual. The panel statement for Proposal 4-21 (Log 1103) in the 2007 ROP indicated disconnects for these loads (systems) must be located remote from ANY other disconnects.

Panel Meeting Action: Reject

Panel Statement: The purpose of this requirement is to prevent accidental operation of the switches. Separation of circuits is adequately covered in 700 and 701.
Frederic P. Hartwell, Hartwell Electrical Services, Inc.

Revise to read as follows:

The disconnecting means specified in 225.31 shall be comprised of a circuit breaker, molded case switch, or a general use switch. Where applied in accordance with 250.32(B) Exception, the disconnecting means shall be suitable for use as service equipment.

Substantiation: The suitability for use as service equipment means it is capable of providing for regrounding of the neutral supply conductor. This is only permitted in accordance with the exception, and in other applications it is unnecessary. The syntax of this proposal makes it possible to leave the wording of the exception unchanged.

Panel Meeting Action: Reject

Panel Statement: There are more requirements for a device to be suitable for service use, including larger spacing. The submitter has not made it clear as to his proposed changes in accordance with Section 4.3.3 content of proposals.

Clyde V. Carl, North Carolina Dept. of Administration/State Construction Office

Add new text as follows:

FPN: Refer to UL 869A, *Reference Standard for Service Equipment*, fourth edition, for the criteria that determines a disconnecting means to be “Suitable for Service Equipment.”

Substantiation: Common misunderstandings are that service entrance equipment is manufactured with special bracing and that breakers for service entrance equipment are especially listed for use in service entrance equipment. In UL 869A, *Reference Standard for Service Equipment*, fourth edition, one learns in Section 14.2, Insulated neutral, Paragraph 14.2.1, that, “Equipment having a neutral insulated from the enclosure, intended for use as service equipment, and that can accommodate not more than six main disconnecting means shall be marked “Suitable for use as service equipment.”

Panel Meeting Action: Reject

Panel Statement: Equipment that is suitable for use as service equipment is investigated and marked accordingly as part of the listing. A user does not need to reference UL 869A. If the equipment is not marked “suitable for use as service equipment” or “service equipment” it cannot be used as such.
4-48 Log #1869 NEC-P04
(225.36 Exception) Final Action: Reject

Submitter: Dan Leaf, Seneca, SC

Recommendation: Revise exception: For garages and outbuildings on residential property, accessory buildings or structures for a dwelling unit(s) or sets of 3-way or 4-way snap switches shall be permitted to be the disconnecting means provided they comply with 404.14. Such switches installed in the supply circuit from its origin to and including the disconnecting switch for the building or structure shall have an ampere rating not less than the circuit rating.

Substantiation: The provision should cover buildings and structures not deemed buildings. "Residential" may be perceived as not including dwellings on a farm. "Snap switches" covers all types and referencing 3-way and 4-way types is superfluous. A snap switch used as the main building or structure disconnecting means should have a rating not less than the supply circuit since the calculated load on a va/sq. ft. or per outlet may not require such rating but the load capability of the circuit could be equal to its rating.

Panel Meeting Action: Reject

Panel Statement: The reference to 3-way and 4-way switches should be retained. These may be snap switches but the disconnecting functionality of these devices is quite different and could be interpreted as not being acceptable as a disconnect for a building.

In this proposal the submitter has made an effort to mark the additional wording and the deleted wording but there is wording in the proposal that is not identified as new or changed that is not in the Code.

4-49 Log #2943 NEC-P04 Final Action: Reject
(225.36 Exception)

Submitter: Phil Simmons, Simmons Electrical Services

Recommendation: Revise text to read as follows:

225.36 Suitable for Service Equipment.

The disconnecting means specified in 225.31 shall be suitable for use as service equipment.

Exception: For garages and outbuildings on residential property, a snap switch or a set of 3-way or 4-way snap switches shall be permitted as the disconnecting means.

Substantiation: The portion of the exception that permits a set of 3-way or 4-way switches to be used as the disconnecting means for garages and outbuildings should be deleted as it violates the very reason behind requiring disconnecting means which is that the electrical circuit can be safely isolated while work is being performed on conductors and equipment.

Panel Meeting Action: Reject

Panel Statement: The reference to 3-way and 4-way switches should be retained. These may be snap switches but the disconnecting functionality of these devices is quite different and could be interpreted as not being acceptable as a disconnect for a building.

In this proposal the submitter has made an effort to mark the additional wording and the deleted wording but there is wording in the proposal that is not identified as new or changed that is not in the Code.
Where a building or structure has any combination of feeders, branch circuits, service-entrance conductors, or services passing through it or supplying it, a permanent plaque or directory shall be installed at each feeder and branch disconnect location denoting all other services, feeders, or branch circuits supplying that building or structure and the area served by each. (Text to remain the same.)

Substantiation: Service-entrance conductors is one of the items to be considered that is associated with the existing text “or services”. Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding affected text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

Service-entrance Cable. Service-entrance conductors made up in the form of a cable.

Service-entrance Conductors. The conductors from the service point to the service disconnecting means.

Service Equipment. The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of “service drops” and “service laterals”. Those, too, are utility installed extensions of the services. What comes after the “point of delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.

It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground) need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of “Service Drop” and “Service Lateral” are “by current definitions and code requirements, not limited to the ‘utility company side of the service point’.” These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as “Service Drop” and “Service Lateral”) will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

Panel Meeting Action: Reject

Panel Statement: These conductors are not always service-entrance conductors.
4-51 Log #2946 NEC-P04
(225.38 Exception)

Final Action: Reject

Submitter: Phil Simmons, Simmons Electrical Services

Recommendation: Revise text to read as follows:

225.38 Disconnect Construction.
Disconnecting means shall meet the requirements of 225.38(A) through (D).

Exception: For garages and outbuildings on residential property, a snap switch or a set of 3-way or 4-way snap switches shall be permitted as the disconnecting means.

Substantiation: The portion of the exception that permits a set of 3-way or 4-way switches to be used as the disconnecting means for garages and outbuildings should be deleted as it violates the very reason behind requiring disconnecting means which is that the electrical circuit can be safely isolated while work is being performed on conductors and equipment.

Panel Meeting Action: Reject
Panel Statement: The reference to 3-way and 4-way switches should be retained. These may be snap switches but the disconnecting functionality of these devices is quite different and could be interpreted as not being acceptable as a disconnect for a building.
In this proposal the submitter has made an effort to mark the additional wording and the deleted wording but there is wording in the proposal that is not identified as new or changed that is not in the code.

4-52 Log #1770 NEC-P04
(225.39(A), (B), and (D))

Final Action: Reject

Submitter: Dan Leaf, Seneca, SC

Recommendation: Revise: (A) ONE CIRCUIT INSTALLATION. For installations to supply only limited loads consisting of a single branch circuit, the feeder and branch circuit disconnecting means shall have a rating not less than 15 amperes.

(B) TWO CIRCUIT INSTALLATION. For installations consisting of not more than two 2-wire circuits or a 2-wire feeder branch circuit, disconnecting means shall have a rating not less than 30 amperes and not less than the calculated load. The disconnecting means for a feeder supplying two multiwire branch circuits or two three-phase branch circuits shall have a rating not less than 30 amperes and not less than the calculated load.

(D) For all other installations the branch circuit and feeder disconnecting means shall have a rating not less than the calculated load 60 amperes.

Substantiation: In (A), the feeder disconnecting means should be included in the 15 ampere minimum rating. A 15 ampere circuit supplying a 15 ampere circuit breaker or fused switch is a feeder by definition.

In (B), the phrase "not more than two 2-wire circuits" includes "one" branch circuit, which is covered by (A). Two 2-wire 15 ampere branch circuits supplied by a 15 ampere 3-wire circuit (feeder) does not warrant a 30 ampere feeder disconnecting means or a 30 ampere branch circuit disconnecting means, and where a circuit breaker is used as the disconnecting means does not warrant a 30 ampere rating for a feeder rated 15 or 20 amperes.

In (D), "all other installations" includes two multiwire branch circuits or two 3-phase branch circuits, which if rated 15 amperes requires a 60 ampere disconnect which is excessive and not required for safety.

Panel Meeting Action: Reject
Panel Statement: The submitter has not presented any technical data to support the recommended changes he has presented. There is no reason to limit Part B to buildings with 2-wire feeders. The existing language allows 1 or 2 branch circuits to be installed for single circuits larger than specified in Part A and anything other than two 2-wire circuits is intended to require a minimum rating of 60 amperes for the disconnecting means.
All dwelling units shall be provided with a surge protective device (SPD) installed in accordance with Article 285. The surge protective device shall be an integral part of the service disconnecting means or shall be located immediately adjacent thereto. The surge protective device shall be a Type 1 or Type 2 SPD. Where equipment is upgraded, all of the requirements of this section shall apply.

Substantiation: This proposed requirement is submitted for consideration by the Technical Committee for the sole purpose of personnel safety. The NEC requires GFCI and AFCI protective devices throughout dwelling units. Additionally, 120-smoke alarms are required by most local building codes in all new dwelling units. In essence we have mandated electronic based protection, designed to prevent shock, fire and to alarm residents in the event of a fire. These devices have all proven that when installed and maintained properly, they will and have saved lives. This proposal seeks a level of protection for these life saving devices as well as general surge protection throughout the home.

All GFCI’s, AFCI’s and smoke alarms may be damaged when a surge occurs due to lighting or other sources. In many cases these devices can be damaged and rendered inoperable by a surge.

It is practical to require a “whole house” SPD to provide a general level of protection. Home owners regularly buy and use Type 3 (point of utilization) SPD’s which are cord and plug connected to protect computers, plasma TV’s and other electronic equipment. However, in almost all new installations as well as upgrades, no consideration is given to providing a general level of protection to the “whole house.”

Typical homeowners have no problem buying multiple Type 3 (point of utilization) SPD’s to protect equipment for entertainment purposes, the additional cost of a Type 1 or Type 2 SPD for the purpose of personnel safety will not represent a financial burden.

First level subdivision (D) is included to require that when an upgrade occurs, an SPD is to be installed. Residents of existing dwelling units deserve the same level of protection as those in new homes.

Note that a sister proposal has been submitted as a new 230.67.

Panel Meeting Action: Reject

Panel Statement: The submitter has not submitted any technical data that supports the statement relative to the installation of SPDs saving lives. These devices may protect some electronic equipment but there is no submitted documentation relative to smoke detector failures due to surges with or without SPDs. In addition, the proposal as written requires these devices as a part of a service installation and Article 225 does not address service installations. This is not an appropriate item for Article 225, which covers outside branch circuits and feeders.
This revision will comply with the recommendations in the NEC Style Manual and the Manual of Style for NFPA Technical Committee Documents and provide consistency throughout the Code. “Per” is not an appropriate term for a standard.

Panel Meeting Action: Accept

4-56 Log #3368 NEC-P04 (230.1) Final Action: Reject


Recommendation: Revise text to read as follows:

230.1 Scope. This article covers service-entrance conductors and equipment for control and protection of services and their installation requirements.

Substantiation: Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

Service-Entrance Cable. Service-entrance conductors made up in the form of a cable.

Service-Entrance Conductors. The conductors from the service point to the service disconnecting means.

Service Equipment. The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of “service drops” and “service laterals”. Those, too, are utility installed extensions of the services. What comes after the “point of delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.

It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground) need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of “Service Drop” and “Service Lateral” are “by current definitions and code requirements, not limited to the ‘utility company side of the service point’.” These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as “Service Drop” and “Service Lateral”) will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

Panel Meeting Action: Reject

Panel Statement: Article 230 still covers all service conductors that are installed on the customer side of the service point, not just service-entrance conductors.
4-57 Log #2141 NEC-P04 Final Action: Accept
(Figure 230.1)

Submitter: William Svensson, National Fuel Gas
Recommendation: Revise text as follows:

Source Serving Utility
The word "Source" near the top of Figure 230.1 Services is incorrect, it should be deleted and replaced with the words "Serving Utility".

Substantiation: The use of the word "Source" is not defined, whereas the "serving utility" is contained in the definition of "Service" in Article 100.
By definition, the "Service" is supplied only from the "Serving Utility".
This correction will help to eliminate confusion and misapplication of Article 230 to Article 215. This correction will also help to remove confusion of when to apply 250.24 or 250.30, especially with the installation of distributed generation systems.
Panel Meeting Action: Accept

4-58 Log #3687 NEC-P04 Final Action: Accept in Principle
(Figure 230.1)

Submitter: Thomas A. Domitrovich, Eaton Corp.
Recommendation: Replace "230.49" with "230.50" in Figure 230.1.

***Insert Figure 230.1 Here***

Substantiation: This figure references section 230.49 which previously, as per the 2005 NEC, was entitled "Protection Against Physical Damage - Underground". This section has been moved into section 230.50, "Protection Against Physical Damage". Figure 230.1 should accurately reference the current section.
Panel Meeting Action: Accept in Principle
Replace "230.49" with "230.32" in Figure 230.1.
Panel Statement: The correct reference is 230.32 under part III of Article 230.

4-59 Log #2052 NEC-P04 Final Action: Reject
(Figure 230.2)

Submitter: Joseph Amato, Delaware County Code Compliance
Recommendation: Revise text to read as follows:

For the purpose of 230.2, Exception No. 2. only, underground sets of conductors, 1/0 AWC and larger, running to the same location and connected together at their supply end but not connected together at their load end shall be considered to be supplying one service.

Substantiation: My thought is 1.0 or larger is intended for service laterals only. The way it is worded in 230.2 in the same paragraph that refers to 230.40, Exception No. 2 confuses people. It sounds like even underground service conductors have to be 1/0 or larger. Article 230.42 addresses size of service conductors. I don't think their size should be any different if underground, unless paralleled (that is addressed in 310.4).
Panel Meeting Action: Reject
Panel Statement: The original language for requiring 1/0 as a minimum size appeared in the 1978 NEC. Research that the panel performed at that time utilized that size based on a combination of a minimum physical size, fault currents at the service disconnecting means, and industry practice. The submitter has not presented any technical data for reducing the minimum size of the conductors when utilizing Section 230.40 Exception No. 2 for multiple sets of service conductors from one lateral. When using this allowance the conductors must be a minimum of 1/0. These conductors are not parallel conductors since they are not connected at the load end.
A Building or other structure served shall be supplied by only one service unless permitted in 230.2(A) through (D). For the purpose of 230.40, Exception No. 2 only, underground sets of service-entrance conductors, 1/0 AWG and larger, running to the same location and connected together at their supply end but not connected together at their load end shall be considered to be supplying one service. (Text to remain the same.)

Service-entrance conductors are what are considered for the underground sets. Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding affected text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

Service-Entrance Cable. Service-entrance conductors made up in the form of a cable.

Service-Entrance Conductors. The conductors from the service point to the service disconnecting means.

Service Equipment. The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of “service drops” and “service laterals”. Those, too, are utility installed extensions of the services. What comes after the “point of delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.

It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground) need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of “Service Drop” and “Service Lateral” are “by current definitions and code requirements, not limited to the ‘utility company side of the service point’.” These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as “Service Drop” and “Service Lateral”) will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

Panel Meeting Action: Reject
Panel Statement: These conductors are not always service-entrance conductors.
4-61  Log #4408  NEC-P04  Final Action: Reject

   (230.2)

Submitter: Dean Hunter, Hunter Electric
Recommendation:  Revise text as follows:
   230.2 Number of Services.
(C) Capacity Requirements. Additional services shall be permitted under any of the following conditions:
(1) Where the capacity requirements are calculated load is in excess of 2000 amperes at a supply voltage of 600 volts or less

Substantiation:  Enforcement of the term "capacity" is an enforcement challenge. Some inspectors believe that if the existing service is rated 1200 amperes at 480/277 an additional 800 amp 480/277 volt service can be installed using this allowance regardless of the demand on the original service. Does "capacity" mean the actual electrical demand of the facility or the amp rating of the service disconnect switch(es)?

Panel Meeting Action:  Reject
Panel Statement:  The submitter is incorrect in the assumption that the existing language is not clear. The only way to determine "capacity requirements" is to calculate the loads to be supplied by the service.

4-62  Log #1692  NEC-P04  Final Action: Reject

   (230.2(C)(2)(1))

Submitter: Mike Theisen, St. Cloud, MN
Recommendation:  Revise text to read as follows:
   230.2 Number of Services.
(C) Capacity Requirements. Additional services shall be permitted under any of the following:
   (1) Where the capacity requirements are numerical sum of the service mains will be at least in excess of 2000 amperes at a supply voltage of 600 volts or less.

Substantiation:  This proposal is a clarification of the requirement in 230.2(C)(1) that the total sum of the service mains, after an additional service is installed for the building or structure, will be more than 2000 amperes at 600 volts or less. Some jurisdictions require the existing load plus the additional load to be calculated and exceed 2000 amperes, before an additional service is permitted. This clarification will make 230.2(C)(1) easier to understand and to apply correctly.

Panel Meeting Action:  Reject
Panel Statement:  The panel agrees that the requirement is clear as written. The submitter is incorrect in the use of the allowance for because use of this requirement is not simply based on the additive sum of the service disconnecting means, it is based on capacity requirements due to the load on the service.

Recommendation: Revise text to read as follows:

230.3 One building or Other Structure Not to be Supplied Through Another. Service-entrance conductors supplying a building or other structure shall not pass through the interior of another building or other structure.

Substantiation: Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

Service-Entrance Cable. Service-entrance conductors made up in the form of a cable.

Service-Entrance Conductors. The conductors from the service point to the service disconnecting means.

Service Equipment. The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of “service drops” and “service laterals”. Those, too, are utility installed extensions of the services. What comes after the “point of delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.

It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground) need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of “Service Drop” and “Service Lateral” are “by current definitions and code requirements, not limited to the ‘utility company side of the service point.’” These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as “Service Drop” and “Service Lateral”) will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

Panel Meeting Action: Reject

Panel Statement: These conductors are not always service entrance-conductors.
Add a new list item (5) and (6) as shown below to 230.6

230.6 Conductors Considered Outside the Building.
Conductors shall be considered outside of a building or other structure under any of the following conditions:

(1) Where installed under not less than 50 mm (2 in.) of concrete beneath a building or other structure
(2) Where installed within a building or other structure in a raceway that is encased in concrete or brick not less than 50 mm (2 in.) thick
(3) Where installed in any vault that meets the construction requirements of Article 450, Part III
(4) Where installed in conduit and under not less than 450 mm (18 in.) of earth beneath a building or other structure
(5) Where installed physically outside the building including attached to the wall surface on the outside of the building
(6) Where installed in overhead service masts on the outside surface of the building traveling through the eave of that building to meet the requirements of 230.24.

This new list item (5) clarifies that conductors installed on the outside of a building including ones that are attached to the wall surface on the outside of the building are “outside the building.”

During a deposition, I had to make an argument that conductors actually installed on the wall surface outside of a building were considered as conductors installed outside of the building. It seemed common sense to me. However, the opposing discussion related to a conductor on wall whose construction was not concrete, brick or masonry. Since the first four conditions of this section are related to concrete, brick or masonry construction, was a conductor installed on an outside surface of a wall not constructed by these materials actually considered “outside the building”? The purpose of this proposal is to clear up this issue that it does not relate to the type of wall construction and that conductors physically outside the building are considered outside the building.

The new list item (6) is necessary to discuss the standard practice of installing a service mast through the eave of a building. One could argue that penetrating the roof eave with a service mast brings the service entrance conductors inside the building at this point and therefore requiring a service disconnecting means per 230.70.

Panel Meeting Action: Reject
Panel Statement: The panel agrees that the requirement is clear as written. The panel agrees that the submitter's proposal does not add clarification to the rules with regard to the outside of the building. The conditions that the submitter has proposed are clearly outside the building.
(2) Where installed within a building or other structure in a raceway in concrete or brick not less than 50 mm (2 in) thick or in rigid metal conduit that is properly supported and enclosed within a architectural enclosure having a three hour (minimum) fire smoke rating.

Installing concrete or brick encased raceways is very difficult, especially when these service conductors must ascend many floors into a building to reach the service entrance switch gear on an upper floor and/or on the roof. The weight, installation difficulties, and costs associated with the concrete (or brick) enclosure are often extreme.

I am reasonably sure reason for the 50 mm (2 in) of concrete (or brick) encasement was to protect the building from the energy that would be released into the building, if the service conductors were to fault on the line side of the building’s service disconnect. While protecting the service cables is important, this was not the driving force for these requirements.

Panel Meeting Action: Reject
Panel Statement: The existing requirement serves to provide additional protection for the service conductor installation and not simply limit the potential of fire spread either onto or from the service conductors.

The concrete or brick is to provide physical protection. A 3-hr rated enclosure may not provide this protection.

Service-entrance conductors are subject to high arc flash energies that may burn through metallic conduit and blow through architectural treatments that provide a 3-hour fire rating (typically 2 layers of ½-inch dry wall). The masonry requirement has effectively protected buildings from service-entrance conductor failures and the resulting generation of heat and gas. The masonry requirement should remain. Designs should consider service-entrance disconnects and overcurrent devices to be located as close as practical to the entry of the service conductors into the building. Feeders extending up into the building will have overcurrent protection to protect the building from conductor failures.

Conductors other than service conductors of the same class shall not be installed in the same raceway, auxiliary gutter, service cable, or other enclosure.

Auxiliary gutters are not indicated in the definition of raceway and should be included, likewise boxes and other enclosures that are not part of the service. Service conductors include those for ac, dc, single-phase, 3-phase, 600 volts or less, over 600 volts. 300.3(1) permits ac and dc circuits in the same wiring enclosure and 490.35(B) has provisions where low-voltage and high-voltage can be in the same compartment. Metering equipment such as current transformers may have conductors installed to remote meter and this equipment doesn't meet the definition of service as it doesn't deliver energy.

Panel Meeting Action: Reject
Panel Statement: The requirement is intended to allow only service conductors in a service raceway or service cable. It has nothing to do with other enclosures.

An auxiliary gutter used for service conductors is a wiring method recognized in Section 230.43. Section 490.35 (B) does not pertain to service conductors and recognizes that wiring rated 600 Volts or less is required to be located in medium voltage equipment enclosures for control and metering such as relaying, metering, cubicle heaters, etc.
Conductors other than service-entrance conductors shall not be installed in the same service raceway or service-entrance cable. (Exception No. 1 and No. 2 text to remain the same.)

Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

**Service-entrance** conductors made up in the form of a cable.

**Service-entrance** conductors from the service point to the service disconnecting means. The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of "service drops" and "service laterals". Those, too, are utility installed extensions of the services. What comes after the "point of delivery" or "the point of connection" are "service-entrance conductors," either underground or overhead.

It is recognized, however, that the definitions of "service entrance conductors" (either overhead and/or underground) need to have the concept of "service point" added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of "Service Drop" and "Service Lateral" are "by current definitions and code requirements, not limited to the 'utility company side of the service point.'" These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as "Service Drop" and "Service Lateral") will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

**Panel Meeting Action:** Reject

**Panel Statement:** These conductors are not always service-entrance conductors.

Recommendation: Revise text to read as follows:

230.9 Clearances on Buildings. Service-entrance conductors and final spans shall comply with 230.9(A), (B), and (C).

Substantiation: Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

Service-Entrance Cable. Service-entrance conductors made up in the form of a cable.

Service-Entrance Conductors. The conductors from the service point to the service disconnecting means.

Service Equipment. The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of “service drops” and “service laterals”. Those, too, are utility installed extensions of the services. What comes after the “point of delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.

It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground) need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of “Service Drop” and “Service Lateral” are “by current definitions and code requirements, not limited to the ‘utility company side of the service point.’” These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as “Service Drop” and “Service Lateral”) will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

Panel Meeting Action: Reject
Panel Statement: These conductors are not always service-entrance conductors.
Service drop conductors installed in open conductors or multi-conductor cable without an overall outer jacket shall have a clearance of not less than 900 mm (3 ft) from windows that are designed to be opened, doors, porches, ladders, stairs, fire escapes, or similar locations. (Exception text to remain the same.)

Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

- **Service-Entrance Cable.** Service-entrance conductors made up in the form of a cable.

- **Service-Entrance Conductors.** The conductors from the service point to the service disconnecting means.

- **Service Equipment.** The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of “service drops” and “service laterals”. Those, too, are utility installed extensions of the services. What comes after the “point of delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.

It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground) need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of “Service Drop” and “Service Lateral” are “by current definitions and code requirements, not limited to the ‘utility company side of the service point’.” These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as “Service Drop” and “Service Lateral”) will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

**Panel Meeting Action:** Reject

**Panel Statement:** These conductors are not always service-entrance conductors.
Revise text to read as follows:

Overhead service-entrance conductors shall not be installed beneath openings through which materials may be moved, such as openings in farm and commercial buildings, and shall not be installed where they obstruct entrance to these building openings.

Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

Service-entrance conductors made up in the form of a cable.

Service-entrance conductors. The conductors from the service point to the service disconnecting means.

Service Equipment. The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of “service drops” and “service laterals.” Those, too, are utility installed extensions of the services. What comes after the “point of delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.

It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground) need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of “Service Drop” and “Service Lateral” are “by current definitions and code requirements, not limited to the ‘utility company side of the service point’.” These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as “Service Drop” and “Service Lateral”) will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

Panel Meeting Action: Reject

Panel Statement: These conductors are not always service-entrance conductors.
Vegetation such as trees shall not be used as support of overhead service-entrance conductors.

Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

Service-entrance conductors made up in the form of a cable.

The conductors from the service point to the service disconnecting means.

The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of “service drops” and “service laterals”. Those, too, are utility installed extensions of the services. What comes after the “point of delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.

It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground) need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of “Service Drop” and “Service Lateral” are “by current definitions and code requirements, not limited to the ‘utility company side of the service point.’” These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as “Service Drop” and “Service Lateral”) will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

Panel Meeting Action: Reject
Panel Statement: These conductors are not always service-entrance conductors.
Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

**Service-entrance conductors** made up in the form of a cable.

The conductors from the service point to the service disconnecting means.

The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of “service drops” and “service laterals”. Those, too, are utility installed extensions of the services. What comes after the “point of delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.

It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground) need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of “Service Drop” and “Service Lateral” are “by current definitions and code requirements, not limited to the ‘utility company side of the service point’.” These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as “Service Drop” and “Service Lateral”) will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

**Panel Meeting Action:** Reject

**Panel Statement:** These conductors are not always service-entrance conductors.

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**II. Overhead Service Drop Conductors.**

This proposal is being submitted by a task group that has been formed by Panel Chair, Ronald Toomer, in response to instructions that were presented to Code-Making Panel 4 by the Technical Correlating Committee as a result of some proposals that were submitted in the last cycle. These proposals spurred some discussion that resulted in differing opinions relative to the use of the term “Service Lateral”. The members of the task group are as follows: Larry D. Cogburn, Chair, Robert J. Deaton, James J. Rogers, John A. Sigmund, and John W. Young.

**Panel Meeting Action:** Accept
Add text to read as follows:

230.24(E) Clearance from Communication Wires and Cables. See 800.44(A)(4).

Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding affected text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

Service-Entrance Cable. Service-entrance conductors made up in the form of a cable.

Service-Entrance Conductors. The conductors from the service point to the service disconnecting means.

Service Equipment. The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of "service drops" and "service laterals". Those, too, are utility installed extensions of the services. What comes after the "point of delivery" or "the point of connection" are "service-entrance conductors," either underground or overhead.

It is recognized, however, that the definitions of "service entrance conductors" (either overhead and/or underground) need to have the concept of "service point" added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of "Service Drop" and "Service Lateral" are "by current definitions and code requirements, not limited to the 'utility company side of the service point'". These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as "Service Drop" and "Service Lateral") will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

Panel Meeting Action: Accept in Principle

Panel Statement: See panel action on Proposal 4-78 for revised wording.
Submitter: James J. Rogers, Bay State Inspectional Agency
Recommendation: Revise text to read as follows:
230.24 Clearances. Overhead service drop conductors, etc.
Substantiation: This proposal is being submitted by a task group that has been formed by Panel Chair, Ronald Toomer, in response to instructions that were presented to Code-Making Panel 4 by the Technical Correlating Committee as a result of some proposals that were submitted in the last cycle. These proposals spurred some discussion that resulted in differing opinions relative to the use of the term “Service Lateral”. The members of the task group are as follows: Larry D. Cogburn, Chair, Robert J. Deaton, James J. Rogers, John A. Sigmund, and John W. Young.
Panel Meeting Action: Accept

Submitter: Allen L. Clapp, Power & Communication Utility Training Center
Recommendation: Revise text to read as follows:
Exception No. 2: Where the voltage between conductors does not exceed 300 and the roof has a slope of 100 mm in 300 mm (4 in. in 12 in.) or greater, a reduction in clearance to 900 mm (3 ft) shall be permitted.
Substantiation: The requirement to have a roof slope exceeding a 4-inch drop in a 12-inch run is not necessary, not desirable, and not in the best overall interest of safety.
Section 230.24 already requires that service drop conductors shall not be readily accessible. As a result, service drops are only accessible to workers on the roof. By requiring a relatively steep slope, the chance that a worker on the roof may lose footing if startled by inadvertent contact with the service drop is increased.
A startle reaction may occur if the worker backs into the service drop, even though no electrical contact occurs. If the worker turns too quickly to see what he has touched, or if the worker realizes that it is a power service drop and tries to jump away too fast, the worker can lose footing and fall from the roof.
This issue was discussed in depth by NESC Subcommittee 4 on overhead clearances during the 1977 revision and again during the mid-1980s. Available accident data did not support requiring a steep roof. The consensus was reached that, should inadvertent contact with the service drop occur by a worker on the roof, it would be preferable that the worker not be on a steep roof. Thus, the NESC does not have the steep slope requirement in the comparable NESC rule.
The NEC requirement for a steep roof has caused confusion for some electrical inspectors when they observe service drops installed by utilities in accordance with NESC requirements over roofs with slopes less than 4 inches of drop in a 12-inch run.
I am a licensed Professional Engineer with over 400 electric and communication utilities and large industrial complexes as clients. I am a member of NFPA, IEEE, and IAEI. I have used both the National Electrical Code and the National Electrical Safety Code in my work since 1964. I have been a member of NESC subcommittees since 1971 and have served several times over the years on NESC/NEC coordination task forces. I have reviewed over 20 years of electrical accident data in that capacity. I have also been involved in over 600 accident investigation and litigation assignments over the years. The above proposal is made to (a) improve safety and (b) harmonize certain requirements of the NEC with those of the NESC to limit the opportunity for confusion.
Panel Meeting Action: Reject
Panel Statement: The NEC requirement is not a requirement as to how to build a roof it simply states that when these conductors are installed over a roof a reduction in the clearance distance to three feet is only allowed when the roof meets or exceeds the slope as defined. If these conductors are installed as part of the utility supply system then the NEC does not apply and the NESC distances would be utilized.
The slope of the roof referenced permits a lower clearance because pedestrian traffic is less likely on steep roofs.
Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding affected text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

- **Service-entrance conductors** made up in the form of a cable.
- The conductors from the service point to the service disconnecting means.
- The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of "service drops" and "service laterals". Those, too, are utility installed extensions of the services. What comes after the "point of delivery" or "the point of connection" are "service-entrance conductors," either underground or overhead.

It is recognized, however, that the definitions of "service entrance conductors" (either overhead and/or underground) need to have the concept of "service point" added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of "Service Drop" and "Service Lateral" are "by current definitions and code requirements, not limited to the 'utility company side of the service point'." These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as "Service Drop" and "Service Lateral") will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

**Proposal Meeting Action:** Accept in Principle

Replace "service-entrance" with "overhead service".

**Panel Statement:** Change the term to be consistent with the panel action on Proposal 4-75. Not all service conductors are service-entrance conductors.
Exception No. 3: Where the voltage between conductors does not exceed 300, a reduction in clearance above only the overhanging portion of the roof to not less than 450 mm (18 in.) shall be permitted if (1) not more than 1.8 m (6 ft) of service-drop conductors, 1.2 m (4 ft) horizontally, pass above the roof overhang, and (2) they are terminated at a through-the-roof raceway or approved support.

Substantiation: Delete the word overhang. As presently worded, the language prevents the through-the-roof mast from coming up inside the wall, since the wall itself is not overhang. This issue came up several years ago with the National Electrical Safety Code and the word overhang was removed. This change will match NECS language and limit confusion.

Panel Meeting Action: Reject
Panel Statement: The word overhang is needed to link and clarify the requirement since it is only applicable to the “overhanging portion of the roof”.
This requirement does not address the installation of a service mast. It simply addresses the maximum distance that service drop conductors can cross the roof at a particular height to connect to the service mast. The requirement does not address whether or not the mast is in the wall. However, there are other code sections that address such an installation.

Add New Exception 5 as follows:

4-82 Log #454 NEC-P04 (230.24(A) Exception No. 5 (New))
Final Action: Accept

Submitter: Lanny G. McMahill, Phoenix, AZ
Recommendation: Add New Exception 5 as follows:

Exception No. 5: Where the voltage between conductors does not exceed 300 and the roof area is guarded or isolated, a reduction in clearance to 900 mm (3 ft) shall be permitted.

Substantiation: This new exception is intended to correlate with allowances in the National Electrical Safety Code (NESC). Currently, there is a minor conflict with the Exceptions in the NEC and the NESC. Generally, the NESC allows the service entrance conductors to be a minimum of 3 foot above the roof if the area is guarded or inaccessible. This new exception will allow correlation between the two documents. Although the NESC allows this clearance for up to 750 volts, the proposed NEC exception is restricted to 300 volts. The requirement that the roof area be guarded or isolated will provide equivalent safety as currently allowed in Exceptions 2, 3 and 4.

Panel Meeting Action: Accept
Submitter: Allen L. Clapp, Power & Communication Utility Training Center  
Recommendation: Revise text to read as follows:

(B) Vertical Clearance for Service-Drop Conductors. Service-drop conductors, where not in excess of 600 volts, nominal, shall have the following minimum clearance from final grade when at maximum final sag resulting from ice loading or thermal line losses, whichever is greater:

FPN: New, unstretched wires are installed at initial sag conditions. Over time, the weight, wind, and ice loading received in service will cause inelastic (nonrecoverable) deformation (permanent stretching) in the wire. Final sag conditions occur when further inelastic deformation is reduced to a negligible amount. Maximum sag occurs when the combination of (a) elastic (recoverable) deformation due to thermal or ice loading and (b) inelastic deformation is the greatest. Rule 230A4, Rule 232A, and Appendix B of the National Electrical Safety Code ANSI C2-2007 contain information on (a) calculating the inelastic deformation due to conductor/cable weight, ice loading, and wind loading that is appropriate for various loading areas and useful in calculating maximum final sag and (b) appropriate conductor temperatures and ice loading useful in determining conditions that will produce maximum final sag, respectively.

(1) 3.0 m (10 ft) — at the electrical service entrance to buildings, also at the lowest point of the drip loop of the building electrical entrance, and above areas or sidewalks accessible only to pedestrians, measured from final grade or other accessible surface only for service-drop cables supported on and cabled together with a grounded bare messenger where the voltage does not exceed 150 volts to ground

(2) 3.7 m (12 ft) — over portions of residential property and residential driveways, and those commercial areas where such portions are not subject to truck traffic and where (b) the voltage does not exceed 300 volts to ground

(3) 4.5 m (15 ft) — for those areas listed in the 3.7-m (12-ft) classification where the voltage exceeds 300 volts to ground

(4) 5.5 m (18 ft) — over public streets, alleys, roads, parking areas subject to truck traffic, driveways on other than residential property, portions of driveways on residential property subject to truck traffic, and other land such as cultivated, grazing, forest, and orchard.

Substantiation: This proposal contains three types of changes. The first addresses the need to assure that the service drop cables or conductors will not sag enough after installation to produce vertical clearances less than those required by this NEC section. The second addresses the need to recognize that the front portions of most residential driveways are general-use driveways and subject to truck traffic. The third prohibits use of the reduced clearance of 12 ft for service drops to commercial buildings.

To assure that service drops are installed high enough to maintain the required clearance throughout their life, and not just at installation, consideration of sag changes due to their own weight, ice loading, and thermal loading is necessary. The National Electrical Safety Code contains appropriate information for use in calculating maximum final sags to assure that vertical clearances are met and is, therefore, a good reference.

Many portions of residential property are subject to truck traffic. In particular, the front portion of most residential driveways is subject to moving vans, delivery trucks, and ambulances. As a result of hundreds of service drops being torn down in the 1980s, the NESC raised the clearances required for service drops above driveways and limited the application of the reduced clearance of 12 ft to only those residential buildings where the height of the building did not allow achieving the full clearance value of 16.0 ft required by NESC Table 232-1. Some of the service-drop teardown accidents reviewed had serious safety consequences. In some cases, service drops torn down by moving vans and delivery trucks (which often exceed 12 ft in height) were touched in a damaged area by personnel trying to move them out of the way. In others, ambulances cut off the lights and power to houses to which they were making an emergency response call.

In essence, NESC Rule 234C and Table 234-1, Footnote 7 essentially limited application of the reduced clearances over driveways to those houses with so-called hip roofs that slope upward toward the peak on all sides; it was recognized that most owners that were spending the extra money to have a hip roof would were also spending the money to get underground service, thus reducing the number of houses with such low service drops. Although a flat-roofed house would qualify to use the footnote, few flat-roofed houses are constructed today. Most or all of the required table clearance of 16 ft can be achieved by attaching at the gable end of houses of that design. In essence, the NESC has prohibited using the reduced 12-ft clearance to through-the-roof service masts on the rear of most single-story houses, since most single story houses have a gable on each end and the peak of the gable is available to gain the extra height.

At the time of limiting the application of the reduced clearances over driveways, the members of NESC Subcommittee...
4 on clearances came within one vote of prohibiting overhead service drops to houses if they could not meet the full 16-ft table clearance. The compromise was to limit application of the reduced clearances only to those buildings that were not tall enough to allow the full clearances. The subcommittee was unanimous at that time that, if this limitation did not solve the problems, we would reconsider requiring underground service for such short residences.

NESC SC4 also considered whether commercial buildings should be allowed to have reduced clearances and concluded that it would not be appropriate to allow reduced clearances for service drops to commercial buildings—the probability of access by a truck during the life of the installations was too great to allow the reduced clearances. Under the NESC, if the full table value of 16 ft cannot be met, the service drop must go underground. It is recommended that the NEC match the NESC in this regard to eliminate confusion and assure that appropriate consideration is given during building design to the need for either an underground service drop or appropriate locations for an overhead service drop and weatherhead.

The above proposal was worded in a manner to make the least changes to the existing language as practical. However, you may find that the following language may be preferable for subpart 4:

4) 5.5 m (18 ft) — over public streets, alleys, roads, parking areas, driveways (excluding portions of driveways on residential property not subject to truck traffic), and other lands (such as cultivated, grazing, forest, and orchard lands) subject to truck traffic, driveways on other than residential property, and other land such as cultivated, grazing, forest, and orchard.

I am a licensed Professional Engineer with over 400 electric and communication utilities and large industrial complexes as clients. I am a member of NFPA, IEEE, and IAEI. I have used both the National Electrical Code and the National Electrical Safety Code in my work since 1964. I have been a member of NESC subcommittees since 1971 and have served several times over the years on NESC/NEC coordination task forces. I have reviewed over 20 years of electrical accident data in that capacity. I have also been involved in over 600 accident investigation and litigation assignments over the years. The above proposal is made to (a) improve safety and (b) harmonize certain requirements of the NEC with those of the NESC to limit the opportunity for confusion.

Panel Meeting Action: Reject

Panel Statement: The submitter has submitted a proposal whereby the only calculation formula is defined in a different ANSI Standard, the National Electrical Safety Code. This additional standard is not uniformly adopted and it would be impossible for local AHJs to enforce this requirement and installers to comply with it. The submitter has not defined any documented problems with the existing requirements.

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Final Action: Accept

4-84 Log #3499 NEC-P04
(230.24(B))

Submitter: James J. Rogers, Bay State Inspectional Agency

Recommendation: Revise text to read as follows:

230.24(B) Vertical Clearance for (Overhead) Service conductors, etc.

Substantiation: This proposal is being submitted by a task group that has been formed by Panel Chair, Ronald Toomer, in response to instructions that were presented to Code-Making Panel 4 by the Technical Correlating Committee as a result of some proposals that were submitted in the last cycle. These proposals spurred some discussion that resulted in differing opinions relative to the use of the term "Service Lateral". The members of the task group are as follows: Larry D. Cogburn, Chair, Robert J. Deaton, James J. Rogers, John A. Sigmund, and John W. Young.

Panel Meeting Action: Accept
Mark T. Rochon, Peabody, MA

230.25 Abandoned services. The accessible portions of abandoned raceways, cables, conductors, and switchboards shall be removed. Where the existing service equipment is energized it shall remain.

Substantiation: Old abandoned service equipment remains with open meter sockets, panels, buses, etc., and is usually in rough shape.

Panel Meeting Action: Reject

Panel Statement: The submitter is correct that these items are sometimes left on a building and they are unsightly, however, they do not create an actual hazard and the general care and aesthetics of a building are really up to the property owner and not an enforceable code concern.
Revise text to read as follows:

230.27 Means of Attachment.  Multiconductor cables used for service-drops entrance conductors shall be attached to buildings or other structures by fittings identified for the use with service-entrance conductors. Open conductors shall be attached to fittings identified for use with service-entrance conductors or to noncombustible, nonabsorbent insulators securely attached to the building or other structure.

Substantiation: Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding affected text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

Service-Entrance Cable. Service-entrance conductors made up in the form of a cable.

Service-Entrance Conductors. The conductors from the service point to the service disconnecting means.

Service Equipment. The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of "service drops" and "service laterals". Those, too, are utility installed extensions of the services. What comes after the "point of delivery" or "the point of connection" are "service-entrance conductors," either underground or overhead.

It is recognized, however, that the definitions of "service entrance conductors" (either overhead and/or underground) need to have the concept of "service point" added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of "Service Drop" and "Service Lateral" are "by current definitions and code requirements, not limited to the 'utility company side of the service point'." These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as "Service Drop" and "Service Lateral") will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

Panel Meeting Action: Accept in Principle

Revise text to read as follows:

230.27 Means of Attachment. Multiconductor cables used for overhead service conductors shall be attached to buildings or other structures by fittings identified for the use with service conductors. Open conductors shall be attached to fittings identified for use with service conductors or to noncombustible, nonabsorbent insulators securely attached to the building or other structure.

Panel Statement: Change the term to be consistent with the panel action on Proposal 4-75. Not all service conductors are service entrance conductors.

Submitter: Jim Davis, Electrical Education Services, LLC

Recommendation: Revise Part III of Article 230 as follows: III. Underground Service-Lateral Conductors.

Substantiation: Article 100 defines "service lateral" as being "underground" so the inclusion of the word "underground" in the title of Part III of Article 230 is redundant and unnecessary. This change provides clarity through brevity.

Panel Meeting Action: Accept in Principle

Panel Statement: See panel action on Proposal 4-92.
Revise text to read as follows:

230.29 Supports over Buildings. Service-drop entrance conductors passing over a roof shall be securely supported by substantial structures. Where practicable, such supports shall be independent of the building.

Substantiation: Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding affected text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

Service-Entrance Cable. Service-entrance conductors made up in the form of a cable.

Service-Entrance Conductors. The conductors from the service point to the service disconnecting means.

Service Equipment. The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth is via the definitions of “service drops” and “service laterals”. Those, too, are utility installed extensions of the services. What comes after the “point of delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.

It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground) need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of “Service Drop” and “Service Lateral” are “by current definitions and code requirements, not limited to the ‘utility company side of the service point.’” These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as “Service Drop” and “Service Lateral”) will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

Panel Meeting Action: Accept in Principle

The panel accepts the deletion of the word "drop". The panel rejects the addition of the word "entrance".

Panel Statement: Not all service conductors are service entrance conductors.
Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

**Service-entrance conductors** made up in the form of a cable.

**Service-lateral conductors** from the service point to the service disconnecting means.

**The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main cutoff and control of the supply.**

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of “service drops” and “service laterals”. Those, too, are utility installed extensions of the services. What comes after the “point of delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.

It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground) need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of "Service Drop" and "Service Lateral" are "by current definitions and code requirements, not limited to the ‘utility company side of the service point’. " These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as "Service Drop" and "Service Lateral") will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

**Panel Meeting Action:** Accept in Principle

**Panel Statement:** See panel action on Proposal 4-92. Not all service conductors are service entrance conductors.

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

**Article 230 Part III Underground Service- lateral Entrance Conductors.**

**Substantiation:** Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

**Service-Entrance Cable.** Service-entrance conductors made up in the form of a cable.

**Service-Entrance Conductors.** The conductors from the service point to the service disconnecting means.

**Service Equipment.** The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of “service drops” and “service laterals”. Those, too, are utility installed extensions of the services. What comes after the “point of delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.

It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground) need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of "Service Drop" and "Service Lateral" are "by current definitions and code requirements, not limited to the ‘utility company side of the service point’. " These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as "Service Drop" and "Service Lateral") will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

**Panel Meeting Action:** Accept in Principle

**Panel Statement:** See panel action on Proposal 4-92. Not all service conductors are service entrance conductors.

Recommendation: Revise text to read as follows:

230.30 Insulation. Service-lateral entrance conductors, underground, shall be insulated for the applied voltage. (The rest of the text to remain the same.)

Substantiation: Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding affected text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

Service-Entrance Cable. Service-entrance conductors made up in the form of a cable.

Service-Entrance Conductors. The conductors from the service point to the service disconnecting means.

Service Equipment. The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of “service drops” and “service laterals”. Those, too, are utility installed extensions of the services. What comes after the “point of delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.

It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground) need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of “Service Drop” and “Service Lateral” are “by current definitions and code requirements, not limited to the ‘utility company side of the service point.’” These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as “Service Drop” and “Service Lateral”) will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

Panel Meeting Action: Accept in Principle
Panel Statement: See the panel action and statement on Proposal 4-93. Not all service conductors are service entrance-conductors.

Submitter: James J. Rogers, Bay State Inspectional Agency

Recommendation: Revise text to read as follows:

III. Underground Service Lateral Conductor.

Substantiation: This proposal is being submitted by a task group that has been formed by Panel Chair, Ronald Toomer, in response to instructions that were presented to Code-Making Panel 4 by the Technical Correlating Committee as a result of some proposals that were submitted in the last cycle. These proposals spurred some discussion that resulted in differing opinions relative to the use of the term “Service Lateral”. The members of the task group are as follows: Larry D. Cogburn, Chair, Robert J. Deaton, James J. Rogers, John A. Sigmund, and John W. Young.

Panel Meeting Action: Accept
Submitter: James J. Rogers, Bay State Inspectional Agency

Recommendation: Revise text to read as follows:

230.30 Insulation

(A) Insulation. Underground service conductors shall be insulated for the applied voltage. Exception: A grounded conductor shall be permitted to be uninsulated as follows:

(1) Bare copper used in a raceway.
(2) Bare copper for direct burial where bare copper is judged to be suitable for the soil conditions.
(3) Bare copper for direct burial without regard to soil conditions where part of a cable assembly identified for underground use.
(4) Aluminum or copper-clad aluminum without individual insulation or covering where part of a cable assembly identified for underground use in a raceway or for direct burial.

(B) Wiring Methods. Underground service conductors shall be installed in accordance with the applicable requirements of this code covering the type of wiring method used and shall be limited to the following methods:

(1) Type RMC conduit
(2) Type IMC conduit
(3) Type NUCC conduit
(4) Type HDPE conduit
(5) Type PVC conduit
(6) Type RTRC conduit
(7) Listed direct-burial conductors.

Substantiation: This proposal is intended to provide a definition of acceptable wiring methods to be utilized for the installation of underground service conductors. This proposal is being submitted by a task group that has been formed by Panel Chair, Ronald Toomer, in response to instructions that were presented to CMP 4 by the Technical Correlating Committee as a result of some proposals that were submitted in the last cycle. These proposals spurred some discussion that resulted in differing opinions relative to the use of the term “Service Lateral”. The member of the task group are as follows: Larry D. Cogburn, Chair, Robert J. Deaton, James J. Rogers, John A. Sigmund, and John W. Young.

Panel Meeting Action: Accept in Principle

Revise text to read as follows:

230.30 Insulation

(A) Insulation. Underground service conductors shall be insulated for the applied voltage. Exception: A grounded conductor shall be permitted to be uninsulated as follows:

(1) Bare copper used in a raceway.
(2) Bare copper for direct burial where bare copper is judged to be suitable for the soil conditions.
(3) Bare copper for direct burial without regard to soil conditions where part of a cable assembly identified for underground use.
(4) Aluminum or copper-clad aluminum without individual insulation or covering where part of a cable assembly identified for underground use in a raceway or for direct burial.

(B) Wiring Methods. Underground service conductors shall be installed in accordance with the applicable requirements of this code covering the type of wiring method used and shall be limited to the following methods:

(1) Type RMC conduit
(2) Type IMC conduit
(3) Type NUCC conduit
(4) Type HDPE conduit
(5) Type PVC conduit
(6) Type RTRC conduit
(7) Listed direct-burial conductors.

Panel Statement: See panel action text for correct strike out and underline in Section 230.30 (A).
4-94     Log #3375  NEC-P04
(230.31(A))


Recommendation: Revise text to read as follows:

230.31(A) Size and Rating. Service-lateral entrance conductors shall have sufficient ampacity to carry the current for the load as calculated in accordance with Article 220 and shall have adequate mechanical strength.

Substantiation: Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding affected text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

Service-Entrance Cable. Service-entrance conductors made up in the form of a cable.

Service-Entrance Conductors. The conductors from the service point to the service disconnecting means.

Service Equipment. The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of “service drops” and “service laterals”. Those, too, are utility installed extensions of the services. What comes after the “point of delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.

It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground) need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of “Service Drop” and “Service Lateral” are “by current definitions and code requirements, not limited to the ‘utility company side of the service point’.” These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as “Service Drop” and “Service Lateral”) will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

Panel Meeting Action: Accept in Principle

See the panel action on Proposal 4-95.

Revise text to read as follows:

230.31 Size and Rating.

(A) General. Service-lateral Underground service conductors shall have sufficient ampacity to carry the current for the load as calculated in accordance with Article 220 and shall have adequate mechanical strength.

Panel Statement: See the panel action on Proposal 4-95 for revised wording. Not all service conductors are service entrance conductors.
4-95 Log #3495 NEC-P04 Final Action: Accept
(230.31(A))

Submitter: James J. Rogers, Vineyard Haven, MA
Recommendation: Revise text to read as follows:
230.31 Size and Rating.
(A) General. Service lateral (Underground service) conductors shall have sufficient ampacity to carry the current for
the load as calculated in accordance with Article 220 and shall have adequate mechanical strength.
Substantiation: This proposal is being submitted by a task group that has been formed by Panel Chair, Ronald
Toomer, in response to instructions that were presented to CMP 4 by the Technical Correlating Committee as a result of
some proposals that were submitted in the last cycle. These proposals spurred some discussion that resulted in
differing opinions relative to the use of the term “Service Lateral”. The members of the task group are as follows: Larry
D. Cogburn, Chair, Robert J. Deaton, James J. Rogers, John A. Sigmund, and John W. Young.
Panel Meeting Action: Accept

4-96 Log #988 NEC-P04 Final Action: Accept in Principle
(230.32)

Submitter: Dan Leaf, Seneca, SC
Recommendation: Add “or structures” after “building” in the second sentence.
Substantiation: Edit. Structures which are not “buildings” should be included as they are in 230.6.
Panel Meeting Action: Accept in Principle

Revise the wording as follows: Add “or other structure” after “building” in the second sentence.
Panel Statement: The panel revised the wording to be consistent with other sections of Article 230.
Underground service-lateral entrance conductors shall be protected against damage in accordance with 300.5. Service-lateral entrance conductors entering a building shall be protected in accordance with 230.6 or protected by a raceway wiring method identified in 230.43.

Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding affected text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

- **Service-Entrance Cable.** Service-entrance conductors made up in the form of a cable.
- **Service-Entrance Conductors.** The conductors from the service point to the service disconnecting means.
- **Service Equipment.** The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or an otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of “service drops” and “service laterals”. Those, too, are utility installed extensions of the services. What comes after the “point of delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.

It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground) need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of “Service Drop” and “Service Lateral” are “by current definitions and code requirements, not limited to the ‘utility company side of the service point’.” These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as “Service Drop” and “Service Lateral”) will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

**Panel Meeting Action:** Accept in Principle

The word “entrance” should not be added.

**Panel Statement:** Not all service conductors are service-entrance conductors.
4-98 Log #3439 NEC-P04 (230.33)

Final Action: Accept in Principle


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

**230.33 Spliced Conductors.** Service-entrance conductors shall be permitted to be spliced or tapped in accordance with 110.14, 300.5(E), 300.13, and 300.15.

**Substantiation:** Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding affected text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

- **Service-Entrance Cable.** Service-entrance conductors made up in the form of a cable.
- **Service-Entrance Conductors.** The conductors from the service point to the service disconnecting means.
- **Service Equipment.** The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of “service drops” and “service laterals”. Those, too, are utility installed extensions of the services. What comes after the “point of delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.

It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground) need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of “Service Drop” and “Service Lateral” are “by current definitions and code requirements, not limited to the ‘utility company side of the service point.’” These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as “Service Drop” and “Service Lateral”) will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

**Panel Meeting Action: Accept in Principle**

Accept the deletion of “-lateral” and don’t add the word “entrance”.

**Panel Statement:** Not all underground service conductors are service-entrance conductors.
Add: SERVICE LATERAL CONDUCTORS. Service lateral conductors shall be installed in accordance with the applicable provisions of this Code and shall be limited to the following methods:

1. Rigid metal conduit
2. Intermediate metal conduit
3. Electrical metallic tubing
4. Type NUCC conduit
5. Type HDPE conduit
6. Rigid nonmetallic conduit
7. Type MI cable
8. Direct burial conductors.

Substantiation: Service lateral conductors may be installed on the load side of the service point by other than the utility. The wiring method is not specified. The panel statement for comment 4.47 in the 2007 ROP indicated the wiring method is the choice of the contractor which does not provide any guidance for the AHJ to determine the suitability of the installation.

Panel Meeting Action: Reject

Panel Statement: Service laterals are no longer addressed in Article 230. The acceptable wiring methods for underground service conductors are listed in new Section 230.30(B) (see Proposal 4-93).
4-100a Log #CP403 NEC-P04

(230.40 Number of Service-Entrance Conductor Sets)

Final Action: Accept

Submitter: Code-Making Panel 4,
Recommendation: Change the language in 230.40 to read as follows:
Each service drop, set of overhead service conductors, set of underground service conductors, or service lateral shall supply only one set of service-entrance conductors.

Substantiation: The panel is submitting this proposal to harmonize these definitions with the remainder of the changes made to the terms service drop and service lateral.
Panel Meeting Action: Accept

4-101 Log #4592 NEC-P04

(230.40 Exception No. 1)

Final Action: Reject

Submitter: Frederic P. Hartwell, Hartwell Electrical Services, Inc.
Recommendation: Add the following wording to the end of the existing exception: “If the number of service disconnect locations for any given classification of service does not exceed six, the requirements of 230.2(E) shall apply at each location. If the number of service disconnect locations exceeds six for any given supply classification, all service disconnect locations for all supply characteristics shall be clearly described using suitable graphics or text or both on one or more plaque(s) located in an approved, readily accessible location(s) on the building or structure served and as near as practicable to the point(s) of attachment or entry(ies) for each service drop or lateral.

Substantiation: On the literal text of the present NEC, it is permitted to group six of seven service disconnects for a seven family dwelling at one point. Then, one can run a set of service conductors around the outside of the building to a remote location and spot the seventh disconnect. In fact, the service conductors need not run outside the building; they could be run in a wall as long as there was two inches of concrete encasement.

Section 230-2 does not apply, since there is only one service. Therefore, it is not even necessary to provide a directory at either disconnect location to inform the fire service of the remote, still energized disconnect. If there is any justification for 230.2(E), and I believe there is, then surely this instance is equally compelling. This proposal addresses a critical safety concern. A ten-family apartment house might have 60 service disconnects. If there are two classes of service, there could be even more disconnects, with the total somewhat in doubt because the prior clarification has been removed.

In prior cycles there has been extensive discussion of the use of 90.4. The submitter happens to be the author of the present version of that section, and the panel should bear in mind that there are limits to the use of that section that apply in these cases. First, the authority to interpret the Code is not and never has been the authority to reinvent the Code or to remove clearly stated permissions in the Code, including 230.40 Exception No. 1. Second, the equivalent safety allowance provision is just that, an allowance. There is no way an inspector can reach the objectives of this proposal, which adds a restriction, by considering some alternate procedure to present Code wording that provides equivalent safety. On the other hand, if this proposal is accepted and proved burdensome in some particular case, then 90.4 could then be used to consider some alternative procedure.

For six code cycles, the Commonwealth of Massachusetts was unsuccessful in persuading CMP 4 that this exception should only apply by special permission. This is a compromise: Allow the exception by right, but address the most significant hazard.

Panel Meeting Action: Reject
Panel Statement: The submitter is correct in his concern for identifying placarding separate servicedisconnecting means. However, different language is needed to identify classification of services to harmonize with the requirements in Section 230.2(E).
4-101a  Log #CP404  NEC-P04
(230.40 Exception No. 2)  Final Action: Accept

**Submitter:** Code-Making Panel 4,

**Recommendation:** Change the language in 230.40, Exception No. 2 to read as follows:
Where two to six service disconnecting means in separate enclosures are grouped at one location and supplying separate loads from one service drop, set of overhead service conductors, set of underground service conductors, or service lateral, one set of service-entrance conductors shall be permitted to supply each or several such service equipment enclosures.

**Substantiation:** The panel is submitting this proposal to harmonize these definitions with the remainder of the changes made to the terms service drop and service lateral.

**Panel Meeting Action:** Accept

4-101b  Log #CP405  NEC-P04
(230.40 Exception No. 3)  Final Action: Accept

**Submitter:** Code-Making Panel 4,

**Recommendation:** Change the language in 230.40, Exception No. 3 to read as follows:
A single-family dwelling unit and a separate structure shall be permitted to have one set of service-entrance conductors run to each from a single service drop, set of overhead service conductors, set of underground service conductors, or service lateral.

**Substantiation:** The panel is submitting this proposal to harmonize these definitions with the remainder of the changes made to the terms service drop and service lateral.

**Panel Meeting Action:** Accept

4-102  Log #1261  NEC-P04
(230.40 Exception No. 3)  Final Action: Accept

**Submitter:** Charles Eldridge, Indianapolis, IN

**Recommendation:** Revise text to read as follows:
A single-family dwelling unit and a separate structure(s) shall be permitted to have one set of service-entrance conductors run to each from a single service drop or lateral.

**Substantiation:** It has come to my attention that some inspectors are permitting only a single separate structure to be served in this manner. The intent is to permit more than one additional structure to be served. As an example, this revision will make it clear that a detached garage and a utility building could be served with separate sets of service entrance conductors.

**Panel Meeting Action:** Accept
Revise 230.40 Exception No. 3 to allow up to two separate buildings or structures, in addition to the house, to be supplied by a single service drop or lateral.

230.40 Number of Service-Entrance Conductor Sets.

Exception No. 3: A single-family dwelling unit and two separate buildings or structures shall be permitted to have one set of service-entrance conductors run to each from a single service drop or lateral.

Substantiation: Many single-family dwellings are located on lots that are large enough to permit two accessory buildings or structures to be located on the same property with the house. It would seem that one additional accessory building or structure [a total of two additional to the house] will not present any increased hazard for such an installation and will save the expense of a service disconnecting means being installed at the service pole or pedestal location in order to comply with the requirements of 230.40 when the third building or structure is added.

Panel Meeting Action: Reject

Panel Statement: The submitter has not presented any technical data to support the limiting of the number of sets of additional service conductors to two. If more than one additional building is allowed to have a separate set of service conductors then there should be no limit of such installations on the same property. See the action on Proposal 4-102 for further clarification.
Inside a building will vary from job to job, but they shall always be kept to an absolute minimum. In some cases the installers and inspectors. One or more states have amended 230.40 Exception 3 out of the NEC during their respective code adoption processes. There is no language in the NEC that correlates with 230.40 Exception No. 3. It should not be assumed that the presence of 230.40 Exception No. 3 in the NEC has some special meaning, or that other historical, fundamental code concepts somehow have a new or different meaning.

Considerable research has been done relative to NEC 230.40 Exception No. 3 and the proposed language that was part of the 1996 National Electrical Code development process. NEC 230.40 Exception No. 3 is completely unnecessary - the basic rules in the NEC have always allowed what the proposer was attempting to accomplish. There is nothing inherently wrong with the language - it is simply not necessary. Unfortunately, the presence of the unnecessary language in 230.40 Exception No. 3 has caused much confusion for installers and inspectors. One or more states have amended 230.40 Exception 3 out of the NEC during their respective code adoption processes. There is no language in the NEC that correlates with 230.40 Exception No. 3. It should not be assumed that the presence of 230.40 Exception No. 3 in the NEC has some special meaning, or that other historical, fundamental code concepts somehow have a new or different meaning.

Overcurrent event do not, in theory, compromise the safety of the building to which they are connected or attached. Ideally, service conductors subjected to a catastrophic event would burn clear of the building.

Various rules in the NEC are in place to ensure that service conductors that are subjected to a catastrophic overcurrent event do not, in theory, compromise the safety of the building to which they are connected or attached. Ideally, service conductors subjected to a catastrophic event would burn clear of the building.

As an absolute minimum, the first occurrence of disconnection and overload protection for service conductors is inside the building nearest the point of entrance of the service conductors (the allowable length of service conductors inside a building will vary from job to job, but they shall always be kept to an absolute minimum). In some cases the disconnecting means and overload protection may be upstream from this inside location (e.g. installed on the exterior wall of the building).

Where the service equipment is located outside on the exterior of the building, there may not be any service-entrance conductors, or they may be entirely outside the building.

Notwithstanding other rules in the NEC (e.g. rules in Article 547 that establish a common distribution point on a multi-building agricultural premises), there is no limit to the quantity of "unfused" conductors that can be installed outside of a building on a premises, or outside of more than one building on a multi-building premises. Notwithstanding any applicable exceptions, a building shall be supplied by only one service drop or service lateral
(230.2) and the service drop or service lateral shall supply only one set of service-entrance conductors (230.40).

- Service conductors that supply a building or other structure shall not pass through the interior of another building or structure (230.3). In other words, if a service drop or service lateral supplies more than one building on a multi-building premises, the service drop or service lateral conductors are permitted to be installed on the exterior of Building A in order to supply a service in Building B, but they are not permitted to pass through the interior of Building A to get to Building B. There is no limitation in the NEC as to how many buildings could be supplied with one set of properly-sized service drop or service lateral conductors.

- Service drop conductors (e.g. at pole tops), service lateral conductors, and service-entrance conductors are permitted to be spliced in accordance with various rules in the NEC. The definition of a run of service conductors does not necessarily and automatically change simply because the run of conductor is interrupted by a terminal box, enclosure, pole, pedestal, or splice. Although not desirable, practical or workmanlike, one properly-sized service lateral could be subdivided (via underground splicing) into several properly-sized sets of service lateral conductors for distribution to multiple buildings on multi-building premises. Overhead service drops have been installed in this manner for decades on multi-building sites.

- On the contrary, a defined set of service lateral conductors automatically may become defined as a set of service-entrance conductors where the underground service lateral conductors penetrate the basement wall of a building (where there is no terminal box, meter, or other enclosure). The point of connection (or transition) from service lateral conductors to service-entrance conductors is the point of entrance of the conductors into the building essentially where the conductors pass through the basement wall.

In an effort to counteract the notion that NEC 230.40 Exception No. 3 has some special significance with regard to safety in the code, I offer the following code-compliant examples - some examples are real and very common; other examples are very extreme, but they help to illustrate the elementary concepts of the NEC.

- (NEC 230.2 and 230.40) Three structurally independent attached "townhouse" buildings (as defined in the International Residential Code) under a common roof line (there may or may not be real property lines between the units - that is not relevant for the purpose of the electrical code). Each townhouse is considered a separate building in the building code, the units are separated by fire-rated wall assemblies, and each townhouse is required to have a separate service lateral or service drop. The first occurrence of overload protection is inside each townhouse at the service panel. The service disconnecting means shall not consist of more than six switches or circuit breakers. (A maximum of six throws of the hand would be permitted to turn off power in each townhouse).

- (NEC 230.2 and 230.40 Exception No. 1) One six-unit apartment building or condominium building (a multifamily dwelling as defined in the NEC): The building is only permitted to have one service lateral or service drop. The service lateral or service drop is permitted to be subdivided into separate sets of service-entrance conductors, one set for each occupant (dwelling unit). The first occurrence of overload protection is inside each dwelling unit at the service panel. The service disconnecting means for each set of service-entrance conductors shall not consist of more than six switches or circuit breakers. (A maximum of 36 throws of the hand would be permitted to turn off power to the entire building).

- (NEC 230.2 and 230.40) An old resort with several cabins is turned into a Common Interest Community (the legal declaration that is used to establish a condominium, cooperative, or association type of property). From a pad-mounted transformer, one service lateral or service drop would be permitted to be installed on the exterior of Building A in order to supply a service in Building B. There is no limitation in the NEC as to how many buildings could be supplied with one set of properly-sized service drop or service lateral conductors.

- (NEC 230.2 and 230.40 Exception No. 2) A large manufacturing building: The building is only permitted to have one service lateral or service drop. The service lateral or service drop is permitted to be subdivided into separate sets of service-entrance conductors to supply loads, in this case the Business Office, Heating and Cooling, and Manufacturing. The three service disconnects in separate enclosures shall be grouped at one location. The first occurrence of overload protection is inside the building at the three grouped service disconnects. (A maximum of 3 throws of the hand would be necessary to turn off power to the entire building).

- (NEC 230.2 and 230.40 Exception No. 1) A large strip mall building (10 stores/occupants): The building is only permitted to have one service lateral or service drop. The service lateral or service drop is permitted to be subdivided into separate sets of service-entrance conductors to supply each occupant. The service disconnect for each set of service-entrance conductors to supply each occupant. The service disconnect for each set of service-entrance
conductors for each occupant shall consist of not more than six switches or circuit breakers. The first occurrence of overload protection is inside the building at the service disconnect. (A maximum of 6 throws of the hand would be necessary to turn off power at each occupant space, with a possible 60 throws of the hand to turn off power to the entire building).

- (NEC 230.2 and 230.40 Exception No. 1) A two-family dwelling building: The building is only permitted to have one service lateral or service drop. The service lateral or service drop is permitted to be subdivided into separate sets of service-entrance conductors to supply each dwelling unit. The service disconnect for each set of service-entrance conductors for each dwelling unit shall consist of not more than six switches or circuit breakers. The first occurrence of overload protection is inside the dwelling unit at the service disconnect. (A maximum of 6 throws of the hand would be necessary to turn off power at each dwelling unit, with 12 throws of the hand necessary to turn off power to the entire building).

- (NEC 230.2 and 230.40 Exception No. 1 and Exception No. 5) The same scenario as above with an additional set of service-entrance conductors to supply common area branch circuits as identified in 210.25. The first occurrence of overload protection is inside the building at each service disconnect. (A maximum of 6 throws of the hand would be necessary to turn off power at each dwelling unit and at the "common area" service, with 18 throws of the hand necessary to turn off power to the entire building).

If all of the above scenarios are permitted by the NEC and the first occurrence of overload protection in each case is inside the respective buildings, and the NEC does not limit the quantity of "unfused" electrical infrastructure on a premises, why does 230.40 Exception No. 3 need to be in the NEC?

Panel Meeting Action: Reject

Panel Statement: The submitter is incorrect in the statement that the existing requirement mandates that the service equipment be placed at a central location. In fact, just the opposite is accomplished. The main rule is that only one service be supplied from one drop or lateral. The exception allows one additional set to one additional structure for a single-family dwelling only. The submitter is incorrect in many of his assumptions relative to the number of buildings under single management that may be supplied by a single service lateral. The rule is very clear one lateral, one service other than multi-occupancy or up to six disconnects at one location.

4-105 Log #3830 NEC-P04
(230.40 Exception No. 4)

Final Action: Accept

Submitter: James H. Maxfield, Dover, NH
Recommendation: Revise text to read as follows:

Exception No. 4: A two-family dwellings or a multifamily dwellings and multiple occupancy structures shall be permitted to have one set of service-entrance conductors installed to supply the circuits covered in 210.25.

Substantiation: The current exception only applies to two family and multifamily dwellings. It would appear that the intent of the exception is to permit an additional disconnecting means to comply with the minimum standards of 210.25 where common area branch circuits are installed on existing two family and multifamily structures.

The current language does not permit the addition of service conductors of the same voltage to an existing multiple occupancy structure.

For example, an existing multifamily dwelling consisting of six individual dwelling units which requires the installation of smoke alarms within the common areas or site illumination of any other common load could use the current exception to install a "house panel" to accommodate the new circuits without performing alterations to an existing code compliant electrical service. While a multiple occupancy structure which may need to add common area branch circuits as described in 210.25(B) of the 2008 edition would need to perform some service alterations to an existing code compliant service to accommodate the necessary new branch circuits. This could be very impracticable depending on the size and location of the existing compliant installation.

Acceptance of this revised language would avoid the need to perform service alterations to an existing code compliant service of a multiple occupancy structure.

Panel Meeting Action: Accept
4-106  Log #1278  NEC-P04  
(230.41)  
Final Action: Reject

Submitter: Stephen Drayton, Eastern Idaho Electrical JATC / Rep. IBEW  
Recommendation: Revise text to read as follows:  
230.41 Insulation of Service-Entrance Conductors. Service-entrance conductors entering or on the exterior of buildings or other structures shall be insulated. A grounded conductor shall be permitted to be uninsulated if used in an auxiliary gutter, or it meets the insulation requirements of an underground service-lateral conductor. See 230.30 and 230.30 exception.  
Substantiation: To further the desire to use exceptions sparingly (see NEC Style Manual 3.1.4) and to make this section a positive rule. We believe this revision would simplify and clarify the intent of the section.  
Panel Meeting Action: Reject  
Panel Statement: The panel agrees that the revision would not add clarity. The present wording is correct. 230.41 is applicable to service-entrance conductors and the reference to 230.30 is to service laterals, which is not the same.

4-107  Log #3043  NEC-P04  
(230.42(A))  
Final Action: Accept

Submitter: Mike Holt, Leesburg, FL  
Recommendation: Add the following new text:  
(A) General. The ampacity of the service-entrance conductors before the application of any adjustment or correction factors shall not be less than either (A)(1) or (A)(2). Loads shall be determined in accordance with Part III, IV, or V of Article 220, as applicable. Ampacity shall be determined from 310.15. The maximum allowable current of busways shall be that value for which the busway has been listed or labeled.  
(1) The sum of the noncontinuous loads plus 125 percent of continuous loads  
Exception: Grounded conductors that are not connected to an overcurrent device shall be permitted to be sized at 100 percent of the continuous and noncontinuous load  
(2) The sum of the noncontinuous load plus the continuous load if the service-entrance conductors terminate in an overcurrent device where both the overcurrent device and its assembly are listed for operation at 100 percent of their rating.  
Substantiation: This proposal is intended to provide consistency with the rules for sizing branch circuits and feeders in 210.19(A)(1) and 215.2(A)(1).  
Panel Meeting Action: Accept

4-108  Log #1718  NEC-P04  
(230.42(A), FPN No. 1 (New))  
Final Action: Reject

Submitter: Larry T. Smith, National Electrical Seminars, Inc.  
Recommendation: Add new text as follows:  
FPN No. 1: See 110.14(C)(1)(a) and (b) for termination provisions of equipment.  
Substantiation: Ignoring the temperature rating of equipment is the most common mistake being made in conductor sizing today. Entirely too many wiremen take no notice of the temperature limitations of 110.14(C) when sizing conductors. They disregard the temperature rating of equipment, and use the 90°C column of Table 310.16 when 90°C rated conductors, such as THHN, are being used. I've even had engineers stand up in seminars and yell "Larry, how are we supposed to know that!?"  
At the very least, there should be a Fine Print Note directing the reader to the rules of 110.14(C)(1)(a) and (b).  
Panel Meeting Action: Reject  
Panel Statement: The NEC already adequately covers this requirement. The problems described by the submitter are best handled through education and enforcement.

Printed on 2/4/2009
4-109 Log #4749 NEC-P04 (230.42(B)) Final Action: Reject

Submitter: Charles M. Trout, Maron Electric Company
Recommendation: Delete Section 230.42(B) Specific Installations
Substantiation: Section 230.42(B) requires ungrounded service conductors to have an ampacity not less than the minimum rating of the service disconnecting means required by 230.79(A) through (D). This conflicts with 230.90(A) Exception No. 3 which permits the sum of the ratings of the circuit breakers or fuses to exceed the ampacity of the service conductors, provided the calculated load does not exceed the ampacity of the service conductors.
Panel Meeting Action: Reject
Panel Statement: There is no conflict. 230.42(B) requires the conductors to have an ampacity not less than the service disconnecting means. Section 230.90 deals with overcurrent protection, not disconnecting means.

4-109a Log #4739 NEC-P04 (230.43(11)) Final Action: Accept

Submitter: James M. Imlah, City of Hillsboro
Recommendation: Revise text to read as follows:
230.43 Wiring Methods for 600 Volts, Nominal, or Less.
Service-entrance conductors shall be installed in accordance with the applicable requirements of this Code covering the type of wiring method used and shall be limited to the following methods:
(1) Open wiring on insulators
(2) Type IGS cable
(3) Rigid metal conduit
(4) Intermediate metal conduit
(5) Electrical metallic tubing
(6) Electrical nonmetallic tubing (ENT)
(7) Service-entrance cables
(8) Wireways
(9) Busways
(10) Auxiliary gutters
(11) Rigid nonmetallic Polyvinyl Chloride Conduit (PVC)
(12) Cablebus
(13) Type MC cable
(14) Mineral-insulated, metal-sheathed cable
(15) Flexible metal conduit not over 1.8 m (6 ft) long or liquidtight flexible metal conduit not over 1.8 m (6 ft) long between raceways, or between raceway and service equipment, with equipment bonding jumper routed with the flexible metal conduit or the liquidtight flexible metal conduit according to the provisions of 250.102(A), (B), (C), and (E)
(16) Liquidtight flexible nonmetallic conduit
(17) High Density Polyethylene Conduit (HDPE)
(18) Non-metallic Underground Conduit with Conductors (NUCC)
(19) Reinforced Thermosetting Resin Conduit (RTRC)
Substantiation: This is an addition from the result of the 2008 NEC adding of new code articles for each of the specific nonmetallic raceways and the conditions for their intended use. Remove the reference of "nonmetallic" in item 11 and add in each of the specific raceway types as acceptable for service entrance conductors as limited by the conditions of the articles.
This is not original material; its reference/source is as follows:
NFPA-70, 2008 NEC
Panel Meeting Action: Accept
<table>
<thead>
<tr>
<th>Log #</th>
<th>Proposal Description</th>
<th>Final Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>2412 NEC-P04</td>
<td><strong>240.43(11) Rigid nonmetallic PVC conduit. Conforming to style manual Article 352.</strong></td>
<td>Accept in Principle</td>
</tr>
<tr>
<td></td>
<td>See Proposal 4-109a for the revised wording.</td>
<td></td>
</tr>
<tr>
<td>4174 NEC-P04</td>
<td>(15) Flexible metal conduit not over 1.8 m (6 ft) long or liquidtight flexible metal conduit not over 1.8 m (6 ft) long between raceways, or between raceway and service equipment, with equipment bonding jumper routed with the flexible metal conduit or the liquidtight flexible metal conduit according to the provisions of 250.102(A), (B), (C), and (E). Liquidtight flexible metal conduit shall be permitted to be installed in one continuous length between service equipment when listed for service entrance use. This change would allow the use of a single run of LFMC for service applications. The conduit would require listing to meet the performance of similar wiring methods allowed for service entrance.</td>
<td>Reject</td>
</tr>
<tr>
<td></td>
<td>Reduce liquidtight flexible metal conduit to one of 1.8 m (6 ft) long.</td>
<td></td>
</tr>
<tr>
<td>1519 NEC-P04</td>
<td>Cable tray systems shall be permitted to support service-entrance conductors. Cable trays used to support service-entrance conductors shall contain only service-entrance conductors. Such cable trays shall be identified with permanently affixed labels with the wording “Service-Entrance Conductors.” The labels shall be located so as to be visible after installation and placed so that the service-entrance conductors may be readily traced through the entire length of the cable tray. Exception: Conductors other than service-entrance conductors shall be permitted to be installed in a cable tray with service-entrance conductors, provided a solid fixed barrier of a material compatible with the cable tray is installed to separate the service-entrance conductors from other conductors installed in the cable tray. Cable trays shall be identified with permanently affixed labels with the wording “Service-Entrance Conductors.” The labels shall be located so as to be visible after installation and placed so that the service-entrance conductors may be readily traced through the entire length of the cable tray.</td>
<td>Accept</td>
</tr>
</tbody>
</table>

**Panel Meeting Action:** Accept
Cable tray systems shall be permitted to support service-entrance conductors. Cable trays used to support service-entrance conductors shall contain only service-entrance conductors and shall be limited to the following methods:

1. Service-entrance cables
2. Type MC cable
3. Mineral-insulated, metal-sheathed cable
4. Type IGS cable
5. Single Thermoplastic-Insulated Conductors 1/0 and Larger with CT rating

Substantiation: 230.44 lists service entrance cable as being allowed for use on a Cable tray. THHN conductors may be used for service entrance conductors in raceways, and for feeders and branch circuits in cable tray if listed and marked with a CT rating. THHN is typically installed in a raceway system for mechanical protection and because it has not undergone the same type of flammability testing as a building type cable such as SE cable. However, when it is marked "CT" as indicated in the ZLGR guide information, then it has undergone the proper flammability test for exposed cables in cable trays which is a more stringent flammability test than is done for SE cable.

Types TW, THW, THW-2, THHN, THHW, THWN, THWN-2, PFA, PFAH and Z in sizes 4 to 1 AWG for grounding conductors only and in sizes 1/0 AWG and larger for circuit and grounding conductors that are marked "Cable Tray Use" or "CT" comply with a vertical-tray cable flame test.

Panel Meeting Action: Accept

PROTECTION AGAINST PHYSICAL DAMAGE.

(A) UNDERGROUND SERVICE CONDUCTORS. Direct-buried service conductors and cables shall be protected in accordance with 300.5 D)(1)

(B) OTHER SERVICE CONDUCTORS. Above ground service conductors and cables, other than service drops, where likely to be subject to physical damage, shall be protected by any of the wiring methods specified in 230.43 that are identified for the use.

(C) INDIVIDUAL OPEN CONDUCTORS. Individual open conductors and aboveground cables, other than Type SE cable, shall not be installed less than 3.0 m (10 ft) above outside finished grade or where likely to be subject to physical damage unless protected in accordance with 250.50(B).

Exception: Type MC and Type MI cables shall be permitted less than 3.0 m (10 ft) above finished grade where not likely to be subject to physical damage or where protected in accordance with 230.50(B).

Substantiation: Underground conductors should be noted as direct buried and include service laterals. (B) should cover all above-ground service conductors except service drops. Protection means should be referenced to specific means of 230.43 which does not include "other approved means". Service cables in present (B) (2) should be service-entrance cables since they are not limited to height above grade. Service-entrance cables exposed to physical damage are covered by 338.12(A)(2).

Panel Meeting Action: Reject

Panel Statement: The panel agrees that the proposed revised wording does not add clarity to existing wording.

Recommendation: Revise text to read as follows:

230.50(B)(1) Service-entrance Cables. Service-entrance cables, where subject to physical damage, shall be protected by any of the following: (The remainder of the text to remain the same.)

Substantiation: Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding affected text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

Service-entrance Cable. Service-entrance conductors made up in the form of a cable.

Service-entrance Conductors. The conductors from the service point to the service disconnecting means.

Service Equipment. The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of "service drops" and "service laterals". Those, too, are utility installed extensions of the services. What comes after the "point of delivery" or "the point of connection" are "service-entrance conductors," either underground or overhead.

It is recognized, however, that the definitions of "service entrance conductors" (either overhead and/or underground) need to have the concept of "service point" added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of "Service Drop" and "Service Lateral" are "by current definitions and code requirements, not limited to the 'utility company side of the service point'." These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as "Service Drop" and "Service Lateral") will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

Panel Meeting Action: Accept

Submitter: Goran Haag, Champion Fiberglass, Inc.

Recommendation: Add new text to read as follows:

Everywhere Schedule 80 PVC is mentioned, “Type RTRC marked with the suffix -XW” should also be included.

Substantiation: For the NEC 2008, Type RTRC marked with the suffix -XW and Schedule 80 PVC were added as sufficient for Class I Division 2 installations. The Type RTRC marked with the suffix -XW were “forgotten” at some places in the NEC, needs to be corrected.

Panel Meeting Action: Accept in Principle

Panel Statement: The panel added a new item to the submitters original proposal. The -XW designation is only required for Article 501, 505, and 515.

Recommendation: Revise text to read as follows:

230.50(B)(2) Other than Service Entrance Cable. Individual open conductors and cables, other than service-entrance cables, shall not be installed within 3.0 m (10 ft) of grade level or where exposed to physical damage.

Substantiation: Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding affected text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

Service Entrance Cable. Service-entrance conductors made up in the form of a cable.

Service-Entrance Conductors. The conductors from the service point to the service disconnecting means.

Service Equipment. The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of “service drops” and “service laterals”. Those, too, are utility installed extensions of the services. What comes after the “point of delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.

It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground) need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of “Service Drop” and “Service Lateral” are “by current definitions and code requirements, not limited to the ‘utility company side of the service point’.” These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as “Service Drop” and “Service Lateral”) will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

Panel Meeting Action: Accept
Service-entrance cables or individual open service-entrance conductors, shall be supported as specified in 230.51(A), (B), or (C). (The remainder of the text to remain the same.)

Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding affected text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

**Service-Entrance Cable.** Service-entrance conductors made up in the form of a cable.

**Service-Entrance Conductors.** The conductors from the service point to the service disconnecting means.

**Service Equipment.** The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of “service drops” and “service laterals”. Those, too, are utility installed extensions of the services. What comes after the “point of delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.

It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground) need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of “Service Drop” and “Service Lateral” are “by current definitions and code requirements, not limited to the ‘utility company side of the service point’.” These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as “Service Drop” and “Service Lateral”) will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

Panel Meeting Action: Accept
Revise text to read as follows:

230.51(A) Service-Entrance Cables. Service-entrance cables shall be supported by straps or other approved means within 300 mm (12 in.) of every service head, gooseneck, or connection to a raceway or enclosure and at intervals not exceeding 750 mm (30 in.).

Substantiation: Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding affected text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

- **Service-Entrance Cable.** Service-entrance conductors made up in the form of a cable.
- **Service-Entrance Conductors.** The conductors from the service point to the service disconnecting means.
- **Service Equipment.** The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of "service drops" and "service laterals". Those, too, are utility installed extensions of the services. What comes after the "point of delivery" or "the point of connection" are "service-entrance conductors," either underground or overhead.

It is recognized, however, that the definitions of "service entrance conductors" (either overhead and/or underground) need to have the concept of "service point" added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of "Service Drop" and "Service Lateral" are "by current definitions and code requirements, not limited to the 'utility company side of the service point'." These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as "Service Drop" and "Service Lateral") will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

Panel Meeting Action: Accept
Revise text: Where exposed to the weather raceways, meter assemblies, conduit bodies, and other enclosures containing service conductors shall be suitable identified for use in wet locations and if practicable, raceways shall be arranged to drain.

“Suitable” is subjective and a term to be avoided per the Style Manual. The provision should apply to all exposed components. Weatherproof components should be covered by protocols for listing as to whether drain provisions are necessary. Conduit bodies for wet locations normally do not have drain holes and drilling holes may void listing. Draining for raceways is widely ignored, and while not justifying a violation does indicate a problem with the provision. In many areas raceway masts are installed through the roof and run inside a wall to service equipment inside the structure or inside a wall where it is not practical to provide drainage. This provision doesn’t cover other enclosures or auxiliary gutters which are not listed as raceways in the Article 100 definition of raceway.

Panel Meeting Action: Reject

Panel Statement: The proposal does not meet the requirements of 4.3.3(b) of the Regulations Governing Committee Projects.
Service raceways shall be equipped with a service head at the point of connection to service-drop conductors. The service head shall comply with the requirement for fittings in 314.15.

Service-entrance cables shall be equipped with a service head. The service head shall comply with the requirement for fittings in 314.15. (The text of the Exception to remain the same.)

Service heads and goosenecks in service-entrance cables shall be located above the point of attachment of the service-drop conductors to the building or other structure. (The text of the Exception to remain the same.)

Service-entrance cables shall be held securely in place.

Service heads shall have conductors of different potential brought out through separately bushed openings.

Drip loops shall be formed on individual conductors. To prevent the entrance of moisture, service-entrance conductors shall be connected to the service-drop conductors either (1) below the level of the service head or (20 below the level of the termination of the service-entrance cable sheath.

Service-drop conductors and service-entrance conductors shall be arranged so that water will not enter service raceway or equipment.

Substantiation: Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding affected text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

Service-entrance cables made up in the form of a cable.

Service-entrance conductors. The conductors from the service point to the service disconnecting means.

Service equipment. The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of “service drops” and “service laterals”. Those, too, are utility installed extensions of the services. What comes after the “point of delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.

It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground) need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of “Service Drop” and “Service Lateral” are “by current definitions and code requirements, not limited to the ‘utility company side of the service point’.” These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as “Service Drop” and “Service Lateral”) will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

Panel Meeting Action: Accept in Principle

Add “or overhead service” immediately after service-drop in “A”.
Add “or overhead service” immediately after service-drop in two locations in “C”.
Add “or overhead service” after the word service-drop in “F”.
Add “and overhead service” immediately after “service-entrance” in “G”.

Printed on 2/4/2009
Panel Statement: Some installations may have overhead service conductors and no service-entrance conductors.

4-122  Log #562  NEC-P04  Final Action: Accept
(230.54(A) and (B))

Submitter: Michael J. Johnston, National Electrical Contractors Association
Recommendation: Revise text to read as follows:
(A) Service Head. Service raceways shall be equipped with a service head at the point of connection to service-drop conductors. The service head shall comply with the requirement for fittings in 314.15: be listed for use in wet locations.
(B) Service Cable Equipped with Service Head or Gooseneck. Service cables shall be equipped with a service head. The service head shall comply with the requirement for fittings in 314.15: be listed for use in wet locations.
Substantiation: The proposal addresses usability. The requirement should appear clearly within these two rules for service weatherheads rather than needing to refer to another rule to find what is required. This proposal does not add technical revisions or requirements, just adds clarity for users and improves usability.

Panel Meeting Action: Accept

4-123  Log #553  NEC-P04  Final Action: Reject
(230.54(F))

Submitter: Joe Riley, City of Arlington
Recommendation: Revise text as follows:
(F) Drip Loops. Drip loops shall be formed on individual services conductors: and the conductors shall extend a minimum of 24 in. from the point where the conductors emerge from the service weather head. To prevent the entrance of moisture, service entrance conductors shall be connected to the service-drop conductors either (1) below the level of the service head or (2) below the level of termination of the service entrance cable sheath.
Substantiation: To form a drip loop on service conductors and provide adequate conductor length for service conductor terminations to an over head drop would require at least 24 in. of free conductor length. An NEC minimum required conductor length from the point where the conductors emerge from the service weather head would make it clear and consistent as to what would be considered adequate conductor length to form a drip loop and terminate service conductors to an overhead drop.
Panel Meeting Action: Reject
Panel Statement: This requirement has been in the NEC for many decades with no documented ongoing problems and the submitter has not presented any technical data supporting the necessity to attach a fixed minimum length to this requirement. The amount of cable required to make a drip loop will depend on the diameter of the cable and the allowable bending radius for that cable. A specific length of 24 inches may be too little for some cable and excessive for others.
On a 4-wire, delta-connected service where the midpoint of one phase winding is grounded, the service-entrance conductor having the higher phase voltage to ground shall be durably and permanently marked by an outer finish that is orange in color, or by other effective means, at each termination or junction point.

Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding affected text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

**Service-Entrance Cable.** Service-entrance conductors made up in the form of a cable.

**Service-Entrance Conductors.** The conductors from the service point to the service disconnecting means.

**Service Equipment.** The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of “service drops” and “service laterals”. Those, too, are utility installed extensions of the services. What comes after the “point of delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.

It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground) need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of “Service Drop” and “Service Lateral” are “by current definitions and code requirements, not limited to the ‘utility company side of the service point’.” These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as “Service Drop” and “Service Lateral”) will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

**Panel Meeting Action:** Reject

**Panel Statement:** Section 230.56 applies to all service conductors, not just service-entrance conductors.
Submitter: Leo F. Martin, Jr., Martin Electrical & Technical Training Services  
Recommendation: Revise text as follows:

230.56 Service Conductor with the Higher Voltage to Ground. On a 4-wire, delta-connected service where the midpoint of one phase is grounded, the service conductor having the higher phase voltage to ground shall be durably and permanently marked by an outer finish that is orange in color, or by other effective means at each termination or junction point be connected to the middle phase terminal in the service disconnect(s).

FPN 1: See 110.15 for the requirements on marking the phase conductor having the higher voltage to ground where supplied from a 4-wire, delta-connected system.

FPN 2: See 408.3(E) for the phase arrangement of 3-phase buses in switchboards and panelboards.

Substantiation: To make the requirement consistent with the requirement found in Article 408.

Panel Meeting Action: Reject

Panel Statement: The submitter has not presented any clearly defined reason for the removal of this basic safety requirement for this type of service installation and then inserting two fine print notes sending users to other code sections to find the information anyway. The existing wording is more user friendly. The user does not have to flip back to find the referenced section. Section 230.56 does not address where the "high leg" conductor terminates in the service-entrance switchboard.

Submitter: Dan Leaf, Seneca, SC  
Recommendation: Revise first sentence:

Service equipment shall be listed and marked to identify it as being suitable for use as service equipment.

Substantiation: Many less critical components of wiring systems are required to be listed; it should be specifically required for service equipment.

Panel Meeting Action: Reject

Panel Statement: The change could introduce confusion. Service equipment may be listed as service equipment and if that is the case it will be marked as service equipment as opposed to being listed and marked suitable for use as service equipment. The present wording is not as specific and only covers that the equipment can be used as service equipment.
Add new text to read as follows:

230.67 Dwelling Unit Surge Protection.

(A) Surge Protective Device. All dwelling units shall be provided with a surge protective device (SPD) installed in accordance with Article 285.

(B) Location. The surge protective device shall be an integral part of the service disconnecting means or shall be located immediately adjacent thereto.

(C) Type. The surge protective device shall be a Type 1 or Type 2 SPD.

(D) Replacement. Where service equipment is upgraded, all of the requirements of this section shall apply.

Substantiation: This proposed requirement is submitted for consideration by the Technical Committee for the sole purpose of personnel safety. The NEC requires GFCI and AFCI protective devices throughout dwelling units. Additionally, 120-smoke alarms are required by most local building codes in all new dwelling units. In essence we have mandated electronic based protection, designed to prevent shock, fire and to alarm residents in the event of a fire. These devices have all proven that when installed and maintained properly, they will and have saved lives. This proposal seeks a level of protection for these life saving devices as well as general surge protection throughout the home.

All GFCI’s, AFCI’s and smoke alarms may be damaged when a surge occurs due to lighting or other sources. In many cases these devices can be damaged and rendered inoperable by a surge.

It is practical to require a “whole house” SPD to provide a general level of protection. Home owners regularly buy and use Type 3 (point of utilization) SPD’s which are cord and plug connected to protect computers, plasma TV’s and other electronic equipment. However, in almost all new service installations as well as service upgrades, no consideration is given to providing a general level of protection to the “whole house.”

Typical homeowners have no problem buying multiple Type 3 (point of utilization) SPD’s to protect equipment for entertainment purposes, the additional cost of a Type 1 or Type 2 SPD for the purpose of personnel safety will not represent a financial burden.

First level subdivision (D) is included to require that when a service is upgraded, an SPD is to be installed. Residents of existing dwelling units deserve the same level of protection as those in new homes.

Note that a sister proposal has been submitted as a new 225.41.

Panel Meeting Action: Reject

Panel Statement: The submitter has not submitted any technical data that supports the statement relative to the installation of SPDs saving lives. These devices may protect some electronic equipment but there is no submitted documentation relative to smoke detector failures due to surges with or without SPDs. This is not an appropriate item for Article 230.
Sprague Owings, Nassau County, FL

Recommendation: 230.70(A)(1) Readily Accessible Location. The service disconnecting means shall be installed at a readily accessible location either outside of a building or structure or inside nearest the point of entrance of the service conductors.

Change to:

Readily Accessible Location. The service disconnecting means shall be installed at a readily accessible location either outside of a building or structure or if inside, nearest the point of entrance of the conductors when encased in rigid metal conduit or encased in 2 in. of concrete.

Substantiation: Since the service entrance conductors are only protected from overcurrents by the utility company’s fusing or jacks, the fault current can far exceed the rating of the entrance conductors. It would seem prudent to attempt to minimize the potential area of contact of these lines to a minimum so that a fault could be confined outside the structure or encased in such a way to lessen the potential effect of a fault.

Panel Meeting Action: Reject

Panel Statement: The submitter has not presented any technical data to support such an extreme limitation on the wiring methods utilized for service conductors to enter a building. For instance type SE cable has been utilized for installation such as this, and there is no track record of failures in this wiring method when properly installed.

Joseph Penachio, Northeast Metro Tech H.S.

Recommendation: Revise text to read as follows:

(1) Readily accessible location. The service disconnecting means shall be installed at a readily accessible location, either outside of a building or structure or inside nearest the point of entrance of the service raceway, cable, or conductors.

Substantiation: As stated, the nearest point of entrance of the service conductors is where the conductors exit the raceway or cable. A legal argument can be made that a disconnect could be installed 20, 30, or even 50 feet inside a building or structure because it would still be installed at the nearest point of entrance of the service conductors as stated.

Adding the wording raceway, cable, or between the words "raceway" and "conductors" clarifies the code’s intent that the service disconnect be at the nearest point of entrance to the building or structure.

Panel Meeting Action: Reject

Panel Statement: The submitter’s revised wording does not address the supposed problem the submitter is referencing. The disconnect should be nearest the point of entrance.
4-130 Log #1485 NEC-P04 Final Action: Reject
(230.70(A)(1))

Submitter: Dennis J. Cox, Elkhart County Building Dept. / Rep. IAEI
Recommendation: Add new text as follows:
Readily Accessible Location. The service disconnecting means shall be installed at a readily accessible location (within
8 ft of the electric meter) either outside of a building or structure or inside nearest the point of entrance of the service con
ductors.
Substantiation: 230.70(A)(1) does not state how far the overcurrent device can be from the meter. It is an AHJ call.
The basis for this change is the service conductors ahead of the main overcurrent device have no protection. How far is
readily accessible? By adding (within 8 ft of the electric meter) this change would make this section standard, not a
guess.
Panel Meeting Action: Reject
Panel Statement: There is no technical substantiation for the proposed distance of 8 ft.

4-131 Log #3437 NEC-P04 Final Action: Reject
(230.70(A)(1))

Force
Recommendation: Revise text to read as follows:
230.70(A)(1) Readily Accessible Location. The service disconnecting means shall be installed at a readily accessible
location either outside of a building or structure or inside nearest the point of entrance of the service-entrance conductor.
Substantiation: Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the
proposed changes and to provide a means to update corresponding affected text using the defined terms. The following
is a listing of the proposed changes to the definitions and the technical substantiation for those changes:
Service Entrance Cable. Service-entrance conductors made up in the form of a cable.
Service-Entrance Conductors. The conductors from the service point to the service disconnecting means.
Service Equipment. The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and
their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and
otherwise designated area, and intended to constitute the main cutoff and control of the supply.
The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and
revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section
90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been
carried forth is that only utilities supply service. That has also been carried forth via the definitions of “service drops”
and “service laterals”. Those, too, are utility installed extensions of the services. What comes after the “point of
delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.
It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground)
need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its
comments in the ROP for the 2008 NEC, the concept of “Service Drop” and “Service Lateral” are “by current definitions
and code requirements, not limited to the ‘utility company side of the service point.’” These revised definitions (and
Corresponding changes to related NEC Sections that use these terms as well as “Service Drop” and “Service Lateral”)
will clarify the application of NEC requirements.
By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be
updated to correlate with existing definitions related to services and service entrances and capture the stated intent and
understanding in the NEC.
Panel Meeting Action: Reject
Panel Statement: Not all service conductors are service-entrance conductors.
(1) Readily Accessible Location. The service disconnecting means shall be installed at a readily accessible location either outside of a building or structure or inside nearest the point of entrance of the service conductors.

Substantiation: Allowing service equipment indoors poses an unnecessary risk to personnel and property, usually for aesthetic reasons. Services supplied by raceway wiring methods provide pathways into a structure for both arc blast events contained in the laterals themselves as well as outdoor transformer explosions. If the NEC were to require service disconnects to be located entirely outdoors, then there would not be a direct conduit from an exploding or burning utility transformer to the vulnerable interior of the structure.

Attached are two events that occurred within a month of each other, within 20 miles of each other. In both events, there were personnel present who could have been seriously injured by the explosions and subsequent fires from service lateral and outdoor transformer faults.

There is no reason to allow deadly equipment to be installed inside a building for aesthetic reasons.

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

Panel Meeting Action: Reject

Panel Statement: The requirement presented by the submitter is far too restrictive and is not supported by technical data other than two incidents that could have happened on installations such as bottom fed switchboards or transformers. This allowance has been in the NEC for many decades without documented widespread problems.

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230.70(A)(1) Readily Accessible Location. The service disconnecting means shall be installed at a readily accessible location either outside of a building or structure or inside nearest the point of entrance of the service conductors. The service disconnecting means for one and two family dwellings shall be in a readily accessible location outside of the building.

Substantiation: This proposal provides added safety for the occupants of one and two family dwellings by having overcurrent protection ahead of any feeder conductors routed inside the building. When the service disconnect is inside the building, there is no overcurrent protection for the service entrance conductors routed inside the building. The primary fuse for the utility transformer is sized only to protect the transformer and not the service entrance conductors.

An added benefit of the acceptance of this proposal would be to possibly reduce property damage and increase safety of fire fighters by having a location outside of a building to de-energize all conductors within a building during a fire. Many fire departments have to wait as much as 30 minutes or more to have a utility representative to disconnect power.

Panel Meeting Action: Reject

Panel Statement: The submitter has not presented any evidence to support his conclusion that the recommended change would increase safety. There is no technical data presented that would support this change. A requirement such as this would be far too restrictive.
4-134 Log #663 NEC-P04
(230.70(A)(1) Exception (New) )

Submitter: Gregory P. Bierals, Samaritan’s Purse World Medical Mission

Recommendation: Add new text to read as follows:

Exception: For installations under single management, where documented safe switching procedures are established and maintained for disconnection, and where the installation is monitored by qualified individuals, the disconnecting means shall be permitted to be located elsewhere on the premises.

Substantiation: This exception applies in 225.32, where buildings or structures are supplied by branch circuit(s) or a feeder(s), and it should apply to service supplied buildings or structures as well.

Panel Meeting Action: Reject

Panel Statement: The exception is correct in Article 225 where there are multiple buildings, but it is not correct in Article 230. The service disconnect is required to be readily accessible for emergency personnel.

4-135 Log #829 NEC-P04
(230.70(C))

Submitter: Dan Leaf, Seneca, SC

Recommendation: Revise first sentence:

Each service disconnecting means shall comply with 230.66 and be suitable identified for the prevailing conditions.

See my proposal for 230.66.

Substantiation: Edit. “Suitable” is subjective and a term to be avoided per the Style Manual.

Panel Meeting Action: Reject

Panel Statement: It would be impossible to identify or mark all the prevailing conditions that a device would be suitable for. The service equipment is required to be marked in Section 230.66. The disconnect itself is not required to be marked.

4-136 Log #348 NEC-P04
(230.71(A))

Submitter: James M. Daly, Upper Saddle River, NJ

Recommendation: Revise text to read as follows:

Change “per” to “for each”.

Substantiation: This revision will comply with the recommendations in the NEC Style Manual and the Manual of Style for NFPA Technical Committee Documents and provide consistency throughout the Code. “Per” is not an appropriate term for a standard.

Panel Meeting Action: Accept
4-137 Log #4140 NEC-P04
(230.71(A)(4)) Final Action: Reject

Submitter: Larry LeVoir, City of Irvine
Recommendation: Add new text to read as follows:
Where the service disconnecting means is located outside the building and is within sight of the building, an additional disconnecting means shall not be required where conductors enter the building.

Substantiation: This addition would permit the disconnect to be located up to fifty feet away from the building. Under current wording, if the disconnect is located outside and not mounted on the building, then the rules in Article 225 would require an additional disconnecting means inside the building where the conductors enter. This would seem needlessly restrictive in my opinion. This proposal also parallels the existing requirements in 700.12(B)(6), 701.11(B)(5), and 702.11 which allow the disconnecting means for a feeder to be remote from the building.

Panel Meeting Action: Reject
Panel Statement: Over the past several code cycles CMP 4 has had to grapple with this issue of what distance from a building or structure is a safe distance for locating a disconnecting means, whether it be for service conductors or feeder conductors, and no agreeable distance has been found. The submitter has not presented and documented technical rationale for changing this opinion.

4-138 Log #793 NEC-P04
(230.72(A)) Final Action: Reject

Submitter: Carol Pafford, City and County of Denver
Recommendation: Revise text to read as follows:
The two to six service disconnects as permitted in 230.71 shall be grouped together. Each disconnect shall be permanently marked to indicate the load served.

Substantiation: The existing language is revised to eliminate confusion between a service disconnect switch and feeder disconnect switches. Also, it has been assumed in practice that the disconnect switches are grouped together, but was not specifically called out as such. The term "grouped" has lead to ambiguity when deciding upon locations for service disconnect switches. Additionally, the labels of service disconnects are not currently required to have permanent labels, leading to missing or damaged non-permanent labels being installed. Requiring permanent labels will eliminate unidentified service disconnects resulting from non-permanently installed labels.

Panel Meeting Action: Reject
Panel Statement: The addition of “together” does not add clarity to “grouped”. Permanent marking is subjective and would suggest it could not be changed but the installation could be modified, requiring a change in the marking.
230.72 Grouping of Disconnects.

(A) General. The two to six disconnects as permitted in 230.71 shall be grouped. Each disconnect shall be marked to indicate the load served.

Exception: One of the two to six service disconnecting means permitted in 230.71, where used only for a water pump also intended to provide fire protection, shall be permitted to be located remote from the other disconnecting means.

(B) Additional Service Disconnecting Means. The one or more additional service disconnecting means for fire pumps, emergency systems, legally required standby, or optional standby services permitted by 230.2 shall be installed remote from the one to six service disconnecting means for normal service to minimize the possibility of simultaneous interruption of supply.

Substantiation: Provide clarification as to the term remote as used in 230.72(A) and (B). Need to define a distance as this term is very vague and leaves a lot to be interpreted by the contractor and AHJ.

Panel Meeting Action: Reject
Panel Statement: The submitter has not provided any change indicated or defined.

Add to the end of 230.72(A):

Exception: The location of water pump service disconnecting means shall be provided at the other disconnecting means.

Substantiation: It is important to know the location of the water pump service disconnecting means. Providing information at the service disconnecting means the location of the water pump service disconnect is beneficial.

Panel Meeting Action: Reject
Panel Statement: The submitter's concerns are already addressed in 230.2(E).
Revise text to read as follows:

The one or more additional disconnecting means for fire pumps, emergency systems, or legally required standby or optional standby services permitted by 230.2 shall be installed remote from the one to six service disconnecting means for normal service to minimize the possibility of simultaneous interruption of supply.

For the purpose of “locating” the disconnecting means for “optional standby systems,” the treatment of optional standby systems as though they were critical loads to be maintained in the ON condition in all possible cases is unnecessary. In fact, safety would be increased if the disconnecting means for “optional loads” was grouped with the other “normal load” disconnecting means where fire incidences are concerned. Electrical services (or feeders) that do NOT supply life safety equipment or other legally required loads should be capable of being quickly de-energized during emergency events by locating all of the disconnecting means in close proximity. Added words are for grammatical accuracy.

Panel Meeting Action: Reject
Panel Statement: The submitter has not presented any technical rationale to support his assumption that locating the disconnects adjacent to one another enhances safety. Even though the systems he references are not legally required, these optional systems could provide assistance to building occupants or responding emergency personnel. There are requirements for proper labeling of these disconnects, as to where other disconnects are located this should provide the additional safety the submitter has mentioned.

Add new text as follows:

230.72 Grouping of Disconnects.
(A) General. The two to six disconnects as permitted in 230.71 shall be grouped. Each disconnect shall be marked to indicate the load served.

Exception: One of the two to six service disconnecting means permitted in 230.71, where used only for a water pump also intended to provide fire protection, shall be permitted to be located remote from the other disconnecting means.

(B) Additional Service Disconnecting means. The one or more additional service disconnecting means for fire pumps, emergency systems, legally required standby, or optional standby services permitted by 230.2 shall be installed a minimum remote distance of 1.8 m (6 ft) from the one to six service disconnecting means for normal service to minimize the possibility of simultaneous interruption of supply.

Substantiation: The current language in these sections is vague and permits a large variation of interpretations from AHJs on what would be considered remote. By codifying a specific distance, the code user and enforcers can apply specific language to determine remoteness of disconnects to ensure that fire pumps, emergency systems, legally required or optional standby power systems are not inadvertently operated simultaneously. The use of 1.8 m or 6 ft is somewhat arbitrary, but would be considered an acceptable distance for an individual that would be servicing equipment or an emergency responder to be unable to physically operate both sets of disconnects. This proposal is also intended to establish dialogue for the code-making panel to consider alternative minimum dimensions based on other quantifiable data.

See also similar proposal to 695.4(B)(2)(4).
Panel Meeting Action: Reject
Panel Statement: As noted in the substantiation the proposed distance is arbitrary. There is not technical substantiation to add a distance.

There is no specified distance for this requirement, nor could there be as adequate separation changes from one installation to another. This separation has to be determined onsite by designers, installers, and AHJs.
4-143     Log #3378  NEC-P04  
(230.74)  Final Action: Reject


Recommendation: Revise text to read as follows:

**230.74 Simultaneous Opening of Poles.** Each service disconnect shall simultaneously disconnect all ungrounded service-entrance conductors that it controls from the premises wiring system.

**Substantiation:** Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding affected text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

- **Service-Entrance Cable.** Service-entrance conductors made up in the form of a cable.
- **Service-Entrance Conductors.** The conductors from the service point to the service disconnecting means.
- **Service Equipment.** The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of “service drops” and “service laterals”. Those, too, are utility installed extensions of the services. What comes after the “point of delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.

It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground) need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of “Service Drop” and “Service Lateral” are “by current definitions and code requirements, not limited to the ‘utility company side of the service point.’” These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as “Service Drop” and “Service Lateral”) will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

Panel Meeting Action: Reject

Panel Statement: Not all service conductors are service-entrance conductors.
The service disconnecting means for ungrounded service-entrance conductors shall consist of one of the following: (The rest of the text to remain the same.)

Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding affected text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

**Service-Entrance Cable.** Service-entrance conductors made up in the form of a cable.

**Service-Entrance Conductors.** The conductors from the service point to the service disconnecting means.

**Service Equipment.** The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of “service drops” and “service laterals”. Those, too, are utility installed extensions of the services. What comes after the “point of delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.

It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground) need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of “Service Drop” and “Service Lateral” are “by current definitions and code requirements, not limited to the ‘utility company side of the service point’.” These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as “Service Drop” and “Service Lateral”) will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

**Panel Meeting Action:** Reject

**Panel Statement:** Not all service conductors are service-entrance conductors.

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The service disconnecting means shall plainly indicate whether it is in the open off or closed on position.

The confusion describing the position indicator is contrary to other professions, i.e., you open a faucet to allow water flow and close it to shut it off. (open door; close door!)

**Panel Meeting Action:** Reject

**Panel Statement:** A disconnecting means is open when the contacts are open. Use of the word open implies an isolating gap. "Open" and "Closed" is well understood when describing an electrical connection.
Revise text: The service disconnecting means shall have a rating not less than the calculated load to be carried determined in accordance with Part I, II, III, IV, and V as applicable. (remainder unchanged).

(A) For installations to supply only limited loads of a single branch circuit the service disconnecting means shall have a rating of not less than 15-amperes.

(B) For installations consisting of not more than two 2-wire branch circuits supplied from a 2-wire service the service disconnecting means shall have a rating of not less than 30 amperes. For installations consisting of two multiwire branch circuits or two 3-phase branch circuits the disconnecting means shall have a rating not less than 30 amperes.

(D) No change.

Substantiation: Parts I and II also have applicable load provisions. The phrase "not more than two" includes a one circuit installation covered by (A) in which "limited load" is superfluous and not defined.

The provisions of (B) should only apply where the service is 2-wire; a 3-wire 15 ampere service can supply two 2-wire branch circuits.

Since (A) is not limited to a 2-wire circuit a single multiwire or 3-phase circuit could have a service disconnecting means rated 15 amperes.

Since (A) and (B) don't cover two multiwire or 3-phase circuits the provisions of (D) require a rating of 60 amperes for a 15 ampere circuit multiwire or 3-phase circuit.

Panel Meeting Action: Reject

Panel Statement: The reference to Article 220 Parts III, IV, or V is correct as written. The submitter has not presented any technical data to support the recommended changes he has presented. There is no reason to limit Part B to buildings with two wire services, and anything other than two 2 wire circuits is intended to require a minimum rating of 60 amperes for the disconnecting means.
The service-entrance conductors shall be connected to the service disconnecting means by pressure connectors, clamps, or other approved means. Connections that depend on solder shall not be used.

Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding affected text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

Service-Entrance Cable. Service-entrance conductors made up in the form of a cable.

Service-Entrance Conductors. The conductors from the service point to the service disconnecting means.

Service Equipment. The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of "service drops" and "service laterals". Those, too, are utility installed extensions of the services. What comes after the "point of delivery" or "the point of connection" are "service-entrance conductors," either underground or overhead.

It is recognized, however, that the definitions of "service entrance conductors" (either overhead and/or underground) need to have the concept of "service point" added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of "Service Drop" and "Service Lateral" are "by current definitions and code requirements, not limited to the 'utility company side of the service point'.” These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as "Service Drop" and "Service Lateral") will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

Panel Meeting Action: Reject
Panel Statement: Not all service conductors are service-entrance conductors.
Add new text as follows:

(9) Taps used to supply communications equipment at the network point of demarcation, where the connection of the communications equipment to the service provider side is optical or non-electrical, if provided with service equipment and installed in accordance with requirements for service-entrance conductors.

**Exception No. 1:** If a supply intended for installation in a meter base is listed for the purpose and the output is Class 2 or limited power circuits used by listed information technology equipment, a service disconnecting means for the supply is not required.

**Substantiation:** Problem: Currently the NEC does not allow meter base powering solutions for communications equipment applications such as fiber to the home (FTTx). There is confusion in the industry and with some AHJs on whether equipment installed at this location is under the jurisdiction of the NEC. In a survey by UL to the Electrical Council a significant number of the respondents felt these devices fall under the NEC, however no exception currently exists to accept this type of equipment. Most of the respondents also indicated that they did not object to a revision of Article 230-82 to accept this type of equipment.

Proposal: Allow for power in two basic cases where the communications equipment is isolated on the network side and energizing the network on the service provider side is not possible if a fault occurs in the communications equipment power supply. The first case would allow powering of these circuits the same as the following existing exception:

(5) Taps used only to supply load management devices, circuits for standby power systems, fire pump equipment, and fire and sprinkler alarms, if provided with service equipment and installed in accordance with requirements for service-entrance conductors.

The second case (exception No. 1 in the proposed text) would allow supplies that have been specifically investigated for use in a meter base with a Class 2 or limited power output to directly power communications equipment at the network demarcation point without the need for a separate service entrance.

**Panel Meeting Action:** Reject

**Panel Statement:** The submitter has not presented to the panel sufficient technical data to make a decision on this proposal.
Revise this section to read as follows:

230.82. Equipment Connected to the Supply Side of Service Disconnect. Only equipment included in this section shall be permitted to be connected to the supply side of the service disconnecting means.

(A) Unswitched Equipment.

(1) Cable limiters or other current limiting devices

(2) Meters or meter sockets nominally rated not in excess of 600 volts, provided all metal housings and service enclosures are grounded in accordance with Part VII and bonded in accordance with Part V of Article 250.

(3) Instrument transformers (current and voltage), high-impedance shunts, load management devices, and Type I surge protective devices

(4) Taps used only to supply load management devices, circuits for standby power systems, fire pump equipment, and fire and sprinkler alarms, if provided with service equipment and installed in accordance with requirements for service-entrance conductors

(5) Solar photovoltaic systems, fuel cell systems, or interconnected electric power production sources

(6) Control circuits for power-operable service disconnecting means, if suitable overcurrent protection and disconnecting means are provided

(7) Ground-fault protection systems or Type 2 surge protective devices, where installed as part of listed equipment, if suitable overcurrent protection and disconnecting means are provided

(B) Meter Disconnect Switches. A disconnecting means shall be permitted to be located ahead of the service equipment provided the installation complies with 230.82(B)(1) through 230.82(B)(3). A separate service disconnecting means that complies with Part V of Article 230 shall be installed, and shall be located as provided in 230.70(A)(1).

(1) Rating. A meter disconnect shall be capable of interrupting the load served. It shall have a short-circuit current rating not less than the available short-circuit current.

(2) Marking. A meter disconnect shall be legibly field marked on its exterior in a manner suitable for the environment substantially as follows:

METER DISCONNECT
NOT SERVICE EQUIPMENT

(3) Grounding. A meter disconnect shall be grounded in accordance with Part VII and bonded in accordance with Part V of Article 250. The grounding connections shall be permitted to be in accordance with 250.142(A)(1).

Substantiation: This proposal should be read as fully supportive of the technical objectives of the 2002 NEC change in this section that added meter disconnects. The problem is to achieve those objectives in a way that does not create confusion and controversy around a fundamental principle of code application, namely, the determination of exactly which device located where constitutes the service disconnect.

Meter disconnects have been around for a very long time, normally consisting of a multipole circuit breaker mounted within a multifunction meter enclosure or in a self-contained metering pedestal. Theoretically a manufacturer could make any of them as convertible to either "hot sequence" (meter ahead of switch) or "cold sequence" (switch ahead of meter) in the field, to suit local utility requirements. At present, most of this market consists of hot sequence units that aren't field-convertible. If these breakers are on the load side of the service point (the usual case), and if they provide overcurrent protection for the conductors they supply (also the usual case), then what they supply is a conventional feeder, and not a continuation of service conductors.

Although these switches can always be installed as service disconnects, the Advisory Committee understands the practical reluctance to do so in many cases. One major reason is that if they are so classified a grounding electrode would have to be provided at the metering point. If the meter is on the outside of the building that isn't a big problem, but if the meter is hundreds of feet away, it would involve an additional electrode that would meet code but accomplish very little in terms of safety, since there would be no electrical loads at the remote metering point. It would be like requiring a grounding electrode conductor to be brought to every conventional meter socket.

The Committee also recognizes the increased, and justified, utility interest in cold sequence metering, especially on self-contained 480Y/277 volt metering systems, because of the greater safety it affords their service personnel. Pulling a meter under load at 277 volts to ground can result in a severe arc, which is why the NEC has required GFPE on 480Y/277 volt services for the last thirty-eight years. The remote switch makes sense, and clearly...
increases safety. Considering that the conductors run from the meter to the "service" disconnect are usually run as unprotected service conductors, requiring overload protection for these conductors has no observable safety justification. Remember also that bypass switches in meter sockets are to maintain load continuity, not load interruption, and opening a meter bypass switch under load may destroy the meter socket.

Some other utilities have also expressed interest in this concept where the metering is to be at a roadside, with the service running to the building served typically using an underground wiring method. This is true even on ordinary 120/240 volt single phase services to single family dwellings. Utility representatives point out, correctly, that here as well a remote disconnect adds an additional level of safety. Often electricians have been in the position of needing to pull a meter in order to deenergize service equipment in a flooded basement; a remote disconnect is much safer.

Unfortunately, countless NEC rules depend on a common understanding of exactly where the service is. Allowing two devices, often widely separated on the same property, that each potentially qualify as service disconnecting means is extremely troublesome. This proposal clearly covers this equipment in a way that precludes confusing meter disconnects with service disconnects.

It was only in the 1999 cycle that the following similar allowance was deleted from Section 230.82: "Fuses and disconnecting means or circuit breakers suitable for use as service equipment, in meter pedestals or otherwise provided and connected in series with the ungrounded service conductors and located away from the building supplied." The reason this provision was deleted (Proposal 4-159 in the 1999 NEC cycle) was that such disconnecting means are in fact service disconnects and the normal requirements in Part B of Article 225 should generally apply because the conductors they supply are feeders. Further, the existence of this provision (which originated in the 1971 NEC, long before building disconnects moved from old Section 230-84 to Article 225) was leading to confusion and inconsistent application of the rules because of conflicts with Article 225. That action was essentially correct.

The meter disconnect supplies no electric equipment in its vicinity, and therefore requiring all the usual grounding provisions at a service disconnect appears to add little to safety, and discouraging its placement means reducing safety for the sake of editorial purity. On the other hand, a remote disconnect that waddles and quacks like a service disconnect will be treated accordingly by many inspectors, resulting in substantial argument and inconsistency in the application of a fundamental concept, the location of the service disconnect. This proposal provides the appropriate context for these switches, including a field-marking requirement that makes the function obvious.

This version of this previously submitted proposal responds to CMP 4’s objections during the comment stage of the 2005 cycle. The subsection (B) title now includes the word “switches” to provide a clearer contrast from (A) on unswitched equipment. The former (B)(1) (service disconnect provided) has been moved into the parent language of (B) so as to not create confusion in a section covering equipment ahead of service disconnects. In addition, for the same reason, former language covering service equipment has been dropped. A service disconnect placed ahead of a meter is not within the scope of this location.

At that time, CMP 4 also raised the issue of “it would not make any sense to locate a meter disconnecting means on the load side of the metering equipment ...” The language in this proposal, however, deliberately allows for such switches on either side of the meter based on the fact that utilities differ as to which side of the meter should be disconnected. The wording has also been clarified to avoid the inference that the entire list must be installed. The second sentence for (B)(1) retains the safety ratings as presently required.

CMP 4 did not respond to the central issue addressed in the 2005 proposal, that being that the switch described here, and with the short-circuit current rating described in the current NEC, may and likely would otherwise qualify as a service disconnect as defined in Article 100, because it would be capable of constituting the main cutoff of supply. This confusion is exacerbated on systems with high available fault currents because the UL Guide Card information can be interpreted as a requirement for a fused switch at this location. The placement of a fused switch at this location will be interpreted by many as a service disconnect, however unintended. Remember that such a switch would fully comply with the overcurrent placement rule in 230.91.

This proposal is essential to avoid extensive field controversies around the location of the real service disconnect. It is highly significant that the submitter of related Proposal 4-106 is the same person as the submitter of the successful Proposal 4-159 in the 1999 cycle that deleted the prior allowance for such switches ahead of a service disconnect, precisely because of the confusion and conflicts such provisions create. We, yet again, respectfully invite CMP 4 to carefully reconsider this proposal.

CMP 4 essentially rejected the two comments supporting this proposal in the prior cycle, one from this Committee. The gravamen of the rejections was purely editorial in that the title of (A) would supposedly make the list inoperative if installed on the load side of a meter disconnect switch. Since the list includes such items as some control circuits with disconnects provided ahead of them and Type 2 surge protection provided with “suitable ... disconnecting means” it is clear that the terminology “unswitched equipment” only applies to equipment that does not disconnect the entire load circuit, in contradistinction to a meter disconnect that does. However, an editorial modification could be made to retile (A) as “Equipment Not Switched Other Than as Provided in (B).” This minor editorial quibble should not obstruct
taking and does not justify the lack of effective action to address the technical merit of both the base proposal as well as the comments (4-35 and 4-36) supporting it.

Panel Meeting Action: Reject
Panel Statement: The current language adequately covers the submitter's concerns. The panel never intended that "meter disconnect switches" would serve as a service disconnecting means and that is why they are allowed "ahead of the service disconnecting means". The combination devices that the submitter references and their use as a service disconnecting means, whether they be at the building or remote from such, is a totally different requirement. A meter disconnecting switch is intended to be a separate device and in some jurisdictions is under the exclusive control of the utility company. In the last several code cycles the panel had a great deal of discussion as to why these devices had to be referenced in the NEC when they are under utility control. It was finally decided that it was best to reference these devices and to require some mandatory ratings.

The submitter offers no clarity but possibly some confusion. The group identified as "unswitched" does include devices (e.g., cable limiters and ground fault systems) that could be considered switching.

4-150 Log #2005 NEC-P04 (230.82(3)) Final Action: Reject

Submitter: Dan Leaf, Seneca, SC
Recommendation: Revise last sentence: A meter disconnect shall be capable of interrupting identified as suitable to interrupt the maximum calculated load served.
Substantiation: Edit. A disconnect switch is an inanimate object and not capable in itself of interrupting the load. The load should be the maximum calculated load since (actual) load served could be less.
Panel Meeting Action: Reject
Panel Statement: The current wording in the referenced section is clear.
Submitter: Joe Riley, City of Arlington

Recommendation: Revise text to read as follows:

230.82(5) Taps used only to supply load management devices, circuits for standby power systems, fire pump equipment, and fire protection systems and fire and sprinkler alarms, if provided with service equipment and installed in accordance with requirements for service entrance conductors.

Substantiation: The NEC does not have provisions for fire protection systems such as exhaust systems to be permitted for connection on the supply side of the disconnecting means as required in the 2006 International Building Code (IBC) Section [F] 910.4.4 Wiring and control. Wiring for operation and control of smoke exhaust fans shall be connected ahead of the main disconnect and protected against exposure to temperatures in excess of 1,000°F (538°C) for a period of not less than 15 minutes. Controls shall be located so as to be immediately accessible to the fire service from the exterior of the building and protected against interior fire exposure by fire barriers having a fire-resistance rating not less than 1 hour.

In IBC Section [F] 910.4.4, smoke exhaust fans installed under this section are not just permissible for connection ahead of the main disconnect, they are required to be connected ahead of the main disconnect. An NEC change allowing fire protective systems to be connected on the supply side of the disconnecting means will permit fire pumps, exhaust fans, and fire and sprinkler alarms for this type of connection and will be more consistent with the International Building Code and Fire Life Safety.

Panel Meeting Action: Reject

Panel Statement: The term “fire protection systems” is too general. Each item permitted to be installed on the line side of the service disconnect should be properly justified.

Submitter: William Gross, Electric Service of Clinton

Recommendation: Revise text to read as follows:

(5) Taps Connections used only to supply load management devices, circuits for standby power systems, fire pump equipment and fire and sprinkler alarms, if provided with service equipment and installed in accordance with requirements for service entrance conductors.

Substantiation: The word "Taps" as used in this section is similar to the definition used in Article 240 for "Tap Conductors." Since this is not an Article 240 application and the definition of the word "Tap" is not defined in Article 100 the wording should be changed.

Panel Meeting Action: Accept
Allen Forbes, L & A Electric, Inc.

Recommendation: Add new text to read as follows:

230.82(9) Terminal boxes.

Substantiation: It is common practice to install terminal boxes on the supply side of service equipment. This change will make Article 230 consistent with the definition of Service Lateral in Article 100.

Panel Meeting Action: Reject

Panel Statement: A terminal box is already permitted as it is an element of the wiring system and is considered an enclosure, not equipment. This is not needed. Conduit and raceways could also be installed.

Allen Forbes, L & A Electric, Inc.

Recommendation: Revise text to read as follows:

Each ungrounded service conductor terminated in a service disconnecting means shall have overload protection.

Substantiation: The existing wording implies that all service conductors shall have overload protection. This change will clarify that service conductors with taps do not require overload protection.

Panel Meeting Action: Reject

Panel Statement: The concern the submitter has raised is clearly described in the next paragraph – 230.90(A).
Revise text to read as follows:

Each ungrounded service-entrance conductor shall have overload protection.

Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding affected text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

**Service-Entrance Cable.** Service-entrance conductors made up in the form of a cable.

**Service-Entrance Conductors.** The conductors from the service point to the service disconnecting means.

**Service Equipment.** The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of “service drops” and “service laterals”. Those, too, are utility installed extensions of the services. What comes after the “point of delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.

It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground) need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of “Service Drop” and “Service Lateral” are “by current definitions and code requirements, not limited to the ‘utility company side of the service point’.” These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as “Service Drop” and “Service Lateral”) will clarify the application of NEC requirements.

Not all service conductors are service-entrance conductors.

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Add to the end of 230.90(A):

The ampacity of the conductor shall be at least the ampere rating of the service entrance enclosure.

As an electrical inspector for 30 years, I have experienced where a MLO service entrance enclosure was rated much higher than the conductors that supply it. So many times engineers assume the conductors are already size for the service enclosure rating instead of the calculated load. This has caused problems when another service disconnect is added to the MLO service equipment enclosure.

The problem the revision is attempting to resolve is an education and enforcement issue.

Recommendation: Revise text to read as follows:

Exception No. 3: Two to six breakers or sets of fuses shall be permitted as the overcurrent device to provide the overcurrent protection. The sum of the ratings of the circuit breakers or fuses shall be permitted to exceed the ampacity of the service-entrance conductors, provided the calculated load does not exceed the ampacity of the service-entrance conductors. (The rest of the text in Exceptions No. 4 and No. 5 to remain the same.)

Substantiation: Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding affected text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

- **Service-Entrance Cable.** Service-entrance conductors made up in the form of a cable.
- **Service-Entrance Conductors.** The conductors from the service point to the service disconnecting means.
- **Service Equipment.** The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or an otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of “service drops” and “service laterals”. Those, too, are utility installed extensions of the services. What comes after the “point of delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.

It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground) need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of “Service Drop” and “Service Lateral” are “by current definitions and code requirements, not limited to the ‘utility company side of the service point.’” These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as “Service Drop” and “Service Lateral”) will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

Panel Meeting Action: Reject
Panel Statement: Not all service conductors are service-entrance conductors.

Submitter: Don A. Hursey, Durham City-County Inspections Department

Recommendation: Delete text as follows:

Exception No. 2: Fuses and circuit breakers with a rating or setting that complies with 240.4(B) or (C) and 240.21(B) shall be permitted:

Substantiation: 240.21(B) and 240.21(C) does not allow the provisions of 240.4(B) or (C). This should also not be permitted for service conductors which have no overcurrent protection on the line side of the conductors.

Panel Meeting Action: Reject
Panel Statement: The submitter has not submitted any technical data to support the deletion of the allowance of utilizing the next standard size rules in accordance with the limitations expressed in Article 240 for service conductors.
Revise text to read as follows:

No overcurrent device shall be inserted in a grounded service-entrance conductor except a circuit breaker that simultaneously opens all conductors of the circuit.

Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding affected text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

Service-Entrance Cable. Service-entrance conductors made up in the form of a cable.

Service-Entrance Conductors. The conductors from the service point to the service disconnecting means.

Service Equipment. The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of "service drops" and "service laterals". Those, too, are utility installed extensions of the services. What comes after the "point of delivery" or "the point of connection" are "service-entrance conductors," either underground or overhead.

It is recognized, however, that the definitions of "service entrance conductors" (either overhead and/or underground) need to have the concept of "service point" added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of "Service Drop" and "Service Lateral" are "by current definitions and code requirements, not limited to the 'utility company side of the service point'." These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as "Service Drop" and "Service Lateral") will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

Panel Meeting Action: Reject
Panel Statement: Not all service conductors are service-entrance conductors.

Revise text as follows:

230.92 Locked Service Overcurrent Devices.

Where the service overcurrent devices are locked or sealed or are not readily accessible to the occupant branch-circuit or feeder overcurrent devices shall be installed on the load side, shall be mounted in a readily accessible location, and shall be of lower ampere rating than the service overcurrent device.

Substantiation: It is quite common for such a panel to contain feeder circuits as well as branch circuits. Current language doesn’t address this situation.

Panel Meeting Action: Accept in Principle
Panel Statement: See panel action and statement on Proposal 4-161.
4-161 Log #2983 NEC-P04
(230.92)

Final Action: Accept

Submitter: Ryan Jackson, West Valley City, UT
Recommendation: Revise text to read as follows:
230.92 Locked Service Overcurrent Devices.
Where the service overcurrent devices are locked or sealed or are not readily accessible to the occupant, branch-circuit or feeder overcurrent devices shall be installed on the load side, shall be mounted in a readily accessible location, and shall be of lower ampere rating than the service overcurrent device.
Substantiation: It is quite common for such a panel to contain feeder circuits as well as branch circuits. Current language doesn’t address this situation.
Panel Meeting Action: Accept

4-162 Log #3432 NEC-P04
(230.93)

Final Action: Reject

Recommendation: Revise text to read as follows:
230.93 Protection of Specific Circuits. Where necessary to prevent tampering, an automatic overcurrent device that protects service-entrance conductors supplying only a specific load, such as a water heater, shall be permitted to be locked or sealed where located so as to be accessible.
Substantiation: Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding affected text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:
Service-Entrance Cable. Service-entrance conductors made up in the form of a cable.
Service-Entrance Conductors. The conductors from the service point to the service disconnecting means.
Service Equipment. The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main cutoff and control of the supply.
The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of "service drops" and "service laterals". Those, too, are utility installed extensions of the services. What comes after the "point of delivery" or "the point of connection" are "service-entrance conductors," either underground or overhead.
It is recognized, however, that the definitions of "service entrance conductors" (either overhead and/or underground) need to have the concept of "service point" added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of "Service Drop" and "Service Lateral" are "by current definitions and code requirements, not limited to the 'utility company side of the service point'." These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as "Service Drop" and "Service Lateral") will clarify the application of NEC requirements.
By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.
Panel Meeting Action: Reject
Panel Statement: Not all service conductors are service-entrance conductors.
Kim Hovey, Howard R. Green Company

Where 1000A (or more) service or feeder terminates in a factory listed device distribution device, ground fault protection is not required. Where any branch circuit of the listed device is 1000A or more, provide ground fault detection.

I think the intent of the 1000A or more ground fault requirement is not clear, especially, when the handbook explanatory notes make it clear that the ground fault protection is only for the line side, not the supply. Since most service (or feeders) utilize the tap rules, and terminate at a main breaker of a factory listed device, it should be clarified whether the ground fault rule is necessary. To me, there is a large difference between factory distribution devices and field installed conduit and wires.

I have submitted the same proposal to sections 215.10, 240.13, and 240.21(C).

Panel Meeting Action: Reject

Panel Statement: The proposal does not meet the requirements of 4.3.3(b) of the Regulations Governing Committee Projects.

Martin Camargo, Popov Engineers, Inc.

Revise the existing text in the second paragraph of 230.95 to read:

The rating of the service disconnect shall be considered to be the rating of the largest actual fuse installed or the highest continuous current trip setting for which the actual overcurrent device installed in a circuit breaker installed in accordance with 240.6 is rated or can be adjusted.

This proposal clarifies that the rating of a service disconnect is the rating of the actual fuse installed or the rating of the actual circuit breaker installed in accordance with 240.6.

For circuit breakers, 240.4(B) or (C) identifies considerations for adjustable trip circuit breakers. Per 240.6(B), the rating of an adjustable trip circuit breaker, not meeting 240.6(C), is the maximum setting possible. Per 240.6(C), the rating of an adjustable trip circuit breaker is considered the actual adjusted setting of the long-time trip if restricted access to the adjusted means is provided by either; removable and sealable covers, bolted equipment doors or locked doors are used. The construction of fused switches provides restricted access to the fuses similar to adjustable trip circuit breakers that meet the provisions of 240.6(C). As such, the actual fuse size installed should be considered to be the rating of the service disconnect.

If this proposal is not accepted, the NEC will continue to add undue cost to users who properly size the service equipment overcurrent protection below 1,000A. The fact that fuses sized less than 1,000A and installed in a 1,200A fused service disconnect, properly sized to comply with the Code, require Ground Fault Protection of Equipment places an unnecessary cost on the user. This is no different than the existing provisions for adjustable trip circuit breakers with restricted access provisions in accordance with 240.4(C) to not require ground fault protection of equipment if the actual setting is less than 1,000A. The ability to increase this rating is achievable for both fused switches and adjustable trip circuit breakers and as such, they should be treated the same. In fact, it is much easier and less costly to change the setting on an adjustable trip circuit breaker, complying with 240.4(C), after the fact with the simple adjustment of a dial than it is to replace lower fuses rated less than 1,000A with fuses rated 1,000A or higher which can cost in excess of $1,500. What happens after the system is installed and inspected, for both fuses and adjustable trip circuit breakers, is out of control of the NEC.

Panel Meeting Action: Reject

Panel Statement: The submitter has not presented any technical data to support the reduction in this requirement other than a potential cost savings. The installation of GFPE equipment can save end users substantial expenses by preventing unwanted catastrophic failures and the resultant loss of use of the facility. This requirement is intended to be treated separately from the requirements found in Article 240.

Add a second exception after the second paragraph, designating the existing exception as Exception No. 1.

For life-safety purposes and system reliability for the prevention of blackouts, it is desirable that a ground-fault on the load side of a transfer switch in an emergency system, legally required standby system, or healthcare essential electrical system, not take out the ground fault protection on the normal source. This proposal allows the ground fault protection on the normal source to be restrained from operating and taking down all or major portions of the normal system because of a ground fault on the load side of the transfer switch. For these critical life-safety-related applications, it requires both audible and visual signaling that a ground fault has occurred and that it is being restrained.

Restraining the normal system ground fault protection relays for faults on the load side of the transfer switch is consistent with the concept of continuity of service for emergency systems (700.26 & 700.7(D)), legally required standby systems (701.17), and healthcare essential electrical systems (517.17(B)).

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

This is a coordination issue and can be handled without revising the NEC. The requirement should be dealt with in Articles 517, 700, 701, and 708.

Roderic Hageman, PRIT Service, Inc.

The ground-fault protection system shall be performance tested when first installed on site. The test shall be conducted in accordance with instructions that shall be provided with the equipment and shall be conducted by primary current injection to functionally test current pickup, time delay, and, if applicable, zone interlocking. A written record of this test shall be made and shall be available to the authority having jurisdiction.

PRIT Service, Inc. is a third-party, independent electrical testing firm accredited by the International Electrical Testing Association. In the over forty years of performing testing of ground fault systems, we have found a significant percentage of them that do not function as intended. We have found everything from faulty equipment to improper placement of primary conductors that defeat the actual ground fault protection while still allowing the push-to-test feature to function.

Time delay tests are important to ensure that the designed delays allow proper coordination with downstream protective equipment. Otherwise, unnecessary total power outages result when only a single feeder should trip. The use of zone interlocking can provide instantaneous tripping and reduce arc-flash incident energy and equipment damage. However, if this feature is not wired correctly, loss of coordination will result.

Panel Meeting Action: Reject
Panel Statement: This is a coordination issue and can be handled without revising the NEC. The requirement should be dealt with in Articles 517, 700, 701, and 708.
The ground-fault protection system shall be performance tested when first installed on site. The test shall be conducted in accordance with instructions that shall be provided with the equipment and shall be conducted by primary current injection. A written record of this test shall be made and shall be available to the authority having jurisdiction.

As an Accredited Member of the InterNational Electrical Testing Association, we perform third-party performance testing on thousands of newly-installed ground fault protection systems. In the process of executing the performance testing, there is a large quantity of performance-related failures uncovered during the performance testing activities. The problems range from relatively minor modes of failure, such as an indicating lamp not functioning; to major modes of failure, such as no trip under primary fault current conditions.

Ground fault systems are not limited to components, but rather, they are a complete system that must be validated and performance tested as a system if the owner and Authority Having Jurisdiction are to be assured of a properly functioning ground fault protective system. Many of the instructions provided with ground fault protection systems only address the protective relay, and only require a “push to test” simulation that does not verify that the other essential components are operational and interconnected properly. The “push to test function”, because it is not done by primary current injection, does not completely verify nor validate the performance of the primary sensor, the current transformer windings, the control wiring, and the control power. Because of this, it puts the owner at risk of a non-functioning ground fault protection system, increasing the possibility of extensive equipment damage and fires under ground fault conditions.


As an easily-executed field test procedure for the performance testing of ground fault protection systems, industry standard procedures (from NETA) dictate the following electrical tests, and of note is item No. 4. And while it is not the author’s intent to add all of the industry consensus standard procedures listed below as NEC requirements, item No. 4 is highlighted as a normal and recognized practice for the performance testing of ground fault protection systems, and would not introduce undo burden to the installing contractor nor the industry:

1. Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable, in accordance with Section 7.14.1.
2. Measure the system neutral-to-ground insulation resistance with the neutral disconnect link temporarily removed. Replace the neutral disconnect link after testing.
3. Perform insulation resistance test on all control wiring with respect to ground. Applied potential shall be 500 volts dc for 300-volt rated cable and 1000 volts dc for 600-volt rated cable. Test duration shall be one minute. For units with solid-state components or control devices that cannot tolerate the applied voltage, follow manufacturer’s recommendation.
4. Perform ground fault protective device pickup tests using primary injection.
5. For summation type systems utilizing phase and neutral current transformers, verify correct polarities by applying current to each phase-neutral current transformer pair. This test also applies to molded-case breakers utilizing an external neutral current transformer.
6. Measure time delay of the ground fault protective device at a value equal to or greater than 150 percent of the pickup value.
7. Verify reduced control voltage tripping capability is 55 percent for ac systems and 80 percent for dc systems.
8. Verify blocking capability of zone interlock systems.
Service-entrance conductors and equipment used on circuits exceeding 600 volts, nominal, shall comply with all the applicable provisions of the preceding sections of this article and with the following sections that supplement or modify the preceding sections. (The rest of the text to remain the same.)

Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding affected text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

**Service-Entrance Cable.** Service-entrance cables made up in the form of a cable.

**Service-Entrance Conductors.** The conductors from the service point to the service disconnecting means.

**Service Equipment.** The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of “service drops” and “service laterals”. Those, too, are utility installed extensions of the services. What comes after the “point of delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.

It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground) need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of “Service Drop” and “Service Lateral” are “by current definitions and code requirements, not limited to the ‘utility company side of the service point’.” These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as “Service Drop” and “Service Lateral”) will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

**Panel Meeting Action:** Reject

**Panel Statement:** Not all service conductors are service-entrance conductors.

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Add the following wording at the end: “provided the disconnecting means can be operated by mechanical linkage from a readily accessible point, or electronically in accordance with 230.205(C) where applicable.”

The literal text of the 2008 NEC amendment, however unconscionable, now considers it to be acceptable to install a pole-top switch with no linkage to the pole base, thereby relying on personnel working with a hot stick out of a bucket truck to open the switch. This was very unlikely to have been the intent. This equipment is commonly used, and routinely provided with such linkage which can be padlocked to prevent inadvertent operation. The requirement should be appropriately stated.

**Panel Meeting Action:** Accept

**Panel Statement:**
4-170     Log #3401  NEC-P04  
Final Action: Reject
(230.205(B))

Force
Recommendation: Revise text to read as follows:
  230.205(B) Type. Each service disconnect shall simultaneously disconnect all ungrounded service-entrance 
conductors that it controls and shall have a fault-closing rating that is not less than the maximum short-circuit current 
available at its supply terminals. (The rest of the text to remain the same.)
Substantiation: Separate Proposals have been submitted to change the definitions of Service Cable, Service 
Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the 
proposed changes and to provide a means to update corresponding affected text using the defined terms. The following 
is a listing of the proposed changes to the definitions and the technical substantiation for those changes:
  Service-Entrance Cable. Service-entrance conductors made up in the form of a cable.
  Service-Entrance Conductors. The conductors from the service point to the service disconnecting means.
  Service Equipment. The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and 
their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and 
otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and 
revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 
90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been 
carried forth is that only utilities supply service. That has also been carried forth via the definitions of “service drops” 
and “service laterals”. Those, too, are utility installed extensions of the services. What comes after the “point of 
delivery” or “the point of connection” are “service-entrance conductors,” either underground or overhead.

It is recognized, however, that the definitions of “service entrance conductors” (either overhead and/or underground) 
need to have the concept of “service point” added to ensure further clarity of the issue. As the TCC noted in its 
comments in the ROP for the 2008 NEC, the concept of “Service Drop” and “Service Lateral” are “by current definitions 
and code requirements, not limited to the ‘utility company side of the service point’.” These revised definitions (and 
corresponding changes to related NEC Sections that use these terms as well as “Service Drop” and “Service Lateral”) 
will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be 
updated to correlate with existing definitions related to services and service entrances and capture the stated intent and 
understanding in the NEC.
Panel Meeting Action: Reject
Panel Statement: Not all service conductors are service-entrance conductors.

4-171     Log #1631  NEC-P04  
Final Action: Accept
(230.208, FPN )

Submitter: James M. Daly, Upper Saddle River, NJ
Recommendation: In the FPN, change “Table 310.67 through Table 310.86” to “Table 310.60(C)(1) through Table 
310.60(C)(20)”.
Substantiation: This revision will correlate with the proposal to revise the table designation of Tables 310.67 through 
310.86 as Tables 310.60(C)(1) through 310.60(C)(20) to comply with 2.3.1 of the NEC Style Manual.
Panel Meeting Action: Accept
Panel Statement:
Surge arresters installed in accordance with the requirements of Article 280 shall be permitted on each ungrounded overhead service-entrance conductor.

Separate Proposals have been submitted to change the definitions of Service Cable, Service Conductors, and Service Equipment. This Proposal is intended to provide the Panel with information about the proposed changes and to provide a means to update corresponding affected text using the defined terms. The following is a listing of the proposed changes to the definitions and the technical substantiation for those changes:

**Service-entrance conductors** made up in the form of a cable.

**Service-entrance conductors** are the conductors from the service point to the service disconnecting means.

**Service Equipment** is the necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service-entrance conductors to a building or other structure, or and otherwise designated area, and intended to constitute the main cutoff and control of the supply.

The aspect of Service and what constitutes Service, and related issues, has been the subject of comments and revisions for the last several code cycles. That issue has also been debated by Panel 1 vis-à-vis the NEC Section 90.2(B)(5) over the last several cycles and it was finally clarified in the 2005 NEC. The primary concept that has been carried forth is that only utilities supply service. That has also been carried forth via the definitions of "service drops" and "service laterals". Those, too, are utility installed extensions of the services. What comes after the "point of delivery" or "the point of connection" are "service-entrance conductors," either underground or overhead.

It is recognized, however, that the definitions of "service entrance conductors" (either overhead and/or underground) need to have the concept of "service point" added to ensure further clarity of the issue. As the TCC noted in its comments in the ROP for the 2008 NEC, the concept of "Service Drop" and "Service Lateral" are "by current definitions and code requirements, not limited to the ‘utility company side of the service point’." These revised definitions (and corresponding changes to related NEC Sections that use these terms as well as "Service Drop" and "Service Lateral") will clarify the application of NEC requirements.

By changing these definitions (and the corresponding Sections where the affected terms are used), these terms will be updated to correlate with existing definitions related to services and service entrances and capture the stated intent and understanding in the NEC.

**Panel Meeting Action:** Reject

**Panel Statement:** Not all service conductors are service-entrance conductors.

Current -Voltage Diversion Trip (CVDT) shall be provided as an integral part of the service disconnect to protect from unwanted current paths or voltage shifts on the service conductors. The circuit should provide trip protection on residential of no more than 10 amps diversion for 30 seconds continuous and/or + - 10% voltage diversion (deviation) on the service conductors. Current sensing will be prior to supply-side equipment bonding jumper.

Note: Background information and pictures, data, and diagrams are supporting material.

**Panel Meeting Action:** Reject

**Panel Statement:** The submitter has not presented sufficient data to require this equipment on every service. In addition, the submitter references single family dwelling services in his substantiation and the proposed requirement is for services over 600 volts.
4-174 Log #2471 NEC-P04
(690.2.Monopole Subarray) Final Action: Accept

Submitter: John Wiles, Southwest Technology Development Inst/New Mexico State Univ. / Rep. PV Industry Forum
Recommendation: Add the following definition to 690.2

**Monopole Subarray.** A PV subarray that has two conductors in the output circuit, one positive (+) and one negative(-). Two monopole PV subarrays are used to form a Bipolar PV array.

Substantiation: This definition is needed to support new system topologies and their configuration requirements.
Panel Meeting Action: Accept

4-175 Log #2476 NEC-P04
(690.2.Photovoltaic System) Final Action: Reject

Submitter: John Wiles, Southwest Technology Development Inst/New Mexico State Univ. / Rep. PV Industry Forum
Recommendation: Add the following definition to 690.2.

**Photovoltaic System.** One or more PV modules connected as a PV source or output circuit either independently or in combination with other devices supplying ac or dc power to utilization equipment. In utility-interactive PV systems, the utility electrical production and distribution network is the utilization equipment. The system devices can include equipment such as inverters, charge controllers, current boosters, and energy storage systems. One or more PV source or PV output circuits can supply power to single utilization equipment.

Substantiation: This definition is needed to clarify the elements of a PV system and to describe how the system relates to other electrical power production sources in terms of the number and grouping of disconnects and the requirements for safely disconnecting all sources of power from a building or structure.
Panel Meeting Action: Reject
Panel Statement: A definition exists in 690.2. The list of devices included is difficult to maintain and is unnecessary.

4-176 Log #2472 NEC-P04
(690.2.Photovoltaic System Disconnecting Means) Final Action: Reject

Submitter: John Wiles, Southwest Technology Development Inst/New Mexico State Univ. / Rep. PV Industry Forum
Recommendation: Add the following definition to 690.2

**Photovoltaic System Disconnecting Means.** A system disconnecting means on the dc photovoltaic output circuit.

Substantiation: Photovoltaic systems can be quite complex in terms of the number of photovoltaic source and output circuits (dc) and the location of the inverters. Many systems have inverters mounted inside the building with the PV disconnecting means on the dc circuit as it penetrates the building. Others have the inverters outside with only ac circuits penetrating the building. A definition of the PV system disconnecting means is needed to support the requirements for this disconnecting means established in 690.13 and 690.14. See related proposals for 690.13 and 690.14.
Panel Meeting Action: Reject
Panel Statement: The definition is self describing and is unnecessary. The term "photovoltaic output circuit disconnecting means" will be used, which contains all defined terms. Proposals that relied on this definition have been changed accordingly.
Add the following definition to Section 690.2

PV. The Abbreviation for photovoltaic in this Code

Substantiation: This abbreviation, PV, is needed to reduce the use of the long and sometimes difficult-to-pronounce term "photovoltaic". The use of the abbreviation will shorten the Code. The term “PV” should be substituted for “photovoltaic” in the second and subsequent uses in each section.

Panel Meeting Action: Accept in Principle

The Abbreviation for photovoltaic (PV) is to be added after the first occurrence of photovoltaic in Section 690.1

Panel Statement: The panel recognizes that the scope is under the purview of the TCC. The panel requests that the TCC review the proposed change to the scope of Article 690. Use of acronyms per 3.2.3 is defined in the style manual.

Add the new definition to 690.2

Conductors between the output of an inverter in a stand-alone PV power system(s) and the utilization equipment. Also applies to the output conductors (not connected to a utility) of a utility-interactive inverter operating in off-grid stand-alone mode. The circuit can be and is normally energized independent of any utilization equipment.

This definition is needed to support the understanding of stand-alone system requirements. New inverters have been introduced which can include both utility-interactive and stand alone outputs. The stand alone outputs of these utility-interactive inverters do not include anti-islanding circuitry and are designed to remain energized during utility outages or when disconnected from the utility source. This definition, and the companion definition for Utility-interactive Inverter Output Circuit, are added to help clarify the different requirements which pertain to Stand-alone Inverter Output versus Utility-interactive Inverter Output of these multi mode devices. These new definitions also help to differentiate requirements of the utility-interactive inverter ac output connections, which are now covered by the requirements of Article 705 from stand-alone ac output connections, which are covered by Articles 690 and 702.

Panel Meeting Action: Reject

The term is self defining.

Add the following definition to 690.2

An electrical subset of a PV array consisting of any connected configuration of PV modules, interconnect devices, wired circuits and protection.

Substantiation: The definition of subarray is needed to support requirements elsewhere in Article 690.

Panel Meeting Action: Accept in Principle

Revise the text in the definition of Subarray as follows: An electrical subset of a PV array, consisting of any connected configuration of PV modules, interconnect devices, wired circuits and protection.

Panel Statement: Simplify and remove the list in the definition that may change over time.
4-180 Log #2475 NEC-P04 Final Action: Reject
(690.2. Utility-Interactive Inverter Output Circuit)

Submitter: John Wiles, Southwest Technology Development Inst/New Mexico State Univ. / Rep. PV Industry Forum
Recommendation: Add the new definition to 690.2
Utility-interactive Inverter Output Circuit. Conductors between the output of a utility-interactive inverter and the utilization equipment including the utility or other power production sources. The circuit is normally de-energized when the external source is disconnected.
Substantiation: This definition is needed to provide a better understanding of Code requirements. New inverters have been introduced, which can include both utility-interactive and stand-alone outputs. The stand-alone outputs of these utility-interactive inverters do not include anti-islanding circuitry and are designed to remain energized during utility outages or when disconnected from the utility source. This definition, and the companion definition for Stand-alone Inverter Output Circuit, are added to help clarify the different requirements which pertain to Stand-alone Inverter Output versus Utility-interactive Inverter Output of these multi mode devices. These new definitions also help to differentiate the requirements of the utility-interactive inverter ac output connections, which are now covered by Article 705, from stand-alone ac output connections, which are now covered by Articles 690 and 702.
Panel Meeting Action: Reject
Panel Statement: The term is self defining.

4-181 Log #597 NEC-P04

Submitter: Mike Kunkel, Kunkel Electric, Inc.
Recommendation: Revise text as follows:
One or more solar photovoltaic system(s) shall be permitted to supply a building or other structure in addition to any service(s) of another electricity supply system(s).
Substantiation: Some inspectors are interpreting the "A" in the current NEC to mean that we are limited to one system on a building. This becomes a problem on large multi-tenant buildings.
230.2(A) allows "additional services", and (5) addresses "parallel power production systems".
Panel Meeting Action: Accept in Principle
Panel Statement: See the panel action on Proposal 4-182.

4-182 Log #2478 NEC-P04 Final Action: Accept
(690.4(A))

Submitter: John Wiles, Southwest Technology Development Inst/New Mexico State Univ. / Rep. PV Industry Forum
Recommendation: Revise 690.4(A) as follows:
960.4 Installation
(A) Solar Photovoltaic Systems. A solar photovoltaic system(s) shall be permitted to supply a building or other structure in addition to any other electricity supply system(s).
Substantiation: The term “Solar” is deleted because it shortens the Code and does not need to be used throughout article 690 for clarity or understanding. The (s) is added to the word “system” to indicate that one or more PV systems may be added to a building that has other sources of supply. Many buildings such as malls and apartment houses now have a requirement that multiple individual PV systems be installed on a single building and connected to the utility service.
Panel Meeting Action: Accept
B Conduits of Different Systems. Photovoltaic source circuits and photovoltaic PV output circuits shall not be contained in the same raceway, cable tray, cable, outlet box, junction box, or similar fitting as conductors, feeders or branch circuits of other non-PV systems, unless the conductors of the different systems are separated by a partition, or are connected together.

1) Identification and Grouping. PV system conductors shall be identified and grouped as required in 690.4(B)(1)(A) through (D). The means of identification shall be permitted by separate color coding, marking tape, tagging, or other approved means.

(A) Photovoltaic Source Circuits. Where a PV system has more than one source or output circuit connected in parallel, either directly or through overcurrent protective devices, the parallel-connected conductors shall be identified at all points of termination, connection, and splices.

(B) Photovoltaic Output and Inverter Circuits. The conductors of PV output circuits and inverter input and output circuits shall be identified at all points of termination, connection, and splices.

(C) Conductors of Multiple Systems. Where the conductors of more than one PV system (subarray or inverter) occupy the same junction box, raceway, or equipment, the conductors of each system shall be identified at all termination, connection, and splice points.

Exception: Where the identification of the conductors is evident by spacing or arrangement, further identification is not required.

(D) Grouping. Where the conductors of more than one PV system (subarray or inverter) occupy the same junction box or raceway with removable cover(s), the ac and dc conductors of each system shall be grouped separately by wire ties or similar means at least once, and then shall be grouped at intervals not to exceed 1.8 m (6 ft).

Exception: Where the association with and function within each system is evident by the spacing or arrangement, further grouping is not required.

Substantiation: The intent of this requirement is to minimize potentially hazardous contact with energized PV dc source and output conductors that are energized whenever the PV array is illuminated. The existing wording of this section is vague in that it is not clear that conductors connected together through an inverter are considered to be part of the same system. Current language could also be misconstrued in that lighting and other loads connected to the output of a PV system are indeed “connected together” with the PV source and input circuits by means of the inverter.

Panel Meeting Action: Accept in Principle
Panel Statement: See the panel action on Proposal 4-184.
Revise the existing section 690.4(B) and add the new paragraphs.

(B) Conductors of Different Systems. Photovoltaic source circuits and photovoltaic PV output circuits shall not be contained in the same raceway, cable tray, cable, outlet box, junction box, or similar fitting as conductors, feeders, or branch circuits of other non-PV systems, unless the conductors of the different systems are separated by a partition, or are connected together.

1) Identification and Grouping. PV system conductors shall be identified and grouped as required in 690.4 (B)(1) (A) through (D). The means of identification shall be permitted by separate color coding, marking tape, tagging, or other approved means.

(A) Photovoltaic Source Circuits. Where a PV system has more than one source or output circuit connected in parallel, either directly or through overcurrent protective devices, the parallel-connected conductors shall be identified at all points of termination, connection, and splices.

(B) Photovoltaic Output and Inverter Circuits. The conductors of PV output circuits and inverter input and output circuits shall be identified at all points of termination, connection, and splices.

(C) Conductors of Multiple Systems. Where the conductors of more than one PV system (subarray or inverter), occupy the same junction box, raceway, or equipment, the conductors of each system shall be identified at all termination, connection, and splice points.

Exception: Where the identification of the conductors is evident by spacing or arrangement, further identification is not required.

(D) Grouping. Where the conductors of more than one PV system (subarray or inverter) occupy the same junction box or raceway with removable cover(s), the ac and dc conductors of each system shall be grouped separately by wire ties or similar means at least once, and then shall be grouped at intervals not to exceed 1.8 m (6 ft).

Exception: Where the association with function within each system is evident by the spacing or arrangement, further grouping is not required.

Substantiation: The intent of this requirement is to minimize potentially hazardous contact with energized PV dc source and output conductors that are energized whenever the PV array is illuminated. The existing wording of this section is vague in that it is not clear that conductors connected together through an inverter are considered to be part of the same system. Current language could also be misconstrued in that lighting and other loads connected to the output of a PV system are indeed “connected together” with the PV source and input circuits by means of the inverter.

The additional requirements for grouping the conductors of each system will help service personnel distinguish the conductors of different systems. DC systems present some unique problems for service in that non-contact voltage testers, which can identify energized dc conductors, are not readily available for dc voltages. Distinguishing markings or groupings of circuit conductors for branch circuits and feeders in distribution systems is well-established and already required elsewhere in the NEC and can be accomplished simply using readily available means such as tags, ties, and tape. Identification of circuit conductors in power-distribution circuits is common practice and is required for multi-wire branch circuits and feeders. This provision would extend the same means of identification to the conductors of PV systems while being slightly more stringent when dc and ac conductors are accessible within the same raceway. (See 210.4, 210.5, and 215.12.)

Panel Meeting Action: Accept in Principle

Revise (A) as follows:

(A) Photovoltaic Source Circuits. Photovoltaic Source Circuits Where a PV system has more than one source or output circuit connected in parallel, either directly or through overcurrent protective devices, the parallel-connected conductors shall be identified at all points of termination, connection, and splices.

Revise (B) as follows:

(B) Conductors of Different Systems. Photovoltaic source circuits and photovoltaic PV output circuits shall not be contained in the same raceway, cable tray, cable, outlet box, junction box, or similar fitting as conductors, feeders, or branch circuits of other non-PV systems, unless the conductors of the different systems are separated by a partition.

1) Identification and Grouping. PV system conductors shall be identified and grouped as required in 690.4 (B)(1) (a) through (d). The means of identification shall be permitted by separate color coding, marking tape, tagging, or other approved means.

(a) Photovoltaic Source Circuits. Photovoltaic source circuits shall be identified at all points of termination, connection, and splices.
(b) Photovoltaic Output and Inverter Circuits. The conductors of PV output circuits and inverter input and output circuits shall be identified at all points of termination, connection, and splices.

(c) Conductors of Multiple Systems. Where the conductors of more than one PV system (subarray or inverter) occupy the same junction box, raceway, or equipment, the conductors of each system shall be identified at all termination, connection, and splice points.

Exception: When the identification of the conductors is evident by spacing or arrangement, further identification is not required.

(d) Grouping. Where the conductors of more than one PV system (subarray or inverter) occupy the same junction box or raceway with removable cover(s), the ac and dc conductors of each system shall be grouped separately by wire ties or similar means at least once, and then shall be grouped at intervals not to exceed 1.8 m (6 ft).

Exception: When the association with and function within each system is evident by the spacing or arrangement, further grouping is not required.

Panel Statement: The panel clarified section (A), removing redundant language.
As per the NEC Style Manual subdivision example, subsection letters were changed from capital to lower case. Where changed to when as appropriate in the exceptions.

4-185 Log #2481 NEC-P04
(690.4(C))

Submitter: John Wiles, Southwest Technology Development Inst/New Mexico State Univ. / Rep. PV Industry Forum

Recommendation: Revise the section as follows:

(C) Module Connection Arrangement . The connection to a module or panel shall be arranged so that removal of a module or panel from a photovoltaic source circuit does not interrupt a grounded conductor to another PV source circuits. Sets of modules interconnected as systems rated at 50 volts or less, with or without blocking diodes, and having a single overcurrent device shall be considered as a single source circuit. Supplementary overcurrent devices used for the exclusive protection of the photovoltaic modules are not considered as overcurrent devices for the purposes of this section.

Substantiation: “Source circuits” are pluralized as this is the more general case. The following sentence “Sets of modules interconnected as systems rated at 50 volts or less, with or without blocking diodes, and having a single overcurrent device shall be considered as a single source circuit.” is deleted because it no longer applies to today’s installed PV systems where every string of photovoltaic modules must have overcurrent protection where subjected to external sources of overcurrent. This sentence was added to the Code when blocking diodes were in common use and were used in place of overcurrent devices. Parallel connections of modules without overcurrent protection was common on 12, 24, and 48-volt systems, but is no longer considered safe, nor Code compliant.

The sentence “Supplementary overcurrent devices used for the exclusive protection of the photovoltaic modules are not considered as overcurrent devices for the purposes of this section.” is deleted because it is not technically correct (both conductors and PV modules may be protected by a single, properly rated, overcurrent device) and belongs in Section 690.9 where a proposal for a modified version of this requirement is being submitted.

The nearly universal use of modules with permanently attached wire leads and connectors makes it unlikely that this situation will occur. However, a few PV module manufacturers have modules with conduit-ready junction boxes still available on special order.

Panel Meeting Action: Accept
Submitter: Keith W. Brand, Baton Rouge Area Electrical JATC

Recommendation: Add new text as follows:

690.4(D) Equipment. Inverters, motor generators, photovoltaic modules, photovoltaic panels, ac photovoltaic modules, source-circuit combinators, and charge controllers intended for use in photovoltaic power systems shall be identified and listed for the application and be installed by qualified persons with documented training and experience in the installation of and NEC requirements applicable to such equipment. The name(s) of the qualified person(s) shall be kept in a permanent record at the office of the establishment in charge of the completed installation. Records of qualified persons must be furnished upon request to the local authority having jurisdiction.

Substantiation: Increasing numbers of Photovoltaic (PV) installations are becoming a hazard to the safety of the general populace and the durability of PV systems that are not correctly installed are also creating a hazard, i.e. according to the National Electrical Code specifications. Present day requirements and mandates to adhere to NEC specifications are not available from the Photovoltaics Industry. To require extensive knowledge of electrical systems and associated National Electrical Code specifications would undoubtedly increase the safety level for PV installations across the country; providing a service to the populace that wish to purchase and have installed for them, Photovoltaic Systems. Therefore it is proposed that extensive knowledge of training within the electrical safety codes and standards must be put in place to protect the people and property in which Photovoltaic systems are installed. The following excerpts and complete articles I have provided as references to support this proposal. The following information is provided by members of the Photovoltaics industry in which they recognize potential safety issues.

Perspectives on PV


From excerpt of article written by John Wiles for the IAEI Magazine.

"...But Not All Systems Are Code-Compliant and Durable"

Unfortunately, we are still a long way from that ideal scenario. While there are a few PV systems integrators (the larger companies) and other PV installers who have done dozens and possibly hundreds of PV installation, they are not common. PV installers, normally with little electrical installation experience, abound. They are familiar with neither Article 690 in the NEC covering PV systems nor the first four chapters of the Code that deal with the basics. On the other side of the installation/inspection equation, inspectors and plan reviewers have had little experience with the unique nature of PV systems and have not worked extensively with these new PV companies. New equipment (inverters and PV modules) is being introduced continually, and all involved with PV systems are hard-pressed to keep up with the ever-changing installation requirements due to the unique nature of each piece of equipment. Unfortunately, even a PV installer who has obtained the NABCEP (North American Board of Certified Energy Practitioners, www.nabcep.org) certificate by passing a 60-question written examination may not have extensive experience installing conventional residential or commercial electrical systems...

I have also provided a complete Article and following excerpt from:

PV INSTALLATIONS, A PROGRESS REPORT

John C. Wiles1, Bill Brooks2, Bob-O Schultze3

Southwest Technology Development Institute, Box 30001/MSC3SOL, Las Cruces, NM 88003, 2. Endecon Engineering, 873 Kells Circle, Vacaville, CA 95688, 3. Electron Connection, POB 203, Hornbrook, CA 96044

"...well-trained and experienced PV designers and installers following the best available information and codes are providing PV electrical power systems that are safe, durable, reliable, and well performing. About 50% of the surveyed installations met this goal [1,7,8,9]. However, the remaining 50% of the installed systems had deficiencies in these same areas of safety, reliability, durability, and performance...".

Additionally, the inclusion of the wording "qualified persons" does have precedence in the NEC. See: 685.1 Scope.

This article covers integrated electrical systems, other than unit equipment, in which orderly shutdown is necessary to ensure safe operation. An integrated electrical system as used in this article is a unitized segment of an industrial wiring system where all of the following conditions are met:

(1) An orderly shutdown is required to minimize personnel hazard and electrical damage.

(2) The conditions of maintenance and supervision ensure that qualified persons service the system. The name(s) of the qualified person(s) shall be kept in a permanent record at the office of the establishment in charge of the completed installation.

A person designated as a qualified person shall possess the skills and knowledge related to the construction and
operation of the electrical equipment and installation and shall have received documented safety training on the hazards involved. **Documentation of their qualifications shall be on file with the office of the establishment in charge of the completed installation.**

(3) Effective safeguards acceptable to the authority having jurisdiction are established and maintained.

Also:

215.2(B)(3) Supervised Installations. For supervised installations, feeder conductor sizing shall be permitted to be determined by qualified persons under engineering supervision. Supervised installations are defined as those portions of a facility where all of the following conditions are met:

(1) Conditions of design and installation are provided under engineering supervision.

(2) **Qualified persons with documented training and experience** in over 600-volt systems provide maintenance, monitoring, and servicing of the system. 215.2

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

**Panel Meeting Action:** Reject

**Panel Statement:** The panel supports installation of these systems by qualified persons. However, the NEC cannot contain requirements relative to the qualifications of installers for any electrical system, these requirements need to be handled by local or state qualification committees or licensing boards. See Annex H of the NEC for recommendations on establishing such bodies.

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4-187 Log #2482 NEC-P04

(690.4(E))

**Submitter:** John Wiles, Southwest Technology Development Inst/New Mexico State Univ. / Rep. PV Industry Forum

**Recommendation:** Add the new Section 690.4(E) as follows:

690.4(E) **Circuit Routing.** Photovoltaic source and PV output conductors, in and out of conduit, and inside of a building or structure, shall be routed along building structural members such as beams, rafters, trusses, and columns, where the location of those structural members can be determined by observation. Where circuits are imbedded in built-up, laminate, or membrane roofing materials in roof areas not covered by PV modules and associated equipment, the location of circuits shall be clearly marked.

**Substantiation:** This proposal is derived from on-going discussions with firefighters throughout the country who have expressed concern about the safety of ventilating roofs where PV circuits are present. By routing these circuits along building structural elements, there is a lower probability that they will be contacted by the firefighters. This will increase safety for these personnel. Several PV module systems are integrated into the roof and the circuits associated with these must be marked on the surface of the roof. This circuit-routing requirement should appear in the NEC since building codes do not generally address electrical circuit routing.

**Panel Meeting Action:** Accept

**Panel Statement:**

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Report on Proposals – June 2010
Submitter: John Wiles, Southwest Technology Development Inst/New Mexico State Univ. / Rep. PV Industry Forum

Recommendation: Add the New paragraph and Exception to 690.4

690.4(F) Bipolar PV Systems. Where the sum, without consideration of polarity, of the PV system voltages of the two monopole subarrays exceeds the rating of the conductors and connected equipment, monopole subarrays in a bipolar PV system shall be physically separated, and the electrical output circuits from each monopole subarray shall be installed in separate raceways until connected to the inverter. The disconnecting means and overcurrent protective devices for each monopole subarray output shall be in separate enclosures. All conductors from each separate monopole subarray shall be routed in the same raceway.

Exception: Listed switchgear containing a physical barrier separating the disconnecting means for each monopole subarray shall be permitted to be used instead of disconnecting means in separate enclosures.

Substantiation: See related proposal for 690.2 defining a monopole subarray.

It is imperative that the positive and negative conductors of a bipolar PV array not come into contact with each other. If they come into contact, the sum of the open-circuit monopole subarray voltages (usually between 800 and 1200 volts) may be applied to switchgear, conductors, PV modules, and other equipment listed for 600 volts. Series-circuit breaks, line-to-line faults, and line-to-ground faults must be avoided. Equipment has been damaged and fires started in the past when faults of these types have occurred on bipolar PV systems.

Underwriters Laboratories is revising UL 1741 to address similar requirements in the bipolar inverter where physically separate subarray inputs will be required as well as internal partitions that keep these circuit conductors apart until they are connected to the internal wiring of the inverter.

Panel Meeting Action: Accept in Principle

Revise the exception to begin: Listed switchgear rated for the maximum voltage between circuits containing a physical barrier separating the disconnecting means for each monopole subarray shall be permitted to be used instead of disconnecting means in separate enclosures.

Revise the Exception to read:

Exception: Listed switchgear rated for the maximum voltage between circuits containing a physical barrier separating the disconnecting means for each monopole subarray shall be permitted to be used instead of disconnecting means in separate enclosures.

Panel Statement: The panel clarified by revising the wording that the switchgear needs to be rated for the voltages involved.
Add the following new paragraph and exception to 690.4:

A PV system shall be permitted to have multiple utility-interactive inverters installed in or on a single building or structure. Where the inverters are remotely located from each other, a directory in accordance with 705.10 shall be installed at each dc PV system disconnecting means, each ac disconnecting means and at the main service disconnecting means showing the location of all ac and dc PV system disconnecting means in the building.

Exception: A directory shall not be required where all inverters and PV dc disconnecting means are grouped at the main service disconnecting means.

PV installations may consist of a number of small (1-7 kW) utility-interactive inverters installed on a building or structure. These multiple inverters are connected in parallel with the existing utility service following the requirements of this Code as allowed by 690.64, 705.12 and 230.2. They operate independently and are designed to operate safely in this manner. There is no safety or operational reason that would preclude the installation of multiple inverters on a single building or connected to a single utility feeder.

Where these inverters are not co-located, a directory shall be required at each dc PV disconnecting means to identify the location of all PV disconnecting means. This directory will facilitate the rapid disconnect of all energized conductors from the PV array(s).

In some cases, all inverters and their associated dc PV disconnecting means are located at the service disconnect, and no directory would be required.

Panel Meeting Action: Accept

Add the following new section to 690.4

Each utility-interactive inverter shall be permitted to have multiple PV source or PV output circuits connected to the inverter input circuit(s) where the inverter is identified and labeled to accommodate multiple inputs.

Small PV systems with 1-3 kW inverters may have only a single string of PV modules and a single PV output circuit connected to the utility-interactive inverter, particularly when large, high-wattage PV modules are used. However, many inverters have combining circuits or bus bars at their inputs that accept and properly combine multiple PV output circuits into a single inverter. Instructions and labels on appropriately identified inverters show how these inputs are to be connected.

Panel Meeting Action: Reject

The panel agrees that this is unnecessary additional code language. No problem statement to substantiate was provided.
NOTE: This proposal appeared as Comment 13-28 on Proposal 13-22 in the 2007 Annual Meeting National Electrical Code Committee Report on Proposals. This comment was held for further study during the processing of the 2008 NATIONAL ELECTRICAL CODE. The recommendation in Proposal 13-22 was:

Revise the section as follows:

690.5 Ground-Fault Protection. Roof-mounted dc photovoltaic arrays located on dwellings shall be provided with ground-fault protection to reduce fire hazards. Grounded dc photovoltaic arrays shall be provided with dc ground-fault protection meeting the requirements of 690.5 (A) through (C) to reduce fire hazards. Ungrounded dc photovoltaic arrays shall comply with 690.35.

Exception 1: Ground-mounted or pole-mounted photovoltaic arrays with not more than two paralleled source circuits and with all dc source and dc output circuits isolated from buildings shall be permitted without ground-fault protection.

Exception 2: PV arrays mounted on other than dwelling units shall be permitted without ground-fault protection if each equipment-grounding conductor has an ampacity of at least two (2) times the temperature and conduit fill corrected circuit conductor ampacity.

Submitter: John C. Wiles, Southwest Technology Development Institute, New Mexico State University / Rep. PV Industry Forum

Recommendation: The original Proposal should be accepted as the Panel Action indicates. A revision is made to EX 2 as follows and a FPN is added for clarity:

Exception 2: PV arrays mounted on other than dwelling units shall be permitted without ground-fault protection if each equipment-grounding conductor, the grounded circuit conductor, and the dc grounded conductor-to-ground bonding conductor has an ampacity of at least 2.8 times the module rated short-circuit current. The ampacity in the equipment-grounding conductors shall be adjusted for the conditions of use including temperature and conduit fill where applicable. No increase in size is required if circuit conductors are oversized.

FPN to EX 2: Where the system and equipment does not employ a ground fault detection device that interrupts the fault current, the equipment-grounding conductors, grounded circuit conductors and the dc grounded conductor-to-ground bonding conductor can carry ground-fault currents continuously, and these currents can be insufficient to cause operation of any overcurrent devices. The equipment-grounding conductors should have conditions-of-use adjustment factors applied.

Substantiation: Many systems will employ equipment that meets the basic requirements of 690.5. See attached explanatory materials.

The revision to EX 2 clarifies the exact ampacity requirement of the equipment grounding conductors, grounded circuit conductors, and the dc system ground-bonding conductor as 2.8 times the module rated short-circuit current and points out that the ampacity should be adjusted for conditions of use, since, under fault conditions, they may have to carry the fault currents continuously where the fault currents are insufficient to operate any overcurrent devices. All conductors that may be subject to these higher ground fault currents are required to be oversized. Note this is not an issue of voltage drop or conductor size limiting the operation of overcurrent devices, it is a problem of insufficient, although somewhat larger than normal, over currents. The FPN is added for clarity.

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

Panel Meeting Action: Reject

Panel Statement: This has already has been addressed in the 2008 NEC in 690.45. No further action is necessary.

4-192 Log #1966 NEC-P04 Final Action: Reject
(690.5(C))

Submitter: Dan Leaf, Seneca, SC

Recommendation: Insert "durable" between "a: and :warning".

Substantiation: Edit. The label should be suitable for the enviroment.

Panel Meeting Action: Reject

Panel Statement: This is a general requirement of all labels and will overly clutter the code by adding "durable" in front of every reference to a label.
FPN: One source for statistically valid, lowest-expected, ambient temperature design data for various locations is the Extreme Annual Mean Minimum Design Dry Bulb Temperature found in the ASHRAE Handbook—Fundamentals. These temperature data can be used to calculate maximum voltage using the manufacturer’s temperature coefficients relative to the rating temperature of 25°C.

Substantiation: This FPN provides clarity to the ambiguous requirement of “lowest-expected temperature” in 690.7(A). The design of PV systems is heavily reliant on an accurate estimate of maximum voltage since it limits the operating voltage at high temperatures. An overly-conservative, lowest-expected temperature (e.g., all-time record low) will yield an overly-conservative estimate of maximum voltage resulting in a lower-than necessary operating voltage on hot summer days. Of all the data provided by the tables in the ASHRAE Handbook—Fundamentals, the “Extreme Annual Mean Minimum Design Dry Bulb Temperature” most closely matches the concerns of the National Electrical Code by establishing a statistically valid, lowest-expected operating temperature value to use for any table that establishes low-temperature correction factors. These extreme temperature values provide a probability of occurrence that is sufficiently low. Table 690.7 assumes that irradiance is at 1000 W/m². The most likely scenario for highest voltage will occur on cold mornings at the end of an extreme nighttime temperature when the irradiance is likely to be 200-300 W/m² before heating of the module reduces voltage. For representative crystalline silicon products, the open-circuit voltage under these extreme conditions will be 90% of the 1000 W/m² values providing an additional safety factor in the use of the “Extreme Annual” temperature value from ASHRAE. This safety factor is useful because the actual module temperatures may be a few degrees lower than the ambient temperatures due to night-sky radiation effects.

Panel Meeting Action: Accept

FPN: Code-Making Panel 4,

Recommendation: Change Part roman numeral I to IX in the last sentence of 690.7(C) to resolve a typographical error.

Substantiation: Correct typographical error.

Panel Meeting Action: Accept
Submitter: John Wiles, Southwest Technology Development Inst/New Mexico State Univ. / Rep. PV Industry Forum

Recommendation: Revise the section as follows and add the exception:

(1) One conductor of each circuit of a bipolar subarray is solidly grounded.

Exception: The operation of ground-fault or arc-fault devices (abnormal operation) may interrupt this connection to ground where the entire bipolar array becomes two distinct arrays isolated from each other and the utilization equipment.

Substantiation: The phrase "of a bipolar subarray" is added for clarity because the entire section is referring to bipolar systems.

Exception: Ground-fault equipment (690.5) may activate switchgear that automatically separates the bipolar array into two isolated monopole arrays that cannot combine to produce voltages that exceeds wiring and switchgear ratings.

Panel Meeting Action: Accept in Principle

Revise text to read:

(1) One conductor of each circuit of a bipolar subarray is solidly grounded.

Exception: The operation of ground-fault or arc-fault devices (abnormal operation) may interrupt this connection to ground when the entire bipolar array becomes two distinct arrays isolated from each other and the utilization equipment.

Panel Statement: The word "where" was changed to "when" to comply with the NFPA Manual of Style.
Photovoltaic system currents shall be considered to be continuous.

(1) Sizing of Conductors and Overcurrent Devices. The circuit conductors and overcurrent devices shall be sized to carry not less than 125% of the maximum currents calculated in 690.8(A).

Exception: Circuits containing an assembly, together with its overcurrent device(s), that is listed for continuous operation at 100 percent of its rating shall be permitted to be utilized at 100 percent of its rating.

(a) Terminal temperature limits shall be in accordance with 110.3(B) and 110.14(C).

(b) Where operated at temperatures greater than 40°C, manufacturer’s temperature correction factors shall apply.

(c) The conductor size selected, after application of conditions of use, shall be protected by the overcurrent protective device, where required.

Substantiation: The proposed changes align the rating of overcurrent devices and the sizing of conductors for PV system circuits with the rating and sizing of overcurrent devices and conductors in other electrical power systems as required in Chapter 2 of the Code. This section in the 2008 NEC was not specific and did not adequately define the requirements as they apply to common PV installations. The second Exception is deleted because it applies only to the rating of overcurrent devices and not to sizing conductors. The previous (2) is deleted because this was applied to PV charge controllers and is now covered by a proposal for 690.72(C).

The word “utilized” is replaced by the more correct term “use” and minimizes the unnecessary use of verbose words.

Panel Meeting Action: Accept in Principle

Revise text to read as follows:

(c) When operated at temperatures greater than 40°C, manufacturer’s temperature correction factors shall apply.

(2) Conductor Ampacity. Circuit conductors shall be sized to carry not less than the larger of 690.8(B)(2)(a) or 690.8(B)(2)(b).

(a) One hundred and twenty-five percent of the maximum currents calculated in 690.8(A) without any additional correction factors for conditions of use.

Exception: Circuits containing an assembly, together with its overcurrent device(s), that is listed for continuous operation at 100 percent of its rating shall be permitted to be utilized at 100 percent of its rating.

(b) The maximum currents calculated in 690.8(A) after conditions of use have been applied.

(c) The conductor selected, after application of conditions of use, shall be protected by the overcurrent protective device, where required.
4-196  Log #2489  NEC-P04
(690.9(A) Exception)

Final Action: Accept

Submitter: John Wiles, Southwest Technology Development Inst/New Mexico State Univ. / Rep. PV Industry Forum

Revise the section as follows:

Exception: An overcurrent device shall not be required for PV modules or PV source circuit conductors sized in accordance with 690.9(B), where one of the following apply:

(a) There are no external sources such as parallel-connected source circuits, batteries, or backfeed from inverters.
(b) The short-circuit currents from all sources do not exceed the ampacity of the conductors or the maximum overcurrent protective device size specified on the PV module nameplate.

Substantiation: Where there are no overcurrents that can damage either a conductor or a PV module, there is no requirement to protect that conductor or PV module with an overcurrent protective device. Module output currents are inherently current limited and, under the very worst-case conditions, are unlikely to exceed 1.25 times the rated short-circuit current (Isc) from the module. All interconnecting conductors are rated for 1.56 Isc (1.25 x 1.25 Isc) or greater. Only external sources can provide significant overcurrents, and if those sources do not exist or are lower in value than the conductor ampacity or the maximum module reverse current (specified by the size of the overcurrent device on the module label), then no overcurrent device is needed.

Panel Meeting Action: Accept

4-197  Log #2490  NEC-P04
(690.9(B) Exception)

Final Action: Accept

Submitter: John Wiles, Southwest Technology Development Inst/New Mexico State Univ. / Rep. PV Industry Forum

Revise the Exception as shown:

690.9(B) Power Transformers.

Exception: A power transformer with a current rating on the side connected toward the PV power source utility-interactive inverter output, not less than the short-circuit rated continuous output current of the inverter, shall be permitted without overcurrent protection from that source the inverter.

Substantiation: Under short-circuit conditions, the anti-islanding circuits required by UL Standard 1741 in all utility-interactive inverters, sense the near zero voltage and cause the inverters to shut down within 0.1 seconds. These inverters cannot operate when connected to a short circuit. Transformer protection is more properly afforded by comparing the transformer rating to the continuous rated output of the inverter.

Panel Meeting Action: Accept

4-198  Log #3635  NEC-P04
(690.9(C))

Final Action: Reject

Submitter: Greg Chontow, Hopatcong, NJ

Revise text to read as follows:

"...shall be accessible but not required to be readily accessible.

Substantiation: Overcurrent devices that are not readily accessible may be difficult and labor intensive if servicing is required.

Panel Meeting Action: Reject

Panel Statement: Ready access will rule out more than half of the PV systems being installed. A commercial rooftop is not readily accessible.

PV often is installed on rooftops where ladders or other means are required for access. Rooftops are usually not readily accessible per the definition in Article 100. Fuses and overcurrent devices included in combiner boxes on the roof seldom fail and are not required to be operated in an emergency. The proposal as submitted is too restrictive, and the submitter has not presented any technical data to support the requirement that these supplemental overcurrent devices be readily accessible.
4-199 Log #1965 NEC-P04
(690.9(D)) Final Action: Reject

Submitter: Dan Leaf, Seneca, SC
Recommendation: Delete text and substitute: Fuses and circuit breakers used in any portion of a photovoltaic power system shall be listed for use in dc circuits, have voltage ratings not less than the circuit voltage, and current ratings in accordance with 690.8.
(B) Interrupting ratings shall not be less than the available fault current at their terminals.
Substantiation: Edit. "Appropriate " is subjective and a term to be avoided per the Style Manual. Proposal is more specific.
Panel Meeting Action: Reject

Panel Statement: The proposal as submitted does not add any clarity to the existing language. The submitter has not presented any technical data to support the change. The proposal does not meet the requirements of 4.3.3(b) of the Regulations Governing Committee Projects.

4-200 Log #2491 NEC-P04
(690.9(E)) Final Action: Accept in Part

Submitter: John Wiles, Southwest Technology Development Inst/New Mexico State Univ. / Rep. PV Industry Forum
Recommendation: Revise the section as follows:
(E) Series Overcurrent Protection. In series-connected strings of two or more modules PV source circuits, a single overcurrent device shall be permitted to protect the PV modules and the interconnecting conductors.
FPN: Fuses and circuit breakers are equivalent forms of overcurrent protection in this application.
Substantiation: Some electrical inspectors have not been accepting a single, properly rated overcurrent device to protect both the conductor and the PV modules in a series-connected source circuit. This revision clarifies that intent.
The FPN addresses the fact that a few inspectors in major jurisdictions are taking the fuse requirement marking on the back of the modules literally and are not allowing the use of circuit breakers that provide equivalent protection. They use 110.3(B) as justification, and the requirement on certain control equipment that a fuse must be used.
UL is changing the marking requirements in UL 1703 to require that the module label specify a "maximum overcurrent device."
Panel Meeting Action: Accept in Part

The panel accepts the revisions to (E). The panel does not accept the addition of the fine print note.
Panel Statement: The FPN is not necessary.
690.10 Stand-Alone Systems.

The premises wiring system shall be adequate to meet the requirements of this Code for a similar installation connected to a service. The wiring on the supply side of the building or structure disconnecting means shall comply with the requirements of Article xxx. this Code except as modified by 690.10(A) through (D):

(A) Inverter Output. The ac output from a stand-alone inverter(s) shall be permitted to supply ac power to the building or structure disconnecting means at current levels less than the calculated load connected to that disconnect. The inverter output rating or the rating of an alternate energy source shall be equal to or greater than the load posed by the largest single utilization equipment connected to the system. Calculated general lighting loads shall not be considered as a single load.

A stand-alone residential or commercial PV installation may have an ac output and be connected to a building wired in full compliance with all articles of this Code. Even though such an installation may have service-entrance equipment rated at 100 or 200 amperes at 120/240 volts, there is no requirement that the PV source provide either the rated full current or the dual voltages of the service equipment. While safety requirements dictate full compliance with the ac wiring sections of the Code, a PV installation is usually designed so that the actual ac demands on the system are sized to the output rating of the PV system. The inverter output is required to have sufficient capacity to power the largest single piece of utilization equipment to be supplied by the PV system, but the inverter output does not have to be sized for the potential multiple loads to be simultaneously connected to it. Lighting loads are managed by the user based on the available energy from the PV system.

(B) Sizing and Protection. The circuit conductors between the inverter output and the building or structure disconnecting means shall be sized based on the output rating of the inverter. These conductors shall be protected from overcurrents in accordance with Article 240. The overcurrent protection shall be located at the output of the inverter.

(C) Single 120-Volt Supply. The inverter output of a stand-alone solar photovoltaic system shall be permitted to supply 120 volts to single-phase, 3-wire, 120/240-volt service equipment or distribution panels where there are no 240-volt outlets and where there are no multiwire branch circuits. In all installations, the rating of the overcurrent device connected to the output of the inverter shall be less than the rating of the neutral bus in the service equipment. This equipment shall be marked with the following words or equivalent:

WARNING
SINGLE 120-VOLT SUPPLY. DO NOT CONNECT MULTIWIRE BRANCH CIRCUITS!

Multwire branch circuits are common in one- and two-family dwelling units. When connected to a normal 120/240-volt ac service, the currents in the neutral conductors of these multiwire branch circuits (typically 14-3 AWG) subtract or are, at most, no larger than the rating of the branch-circuit overcurrent device. When these electrical systems are connected to a single 120-volt PV power system inverter by paralleling the two ungrounded conductors in the service entrance load center, the currents in the neutral conductor for each multiwire branch circuit add rather than subtract. The currents in the neutral conductor may be as high as twice the rating of the branch-circuit overcurrent device. With this configuration, neutral conductor overloading is possible.

(D) Energy Storage or Backup Power System Requirements. Energy storage or backup power supplies are not required:

Article 70X – Stand-Alone Electric Systems

Scope: This Article covers electric systems that supply power independently of the electric production and distribution network.

70X.1 Stand-Alone Systems.

The premises wiring system shall be adequate to meet the requirements of this Code for a similar installation connected to a service. The wiring on the supply side of the building or structure disconnecting means shall comply with this Code except as modified by 690.10(A) through (D):

(A) Inverter Output. The ac output from a stand-alone inverter(s) shall be permitted to supply ac power to the building or structure disconnecting means at current levels less than the calculated load connected to that disconnect. The inverter output rating or the rating of an alternate energy source shall be equal to or greater than the load posed by the largest single utilization equipment connected to the system. Calculated general lighting loads shall not be considered as a single load.
A stand-alone residential or commercial PV installation may have an ac output and be connected to a building wired in full compliance with all articles of this Code. Even though such an installation may have service-entrance equipment rated at 100 or 200 amperes at 120/240 volts, there is no requirement that the PV source provide either the rated full current or the dual voltages of the service equipment. While safety requirements dictate full compliance with the ac wiring sections of the Code, a PV installation is usually designed so that the actual ac demands on the system are sized to the output rating of the PV system. The inverter output is required to have sufficient capacity to power the largest single piece of utilization equipment to be supplied by the PV system, but the inverter output does not have to be sized for the potential multiple loads to be simultaneously connected to it. Lighting loads are managed by the user based on the available energy from the PV system.

(B) Sizing and Protection. The circuit conductors between the inverter output and the building or structure disconnecting means shall be sized based on the output rating of the inverter. These conductors shall be protected from overcurrents in accordance with Article 240. The overcurrent protection shall be located at the output of the inverter.

(C) Single 120-Volt Supply. The inverter output of a stand-alone solar photovoltaic system shall be permitted to supply 120 volts to single-phase, 3-wire, 120/240-volt service equipment or distribution panels where there are no 240-volt outlets and where there are no multiwire branch circuits. In all installations, the rating of the overcurrent device connected to the output of the inverter shall be less than the rating of the neutral bus in the service equipment. This equipment shall be marked with the following words or equivalent:

WARNING
SINGLE 120-VOLT SUPPLY. DO NOT CONNECT
MULTIWIRED BRANCH CIRCUITS!

Multiwire branch circuits are common in one- and two-family dwelling units. When connected to a normal 120/240-volt ac service, the currents in the neutral conductors of these multiwire branch circuits (typically 14-3 AWG) subtract or are, at most, no larger than the rating of the branch-circuit overcurrent device. When these electrical systems are connected to a single 120-volt PV power system inverter by paralleling the two ungrounded conductors in the service entrance load center, the currents in the neutral conductor for each multiwire branch circuit add rather than subtract. The currents in the neutral conductor may be as high as twice the rating of the branch-circuit overcurrent device. With this configuration, neutral conductor overloading is possible.

(D) Energy Storage or Backup Power System Requirements. Energy storage or backup power supplies are not required.

Substantiation: The section on the application of inverters in stand-alone systems Article 690 is applicable to systems other than photovoltaics. In writing the new proposed article for Small Wind Electric Systems, we copied this language verbatim. These requirements should apply to any stand-alone system, and thus should be moved to a general section of the code.

The problem — language duplicated in several articles, and not being applied for other situations where it is relevant — e.g. small wind, hydro, and something that will be important in the near future — electric vehicles as a power source.

The solution — Create a new article. I believe that this language belongs along side Article 705. If so moved, the same language in the proposed small wind electric system article could be deleted.

Panel Meeting Action: Reject
Panel Statement: The new article is incomplete as proposed.
Add the following new section:

**690.10(E) Backfed Circuit Breakers.** Backfed circuit breakers connected to a stand-alone inverter output in either stand-alone or utility-interactive systems shall be identified and listed for backfeeding and shall be secured in accordance with 408.36(D).

**Substantiation:** More than 95% of the PV installations are accomplished with utility-interactive inverters that are exempt from having the output back-fed circuit breakers clamped to the panel busbar as permitted by 690.64(B)(5) and (6) and 705.12(D)(5) and (6). Inverters in stand-alone systems and the stand-alone outputs of utility-interactive inverters act as voltage sources without anti-islanding circuits. The stand-alone output circuit does not shut down when the utility-interactive output circuits are disconnected. Installers familiar with utility-interactive systems may fail to clamp the back fed circuit breaker connected to output of a stand-alone inverter or the output of an inverter in a utility-interactive system. Such a circuit breaker represents a safety hazard if inadvertently unplugged from a panel board when energized.

**Panel Meeting Action:** Accept in Principle

Revise the wording as follows:

**690.10(E) Backfed Circuit Breakers.** Plug-in type backfed circuit breakers connected to a stand-alone inverter output in either stand-alone or utility-interactive systems shall be identified and listed for backfeeding and shall be secured in accordance with 408.36(D). Circuit breakers that are marked line and load shall not be backfed.

**Panel Statement:** Circuit breakers are not “identified” for back feed use. The only identification is that the circuit breaker would not be marked Line and Load. The requirement is only applicable to plug-in breakers and all breakers are not plug in. The referenced Section – 408.36 – clearly only has the requirement for plug-in circuit breakers.
Add the following new section to Article 690.

PV systems with dc source and/or output circuits on or penetrating a building operating at a system voltage of 80 volts or greater shall be protected with a listed direct-current, arc-fault circuit interrupter (DCAFCI), PV Type, or other system components listed to provide equivalent protection. The PV Arc-Fault Protection System shall comply with 690.11 (A) through 690.11(D).

(A). The system shall detect series arcing faults in the direct current PV source and output circuits.

(B). The system shall interrupt the arc-fault currents.

(C). The system shall disable or disconnect inverters or charge controllers connected to the faulted circuit when a fault is detected. The system shall require that the disabled or disconnected equipment be manually reconnected and restarted.

(D). The system shall have an annunciator that must be manually disabled.

PV systems are subjected to extreme environmental conditions including wind, rain, snow, ice, UV radiation, and temperature extremes. The systems are installed in dwellings and commercial locations and are not routinely inspected or maintained by qualified people. These systems, as they deteriorate over time, will eventually develop insulation failures or internal PV module conductor faults. Even new modules with manufacturing defects have faulted and caught fire. These failures will result in fault currents and/or series arcing faults. These fault currents and any arcs are direct current (dc) and are far more difficult to deal with since the arcs are not self extinguishing 120 times per second as are alternating current (ac) arcs. These faults may occur anywhere in the dc system. A voltage of 50V was selected since it applies to nearly all PV systems on buildings that could pose hazards. This would exempt 12V and most 24V PV systems and other similar systems at these operating voltages powered by PV modules.

The proposal is written to require that the series arcs be detected and the connected equipment turned off. Audible and visual alarms must manually be turned off to ensure that attention is paid to the faults. It would be premature, at the time this requirement will be enacted, to direct the location of the interruption device or the means of achieving that interruption. It is anticipated that a low cost integrated circuit will be developed that will go into utility-interactive inverters and charge controllers that will sense the series arc fault and turn off the inverter which will interrupt the series arc fault current.

The Exception is included to allow for newly developed and evolving complete systems that use highly integrated circuits imbedded in PV modules or packaged systems. These systems will be listed for safety, hence no requirements are needed in the NEC.

Panel Meeting Action: Accept in Principle
Panel Statement: See the panel action on Proposal 4-205.
PV systems with dc source and/or output circuits on or penetrating a building operating at a PV system maximum system voltage of 80 volts or greater shall be protected by a listed (DC) arc-fault circuit interrupter, PV type, or other system components listed to provide equivalent protection. The PV arc-fault protection means shall comply with the following requirements:

1. The system shall detect and interrupt arcing faults resulting from a failure in the intended continuity of a conductor, connection, module, or other system component in the direct current PV source and output circuits.
2. The system shall disable or disconnect one of the following:
   a. Inverters or charge controllers connected to the fault circuit when the fault is detected
   b. The system components within the arcing circuit
3. The system shall require that the disabled or disconnected equipment be manually restarted.
4. The system shall have an annunciator that must be manually disabled.

Substantiation: PV systems may be subjected to extreme environmental conditions including wind, rain, snow, ice, dirt, and temperature extremes. The systems are installed on or near dwellings and commercial locations where they may not be routinely inspected or maintained by qualified people. These systems, can deteriorate over time, and eventually develop insulation failures or internal PV module conductor faults. Under rare occasions, new modules with manufacturing defects have faulted and caught fire. These failures will result in fault currents and/or arcing faults. These fault currents, including arcing faults, are direct current (dc) and are far more difficult to interrupt than ac faults because of the non-time varying (non-zero crossing) nature of dc. Series arcing faults resulting from a failure in the intended continuity of a conductor, connection, module, or other system component are most prevalent and may occur anywhere in the dc system. Fault currents to ground will be detected by the ground-fault protection required by Sec. 690.5(A).

Drawing on the success of arc-fault circuit interrupter protection for dwelling unit branch circuits as described in Sec. 210.12, UL has formed a PV AFCI Ad Hoc Working Group. This group, which consists of AFCI manufacturers and PV experts and system manufacturers, is assisting UL with the research and standards development activities related to requirements for arc-fault circuit interrupter protection for PV system applications. The goal of this effort is to have requirements for a PV AFCI developed by 2009 to enable the Listing of PV AFCIs in 2010 prior to the Publication of the 2011 NEC.

Panel Meeting Action: Accept
**NOTE:** This proposal appeared as Comment 13-38 on Proposal 13-22 in the 2007 Annual Meeting National Electrical Code Committee Report on Proposals. This comment was held for further study during the processing of the 2008 NATIONAL ELECTRICAL CODE. The recommendation in Proposal 13-22 was:

Revise the section as follows:

**690.5 Ground-Fault Protection.** Roof-mounted dc photovoltaic arrays located on dwellings shall be provided with

dc ground-fault protection to reduce fire hazards.

Grounded dc photovoltaic arrays shall be provided with dc ground-fault protection meeting the requirements of

690.5 (A) through (C) to reduce fire hazards. Ungrounded dc photovoltaic arrays shall comply with 690.35.

**Exception 1:** Ground-mounted or pole-mounted photovoltaic arrays with not more than two paralleled source

circuits and with all dc source and dc output circuits isolated from buildings shall be permitted without ground-fault

protection.

**Exception 2:** PV arrays mounted on other than dwelling units shall be permitted without ground-fault protection if

each equipment-grounding conductor has an ampacity of at least two (2) times the temperature and conduit fill

corrected circuit conductor ampacity.

Submitter: John C. Wiles, Southwest Technology Development Institute, New Mexico State University / Rep. PV

Industry Forum

Recommendation: The PV Industry Forum agrees with and supports the Panel Action without the change suggested

by the TCC in 13-31a Log CP 1301. An additional Exception #2 is proposed as follows:

**Exception 2:** A disconnecting switch shall be permitted in a grounded conductor if it is:

- used only for PV array maintenance, and
- accessible only by qualified persons.

Substantiation: The location and correction of ground faults in PV arrays may require that the ungrounded conductor

be disconnected from the system and from ground during maintenance operations. This permissive allowance provides

that a maintenance-only switch can be added to the system to facilitate such operations.

Panel Meeting Action: Accept in Principle

Revise the language in the proposal as follows:

Exception No. 2 is proposed as follows:

**Exception No. 2:** A disconnecting switch shall be permitted in a grounded conductor providing the following conditions

are met:

- a. The switch is used only for PV array maintenance, and
- b. The switch is accessible only by qualified persons.
- c. The switch is rated for the maximum dc voltage and current that could be present during any operation including

ground fault conditions.

Panel Statement: The panel revised the wording in Proposal 4-206. Additionally, some of the text from the original

proposal was not in the travel file recommendation.
Revise 690.13 as follows:

690.13 All Conductors. Means shall be provided to disconnect all current-carrying dc conductors of a photovoltaic system power source from all other conductors in a building or other structure.

A switch, circuit breaker, or other device, either ac or dc, shall not be installed in a grounded conductor if operation of that switch, circuit breaker, or other device leaves, the marked, grounded conductor in an ungrounded and energized state.

Exception: A switch or circuit breaker that is part of a ground-fault detection system required by 690.5 or that is part of an arc-fault detection/interruption system required by 690.11 shall be permitted to open the grounded conductor when that switch or circuit breaker is automatically opened as a normal function of the device in responding to ground faults.

The Exception and Fine Print Note remain the same except for the addition of the proposed arc-fault circuit detector/interrupter requirement and assumes that a separate proposal for 690.11 DC Arc Fault Circuit Detection/Interruption Device is approved. The last line of the exception is a requirement (found elsewhere in the Code) and does not pertain to this section of the Code.

Panel Meeting Action: Accept
Submitter: Jim Eichner, Xantrex Technology, Inc.

Recommendation: Revise wording to:

690.13 All Conductors. Means shall be provided to disconnect all current-carrying conductors of a photovoltaic power source from all other conductors in a building or other structure. A switch, circuit breaker, or other device, either ac or dc, shall not be installed in a grounded conductor if operation of that switch, circuit breaker, or other device leaves the marked, grounded conductor in an ungrounded and energized state.

Exception: A switch or circuit breaker that is part of a ground-fault detection system required by 690.5 shall be permitted to open or unground the grounded conductor when that switch or circuit breaker is automatically opened as a normal function of the device in responding to ground faults, or is opened as a result of some other fault or service condition, such as disconnection of the AC supply circuit. The marking of 690.5(C) shall be revised, or an additional marking added, to list all conditions in which the normally grounded conductor is ungrounded. The switch or circuit breaker shall indicate the presence of a ground fault.

Substantiation: Problem: The Exception’s restriction to only unground the array during ground faults is overly-restrictive. While fuses are an option for the array grounding and ground-fault system, they can be prone to nuisance tripping and to other problems, so in some systems a relay or contactor is preferable. However allowing ungrounding only as the result of a ground-fault means that normally-open contactors energized with power derived from the AC grid cannot be used, because the contactors would open during loss or disconnection of AC power. The remaining options are not desirable. Normally-closed contactors are inherently less safe because they would re-ground the array if a ground fault trip was accompanied by, or followed by, loss of AC or control power. Providing power to the contactors from the PV array causes increased tare loss and lowered efficiency, and has an undesirable effect on safety because it requires placing connections for that power supply on the array side of the disconnect (so that it has power when the PV disconnect is operated, since that too is not allowed to unground the array) which means with the PV disconnect open, part of the product is still energized.

Proposed Solution:
1. The existing Code allows the grounded conductor to be ungrounded under one abnormal condition (ground fault trip). Extend that to other abnormal conditions such as other faults, disconnection or blackout of the AC grid, and servicing operations. In a typical inverter with integral PV ground fault protection, removing the inverter for servicing leaves the array ungrounded, and in any system during installation the installers are working with energized and ungrounded arrays, so safe working practices have already been established, and the markings make personnel aware of the conditions under which the array is ungrounded. Furthermore, a fully floating array is safer from a fire- and shock-hazard point of view than one with one conductor grounded. From a fire hazard perspective it takes 2 simultaneous ground faults for PV current to flow through an unintentional conducting path. From a shock hazard perspective, the floating array can source only leakage current to ground, while a the ungrounded conductor of a grounded array can source the full array short-circuit current to ground.
2. The sentence ‘The switch or circuit breaker shall indicate the presence of a ground fault’. is proposed to be deleted because it is not appropriate if a fault condition other than ground fault has resulted in the switch or breaker opening, and because the sentence is redundant with the indication requirement in 690.5(A), which already requires this indication, if the ground fault detection is tripped.

Panel Meeting Action: Accept in Principle

Revise the wording of the proposal as follows:

690.13 All Conductors. Means shall be provided to disconnect all current-carrying conductors of a photovoltaic power source from all other conductors in a building or other structure. A switch, circuit breaker, or other device, either ac or dc, shall not be installed in a grounded conductor if operation of that switch, circuit breaker, or other device leaves the marked, grounded conductor in an ungrounded and energized state.

Exception: A switch or circuit breaker that is part of a ground-fault detection system required by 690.5 shall be permitted to open (unground) the grounded conductor when that switch or circuit breaker is automatically opened as a normal function of the device in responding to ground faults, or is opened as a result of some other fault or service condition, such as disconnection of the AC supply circuit. Labeling and marking of the inverter in accordance with 690.5(C) shall be added to list all operating conditions in which the normally grounded conductor may become ungrounded. The switch or circuit breaker shall indicate the presence of a ground fault.
Panel Statement: The wording in the proposal is changed to improve readability and clarification.
It is proposed that Section 690.14 be restructured and revised to improve clarity and intent. This proposal is an overview proposal. The original section and the revised, integrated proposal are shown together in this submittal with substantiations. Additional proposals are provided on a subsection-by-subsection basis to allow comparisons with proposals submitted by others.

**2008 NEC Original:**

- **690.14 Additional Provisions.** Photovoltaic disconnecting means shall comply with 690.14(A) through (D).
  - **(A) Disconnecting Means.** The disconnecting means shall not be required to be suitable as service equipment and shall comply with 690.17.
  - **(B) Equipment.** Equipment such as photovoltaic source circuit isolating switches, overcurrent devices, and blocking diodes shall be permitted on the photovoltaic side of the photovoltaic disconnecting means.
  - **(C) Requirements for Disconnecting Means.** Means shall be provided to disconnect all conductors in a building or other structure from the photovoltaic system conductors.
    - **(1) Location.** The photovoltaic disconnecting means shall be installed at a readily accessible location either on the outside of a building or structure or inside nearest the point of entrance of the system conductors.
      - **Exception:** Installations that comply with 690.31(E) shall be permitted to have the disconnecting means located remote from the point of entry of the system conductors.
    - The photovoltaic system disconnecting means shall not be installed in bathrooms.
  - **(2) Marking.** Each photovoltaic system disconnecting means shall be permanently marked to identify it as a photovoltaic system disconnect.
  - **(3) Suitable for Use.** Each photovoltaic system disconnecting means shall be suitable for the prevailing conditions. Equipment installed in hazardous (classified) locations shall comply with the requirements of Articles 500 through 517.
  - **(4) Maximum Number of Disconnects.** The photovoltaic system disconnecting means shall consist of not more than six switches or six circuit breakers mounted in a single enclosure, in a group of separate enclosures, or in or on a switchboard.
  - **(5) Grouping.** The photovoltaic system disconnecting means shall be grouped with other disconnecting means for the system to comply with 690.14(C)(4). A photovoltaic disconnecting means shall not be required at the photovoltaic module or array location.
  - **(D) Utility-Interactive Inverters Mounted in Not-Readily-Accessible Locations.** Utility-interactive inverters shall be permitted to be mounted on roofs or other exterior areas that are not readily accessible. These installations shall comply with (1) through (4):
    - **(1)** A direct-current photovoltaic disconnecting means shall be mounted within sight of or in the inverter.
    - **(2)** An ac disconnecting means shall be mounted within sight of or in the inverter.
    - **(3)** The ac output conductors from the inverter and an additional ac disconnecting means for the inverter shall comply with 690.14(C)(1).
    - **(4)** A plaque shall be installed in accordance with 705.10.

**Proposed Reorganized and Revised:** Only additions are shown. Deletions and renumbering (where changed) not shown.

- **690.14 Additional Provisions.** The direct current (dc) PV system disconnecting means shall comply with (A) through (H). AC PV disconnecting means for PV systems or AC PV modules shall comply with (H) and (I).
  - **(A) Disconnecting Means.** The disconnecting means shall not be required to be suitable as service equipment and shall comply with 690.17.
  - **(B) Equipment.** Equipment such as PV source circuit isolating switches, overcurrent devices and blocking diodes shall be permitted on the PV side of the dc PV disconnecting means.
  - **(C) Location.** The dc PV system disconnecting means shall be installed at a readily accessible location either on the outside of a building or structure or inside nearest the point of entrance of the system conductors.
    - **Exception:** The location of the PV system disconnecting means for the dc PV source and output circuits that comply with 690.31(E) shall be permitted to be in a location that is remote from the point of entry of the system conductors.
    - The PV disconnecting means shall not be installed in bathrooms.
  - **FPN #1:** The readily accessible location requirement for the dc PV system disconnecting means and the requirement that it be at the point of entry of the conductors implies that the PV system conductors remain outside the building until
the first disconnect is reached. The exception, when met, allows these conductors to be routed through the building to the disconnecting means location that is still required to be readily accessible, but no longer is required to be at the point of penetration.

(D) **Marking.** Each dc PV system disconnecting means shall be permanently marked and identified.

(E) **Suitable for Use.** Each dc PV system disconnecting means shall be suitable for the prevailing conditions.

Equipment in hazardous (classified) locations shall comply with Articles 500 through 517.

(F) **Maximum Number of Disconnects.** Each PV system, as a parallel power production service permitted by 230.2, shall have dc PV system disconnecting means consisting of not more than six switches or six circuit breakers mounted in a single enclosure, in a group of separate enclosures, or in or on a panel board as permitted by 230.71.

(G) **Grouping.** The dc disconnecting means shall be grouped with the disconnecting means for other services connected to the building or structure. A dc PV disconnecting means shall not be required at the PV module or array location. A dc PV disconnecting means shall be permitted at the array location if that location complies with 690.14 (C).

Exception: The disconnecting means for multiple PV systems on a single building or structure shall not be required to be grouped together where the requirements of 705.10 are met.

(H) **Utility-Interactive Inverters Mounted in Not Readily-Accessible Locations,** Utility-interactive inverters shall be permitted to be mounted on roofs or other exterior areas that are not readily accessible. These installations shall comply with 690.14(H) (1) through (5):

1. A dc PV disconnecting means shall be mounted within sight of or in each inverter.
2. An ac disconnecting means shall be mounted within sight of or in each inverter.
3. An additional disconnecting means complying with 690.14 (A), (C), and (E) shall be installed on the ac output circuit of the inverter(s).
4. A plaque shall be installed in accordance with 705.10.

(I) **AC PV Disconnect.** The main service disconnect on a building or structure shall be permitted to serve as the ac PV disconnect for utility-interactive inverters or ac PV modules connected to the load side of the service disconnect.

Disconnecting means in the ac output circuit shall be required where the individual inverter is not within sight of the main service disconnect.

Where connections, as permitted by 705.12(A), are made on the supply side of the service disconnect, they shall be considered parallel power production systems as permitted by 230.2 and shall be permitted an additional six ac PV disconnects per PV system as allowed by 230.71.

Disconnecting means in the ac output circuit shall be permitted for each individual inverter.

The disconnecting means shall comply with 690.17.

**Substantiation:** Revision of Section 690.14 has been proposed because it contained duplicate requirements to 690.13 and was not clear that it applied mainly to the dc PV system disconnecting means. See the new definition proposed for Photovoltaic System Disconnect in 690.2.

690.14 **Introductory Text – First Paragraph**

The previous 690.14(C) was removed since it duplicated 690.13 and all other sections were upgraded one level. Several related revisions and clarifications have been made as shown below:

The unneeded reference to 690.14 was removed to comply with the NEC Style Manual.

While the main emphasis is on the dc PV disconnect some clarification to the ac disconnect is needed in this system and is referenced.

690.14(A) No change

690.14(B) “PV” added for clarity. Added direct-current (dc) to clarify that these device requirements do not apply to ac circuits.

690.14(C) Removed old 690.14(C) since the requirement is addressed in 690.13. The introduction used to be 690.14(C)1. No change

Exception: The exception was modified so that it pertains only to the dc outputs for modules and arrays. See related proposal for 690.31(E).

FPN #1 has been added because of the continuing inability of PV installers to realize that these disconnecting means requirements (added to the 2002 NEC at the request of the Technical Correlating Committee) affect the routing of the conductors from the PV array to the inverter. This FPN gives information to improve understanding of the requirement and the exception.

690.14(D). Previously 690.14(C)(2). No change

690.14(E). Previously 690.14(C)(3). No change

690.14(F). Previously 690.14(C)(4). Revised to indicate that each PV system may be considered a separate service per 230.2 and that each service/system may have no more than six dc disconnecting means per 230.71

690.14(G). Previously 690.14(C)(5). Revised to be consistent with 690.14(F) and to indicate that PV disconnecting means may be required in areas normally considered not readily accessible in some situations (e.g. flat roofed buildings.
The Exception is needed for installations where there are multiple widely spaced PV systems on a large commercial building and it is not feasible to group either the dc or ac disconnects from all systems in a single location. Examples include warehouses, malls, and apartment complexes.

690.14(H) Previously (D) with revisions:
- Clarified to be consistent with definitions.

690.14(I)
Utility-interactive inverters and ac PV modules shut down when the utility voltage is not present at their output terminals. Opening the main service disconnect will disable or turn off all utility-interactive inverters and ac PV modules connected to the load side of that disconnect.

In order for the main service disconnect to serve as the required maintenance disconnect, the inverter must be within sight of the main service disconnect. If the inverter and main service are not in sight, then a maintenance disconnect must be installed at each inverter to allow safe servicing. Optional, permitted disconnects may be installed at each inverter for system segregation or other purposes.

Panel Meeting Action: Reject
Panel Statement: The panel sees insufficient justification for the proposed language. The proposed language does not add any clarity.

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4-211 Log #2500 NEC-P04 Final Action: Reject
(690.14)

Submitter: John Wiles, Southwest Technology Development Inst/New Mexico State Univ. / Rep. PV Industry Forum
Recommendation: It is proposed that Section 690.14 be restructured and revised to improve clarity and intent. This proposal covers the introduction section of 690.14. An overview proposal has been submitted. Additional proposals are provided on a subsection-by-subsection basis to allow comparisons with proposals submitted by others.

690.14 Additional Provisions. The direct current (dc) photovoltaic disconnecting means shall comply with 690.14(A) through (H). AC PV disconnecting means for PV systems or AC PV modules shall comply with (H) and (I).

Substantiation: Section 690.14 has been revised because it contained duplicate requirements to 690.13 and was not clear that it applied primarily the dc PV system disconnecting means. See the new definition proposed for Photovoltaic System Disconnect in 690.2.

The unneeded reference to 690.14 was removed to comply with the NEC Style Manual. Added subsections have been proposed and need to be called out.

While the main emphasis is on the dc PV disconnect some clarification to the ac disconnect is needed in this system and is referenced.

Panel Meeting Action: Reject
Panel Statement: See the action and statement on Proposal 4-210.

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4-212 Log #2495 NEC-P04 Final Action: Reject
(690.14(B))

Submitter: John Wiles, Southwest Technology Development Inst/New Mexico State Univ. / Rep. PV Industry Forum
Recommendation: It is proposed that Section 690.14 be restructured and revised to improve clarity and intent. This proposal covers 690.14(B). An overview proposal has been submitted. Additional proposals are provided on a subsection-by-subsection basis to allow comparisons with proposals submitted by others.

(B) Equipment. Equipment such as photovoltaic source circuit isolating switches, overcurrent devices and blocking diodes shall be permitted on the PV side of the dc PV photovoltaic disconnecting means.

Substantiation: “PV” added for clarity. Added direct-current (dc) to clarify that these device requirements do not apply to ac circuits.

Panel Meeting Action: Reject
Panel Statement: See the action and statement on Proposal 4-210.
Add new text to read as follows: See 690.13 for grounded conductors.

This provision applies to all conductors which may or may not be permitted to be disconnected per 690.13.

The proposal does not meet the requirements of 4.3.3. (b) of the Regulations Governing Committee Projects. Submitter does not indicate where new text is to be added.
**Submitter:** John Wiles, Southwest Technology Development Inst/New Mexico State Univ. / Rep. PV Industry Forum

**Recommendation:** It is proposed that Section 690.14 be restructured and revised to improve clarity and intent. This proposal is for 690.14(C). 690.14(C) contains information duplicated in 690.13 and is modified as shown below. An overview proposal has been submitted. Additional proposals are provided on a subsection-by-subsection basis to allow comparisons with proposals submitted by others.

- **(C) Requirements for Disconnecting Means.** Means shall be provided to disconnect all conductors in a building or other structure from the photovoltaic system conductors:
  - **(1) Location.** The dc photovoltaic disconnecting means shall be installed at a readily accessible location either on the outside of a building or structure or inside nearest the point of entrance of the system conductors.
    - **Exception:** The location of the PV system disconnecting means for the dc PV source and output circuits for installations that comply with 690.31(E) shall be permitted to be in a location that is have the disconnecting means located remote from the point of entry of the system conductors.
  - The photovoltaic PV system disconnecting means shall not be installed in bathrooms.
  - **FPN #1:** The readily accessible location requirement for the dc PV system disconnecting means and the requirement that it be at the point of entry of the conductors implies that the PV system conductors remain outside the building until the first disconnect is reached. The exception, when met, allows these conductors to be routed through the building to the disconnecting means location that is still required to be readily accessible, but no longer is required to be at the point of penetration.
  - **(2) (D) Marking.** Each dc photovoltaic system disconnecting means shall be permanently marked and identified to identify it as a photovoltaic system disconnect.
  - **(3) (E) Suitable for Use.** Each dc photovoltaic system disconnecting means shall be suitable for the prevailing conditions. Equipment installed in hazardous (classified) locations shall comply with the requirements of Articles 500 through 517.
  - **(4) (F) Maximum Number of Disconnects.** Each PV system, as a parallel power production service permitted by 230.2, shall have dc PV system disconnecting means consisting of not more than six switches or six circuit breakers mounted in a single enclosure, in a group of separate enclosures, or in or on a switchboard panelboard as permitted by 230.71.
  - **(5) (G) Grouping.** The photovoltaic dc PV system disconnecting means shall be grouped with the other disconnecting means for other services connected to the building or structure to comply with 690.14(C)(4). A photovoltaic dc PV disconnecting means shall not be required at the photovoltaic module or array location. A dc PV disconnecting means shall be permitted at the array location if that location complies with 690.14(C).
    - **Exception:** The disconnecting means for multiple PV systems on a single building or structure shall not be required to be grouped together where the requirements of 705.10 are met.

**Substantiation:** The introductory information in 690.14(C) is deleted since it duplicates 690.13 and the information in subsection (1) is elevated to (C) with revisions.

- Subsections (2) through (5) are renumbered as (D) through (G) with revisions.
- 690.14(C) Removed old 690.14(C) since the requirement is addressed in 690.13. The introduction used to be 690.14(C)1. No change in language; just location.
- **Exception:** The exception was modified so that it pertains only to the dc outputs for modules and arrays. See related proposal for 690.31(E).
  - **FPN #1** has been added because of the continuing inability of PV installers to realize that these disconnecting means requirements (added to the 2002 NEC at the request of the Technical Correlating Committee) affect the routing of the conductors from the PV array to the inverter. This FPN gives information to improve understanding of the requirement and the exception.

- 690.14(D). Previously 690.14(C)(2). No change
- 690.14(E). Previously 690.14(C)(3). No change
- 690.14(F). Previously 690.14(C)(4). Revised to indicate that each PV system may be considered a separate service per 230.2 and that each service/system may have no more than six dc disconnecting means per 230.71
- 690.14(G). Previously 690.14(C)(5). Revised to be consistent with 690.14(F) and to indicate that PV disconnecting means may be required in areas normally considered not readily accessible in some situations (e.g. flat roofed buildings with ready access).

The Exception is needed for installations where there are multiple widely spaced PV systems on a large commercial
building and it is not feasible to group either the dc or ac disconnects from all systems in a single location. Examples include warehouses, malls, and apartment complexes.

Panel Meeting Action: Reject
Panel Statement: See the action and statement on Proposal 4-210.

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4-215     Log #2497  NEC-P04
Final Action: Reject
(690.14(D))

Submitter: John Wiles, Southwest Technology Development Inst/New Mexico State Univ. / Rep. PV Industry Forum

Recommendation: It is proposed that Section 690.14 be restructured and revised to improve clarity and intent. This new proposal revises 690.14(D), which is renumbered to (H). An overview proposal has been submitted. Additional proposals are provided on a subsection-by-subsection basis to allow comparisons with proposals submitted by others.

(HE) Utility-interactive Inverters Mounted in Not Readily-Accessible Locations,
Utility-interactive inverters shall be permitted to be mounted on roofs or other exterior areas that are not readily accessible. These installations shall comply with 690.14(H) (1) through (5):
(1) A dc PV disconnecting means shall be mounted within sight of or in each inverter.
(2) An ac disconnecting means shall be mounted within sight of or in each inverter.
(3) An additional disconnecting means complying with 690.14 (A), (C), and (E) shall be installed on the ac output circuit of the inverter(s).
(4) A plaque shall be installed in accordance with 705.10.

Substantiation: 690.14(H) Previously (D) with revisions: Clarified to be consistent with definitions and other requirements.

Panel Meeting Action: Reject
Panel Statement: See the action and statement on Proposal 4-210.
John Wiles, Southwest Technology Development Inst/New Mexico State Univ. / Rep. PV Industry Forum

Recommendation: It is proposed that Section 690.14 be restructured and revised to improve clarity and intent. This proposal covers new proposal 690.14(I). An overview proposal has been submitted. Additional proposals are provided on a subsection-by-subsection basis to allow comparisons with proposals submitted by others.

(I) AC PV Disconnect

The main service disconnect(s) on a building or structure shall be permitted to serve as the ac PV disconnect for utility-interactive inverters or ac PV modules connected to the load side of the service disconnect.

Where connections, as permitted by 705.12(A), are made on the supply side of the service disconnect, they shall be considered parallel power production systems as permitted by 230.2 and shall be permitted an additional six ac PV disconnects per PV system as allowed by 230.71.

Disconnecting means in the ac output circuit shall be required where the individual inverter is not within sight of the main service disconnect.

Disconnecting means in the inverter ac output circuit shall be permitted for each individual inverter.

The disconnecting means shall comply with 690.17.

Utility-interactive inverters and ac PV modules shut down when the utility voltage is not present at their output terminals. Opening the main service disconnect will disable or turn off all utility-interactive inverters and ac PV modules connected to the load side of that disconnect.

Many PV systems, because of their size, are connected on the supply side of the service disconnect. The main service disconnect cannot serve as a disconnect for the supply-side systems and they must have individual disconnects. This is consistent with 230.2(A)(5) and each of these PV systems as parallel power production systems is allowed six disconnects per 230.71.

In order for the main service disconnect to serve as the required maintenance disconnect, the inverter must be within sight of the main service disconnect. If the inverter and main service are not in sight, then a maintenance disconnect must be installed at each inverter to allow safe servicing. Optional, permitted disconnects may be installed at each inverter for system segregation or other purposes.

Panel Meeting Action: Reject
Panel Statement: See the action and statement on Proposal 4-210.

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Dan Leaf, Seneca, SC

Revise text to read as follows:

Identified disconnecting means shall be provided to disconnect a fuse from all sources of supply if the fuse can be energized from both directions line and load terminals. and is accessible to other than qualified persons. Such a fuse in a photovoltaic circuit shall be capable of having approved means of being disconnected independently of fuses in photovoltaic source circuits.

Substantiation: The disconnecting means should be suitable for the use. The provision should apply where accessible to qualified persons since they should be provided the same protection. "Both directions" is not specific; does it mean North or South or East and West top or bottom or left and right? (facetious)

Panel Meeting Action: Reject
Panel Statement: The proposal does not meet the requirements of 4.3.3. (b) of the Regulations Governing Committee Projects. Additionally, the use of line and load terminals for fuses is technically incorrect.

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Disdisconnecting means shall be installed on PV output circuits where overcurrent devices (fuses) must be serviced that cannot be isolated from energized PV circuits. The disconnecting means shall be within sight and accessible to the location of the fuse or integral with fuse holder and shall comply with 690.17. Where the disconnecting means are located more than 1.8m (6 feet) from the overcurrent device, a directory showing the location of each disconnect shall be installed at the overcurrent device location.

Non-load-break rated disconnecting means shall be marked “Do not open under load.”

Fuses must be serviced in a safe manner, and this usually means that they be disconnected from all sources of voltage. Most PV combiners use “finger safe” fuse holders for this purpose. Inverters are being manufactured that have internal PV source and output circuit combining fuses on the input circuits connected directly to the inverter input terminals. Unless external disconnecting means are installed, these fuses cannot be safely serviced when the PV array is illuminated. Typical fuses in the inverters used in these larger systems may be 100 amps or larger.

Panel Meeting Action: Accept
Robert H. Wills, Intergrid, LLC

As the submitter of panel actions 13-31a and 13-35a, I request that CMP-13 Reject both actions as they now stand, and also consider modifying 690.13 as follows:

690.13 All Conductors. Means shall be provided to disconnect all current-carrying conductors of a photovoltaic power source from all other conductors in a building or other structure. A switch or circuit breaker shall not be installed in a grounded conductor unless:

1. that the switch or circuit breaker is part of a ground-fault detection system required by 690.5 and that the switch or circuit breaker is automatically opened and indicated as a normal function of the device in responding to ground faults, or,

2. an optional switch or circuit breaker is provided in a grounded conductor for maintenance and troubleshooting, and only operable by qualified personnel.

FPN: The grounded conductor may have a bolted or terminal disconnecting means to allow maintenance or troubleshooting by qualified personnel.

Substantiation: I brought up the inconsistency in 690.13 and 690.14(C) that requires means for disconnecting all current-carrying conductors, then go on to say that grounded conductors should not be disconnected.

This resulted in panel actions 13-31a and 13-35a.

Further research has shown that the inconsistency stems from the addition of the second sentence of 690.13 in the 1990s when GFI language was added.

Substantiation: The paper's Figure 2 showed a 2 pole disconnect opening both current-carrying conductors to the array, with the ground bond being on the inverter side of the switch.

Photovoltaic arrays typically contain many photovoltaic modules and interconnection wiring that can be subject to ground faults.

The requirement has changed over the years form opening all current-carrying conductors to ground fault interruption (which typically opens the grounded conductor) plus a FPN provision for bolted or terminal disconnect.

It is reasonable to consider the GFI equipment as now fulfilling the requirement that grounded conductors be disconnected (if there is a ground fault).

The FPN provision is, however, not a safe or sufficient substitute for a switched disconnect in large-scale photovoltaic systems. If multiple ground faults were to occur on different strings, the grounded conductors of the faulted strings would have to be disconnected in order to find the fault locations.

In doing so, the service person would have to open a bolted connection under load - a potentially hazardous activity.

An optional switched disconnect or circuit breaker in grounded conductors for service use only, and only operable by qualified personnel, satisfies the original intent of this section of the code and allows for the removal of a service hazard in large-scale systems.

Panel Meeting Action: Accept in Principle

Panel Statement: The addition of a new Section 690-19 is unnecessary. This proposal is similar to Proposal 4-206. See panel action on Proposal 4-206.
4-221 Log #1916 NEC-P04
(690.31)
Final Action: Reject

Submitter: Dan Leaf, Seneca, SC
Recommendation:
Revise text of (A): All identified raceway and cable wiring methods included in this Code, flexible cords and cables covered in 690.31(C) and other wiring systems specifically intended and identified for use on photovoltaic systems shall be permitted...(remainder unchanged)
Delete text of (C) and substitute: Flexible cords and cables shall be permitted to connect moving parts of PV modules and shall be an extra-hard usage type identified for the use, water resistant, and sunlight resistant. (remainder unchanged)
Substantiation: Edit. Wiring methods should be identified for the use. This section can be perceived as modifying uses permitted or not permitted in the raceway and cable articles. Reference to 690.31(C) will correlate with that section. Subsection (C) should specifically indicate cords and cables are permitted if identified for the use. Some extra-hard usage types (EV, EVE, EVJE, EVT, are not suitable. Article 400 does not require listing and no "outdoor" use is indicated.
Panel Meeting Action: Reject
Panel Statement: The addition of "identified" and the reference to Section 690.31(C) is redundant and unnecessary.

4-222 Log #3619 NEC-P04
(690.31(A))
Final Action: Reject

Submitter: William Peter Kenney, III, Berkeley, CA
Recommendation:
Revise text to read as follows:
Where photovoltaic source and output circuits operating at maximum system voltages greater then 30 volts are installed in readily accessible locations, circuit conductors shall be installed in a metallic raceway, or rendered not readily accessible by approved guards or covers.
Substantiation: These source circuits are considered energized in sunlight at levels up to 600 volts DC. The current installation practice that I have seen in California is to use nonmetallic flexible conduit installed with a one or two hole straps as support. Two concerns.
1. Temperature ratings of the raceway system they are using are not appropriate for the installation.
2. We are encouraging education for these systems to include an up close look at these systems. Families looking at these readily accessible systems often have young children that are looking for anything to occupy their time while the parents are learning about the benefits of a PV system. It would be very easy for a child to see this hanging loop of LFMC or LFNC as a place to swing from if it is less than 8 ft off the ground.
Panel Meeting Action: Reject
Panel Statement: The submitter has not presented any technical data to support such a severe restriction on wiring methods for these systems. There are already other NEC requirements that address the physical damage concerns of various wiring methods and the temperature limitations for conductors in non-metallic wiring methods. The phrase “or rendered not readily accessible by approved guards or covers” is not the only method to render a system not readily accessible and could be interpreted as the only approved method.
4-223  Log #2502  NEC-P04
(690.31(A), FPN 1 and 2)  Final Action: Reject

Submitter: John Wiles, Southwest Technology Development Inst/New Mexico State Univ. / Rep. PV Industry Forum
Recommendation: Renumber the existing FPN on 690.31(A) as #2 and add this new FPN #1 as follows:
  FPN #1: Adding fences or barriers around a PV array or installing protective barriers to the mounting racks of the modules may make the circuits not readily accessible.
Substantiation: There are very few PV modules that are made with conduit-ready junction boxes. The great majority of modules being produced today are constructed with factory-attached pigtail leads using exposed, single-conductor cables and quick-connect (soon to be locking) connectors. Only a few manufacturers have special order modules available that can be used with conduits. This Fine Print Note informs the installer and inspectors that there are “out of the box” solutions to this seemingly very difficult requirement.
Panel Meeting Action: Reject
Panel Statement: Section 690.31 covers wiring methods for solar photovoltaic systems. It is not practical nor necessary to render these wiring methods not readily accessible and may also violate the listing of the PV array.

4-224  Log #2503  NEC-P04
(690.31(B), FPN )  Final Action: Accept

Submitter: John Wiles, Southwest Technology Development Inst/New Mexico State Univ. / Rep. PV Industry Forum
Recommendation: Add the following FPN:
  FPN: Photovoltaic (PV) Wire (also Photovoltaic (PV) Cable) has a non-standard outer diameter. Conduit fill should be calculated using Table 1, Chapter 9. Conduit fill tables in Annex C should not be used.
Substantiation: Underwriters Laboratories (UL) Subject 4703 establishes the specifications for Photovoltaic Wire/PV Wire/Photovoltaic Cable/PV Cable. It requires that the insulation thickness be at least 15 mils thicker than the insulation on types UF or RHW conductors. This non-standard thickness will not permit the correct use of the conduit fill tables in Annex C. The conduit fill will have to be calculated using the measured outer diameter of the cable (which may vary from manufacturer to manufacturer) and the fill percentages in Table #1, Chapter 9.
Panel Meeting Action: Accept

4-225  Log #3453  NEC-P04
(690.31(B), FPN (New))  Final Action: Reject

Submitter: Larry Cross, Local Union #98 IBEW
Recommendation: Provide Fine Print Note: Thermoplastic insulation may stiffen at temperatures lower than - 10 deg. C (+14 deg. F). Thermoplastic insulation may also be deformed at normal temperatures where subjected to pressure, such as at points of support. Thermoplastic insulation, where used on dc circuits in wet locations, may result in Electro-endosmosis between conductor and insulation.
Substantiation: The installer should be aware of damage to conductor thermoplastic insulation due to the elements and conditions in the Solar Photovoltaic Systems installations. Thermoplastic insulation is the most common conductor insulation used in the marketplace and most installers are not aware of this reaction to thermoplastic insulation on DC circuits, lower temperatures and supports which are common practices on Solar Photovoltaic installation.
Panel Meeting Action: Reject
Panel Statement: This is an exact copy of the FPN in Section 330.13 that already provides the necessary information.
(D) Small-Conductor Cables. Single-conductor cables listed for outdoor use that are sunlight resistant and moisture resistant in sizes 16 AWG and 18 AWG shall be permitted for module interconnections where such cables meet the ampacity requirements of 690.8. Section 310.15 shall be used to determine the cable ampacity and temperature adjustment and correction derating factors.

Substantiation: The terms "adjustment factors" and "correction" are the terms used in 310.15(B)(2)(a) and 310.16.
Panel Meeting Action: Accept

See the panel action on Proposal 4-226.
Revise the Section as follows:

Where dc photovoltaic source or output circuits from a building-integrated or other photovoltaic system are run inside a building or structure, they shall be contained in metal raceways, Type MC metal clad cable, or metal enclosures, from the point of penetration of the surface of the building or structure to the first readily accessible disconnecting means. The disconnecting means shall comply with 690.14 (A), (B) and (D) through (I).

Wiring methods shall not be installed within 25 cm (10 in.) of the roof decking or sheathing except where directly below the roof surface covered by PV modules and associated equipment. To the extent practical, circuits shall be run vertically from the roof penetration point to supports a minimum of 25 cm (10 in.) below the roof decking.

FPN: The 25 cm (10 in) requirement is to prevent accidental damage from saws used by firefighters for roof ventilation during a structure fire.

Where flexible metal conduit (FMC) or metal clad cable (MC) smaller than metric designator 21 (trade size ¾), containing PV power circuit conductors is installed across ceilings or floor joists, the raceway or cable shall be protected by substantial guard strips that are at least as high as the cable. Where run exposed, other than within 1.8 m (6 feet) of their connection to equipment, these wiring methods shall closely follow the building surface or be protected from physical damage by an approved means.

(1) The wiring methods and enclosures listed in (A) through (C) that contain photovoltaic power source conductors shall be marked with the wording “Photovoltaic Power Source” by means of identified permanently affixed labels or other approved permanent marking:

(A) Exposed raceways, cable trays, and other wiring methods.
(B) The covers or enclosures of pull boxes and junction boxes.
(C) Conduit bodies in which any of the available conduit openings are unused.

(2) The labels or markings shall be visible after installation. PV power circuit labels shall appear in every section of the wiring system that is separated by enclosures, walls, partitions, ceilings, or floors. Spacing between labels and/or markings shall not be more than 3 m (10 ft). Labels required by this section shall be suitable for the environment where they are installed.

Substantiation: The reference to utility-interactive inverter was an error and is removed.

Type MC metal clad cable, a metallic cable assembly, has been added because, with the internal equipment-grounding conductor, it may provide equal and possibly superior safety and mechanical protection when compared with the allowed flexible metal conduit (FMC) for these PV output circuit conductors. The proper use of Type MC, metal clad cable, while maintaining system safety, greatly aids in new construction and the retrofit of existing houses with PV power systems. Type AC armored cable is not included, because when it has an aluminum enclosure, it is not allowed to be used for direct-current circuits (ref UL White Book).

Deliberate hand pressure or sharp bending over edges such as ceiling joists in attics can break smaller sizes of flexible metal conduit and metal clad cable. This is a concern because PV output conductors are often run through attics, an area that homeowners frequently use for storage. This is why routing of raceways and cable assemblies is critical, along with the use of guard strips where necessary. In other areas of the home (cellars/basements) children may hang on to or pull upon these raceways. There is also a concern for the safety of firefighters who in fighting a structure fire may inadvertently cut through a raceway.

Marking raceways that contain photovoltaic circuit conductors will help firefighters, homeowners, and electricians identify the location of such circuits within a building. It would also help to ensure that persons seeking to add on to an existing electrical installation do not accidentally connect other building wiring to the PV source or output circuit wiring. Similar marking is already required elsewhere in the NEC for fire alarm and intrinsic safety systems.

Panel Meeting Action: Accept in Principle

Revise the recommended text to read as follows:

(E) Direct-Current Photovoltaic Source and Output Circuits Inside a Building. Where dc photovoltaic source or output circuits from a building-integrated or other photovoltaic system are run inside a building or structure, they shall be contained in metal raceways, Type MC metal clad cable that complies with 250.118.(10), or metal enclosures, from the point of penetration of the surface of the building or structure to the first readily accessible disconnecting means. The disconnecting means shall comply with 690.14 (A), (B) and (D) through (I).

Wiring methods shall not be installed within 25 cm (10 in.) of the roof decking or sheathing except where directly below
the roof surface covered by PV modules and associated equipment. Circuits shall be run vertically from the roof penetration point to supports a minimum of 25 cm (10 in.) below the roof decking.

FPN: The 25 cm (10 in.) requirement is to prevent accidental damage from saws used by firefighters for roof ventilation during a structure fire.

Where flexible metal conduit (FMC) or metal clad cable (MC) smaller than metric designator 21 (trade size ¾) containing PV power circuit conductors is installed across ceilings or floor joists, the raceway or cable shall be protected by substantial guard strips that are at least as high as the raceway or cable. Where run exposed, other than within 1.8 m (6 ft) of their connection to equipment, these wiring methods shall closely follow the building surface or be protected from physical damage by an approved means:

(1) The following wiring methods and enclosures that contain photovoltaic power source conductors shall be marked with the wording “Photovoltaic Power Source” by means of permanently affixed labels or other approved permanent marking:

(1) Exposed raceways, cable trays, and other wiring methods.
(2) The covers or enclosures of pull boxes and junction boxes.
(3) Conduit bodies in which any of the available conduit openings are unused.
(2) The labels or markings shall be visible after installation. PV power circuit labels shall appear on every section of the wiring system that is separated by enclosures, walls, partitions, ceilings, or floors. Spacing between labels and/or markings shall not be more than 3 m (10 ft). Labels required by this section shall be suitable for the environment where they are installed.

Panel Statement: The panel added wording to clarify the intent of the proposal.

4-229 Log #2755 NEC-P04
(690.31(E))

Final Action: Accept in Principle

Submitter: Paul R. Picard, AFC Cable Systems, Inc.
Recommendation: Revise text to read as follows:

(E) Direct-Current Photovoltaic Source and Output Circuits Inside a Building. Where direct-current photovoltaic source or output circuits of a utility-interactive inverter from a building-integrated or other photovoltaic are run inside a building or structure, they shall be contained in metal raceways, Metal-Clad Cable, Armored Cable, or metal enclosures, from the point of penetration of the surface of the building or structure to the first readily accessible disconnecting means. The disconnecting means shall comply with 690.14(A) through (D).

Substantiation: The present wording only permits metal raceways; the use of Metal-Clad Cable or Armored Cable would provide equivalent mechanical protection.

Panel Meeting Action: Accept in Principle
Panel Statement: See panel action and statement on proposal 4-228. Armored cable is not permitted for dc systems in accordance with the UL white book.
690.31 Methods Permitted.

(F) Flexible, Fine-Stranded Cables. Flexible, fine-stranded cables shall be terminated only with terminals, lugs, devices, or connectors that are identified and listed for such use. as per 110.14(A)(1)

Substantiation: Relocate this text to 110.14(A)(1) so this requirement can be applied to all installations where fine-stranded conductors and fine-stranded jacketed cables are installed, not just for solar or battery connections. This was a new item that was added in article 690.31 (F) in the 2008 NEC. The issue is that fine-stranded conductors and jacketed cables are being installed for other installation types where a wide range of flexibility is desired. With the expanded use of fine-stranded cables and conductors being used for welders, cranes, elevators, battery bank connections, computer data cables, UPS cables and many other installations, this requirements needs to be relocated to requirements for electrical installations. As this rule is applied currently within the NEC, only specific applications can require terminations to use devices and equipment rated for these conductor types. This relocated requirement will provide a procedure for identified lugs and terminations providing a safer installation without possible hot spots or cable overheating due to bad or loose lug connections when terminated with acceptable identified crimping tools.

Panel Meeting Action: Reject

Panel Statement: The submitter's section referenced does not exist.

4-231 Log #4667 NEC-P04 Final Action: Reject

(690.31(F))

Submitter: Frederic P. Hartwell, Hartwell Electrical Services, Inc.
Recommendation: Delete this lettered paragraph.
Substantiation: This is a companion proposal to one from this submitter to relocate this material into 110.14. These requirements are hardly unique to photovoltaic installations, and should therefore apply to all installations, as the testing laboratories intend. This proposal should be provisionally accepted until CMP 1 acts on the other proposal.

Panel Meeting Action: Reject
Panel Statement: The required text does not currently exist in Section 110.14.
John Wiles, Southwest Technology Development Inst/New Mexico State Univ. / Rep. PV Industry Forum

Revise 690.43 as follows:

(A) Equipment Grounding Required. Exposed non-current carrying metal parts of PV module frames, electrical equipment, and conductor enclosures shall be grounded in accordance with 250.134 or 250.136(A) regardless of voltage.

(B) Equipment Grounding Conductor Required. An equipment-grounding conductor between a PV array and other equipment shall be required in accordance with 250.110.

(C) Structure as Equipment Grounding Conductor. Devices listed and identified for grounding the metallic frames of PV modules or other equipment shall be permitted to bond the exposed metallic frames of PV modules, metal surfaces or other equipment to mounting structures. Metallic mounting structures, other than building steel, used for grounding purposes shall be identified as equipment-grounding conductors or shall have identified bonding jumpers or devices connected between the separate metallic sections and shall be bonded to the grounding system.

(D) PV Mounting Systems and Devices. Devices and systems used for mounting PV modules that are also used to provide grounding of the module frames shall be identified for the purpose of grounding PV modules.

(E) Adjacent Modules. Devices identified and listed for bonding the metallic frames of PV modules shall be permitted to bond the exposed metallic frames of PV modules to the metallic frames of adjacent PV modules.

(F) All Conductors Together. Equipment grounding conductors for the PV array and structure (where installed) shall be contained within the same raceway or cable, or otherwise run with the PV array circuit conductors when those circuit conductors leave the vicinity of the PV array.

Substantiation: The section has been rearranged to allow the inclusion of two new requirements. Making a durable connection between an aluminum PV module frame and a grounding system is difficult because aluminum and copper are dissimilar metals and aluminum is frequently clear coated and/or oxidizes very rapidly when the surface is exposed to the atmosphere. UL has clarified UL Standard 1703 with respect to the grounding requirements of PV modules, and numerous devices are being developed to quickly and effectively ground the frames of PV modules. The Code must establish installation requirements that allow these grounding devices and methods to be used in a manner that effectively provides for a durable and safe grounded PV system.

(C) Devices are being developed that bond the module frame to an aluminum mounting rack. These racks are normally designed to mechanical standards and are not designed or certified as equipment grounding conductors. They may have mechanical joints that allow for thermal expansion but do not provide electrical continuity. Unlike building steel, which is generally acknowledged as a suitable grounded structure, these aluminum racks are as difficult to make electrical connections to as the PV modules themselves. Requiring them to be identified as equipment-grounding conductors will correct this problem. Additionally, these racks, after being identified as equipment-grounding conductors must make a connection to an accepted grounding system. A copper conductor connected to ground would be acceptable.

(D) Devices are being developed that will ground the module frame through the mechanical fasteners that hold the module to the supporting structure. The difficulty in making a good, durable electrical contact with aluminum and any other materials dictates that these devices must be identified for the use.

Panel Meeting Action: Accept
Revise 690.46 as follows. Add the following second paragraph.

Equipment grounding conductors for PV modules smaller than 6 AWG shall comply with 250.120(C).

Solid (non-stranded) equipment-grounding conductors and grounding-electrode conductors of 6 AWG and smaller shall be permitted in raceways for PV array grounding.

Section 310.3 requires the use of stranded conductors of 8 AWG and larger in raceways, but the exception to 310.3 does allow the use of larger, solid conductors where permitted elsewhere in the Code. Given the problem of moisture, which is generally present at the location of the modules, and the installation requirements of 690.46/250.120(C), it would simplify PV installations if the use of solid conductors of 6 AWG in raceways were allowed. This would address not only issues of water migration into stranded grounding conductors and subsequent degradation of the conductor and/or connection, but would also allow electricians to more effectively deal with the concerns of inspectors who expect to see grounding conductors smaller than 6 AWG protected in a raceway. The allowance of 6 AWG solid conductors in raceways would allow an electrician to run an unspliced #6 (or smaller) solid conductor from the DC disconnect or combiner box to the array. This conductor could then be used to bond all of the mounting components and even connect to any auxiliary grounding electrodes installed at the location of the array without a splice.

The submitter has not presented sufficient technical data to support this change. The requirement for stranded conductors in raceways has been in place for a long period of time based on installation limitations when larger sizes of solid conductors are used.

Add the following second paragraph to 690.47(B).

A common dc grounding-electrode conductor shall be permitted to serve multiple inverters. The size of the common grounding electrode and the tap conductors shall be in accordance with 250.166. The tap conductors shall be connected to the common grounding-electrode conductor by exothermic welding or with connectors identified for the purpose.

PV installations using multiple small inverters are becoming more common as costs continue to decline for these products. Since each inverter and the connected modules represent individual dc systems, a common dc grounding electrode can be used to provide the necessary connection to earth for all inverters. The size of this common grounding-electrode conductor is determined by the type of grounding electrode in accordance with 250.166. Because the dc circuits for each inverter are separate and distinct, there is no requirement to make the common conductor any larger than the size of the grounding-electrode conductor required for a single inverter.
(C) Systems with Alternating-Current and Direct-Current Grounding Requirements. Systems with alternating-current and direct-current grounding requirements shall comply with items (C)(1) through (C)(9):

(1) Where photovoltaic power systems have both alternating-current (ac) and direct-current (dc) grounding requirements, the dc grounding system shall be bonded to the ac grounding system.

(2) A bonding conductor between these systems shall be sized as the larger of the dc requirement in accordance with 690.45, the ac requirements based on the inverter alternating current overcurrent device rating and 250.122, and the system bonding requirements of 250.28:

(3) A conductor that serves as both an equipment grounding conductor and as part of the bond between ac and dc systems for an inverter incorporating dc ground-fault protection shall meet the requirements for equipment bonding jumpers in accordance with 250.102 but shall not be subject to the requirements for bonding jumpers in accordance with 250.28. A single conductor shall be permitted to be used to perform the multiple functions of dc grounding, ac grounding, and bonding between ac and dc systems.

(4) A bonding conductor or equipment grounding conductor that serves multiple inverters shall be sized based on the sum of applicable maximum currents used in item (2).

(5) A common ground bus shall be permitted to be used for both systems.

(6) A common grounding electrode shall be permitted to be used for both systems, in which case the grounding electrode conductor shall be connected to the ac ground system bonding point.

(7) Grounding electrode conductor(s) shall be sized to meet the requirements of both 250.60 (ac system) and 250.166 (dc system).

(8) For systems with utility-interactive inverters, the premises grounding system serves as the ac grounding system. 690.47(C) Systems with Alternating and Direct Current Grounding Requirements. PV systems having direct current (dc) circuits and alternating current (ac) circuits with no direct connection between the dc grounded conductor and ac grounded conductor shall have a dc grounding system. The dc grounding system shall be bonded to the ac grounding system by one of the methods listed in (1), (2), or (3).

This section shall not apply to ac PV modules.

When using the methods of (2) or (3), a visual inspection shall be made to ensure that the existing ac grounding-electrode system meets the applicable requirements of Article 250, Part III.

FPN No. 1: ANSI/Underwriters Laboratory Standard 1741 for PV inverters and charge controllers requires that any inverter or charge controller that has a bonding jumper between the grounded dc conductor and the grounding system connection point have that point marked as a grounding-electrode conductor (GEC) connection point. In PV inverters, the terminals for the dc equipment-grounding conductors and the terminals for ac equipment-grounding conductors are generally connected to or electrically in common with a grounding busbar that has a marked dc GEC terminal.

FPN No.2: For utility-interactive systems, the existing premises grounding system serves as the ac grounding system. (1) Separate DC Grounding Electrode System Bonded to the AC Grounding Electrode System. A separate dc grounding electrode or system shall be installed and it shall be bonded directly to the ac grounding-electrode system.

The size of any bonding jumper(s) between ac and dc systems shall be based on the larger size of the existing ac grounding-electrode conductor or the size of the dc grounding-electrode conductor specified by 250.166. The dc grounding-electrode system conductor(s) or the bonding jumpers to the ac grounding-electrode system shall not be used as a substitute for any required ac equipment-grounding conductors.

(2) Common DC and AC Grounding Electrode. A dc grounding-electrode conductor of the size specified by 250.166 shall be run from the marked direct-current grounding electrode connection point to the ac grounding-electrode. Where an ac grounding electrode is not accessible, the dc grounding-electrode conductor shall be connected to the ac grounding-electrode conductor in accordance with 250.64(C)(1). This dc grounding-electrode conductor shall not be used as a substitute for any required ac equipment-grounding conductors.

(3) Combined DC Grounding-Electrode Conductor and AC Equipment-Grounding Conductor. An unspliced, or irreversibly spliced, combined grounding conductor shall be run from the marked dc grounding-electrode conductor connection point along with the ac circuit conductors to the grounding bus bar in the associated ac equipment. This combined grounding conductor shall be the larger of the size specified by 250.122 or 250.166 and shall be installed in accordance with 250.64(E).
Substantiation: Section 690.47(C) was edited extensively in the Code Making Panel during the final meeting of the 2008 NEC cycle and was not subject to public review.

This proposal takes a combination of the 2005 NEC 690.47(C) and the 2008 NEC 690.47(C), clarifies that Code language and includes the requirements meeting the intent of the 2008 NEC in a clear and understandable manner.

This proposal establishes when ac and dc grounding are required, it presents the requirement for bonding the two grounding systems together, and it gives three ways of achieving that bonding. The proposal presents this information as concisely as possible without unnecessary duplication of material found elsewhere in the Code. It also provides informative material to assist installers and inspectors.

Section 690.47(C) in the 2008 NEC did not establish the need for bonding the dc grounding system to the ac grounding system. The revised proposal does so.

Section 690.47(C) in the 2008 NEC presented only one method of achieving the ac and dc bonding. This is a method that may not be applicable to all PV systems, large and small. This proposal presents three distinct methods, including the one in 690.47(C) in the 2008 NEC. It can also be used when the listed inverter instructions require that each inverter have a dc grounding electrode installed near each inverter.

It should be noted that the combined conductor bonding method (3) requires that all entry and exit points for metal enclosures and raceways be bonded. This is important because each ferrous metal enclosure or raceway that the combined conductor passes through represents a significant increase in ground path inductance if not properly bonded. Such inductances reduce the ability of the conductor to carry surges to ground.

When using the method described in (2) or (3), it should not be presumed that the existing grounding at a building or structure is present and properly installed. Many older buildings are deficient in their grounding electrode systems. A cursory check should therefore be performed to ensure that the premises grounding electrode system exists and appears to be installed properly.

Fine Print Note (FPN) No. 1 provides information that many inspectors need to know so that they can make informed inspections of this equipment and these installations without having to search elsewhere for the information.

The Exceptions are necessary because of the increasing use of concrete encased electrodes.

Panel Meeting Action: Accept in Principle


Revise the title to read: 690.47(C) Systems with Alternating -Current and Direct-Current Grounding Requirements.

Panel Statement: Revise the wording in the proposal to correct the reference to Underwriters laboratories. Add the word current back into the title.
4-237 Log #4669 NEC-P04 Final Action: Accept in Principle
(690.47(C)(2) Exception (New))

Submitter: Frederic P. Hartwell, Hartwell Electrical Services, Inc.
Recommendation: Insert the following exception:
Exception: The bonding conductor shall not be required to be larger than the conductor required in 680.47(C)(3).
Substantiation: Consider a utility-interactive inverter with a 30A connection to a 200A service panel. The bonding conductor size per (2) is the largest of three sizes: a) the dc 690.45 requirement, or b) the ac requirement based on the inverter overcurrent device size and Table 250.122 (normally 10 AWG in this case), or c) the system bonding requirements of 250.28 (if connected at a 200A service with the usual conductors this would be 4 AWG), so the minimum size would be 4 AWG; but, now look at (3).
In item (3), a conductor that is both an equipment grounding conductor and part of the bonding path between an ac system and a dc system that incorporates GFP, and therefore has the dc grounding connection at that location, is sized in accordance with 250.102. There are two equipment bonding conductors in 250.102, one on the load side of the service sized by 250.122, and one on the line side, sized per 250.66. Since this is on the load side, 250.122 governs the sizing and we are back to a 10 AWG conductor. This is reinforced by the statement that 250.28 does not apply, which is what drove the 4 AWG result in item 2. That said, there is no language in the parent text that provides for resolving an internal conflict, other than compliance with all 8 rules, and that could be argued as mandating the 4 AWG conductor. There is no technical merit to the larger size wire. This is purely to hold two systems at the same potential, and the worst case fault on either system is one that will be resolved through a conductor sized in accordance with 250.122.
This proposal provides the mechanism to resolve these conflicts.

Panel Meeting Action: Accept in Principle
Panel Statement: See panel action and panel statement for Proposal 4-235 for 690.47(C) that covers the size of the common grounding bus and common grounding electrode case addressed in this proposal.

4-238 Log #2509 NEC-P04 Final Action: Reject
(690.47(D))

Submitter: John Wiles, Southwest Technology Development Inst/New Mexico State Univ. / Rep. PV Industry Forum
Recommendation: Delete 690.47(D)
(D) Additional Electrodes for Array Grounding. Grounding electrodes shall be installed in accordance with 250.52 at the location of all ground- and pole-mounted photovoltaic arrays and as close as practicable to the location of roof-mounted photovoltaic arrays. The electrodes shall be connected directly to the array frame(s) or structure. The dc grounding electrode conductor shall be sized according to 250.166. Additional electrodes are not permitted to be used as a substitute for equipment bonding or equipment grounding conductor requirements.
The structure of a ground- or pole-mounted photovoltaic array shall be permitted to be considered a grounding electrode if it meets the requirements of 250.52. Roof-mounted photovoltaic arrays shall be permitted to use the metal frame of a building or structure if the requirements of 250.52(A)(2) are met.
Exception No. 1: Array grounding electrode(s) shall not be required where the load served by the array is integral with the array.
Exception No. 2: Additional array grounding electrode(s) shall not be required if located within 6 ft of the premises wiring electrode.
Substantiation: This requirement, new to the 2008 NEC, was added to mandate lightning protection for PV arrays. It does not replace or substitute for any other Code-required grounding systems that are designed to ensure the safety of the public.
Lightning protection is beyond the scope of the NEC and is covered in other NFPA documents.
Normal, equipment-grounding systems provide the necessary safety for PV systems.
A similar, optional requirement is already in the Codes as 250.54.
These lightning-protection requirements should be deleted from the Code.
Panel Meeting Action: Reject
Panel Statement: The submitter has not provided sufficient technical data to support the removal of this requirement.
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4-239     Log #4670  NEC-P04

Submitter: Frederic P. Hartwell, Hartwell Electrical Services, Inc.
Recommendation: Either:
  1) Insert the following sentence after the second sentence: The electrodes shall be bonded to the grounding electrode system for the building.
Or:
  2) Change the beginning of the first sentence to read “Auxiliary grounding electrodes shall be installed in accordance with 250.54 at the location...”.

Substantiation: If a separate electrode is used, whether or not it must be bonded to the power system electrodes depends on whether they are classified as “auxiliary” electrodes as covered in 250.54. The proposal for this 2008 change clearly intended that they be so classified; but the panel removed the reference and failed to substantiate its actions. This proposal seeks to force a clear stand on whether or not to bond these electrodes. The fact that they are a down payment on lightning protection suggests they are not supplemental, because NFPA 780 requires bonding to power system grounding electrode systems while retaining separate electrodes for their protective system.

Panel Meeting Action: Reject
Panel Statement: Conductors between the array and inverter is an equipment grounding conductor. Section 250.54 allows auxiliary grounding electrodes to be installed without bonding to the grounding system. Additionally, the proposal does not meet the requirements of 4.3.3(b) the Regulations Governing Committee Projects.

4-240     Log #4671  NEC-P04

Submitter: Frederic P. Hartwell, Hartwell Electrical Services, Inc.
Recommendation: Insert the following sentence at the end: “A conductor meeting the terms of this requirement together with fittings suitable for creating a bonding connection shall be secured to the building surface at an easily seen location at the system connection to the grounding electrode conductor, together with instructions regarding when to install the temporary bonding jumper.”

Substantiation: The present NEC text is a maintenance procedure requirement suitable for NFPA 70E and not an installation requirement, and therefore it has no business being in the NEC as written. The rule says, in effect, that if you remove the equipment for servicing, you must install a temporary bonding conductor so as to maintain the continuity between the two equipment grounding systems that normally are bonded through the missing equipment. Now this is a very good idea, just like it is a very good idea to test electrical components for voltage before working on them. But what steps can be taken prior to the final electrical inspection by way of modifications to the electrical system to achieve the result? The rule cannot be complied with by an installing electrician.

This proposal adds actual field installation criteria that could be enforced as part of normal electrical inspections. The submitter understands that this proposal may not be suitable either. If the panel cannot develop an appropriate installation requirement, then this section should be marked for deletion.

Panel Meeting Action: Reject
Panel Statement: The proposal as submitted does not add clarity to Section 690.48. It is unclear how the submitter intends for instructions to be placarded and followed.
Insert the following sentence at the end: "A conductor meeting the terms of this requirement together with fittings suitable for creating a bonding connection shall be secured to the building surface at an easily seen location at the system connection to the grounding electrode conductor, together with instructions regarding when to install the temporary bonding jumper."

The present NEC text is a maintenance procedure requirement suitable for NFPA 70E and not an installation requirement, and therefore it has no business being in the NEC as written. The rule says, in effect, that if you remove an inverter for servicing, you must install a temporary bonding conductor so as to maintain the continuity between the two equipment grounding systems that normally are bonded through the missing equipment. Now this is a very good idea, just like it is a very good idea to test electrical components for voltage before working on them. But what steps can be taken prior to the final electrical inspection by way of modifications to the electrical system to achieve the result? The rule cannot be complied with by an installing electrician.

This proposal adds actual field installation criteria that could be enforced as part of normal electrical inspections. The submitter understands that this proposal may not be suitable either. If the panel cannot develop an appropriate installation requirement, then this section should be marked for deletion.

Panel Meeting Action:  Reject
Panel Statement:  The proposal as submitted does not add clarity to Section 690.49. It is unclear how the submitter intends for instructions to be placarded and followed.
If a single-phase, 2-wire inverter output is connected to the neutral conductor and one the ungrounded conductor (only) of a 3-wire or of a 3-phase 4-wire, wye-connected system, the maximum load connected between the neutral conductor and any one ungrounded conductor plus the inverter output rating shall not exceed the ampacity if the neutral conductor.

The ampacity of the neutral conductors shall comply with either A or B.

A. Where the outputs of single or multiple single-phase inverter(s) are connected between the neutral conductor and one or more of the ungrounded conductors of a 3-phase 4-wire, wye-connected system or a 120/240V single-phase system, the ampacity of the neutral conductor shall be no less than the greater of (1) or (2)

(1) 125% of the continuous load plus 100% of the non continuous load on that neutral conductor or
(2) 125% of the sum of the rated output current of all inverters considering worst-case imbalance.

These two currents ((1) and (2)) are not additive in this requirement because they may exist separately at different times. The existing requirement, as written, is incorrect in requiring the sum of these two currents to be used. Since the currents (power) will generally flow in opposite directions, the sum may be near zero at times. If the inverters are not operating, the neutral must be able to carry any connected load currents. The operation of the inverters in the presence of load currents will tend to decrease currents in the neutral. If there are no loads, then the circuit must carry the full rated output of the inverter(s). Where multiple inverters are installed and connected phase-to-neutral, consideration must be given to situations where one or more inverters could fail, be turned off, or the connected array shaded thus eliminating any balance between the phases and increasing the neutral currents. The 125% of rated output is needed to ensure that the neutral conductor ampacity is consistent with the ampacity calculated elsewhere in the Code.

Example:

480/277V, 3-phase, 4-wire, wye system: Existing maximum, connected, unbalanced load current in the neutral is 40 amps. Two 7 kW inverters are connected between each phase and neutral. A total of six inverters are connected. Rated output current of each inverter is 27.3 amps. When all six inverters are producing rated current, the neutral currents from the inverters are near zero. In a worst-case situation, only two inverters connected on one phase are working at rated output and the others are shut off or have failed. The currents in the neutral from these two inverters would total 2 x 27.3 amps or 54.6 amps, and this should be used to calculate the required ampacity for the neutral, since it is larger than the 40 amps of load current.

Panel Meeting Action: Accept
Submitter: Todd W. Stafford, National Joint Apprentice & Training Committee
Recommendation: Revise text to read as follows:

   690.63 Unbalanced Interconnections.
   (A) Single Phase. Single phase inverters for photovoltaic systems are ac modules in interactive solar photovoltaic-
   systems shall not be connected to 3-phase power systems unless the interconnected system is designed so that
   significant unbalanced voltages cannot result.
   (B) Three Phase. Three phase inverters and 3-phase ac modules in interactive systems shall have all phases
   automatically de-energized upon loss of, or unbalanced, voltage in one or more phases unless the interconnected
   system is designed so that significant unbalanced voltages will not result.

See 705.100 Unbalanced Connections

Substantiation: This proposal was generated by the Task Group for CMP4. This Task group was asked to develop
appropriate proposals to address the redundant point of interconnection requirements for PV in 690, Fuel Cells in 692
and Electric Power Sources in 705.

   Task Group members are:
   Todd W. Stafford, Chair
   Ward I. Bower
   Kenneth Krastins
   Vincent C. Zinnante
   Timothy P. Zgonena

Panel Meeting Action: Accept
Delete all of Section 690.64.

The output of a utility-interactive inverter shall be connected as specified in 690.64(A) or (B):

(A) Supply Side. The output of a utility-interactive inverter shall be permitted to be connected to the supply side of the service disconnecting means as permitted in 230.82(6):

(B) Load Side. The output of a utility-interactive inverter shall be permitted to be connected to the load side of the service disconnecting means of the other source(s) at any distribution equipment on the premises. Where distribution equipment, including switchboards and panelboards, is fed simultaneously by a primary source(s) of electricity and one or more utility-interactive inverters, and where this distribution equipment is capable of supplying multiple branch circuits or feeders, or both, the interconnecting provisions for the utility-interactive inverter(s) shall comply with (B)(1) through (B)(7):

(1) Dedicated Overcurrent and Disconnect. Each source interconnection shall be made at a dedicated circuit breaker or fusible disconnecting means:

(2) Bus or Conductor Rating. The sum of the ampere ratings of overcurrent devices in circuits supplying power to a busbar or conductor shall not exceed 120 percent of the rating of the busbar or conductor. In systems with panelboards connected in series, the rating of the first overcurrent device directly connected to the output of a utility-interactive inverter(s) shall be used in the calculations for all busbars and conductors:

(3) Ground-Fault Protection. The interconnection point shall be on the line side of all ground-fault protection equipment. Exception: Connection shall be permitted to be made to the load side of ground-fault protection, provided that there is ground-fault protection for equipment from all ground-fault current sources. Ground-fault protection devices used with supplies connected to the load-side terminals shall be identified and listed as suitable for backfeeding:

(4) Marking. Equipment containing overcurrent devices in circuits supplying power to a busbar or conductor supplied from multiple sources shall be marked to indicate the presence of all sources:

(5) Suitable for Backfeed. Circuit breakers, if backfed, shall be suitable for such operation:

FPN: Circuit breakers that are marked “Line” and “Load” have been evaluated only in the direction marked. Circuit breakers without “Line” and “Load” have been evaluated in both directions:

(6) Fastening. Listed plug-in-type circuit breakers backfed from utility-interactive inverters complying with 690.60 shall be permitted to omit the additional fastener normally required by 408.36(D) for such applications:

(7) Inverter Output Connection. Unless the panelboard is rated not less than the sum of the ampere ratings of all overcurrent devices supplying it, a connection in a panelboard shall be positioned at the opposite (load) end from the input feeder location or main circuit location. The bus or conductor rating shall be sized for the loads connected in accordance with Article 220. A permanent warning label shall be applied to the distribution equipment with the following or equivalent marking:

WARNING

INVERTER OUTPUT CONNECTION:

DO NOT RELOCATE THIS OVERCURRENT DEVICE

Substantiation: The requirements of 690.64 were moved to 705.12 during the 2008 NEC Code making cycle and are no longer needed in Article 690.

Proposals submitted for 690.64 should be addressed as proposals for 705.12.

Panel Meeting Action: Accept in Principle

Panel Statement: See panel action and statement on Proposal 4-246.
Revise text to read as follows:

690.64 Point of Connection. The output of a utility-interactive inverter shall be connected as specified in 690.64(A) or (B) 705.12(A) or (D).

(A) Supply Side. The output of a utility-interactive inverter shall be permitted to be connected to the supply side of the service disconnecting means as permitted in 230.82(6).

(B) Load Side. The output of a utility-interactive inverter shall be permitted to be connected to the load side of the service disconnecting means of the other source(s) at any distribution equipment on the premises. Where distribution equipment, including switchboards and panelboards, is fed simultaneously by a primary source(s) of electricity and one or more utility interactive inverters, and where this distribution equipment is capable of supplying multiple branch circuits or feeder, or both, the interconnecting provisions for the utility-interactive inverter(s) shall comply with (D)(1) through (D)(7).

(1) Dedicated Overcurrent and Disconnect. Each source interconnection shall be made at a dedicated circuit breaker or fusable disconnecting means.

(2) Bus or Conductor Rating. The sum of the ampere ratings of overcurrent devices in circuits supplying power to a busbar or conductor shall not exceed 120 percent of the rating of the busbar or conductor. In systems with panelboards connected in series, the rating of the first overcurrent device directly connected to the output of a utility-interactive inverter(s) shall be used in the calculations for all busbars and conductors.

(3) Ground-Fault Protection. The connection point shall be on the line side of all ground-fault protection equipment.

Exception: Connection shall be permitted to be made to the load side of ground-fault protection, provided that there is ground-fault protection for equipment from all ground fault current sources. Ground fault protection devices used with supplies connected to the load side terminals shall be identified and listed as suitable for backfeeding.

(4) Marking. Equipment containing overcurrent devices in circuits supplying power to a busbar or conductor supplied from multiple sources shall be marked to indicate the presence of all sources.

(5) Suitable for Backfeed. Circuit breakers, if backfed, shall be suitable for such operation.

FPN: Circuit breakers that are marked “Line” and “Load” have been evaluated only in the direction marked. Circuit breakers without “Line” and “Load” have been evaluated in both directions.

(6) Fastening. Listed plug-in-type circuit breakers backed from utility-interactive inverters complying with 690.60 shall be permitted to omit the additional fastener normally required by 408.36(D) for such applications.

(7) Inverter Output Connection. Unless the panelboard is rated not less than the sum of the ampere ratings of all overcurrent devices supplying it, a connection in a panel-board shall be positioned at the opposite (load) end from the input feeder location or main circuit location. The bus or conductor rating shall be sized for the loads connected in accordance with Article 220. A permanent warning label shall be applied to the distribution equipment with the following or equivalent marking:

WARNING
INVERTER OUTPUT CONNECTION
DO NOT RELOCATE
THIS OVERCURRENT DEVICE

Substantiation: Photovoltaic systems operating in parallel with another electric supply to a premise electrical system are considered Interconnected Electric Power Production Systems and fall within the scope of Article 705. The point of connection requirements in 690.64 duplicate the text Section 705.12. Repeating the requirements, to interconnect a photovoltaic utility-interactive inverter in Article 690 is redundant. The requirements in Section 690.64 are not specific to photovoltaic installations. Many types of interconnected electric production systems use utility-interactive inverters, such as wind, photovoltaic, fuel cells, and micro-turbines, to mention a few. Section 705.12(A) and (D) provides uniform interconnection requirements for this inverter technology, regardless of the primary energy source.

The requirements in Section 690.64 duplicate the text in 705.12 as listed below:

- 690.64(A) is duplicated text from 705.12(A)
- 690.64(B), B(1) through B(7) is duplicated by 705.12(D), (D)(1) through (D)(7)

Printed on 2/4/2009
This proposal removes the duplicated text in Article 690 and references Article 705 sections that state the utility-interactive inverter point of connection requirements.

Panel Meeting Action: Accept in Principle
Panel Statement: See the panel action on Proposal 4-246.
The output of a utility interactive inverter shall be connected as specified in 690.64(A) or (B):

(A) Supply Side. The output of a utility interactive inverter shall be permitted to be connected to the supply side of the service disconnecting means as permitted in 230.82(6):

(B) Load Side. The output of a utility interactive inverter shall be permitted to be connected to the load side of the service disconnecting means of the other source(s) at any distribution equipment on the premises. Where distribution equipment, including switchboards and panelboards, is fed simultaneously by a primary source(s) of electricity and one or more utility interactive inverters, and where this distribution equipment is capable of supplying multiple branch circuits or feeders, or both, the interconnecting provisions for the utility interactive inverter(s) shall comply with (B)(1) through (B)(7):

(1) Dedicated Overcurrent and Disconnect. Each source interconnection shall be made at a dedicated circuit breaker or fusible disconnecting means:

(2) Bus or Conductor Rating. The sum of the ampere ratings of overcurrent devices in circuits supplying power to a busbar or conductor shall not exceed 120 percent of the rating of the busbar or conductor. In systems with panelboards connected in series, the rating of the first overcurrent device directly connected to the output of a utility interactive inverter(s) shall be used in the calculations for all busbars and conductors:

(3) Ground Fault Protection. The interconnection point shall be on the line side of all ground fault protection equipment:

Exception: Connection shall be permitted to be made to the load side of ground fault protection, provided that there is ground fault protection for equipment from all ground fault current sources. Ground fault protection devices used with supplies connected to the load side terminals shall be identified and listed as suitable for backfeeding:

(4) Marking. Equipment containing overcurrent devices in circuits supplying power to a busbar or conductor supplied from multiple sources shall be marked to indicate the presence of all sources:

(5) Suitable for Backfeed. Circuit breakers, if backfed, shall be suitable for such operation:

FPN: Circuit breakers that are marked “Line” and “Load” have been evaluated only in the direction marked. Circuit breakers without “Line” and “Load” have been evaluated in both directions:

(6) Fastening. Listed plug in type circuit breakers backfed from utility interactive inverters complying with 690.60 shall be permitted to omit the additional fastener normally required by 408.36(D) for such application:

(7) Inverter Output Connection. Unless the panelboard is rated not less than the sum of the ampere ratings of all overcurrent devices supplying it, a connection in a panelboard shall be positioned at the opposite (load) end from the input feeder location or main circuit location. The bus or conductor rating shall be sized for the loads connected in accordance with Article 220. A permanent warning label shall be applied to the distribution equipment with the following or equivalent marking:

Warning
Inverter Output Connection
Do Not Relocate
The Overcurrent Device
See 705.12 Point of Connection

Substantiation: This proposal was generated by the Task Group for CMP4. This Task group was asked to develop appropriate proposals to address the redundant point of interconnection requirements for PV in 690, Fuel Cells in 692 and Electric Power Sources in 705.

Task Group members are:
Todd W. Stafford, Chair
Ward I. Bower
Kenneth Krastins
Vincent C. Zinnante
Timothy P. Zgonena

Panel Meeting Action: Accept
VIII. Storage Batteries

690.71 Installation.

(A) General. Storage batteries in a solar photovoltaic system shall be installed in accordance with the provisions of Article 480. The interconnected battery cells shall be considered grounded where the photovoltaic power source is installed in accordance with 690.41.

Batteries in PV power systems are usually grounded when the PV power system is grounded in accordance with Article 690, Part VI.

(B) Dwellings.

(1) Operating Voltage. Storage batteries for dwellings shall have the cells connected so as to operate at less than 50 volts nominal. Lead-acid storage batteries for dwellings shall have no more than twenty-four 2-volt cells connected in series (48 volts nominal).

Exception: Where live parts are not accessible during routine battery maintenance, a battery system voltage in accordance with 690.7 shall be permitted:

(2) Guarding of Live Parts. Live parts of battery systems for dwellings shall be guarded to prevent accidental contact by persons or objects, regardless of voltage or battery type.

FPN: Batteries in solar photovoltaic systems are subject to extensive charge–discharge cycles and typically require frequent maintenance, such as checking electrolyte and cleaning connections.

At any voltage, a primary safety concern in battery systems is that a fault (e.g., a metal tool dropped onto a terminal) might cause a fire or an explosion. Guarded, as defined in Article 100, describes the best method to reduce this hazard.

(C) Current Limiting. A listed, current-limiting, overcurrent device shall be installed in each circuit adjacent to the batteries where the available short-circuit current from a battery or battery bank exceeds the interrupting or withstand ratings of other equipment in that circuit. The installation of current-limiting fuses shall comply with 690.16.

Large banks of storage batteries can deliver significant amounts of short-circuit current. Current-limiting overcurrent devices should be used if necessary:

(D) Battery Nonconductive Cases and Conductive Racks. Flooded, vented, lead-acid batteries with more than twenty-four 2-volt cells connected in series (48 volts, nominal) shall not use conductive cases or shall not be installed in conductive cases. Conductive racks used to support the nonconductive cases shall be permitted where no rack material is located within 150 mm (6 in.) of the tops of the nonconductive cases.

This requirement shall not apply to any type of valve-regulated lead-acid (VRLA) battery or any other types of sealed batteries that may require steel cases for proper operation:

Grounded metal trays and cases or containers (as normally required by 250.110) in flooded, lead-acid battery systems operating over 48 volts, nominal, have been shown to be a contributing factor in ground faults. Nonconductive racks, trays, and cases minimize this problem:

(E) Disconnection of Series Battery Circuits. Battery circuits subject to field servicing, where more than twenty-four 2-volt cells are connected in series (48 volts, nominal), shall have provisions to disconnect the series-connected strings into segments of 24 cells or less for maintenance by qualified persons. Non–load-break bolted or plug-in disconnects shall be permitted:

(F) Battery Maintenance Disconnecting Means. Battery installations, where there are more than twenty-four 2-volt cells connected in series (48 volts, nominal), shall have a disconnecting means, accessible only to qualified persons, that disconnects the grounded circuit conductor(s) in the battery electrical system for maintenance. This disconnecting means shall not disconnect the grounded circuit conductor(s) for the remainder of the photovoltaic electrical system. A non–load-break-rated switch shall be permitted to be used as the disconnecting means:

(G) Battery Systems of More Than 48 Volts. On photovoltaic systems where the battery system consists of more than twenty-four 2-volt cells connected in series (more than 48 volts, nominal), the battery system shall be permitted to operate with ungrounded conductors, provided that the photovoltaic array source and output circuits comply with 690.41.

(2) The dc and ac load circuits shall be solidly grounded:

(3) All main ungrounded battery input/output circuit conductors shall be provided with switched disconnects and overcurrent protection:

(4) A ground fault detector and indicator shall be installed to monitor for ground faults in the battery bank.

Insert into Article 480, Storage Batteries
480.xx Installation.

(A) Dwellings.

(1) Operating Voltage. Storage batteries for dwellings shall have the cells connected so as to operate at less than 50 volts nominal. Lead-acid storage batteries for dwellings shall have no more than twenty-four 2-volt cells connected in series (48-volts nominal).

Exception: Where live parts are not accessible during routine battery maintenance, a battery system voltage in accordance with 690.7 shall be permitted.

(2) Guarding of Live Parts. Live parts of battery systems for dwellings shall be guarded to prevent accidental contact by persons or objects, regardless of voltage or battery type.

FPN: Batteries in systems subject to extensive charge-discharge cycles typically require frequent maintenance, such as checking electrolyte and cleaning connections.

At any voltage, a primary safety concern in battery systems is that a fault (e.g., a metal tool dropped onto a terminal) might cause a fire or an explosion. Guarded, as defined in Article 100, describes the best method to reduce this hazard.

(B) Current Limiting. A listed, current-limiting, overcurrent device shall be installed in each circuit adjacent to the batteries where the available short-circuit current from a battery or battery bank exceeds the interrupting or withstand ratings of other equipment in that circuit. The installation of current-limiting fuses shall comply with 690.16.

Large banks of storage batteries can deliver significant amounts of short-circuit current. Current-limiting overcurrent devices should be used if necessary.

(C) Battery Nonconductive Cases and Conductive Racks. Flooded, vented, lead-acid batteries with more than twenty-four 2-volt cells connected in series (48 volts, nominal) shall not use conductive cases or shall not be installed in conductive cases. Conductive racks used to support the nonconductive cases shall be permitted where no rack material is located within 150 mm (6 in.) of the tops of the nonconductive cases.

This requirement shall not apply to any type of valve-regulated lead-acid (VRLA) battery or any other types of sealed batteries that may require steel cases for proper operation.

Grounded metal trays and cases or containers (as normally required by 250.110) in flooded, lead-acid battery systems operating over 48 volts, nominal, have been shown to be a contributing factor in ground faults. Nonconductive racks, trays, and cases minimize this problem.

(D) Disconnection of Series Battery Circuits. Battery circuits subject to field servicing, where more than twenty-four 2-volt cells are connected in series (48 volts, nominal), shall have provisions to disconnect the series-connected strings into segments of 24 cells or less for maintenance by qualified persons. Non–load-break bolted or plug-in disconnects shall be permitted.

(E) Battery Maintenance Disconnecting Means. Battery installations, where there are more than twenty-four 2-volt cells connected in series (48 volts, nominal), shall have a disconnecting means, accessible only to qualified persons, that disconnects the grounded circuit conductor(s) in the battery electrical system for maintenance. This disconnecting means shall not disconnect the grounded circuit conductor(s) for the remainder of the electrical system. A non–load-break-rated switch shall be permitted to be used as the disconnecting means.

(F) Battery Systems of More Than 48 Volts. On systems where the battery system consists of more than twenty-four 2-volt cells connected in series (more than 48 volts, nominal), the battery system shall be permitted to operate with ungrounded conductors, provided the following conditions are met:

1. The dc and ac load circuits shall be solidly grounded.

2. All main ungrounded battery input/output circuit conductors shall be provided with switched disconnects and overcurrent protection.

3. A ground-fault detector and indicator shall be installed to monitor for ground faults in the battery bank.

Substantiation: The section on the installation of storage batteries in residences in Article 690 makes a lot of sense for systems other than photovoltaics. In writing the new proposed article for Small Wind Electric Systems, we copied this language, changing PV to Small Wind Electric. These requirements should apply to any substantial battery storage system, and thus should be moved to a general section of the code.

The problem – language duplicated in several articles, and not being applied for other situations where it is relevant – e.g. small wind, hydro, etc.

The solution – move it to Article 480, perhaps

Panel Meeting Action: Reject

Panel Statement: The proposal is incomplete as written. The panel suggests that the submitter comments on the proposal with technical data to substantiate the comment.
VIII. Storage Batteries

690.71 Installation.

(A) General. Storage batteries in a solar photovoltaic system shall be installed in accordance with the provisions of Article 480. The interconnected battery cells shall be considered grounded where the photovoltaic power source is installed in accordance with 690.41.

Batteries in PV power systems are usually grounded when the PV power system is grounded in accordance with Article 690, Part VI.

(B) Dwellings.

(1) Operating Voltage. Storage batteries for dwellings shall have the cells connected so as to operate at less than 50 volts nominal. Lead-acid storage batteries for dwellings shall have no more than twenty-four 2-volt cells connected in series (48 volts nominal).

Exception: Where live parts are not accessible during routine battery maintenance, a battery system voltage in accordance with 690.7 shall be permitted:

(2) Guarding of Live Parts. Live parts of battery systems for dwellings shall be guarded to prevent accidental contact by persons or objects, regardless of voltage or battery type.

FPN: Batteries in solar photovoltaic systems are subject to extensive charge-discharge cycles and typically require frequent maintenance, such as checking electrolyte and cleaning connections.

At any voltage, a primary safety concern in battery systems is that a fault (e.g., a metal tool dropped onto a terminal) might cause a fire or an explosion. Guarded, as defined in Article 100, describes the best method to reduce this hazard.

(C) Current Limiting. A listed, current-limiting, overcurrent device shall be installed in each circuit adjacent to the batteries where the available short-circuit current from a battery or battery bank exceeds the interrupting or withstand ratings of other equipment in that circuit. The installation of current-limiting fuses shall comply with 690.16.

Large banks of storage batteries can deliver significant amounts of short-circuit current. Current-limiting overcurrent devices should be used if necessary.

(D) Battery Nonconductive Cases and Conductive Racks. Flooded, vented, lead-acid batteries with more than twenty-four 2-volt cells connected in series (48 volts, nominal) shall not use conductive cases or shall not be installed in conductive cases. Conductive racks used to support the nonconductive cases shall be permitted where no rack material is located within 150 mm (6 in.) of the tops of the nonconductive cases.

This requirement shall not apply to any type of valve-regulated lead-acid (VRLA) battery or any other types of sealed-batteries that may require steel cases for proper operation.

Grounded metal trays and cases or containers (as normally required by 250.110) in flooded, lead-acid battery systems operating over 48 volts, nominal, have been shown to be a contributing factor in ground faults. Nonconductive racks, trays, and cases minimize this problem.

(E) Disconnection of Series Battery Circuits. Battery circuits subject to field servicing, where more than twenty-four 2-volt cells are connected in series (48 volts, nominal), shall have provisions to disconnect the series-connected strings into segments of 24 cells or less for maintenance by qualified persons. Non-load-break bolted or plug-in disconnects shall be permitted.

(F) Battery Maintenance Disconnecting Means. Battery installations, where there are more than twenty-four 2-volt cells connected in series (48 volts, nominal), shall have a disconnecting means, accessible only to qualified persons, that disconnects the grounded circuit conductors in the battery electrical system for maintenance. This disconnecting means shall not disconnect the grounded circuit conductor(s) for the remainder of the photovoltaic electrical system. A non-load-break-rated switch shall be permitted to be used as the disconnecting means.

(G) Battery Systems of More Than 48 Volts. On photovoltaic systems where the battery system consists of more than twenty-four 2-volt cells connected in series (more than 48 volts, nominal), the battery system shall be permitted to operate with ungrounded conductors, provided that the photovoltaic array source and output circuits comply with 690.41.

(2) The dc and ac load circuits shall be solidly grounded:

(3) All main ungrounded battery input/output circuit conductors shall be provided with switched disconnects and overcurrent protection:

(4) A ground fault detector and indicator shall be installed to monitor for ground faults in the battery bank.

Insert into Article 480, Storage Batteries
480.xx Installation.

(A) Dwellings.

(1) Operating Voltage. Storage batteries for dwellings shall have the cells connected so as to operate at less than 50 volts nominal. Lead-acid storage batteries for dwellings shall have no more than twenty-four 2-volt cells connected in series (48-volts nominal).

Exception: Where live parts are not accessible during routine battery maintenance, a battery system voltage in accordance with 690.7 shall be permitted.

(2) Guarding of Live Parts. Live parts of battery systems for dwellings shall be guarded to prevent accidental contact by persons or objects, regardless of voltage or battery type.

FPN: Batteries in systems subject to extensive charge–discharge cycles typically require frequent maintenance, such as checking electrolyte and cleaning connections.

At any voltage, a primary safety concern in battery systems is that a fault (e.g., a metal tool dropped onto a terminal) might cause a fire or an explosion. Guarded, as defined in Article 100, describes the best method to reduce this hazard.

(B) Current Limiting. A listed, current-limiting, overcurrent device shall be installed in each circuit adjacent to the batteries where the available short-circuit current from a battery or battery bank exceeds the interrupting or withstand ratings of other equipment in that circuit. The installation of current-limiting fuses shall comply with 690.16.

Large banks of storage batteries can deliver significant amounts of short-circuit current. Current-limiting overcurrent devices should be used if necessary.

(C) Battery Nonconductive Cases and Conductive Racks. Flooded, vented, lead-acid batteries with more than twenty-four 2-volt cells connected in series (48 volts, nominal) shall not use conductive cases or shall not be installed in conductive cases. Conductive racks used to support the nonconductive cases shall be permitted where no rack material is located within 150 mm (6 in.) of the tops of the nonconductive cases.

This requirement shall not apply to any type of valve-regulated lead-acid (VRLA) battery or any other types of sealed batteries that may require steel cases for proper operation.

Grounded metal trays and cases or containers (as normally required by 250.110) in flooded, lead-acid battery systems operating over 48 volts, nominal, have been shown to be a contributing factor in ground faults. Nonconductive racks, trays, and cases minimize this problem.

(D) Disconnection of Series Battery Circuits. Battery circuits subject to field servicing, where more than twenty-four 2-volt cells are connected in series (48 volts, nominal), shall have provisions to disconnect the series-connected strings into segments of 24 cells or less for maintenance by qualified persons. Non–load-break bolted or plug-in disconnects shall be permitted.

(E) Battery Maintenance Disconnecting Means. Battery installations, where there are more than twenty-four 2-volt cells connected in series (48 volts, nominal), shall have a disconnecting means, accessible only to qualified persons, that disconnects the grounded circuit conductor(s) in the battery electrical system for maintenance. This disconnecting means shall not disconnect the grounded circuit conductor(s) for the remainder of the electrical system. A non–load-break-rated switch shall be permitted to be used as the disconnecting means.

(F) Battery Systems of More Than 48 Volts. On systems where the battery system consists of more than twenty-four 2-volt cells connected in series (more than 48 volts, nominal), the battery system shall be permitted to operate with ungrounded conductors, provided the following conditions are met:

(1) The dc and ac load circuits shall be solidly grounded.

(2) All main ungrounded battery input/output circuit conductors shall be provided with switched disconnects and overcurrent protection.

(3) A ground-fault detector and indicator shall be installed to monitor for ground faults in the battery bank.

Substantiation: The section on the installation of storage batteries in residences in Article 690 makes a lot of sense for systems other than photovoltaics. In writing the new proposed article for Small Wind Electric Systems, we copied this language, changing PV to Small Wind Electric. These requirements should apply to any substantial battery storage system, and thus should be moved to a general section of the code.

The problem – language duplicated in several articles, and not being applied for other situations where it is relevant – e.g. small wind, hydro, etc.

The solution – move it to Article 480, perhaps

Panel Meeting Action: Reject

Panel Statement: The proposal is incomplete as written. The panel suggests that the submitter comments on the proposal with technical data to substantiate the comment.
Add the following section H to 690.71

(H) Disconnects and Overcurrent Protection. Where battery bank input and output terminals are more than 1.5 meters (5 feet) from connected equipment, or where the circuits from these terminals pass through a wall or partition, a switched disconnecting means and overcurrent protection shall be provided at the battery end of the circuit. Fused disconnecting means or circuit breakers are acceptable. Where fused disconnecting means are used, the “Line” terminals of the disconnecting means shall be connected toward the battery terminals. Overcurrent devices or disconnecting means shall not be installed in battery enclosures where explosive atmospheres can exist.

Substantiation: Batteries represent significant sources of short-circuit current, and circuits connected to these sources must be protected with overcurrent devices. A switched disconnecting means is required to allow rapid disconnection of the batteries from the circuit under connected equipment failure and during maintenance. It is difficult to install this equipment when the cable lengths are shorter than about five feet, and this is the distance that Underwriters Laboratories (UL) generally allows for unprotected cable lengths when testing PV power centers. Any penetration of a wall or partition necessitates the installation of a disconnecting means and overcurrent protection at the battery end of the circuit to protect the circuit as it passes through the wall and to allow the battery to be disconnected at the source.

Panel Meeting Action: Reject

Panel Statement: The submitter’s proposed new section and requirements are addressed in other sections of the code. See 240.21(H) and Section 480.5. The 5 ft rule is not substantiated as a UL requirement.

Add the new section as follows:

690.72(C) Buck/Boost DC Converters. Buck/boost charge controllers and other dc power converters that increase or decrease the output current or output voltage with respect to the input current or input voltage shall be installed in compliance with (1) and (2).

(1) The ampacity of the conductors in output circuits shall be based on the maximum rated continuous, output current of the charge controller or converter for the selected output voltage range.

(2) The voltage rating of the output circuits shall be based on the maximum voltage output of the charge controller or converter for the selected output voltage range.

Substantiation: Many new charge controllers and other power converters (aka linear current boosters) are of the buck/boost type that can accept high input voltages at low current and deliver lower output voltages at considerably higher currents to a load. For example: A PV array producing 150 volts at 12 amps would be processed through the charge controller to 24 volts at 60 amps for battery charging. These controllers usually have several different nominal output operating voltage ranges that are selected by the installer to match the nominal battery voltage. Nominal voltages such as 12, 24, and 48 are common, and the maximum output current may vary with each voltage range. The proposal requires that these variations in output voltage and current be addressed when determining the rating of overcurrent protective devices and the ampacity of conductors in the output circuits.

Panel Meeting Action: Accept in Principle

Revise the wording as follows:

690.72(C) Buck/Boost DC Converters. When buck/boost charge controllers and other dc power converters that increase or decrease the output current or output voltage with respect to the input current or input voltage are installed, the following requirements must be met:

(1) The ampacity of the conductors in output circuits shall be based on the maximum rated continuous, output current of the charge controller or converter for the selected output voltage range.

(2) The voltage rating of the output circuits shall be based on the maximum voltage output of the charge controller or converter for the selected output voltage range.

Panel Statement: The panel revised the language to clarify that installation of buck-boost converters is not mandatory, however, when installed the requirements must be met.
690.74 Battery Interconnections.

Flexible cables, as identified in Article 400, in sizes 2/0 AWG and larger shall be permitted within the battery enclosure from battery terminals to a nearby junction box where they shall be connected to an approved wiring method. Flexible battery cables shall also be permitted between batteries and cells within the battery enclosure. Such cables shall be listed for hard-service use and identified as moisture resistant.

Flexible, fine-stranded cables shall **only** be used with terminals, lugs, devices, and connectors that are listed and marked for such use—terminated as per 110.14(A)(1).

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

Flexible cables, as identified in Article 400, in sizes 2/0 AWG and larger shall be permitted within the battery enclosure from battery terminals to a nearby junction box where they shall be connected to an approved wiring method. Flexible battery cables shall also be permitted between batteries and cells within the battery enclosure. Such cables shall be listed for hard-service use and identified as moisture resistant.

Flexible, fine-stranded cables shall **only** be used with terminals, lugs, devices, and connectors that are listed and marked for such use—terminated as per 110.14(A)(1).

**Substantiation:** Relocate this text to 110.14(A)(1) so this requirement can be applied to all installations where fine-stranded conductors are being installed for other installation types where a wide range of flexibility is desired. With the expanded use of fine-stranded cables and conductors being used for welders, cranes, elevators, battery bank connections, computer data cables, UPS cables and many other installations, this requirements needs to be relocated to requirements for electrical installations. As this rule is applied currently within the NEC, only specific applications can require terminations to use devices and equipment rated for these conductor types. This relocated requirement will provide a procedure for identified lugs and terminations providing a safer installation without possible hot spots or cable overheating due to bad or loose lug connections when terminated with acceptable identified crimping tools. Conductors and fine-stranded jacketed cables are installed, not just for solar or battery connections.

**Panel Meeting Action:** Reject

**Panel Statement:** The required text does not currently exist in Section 110.14.
Add the following new text:

692.4(C) System Installation. Fuel Cell Systems shall be installed by qualified persons with documented training and experience in the installation of and NEC requirements applicable to such equipment. The name(s) of the qualified person(s) shall be kept in a permanent record at the office of the establishment in charge of the completed installation. Records of qualified persons must be furnished upon request to the local authority having jurisdiction.

Substantiation: Electrical power sources that operate in parallel to utility power sources, or operate alone, provide the same voltage thresholds that were previously determined to be within a cautious working environment. It follows that training and qualifications should be required before work is allowed on such systems. To prevent the unsafe conditions that have been exposed in the Photovoltaics industry and to be consistent within the area of parallel energy sources, the above proposed added text does provide a method to ensure increased adherence to the National Electrical Code. The Code Making Panel has the opportunity to help prevent unsafe conditions by being proactive within this emerging industry.

Additionally, The inclusion of the wording "qualified persons" does have precedence in the NEC.

See: 685.1 Scope.

This article covers integrated electrical systems, other than unit equipment, in which orderly shutdown is necessary to ensure safe operation. An integrated electrical system as used in this article is a unitized segment of an industrial wiring system where all of the following conditions are met:

1. An orderly shutdown is required to minimize personnel hazard and electrical damage.
2. The conditions of maintenance and supervision ensure that qualified persons service the system. The name(s) of the qualified person(s) shall be kept in a permanent record at the office of the establishment in charge of the completed installation.

A person designated as a qualified person shall possess the skills and knowledge related to the construction and operation of the electrical equipment and installation and shall have received documented safety training on the hazards involved. Documentation of their qualifications shall be on file with the office of the establishment in charge of the completed installation.

3. Effective safeguards acceptable to the authority having jurisdiction are established and maintained.

Also:

215.2(B)(3) Supervised Installations. For supervised installations, feeder conductor sizing shall be permitted to be determined by qualified persons under engineering supervision. Supervised installations are defined as those portions of a facility where all of the following conditions are met:

1. Conditions of design and installation are provided under engineering supervision.
2. Qualified persons with documented training and experience in over 600-volt systems provide maintenance, monitoring, and servicing of the system. 215.2

Panel Meeting Action: Reject

Panel Statement: The panel supports installation of these systems by qualified persons. However, the NEC cannot contain requirements relative to the qualifications of installers for any electrical system, these requirements need to be handled by local or state qualification committees or licensing boards. See Annex H of the NEC for recommendations on establishing such bodies.
Submitter: Keith W. Brand, Baton Rouge Area Electrical JATC

Recommendation: Add the following new text:

69X.4(C) Equipment Installation. Equipment shall be installed by qualified persons with documented training and experience in the installation of and NEC requirements applicable to such equipment. The name(s) of the qualified person(s) shall be kept in a permanent record at the office of the establishment in charge of the completed installation. Records of qualified persons must be furnished upon request to the local authority having jurisdiction.

Substantiation: Electrical power sources that operate in parallel to utility power sources, or operate alone, provide the same voltage thresholds that were previously determined to be within a cautious working environment. It follows that training and qualifications should be required before work is allowed on such systems. To prevent the unsafe conditions that have been exposed in the Photovoltaics industry and to be consistent within the area of parallel energy sources, the above proposed added text does provide a method to ensure increased adherence to the National Electrical Code. The Code Making Panel has the opportunity to help prevent unsafe conditions by being proactive within this emerging industry.

Additionally, The inclusion of the wording “qualified persons” does have precedence in the NEC. See: 685.1 Scope.

This article covers integrated electrical systems, other than unit equipment, in which orderly shutdown is necessary to ensure safe operation. An integrated electrical system as used in this article is a unitized segment of an industrial wiring system where all of the following conditions are met:

1. An orderly shutdown is required to minimize personnel hazard and equipment damage.
2. The conditions of maintenance and supervision ensure that qualified persons service the system. The name(s) of the qualified person(s) shall be kept in a permanent record at the office of the establishment in charge of the completed installation.

A person designated as a qualified person shall possess the skills and knowledge related to the construction and operation of the electrical equipment and installation and shall have received documented safety training on the hazards involved. Documentation of their qualifications shall be on file with the office of the establishment in charge of the completed installation.

3. Effective safeguards acceptable to the authority having jurisdiction are established and maintained.

Also:

215.2(B)(3) Supervised Installations. For supervised installations, feeder conductor sizing shall be permitted to be determined by qualified persons under engineering supervision. Supervised installations are defined as those portions of a facility where all of the following conditions are met:

1. Conditions of design and installation are provided under engineering supervision.
2. Qualified persons with documented training and experience in over 600-volt systems provide maintenance, monitoring, and servicing of the system. 215.2

Panel Meeting Action: Reject

Panel Statement: The panel supports installation of these systems by qualified persons. However, the NEC cannot contain requirements relative to the qualifications of installers for any electrical system. These requirements need to be handled by local or state qualification committees or licensing boards. See Annex H of the NEC for recommendations on establishing such bodies.
Frederic P. Hartwell, Hartwell Electrical Services, Inc.

Delete this section.

This is a very strange requirement because none of these rules have anything to do with fuel cells in particular. If a fuel cell system is in a building fed with a feeder, it will be an additional power source at that location, the rules in Chap. 2 will apply to it because nothing in Art. 692 amends those rules. After reviewing the substantiation when this article went into the NEC, it appears that the panel was trying to make sure not that the remote building was protected from the fuel cell source, but rather that the fuel cell source could be disconnected from the building. However, the present wording in 692.13 does the whole job, and much more simply.

Panel Meeting Action: Accept

Rewrite the final sentence to read as follows: “Transfer switches with one side connected to a service conductors shall be listed as being suitable for use as service equipment.”

Transfer switches with one side connected to a service conductors shall be listed as being suitable for use as service equipment.

If the fuel cell is used in a noninteractive system that also has a service connection as a backup supply, the fuel cell system is to be connected to the premises system through one side of a transfer switch that keeps the two supply sources separated. This simply requires what 702.6 already requires anyway. However, the last sentence is apparently incorrect because it requires that “when” (condition of time) the transfer switch is connected on the utility side, the switch must comply with a part of Art. 230 that is about the manufactured characteristics of service equipment, specifically, its energized parts must be enclosed or guarded, and the equipment is to have been marked by the manufacturer to identify it as suitable for use as service equipment. These are not conditions of time. The only practical way to address this for now is to make certain that the transfer switch has been listed as “suitable for use as service equipment.”

Panel Meeting Action: Reject

Panel Statement: The requirements are covered in Article 230 and 702.

Change “listed and identified” to “listed and marked.”

The definition of “identified” in Article 100 does not mean marked, and this section pretty clearly expects this equipment to be marked so interested parties know what they are dealing with. Identified means recognizable as suitable, and since the requirement is for a listing, that will necessitate the use of equipment that meets the lesser standard of being identified.

Panel Meeting Action: Accept
692.61 Output Characteristics. The output of a fuel cell system operating in a parallel with an electric supply system shall be compatible with the voltage, wave shape, and frequency of the system to which it is connected.

See 705.14 Output Characteristics.

This proposal was generated by the Task Group for CMP4. This Task group was asked to develop appropriate proposals to address the redundant point of interconnection requirements for PV in 690, Fuel Cells in 692 and Electric Power Sources in 705.

Task Group members are:
Todd W. Stafford, Chair
Ward I. Bower
Kenneth Krastins
Vincent C. Zinnante
Timothy P. Zgonena

Panel Meeting Action: Accept

(A) Single Phase. Single phase interactive fuel cell systems shall not be connected to a 3-phase power system unless the interactive system is so designed that significant unbalanced voltages cannot result.

(B) Three Phase. Three phase interactive fuel cell systems shall have all phases automatically de-energized upon loss of voltage, or upon unbalance of voltage in one or more phases, unless the interactive system is designed so that significant unbalanced voltages will not result.

See 705.100 Unbalanced Connections.

This proposal was generated by the Task Group for CMP4. This Task group was asked to develop appropriate proposals to address the redundant point of interconnection requirements for PV in 690, Fuel Cells in 692 and Electric Power Sources in 705.

Task Group members are:
Todd W. Stafford, Chair
Ward I. Bower
Kenneth Krastins
Vincent C. Zinnante
Timothy P. Zgonena

Panel Meeting Action: Accept

Recommendation: Revise text to read as follows:

692.65 Utility-Interactive Point of Connection. The output of a utility-interactive inverter shall be connected as specified in 692.65 (A) or (B) 705.12 (A) or (D).

(A) Supply Side. The output of a utility-interactive inverter shall be permitted to be connected to the supply side of the service disconnecting means as permitted in 239.82 (6):

(B) Load Side. The output of a utility-interactive inverter shall be permitted to be connected to the load side of the service disconnecting means of the other source(s) at any distribution equipment on the premises. Where distribution equipment, including switchboards and panelboards, is fed simultaneously by a primary source(s) of electricity and one or more utility interactive inverters, and where this distribution equipment is capable of supplying multiple branch circuits or feeders, or both, the interconnecting provisions for the utility-interactive inverter(s) shall comply with (B)(1) through (B)(7).

(1) Dedicated Overcurrent and Disconnect. Each source interconnection shall be made at a dedicated circuit breaker or fusible disconnecting means.

(2) Bus or Conductor Rating. The sum of the ampere ratings of overcurrent devices in circuits supplying power to a bus or conductor shall not exceed 120 percent of the rating of the bus or conductor. In systems with panelboards connected in series, the rating of the first overcurrent device directly connected to the output of a utility-interactive inverter(s) shall be used in the calculations for all busbars and conductors.

(3) Ground-Fault Protection. The interconnection point shall be on the line side of all ground-fault protection equipment.

Exception: Connection shall be permitted to be made to the load side of ground-fault protection, provided that there is ground-fault protection for equipment from all ground fault current sources. Ground fault protection devices used with supplies connected to the load side terminals shall be identified and listed as suitable for backfeeding.

(4) Marking. Equipment containing overcurrent devices in circuits supplying power to a busbar or conductor supplied from multiple sources shall be marked to indicate the presence of all sources.

(5) Suitable for Backfeed. Circuit breakers, if backfed, shall be suitable for such operation.

FPN: Circuit breakers that are marked “Line” and “Load” have been evaluated only in the direction marked. Circuit breakers without “Line” and “Load” have been evaluated in both directions.

(6) Fastening. Listed plug-in-type circuit breakers backfed from utility-interactive inverters complying with 696.60 shall be permitted to omit the additional fastener normally required by 408.36 (D) for such applications.

(7) Inverter Output Connection. Unless the panelboard is rated not less than the sum of the ampere ratings of all overcurrent devices supplying it, a connection in a panelboard shall be positioned at the opposite (load) end from the input feeder location or main circuit location. The bus or conductor rating shall be sized for the loads connected in accordance with Article 220. A permanent warning label shall be applied to the distribution equipment with the following or equivalent marking:

WARNING
INVERTER OUTPUT CONNECTION
DO NOT RELOCATE THIS OVERCURRENT DEVICE

Substantiation: Fuel Cell systems operating in parallel with another electric supply to a premise electrical system are considered Interconnected Electric Power Production Systems and fall within the scope of Article 705. The point of connection requirements in 692.65 duplicate the text Section 705.12. Repeating the requirements, to interconnect a fuel cell utility-interactive inverter in Article 692 is redundant. The requirements in Section 692.65 are not specific to fuel cell installations. Many types of interconnected electric production systems use utility-interactive inverters, such as wind, solar, fuel cells, and micro-turbines, to mention a few. Section 705.12(A) and (D) provides uniform interconnection requirements for this inverter technology, regardless of the primary energy source. The requirements in Section 692.65 duplicate the text in 705.12 as listed below:

- 692.65 (A) is duplicated text from 705.12(A)
- 692.65(B), B(1) through B(7) is duplicated by 705.12(D), (D)(1) through (D)(7)

This proposal removes the duplicated text in Article 692 and references Article 705 sections that state the
utility-interactive inverter point of connection requirements.

Panel Meeting Action: Accept in Principle
Panel Statement: See panel action on Proposal 4-260.
4-260 Log #4735 NEC-P04
(692.65)

Final Action: Accept

Submitter: Todd W. Stafford, National Joint Apprentice & Training Committee

Recommendation: Revise text to read as follows:

692.65 Utility-Interactive Point of Connection. The output of a utility interactive inverter shall be connected as specified in 692.65(A) or (B):

(A) Supply Side. The output of a utility interactive inverter shall be permitted to be connected to the supply side of the service disconnecting means as permitted in 230.82(6):

(B) Load Side. The output of a utility interactive inverter shall be permitted to be connected to the load side of the service disconnecting means of the other source(s) at any distribution equipment on the premises. Where distribution equipment, including switchboards and panelboards, is fed simultaneously by a primary source(s) of electricity and one or more utility interactive inverters, and where this distribution equipment is capable of supplying multiple branch circuits or feeders, or both, the interconnecting provisions for the utility interactive inverter(s) shall comply with (B)(1) through (B)(7):

(1) Dedicated Overcurrent and Disconnect. Each source interconnection shall be made at a dedicated circuit breaker or fusible disconnecting means:

(2) Bus or Conductor Rating. The sum of the ampere rating of overcurrent devices in circuits supplying power to a busbar or conductor shall not exceed 120 percent of the rating of the busbar or conductor:

(3) Ground Fault Protection. The interconnection point shall be on the line side of all ground fault protection equipment:

Exception: Connection shall be permitted to be made to the load side of ground fault protection, provided that there is ground fault protection for equipment from all ground fault current sources. Ground fault protection devices used with supplies connected to the load side terminals shall be identified and listed as suitable for backfeeding:

(4) Marking. Equipment containing overcurrent devices in circuits supplying power to a busbar or conductor supplied from multiple sources shall be marked to indicate the presence of all sources:

(5) Suitable for Backfeed. Circuit breakers, if backfed, shall be suitable for such operation:

FPN: Circuit breakers that are marked “Line” and “Load” have been evaluated only in the direction marked. Circuit breakers without “Line” and “Load” have been evaluated in both directions:

(6) Fastening. Listed plug in type circuit breakers backfed from utility interactive inverters complying with 692.60 shall be permitted to omit the additional fastener normally required by 408.36(D) for such application:

(7) Inverter Output Connection. Unless the panelboard is rated not less than the sum of the ampere ratings of all overcurrent devices supplying it, a connection in a panelboard shall be positioned at the opposite (load) end from the input feeder location or main circuit location. The bus or conductor rating shall be sized for the loads connected in accordance with Article 220. A permanent warning label shall be applied to the distribution equipment with the following or equivalent marking:

Warning
Inverter Output Connection
Do Not Relocate
The Overcurrent Device
See 705.12 Point of Connection

Substantiation: This proposal was generated by the Task Group for CMP4. This Task group was asked to develop appropriate proposals to address the redundant point of interconnection requirements for PV in 690, Fuel Cells in 692 and Electric Power Sources in 705.

Task Group members are:
Todd W. Stafford, Chair
Ward I. Bower
Kenneth Krastins
Vincent C. Zinnante
Timothy P. Zgonena

Panel Meeting Action: Accept
Report on Proposals – June 2010

4-261  Log #1412  NEC-P04 (692.65(B)(5) and Exception) Final Action: Reject

Submitter: Dan Leaf, Seneca, SC

Recommendation: Revise text as follows:

Circuit breakers, if backfed, shall be suitable identified for such operation.
FPN: Circuit breakers that are marked "Line" and "Load" have been evaluated only for such connections and shall only be so connected. Circuit breakers without such markings have been evaluated for backfeed connections in both directions and shall be permitted to be so connected.

Substantiation: Edit. "Suitable" is a term to be avoided per the Style Manual. Proposal is more specific than "in both directions".

Panel Meeting Action: Reject

Panel Statement: The circuit breakers are not "identified". The FPN is written in the form of a requirement. An FPN is not a requirement. The submitter has not presented sufficient technical data to support the change stated in the proposal. The proposal attempts to place mandatory requirements into a fine print note. The proposal does not meet the requirements of 4.3.3(b) of the Regulations Governing Committee Projects.
Create new article 694 WIND TURBINES

Wind driven generator equipment. This equipment includes alternators or generators that produce electrical current through the conversion of wind energy into electrical energy. Wind driven generation equipment must demonstrate conformance to applicable safety standards.

Installation

(1) A wind driven generator system design review must be submitted at the time of the inspection request. Permit holders must submit a copy of the wind driven generator equipment manufacturer’s installation information and a legible one-line diagram of the wind driven generator design and calculations used to determine voltage and current within the generation system to the electrical inspector. This diagram must show the wind driven generator equipment, devices, overcurrent protection, conductor sizing, grounding, ground fault protection if required, and any system interconnection points.

(2) For utility interactive systems, any person making interconnections between the generator system and the utility distribution network must consult the serving utility and is required to meet all additional utility standards.

(3) All wind driven generator equipment and disconnecting means must be permanently identified as to their purpose, maximum voltages and type of current within the system with an identification plate.

Substantiation: There are no rules in the NEC for Wind turbines. This proposal would create a new article to address scope, circuit requirements, disconnecting means, wiring methods, grounding, marking and other requirements for users to safely install this equipment.

The proposed rules are taken from the Washington State Electrical Rules that are to be adopted late in 2008.

While most wind turbines are installed by electric utilities and are not under the scope of the NEC, there are some installations done under the scope of the NEC. In Washington State, there have been several of the small wind turbines installed, creating difficulties for electrical approval, as there are no product standards or NEC rules.

Several companies market wind turbines that are targeted toward the residential market. The American Wind Turbine Association (AWEA) designation is small wind, defined as 100 Kw and below.

The payback for a small wind turbine can be better than a photovoltaic system, as it can operate more hours per day. According to the AWEA, a 3 kW, 15 ft rotor, on a 23 ft tower can produce about 5,000 kWh/yr, if wind conditions allow.

There is a significant market for wind turbines. The Mayor of San Francisco announced in July 2008 that the city would "expedite permitting and minimize costs for the installation of residential, commercial and municipal wind generation in the city”.

The U.S. Department of Energy, in its 2007 edition of the annual report on U.S. wind power installation, noted that wind power capacity increased 46%.

It is expected that the new article would be created with input from stakeholders, manufacturers and trade associations.

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


Panel Meeting Action: Accept in Principle

See Panel Action on Proposal 4-263.
Section (3) of the proposal has been addressed by the panel action on Proposal 4-263 in Article 694, Part VI, Marking.
Robert H. Wills, Intergrid, LLC

Add new text as follows:

Note: this is a proposed new article. All text is new. For clarity, the text is not underscored.

Notes in square brackets [...] are informational and not intended to be part of the final article.

ARTICLE 69x Small Wind Electric Systems

I. General

69X.1 Scope

The provisions of this article apply to small wind electric systems (also known as small wind turbine systems), including generators, alternators, inverter(s), and controller(s) for such systems. [See Figures 69X.1(A) and 69X.1(B).]

This article applies to small wind electric systems consisting of one or more wind electric generators with individual systems up to and including 100KW rated power output.

Systems covered by this article may be interactive with other electrical power production sources or stand-alone, with or without electrical energy storage such as batteries. These systems may have ac or dc output for utilization.

Figure 69x.1(A) Identification of Small Wind Electric System Components – Interactive System.

Figure 69x.1(B) Identification of Small Wind Electric System Components – Stand-Alone System.

69x.2 Definitions

Wind Turbine. A mechanical device that converts wind energy to electrical energy.

Wind Turbine System. A small wind electric generating system.

Tower. A pole or other structure that supports a wind turbine.

Guy. A cable that mechanically supports a wind turbine tower.

Nacelle. An enclosure housing the alternator and other parts of a wind turbine.

Rated Power. The wind turbine’s power output at 11.0 m/s (24.6 mph) when measured in accordance with IEC 61400-12-1, Power Performance Measurements of Electricity Producing Wind Turbines.

Maximum Output Power. The maximum one-minute average power output a wind turbine will produce in normal steady-state operation (peak instantaneous power output can be higher).

Maximum Voltage. The maximum voltage the wind turbine will produce in operation including open circuit conditions.

Wind Turbine Output Circuit. Circuit conductors between the internal components of a small wind turbine (which may include an alternator, integrated rectifier, controller and/or inverter), and other equipment.

Inverter Output Circuit. Conductors between the inverter and an ac panelboard for stand-alone systems or the conductors between the and inverter and service equipment or another electric power production source, such as a utility, for an electrical production and distribution network.

Charge Controller. Equipment that controls dc voltage or dc current, or both, used to charge a battery.

Diversion Charge Controller. Equipment that regulates the charging process of a battery by diverting power from energy storage to direct-current or alternating-current loads or to an interconnected utility service.

Diversion Load Controller. Equipment that regulates the output of a wind generator by diverting power from the generator to direct-current or alternating-current loads or to an interconnected utility service.

Diversion Load. A load connected to a diversion charge controller or diversion load controller. Also known as a Dump Load.

FPN: See also definitions for Interconnected Systems in Article 705 [or Article 100 if they are moved there].
[Note: Other definitions from Article 69x may need to be included, but hopefully common language will be moved to Article 705 or Article 100].

69x.3 Other Articles
Wherever the requirements of other articles of this Code and Article 69x differ, the requirements of Article 69x shall apply and, if the system is operated in parallel with a primary source(s) of electricity, the requirements in 705 shall apply.

**Exception: Small wind electric systems, equipment, or wiring installed in a hazardous (classified) location shall also comply with the applicable portions of Articles 500 through 516.**

69x.4 Installation

(A) Small Wind Electric System. A small wind electric system shall be permitted to supply a building or other structure in addition to any service(s) of another electricity supply system(s).

(B) Equipment. Inverters or motor generators intended for use in small wind electric systems shall be identified and either listed or recognized for the application.

[Note: Justification for other than the PV listing requirements – the industry group developing this article plans to include requirements that all electrical components in small wind electric systems be listed or recognized in a future edition of the NEC, but currently there are no UL standards for listing wind turbines, although a standard is planned. This language ensures safety for parallel operation with the grid, while giving the industry time to develop standards and to test equipment to these standards].

(C) Diversion Load Controllers. A small wind electric system employing a diversion load controller as the sole means of regulating the speed of a wind turbine rotor shall be equipped with two reliable independent means to prevent over-speed operation. An interconnected utility service shall not be considered to be a reliable diversion load.

(D) Surge Protective Devices. A surge protective device shall be installed between a small wind electric system and any loads served by the premises electrical system. The surge protective device is permitted to be a Type 3 device located on a dedicated branch circuit serving a small wind electric system, or a Type 2 device anywhere on the load side of the service disconnect. Surge protective devices shall be installed in accordance with Article 285.

(E) Receptacles. A receptacle is permitted to be attached to a small wind electric system branch or feeder circuit for maintenance or data acquisition use. Receptacles shall be protected with an overcurrent device that is rated at no greater than the current rating of the receptacle.

II. Circuit Requirements

69x.7 Maximum Voltage.

(A) Turbine Output Circuits. For wind turbines connected to one- and two-family dwellings, turbine output circuits shall be permitted to have a maximum voltage up to 600 volts. Other installations with a maximum voltage over 600 volts shall comply with Article 69x, Part IX.

(B) Direct-Current Utilization Circuits. The voltage of dc utilization circuits shall conform to 210.6.

(C) Circuits over 150 Volts to Ground. In one- and two-family dwellings, live parts in circuits over 150 volts to ground shall not be accessible to other than qualified persons while energized.

FPN: See 110.27 for guarding of live parts, and 210.6 for voltage to ground and between conductors.

69x.8 Circuit Sizing and Current.

(A) Calculation of Maximum Circuit Current. The maximum current for the specific circuit shall be calculated in accordance with 69x.8(A)(1) through (A)(3).

(1) Turbine Output Circuit Currents. The maximum current shall be the circuit current when the wind turbine is operating at Maximum Output Power.

(2) Inverter Output Circuit Current. The maximum current shall be the inverter continuous output current rating.

(3) Stand-Alone Inverter Input Circuit Current. The maximum current shall be the stand-alone continuous inverter input current rating when the inverter is producing rated power at the lowest input voltage.

(B) Ampacity and Overcurrent Device Ratings. Small wind electric system currents shall be considered to be continuous.

(1) Sizing of Conductors and Overcurrent Devices. The circuit conductors and overcurrent devices shall be sized to carry not less than 125 percent of the maximum currents as calculated in 69x.8(A). The rating or setting of overcurrent devices shall be permitted in accordance with 240.4(B) and (C).

Exception: Circuits containing an assembly, together with its overcurrent device(s), that is listed for continuous operation at 100 percent of its rating shall be permitted to be utilized at 100 percent of its rating.

69x.9 Overcurrent Protection.

(A) Circuits and Equipment. Turbine output circuits, inverter output circuits, and storage battery circuit conductors and equipment shall be protected in accordance with the requirements of Article 240. Circuits connected to more than one electrical source shall have overcurrent devices located so as to provide overcurrent protection from all sources.

Exception: An overcurrent device shall not be required for circuit conductors sized in accordance with 69x.8(B) and located where one of the following apply:

(a) There are no external sources such as batteries or backfeed from inverters.

(b) The maximum currents from all sources do not exceed the ampacity of the conductors.

FPN: Possible backfeed of current from any source of supply, including a supply through an inverter into the alternator
output circuit, is a consideration in determining whether adequate overcurrent protection from all sources is provided for conductors and modules. Some small wind electric systems rely on the turbine output circuit to regulate turbine speed. In systems of this type, manufacturers instructions should be followed.

(B) Power Transformers. Overcurrent protection for a transformer with a source(s) on each side shall be provided in accordance with 450.3 by considering first one side of the transformer, then the other side of the transformer, as the primary.

Exception: A power transformer with a current rating on one side connected toward the small wind electric power source, not less than the short-circuit output current rating of the inverter, shall be permitted without overcurrent protection from that source.

(C) Direct-Current Rating. Overcurrent devices, either fuses or circuit breakers, used in any dc portion of a small wind electric system shall be listed for use in dc circuits and shall have the appropriate voltage, current, and interrupting ratings.

[Note: The following common language to 69x, 692 and 69x should move to a common Article – perhaps a new one near 705, but focused on stand-alone rather than interconnected systems.

A separate proposal has been submitted to this effect. If this proposal is accepted, 69x.10 could be deleted]

69x.10 Stand-Alone Systems.

The premises wiring system shall be adequate to meet the requirements of this Code for a similar installation connected to a service. The wiring on the supply side of the building or structure disconnecting means shall comply with this Code except as modified by 69x.10(A) through (D).

(A) Inverter Output. The ac output from a stand-alone inverter(s) shall be permitted to supply ac power to the building or structure disconnecting means at current levels less than the calculated load connected to that disconnect. The inverter output rating or the rating of an alternate energy source shall be equal to or greater than the load posed by the largest single utilization equipment connected to the system. Calculated general lighting loads shall not be considered as a single load.

(B) Sizing and Protection. The circuit conductors between the inverter output and the building or structure disconnecting means shall be sized based on the output rating of the inverter. These conductors shall be protected from overcurrents in accordance with Article 240. The overcurrent protection shall be located at the output of the inverter.

(C) Single 120-Volt Supply. The inverter output of a stand-alone small wind electric system shall be permitted to supply 120 volts to single-phase, 3-wire, 120/240-volt service equipment or distribution panels where there are no 240-volt outlets and where there are no multiwire branch circuits. In all installations, the rating of the overcurrent device connected to the output of the inverter shall be less than the rating of the neutral bus in the service equipment. This equipment shall be marked with the following words or equivalent:

WARNING
SINGLE 120-VOLT SUPPLY. DO NOT CONNECT MULTIWIRE BRANCH CIRCUITS!

(D) Energy Storage or Backup Power System Requirements. Energy storage or backup power supplies are not required.

III. Disconnecting Means
69X.13 All Conductors.

Means shall be provided to disconnect all current-carrying conductors of a small wind electric power source from all other conductors in a building or other structure. A switch, circuit breaker, or other device, either ac or dc, shall not be installed in a grounded conductor if operation of that switch, circuit breaker, or other device leaves the marked, grounded conductor in an ungrounded and energized state.

Exception: A wind turbine that uses the turbine output circuit for regulating turbine speed does not require a turbine output circuit disconnecting means.

69X.14 Additional Provisions.

Disconnecting means shall comply with 69X.14(A) through (D).

(A) Disconnecting Means. The disconnecting means shall not be required to be suitable as service equipment and shall comply with the following:

The disconnecting means for ungrounded conductors shall consist of a manually operable switch(es) or circuit breaker(s) complying with all of the following requirements:

1. Located where readily accessible
2. Externally operable without exposing the operator to contact with live parts
3. Plainly indicating whether in the open or closed position
4. Having an interrupting rating sufficient for the nominal circuit voltage and the current that is available at the line terminals of the equipment
Where all terminals of the disconnecting means may be energized in the open position, a warning sign shall be mounted on or adjacent to the disconnecting means. The sign shall be clearly legible and have the following words or equivalent:

**WARNING**
ELECTRIC SHOCK HAZARD. DO NOT TOUCH TERMINALS.
TERMINALS ON BOTH THE LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION.

(B) **Equipment.** Equipment such as rectifiers, controllers, output circuit isolating and shorting switches and overcurrent devices shall be permitted on the wind turbine side of the disconnecting means.

(C) **Requirements for Disconnecting Means**

(1) **Location.** The small wind electric system disconnecting means shall be installed at a readily accessible location either on or adjacent to the turbine tower, on the outside of a building or structure or inside nearest the point of entrance of the system conductors.

*Exception: Installations that comply with 69X.31(E) shall be permitted to have the disconnecting means located remotely from the point of entry of the system conductors.*

The disconnecting means shall not be installed in bathrooms.

(2) **Marking.** Each turbine disconnecting means shall be permanently marked to identify it as a small wind electric system disconnect. A plaque shall be installed in accordance with 705.10.

(3) **Suitable for Use.** Each turbine system disconnecting means shall be suitable for the prevailing conditions. Equipment installed in hazardous (classified) locations shall comply with the requirements of Articles 500 through 517.

(4) **Maximum Number of Disconnects.** The turbine disconnecting means shall consist of not more than six switches or six circuit breakers mounted in a single enclosure, in a group of separate enclosures, or in or on a switchboard.

(5) **Grouping.** The turbine disconnecting means shall be grouped with other disconnecting means for the system to comply with 69X.14(C)(4). A turbine disconnecting means shall not be required at the nacelle or tower location.

(D) **Equipment Mounted in Not-Readily-Accessible Locations.** Rectifiers, controllers, and inverters shall be permitted to be mounted in nacelles or other exterior areas that are not readily accessible.

**69X.15 Disconnection of Small Wind Electric System Equipment.**

Means shall be provided to disconnect equipment, such as inverters, batteries, charge controllers, and the like, from all ungrounded conductors of all sources. If the equipment is energized from more than one source, the disconnecting means shall be grouped and identified. A single disconnecting means in accordance with 69X.17 shall be permitted for the combined ac output of one or more inverters in an interactive system.

*Exception: Equipment housed in a turbine nacelle is not required to have a disconnecting means.*

**69X.16 Fuses.**

Means shall be provided to disconnect a fuse from all sources of supply if the fuse is energized from both directions and is accessible to other than qualified persons. Switches, pullouts, or similar devices that have suitable ratings may serve as means to disconnect fuses from all sources of supply. A shorting plug shall be permitted to be used as an alternative to a disconnect in systems that regulate turbine speed using the turbine output circuit.

**69X.18 Installation and Service of a Wind Turbine.**

Open circuiting, short circuiting, or mechanical brakes shall be used to disable a turbine for installation and service.

*FPN: Some wind turbines rely on the connection from the alternator to a remote controller for speed regulation.*

Opening turbine output circuit conductors may cause mechanical damage to a turbine and create excessive voltages that could damage equipment or expose persons to electric shock.

**69X.20 Disconnection of Wind Turbine Alternators.**

**IV. Wiring Methods**

**69X.31 Methods Permitted**

(A) **Wiring Systems.** All raceway and cable wiring methods included in this Code and other wiring systems and fittings specifically intended for use on wind turbines shall be permitted. Where turbine output circuits operating at maximum voltages greater than 30 volts are installed in readily accessible locations, circuit conductors shall be installed in raceway.

(B) **Flexible Cords and Cables.** Flexible cords and cables, where used to connect the moving parts of turbines, shall comply with Article 400 and shall be of a type identified as a hard service cord or portable power cable; they shall be suitable for extra-hard usage, listed for outdoor use, and water resistant. Cables exposed to sunlight shall be sunlight resistant.

**V. Grounding**

**69X.43 Equipment Grounding.**

(A) **General.** Exposed non–current-carrying metal parts of towers, turbine nacelles, other equipment, and conductor enclosures shall be grounded in accordance with 250.134 or 250.136(A) regardless of voltage. Attached metal parts
such as turbine blades and tails that have no source of electrical energization are not required to be grounded.

(B) Guy Wires. Guy wires used to support turbine towers shall not be required to be grounded.

[FPN] Guy wires supporting towers that are adequately grounded are not likely to become energized and so are not subject to the requirements of 250.110. Grounding of metallic guy wires may be required by lighting codes.

(C) Tower Grounding.

(1) Auxiliary Electrode(s). A wind turbine tower shall be grounded with auxiliary electrode(s) to limit voltages imposed by lightning. Auxiliary electrodes are permitted to be installed in accordance with 250.54. Electrodes that are part of the tower foundation and that meet the requirements for concrete encased electrodes (250.52(A)(3)) are acceptable. A grounded metal tower support is acceptable if it meets the requirements of 250.136(A).

(2) Equipment Grounding Conductor. An equipment grounding conductor shall be required between a turbine and the system grounded conductor in accordance with 250.110.

(3) Tower Grounding Connections. The equipment grounding conductor, and grounding electrode conductors (if used), shall be shall be connected to a metallic tower by exothermic welding, listed lugs, listed pressure connectors, listed clamps, or other listed means. Devices such as connectors and lugs shall be suitable for the material of the conductor and the structure to which they connect. Where practicable, dissimilar metals in contact anywhere in the system shall be avoided to eliminate the possibility of galvanic action and corrosion. All mechanical elements used to terminate these conductors shall be accessible.

(4) Lightning Protection Systems. Auxiliary electrodes and grounding electrode conductors shall be permitted to act as lightning protection system components if they meet the requirements of NFPA 780. If separate, the tower lightning protection system grounding electrodes shall be bonded to the tower auxiliary grounding electrode system. Guy lightning protection system ground electrodes shall not be required to be bonded to the tower auxiliary grounding electrode system.


VI. Marking

69x.54 Interactive System Point of Interconnection.

All interactive system(s) points of interconnection with other sources shall be marked at an accessible location at the disconnecting means as a power source and with the rated ac output current and the nominal operating ac voltage.

69x.55 Power Systems Employing Energy Storage.

Small wind electric systems employing energy storage shall be marked with the maximum operating voltage, including any equalization voltage and the polarity of the grounded circuit conductor.

69x.56 Identification of Power Sources.

(A) Facilities with Stand-Alone Systems. Any structure or building with a power system that is not connected to a utility service source and is a stand-alone system shall have a permanent plaque or directory installed on the exterior of the building or structure at a readily visible location. The plaque or directory shall indicate the location of system disconnecting means and that the structure contains a stand-alone electrical power system.

(B) Facilities with Utility Services and Small Wind Electric Systems. Buildings or structures with both utility service and a small wind electric system shall have a permanent plaque or directory providing the location of the service disconnecting means and the small wind electric system disconnecting means if not located at the same location.

VII. Connection to Other Sources

[This section should be coordinated with similar language in 69x and 692 that indicates that the requirements of Article 705 apply.]

69x.60 Identified Interactive Equipment. Only inverters listed or recognized, and identified as interactive shall be permitted in interactive systems.

69x.62 Installation. Small wind electric systems, when connected to other electric sources, shall comply with the requirements of article 705.

69x.62 Ampacity of Neutral Conductor.

If a single-phase, 2-wire inverter output is connected to the neutral conductor and one ungrounded conductor (only) of a 3-wire system or of a 3-phase, 4-wire, wye-connected system, the maximum load connected between the neutral conductor and any one ungrounded conductor plus the inverter output rating shall not exceed the ampacity of the neutral conductor.

A conductor used solely for instrumentation, voltage detection, or phase detection, and connected to a single-phase or 3-phase utility-interactive inverter, shall be permitted to be sized at less than the ampacity of the other current-carrying conductors and shall be sized equal to or larger than the equipment grounding conductor.

69x.63 Operating Voltage Range. Systems operating on dedicated branch or feeder circuits may exceed normal voltage operating ranges provided that the voltage at any general distribution equipment remains within these ranges.

[Justification - This provision is added in recognition that wind turbines may use the electric grid to dump energy from...]

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short-term wind gusts. This may result in the voltage at the turbine exceeding the limits set out in ANSI C84.1-2006, Voltage Ratings for Electric Power Systems and Equipment (60 Hz), however the voltage at the distribution equipment must stay within the C84.1 range.

69x.64 Point of Connection.

[Note – this section may be deleted if Article 705 has equivalent language]

The output of a utility-interactive inverter shall be connected as specified in 69x.64(A) or (B).

(A) Supply Side. The output of a utility-interactive inverter shall be permitted to be connected to the supply side of the service disconnecting means as permitted in 230.82(6).

(B) Load Side. The output of a utility-interactive inverter shall be permitted to be connected to the load side of the service disconnecting means of the other source(s) at any distribution equipment on the premises. Where distribution equipment, including switchboards and panelboards, is fed simultaneously by a primary source(s) of electricity and one or more utility-interactive inverters, and where this distribution equipment is capable of supplying multiple branch circuits or feeders, or both, the interconnecting provisions for the utility-interactive inverter(s) shall comply with (B)(1) through (B)(7).

(1) Dedicated Overcurrent and Disconnect. Each source interconnection shall be made at a dedicated circuit breaker or fusible disconnecting means.

(2) Bus or Conductor Rating. The sum of the ampere ratings of overcurrent devices in circuits supplying power to a busbar or conductor shall not exceed 120 percent of the rating of the busbar or conductor. In systems with panelboards connected in series, the rating of the first overcurrent device directly connected to the output of a utility-interactive inverter(s) shall be used in the calculations for all busbars and conductors.

(3) Ground-Fault Protection. The interconnection point shall be on the line side of all ground-fault protection equipment.

Exception: Connection shall be permitted to be made to the load side of ground-fault protection, provided that there is ground-fault protection for equipment from all ground-fault current sources. Ground-fault protection devices used with supplies connected to the load-side terminals shall be identified and listed as suitable for backfeeding.

(4) Marking. Equipment containing overcurrent devices in circuits supplying power to a busbar or conductor supplied from multiple sources shall be marked to indicate the presence of all sources.

(5) Suitable for Backfeed. Circuit breakers, if backfed, shall be suitable for such operation.

FPN: Circuit breakers that are marked “Line” and “Load” have been evaluated only in the direction marked. Circuit breakers without “Line” and “Load” have been evaluated in both directions.

(6) Fastening. Listed plug-in-type circuit breakers backfed from utility-interactive inverters complying with 69x.60 shall be permitted to omit the additional fastener normally required by 408.36(D) for such applications.

(7) Inverter Output Connection. Unless the panelboard is rated not less than the sum of the ampere ratings of all overcurrent devices supplying it, a connection in a panelboard shall be positioned at the opposite (load) end from the input feeder location or main circuit location. The bus or conductor rating shall be sized for the loads connected in accordance with Article 220. A permanent warning label shall be applied to the distribution equipment with the following or equivalent marking:

WARNING
INVERTER OUTPUT CONNECTION
DO NOT RELOCATE THIS OVERCURRENT DEVICE

VIII. Storage Batteries

[This common language should move to 480 or another common article]

69X.71 Installation.

(A) General. Storage batteries in small wind electric systems shall be installed in accordance with the provisions of Article 480.

(B) Dwellings.

(1) Operating Voltage. Storage batteries for dwellings shall have the cells connected so as to operate at less than 50 volts nominal. Lead-acid storage batteries for dwellings shall have no more than twenty-four 2-volt cells connected in series (48-volts nominal).

Exception: Where live parts are not accessible during routine battery maintenance, a battery system voltage in accordance with 69X.7 shall be permitted.

(2) Guarding of Live Parts. Live parts of battery systems for dwellings shall be guarded to prevent accidental contact by persons or objects, regardless of voltage or battery type.

FPN: Batteries in small wind electric systems are subject to extensive charge–discharge cycles and typically require frequent maintenance, such as checking electrolyte and cleaning connections.

(C) Current Limiting. A listed, current-limiting, overcurrent device shall be installed in each circuit adjacent to the batteries where the available short-circuit current from a battery or battery bank exceeds the interrupting or withstand
ratings of other equipment in that circuit. The installation of current-limiting fuses shall comply with 69X.16.

(D) Battery Nonconductive Cases and Conductive Racks. Flooded, vented, lead-acid batteries with more than twenty-four 2-volt cells connected in series (48 volts, nominal) shall not use conductive cases or shall not be installed in conductive cases. Conductive racks used to support the nonconductive cases shall be permitted where no rack material is located within 150 mm (6 in.) of the tops of the nonconductive cases.

This requirement shall not apply to any type of valve-regulated lead-acid (VRLA) battery or any other types of sealed batteries that may require steel cases for proper operation.

(E) Disconnection of Series Battery Circuits. Battery circuits subject to field servicing, where more than twenty-four 2-volt cells are connected in series (48 volts, nominal), shall have provisions to disconnect the series-connected strings into segments of 24 cells or less for maintenance by qualified persons. Non–load-break bolted or plug-in disconnects shall be permitted.

(F) Battery Maintenance Disconnecting Means. Battery installations, where there are more than twenty-four 2-volt cells connected in series (48 volts, nominal), shall have a disconnecting means, accessible only to qualified persons, that disconnects the grounded circuit conductor(s) in the battery electrical system for maintenance. This disconnecting means shall not disconnect the grounded circuit conductor(s) for the remainder of the small wind electric system. A non–load-break-rated switch shall be permitted to be used as the disconnecting means.

(G) Battery Systems of More Than 48 Volts. On small wind electric systems where the battery system consists of more than twenty-four 2-volt cells connected in series (more than 48 volts, nominal), the battery system shall be permitted to operate with ungrounded conductors, provided the following conditions are met:

1. The turbine output circuits shall comply with 69X.41.
2. The dc and ac load circuits shall be solidly grounded.
3. All main ungrounded battery input/output circuit conductors shall be provided with switched disconnects and overcurrent protection.
4. A ground-fault detector and indicator shall be installed to monitor for ground faults in the battery bank.

69X.72 Charge Control.

(A) General. Equipment shall be provided to control the charging process of the battery. Charge control shall not be required where the design of the small wind electric source is matched to the voltage rating and charge current requirements of the interconnected battery cells and the maximum charging current multiplied by 1 hour is less than 3 percent of the rated battery capacity expressed in ampere-hours or as recommended by the battery manufacturer. All adjusting means for control of the charging process shall be accessible only to qualified persons.

FPN: Certain battery types such as valve-regulated lead acid or nickel cadmium can experience thermal failure when overcharged.

(B) Diversion Charge Controller.

1. Sole Means of Regulating Charging. A small wind electric system employing a diversion charge controller as the sole means of regulating the charging of a battery shall be equipped with two reliable independent means to prevent overcharging of the battery. An interconnected utility service shall not be considered to be a reliable diversion load.

2. Circuits with Direct-Current Diversion Charge Controller and Diversion Load. Circuits containing a dc diversion charge controller and a dc diversion load shall comply with the following:

1. The current rating of the diversion load shall be less than or equal to the current rating of the diversion load charge controller. The voltage rating of the diversion load shall be greater than the maximum battery voltage. The power rating of the diversion load shall be at least 150 percent of the maximum power rating of the turbine.

2. The conductor ampacity and the rating of the overcurrent device for this circuit shall be at least 150 percent of the maximum current rating of the diversion charge controller.

IX. Systems over 600 Volts

69x.80 General

Small wind electric systems with a maximum system voltage over 600 volts dc shall comply with Article 490 and other requirements applicable to installations rated over 600 volts.

69x.85 Definitions

For the purposes of Part IX of this article, the voltages used to determine cable and equipment ratings are as follows.

Battery Circuits. In battery circuits, the highest voltage experienced under charging or equalizing conditions.

Other Circuits. In other circuits, the maximum voltage experienced in normal operation.

Substantiation: This proposal was generating by a working group from the small wind electric industry comprising over 50 members, and is supported by the American Wind Energy Association.

The problem: Hundreds of small wind turbines are being installed in the USA every month and there is no specific article to address the particular characteristics of their electrical systems. While many installations are stand-alone applications, most nowadays are utility interactive, and so requirements similar to Article 690, Photovoltaic Systems,
Small wind electric systems are being installed at rural, and now increasingly, in urban locations. The electrical safety of these installations can be improved by clear requirements for grounding and other aspects of the electrical installation. As wind turbine towers are typically tall structures, they are subject to lightning strikes and as such deserve special attention when connected to a premises electrical system.

The proposed text follows the structure, and in many cases the language of Articles 690 and 692. It will be a welcome addition to the 2011 NEC for all installers of small wind electric systems.

Panel Meeting Action: Accept in Principle

***Insert file 70-4499-Panel4_CA.doc here***

Panel Statement:

***Insert file 70-4499-Panel4_CS.doc here***

4-264 Log #4683 NEC-P04 (705.2) Final Action: Reject

Submitter: Frederic P. Hartwell, Hartwell Electrical Services, Inc.
Recommendation: Delete this definition.
Substantiation: This definition is not used in Article 705.

Panel Meeting Action: Reject
Panel Statement: The submitter did not specify which of the three definitions in 705.2 is to be deleted. The proposal does not meet the requirements of 4.3.3(b) of the Regulations Governing Committee Projects.

4-265 Log #2514 NEC-P04 (705.3) Final Action: Reject

Submitter: John Wiles, Southwest Technology Development Inst/New Mexico State Univ. / Rep. PV Industry Forum
Recommendation: Revise the section as follows

705.3 Other Articles. Interconnected electrical power production sources shall comply with this article and also with applicable requirements of the other articles in Table 705.3.

Where the requirements pertaining to listed utility-interactive inverters in Article 705 differ from requirements elsewhere in this Code, the requirements of Article 705 shall apply.

Substantiation: Listed utility-interactive inverters have unique characteristics associated with their limited current output and response to conditions on the output circuit and in the connected utility systems. These characteristics are addressed by the requirements established in Article 705. Applying contrary requirements from other articles in the Code may result in safety issues and hazardous conditions.

Panel Meeting Action: Reject
Panel Statement: The proposal does not meet the requirements of 4.3.3(b) of the Regulations Governing Committee Projects. The information is covered in the requirements of Section 90.3.
Add the following new text:

705.6 System Installation. Installation of one or more electrical power production sources operating in parallel with a primary source(s) of electricity shall be installed by qualified persons with documented training and experience in the installation of such equipment. The name(s) of the qualified person(s) shall be kept in a permanent record at the office of the establishment in charge of the completed installation.

Substantiation: Electrical power sources that operate in parallel to utility power sources, or operate alone, provide the same voltage thresholds that were previously determined to be within a cautious working environment. It follows that training and qualifications should be required before work is allowed on such systems. To prevent the unsafe conditions that have been exposed in the Photovoltaics industry and to be consistent within the area of parallel energy sources, the above proposed added text does provide a method to ensure increased adherence to the National Electrical Code. The Code Making Panel has the opportunity to help prevent unsafe conditions by being proactive within this emerging industry.

Additionally, The inclusion of the wording "qualified persons" does have precedence in the NEC. See: 685.1 Scope.

This article covers integrated electrical systems, other than unit equipment, in which orderly shutdown is necessary to ensure safe operation. An integrated electrical system as used in this article is a unitized segment of an industrial wiring system where all of the following conditions are met:

1. An orderly shutdown is required to minimize personnel hazard and equipment damage.
2. The conditions of maintenance and supervision ensure that qualified persons service the system. The name(s) of the qualified person(s) shall be kept in a permanent record at the office of the establishment in charge of the completed installation.

A person designated as a qualified person shall possess the skills and knowledge related to the construction and operation of the electrical equipment and installation and shall have received documented safety training on the hazards involved. Documentation of their qualifications shall be on file with the office of the establishment in charge of the completed installation.

3. Effective safeguards acceptable to the authority having jurisdiction are established and maintained.

Also:

215.2(B)(3) Supervised Installations. For supervised installations, feeder conductor sizing shall be permitted to be determined by qualified persons under engineering supervision. Supervised installations are defined as those portions of a facility where all of the following conditions are met:

1. Conditions of design and installation are provided under engineering supervision.
2. Qualified persons with documented training and experience in over 600-volt systems provide maintenance, monitoring, and servicing of the system. 215.2

Panel Meeting Action: Reject

Panel Statement: The panel supports installation of these systems by qualified persons. However, the NEC cannot contain requirements relative to the qualifications of installers for any electrical system. These requirements need to be handled by local or state qualification committees or licensing boards. See Annex H of the NEC for recommendations on establishing such bodies.
John Wiles, Southwest Technology Development Inst/New Mexico State Univ. / Rep. PV Industry Forum

Revise Section 705.12(A) as follows:

(A) Supply Side. An electrical power production source shall be permitted to be connected to the supply side of the service disconnecting means as permitted in 230.82(6) in accordance with 705.12(A)(1) through 705.12(A)(4)

(1) The sum of the ratings of all overcurrent devices connected to power production sources shall not exceed the rating of the service.

(2) The service conductor connection shall comply with the requirements established for services in Article 230.

(3) The Tap Rules of Section 240.21 shall not be applied.

(4) Where a main-lug-only main service panel is used, the sum of the ratings of all overcurrent devices in the panel connected to power production sources shall not exceed the rating of the service panel.

Substantiation: Supply side connections of PV equipment are becoming more frequent as the size of these PV systems exceeds the allowances for load side connections. Requirements for these supply-side taps must be established which are not found elsewhere in the Code.

(1) Self explanatory.

(2) Self explanatory

(3) The Section 240.21 Tap Rules have been developed over many years with a carefully controlled system where there is only one source of current and that source is protected by an overcurrent device. With a service tap, and a PV utility-interactive inverter, there are two sources of current and one (the utility-source) is effectively not protected at anywhere near the ampacity of the conductors. Tap rules have not been developed for this type of system, and the allowances of Section 240.21 should not be applied.

(4) In some installations, a main-lug-only main service panel may be used that has one or more open breaker positions (of the allowed six) that can be used for the connection of utility-interactive inverter(s). This requirement limits the output of the added power production sources to the rating of the service panel. Without this requirement, installers may inadvertently connect two 60-amp utility-interactive inverters to a 100-amp panel.

Panel Meeting Action: Accept in Principle

Revise Section 705.12(A) as follows:

(A) Supply Side. An electrical power production source shall be permitted to be connected to the supply side of the service disconnecting means as permitted in 230.82(6). The sum of the ratings of all overcurrent devices connected to power production sources shall not exceed the rating of the service.

Panel Statement: Add a second sentence to 705.12(A) consisting of the language submitted in item (1) in the proposal. The remainder of the proposal is not required for the following reasons: item (2) is already covered by the requirements found in Article 230 and item (3) is not necessary as this installation would not be permitted with the existing tap rules located in 240.21, item (4) is not necessary as it is covered by the language extracted from item (1) of this proposal. In addition, Section 408.36 prohibits the use of MLO panelboards in this application.
Submitter: Frederic P. Hartwell, Hartwell Electrical Services, Inc.
Recommendation: Insert a new (4) as follows:

(4) The interconnection point within the premises supplied shall comply with the requirements in 705.12(D)(1) through 705.12(D)(7). Where a utility-interactive inverter is specified, apply the rule as though an interconnected power production source were specified instead. In the warning label required in 705.12(D)(7), substitute "INTERCONNECTED ELECTRIC POWER PRODUCTION SOURCE CONNECTION" for "INVERTER OUTPUT CONNECTION".

Substantiation: These rules result in many large cogeneration projects being connected downstream of the service. Remember this is any form of cogeneration, including internal combustion engines that turn large induction generators while creating hot water from their cooling systems that is used for other purposes. Such systems use electronic controls to synchronize their output to the utility network, in accordance with 705.14. These systems do not begin with the production of dc current, and therefore their connections do not involve a utility-interactive inverter.

This part has not been correlated with (D) with respect to the size limitation and the connection location limitations that apply where utility-interactive inverters connect to conventional panelboards. A connection under this paragraph is presently not limited in those ways, even though the potential current injection is far higher, which makes the problem potentially far worse. This proposal places these sources of current injection on the same footing as those from inverters.

Panel Meeting Action: Reject
Panel Statement: The wording does not fit or work with 705.12(C). This section is a list of items, all of which must be complied with, and there are variables in the proposal. Interconnection requirements for utility interactive inverters are based on UL 1741 listing for the inverters to meet IEEE 1547. The requirements in 705.12(D) are not applicable to other types of interconnected power systems.
Revise 705.12(D) as follows:

The output of a utility-interactive inverter shall be permitted to be connected to the load side of the service disconnecting means of the other source(s) at any distribution equipment on the premises. Where distribution equipment including switchboards and panelboards is fed simultaneously by a primary source(s) of electricity and one or more utility-interactive inverters, and where this distribution equipment is capable of supplying multiple branch circuits or feeders or both, the interconnecting provisions for the utility-interactive inverter(s) shall comply with (D)(1) through (D)(6).

1. **Dedicated Overcurrent and Disconnect**: Each source interconnection shall be made at a dedicated circuit breaker or fusible disconnecting means.

2. **Bus or Conductor Ampere Rating**: The continuous current output of the inverter(s) shall not exceed the ampere rating of the busbar or conductor to which they are connected. In systems where panelboards are connected in series, the ampere rating of the first overcurrent device connected directly to the inverter(s) shall be used in the calculations for all busbars and conductors. The busbar or conductor shall be sized for the loads connected in accordance with Article 220. One of the methods in (a)-(e) shall be used to determine the ratings of busbars in panelboards or the ampacity of conductors:
   - (a) The sum of the ampere ratings of the overcurrent devices supplying power to the busbar or conductor shall not exceed the ampacity of the busbar or conductor. FPN: This general rule assumes no limitation in the number of the loads or sources applied to a busbar or their locations.
   - (b) Where two sources are located at opposite ends of a conductor that contains no taps, the ampere rating of the largest overcurrent device supplying power to the conductor shall not exceed the rating of the conductor. Permanent warning labels shall be applied to conductor access points, and at 2.8m (10 ft) intervals along raceways, with the following or equivalent wording:
     
     **WARNING**
     
     **THIS EQUIPMENT FED BY MULTIPLE SOURCES**
     
     **DO NOT TAP CONDUCTOR.**
     
   - (c) Where two sources, one utility and the other an inverter, are located at opposite ends of a busbar or conductor that contains loads, the sum of the ampere ratings of the overcurrent protection supplying power to the busbar or conductor shall not exceed 120% the ampacity of the busbar or conductor. A permanent warning label shall be applied to the distribution equipment with the following or equivalent wording:
     
     **WARNING**
     
     **INVERTER OUTPUT CONNECTION**
     
     **DO NOT RELOCATE**
     
     **THIS OVERCURRENT DEVICE**
     
     **Exception: Panelboards with multiple ampacity buswork are not addressed by this provision.**
     
   - (d) The sum of the ampere ratings of all overcurrent devices on panelboards, both load and supply devices, excluding the main supply overcurrent device, shall not exceed the ampacity of the busbar. The ampere rating of the main supply overcurrent device shall not exceed the rating of the busbar. Permanent warning labels shall be applied to distribution equipment with the following or equivalent wording:
     
     **WARNING**
     
     **THIS EQUIPMENT FED BY MULTIPLE SOURCES**
     
     **TOTAL RATING OF ALL OVERCURRENT DEVICES, EXCLUDING MAIN SUPPLY OVERCURRENT DEVICE**
     
     **SHALL NOT EXCEED AMPACITY OF BUSBAR.**
     
   - (e) Connections shall be permitted on feeders where designed under engineering supervision that includes, but is not limited to, fault studies and conductor damage curves.

3. **Ground-Fault Protection**: The interconnection point shall be on the line side of all ground-fault protection equipment.

   **Exception**: Connection shall be permitted to be made to the load side of ground-fault protection, where, provided that there is ground-fault protection for equipment from all ground-fault current sources. Ground-fault protection devices used with supplies connected to the load-side terminals those devices are identified and listed as suitable for backfeeding.
(4) **Marking.** Equipment containing overcurrent devices in circuits supplying power to a busbar or conductor supplied from multiple sources shall be marked to indicate the presence of all sources.

(5) **Suitable for Backfeed.** Circuit breakers, if backfed, shall be suitable for such operation.

FPN: Circuit breakers that are marked "Line" and "Load" have been evaluated only in the direction marked. Circuit breakers without "Line" and "Load" have been evaluated in both directions.

(6) **Fastening.** Listed plug-in-type circuit breakers backfed from utility-interactive inverters that are listed and identified as interactive shall be permitted to omit the additional fastener normally required by 408.36(D) for such applications.

(7) **Inverter Output Connection.** Unless the panelboard is rated not less than the sum of the ampere ratings of all overcurrent devices supplying it, a connection in a panelboard shall be positioned at the opposite (load) end from the input feeder location or main circuit location. The bus or conductor rating shall be sized for the loads connected in accordance with Article 220. In systems with panelboards connected in series, the rating of the first overcurrent device directly connected to the output of a utility-interactive inverter(s) shall be used in the calculations for all busbars and conductors. A permanent warning label shall be applied to the distribution equipment with the following or equivalent wording:

**WARNING**

**INVERTER OUTPUT CONNECTION**

**DO NOT RELOCATE THIS OVERCURRENT DEVICE**

Substantiation: 705.12(D) was edited extensively during code making panel meetings and did not receive public review. Subparagraph (D)(7) is very difficult to read and understand. New, and safe methods or connecting utility-interactive inverters to conductors and panelboards have been identified and defined. This proposed revision addresses those items and others as noted.

(D) **Introduction—** No change except in the numbering of the paragraph that was changed from 7 to 6 because (7) has been included in (2).

(D)(1) No change

(D)(2) Substantial changes to allow additional safe and cost effective methods of connecting the output of utility-interactive inverters to a panelboard bus bar or a conductor.

The second sentence is extracted from 690.64(B)(2) in the 2008 NEC that was omitted in error during the transition to 705. A separate proposal has been submitted to delete 690.64 since those requirements are now in 705.12(D).

(a) This general rule as explained by the FPN ensures that any conductor or bus bar with multiple sources and multiple loads will be protected.

(b) With these restrictions on the location of sources at each end, it is not possible to overload a conductor through the connection of any load in any position.

(c) This is a revision of 705.12(D)(7) for clarity. It belongs under (D) as it is a method of determining bus rating and protection. The warning is self explanatory.

The exception is required because center tapped bus bars cannot be protected by this method.

(d) This new method protects the busbar or conductor by limiting the sum of the ratings of all (source and load) overcurrent devices, except the overcurrent device on the main (largest) source. For example: With a 100 amp bus, the method would allow 100 amps of supply breakers and no load breakers, 100 amps of load breakers and no supply breakers, or any combination of the two adding to 100 amps or less. The rating of the main breaker need not be counted in protecting the busbar except that its rating must also not exceed the bus bar rating.

(e) This new allowance lets engineering evaluations be made by qualified people in making taps where multiple sources of power are involved.

(3) The ground-fault requirement is modified to address the unique characteristics of utility-interactive inverters where the tripping of a ground-fault protected main breaker will turn off, not only the connected loads, but also the load-side connected utility-interactive inverter. This automatically provides protection from ground-fault currents from all sources (4), (5), and (6) no change.

(7) is deleted, the requirements revised for clarity, and placed in (D)(2).

Panel Meeting Action: **Reject**

Panel Statement: The proposal has insufficient substantiation for the panel to accept.
**4-270 Log #2516 NEC-P04**

*(705.12(D) Exception)*

**Final Action: Accept in Principle**

**Submitter:** John Wiles, Southwest Technology Development Inst/New Mexico State Univ. / Rep. PV Industry Forum

**Recommendation:** Add the following exception.

**705.12(D)(2) Bus or Conductor Rating.**

**Exception:** Where the photovoltaic system has an energy storage device to allow stand-alone operation of loads, 125% of the rated utility-interactive current from the inverter shall be permitted to be used in the calculation of bus rating or conductor ampacity instead of the rating of the overcurrent device between the inverter and the bus or conductor. In no case shall the bus or conductor have a rating less than the connected loads.

**Substantiation:** In many systems, these multi-mode inverters (utility-interactive inverters/stand-alone inverters/battery chargers) can process power from the utility to the batteries and to the connected output loads in excess of their ability to backfeed current to the utility grid. For example, several popular inverters can take 60 amps from the grid for battery charging and supplying battery-backed up loads, but can only supply 30 amps in the utility-interactive mode to the grid. For the load circuit, a circuit breaker of 80 amps (1.25 x 60 plus round up to next standard breaker) must be used in the panel supplying the system to meet NEC requirements. If 705.12(D)(2) is used as currently written, then the impact of this 80-amp breaker on sizing the panel is severe. Since the inverter is capable of supplying only 30 amps of utility-interactive current to the panel and to the utility grid, it is safe to allow 125% of the continuous inverter backfeed current (37.5 amps) to be used in the 705.12(D)(2) calculation rather than the rating of the required load breaker (80 amps).

**Panel Meeting Action:** Accept in Principle

Revise text to read as follows:

Exception: Where the photovoltaic system has an energy storage device to allow stand-alone operation of loads, the value used in the calculation of bus or conductor loading shall be 125% of the rated utility-interactive current from the inverter instead of the rating of the overcurrent device between the inverter and the bus or conductor. In no case shall the bus or conductor have a rating less than the connected loads.

**Panel Statement:** Exception reworded for readability. Last sentence omitted since it is not relevant to the exception and is not substantiated.

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**4-271 Log #3281 NEC-P04**

*(705.22)*

**Final Action: Reject**

**Submitter:** Dan Leaf, Seneca, SC

**Recommendation:** Delete text and substitute:

The disconnecting means for ungrounded conductors shall consist of an identified manually externally operable enclosed switch(es) or circuit breaker(s) in accordance with the following:

1. Located where readily accessible
2. Externally operable
3. If power operable of a type that can be manually opened
4. Plainly and durably marked to indicate the open (off) and Closed (on) position
5. Have ratings not less than the calculated load and the available fault current. Disconnecting means that can be energized from load terminals shall be provided with a durable and permanent sign on the exterior with the words "Warning Load terminals may be energized from a different source."

**Substantiation:** Edit. Disconnecting means should be manually operable whether or not power operable. A readily accessible location is not a feature of disconnecting means but an installation requirement. The on and off positions should be marked; up and down positions may be deemed "indicating". "Externally operable" is defined in Article 100 and should apply without reference to power failure. "Both sides" is not specific.

**Panel Meeting Action:** Reject

**Panel Statement:** The proposal does not meet the requirements of 4.3.3(b) of the Regulations Governing Committee Projects.
4-272 Log #2518 NEC-P04 Final Action: Accept
(705.22(4), FPN No. 2 to (4))

Submitter: John Wiles, Southwest Technology Development Inst/New Mexico State Univ. / Rep. PV Industry Forum
Recommendation: Delete 705.22(4) FPN No. 2 to (4).

705.22 Disconnect Device.
The disconnecting means for ungrounded conductors shall consist of a manually or power operable switch(es) or circuit breaker(s) with the following features:
(1) Located where readily accessible
(2) Externally operable without exposing the operator to contact with live parts and, if power operable, of a type that could be opened by hand in the event of a power-supply failure
(3) Plainly indicating whether in the open (off) or closed (on) position
(4) Having ratings not less than the load to be carried and the fault current to be interrupted. For disconnect equipment energized from both sides, a marking shall be provided to indicate that all contacts of the disconnect equipment might be energized.
FPN No. 1 to (4): In parallel generation systems, some equipment, including knife blade switches and fuses, is likely to be energized from both directions. See 240.40.
FPN No. 2 to (4): Interconnection to an off-premises primary source could require a visibly verifiable disconnecting device.
(5) Simultaneous disconnect of all ungrounded conductors of the circuit
(6) Capable of being locked in the open (off) position

Substantiation: This FPN is related to utility requirements and should not be addressed, even as information, in the NEC. Many utilities in areas of highest PV system penetration are no longer requiring a visibly verifiable disconnecting means because of the inherent safety systems built into the listed/certified utility-interactive inverters.
Panel Meeting Action: Accept

4-273 Log #2520 NEC-P04 Final Action: Reject
(705.22(6))

Submitter: John Wiles, Southwest Technology Development Inst/New Mexico State Univ. / Rep. PV Industry Forum
Recommendation: Delete 705.22(6).

705.22 Disconnect Device.
The disconnecting means for ungrounded conductors shall consist of a manually or power operable switch(es) or circuit breaker(s) with the following features:
(1) Located where readily accessible
(2) Externally operable without exposing the operator to contact with live parts and, if power operable, of a type that could be opened by hand in the event of a power-supply failure
(3) Plainly indicating whether in the open (off) or closed (on) position
(4) Having ratings not less than the load to be carried and the fault current to be interrupted. For disconnect equipment energized from both sides, a marking shall be provided to indicate that all contacts of the disconnect equipment might be energized.
FPN No. 1 to (4): In parallel generation systems, some equipment, including knife blade switches and fuses, is likely to be energized from both directions. See 240.40.
FPN No. 2 to (4): Interconnection to an off-premises primary source could require a visibly verifiable disconnecting device.
(5) Simultaneous disconnect of all ungrounded conductors of the circuit
(6) Capable of being locked in the open (off) position

Substantiation: The lockable disconnect requirement is a utility requirement imposed by some, but not all utilities. There is no safety reason that would require a lockable disconnect requirement in the NEC.
Panel Meeting Action: Reject
Panel Statement: The submitter has not submitted any technical data to support the removal of this enhanced safety requirement. There is a difference between a utility company requiring these devices to be locked to prevent access to internal parts and the ability to lock the disconnect in the off position.
4-274     Log #3941  NEC-P04  Final Action: Accept
(705.32)

Submitter: James Kelley, Sargent & Lundy
Recommendation: Revise text to read as follows:
705.32 Ground-Fault Protection.
here When ground-fault protection is used, the output of an interactive system shall be connected to the supply side of the ground-fault protection.

Substantiation: Editorial change of the first word "Where" to be "When" according to the 2003 National Electrical Code Style Manual amended January 15, 2003 (in 3.3.4 Word Clarity) example of word use that shall not be permitted. "Where (in the sense of when or if- use when or if) instead."
The comment is based on the printed version that is missing the first letter "W" though the electronic version available to subscribers of the NFPA Codes has the "W".
Panel Meeting Action: Accept

4-275     Log #4685  NEC-P04  Final Action: Accept
(705.60(B))

Submitter: Frederic P. Hartwell, Hartwell Electrical Services, Inc.
Recommendation: Delete the title of (1), so as to close up the first sentence (in 705.60) about currents being classified as continuous with the what will be the second sentence of (B), namely, the 125 percent rule in (1) followed by the last sentence regarding 240.4(B) and 240.4(C).
Substantiation: The Style Manual does not allow for a single, orphaned numbered paragraph below a lettered paragraph, and there is not paragraph (2) in this section. This proposal corrects this editorial problem.
Panel Meeting Action: Accept

4-276     Log #4686  NEC-P04  Final Action: Accept
(705.65)

Submitter: Frederic P. Hartwell, Hartwell Electrical Services, Inc.
Recommendation: Delete paragraphs (C) and (E).
Substantiation: This is section is 690.9 verbatim except that “Photovoltaic” has been replaced by “Inverter” in the title of (C). Some of this information is highly questionable in a section supposedly designed for generic applicability. In particular, the one-ampere fuse increment rule in (C) and the express use of the word “modules” in (E) are specific to photovoltaic systems and highly questionable in a section covering generic requirements. In addition, (C) allows the use of supplementary overcurrent protective devices by right; many cogenerating sources have far higher current and available fault currents than photovoltaic panels, and a more robust branch-circuit overcurrent device would probably be required. The approach in this section needs to be thoroughly reconsidered.
Panel Meeting Action: Accept
Revise the Exception as shown:

705.65(B) Power Transformers.

Exception: A power transformer with a current rating on the side connected toward the PV power source utility-interactive inverter output, not less than the short-circuit rated continuous output current of the inverter, shall be permitted without overcurrent protection from that source.

Substantiation: Under short-circuit conditions, the anti-islanding circuits required by UL Standard 1741 in all utility-interactive inverters, sense the near zero voltage and cause the inverters to immediately shut down. These inverters cannot operate when connected a short circuit. Transformer protection is more properly afforded by comparing the transformer rating to the continuous rated output of the inverter.

Panel Meeting Action: Accept in Principle

Revise the recommendation to read as follows:

Exception: A power transformer with a current rating on the side connected toward the utility-interactive inverter output that is not less than the rated continuous output current of the inverter shall be permitted without overcurrent protection from that source.

This rewording improves clarity of sentence.

Delete section 705.65(C)

Branch-circuit or supplementary-type overcurrent devices shall be permitted to provide overcurrent protection in inverter source circuits. The overcurrent devices shall be accessible but shall not be required to be readily accessible. Standard values of supplementary overcurrent devices allowed by this section shall be in one-ampere size increments, starting at 1 ampere up to and including 15 amperes. Higher standard values above 15 amperes for supplementary overcurrent devices shall be based on the standard sizes provided in 240.6(A).

Substantiation: This section was inadvertently copied from Article 690 during the 2008 NEC code making cycle and does not belong in a section on utility-interactive inverters. The input circuits to utility-interactive inverters are direct current outputs of the PV or other dc power system. Those requirements are addressed in Article 690 or in other articles dealing with the inputs to utility-interactive inverters.

Panel Meeting Action: Accept

Delete Section 705.65(D).

Overcurrent devices, either fuses or circuit breakers, used in any dc portion of a utility-interactive inverter power system shall be listed for use in dc circuits and shall have the appropriate voltage, current, and interrupt ratings.

Substantiation: The section does not apply to the parallel connection of ac power production sources. It is related to the dc input for such devices. The requirement is addressed in other articles relating to the direct-current input of utility-interactive inverters.

Panel Meeting Action: Accept
4-280 Log #2524 NEC-P04
(705.65(E)) Final Action: Accept

Submitter: John Wiles, Southwest Technology Development Inst/New Mexico State Univ. / Rep. PV Industry Forum
Recommendation: Delete 705.65(E)

(E) Series Overcurrent Protection. In series-connected strings of two or more modules, a single overcurrent protection device shall be permitted.

Substantiation: This section is not applicable to utility-interactive inverters. It applies to PV systems and is addressed in Article 690.

Panel Meeting Action: Accept

4-281 Log #2291 NEC-P04
(705.70) Final Action: Reject

Submitter: James W. Beutler, Laclede, ID
Recommendation: These installations shall comply with (1) through (4) (5):

(5) An inverter installed on a rooftop, where conductors or cables are installed in conduits exposed to direct sunlight, shall be installed in accordance with 310.15 (B)(2)(c).

Substantiation: This addition is inserted, because 705.70 allows for the installation of an inverter on a roof, which introduces safety factors associated with proper conductor sizing. Some installations, depending on the location on the rooftop, may require the installation of conduits to, and from the inverter for the protection of conductors or cabling from damage such as wind, debris, snow load, and person/persons climbing/scaling on the rooftop. This would require additional adjustments made to the ampacity of the conductors, because of temperature adjustments for conduits above rooftops in direct sunlight, as per 310.15(B)(2)(c). This addition would address such situations, making those installations safer.

Panel Meeting Action: Reject

Panel Statement: This proposal restates existing code language unnecessarily. The necessity to comply with this requirement is inherent in the code.