2020 NEC Significant Code Changes Part 4

Four (4) Continuing Education Hours
Course #EE2004

Approved Continuing Education for Licensed Professional Engineers

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Course Description:

The 2020 NEC Significant Code Changes Part 4 course satisfies four (4) hours of professional development.

The course is designed as a distance learning course that overviews the significant changes to the updated National Electrical Code (NEC).

Objectives:

The primary objective of this course is to enable the student to understand some of the significant changes including additions, deletions, and modification to Articles 600 of the 2020 Edition of NFPA 70: National Electrical Code (NEC) from the 2017 Edition.

Grading:

Students must achieve a minimum score of 70% on the online quiz to pass this course. The quiz may be taken as many times as necessary to successful pass and complete the course.

A copy of the quiz questions are attached to last pages of this document.

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2020 NEC Significant Code Changes Part 4

Introduction

Every three years, the National Electrical Code® (NEC®) is revised and expanded. Initially the NFPA® received **3,730** public suggestions for changes, which resulted in **1,400** first revisions. There were **1,930** public comments submitted in response to these **1,400** first revisions, resulting in **635** second revisions. Changes included editorial clarification, expanded requirements, new requirements, deleted requirements, and the relocation of other requirements. Nine new articles were proposed, and four new articles were added to the 2020 NEC. With the fast pace of technology, it's more important than ever for anyone participating in the electrical industry to get up to speed with all the changes.

2020 National Electric Code (NEC)

- 5,660 Public Suggestions to 2014 NEC
- 2.035 Revisions Made
- Changes Included
  - Editorial Clarification,
  - Expanded Requirements,
  - New Requirements,
  - Deleted Requirements,
  - Relocation of Requirements
- Four New Articles Added

What to Expect

In this course the student will be presented an overview of the most significant changes found in the 2020 NEC. This is part 4 of a series of courses covering the changes and will progress through each chapter and its articles presenting the many important changes. The changes will be underlined for easy recognition and a short synopsis of the reason for the change is presented as well.

2020 NEC Major Additions

Article 242 Overvoltage Protection provides the general, installation, and connection requirements for overvoltage protection and overvoltage protective devices.

Article 311 Medium Voltage Conductors and Cable covers the use, installation, construction specifications and ampacities for medium voltage conductors and cable (Type MV).

Article 337 Type P Cable covers the use, installation, and construction specifications for up through 2000-volt Type P cable (armored and unarmored).

Article 800 General Requirements for Communications Systems combines common requirements previously found in Articles 800 (now Article 805) for communications circuits, 820 for community antenna television and radio distribution systems, 830 for network-powered broadband communications systems and 840 for premises-powered broadband communications systems into a new "general" article that applies to all of these articles unless modified by the forenamed articles.

Chapter 6. Special Equipment
Article 600-695

600 – Electric Signs and Outline Lighting

600.2
Four New Definitions for Retrofit Kits

Reason for Change:

Four new definitions were added to 600.2 pertaining to retrofit kits for signs (1) Host Sign, (2) Retrofit Kit, General Use, (3) Retrofit Kit, Sign Specific, (4) Subassembly.

600.2 Definitions. (*Electric Signs and Outline Lighting*)

The definitions in this section shall apply only within this article.

Host Sign. A sign or outline lighting system already installed in the field that is designated for field conversion of the illumination system with a retrofit kit.
LED Sign Illumination System.
Neon Tubing.
Photovoltaic (PV) Powered Sign.
Retrofit Kit, General Use. A kit consisting of primary parts, which does not include all the parts for a complete subassembly but includes a list of required parts and installation instructions to complete the subassembly in the field.
Retrofit Kit, Sign Specific. A kit consisting of the necessary parts and hardware to allow for field installation in a host sign, based on the included installation instructions.
Section Sign.
Sign Body.
Skeleton Tubing.
Subassembly. Component parts or a segment of a sign, retrofit kit, or outline lighting system that, when assembled, forms a complete unit or product.

(See NEC for complete text of existing definitions).

600.4(D)
Electric Signs and Outline Lighting

Reason for Change:

Revisions now require visibility of markings at the time of installation, inspection, and prior to servicing, but can be installed in a location not viewed by the public.

600.4 Markings. (*Electric Signs and Outline Lighting*)

(A) Signs and Outline Lighting Systems. Signs and outline lighting systems shall be listed and labeled; marked with the manufacturer's name, trademark, or other means of identification; and input voltage and current rating.

(B) Signs with a Retrofitted Illumination System. *(see NEC for complete text)*

(C) Signs with Lampholders for Incandescent Lamps. *(see NEC for complete text)*

(D) Visibility. The markings required in 600.4(A) and listing labels shall ~~not be required to~~ be visible after installation ~~but~~ and shall be permanently applied in a

location visible ~~during~~ prior to servicing. The marking shall be permitted to be installed in a location not viewed by the public.

(E) Durability. *(see NEC for complete text)*

(F) Installation Instructions. *(see NEC for complete text)*

600.5(A)
Entrances for Deliveries, Service Corridors, or Service Hallways

Reason for Change:

Revision clarifies that entrances not accessible to customers, such as delivery doors, do not require a sign outlet.

600.5 Branch Circuits. (*Electric Signs and Outline Lighting*)

(A) Required Branch Circuit. Each commercial building and each commercial occupancy accessible to pedestrians shall be provided with at least one outlet in an accessible location at each entrance to each tenant space for sign or outline lighting system use. The outlet(s) shall be supplied by a branch circuit rated at least 20 amperes that supplies no other load. ~~Service hallways or corridors shall not be considered accessible to pedestrians~~. A sign or outline lighting outlet shall not be required at entrances for deliveries, service corridors, or service hallways that are intended to be used only by service personnel or employees.

600.5(B) and 600.6(A)(4)
Electric Signs and Outline Lighting Branch Circuits

Reason for Change:

A disconnecting means for a sign, outline lighting system, or controller is now required to be marked to identity of the sign, outline lighting system, or controller it controls (*Exception for external disconnect mounted on the sign, etc.*). If located remote, disconnect required to be installed at an accessible location available to first responders and service personnel.

600.5 Branch Circuits. (*Electric Signs and Outline Lighting*)

(A) Required Branch Circuit. *(see NEC for complete text)*

(B) Marking. A disconnecting means for a sign, outline lighting system, or controller shall be marked to identify the sign, outline lighting system, or controller it controls.

Exception: *An external disconnecting means that is mounted on the sign body, sign enclosure, sign pole, or controller shall not be required to identify the sign or outline lighting system it controls.*

~~**(B)**~~ **(C) Rating.** *(see NEC for complete text)*

~~**(C)**~~ **(D) Wiring Methods.** *(see NEC for complete text)*

600.6 Disconnects.

(A) Location. The disconnecting means shall be permitted to be located in accordance with 600.6(A)(1), (A)(2), ~~and~~ (A)(3), and (A)(4):

(4) Remote Location. The disconnecting means, if located remote from the sign, sign body, or pole, shall be mounted at an accessible location available to first responders and service personnel. The location of the disconnect shall be marked with a label at the sign location and marked as the disconnect for the sign or outline lighting system. The label shall comply with 110.21(B).

600.35
Retrofit Kits for Signs and Outline Lighting Systems

Reason for Change:

A new section was added pertaining to Retrofit Kits for signs and outline lighting systems.

600.35 Retrofit Kits. (*Electric signs and Outline Lighting*)

(A) General. A general-use or sign-specific retrofit kit for a sign or outline lighting system shall include installation instructions and requirements for field conversion of a host sign. The retrofit kit shall be listed and labeled.

(B) Installation. The retrofit kit shall be installed in accordance with the installation instructions.

(1) Wiring Methods. Wiring methods shall be in accordance with Chapter 3.

Exception: *If powered from a Class 2 source, wiring methods shall be in accordance with 600.12(C)(1)(2), 600.24, and 600.33.*

(2) Damaged Parts. All parts that are not replaced by a retrofit kit shall be inspected for damage. Any part found to be damaged or damaged during conversion of the sign shall be replaced or repaired to maintain the sign or outline lighting system's dry, damp, or wet location rating.
(3) Workmanship. Field conversion workmanship shall be in accordance with 110.12.
(4) Marking. The retrofitted sign shall be marked in accordance with 600.4(B).

605 – Office Furnishings

605.1(B)
Scope of Covered and Not Covered Items for Office Furnishings

Reason for Change:

The scope of Article 605 was clarified to specify items that are not covered by the article.

605.1 Scope. (*Office Furnishings*)

(A) Covered. This article covers electrical equipment, lighting accessories, and wiring systems used to connect, contained within, or installed on office furnishings.

(B) Not Covered. This article does not apply to individual office furnishings not connected to a system, such as chairs, freestanding desks, tables, storage units, and shelving units.

620 – Electric Vehicle Power Transfer System

620.6
GFCI Protection Requirements in Elevators, Dumbwaiters, Escalators, Moving Walks, Platform Lifts, and Stairway Chairlifts

Reason for Change:

Revision clarifies that any receptacle in a pit must be GFCI protected. GFCI protection not required for a hard-wired sump pump.

620.6 Ground-Fault Circuit-Interrupter Protection for Personnel. (*Elevators, Dumbwaiters, Escalators, Moving Walks, Platform Lifts, and Stairway Chairlifts*)

Each 125-volt, single-phase, 15- and 20-ampere receptacle installed in pits, in hoistways, on the cars of elevators and dumbwaiters associated with wind turbine tower elevators, on the platforms or in the runways and machinery spaces of platform lifts and stairway chairlifts, and in escalator and moving walk wellways shall be of the ground-fault circuit-interrupter type.

All 125-volt, single-phase, 15- and 20-ampere receptacles installed in machine rooms, control spaces, machinery spaces, and control rooms shall have ground-fault circuit-interrupter protection for personnel.

A ~~single receptacle supplying a~~ permanently installed sump pump shall be permanently wired or shall be supplied by a single receptacle that is ~~not require~~ ground-fault circuit-interrupter ~~protection~~ protected.

620.65
Signage for Selective Coordination

Reason for Change:

New section added to require equipment enclosures for elevators, etc. containing selectively coordinated overcurrent devices to be legibly marked in the field.

620.65 Signage. (*Elevators, Dumbwaiters, Escalators, Moving Walks, Platform Lifts, and Stairway Chairlifts*)

Equipment enclosures containing selectively coordinated overcurrent devices shall be legibly marked in the field to indicate that the overcurrent devices are selectively coordinated. The marking shall meet the requirements of 110.21(B), shall be readily

visible, and shall state the following: CAUTION: OVERCURRENT DEVICES IN THIS ENCLOSURE ARE SELECTIVELY COORDINATED. EQUIVALENT REPLACEMENTS AND TRIP SETTINGS ARE REQUIRED.

625 – Electrical Vehicle Power Transfer System

Article 625 and 625.1
Electric Vehicle Power Transfer Systems

Reason for Change:

With the addition of power export equipment and bidirectional current flow equipment, a change to the title and scope of Article 625 was needed for clarity.

Article 625 Electric Vehicle Charging Power Transfer Systems

625.1 Scope. This article covers the electrical conductors and equipment ~~external to~~ connecting an electric vehicle to premises wiring ~~that connect an electric vehicle to a supply of electricity by conductive, inductive, or wireless power transfer (contactless inductive charging) means, and the installation of equipment and devices related to electric vehicle charging~~ for the purposes of charging, power export, or bidirectional current flow.

Informational Note No. 1: For industrial trucks, see NFPA 505-~~2013~~ 2018, Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operations.

Informational Note No. 2: UL 2594-2013, Standard for Electric Vehicle Supply Equipment, is a safety standard for conductive electric vehicle supply equipment. UL 2202-2009, Standard for Electric Vehicle Charging System Equipment, is a safety standard for conductive electric vehicle charging equipment.

Article 625, Part II
Product Construction Requirements

Reason for Change:

Product construction requirements in Part II of Article 625 were deleted from Article 625.

Article 625, Part II. Equipment Construction (*Electric Vehicle Power Transfer System*)

~~**625.10 Electric Vehicle Coupler.**~~
~~**625.15 Markings.**~~
~~**625.16 Means of Coupling.**~~
625.17 Cords and Cables.
(A) Power-Supply Cord.
(B) Output Cable to the Electric Vehicle.
(C) Overall Cord and Cable Length.
(D) Interconnecting Cabling Systems.
~~**625.18 Interlock.**~~
~~**625.19 Automatic De-Energization of Cable.**~~
625.22 Personnel Protection Systems.

(See NEC for complete Code text).

625.17(B)
Output Cable to Electric Vehicle.

Reason for Change:

Revision allows the output cable to an electric vehicle to be an integral part of listed electric vehicle supply equipment.

625.17 Cords and Cables. (*Electric Vehicle Power Transfer System*)

(B) Output Cable to the Electric Vehicle. The output cable to the electric vehicle shall be one of the following:

(1) Listed Type EV, EVJ, EVE, EVJE, EVT, or EVJT flexible cable as specified in Table 400.4
(2) An integral part of listed electric vehicle supply equipment

Informational Note: ~~Listed electric vehicle supply equipment may incorporate output cables having ampacities greater than 60°C based on the permissible temperature limits for the components and the cable.~~ For information and listing requirements for electric vehicle supply equipment, see UL 2594-2016, Standard for Electric Vehicle Supply Equipment, and UL 2202-2009, Standard for Electric Vehicle (EV) Charging System Equipment.

625.44
Electric Vehicle Power Transfer System

Reason for Change:

The connection methods for connection portable EV charging equipment to the premises wiring system has been expanded to include certain 250- volt rated receptacle outlets.

625.44 Equipment Connection. (*Electric Vehicle Power Transfer System*)

~~Equipment~~ EVSE and WPTE shall be connected to the premises wiring system in accordance with one of the ~~following~~: methods in 625.44(A) through (C).

(A) Portable Equipment. Portable equipment shall be connected to the premises wiring systems system by one or more of the following methods:

(1) A nonlocking, 2-pole, 3-wire grounding-type receptacle outlet rated at 125 volts, single phase, 15 or 20 amperes
(2) A nonlocking, 2-pole, 3-wire grounding-type receptacle outlet rated at 250 volts, single phase, 15 or 20 amperes
(3) A nonlocking, 2-pole, 3-wire or 3-pole, 4-wire grounding-type receptacle outlet rated at 250 volts, single phase, 30 or 50 amperes
(4) A nonlocking, 2-pole, 3-wire grounding-type receptacle outlet rated at 60 volts dc maximum, 15 or 20 amperes

~~The length of the power supply cord, if provided, between the receptacle outlet and the equipment shall be in accordance with 625.17(A)(3).~~

(B) ~~Stationary~~ Fastened-in-Place Equipment. ~~Stationary equipment intended to be~~ Equipment that is fastened in place ~~in such a way as to permit ready removal for interchange, facilitation of maintenance or repair, or repositioning~~ shall be connected to the premises wiring system by one of the following methods:

(1) A nonlocking, 2-pole, 3-wire grounding-type receptacle outlet rated 125 ~~volt~~ volts or 250 ~~volt~~ volts, single phase, up to 50 amperes
(2) A nonlocking, 3-pole, 4-wire grounding-type receptacle outlet rated 250 ~~volt~~ volts, three phase, up to 50 amperes
(3) ~~Any of the receptacle outlets in 625.44(A)(1) or (2)~~ A nonlocking, 3-pole, 4-wire grounding- type receptacle outlet rated 250 volts, single phase, 30 or 50 amperes
(4) A nonlocking, 2-pole, 3-wire grounding-type receptacle outlet rated 60 volts dc maximum, 15 or 20 amperes

~~The length of the power supply cord, if provided, between the receptacle outlet and the equipment shall be in accordance with 625.17(A)(3).~~

(C) Fixed Equipment. All other ~~equipment~~ EVSE and WPTE shall be permanently wired and fixed in place to the supporting surface.

625.54
Receptacle Outlets Used for EV Charging

Reason for Change:

Revision clarifies that all receptacle outlets used for EV charging be provided with GFCI protection for personnel for all cord and plug connected electric vehicle power transfer equipment.

625.54 Ground-Fault Circuit-Interrupter Protection for Personnel. (*Electric Vehicle Power Transfer System***)**

In addition to the requirements in 210.8, all receptacles installed for the connection of electric vehicle charging shall have ground-fault circuit-interrupter protection for personnel.

625.56
Receptacles Installed in a Wet Location for Electric Vehicle (EV) Charging

Reason for Change:

New requirement added to require all receptacles installed in a wet location

for EV charging to be installed in an enclosure that provides weatherproof protection with or without an attachment plug cap inserted.

625.56 Receptacle Enclosures. (*Electric Vehicle Power Transfer System*)

All receptacles installed in a wet location for electric vehicle charging shall have an enclosure that is weatherproof with the attachment plug cap inserted or removed. An outlet box hood installed for this purpose shall be listed and shall be identified as extra duty. Other listed products, enclosures, or assemblies providing weatherproof protection that do not utilize an outlet box hood shall not be required to be marked extra duty.

625.60
AC Receptacle Outlets Used for EVPE

Reason for Change:

New section added to require all on-board receptacle outlets on or in an electric vehicle to be GFCI protected.

625.60 AC Receptacle Outlets Used for EVPE. (*Electric Vehicle Power Transfer System*)

AC receptacles installed in electric vehicles and intended to allow for connection of off-board utilization equipment shall comply with 625.60(A) through (D).

(A) Type. The receptacle outlet shall be listed.

(B) Rating. The receptacle outlet shall be rated 250 volts maximum, single phase 50 amperes maximum.

(C) Overcurrent Protection. Electric vehicles provided with receptacle outlets for power export shall be provided with overcurrent protection integral to the power export system. The overcurrent protection shall have a nominal rating sufficient for the receptacle it protects. The overcurrent protection shall also be sufficiently rated for the maximum available fault current at the receptacle and shall be included in the interactive equipment evaluation. See 625.48.

(D) GFCI Protection for Personnel. Groundfault circuit-interrupter protection for personnel shall be provided for all receptacles. The groundfault circuit-interrupter indication and reset shall be installed in a readily accessible location.

Informational Note: There are various methods available to achieve ground-fault circuit-interrupter protection.

645 – Information Technology Equipment

645.5(E)(2) and 645.5(E)(3)
Supply Circuits and Interconnecting Cables Installed Under a Raised Floor of IT Equipment Rooms

Reason for Change:

Revisions were incorporated into 645.5(E) to distinguish between air space under a raised floor in an IT room when protected by an automatic fire suppression system and those that are not.

645.5 Supply Circuits and Interconnecting Cables. (*Information Technology Equipment*)

(E) Under Raised Floors. Where the area under the floor is accessible and openings minimize the entrance of debris beneath the floor, power cables, ~~communication~~ communications cables, connecting cables, interconnecting cables, cord-and-plug connections, and receptacles associated with the information technology equipment shall be permitted under a raised floor of approved construction. The installation requirement shall comply with 645.5(E)(1) through (E)(3).

(1) Installation Requirements for Branch Circuit Supply Conductors Under a Raised Floor. *[See NEC for complete text of 645.5(E)(1)]*
(2) Installation Requirements for Electrical Supply Cords, Data Cables, Interconnecting Cables, and Grounding Conductors Under a Raised Floor. The following cords, cables, and conductors shall be permitted to be installed under a raised floor:

(1) Supply cords of listed information technology equipment in accordance with 645.5(B).
(2) Interconnecting cables enclosed in a raceway.
(3) Equipment grounding conductors.
(4) ~~In~~ Where the air space under a raised floor is protected by an automatic fire suppression system, in addition to wiring installed in compliance with 725.135(C),

Types CL2R, CL3R, CL2, and CL3 and substitute cables including CMP, CMR, CM, and CMG installed in accordance with 725.154(A) shall be permitted under raised floors.

Informational Note: Figure 725.154(A) illustrates the cable substitution hierarchy for Class 2 and Class 3 cables.

(5) Where the air space under a raised floor is not protected by an automatic fire suppression system, in addition to wiring installed in compliance with 725.135(C), substitute cable Type CMP installed in accordance with 725.154(A) shall be permitted under raised floors.
(6) Listed Type DP cable having adequate fire-resistant characteristics suitable for use under raised floors of an information technology equipment room.

Informational Note: *(see NEC for text of informational note).*

(3) Installation Requirements for Optical Fiber Cables Under a Raised Floor. The installation of optical fiber cables shall comply with either of the following:

(1) ~~In addition to~~ Where the air space under a raised floor is protected by an automatic fire suppression system, optical fiber cables installed in accordance with 770.113(C), Types OFNR, OFCR, OFN, and OFC shall be permitted under raised floors.
(2) Where the air space under a raised floor is not protected by an automatic fire suppression system, only optical fiber cables installed in accordance with 770.113(C) shall be permitted under raised floors.

680 – Swimming Pools, Fountains, and Similar Installations

680.2 and 680.14
Definition, Corrosive Equipment

Reason for Change:

The definition of "Corrosive Environment" was revised and moved from 680.14 to 680.2.

680.2 Definitions. (*Swimming Pools, Fountains, and Similar Installations*)

Corrosive Environment. Areas where pool sanitation chemicals are stored, handled, or dispensed, and confined areas under decks adjacent to such areas, as well as

areas with circulation pumps, automatic chlorinators, filters, open areas under decks adjacent to or abutting the pool structure, and similar locations ~~shall be considered to be a corrosive environment.~~

Informational Note: Sanitation chemicals and pool water are considered to pose a risk of corrosion (gradually damage or destroy materials) due to the presence of oxidizers (e.g., calcium hypochlorite, sodium hypochlorite, bromine, chlorinated isocyanurates) and chlorinating agents that release chlorine when dissolved in water. More information about swimming pool chemicals can be found on or in the following:

(1) Environmental Protection Agency website
(2) NFPA 400-2019, Hazardous Materials Code
(3) Advisory: Swimming Pool Chemicals: Chlorine, OSWER 90-008.1, June 1990, available from the EPA National Service Center for Environmental Publications (NSCEP)

680.14 Wiring Methods in Corrosive Environment. Wiring methods in ~~the areas described in 680.14(A)~~ a corrosive environment shall be listed and identified for use in such areas. Rigid metal conduit, intermediate metal conduit, rigid polyvinyl chloride conduit, and reinforced thermosetting resin conduit shall be considered to be resistant to the corrosive environment. ~~specified in 680.14(A).~~

~~**(A) General.** Areas where pool sanitation chemicals are stored, as well as areas with circulation pumps, automatic chlorinators, filters, open areas under decks adjacent to or abutting the pool structure, and similar locations shall be considered to be a corrosive environment. The air in such areas shall be considered to be laden with acid, chlorine, and bromine vapors, or any combination of acid, chlorine, or bromine vapors, and any liquids or condensation in those areas shall be considered to be laden with acids, chlorine, and bromine vapors, or any combination of acid, chlorine, or bromine vapors.~~

~~**(B) Wiring Methods.** Wiring methods in the areas described in 680.14(A) shall be listed and identified for use in such areas. Rigid metal conduit, intermediate metal conduit, rigid polyvinyl chloride conduit, and reinforced thermosetting resin conduit shall be considered to be resistant to the corrosive environment specified in 680.14(A).~~

680.2, 680.35, and 680.45
Immersion Pools

Reason for Change:

Two new sections covering immersion pools were added to Article 680 providing installation requirements for a newly added definition at 680.2 for "Immersion Pools."

680.2 Definitions. (*Swimming Pools, Fountains, and Similar Installations*)

Immersion Pool. A pool for ceremonial or ritual immersion of users, which is designed and intended to have its contents drained or discharged.

680.35 Storable and Portable Immersion Pools. Storable and portable immersion pools shall additionally comply with 680.35(A) through (G).

(**A) Cord Connection for Self-Contained Storable and Portable Immersion Pools.**

(B) Storable and Portable Pumps.

(C) Storable and Portable Heaters.

(D) Audio Equipment.

(E) Location Proximate to Luminaires, Lighting Outlets, and Ceiling-Suspended (Paddle) Fans.

(F) Location Proximate to Switches.

(G) Receptacles.

680.45 Permanently Installed Immersion Pools. Electrical installations at permanently installed immersion pools, whether installed indoors or outdoors, shall comply with the provisions of Part I, Part II, and Part IV of this article except as modified by this section and shall be connected by the wiring methods of Chapter 3. With regard to provisions in Part IV of this article, an immersion pool shall be considered to be a spa or hot tub.

Exception No. 1: *The equipotential bonding requirements in 680.26(B) shall not apply to immersion pools that incorporate no permanently installed or permanently connected electrical equipment, and that are installed with all portions located on or above a finished floor.*

Exception No. 2: *The equipotential bonding requirements for perimeter surfaces in 680.26(B)(2) shall not apply to nonconductive perimeter surfaces, such as steps, treads, and walking surfaces made of fiberglass composite.*

(A) Cord-and-Plug Connections.

(B) Storable and Portable Pumps.

(C) Heaters.

(1) Permanently Installed Heaters.
(2) Storable and Portable Heaters.

(D) Audio Equipment.

(See NEC for complete Code text).

680.2 and 680.50
Splash Pads

Reason for Change:

A new definition for "Splash Pads" was added at 680.2 and provisions added at 680.50 for splash pads. Splash pads are required to comply with Part II (permanently installed pools) and equipotential bonding requirements.

680.2 Definitions. (*Swimming Pools, Fountains, and Similar Installations*)

Splash Pad. A fountain with a pool depth 25 mm (1 in.) or less, intended for recreational use by pedestrians. This definition does not include showers intended for hygienic rinsing prior to use of a pool, spa, or other water feature.

Part V. Fountains

680.50 General. ~~The provisions of~~ Part I and Part V of this article shall apply to all permanently installed fountains as defined in 680.2. Fountains that have water common to a pool and fountains intended for recreational use by pedestrians, including splash pads, shall additionally comply with the requirements in Part II of this article. Part V does not cover self-contained, portable fountains. Portable fountains shall comply with Parts II and III of Article 422.

680.4
Inspections After Installation

Reason for Change:

New section (*Inspections After Installation*) was added to provide the AHJ with the opportunity to address hazards associated with aging pool installations.

680.4 Inspections After Installation. (*Swimming Pools, Fountains, and Similar Installations*)

The authority having jurisdiction shall be permitted to require periodic inspection and testing.

680.9(A)
Overhead Power Conductors Installed over Swimming Pools

Reason for Change:

Revision clarifies that all overhead conductor (not just service conductors) need proper clearances when installed over swimming pools and similar installations.

680.9 Overhead Conductor Clearances. (*Swimming Pools, Fountains, and Similar Installations*)

Overhead conductors shall meet the clearance requirements in this section. Where a minimum clearance from the water level is given, the measurement shall be taken from the maximum water level of the specified body of water.

(A) Power. With respect to ~~service-drop conductors,~~ overhead ~~service~~ conductors, and open overhead wiring, swimming pool and similar installations shall comply with the minimum clearances given in Table 680.9(A) and illustrated in Figure 680.9(A).

Informational Note: Open overhead wiring as used in this article ~~typically~~ refers to conductor(s) not in an enclosed raceway

680.11
Underground Wiring and Swimming Pools

Reason for Change:

Underground wiring methods around a swimming pool revised into a list format. The long-standing distance of 1.5 m (5 ft) around pool has been revived for this Code cycle which detailed acceptable wiring methods that are listed for direct burial in these areas where exposure is a concern.

680.11 Underground Wiring Location. (*Swimming Pools, Fountains, and Similar Installations*)

Underground wiring shall comply with 680.11(A) through (C).

(A) Underground Wiring. Underground wiring within 1.5 m (5 ft) horizontally from the inside wall of the pool shall be permitted. The following wiring methods shall be considered suitable for the conditions in these locations:

(1) Rigid metal conduit
(2) Intermediate metal conduit
(3) Rigid polyvinyl chloride conduit
(4) Reinforced thermosetting resin conduit
(5) Jacketed Type MC cable ~~suitable for the conditions subject to that location~~ that is listed for burial use
(6) Liquidtight flexible nonmetallic conduit listed for direct burial use
(7) Liquidtight flexible metal conduit listed for direct burial use

(B) Wiring Under Pools. Underground wiring shall not be permitted under the pool unless this wiring is necessary to supply pool equipment permitted by this article.

(C) Minimum Cover Requirements. Minimum cover depths shall be as given in Table 300.5.

680.21(C)
GFCI Protection in Motors Used in Swimming Pools

Reason for Change:

GFCI protection is applicable to all motors used in pool applications. Exception added for listed low-voltage motors not requiring grounding.

680.21 Motors. (*Swimming Pools, Fountains, and Similar Installations*)

(C) GFCI Protection. Outlets supplying all pool ~~pump~~ motors ~~connected to single-phase, 120-volt through 240-volt~~ on branch circuits, rated 150 volts or less to ground and 60 amperes or less, single- or 3-phase, ~~whether by receptacle or by direct connection,~~ shall be provided with Class A ground-fault circuit-interrupter protection ~~for personnel.~~

Exception: *Listed low-voltage motors not requiring grounding, with ratings not exceeding the low-voltage contact limit that are supplied by listed transformers or power supplies that comply with 680.23(A)(2), shall be permitted to be installed without GFCI protection.*

680.21(D)
Pool Pump Motor Replacement

Reason for Change:

A new requirement was added that specifies GFCI protection implementation for motors at older pools when they are replaced.

680.21 Motors. (*Swimming Pools, Fountains, and Similar Installations*)

(D) Pool Pump Motor Replacement. Where a pool pump motor in 680.21(C) is replaced for maintenance or repair, the replacement pump motor shall be provided with ground-fault circuit-interrupter protection.

680.22(A)(5)
Pool Equipment Room

Reason for Change:

New provisions were added to require at least one GFCI-protected receptacle within a pool equipment room. All other receptacles in a pool equipment room now require GFCI protection as well.

680.22 Lighting, Receptacles, and Equipment (*Swimming Pools, Fountains, and Similar Installations*)

(A) Receptacles.

(5) Pool Equipment Room. At least one GFCI- protected 125-volt, 15- or 20- ampere receptacle on a general-purpose circuit shall be located within a pool equipment room, and all other receptacles supplied by branch circuits rated 150 volts or less to ground within a pool equipment room shall be GFCI protected.

680.22(E)
Other Equipment with Ratings Exceeding the Low-Voltage Contact Limit

Reason for Change:

Other equipment (other than traditional pool pump motors and controllers) are now required to generally be located at least 1.5 m (5 ft) horizontally from the inside walls of a pool

680.22 Lighting, Receptacles, and Equipment (*Swimming Pools, Fountains, and Similar Installations*)

(E) Other Equipment. Other equipment with ratings exceeding the low-voltage contact limit shall be located at least 1.5 m (5 ft) horizontally from the inside walls of a pool unless separated from the pool by a solid fence, wall, or other permanent barrier.

680.23(B)(6)
Wet-Niche Luminaire Servicing

Reason for Change:

The “servicing” requirement for a wet-niche luminaire was revised for clarity and added provision for spas that can be drained so luminaire can be placed on the spa bench for servicing.

680.23 Underwater Luminaires. (Swimming Pools, Fountains, and Similar Installations)

(B) Wet-Niche Luminaires.

(6) Servicing. ~~All~~ Wet-niche luminaires shall be removable from the water for inspection, relamping, or other maintenance. The forming shell location and length of

cord in the forming shell shall permit personnel to place the removed luminaire on the deck or other dry location for such maintenance. The luminaire maintenance location shall be accessible without entering or going in the pool water.

In spa locations where wet-niche luminaires are installed low in the foot well of the spa, the luminaire shall only be required to reach the bench location, where the spa can be drained to make the bench location dry.

680.26(B)(2)(c)
Copper Grid System as Alternative Method for Equipotential Bonding

Reason for Change:

A new option was added to allow a copper grid system as alternative method for equipotential bonding at the perimeter surface if structural steel is not available. A copper ring system is also still permitted.

680.26 Equipotential Bonding. (*Swimming Pools, Fountains, and Similar Installations*)

(B) Bonded Parts. The parts specified in 680.26(B) (1) through (B)(7) shall be bonded together using solid copper conductors, insulated covered, or bare, not smaller than 8 AWG or with rigid metal conduit of brass or other identified corrosion-resistant metal. Connections to bonded parts shall be made in accordance with 250.8. An 8 AWG or larger solid copper bonding conductor provided to reduce voltage gradients in the pool area shall not be required to be extended or attached to remote panelboards, service equipment, or electrodes.

(1) Conductive Pool Shells. *(see NEC for complete Code text).*
(2) Perimeter Surfaces. The perimeter surface to be bonded shall be considered to extend for 1 m (3 ft) horizontally beyond the inside walls of the pool and shall include unpaved surfaces and other types of paving. Perimeter surfaces separated from the pool by a permanent wall or building 1.5 m (5 ft) in height or more shall require equipotential bonding only on the pool side of the permanent wall or building. Bonding to perimeter surfaces shall be provided as specified in 680.26(B)(2)(a), ~~or~~ (B)(2)(b), or (B)(2)(c) and shall be attached to the pool reinforcing steel or copper conductor grid at a minimum of four ~~(4)~~ points uniformly spaced around the perimeter of the pool. For nonconductive pool shells, bonding at four points shall not be required.

(a) Structural Reinforcing Steel. *(see NEC for complete Code text).*
(b) ~~Alternate Means~~ Copper Ring*. (see NEC for complete Code text).*
(c) Copper Grid. Where structural reinforcing steel is not available or is encapsulated in a nonconductive compound, copper grid shall be utilized where the following requirements are met:

(1) The copper grid shall be constructed of 8 AWG solid bare copper and be arranged in accordance with 680.26(B)(1)(b)(3).
(2) The copper grid shall follow the contour of the perimeter surface extending 1 m (3 ft) horizontally beyond the inside walls of the pool.
(3) Only listed splicing devices or exothermic welding shall be permitted.
(4) The copper grid shall be secured within or under the deck or unpaved surfaces between 100 mm to 150 mm (4 in. to 6 in.) below the subgrade.

680.26(B)(5)
Bonding of Metal Anchors Used for Pool Safety Covers

Reason for Change:

Bonding of metal anchors used for pool safety covers were added to items that are not required to be bonded to the equipotential bonding grid.

680.26 Equipotential Bonding. (*Swimming Pools, Fountains, and Similar Installations*)

(B) Bonded Parts. The parts specified in 680.26(B) (1) through (B)(7) shall be bonded together using solid copper conductors, insulated covered, or bare, not smaller than 8 AWG or with rigid metal conduit of brass or other identified corrosion-resistant metal. Connections to bonded parts shall be made in accordance with 250.8. An 8 AWG or larger solid copper bonding conductor provided to reduce voltage gradients in the pool area shall not be required to be extended or attached to remote panelboards, service equipment, or electrodes.

(5) Metal Fittings. All metal fittings within or attached to the pool structure shall be bonded. Isolated parts that are not over 100 mm (4 in.) in any dimension and do not penetrate into the pool structure more than 25 mm (1 in.) shall not require bonding. Metallic pool cover anchors intended for insertion in a concrete or masonry deck surface, 25 mm (1 in.) or less in any dimension and 51 mm (2 in.) or less in length, and metallic pool cover anchors intended for insertion in a wood or composite deck

surface, 51 mm (2 in.) or less in any flange dimension and 51 mm (2 in.) or less in length, shall not require bonding.

680.59
GFCI Protection for Non-submersible Fountain Pump

Reason for Change:

New section added to specifically address GFCI protection for non-submersible fountain pumps.

680.59 GFCI Protection for Permanently Installed Nonsubmersible Pumps. (*Fountains*)

Outlets supplying all permanently installed nonsubmersible pump motors rated 250 volts or less and 60 amperes or less, single- or 3-phase, shall be provided with ground-fault circuit-interrupter protection.

680.80 and 680.84
Electrically Powered Pool Lifts

Reason for Change:

Revision removes text indicating that electrically powered pool lifts do not have to comply with other parts of Article 680.

680.80 General. (*Electrically Powered Pool Lifts*)

Electrically powered pool lifts as defined in 680.2 shall comply with Part VIII of this article. ~~They shall not be required to comply with other parts of this article~~. Part VIII shall not be subject to the requirements of other parts of this article except where the requirements are specifically referenced.

680.84 Switching Devices and Receptacles. Switches and switching devices that are operated above the low-voltage contact limit shall comply with 680.22(C). Receptacles for electrically powered powered pool lifts that are operated above the low-voltage contact limit shall comply with 680.22(A)(3) and (A)(4).

682 – Natural and Artificially Made Bodies of Water

682.15
GFCI Rules Pertaining to Natural and Artificially Made Bodies of Water

Reason for Change:

Revision organizes ground-fault protection to one location in Article 682. New provisions added for GFP (not exceeding 30 mA) for feeder and branch circuit conductors installed on piers.

682.15 Ground-Fault Circuit-Interrupter (GFCI) Protection. (*Natural and Artificially Made Bodies of Water)*

~~Fifteen- and 20-ampere single-phase, 125-volt through 250-volt receptacles installed outdoors and in or on floating buildings or structures within the electrical datum plane area shall be provided with GFCI protection for personnel.~~ The GFCI requirements in this article, unless otherwise noted, shall be in addition to the requirements in 210.8. Ground-fault protection shall be provided in accordance with 682.15(A) and (B). The ~~GFCI~~ protection device shall be located not less than 300 mm (12 in.) above the established electrical datum plane.

(A) Outlets. Outlets supplied by branch circuits not exceeding 150 volts to ground and ~~All circuits rated not more than~~ 60 amperes ~~at 120 through 250 volts,~~ single-phase, shall ~~have~~ be provided with ~~GFCI~~ ground-fault circuit-interrupter protection for personnel. [*was 680.33(B)*]

(B) Feeder and Branch Circuits on Piers. Feeder and branch-circuit conductors that are installed on piers shall be provided with ground-fault protection not exceeding 30 mA. Coordination with downstream ground-fault protection shall be permitted at the feeder overcurrent protective device.

Exception No. 1: *Transformer secondary conductors of a separately derived ac system, operating at voltages exceeding 15 volts ac, that do not exceed 3 m (10 ft) and are installed in a raceway shall be permitted to be installed without ground-fault protection. This exception shall also apply to the supply terminals of the equipment supplied by the transformer secondary conductors.*

Exception No. 2: *Low-voltage circuits not requiring grounding, not exceeding the low-voltage contact limit as defined in 680.2, and supplied by listed transformers or power supplies that comply with 680.23(A) (2) shall be permitted to be installed without groundfault protection.*

682.33(C)
Equipotential Planes and Bonding of Equipotential Planes

Reason for Change:

Revision were made to 682.33(C) to more clearly details what needs to be bonded together and how to bond each part in order to properly construct an equipotential plane.

682.33 Equipotential Planes and Bonding of Equipotential Planes. (*Natural and Artificially Made Bodies of Water*) An equipotential plane shall be installed where required in this section to mitigate step and touch voltages at electrical equipment.

(A) Areas Requiring Equipotential Planes. *(see NEC for complete text)*

(B) Areas Not Requiring Equipotential Planes. *(see NEC for complete text)*

(C) Bonding

(1) Bonded Parts. ~~Equipotential planes~~ The parts specified in 682.33(C)(1) through (C)(3) shall be bonded together and to the electrical grounding system. ~~The bonding conductor~~ Bonding conductors shall be solid copper, insulated, covered or bare, and not smaller than 8 AWG. Connections shall be made by exothermic welding or by listed pressure connectors or clamps that are labeled as being suitable for the purpose and are of stainless steel, brass, copper, or copper alloy.

(2) Outdoor Service Equipment and Disconnects. Outdoor service equipment or disconnecting means that control equipment in or on water, that have a metallic enclosure and controls accessible to personnel, and that are likely to become energized shall be bonded to the equipotential plane.

(3) Walking Surfaces. Surfaces directly below the equipment specified in 682.33(C)(2) but not less than 900 mm (36 in.) in all directions from the equipment from which a person would be able to stand and come in contact with the equipment shall be bonded to the equipotential plane. Bonding to this surface shall be wire mesh or other conductive elements on, embedded in, or placed under the walk surface within 75 mm (3 in.).

690 – Solar Photovoltaic (PV) Systems

690.2
Definition of Grounded, Functionally

Reason for Change:

The previous definition for "Functional Grounded PV System" was revised to "Grounded, Functionally." Informational Note also revised to clarify the operational purposes for functionally grounding a system.

690.2 Definitions. [*Solar Photovoltaic (PV) Systems*]

Functional Grounded, Functionally ~~PV System~~. A PV system that has an electrical ground reference ~~to ground~~ for operational purposes that is not solidly grounded.

Informational Note: A ~~functional~~ functionally grounded ~~PV~~ system is often connected to ground through ~~a fuse, circuit breaker, resistance device, non-isolated grounded ac circuit, or~~ an electronic means internal to an inverter or charge controller that ~~is part of a listed~~ provides ground-fault protection ~~system. Conductors in these systems that are normally at ground potential may have voltage to ground during fault conditions.~~ Examples of operational purposes for functionally grounded systems include ground-fault detection and performance- related issues for some power sources.

690.4(B)
Solar Photovoltaic (PV) Systems Equipment

Reason for Change:

Revision clarifies that if the listed PV equipment is not listed for the application then it must be field evaluated by a NRTL and have a field label applied if it passes the evaluation.

690.4 General Requirements. [*Solar Photovoltaic (PV) Systems*]

(B) Equipment. Inverters, motor generators, PV modules, ~~PV panels~~, ac modules and ac module systems, dc combiners, dc-to-dc converters, rapid shutdown equipment,

dc circuit controllers, and charge controllers intended for use in PV systems shall be listed or ~~field labeled~~ be evaluated for the PV application and have a field label applied.

690.8(A)
Maximum Current for Specific PV Circuits

Reason for Change:

Reorganization provides improvement to the understanding of the requirements for PV circuit sizing and current.

690.8 Circuit Sizing and Current. [*Solar Photovoltaic (PV) Systems*]

690.8 Circuit Sizing and Current.

(A) Calculation of Maximum Circuit Current. The maximum current for the specific circuit shall be calculated in accordance with one of the methods in 690.8(A)(1) through ~~(A)(6)~~ (A)(2).

~~**Informational Note:** Where the requirements of 690.8(A)(1) and (B)(1) are both applied, the resulting multiplication factor is 156 percent.~~

(1) ~~Photovoltaic Source Circuit Currents~~ PV System Circuits. The maximum current shall be calculated ~~by one of the following methods:~~ in accordance with 690.8(A)(1)(a) through (A)(1)(e).

(a) Photovoltaic Source Circuit Currents. The maximum current shall be as calculated in either of the following:

(1) The maximum current shall be the sum of ~~parallel-connected~~ the short-circuit current ratings of the PV ~~module-rated short-circuit currents~~ modules connected in parallel multiplied by 125 percent

(2) For PV systems with ~~a~~ an inverter generating capacity of 100 kW or greater, a documented and stamped PV system design, using an industry standard method and maximum current calculation provided by a licensed professional electrical engineer, shall be permitted. The calculated maximum current value shall be based on the highest 3-hour current average resulting from the simulated local irradiance on the PV array accounting for elevation and orientation. The current value used by this method shall not be less than 70 percent of the value calculated using 690.8(A)(1)(a)(1).

Informational Note: One industry standard method for calculating maximum current of a PV system is available from Sandia National Laboratories, reference SAND 2004-3535, Photovoltaic Array Performance Model. This model is used by the System Advisor Model simulation program provided by the National Renewable Energy Laboratory.

(b) Photovoltaic Output Circuit Currents. The maximum current shall be the sum of parallel source circuit maximum currents as calculated in 690.8(A)(1)(a). *[was 690.8(A)(2)]*

(c) DC-to-DC Converter Source Circuit Current. The maximum current shall be the dc-to-dc converter continuous output current rating. *[was 690.8(A)(5)]*

(d) DC-to-DC Converter Output Circuit Current. The maximum current shall be the sum of parallel connected dc-to-dc converter source circuit currents as calculated in ~~690.8(A)(5)~~ 690.8(A) (1)(c). *[was 690.8(A)(6)]*

(e) Inverter Output Circuit Current. The maximum current shall be the inverter continuous output current rating. *[was 690.8(A)(3)]*

(2) Circuits Connected to the Input of Electronic Power Converters. Where a circuit is protected with an overcurrent device not exceeding the conductor ampacity, the maximum current shall be permitted to be the rated input current of the electronic power converter input to which it is connected.

690.9(A)
Overcurrent Protection in Solar Photovoltaic (PV) Systems

Reason for Change:

Overcurrent Protection: Revision reorganizes 690.9(A) to eliminate exception. Three List Items are made for unique and different protection scenarios.

690.9 Overcurrent Protection. [*Solar Photovoltaic (PV) Systems*]

(A) Circuits and Equipment. PV system dc circuit and inverter output conductors and equipment shall be protected against overcurrent. ~~Overcurrent protective devices shall not be required for circuits with sufficient ampacity for the highest available current. Circuits connected to current limited supplies (e.g., PV modules, dc-to-dc converters, interactive inverter output circuits) and also connected to sources having higher current availability (e.g., parallel strings of modules, utility power) shall be protected at the higher current source connection.~~ Circuits sized in accordance

with 690.8(A)(2) are required to be protected against overcurrent with overcurrent protective devices. Each circuit shall be protected from overcurrent in accordance with 690.9(A)(1), (A)(2), or (A)(3).

(1) Circuits Where Overcurrent Protection Not Required. Overcurrent protective devices shall not be required where both of the following conditions are met:

(1) The conductors have sufficient ampacity for the maximum circuit current.
(2) The ~~short-circuit~~ currents from all sources do not exceed the ~~ampacity of the conductors and~~ maximum overcurrent protective device ~~size~~ rating specified for the PV module or ~~dc-to-dc~~ electronic power converter.

Exception: *An overcurrent device shall not be required for PV modules or PV source circuit or dc-to-dc converters source circuit conductors sized in accordance with 690.8(B) where one of the following applies:*

(1) *There are no external sources such as parallel-connected source circuits, batteries, or backfeed from inverters.*
(2) *The short-circuit currents from all sources do not exceed the ampacity of the conductors and the maximum overcurrent protective device size rating specified for the PV module or dc-to-dc converter.*

(2) Circuits Where Overcurrent Protection is Required on One End. A circuit conductor connected at one end to a current-limited supply, where the conductor is rated for the maximum circuit current from that supply, and also connected to sources having an available maximum circuit current greater than the ampacity of the conductor, shall be protected from overcurrent at the point of connection to the higher current source.

Informational Note: Photovoltaic system dc circuits and electronic power converter outputs powered by these circuits are current limited ~~circuits~~ and in some cases do not ~~that only~~ need overcurrent protection. ~~when connected in parallel~~ Where these circuits are connected to higher current sources, such as parallel-connected PV system dc circuits, energy storage systems, or a utility service, the overcurrent device is often installed at the higher current source end of the circuit conductor.

(3) Other Circuits. Circuits that do not comply with 690.9(A)(1) or (A)(2) shall be protected with one of the following methods:

(1) Conductors not greater than 3 m (10 ft) in length and not in buildings, protected from overcurrent on one end
(2) Conductors not greater than 3 m (10 ft) in length and in buildings, protected from overcurrent on one end and in a raceway or metal clad cable
(3) Conductors protected from overcurrent on both ends

(4) Conductors not installed on or in buildings are permitted to be protected from overcurrent on one end of the circuit where the circuit complies with all of the following conditions:

(a) The conductors are installed in metal raceways or metal-clad cables, or installed in enclosed metal cable trays, or underground, or where directly entering pad-mounted enclosures.
(b) The conductors for each circuit terminate on one end at a single circuit breaker or a single set of fuses that limit the current to the ampacity of the conductors.
(c) The overcurrent device for the conductors is an integral part of a disconnecting means or shall be located within 3 m (10 ft) of conductor length of the disconnecting means.
(d) The disconnecting means for the conductors is installed outside of a building, or at a readily accessible location nearest the point of entrance of the conductors inside of a building, including installations complying with 230.6.

690.12
Rapid Shutdown of PV Systems

Reason for Change:

The requirements for a Rapid Shutdown of PV systems received extensive revision again this *Code* cycle. A new product standard has been developed by UL so that hazardous energy levels within a PV array can be reduced when firefighters or other emergency response personnel are required to enter the array area to mitigate emergency conditions.

690.12 Rapid Shutdown of PV Systems on Buildings. [*Solar Photovoltaic (PV) Systems*] PV system circuits installed on or in buildings shall include a rapid shutdown function to reduce shock hazard for ~~emergency responders~~ fire fighters in accordance with 690.12(A) through (D).

Exception: *Ground-mounted PV system circuits that enter buildings, of which the sole purpose is to house PV system equipment, shall not be required to comply with 690.12.*

(A) Controlled Conductors. Requirements for controlled conductors shall apply to ~~PV circuits supplied by the PV system~~. the following:

(1) PV system dc circuits
(2) Inverter output circuits originating from inverters located within the array boundary

Informational Note: The rapid shutdown function reduces the risk of electrical shock that dc circuits in a PV system could pose for firefighters. The ac output conductors from PV systems that include inverters will either be de-energized after shutdown initiation or will remain energized by other sources such as a utility service. To prevent PV arrays with attached inverters from having energized ac conductors within the PV array(s), those circuits are also specifically controlled after shutdown initiation.

(B) Controlled Limits. The use of the term array boundary in this section is defined as 305 mm (1 ft) from the array in all directions. Controlled conductors outside the array boundary shall comply with 690.12(B)(1) and inside the array boundary shall comply with 690.12(B)(2).

(1) Outside the Array Boundary. Controlled conductors located outside the boundary or more than 1 m (3 ft) from the point of entry inside a building shall be limited to not more than 30 volts within 30 seconds of rapid shutdown initiation. Voltage shall be measured between any two conductors and between any conductor and ground.

(2) Inside the Array Boundary. The PV system shall comply with one of the following:

(1) ~~The~~ A PV ~~array~~ hazard control system listed ~~or field labeled as a rapid shutdown PV array~~ for the purpose ~~Such a PV array~~ shall be installed and used in accordance with the instructions included with the the ~~rapid shutdown PV array~~ listing or field labeling. Where a hazard control system requires initiation to transition to a controlled state, the rapid shutdown initiation device required in 690.12(C) shall perform this initiation.

Informational Note: A listed or field-labeled hazard ~~rapid shutdown~~ PV control system ~~array is evaluated as an assembly or system as defined in the installation instructions to reduce but not eliminate risk of electric shock hazard within a damaged PV array during fire-fighting procedures. These rapid shutdown PV arrays are designed to reduce shock hazards by methods such as limiting access to energized components, reducing the voltage difference between energized components, limiting the electric current that might flow in an electrical circuit involving personnel with increased resistance of the conductive circuit, or by a combination of such methods.~~ is comprised of either an individual piece of equipment that fulfills the necessary functions or multiple pieces of equipment coordinated to perform the functions as described in the installation instructions to reduce the risk of electric shock hazard within a damaged PV array for fire fighters. See UL 3741, Photovoltaic Hazard Control.

(2) Controlled conductors located inside the boundary ~~or not more than 1 m (3 ft) from the point of penetration of the surface of the building~~ shall be limited to not more than 80 volts within 30 seconds of rapid shutdown initiation. Voltage shall be measured between any two conductors and between any conductor and ground.
(3) PV arrays ~~with~~ shall have no exposed wiring methods, ~~no exposed~~ or conductive parts and be installed more than 2.5 m (8 ft) from exposed grounded conductive parts or ground ~~shall not be required to comply with 690.12(B)(2). The requirement of 690.12(B)(2) shall become effective January 1, 2019.~~

(C) Initiation Device. The initiation device(s) shall initiate the rapid shutdown function of the PV system. The device's "off" position shall indicate that the rapid shutdown function has been initiated for all PV systems connected to that device. For one-family and two-family dwellings, an initiation device(s) shall be located at a readily accessible location outside the building.

(C) Initiation Device. The initiation device(s) shall initiate the rapid shutdown function of the PV system. The device "off" position shall indicate that the rapid shutdown function has been initiated for all PV systems connected to that device. For one-family and two-family dwellings, an initiation device(s) shall be located at a readily accessible location outside the building.

For a single PV system, the rapid shutdown initiation ~~device(s)~~ shall occur by the operation of any single initiation device. Devices shall consist of at least one or more of the following:

(1) Service disconnecting means
(2) PV system disconnecting means
(3) Readily accessible switch that plainly indicates whether it is in the "off" or "on" position

Informational Note: ~~One~~ Examples of ~~why~~ where an initiation device that complies with 690.12(C) (3) would be used is where a PV system is connected to an optional standby ~~system that remains energized upon loss of utility voltage~~ or standalone system.

Where multiple PV systems are installed with rapid shutdown functions on a single service, the initiation device(s) shall consist of not more than six switches or six sets of circuit breakers, or a combination of not more than six switches and sets of circuit breakers, mounted in a single enclosure, or in a group of separate enclosures. These initiation device(s) shall initiate the rapid shutdown of all PV systems with rapid shutdown functions on that service. ~~Where auxiliary initiation devices are installed, these auxiliary devices shall control all PV systems with rapid shutdown functions on that service.~~

(D) Equipment. Equipment that performs the rapid shutdown functions, other than initiation devices such as listed disconnect switches, circuit breakers, or control switches, shall be listed for providing rapid shutdown protection.

~~**Informational Note:** Inverter input circuit conductors often remain energized for up to 5 minutes with inverters not listed for rapid shutdown.~~

690.13(A)
Photovoltaic System Disconnecting Means

Reason for Change:

New requirement calls for any PV disconnect enclosure with a door or hinged cover that exposes live parts when open to be locked or require a tool to open where a disconnecting means of systems above 30 volts are readily accessible to unqualified persons.

690.13 Photovoltaic System Disconnecting Means.

(A) Location. The PV system disconnecting means shall be installed at a readily accessible location. Where disconnecting means of systems above 30 volts are readily accessible to unqualified persons, any enclosure door or hinged cover that exposes live parts when open shall be locked or require a tool to open.

Informational Note: PV systems installed in accordance with 690.12 address the concerns related to energized conductors entering a building.

~~**(C) Suitable for Use.** If the PV system is connected to the supply side of the service disconnecting means as permitted in 230.82(6), the PV system disconnecting means shall be listed as suitable for use as service equipment.~~

690.13(E)
Types of Disconnects for Photovoltaic Systems

Reason for Change:

Previous List Items under “Type of Disconnect” has been removed and the revision summarizes the type of disconnects that may be used as a PV system disconnect. Lockability requirements of 110.25 are included.

690.13 Photovoltaic System Disconnecting Means.

~~**(F)**~~ **(E) Type of Disconnect.** ~~**(1) Simultaneous Disconnection.**~~ The PV system disconnecting means shall simultaneously disconnect the PV system conductors ~~of the circuit from all conductors of other wiring systems. The PV system disconnecting means shall be an externally operable general-use switch or circuit breaker, or other approved means. A dc PV system disconnecting means shall be marked for use in PV systems or be suitable for backfeed operation~~ that are not solidly grounded from all conductors of other wiring systems. The PV system disconnecting means or its remote operating device or the enclosure providing access to the disconnecting means shall be capable of being locked in accordance with 110.25. The PV system disconnecting means shall be one of the following:

(1) A manually operable switch or circuit breaker
(2) A connector meeting the requirements of 690.33(D)(1) or (D)(3)
(3) A pull-out switch with the required interrupting rating
(4) A remote‐controlled switch or circuit breaker that is operable locally and opens automatically when control power is interrupted
(5) A device listed or approved for the intended application

Informational Note: Circuit breakers marked "line" and "load" may not be suitable for backfeed or reverse current.

~~**(2) Devices Marked "Line" and "Load."** Devices marked with "line" and "load" shall not be permitted for backfeed or reverse current.~~
~~**(3) DC-Rated Enclosed Switches, Open-Type Switches, and Low-Voltage Power Circuit Breakers.** DC-rated, enclosed switches, open-type switches, and low-voltage power circuit breakers shall be permitted for backfeed operation.~~

690.15
Disconnecting Means for Photovoltaic Equipment

Reason for Change:

The requirements for disconnecting means for isolating PV equipment of PV systems received extensive revision to emphasis isolation of equipment from energized conductors.

690.15 ~~Disconnection of~~ Disconnecting Means for Photovoltaic Equipment.

~~Isolating devices~~ Disconnecting means of the type required in 690.15(D) shall be provided to ~~isolate~~ disconnect ~~PV modules~~, ac PV modules, fuses, dc-to- dc converters, inverters, and charge controllers from all conductors that are not solidly grounded. An equipment disconnecting means or a PV system disconnecting means shall be permitted in place of an isolating device. Where the maximum circuit current is greater than 30 amperes for the output circuit of a dc combiner or the input circuit of a charge controller or inverter, an equipment disconnecting means shall be provided for isolation. Where a charge controller or inverter has multiple input circuits, a single equipment disconnecting means shall be permitted to isolate the equipment from the input circuits.

~~**Informational Note:** The purpose of these isolating devices is the safe and convenient replacement or service of specific PV system equipment without exposure to energized conductors.~~

(A) Location. Isolating devices or equipment disconnecting means shall be installed in circuits connected to equipment at a location within the equipment, or within sight and within 3 m (10 ft) of the equipment. An equipment disconnecting means shall be permitted to be remote from the equipment where the equipment disconnecting means can be remotely operated from within 3 m (10 ft) of the equipment. Where disconnecting means of equipment operating above 30 volts are readily accessible to unqualified persons, any enclosure door or hinged cover that exposes live parts when open shall be locked or require a tool to open.

~~**(B) Interrupting Rating.** An equipment disconnecting means shall have an interrupting rating sufficient for the maximum short-circuit current and voltage that is available at the terminals of the equipment. An isolating device shall not be required to have an interrupting rating.~~

(B)~~(C)~~ Isolating Device. An isolating device shall not be required to have an interrupting rating. Where an isolating device ~~shall be~~ is not rated ~~to open the maximum circuit current under load or be~~ for interrupting the circuit current, it shall be marked “Do Not Disconnect Under Load” or “Not for Current Interrupting.” An isolating device shall not be required to simultaneously disconnect all current-carrying conductors of a circuit. The isolating device shall be one of the following:

(1) A mating connector meeting the requirements of 690.33 and listed and identified for use with specific equipment
(2) A finger safe fuse holder
(3) An isolating switch that requires a tool to place the device in the ~~to~~ open (off) position
(4) An isolating device listed for the intended application

(C) ~~(D)~~ Equipment Disconnecting Means. Equipment disconnecting means shall have ratings sufficient for the maximum circuit current, available fault current, and voltage that is available at the terminals. An equipment disconnecting means shall simultaneously disconnect all current carrying conductors that are not solidly grounded ~~of~~ to the circuit to which it is connected. ~~An~~ Equipment disconnecting means shall be externally operable without exposing the operator to contact with energized parts~~,~~ and shall indicate whether in the open (off) or closed (on) position. ~~and shall be lockable~~ Where not within sight and within 3 m (10 ft) of the equipment, the disconnecting means or its remote operating device or enclosure providing access to the disconnecting means shall be capable of being locked in accordance with 110.25. ~~An~~ Equipment disconnecting means shall be ~~one of the following devices:~~ of the same type as required in 690.13(E).

~~**(1)** A manually operable switch or circuit breaker~~
~~**(2)** A connector meeting the requirements of 690.33(E)(1)~~
~~**(3)** A load break fused pull out switch~~
~~**(4)** A remote-controlled circuit breaker that is that is operable locally and opens automatically when control power is Interrupted~~

~~For~~ Equipment disconnecting means, other than those complying with 690.33, ~~where~~ the shall be marked in accordance with the warning in 690.13(B) if the line and load terminals can be energized in the open position~~, the device shall be marked in accordance with the warning in 690.13(B).~~

Informational Note: A common installation practice is to terminate PV source-side dc conductors in the same manner that utility source-side ac conductors are generally connected on the line side of a disconnecting means. This practice is more likely to de-energize load-side terminals, blades, and fuses when the disconnect is in the open position and no energized sources are connected to the load side of the disconnect.

(D) Type of Disconnecting Means. Where disconnects are required to isolate equipment, the disconnecting means shall be one of the following applicable types:

(1) An equipment disconnecting means in accordance with 690.15(C) shall be required to isolate dc circuits with a maximum circuit current over 30 amperes.
(2) An isolating device in accordance with 690.15(B) shall be permitted for circuits other than those covered by 690.15(D)(1).

690.31
Wiring Methods for PV Installations

Reason for Change:

Wiring methods for PV installations were previously located in various areas. Revisions to 690.31 organized PV wiring methods into one section. Installation and listing requirements for a new Distributed Generation (Type DG) cable were introduced.

690.31 Wiring Methods Permitted [*Solar Photovoltaic (PV) Systems*]

(A) Wiring Systems.

Table 690.31(A)(a) Correction Factors
Table 690.31(A)(b) Ampacities of Insulated Conductors Rated Up To and Including 2000 Volts, 105°C Through 125°C (221°F Through 257°F), Not More Than Three Current-Carrying Conductors in Raceway, Cable, or Earth (Directly Buried), Based on Ambient Temperature of 30°C (86°F)

(B) Identification and Grouping.

(1) Identification.
(2) Grouping.

(C) Cables.

(1) Single-Conductor Cable.
(2) Cable Tray.
(3) Multiconductor Jacked Cables.
(4) Flexible Cords and Cables Connected to Tracking PV Arrays.
(5) Flexible, Fine-Stranded Cables.
(6) Small-Conductor Cables.

(D) ~~Photovoltaic System~~ Direct-Current Circuits on or in ~~a Building~~ Buildings.

~~(1) Embedded in Building Surfaces.~~
(1) Flexible Wiring Methods.
(2) Marking and Labeling Required.
~~(4) Marking and Labeling Methods and Locations.~~

(E) Bipolar Photovoltaic Systems.

~~(F) Wiring Methods and Mounting Systems.~~

~~**(H) Flexible, Fine-Stranded Cables.**~~

(See NEC for complete Code text)

690.33(C)
Mating Connectors for Photovoltaic PV Systems

Reason for Change:

Mating connectors not of the identical type and brand are required to be "listed and identified for intermatability," as described in the manufacturer's instructions.

690.33 Mating Connectors. [*Solar Photovoltaic (PV) Systems*]

Mating connectors, other than ~~those~~ connectors covered by 690.32, shall comply with 690.33(A) through ~~(E)~~ (D).

(A) Configuration. The mating connectors shall be polarized and shall have a configuration that is noninterchangeable with receptacles in other electrical systems on the premises.

(B) Guarding. The mating connectors shall be constructed and installed so as to guard against inadvertent contact with live parts by persons.

(C) Type. The mating connectors shall be of the latching or locking type. Mating connectors that are readily accessible and that are used in circuits operating at over 30 volts dc or 15 volts ac shall require a tool for opening. Where mating connectors are not of the identical type and brand, they shall be listed and identified for intermatability, as described in the manufacturer's instructions.

~~**(D) Grounding Member.** The grounding member shall be the first to make and the last to break contact with the mating connector.~~

~~**(E)**~~ **(D) Interruption of Circuit.** Mating connectors shall be ~~either (1) or (2)~~ one of the following:

(1) ~~Be~~ Rated for interrupting current without hazard to the operator
(2) ~~Be~~ A type that requires the use of a tool to open and marked "Do Not Disconnect Under Load" or "Not for Current Interrupting"
(3) Supplied as part of listed equipment and used in accordance with instructions provided with the listed connected equipment

Informational Note: Some listed equipment, such as microinverters, are evaluated to make use of mating connectors as disconnect devices even though the mating connectors are marked as "Do Not Disconnect Under Load" or "Not for Current Interrupting."

690.41(B)
PV System dc Circuits Exceeding 30 Volts or 8 Amperes

Reason for Change:

PV system dc circuits (*not just the arrays*) that exceed 30 volts or 8 amperes are now required to be provided with dc ground-fault protection.

690.41 System Grounding [*Solar Photovoltaic (PV) Systems*]

(B) Ground-Fault Protection. ~~DC~~ PV system ~~arrays~~ dc circuits that exceed 30 volts or 8 amperes shall be provided with dc ground-fault protection meeting the requirements of 690.41(B)(1) and (2) to reduce fire hazards.

~~Exception:~~ ~~PV arrays~~ Solidly grounded PV source circuits with not more than two ~~PV source circuits and with all PV system dc circuits~~ modules in parallel and not on or in buildings shall be permitted without ground-fault protection where solidly grounded.

Informational Note: Not all inverters, charge controllers, or dc-to-dc converters include groundfault protection. Equipment that does not have ground-fault protection often includes the following statement in the manual: "Warning: This unit is not provided with a GFDI device."

(1) Ground-Fault Detection. The ground-fault ~~protective~~ protection device or system shall detect ground fault(s) in the PV ~~array~~ system dc ~~current- carrying~~ circuit conductors and components, including any functional grounded conductors, and be listed for providing PV ground-fault protection. For dc-to-dc converters not listed as providing ground-fault protection, where required, listed ground fault protection equipment identified for the combination of the dc-to-dc converter and ground-fault protection device shall be installed to protect the circuit.

Informational Note: Some dc-to-dc converters without integral ground-fault protection on their input (source) side can prevent other ground-fault protection equipment from properly functioning on portions of PV system dc circuits.

(2) ~~Isolating~~ Faulted Circuits. The faulted circuits shall be ~~isolated~~ controlled by one of the following methods:

(1) The current-carrying conductors of the faulted circuit shall be automatically disconnected.
(2) The ~~inverter or charge controller~~ device providing ground-fault protection fed by the faulted circuit shall automatically cease to supply power to output circuits and ~~isolate~~ interrupt the faulted PV system dc circuits from the ground reference in a ~~functional~~ functionally grounded system.
(3) Indication of Faults. Ground-fault protection equipment shall provide indication of ground faults at a readily accessible location.

Informational Note: Examples of indication include, but are not limited to, the following: remote indicator light, display, monitor, signal to a monitored alarm system, or receipt of notification by web-based services.

690.51, ~~690.52~~, 690.53
Marking of Modules and AC Modules

Reason for Change:

Information outlined at previous 690.51, 690.52, and 690.53 that is required as part of the listing requirement of this equipment has been deleted as it is being provided on the device by the manufacturer.

Part VI. Marking [*Solar Photovoltaic (PV) Systems*]

690.51 Modules and AC Modules. Modules and ac modules shall be marked in accordance with their listing. ~~identification of terminals or leads as to polarity, maximum overcurrent device rating for module protection, and with the following ratings:~~

~~**(1)** Open-circuit voltage~~
~~**(2)** Operating voltage~~
~~**(3)** Maximum permissible system voltage~~
~~**(4)** Operating current~~
~~**(5)** Short-circuit current~~
~~**(6)** Maximum power~~

~~**690.52 Alternating-Current Photovoltaic Modules.** Alternating-current modules shall be marked with identification of terminals or leads and with identification of the following ratings:~~

~~**(1)** Nominal operating ac voltage~~
~~**(2)** Nominal operating ac frequency~~
~~**(3)** Maximum ac power~~
~~**(4)** Maximum ac current~~
~~**(5)** Maximum overcurrent device rating for ac module protection~~

690.53 ~~Direct-Current Photovoltaic Power Source~~ DC PV Circuits. A permanent readily visible label ~~for the dc PV power source indicating the information specified in (1) through (3) shall be provided by the installer at dc PV system disconnecting means and at each dc equipment disconnecting means required by 690.15. Where a disconnecting means has more than one dc PV power source, the values in 690.53(1) through (3) shall be specified for each source.~~ indicating the highest maximum dc voltage in a PV system, calculated in accordance with 690.7, shall be provided by the installer at one of the following locations:

(1) ~~Maximum voltage~~ DC PV system disconnecting means

~~**Informational Note to (1):** See 690.7 for voltage.~~

(2) ~~Maximum circuit current~~ PV system electronic power conversion equipment

~~**Informational Note to (2):** See 690.8(A) for calculation of maximum circuit current.~~

(3) ~~Maximum rated output current of the charge controller or dc-to-dc converter (if installed)~~ Distribution equipment associated with the PV system

690.56(C)
Identification of Power Sources

Reason for Change:

Several changes were made to 690.56(C) to address the updated requirements in 690.12. The title of the remaining figure has been changed to identify this figure as an informational note figure to clarify that the label as shown is merely an example of a rapid shutdown system label.

690.56 Identification of Power Sources. [*Solar Photovoltaic (PV) Systems*]

(C) Buildings with Rapid Shutdown. Buildings with PV systems shall have permanent labels as ~~described in 690.56(C) (1) through (C)(3).~~ located at each service equipment location to which the PV systems are connected or at an approved readily visible location and shall indicate the location of rapid shutdown initiation devices.

The label shall include a simple diagram of a building with a roof and shall include the following words:

~~**(1) Rapid Shutdown Type.** The type of PV system rapid shutdown shall be labeled as described in 690.56(C)(1)(a) or (1)(b):~~

~~**(a)** For PV systems that shut down the array and conductors leaving the array:~~

SOLAR PV SYSTEM IS EQUIPPED WITH
RAPID SHUTDOWN.
TURN RAPID SHUTDOWN SWITCH
TO THE "OFF" POSITION
TO SHUT DOWN PV SYSTEM AND RE-
DUCE SHOCK
HAZARD IN ARRAY.

The title "SOLAR PV SYSTEM IS EQUIPPED WITH RAPID SHUTDOWN" shall utilize capitalized characters with a minimum height of 9.5 mm (3⁄8 in.) in black on yellow background, and the remaining characters shall be capitalized with a minimum height of 4.8 mm (3⁄16 in.) in black on white background. ~~[See Figure 690.56(C)(1)(a).]~~

Informational Note: See Informational Note Figure 690.56(C).

Figure Informational Note Figure 690.56(C) Label for Roof-Mounted PV Systems with Rapid Shutdown.

[See NEC and illustration provided for Figure Informational Note Figure 690.56(C)]

~~FIGURE 690.56(C)(1)(a) Label for PV Systems that Shut Down the Array and the Conductors Leaving the Array.~~

~~**(b)** For PV systems that only shut down conductors leaving the array:~~

SOLAR PV SYSTEM IS EQUIPPED WITH
RAPID SHUTDOWN
TURN RAPID SHUTDOWN SWITCH TO
THE "OFF" POSITION
TO SHUT DOWN
CONDUCTORS OUTSIDE THE ARRAY.
CONDUCTORS IN
ARRAY REMAIN
ENERGIZED IN SUNLIGHT.

~~The title "SOLAR PV SYSTEM IS EQUIPPED WITH RAPID SHUTDOWN" shall utilize capitalized characters with a minimum height of 9.5 mm (3⁄8 in.) in white on red~~

~~background, and the remaining characters shall be capitalized with a minimum height of 4.8 mm (3⁄16 in.) in black on white background. [See Figure 690.56(C)(1)(b).] The labels in 690.56(C)(1)(a) and (b) shall include a simple diagram of a building with a roof. The diagram shall have sections in red to signify sections of the PV system that are not shut down when the rapid shutdown switch is operated.~~

~~The rapid shutdown label in 690.56(C)(1) shall be located on or no more than 1 m (3 ft) from the service disconnecting means to which the PV systems are connected and shall indicate the location of all identified rapid shutdown switches if not at the same location.~~

(1) ~~(2)~~ Buildings with More Than One Rapid Shutdown Type. For buildings that have PV systems with ~~both~~ more than one rapid shutdown types or a PV systems with ~~a~~ no rapid shutdown ~~type and a PV system with no rapid shutdown,~~ a detailed plan view diagram of the roof shall be provided showing each different PV system ~~and~~ with a dotted line around areas that remain energized after the rapid shutdown ~~switch~~ is ~~operated~~ initiated.

(2) ~~(3)~~ Rapid Shutdown Switch. A rapid shutdown switch shall have a label that includes the following wording located on or no more than 1 m (3 ft) from the switch ~~that includes the following wording~~:

RAPID SHUTDOWN SWITCH FOR SO-
LAR PV SYSTEM

The label shall be reflective, with all letters capitalized and having a minimum height of 9.5 mm (3⁄8 in.), in white on red background.

~~FIGURE 690.56(C)(1)(b) Label for PV Systems that Shut Down the Conductors Leaving the Array Only.~~

691 – Large-Scale Photovoltaic (PV) Electric Supply Stations

Informational Note Figure 691.1
I-Note No. 3 and Informational Note Figure 691.1

Reason for Change:

A new I-Note No. 3 and Informational Note Figure 691.1 were added to Article 691 as an aid in interpretation.

691.1 Scope. [*Large-Scale Photovoltaic (PV) Electric Power ~~Production Facility~~ Supply Stations]*

This article covers the installation of large-scale PV electric ~~power production facilities with a~~ supply stations with an inverter generating capacity of no less than 5000 kW, and not under exclusive utility control.

Informational Note No. 1: Facilities covered by this article have specific design and safety features unique to large-scale PV facilities and are operated for the sole purpose of providing electric supply to a system operated by a regulated utility for the transfer of electric energy.

Informational Note No. 2: Section 90.2(B)(5) includes information about utility-owned properties not covered under this Code. For additional information on electric supply stations, see ANSI/ IEEE C2-2012 2017, National Electrical Safety Code.

Informational Note No. 3: See Informational Note Figure 691.1.

Figure Informational Note Figure 691.1 Identification of Large Scale PV Electric Supply Station Components.

(See NEC and illustration provided for complete figure)

692 – Fuel Cell Systems

692.4(B)
Identification of Power Sources in Fuel Cell Systems

Reason for Change:

Three separate List Items where created to clearly identify the requirements

for different fuel cell system types to add clarity to the placarding of these systems.

692.4 Installations (*Fuel Cell Systems*)

(A) Fuel Cell System. A fuel cell system shall be permitted to supply a building or other structure in addition to any service(s) of another electricity supply system(s).

(B) Identification of Power Sources. ~~A permanent plaque or directory, denoting all electric power sources on or in the premises, shall be installed at each service equipment location.~~ Fuel cell systems shall be identified according to 692.4(B)(1) through (B)(3).

(1) Interconnected AC Systems. Plaques or directories shall be installed in accordance with 705.10.
(2) DC Microgrid Systems. Plaques or directories shall be installed in accordance with 712.10.
(3) Stand-Alone Systems. Plaques or directories shall be installed in accordance with 710.10.

(C) System Installation. Fuel cell systems including all associated wiring and interconnections shall be installed by only qualified persons.

Informational Note: See Article 100 for the definition of qualified person.

695 – Fire Pumps

695.3(C)(3)
Selective Coordination of OCPD for Fire Pumps

Reason for Change:

New provisions were added providing guidance for selective coordination of OCPD for fire pumps.

695.3 Power Source(s) for Electric Motor-Driven Fire Pumps.

Electric motor-driven fire pumps shall have a reliable source of power.

Informational Note: See Sections 9.3.2 and A.9.3.2 from NFPA 20-~~2013~~ 2016, Standard for the Installation of Stationary Pumps for Fire Protection, for guidance on the determination of power source reliability.

(A) Individual Sources. *(See NEC for complete text)*

(B) Multiple Sources. *(See NEC for complete text)*

(C) Multibuilding Campus-Style Complexes. If the sources in 695.3(A) are not practicable and the installation is part of a multibuilding campus-style complex, feeder sources shall be permitted if approved by the authority having jurisdiction and installed in accordance with either 695.3(C)(1) and (C)(3) or (C) (2) and (C)(3).

(1) Feeder Sources. *(See NEC for complete text)*
(2) Feeder and Alternate Source. *(See NEC for complete text)*
(3) Selective Coordination. ~~The~~ Overcurrent protective device(s) ~~in each disconnecting means~~ shall be selectively coordinated with ~~any other~~ all supply-side overcurrent protective device(s).

Selective coordination shall be selected by a licensed professional engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems. The selection shall be documented and made available to those authorized to design, install, maintain, and operate the system.

Exception: *Selective coordination shall not be required between two overcurrent devices located in series if no loads are connected in parallel with the downstream device.*

695.6(J)
Terminations Fittings at a Fire Pump Controller

Reason for Change:

Revision were made to align the allowable wiring methods in 695.6(D) with the required terminations fittings at a fire pump controller. Cable fittings that are listed for the wiring method used and with a type rating at least equal to that of the fire pump controller are appropriate for these installations.

695.6 Power Wiring. (*Fire Pumps*)

Power circuits and wiring methods shall comply with the requirements in 695.6(A) through (J), and as permitted in 230.90(A), Exception No. 4; 230.94, Exception No. 4; 240.13; 230.208; 240.4(A); and 430.31.

(J) ~~Raceway~~ Terminations. Where raceways or cable are terminated at a fire pump controller, the following requirements shall be met: ~~[20:9.9]~~

(1) ~~Listed conduit hubs~~ Raceway or cable fittings listed and identified for use in wet locations shall be used. ~~[20:9.9.1]~~
(2) The type rating of the ~~conduit hub(s)~~ raceway or cable fittings shall be at least equal to that of the fire pump controller. ~~[20:9.9.2]~~
(3) The installation instructions of the manufacturer of the fire pump controller shall be followed. ~~[20:9.9.3]~~
(4) Alterations to the fire pump controller, other than ~~conduit entry~~ raceway or cable terminations as allowed elsewhere in this *Code*, shall be approved by the authority having jurisdiction. ~~[20:9.9.4]~~

Quiz Questions

1. **Listing and labeling of electric signs & outline lighting are required to be?**

   - Marked with manufacturer's name
   - Applied prior to servicing
   - Marked with input voltage and current rating
   - All of the above

2. **Which of the following are covered by article 605?**

   - Freestanding desks
   - Storage Units
   - Shelving units
   - Connected cubicle

3. **Article 625 title was updated for clarity as it pertains to which of the following for electric vehicles?**

   - Charging
   - Power export
   - Bidirectional current flow
   - All of the above

4. **Why was article 625.44 revised?**

   - It was expanded to include certain 250-volt rated receptacles
   - It was reduced to remove certain 250-volt rated receptacles
   - It was overly restrictive to EV vehicle manufactures
   - It was modified to remove outdated terms and improve clarity

5. **When is GFCI protection required for receptacles installed for the connection of electric vehicle charging?**

   - Only for 125 volt, 15 – 20 ampere
   - Only for 250 volt, 30 – 50 ampere
   - GFCI protection is not required
   - All require GFCI protection

6. **Do on-board receptacles located in an electric vehicle require GFCI protection?**

   - No, it is in a vehicle and not covered by the code
   - No, electric vehicles do not have AC receptacles on-board
   - Yes, but is isolated to hybrid type vehicles
   - Yes, it is a new requirement

7. **Why where pool sanitation chemicals are stored considered a corrosive environment?**

   - There is a high risk of corrosion due to the presence of oxidizers and chlorinating agents
   - The tendency for pool chemicals to spill and leak causing a fire hazard
   - Modern chemicals do not pose a risk but code remains for antiquated chemicals
   - None of the above

8. **Why was article 680.4 added?**

   - To address hazards associated with new pool installations
   - To address hazards associated with aging pool installations
   - To ensure the AHJ (Authority Having Jurisdiction) remains employed
   - All of the above

9. **Regarding underground wiring adjacent pools, what is the minimum distance from the pool that certain wiring methods are permitted?**

   - 1 ft.
   - 5 ft.
   - 22.5 ft.
   - 100 ft.

10. **Replacing an aging pool motor now requires what?**

   - Listing and label of new motor
   - Maintenance label indicating replacement date, input voltage, current, etc.
   - GFCI protection
   - Complete pool inspection by AHJ.

11. **Which of the following other equipment can be closer than 5 feet to a pool without a barrier?**

   - Ceiling fan
   - Pool pump
   - Low-voltage lighting
   - No electrical equipment can be within 5ft of a pool

12. **Regarding equipotential bonding, which of the following can be used for the pool perimeter?**

   - Structural reinforcing steel
   - Copper ring
   - Copper grid
   - All of the above

13. **Do metallic anchors used for pool safety covers require to be bonded?**

- Yes
- No
- Yes, only if within 5 ft. of pool
- None of the above

14. **A fountain installation is being installed with a 125-volt non-submersible pump, the receptacle is not GFCI protected, is the code violated?**

- Yes
- No
- No, as it is single phase under 60 amperes
- No, as it is non-submersible

15. **A walking surface adjacent a man-made pond is being designed, you notice it runs close too some electrical equipment and determine an area of the surface needs to be bonded because?**

- it is within 5 ft. of the pond
- it is within 36 in. to the equipment
- it has low-voltage lighting
- None of the above

16. **Which article should be referenced for solar photovoltaic circuit sizing & current?**

- 690.8
- 680.9
- 690.4
- 690.2

17. **What is the purpose of the rapid shutdown function on solar photovoltaic systems on buildings?**

- To reduce fire hazards
- To reduce hazards for service technicians
- To reduce shock hazards for firefighters
- To prevent system overload

18. **Is the photovoltaic system disconnecting means required to be locked?**

- Yes
- No
- Never, defeats the purpose
- Only on systems above 30 volts & readily accessible to unqualified persons

19. **What is the new type DG cable?**

- Data Group
- Directional Gauge
- Distributed Generation
- Doggone

20. **Which plaque(s) are required on fuel cell systems?**

- Interconnected AC systems
- DC microgrid systems
- Stand-alone systems
- All of the above