City of Phoenix
PLANNING & DEVELOPMENT DEPARTMENT

BUILDING CONSTRUCTION CODE CHANGE PROPOSAL

Proposed Amendments to the 2011 National Electrical Code
Section 210.8(B)(6)

Submitted by: Phoenix Planning and Development Department Code Committee

ARTICLE 210 – Branch Circuits

Section 210.8 Ground-Fault Circuit-Interrupter Protection for Personnel.

(B) Other Than Dwelling Units. All 125-volt, single-phase, 15- and 20-ampere receptacles installed in the locations specified in 210.8(B)(1) through (8) shall have ground-fault circuit-interrupter protection for personnel.

(6) Indoor damp and wet locations

Reasons:
Added safety in damp locations indoors. This is a continuation of previous code amendments.

NEC Article 100 defines Damp Location as follows: Locations protected from weather and not subject to saturation with water or other liquids but subject to moderate degrees of moisture. Examples of such locations include partially protected locations under canopies, marquees, roofed open porches, and like locations, and interior locations subject to moderate degrees of moisture, such as some basements, some barns, and some cold-storage warehouses.

Additionally NEC Section 406.9(A) requires that a receptacle located in any damp location is installed in a weatherproof enclosure.

Since receptacles located in an outdoor damp location require GFCI protection, logically, receptacles located in an indoor damp location should also be provided with the same GFCI protection.

Cost Impact: Minimal additional cost.

ACTION TAKEN:

2012 Code Committee				Date: 10/22/12
☒ Approved as submitted	☐ Modified and approved	☐ Denied	☐ No action taken	
Development Advisory Board Technical Subcommittee				Date: 11/15/12
☒ Approved as submitted	☐ Modified and approved	☐ Denied	☐ No action taken	
Development Advisory Board				Date: 11/15/12
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Council Subcommittee				Date: 4/16/13
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City Council Action				Date: 5/15/13
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City of Phoenix
PLANNING & DEVELOPMENT DEPARTMENT

BUILDING CONSTRUCTION CODE CHANGE PROPOSAL

Proposed Amendments to 2011 National Electrical Code Section 225.36

Submitted by: Electrical Section – Rob Runge, PE, Electrical Technical Lead

~~**225.36 Suitable for Service Equipment.** The disconnecting means specified in 225.31 shall be suitable for use as service equipment.~~

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

225.36 Type. The disconnecting means specified in 225.31 shall be comprised of a circuit breaker, molded case switch, general-use switch, snap switch, or other approved means. Where applied in accordance with 250.32(B), Exception No. 1, the disconnecting means shall be suitable for use as service equipment.

Reasons:
Amendment replaces Section 225.36 as written in 2011 National Electrical Code with Section 225.36 as written in 2014 National Electrical Code.

The 2014 National Electrical Code revised 225.36 to require a service rated disconnecting means only where the grounded conductor is also used as the return path for ground-fault current per 250.32(B)(1).

Cost Impact:
Cost decrease

Approved in previous 2011 Code Adoption process: ☐ **YES** ☒ **NO**

ACTION TAKEN:

2015 Code Committee				Date: 1/14/16
☒ Approved as submitted	☐ Modified and approved	☐ Denied	☐ No action taken	
Development Advisory Board Technical Subcommittee				Date: 3/17/16
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Development Advisory Board				Date: 5/19/16
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Neighborhoods, Housing and Development Subcommittee				Date: 6/21/2016
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City of Phoenix
PLANNING & DEVELOPMENT DEPARTMENT

BUILDING CONSTRUCTION CODE CHANGE PROPOSAL

Proposed Amendments to the 2011 National Electrical Code
Section 250.118

Submitted by: Phoenix Planning and Development Department Code Committee

ARTICLE 250 - Grounding and Bonding

250.118 Types of Equipment Grounding Conductors.
The equipment grounding conductor run with or enclosing the circuit conductors shall be one or more or a combination of the following:

(1) A copper, aluminum, or copper-clad aluminum conductor. This conductor shall be solid or stranded; insulated, covered, or bare; and in the form of a wire or a busbar of any shape.

(2) Rigid metal conduit.

(3) Intermediate metal conduit.

(4) Electrical metallic tubing <u>with an additional equipment grounding conductor</u>.

(5) Listed flexible metal conduit meeting all the following conditions:

a. The conduit is terminated in listed fittings.

b. The circuit conductors contained in the conduit are protected by overcurrent devices rated at 20 amperes or less.

c. The combined length of flexible metal conduit and flexible metallic tubing and liquidtight flexible metal conduit in the same ground-fault current path does not exceed 1.8 m (6 ft).

d. If used to connect equipment where flexibility is necessary to minimize the transmission of vibration from equipment or to provide flexibility for equipment that requires movement after installation, an equipment grounding conductor shall be installed.

(6) Listed liquidtight flexible metal conduit meeting all the following conditions:

a. The conduit is terminated in listed fittings.

b. For metric designators 12 through 16 (trade sizes 3/8 through 1/2), the circuit conductors contained in the conduit are protected by overcurrent devices rated at 20 amperes or less.

c. For metric designators 21 through 35 (trade sizes 3/4 through 1-1/4), the circuit conductors contained in the conduit are protected by overcurrent devices rated not more than 60 amperes and there is no flexible metal conduit, flexible metallic tubing, or liquidtight flexible metal conduit in trade sizes metric designators 12 through 16 (trade sizes 3/8 through 1/2) in the ground-fault current path.

d. The combined length of flexible metal conduit and flexible metallic tubing and liquidtight flexible metal conduit in the same ground-fault current path does not exceed 1.8 m (6 ft).

e. If used to connect equipment where flexibility is necessary to minimize the transmission of vibration from equipment or to provide flexibility for equipment that requires movement after

installation, an equipment grounding conductor shall be installed.

(7) Flexible metallic tubing where the tubing is terminated in listed fittings and meeting the following conditions:

a. The circuit conductors contained in the tubing are protected by overcurrent devices rated at 20 amperes or less.

b. The combined length of flexible metal conduit and flexible metallic tubing and liquidtight flexible metal conduit in the same ground-fault current path does not exceed 1.8 m (6 ft).

(8) Armor of Type AC cable as provided in 320.108.

(9) The copper sheath of mineral-insulated, metal-sheathed cable.

(10) Type MC cable that provides an effective ground-fault current path in accordance with one or more of the following:

a. It contains an insulated or uninsulated equipment grounding conductor in compliance with 250.118(1)

b. The combined metallic sheath and uninsulated equipment grounding/bonding conductor of interlocked metal tape–type MC cable that is listed and identified as an equipment grounding conductor

c. The metallic sheath or the combined metallic sheath and equipment grounding conductors of the smooth or corrugated tube-type MC cable that is listed and identified as an equipment grounding conductor

(11) Cable trays as permitted in 392.10 and 392.60.

(12) Cablebus framework as permitted in 370.3.

(13) Other listed electrically continuous metal raceways and listed auxiliary gutters.

(14) Surface metal raceways listed for grounding.

Reasons:
This amendment requires that specific wiring methods include an individual equipment-grounding conductor. This amendment is more restrictive than the NEC, but provides for a higher degree of equipment grounding safety. The intent of the amendment is to supplement the low impedance path to ground and to attain reasonable compliance with requirements for the performance of the fault current path.

Note: This amendment is, essentially, a continuation of the amendment to the currently adopted code, 2008 NEC, with updated code language from the 2011 NEC.

Cost Impact: Minimal additional cost due to additional grounding conductor.

ACTION TAKEN:

2012 Code Committee				Date: 10/22/12
☒ Approved as submitted	☐ Modified and approved	☐ Denied	☐ No action taken	
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Development Advisory Board				Date: 11/15/12
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Council Subcommittee			Date: 4/16/13
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City Council Action			Date: 5/15/13
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City of Phoenix
PLANNING & DEVELOPMENT DEPARTMENT

BUILDING CONSTRUCTION CODE CHANGE PROPOSAL

Proposed Amendments to 2011 National Electrical Code
Section 310.15(B)(7)

Submitted by: Electrical Section – Rob Runge, PE, Electrical Technical Lead

Amendment deletes Section 310.15(B)(7) in its entirety, including Table 310.15(B)(7), as written in the 2011 National Electrical Code and replaces it with Section 310.15(B)(7) in its entirety as written in the 2014 National Electrical Code.

~~**(7) 120/240-Volt, 3-Wire, Single-Phase Dwelling Services and Feeders.**~~
~~For individual dwelling units of one-family, two-family, and multifamily dwellings, conductors, as listed in Table 310.15(B)(7), shall be permitted as 120/240-volt, 3-wire, single-phase service-entrance conductors, service-lateral conductors, and feeder conductors that serve as the main power feeder to each dwelling unit and are installed in raceway or cable with or without an equipment grounding conductor. For application of this section, the main power feeder shall be the feeder between the main disconnect and the panelboard that supplies, either by branch circuits or by feeders, or both, all loads that are part or associated with the dwelling unit. The feeder conductors to a dwelling unit shall not be required to have an allowable ampacity rating greater than their service-entrance conductors. The grounded conductor shall be permitted to be smaller than the ungrounded conductors, provided the requirements of 215.2, 220.61, and 230.42 are met.~~

~~**Table 310.15(B)(7) Conductor Types and Sizes for 120/240-Volt, 3-Wire, Single-Phase Dwelling Services and Feeders. Conductor Types RHH, RHW, RHW-2, THHN, THHW, THW, THW-2, THWN, THWN-2, XHHW, XHHW-2, SE, USE, USE-2**~~

	Conductor (AWG or kcmil)	
Service or Feeder Rating (Amperes)	Copper	Aluminum or Copper-Clad Aluminum
100	4	2
110	3	1
125	2	1/0
150	1	2/0
175	1/0	3/0
200	2/0	4/0
225	3/0	250
250	4/0	300
300	250	350
350	350	500
400	400	600

(7) 120/240-Volt, Single-Phase Dwelling Services and Feeders.
For one-family dwellings and the individual dwelling units of two-family and multifamily dwellings, service and feeder conductors supplied by a single-phase, 120/240-volt system shall be permitted be sized in accordance with 310.15(B)(7)(1) through (4).

(1) For a service rated 100 through 400 A, the service conductors supplying the entire load associated with a one-family dwelling, or the service conductors supplying the entire load

associated with an individual dwelling unit in a two-family or multifamily dwelling, shall be permitted to have an ampacity not less than 83 percent of the service rating.

(2) For a feeder rated 100 through 400 A, the feeder conductors supplying the entire load associated with a one-family dwelling, or the feeder conductors supplying the entire load associated with an individual dwelling, unit in a two-family or multifamily dwelling, shall be permitted to have an ampacity not less than 83 percent of the feeder rating.

(3) In no case shall a feeder for an individual dwelling unit be required to have an ampacity greater than that specified in 310.15(B)(7)(1) or (2).

(4) Grounded conductors shall be permitted to be sized smaller than the ungrounded conductors, provided that the requirements of 220.61 and 230.42 for service conductors or the requirements of 215.2 and 220.61 for feeder conductors are met.

Informational Note No. 1: The conductor ampacity may require other correction or adjustment factors applicable to the conductor installation.

Informational Note No. 2: See Example D7 in Annex D.

Reasons:
Revised section 310.15(B)(7) clarifies ampacity correction for temperature for residential service conductors and feeders including diversity factors.

Cost Impact:
Neutral

Approved in previous 2011 Code Adoption process: ☐ **YES** ☒ **NO**

ACTION TAKEN:

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Development Advisory Board Technical Subcommittee				Date: 3/17/16
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City Council Action				Date: 9/7/2016
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City of Phoenix
PLANNING & DEVELOPMENT DEPARTMENT

BUILDING CONSTRUCTION CODE CHANGE PROPOSAL

Proposed Amendments to the 2011 National Electrical Code Sections 334.10 & 334.12

Submitted by: Phoenix Planning and Development Department Code Committee

ARTICLE 334 – Nonmetallic-Sheathed Cable; Types NM, NMC and NMS

II. Installation

334.10 Uses Permitted. Type NM, Type NMC, and Type NMS cables shall be permitted to be used in the following:

(1) One- and two-family dwellings and their attached or detached garages, and their storage buildings.

(2) Multifamily dwellings permitted to be of Types III, IV, and V construction except as prohibited in 334.12.

(3) Other dwelling unit accessory buildings and structures ~~permitted to be of Types III, IV, and V construction except as prohibited in 334.12. Cables shall be concealed within walls, floors, or ceilings that provide a thermal barrier of material that has at least a 15-minute finish rating as identified in listings of fire-rated assemblies.~~ in accordance with 334.10(1) and (2) and other provisions of this Code.

Informational Note No. 1: Types of building construction and occupancy classifications are defined in NFPA 220-2009, *Standard on Types of Building Construction*, or the applicable building code, or both.

Informational Note No. 2: See Informative Annex E for determination of building types [NFPA 220, Table 3-1].

(4) Cable trays in structures permitted to be Types III, IV, or V in accordance with 334.10(1) and (2) where the cables are identified for the use.

Informational Note: See 310.15(A)(3) for temperature limitation of conductors.

(5) Types I and II construction in accordance with 334.10(1) and (2) where installed within raceways permitted to be installed in Types I and II construction.

(A) Type NM. Type NM cable shall be permitted as follows:

(1) For both exposed and concealed work in normally dry locations ~~except as prohibited in 334.10(3)~~

(2) To be installed or fished in air voids in masonry block or tile walls

(B) Type NMC. Type NMC cable shall be permitted as follows:

(1) For both exposed and concealed work in dry, moist, damp, or corrosive locations ~~except as prohibited in 334.10(3)~~

(2) In outside and inside walls of masonry block or tile

(3) In a shallow chase in masonry, concrete, or adobe protected against nails or screws by a steel plate at least 1.59 mm (1/16 in.) thick and covered with plaster, adobe, or similar finish

(C) Type NMS. Type NMS cable shall be permitted as follows:

(1) For both exposed and concealed work in normally dry locations ~~except as prohibited in 334.10(3)~~

(2) To be installed or fished in air voids in masonry block or tile walls

334.12 Uses Not Permitted.
(A) Types NM, NMC, and NMS. Types NM, NMC, and NMS cables shall not be permitted as follows:

(1) In any dwelling or structure not specifically permitted in 334.10(1), (2), and (3)

~~(2) Exposed in dropped or suspended ceilings in other than one- and two-family and multifamily dwellings~~

~~(3)~~ (2) As service-entrance cable

~~(4) In commercial garages having hazardous (classified) locations as defined in 511.3~~

~~(5) In theaters and similar locations, except where permitted in 518.4(B)~~

~~(6) In motion picture studios~~

~~(7) In storage battery rooms~~

~~(8)~~ (3) In hoistways or on elevators or escalators

~~(9)~~ (4) Embedded in poured cement, concrete, or aggregate

~~(10) In hazardous (classified) locations, except where permitted by the following:~~
~~a. 501.10(B)(3)~~
~~b. 502.10(B)(3)~~
~~c. 504.20~~

(B) Types NM and NMS. Types NM and NMS cables shall not be used under the following conditions or in the following locations:

(1) Where exposed to corrosive fumes or vapors

(2) Where embedded in masonry, concrete, adobe, fill, or plaster

(3) In a shallow chase in masonry, concrete, or adobe and covered with plaster, adobe, or similar finish

(4) In wet or damp locations

Reasons:
The use of Nonmetallic-Sheathed cable in commercial buildings has not typically been permitted in the Phoenix metropolitan area as well as many surrounding cities. Nonmetallic-Sheathed cable (NM) is traditionally used in dwelling units, whereas a more stout wiring method enclosed within raceways is traditionally used in commercial buildings. The code restrictions of the NEC, with respect to allowing type NM cable in a commercial building, would tend to make the installation impractical in most cases, (i.e. NM cable would not be allowed underground or in drop ceilings), and at best the resulting installation would likely be a mixture of several different wiring methods, (each with their own requirements). This type of mixture would actually tend to make the installation more complex, creating a larger hurdle to providing a code compliant installation. Concerns also exist that Nonmetallic-Sheathed Cable would be more subject to damage, such as nicks in the insulation, etc. The integrity of the insulation is critical to safety of the electrical installation. In dwelling units, the NEC requires AFCI (Arc-Fault Circuit Interrupter) protection for most circuits since a nick in the insulation, such as from a nail for hanging a picture, can cause an arcing fault which may not be cleared by a normal circuit breaker before a fire starts. The AFCI breaker was developed specifically to detect and clear arcing faults; however, the NEC does not require AFCI protection in other than dwelling units.
It is therefore the general consensus of the electrical section, and supported in general by the Electrical Focus Group, (made up of members of the local electrical engineering community and others members of the industry), that the use of Nonmetallic-Sheathed Cable should be restricted to dwelling units, as described within this document, to provide a higher degree of electrical safety in other occupancies.

Note: This amendment is, essentially, a continuation of the amendment to the currently adopted code, 2008 NEC, with updated code language from the 2011 NEC.

Cost Impact: Additional cost due to the cost difference between an installation consisting of Nonmetallic-Sheathed Cable and an installation consisting of another wiring method, depending on the wiring method chosen.

ACTION TAKEN:

2012 Code Committee				Date: 10/22/12
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Development Advisory Board				Date: 11/15/12
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Council Subcommittee				Date: 4/16/13
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City of Phoenix
PLANNING & DEVELOPMENT DEPARTMENT

BUILDING CONSTRUCTION CODE CHANGE PROPOSAL

Proposed Amendments to 2011 National Electrical Code
Article 646

Submitted by: Electrical Section – Rob Runge, PE, Electrical Technical Lead

Amendment adds a new Article 646 – Modular Data Centers that was added to the 2014 National Electrical Code.

ARTICLE 646 - Modular Data Centers

I. General

646.1 Scope. This article covers modular data centers.

Informational Note No. 1: Modular data centers include the installed information technology equipment (ITE) and support equipment, electrical supply and distribution, wiring and protection, working space, grounding, HVAC, and the like, that are located in an equipment enclosure.

Informational Note No. 2: For further information, see NFPA 75-2013, Standard for the Protection of Information Technology Equipment, which covers the requirements for the protection of information technology equipment and systems in an information technology equipment room.

646.2 Definitions.
The definitions in 645.2 shall apply. For the purposes of this article, the following additional definition applies.

Modular Data Center (MDC). Prefabricated units, rated 600 volts or less, consisting of an outer enclosure housing multiple racks or cabinets of information technology equipment (ITE) (e.g., servers) and various support equipment, such as electrical service and distribution equipment, HVAC systems, and the like.

Informational Note No. 1: A typical construction may use a standard ISO shipping container or other structure as the outer enclosure, racks or cabinets of ITE, service-entrance equipment and power distribution components, power storage such as a UPS, and an air or liquid cooling system. Modular data centers are intended for fixed installation, either indoors or outdoors, based on their construction and resistance to environmental conditions. MDCs can be configured as an all-in-one system housed in a single equipment enclosure or as a system with the support equipment housed in separate equipment enclosures.

Informational Note No. 2: For information on listing requirements for both information technology equipment and communications equipment, see UL 60950-1-2011, Information Technology Equipment — Safety — Part 1: General Requirements, and UL 62368-1-2012, Audio/Video, Information and Communication Technology Equipment — Part 1: Safety Requirements.

Informational Note No. 3: Modular data centers as defined in this article are sometimes referred to as containerized data centers.

Informational Note No. 4: Equipment enclosures housing only support equipment (e.g., HVAC or power distribution equipment) that are not part of a specific modular data center are not considered a modular data center as defined in this article.

646.3 Other Articles.
Circuits and equipment shall comply with 646.3(A) through (N) as applicable. Wherever the requirements of other articles of this Code and Article 646 differ, the requirements of Article 646 shall apply.

(A) Spread of Fire or Products of Combustion. Sections 300.21, 770.26, 800.26, and 820.26 shall apply to penetrations of a fire-resistant room boundary, if provided.

(B) Plenums. Sections 300.22(C)(1), 725.154(A), 760.53(B)(2), 760.154(A), 770.113(C), 800.113(C), and Table 725.154, Table 760.154, Table 770.154(a), Table 800.154(a), and Table 820.154(a) shall apply to wiring and cabling in other spaces used for environmental air (plenums).

Informational Note: Environmentally controlled working spaces, aisles, and equipment areas in an MDC are not considered a plenum.

(C) Grounding. Grounding and bonding of an MDC shall comply with Article 250. The non–current-carrying conductive members of optical fiber cables in an MDC shall be grounded in accordance with 770.114. Grounding and bonding of communications protectors, cable shields, and non–current-carrying metallic members of cable shall comply with Part IV of Article 800.

(D) Electrical Classification of Data Circuits. Section 725.121(A)(4) shall apply to the electrical classification of listed information technology equipment signaling circuits. Sections 725.139(D)(1) and 800.133(A)(1)(b) shall apply to the electrical classification of Class 2 and Class 3 circuits in the same cable with communications circuits.

(E) Fire Alarm Equipment. The provisions of Parts I, II, and III of Article 760 shall apply to fire alarm system equipment installed in an MDC, where provided.

(F) Communications Equipment. Parts I, II, III, IV, and V of Article 800 shall apply to communications equipment installed in an MDC.

Informational Note: See Part I of Article 100 for a definition of communications equipment.

(G) Community Antenna Television and Radio Distribution Systems Equipment. Parts I, II, III, IV, and V of Article 820 shall apply to community antenna television and radio distribution systems equipment installed in an MDC.

(H) Storage Batteries. Installation of storage batteries shall comply with Article 480.

Exception: Batteries that are part of listed and labeled equipment and installed in accordance with the listing requirements.

(I) Surge-Protective Devices (SPDs). Where provided, surge-protective devices shall be listed and labeled and installed in accordance with Article 285.

(J) Lighting. Lighting shall be installed in accordance with Article 410.

(K) Power Distribution Wiring and Wiring Protection. Power distribution wiring and wiring protection within an MDC shall comply with Article 210 for branch circuits.

(L) Wiring Methods and Materials.
(1) Unless modified elsewhere in this article, wiring methods and materials for power distribution shall comply with Chapter 3. Wiring shall be suitable for its use and installation and shall be listed and labeled.

Exception: This requirement shall not apply to wiring that is part of listed and labeled equipment.

(2) The following wiring methods shall not be permitted:
a. Integrated gas spacer cable: Type IGS (Article 326)
b. Concealed knob-and-tube wiring (Article 394)
c. Messenger-supported wiring (Article 396)
d. Open wiring on insulators (Article 398)
e. Outdoor overhead conductors over 600 volts (Article 399)

(3) Wiring in areas under a raised floor that are constructed and used for ventilation as described in 645.5(E) shall be permitted to use the wiring methods described in 645.5(E).

(4) Installation of wiring for remote-control, signaling, and power-limited circuits shall comply with Part III of Article 725.

(5) Installation of optical fiber cables shall comply with Part V of Article 770.

(6) Installation of wiring for fire alarm systems shall comply with Parts II and III of Article 760.

(7) Installation of communications wires and cables, raceways, and cable routing assemblies shall comply with Part V of Article 800.

(8) Alternate wiring methods as permitted by Article 645 shall be permitted for MDCs, provided that all of the conditions of 645.4 are met.

(M) Service Equipment. For an MDC that is designed such that it may be powered from a separate electrical service, the service equipment for control and protection of services and their installation shall comply with Article 230. The service equipment and their arrangement and installation shall permit the installation of the service-entrance conductors in accordance with Article 230. Service equipment shall be listed and labeled and marked as being suitable for use as service equipment.

(N) Disconnecting Means. An approved means shall be provided to disconnect power to all electronic equipment in the MDC in accordance with 645.10. There shall also be a similar approved means to disconnect the power to all dedicated HVAC systems serving the MDC that shall cause all required fire/smoke dampers to close.

646.4 Applicable Requirements.
All MDCs shall:

(1) Be listed and labeled and comply with 646.3(N) and 646.5 through 646.9, or

Informational Note: One way to determine applicable listing requirements is to refer to UL Subject 2755, Outline of Investigation for Modular Data Centers.

(2) Comply with the provisions of this article.

646.5 Nameplate Data.
A permanent nameplate shall be attached to each equipment enclosure of an MDC and shall be plainly visible after installation. The nameplate shall include the information in 646.5(1) through (6), as applicable:

(1) Supply voltage, number of phases, frequency, and full-load current. The full-load current shown on the nameplate shall not be less than the sum of the full-load currents required for all motors and other equipment that may be in operation at the same time under normal conditions of use. Where unusual type loads, duty cycles, and so forth, require oversized conductors or permit reduced-size conductors, the required capacity shall be included in the marked full-load current. Where more than one incoming supply circuit is to be provided, the nameplate shall state the preceding information for each circuit.

Informational Note No. 1: See 430.22(E) and 430.26 for duty cycle requirements.

Informational Note No. 2: For listed equipment, the full-load current shown on the nameplate may be the maximum, measured, 15-minute, average full-load current.

(2) For MDCs powered by a separate service, the short-circuit current rating of the service equipment provided as part of the MDC.

Informational Note: This rating may be part of the service equipment marking.

(3) For MDCs powered by a separate service, if the required service as determined by Parts III and IV of Article 220 is less than the rating of the service panel used, the required service shall be included on the nameplate.

Informational Note: Branch circuits supplying ITE loads are assumed to be loaded not less than 80 percent of the branch-circuit rating with a 100 percent duty cycle. As an alternative to the feeder and service load calculations required by Parts III and IV of Article 220, feeder and service load calculations for new, future, or existing loads may be permitted to be used if performed by qualified persons under engineering supervision.

(4) Electrical diagram number(s) or the number of the index to the electrical drawings.

(5) For MDC equipment enclosures that are not powered by a separate service, feeder, or branch circuit, a reference to the powering equipment.

(6) Manufacturer's name or trademark.

646.6 Supply Conductors and Overcurrent Protection.

(A) Size. The size of the supply conductor shall be such as to have an ampacity not less than 125 percent of the full-load current rating.

Informational Note No. 1: See the 0–2000-volt ampacity tables of Article 310 for ampacity of conductors rated 600 V and below.

Informational Note No. 2: See 430.22(E) and 430.26 for duty cycle requirements.

(B) Overcurrent Protection. Where overcurrent protection for supply conductors is furnished as part of the MDC, overcurrent protection for each supply circuit shall comply with 646.6(B)(1) through (B)(2):

(1) Service Equipment — Overcurrent Protection. Service conductors shall be provided with overcurrent protection in accordance with 230.90 through 230.95.

(2) Taps and Feeders. Where overcurrent protection for supply conductors is furnished as part of the MDC as permitted by 240.21, the overcurrent protection shall comply with the following:

(1) The overcurrent protection shall consist of a single circuit breaker or set of fuses.

(2) The MDC shall be marked "OVERCURRENT PROTECTION PROVIDED AT MDC SUPPLY TERMINALS."

(3) The supply conductors shall be considered either as feeders or as taps and be provided with overcurrent protection complying with 240.21.

646.7 Short-Circuit Current Rating.

(A) Service Equipment. The service equipment of an MDC that connects directly to a service shall have a short-circuit current rating not less than the available fault current of the service.

(B) MDCs Connected to Branch Circuits and Feeders. Modular data centers that connect to a branch circuit or a feeder circuit shall have a short-circuit current rating not less than the available fault current of the branch circuit or feeder. The short-circuit current rating of the MDC shall be based on the short-circuit current rating of a listed and labeled MDC or the short-circuit current rating established utilizing an approved method.

Informational Note No. 1: UL 508A-2001, Standard for Industrial Control Panels, Supplement SB, is an example of an approved method.

Informational Note No. 2: This requirement does not apply to listed and labeled equipment connected to branch circuits located inside of the MDC equipment enclosure.

(C) MDCs Powered from Separate MDC System Enclosures. Modular data center equipment enclosures, powered from a separate MDC system enclosure that is part of the specific MDC system, shall have a short-circuit current rating coordinated with the powering module in accordance with 110.10.
Informational Note: UL 508A-2001, Standard for Industrial Control Panels, Supplement SB, is an example of an approved method for determining short-circuit current ratings.

646.8 Field-Wiring Compartments. A field-wiring compartment in which service or feeder connections are to be made shall be readily accessible and comply with 646.8(1) through (3) as follows:

(1) Permit the connection of the supply wires after the MDC is installed

(2) Permit the connection to be introduced and readily connected

(3) Be located so that the connections may be readily inspected after the MDC is installed

646.9 Flexible Power Cords and Cables for Connecting Equipment Enclosures of an MDC System.
(A) Uses Permitted. Flexible power cords and cables shall be permitted to be used for connections between equipment enclosures of an MDC system where not subject to physical damage.

Informational Note: One example of flexible power cord usage for connections between equipment enclosures of an MDC system is between an MDC enclosure containing only servers and one containing power distribution equipment.

(B) Uses Not Permitted. Flexible power cords and cables shall not be used for connection to external sources of power.

Informational Note: Examples of external sources of power are electrical services, feeders, and premises branch circuits.

(C) Listing. Where flexible power cords or cables are used, they shall be listed as suitable for extra-hard usage. Where used outdoors, flexible power cords and cables shall also be listed as suitable for wet locations and shall be sunlight resistant.

(D) Single-Conductor Cable. Single-conductor power cable shall be permitted to be used only in sizes 2 AWG or larger.

II. Equipment

646.10 Electrical Supply and Distribution. Equipment used for electrical supply and distribution in an MDC, including fittings, devices, luminaires, apparatus, machinery, and the like, shall comply with Parts I and II of Article 110.

646.11 Distribution Transformers.
(A) Utility-Owned Transformers. Utility-owned distribution transformers shall not be permitted in an MDC.

(B) Non-Utility-Owned Premises Transformers. Nonutility-owned premises distribution transformers installed in the vicinity of an MDC shall be of the dry type or the type filled with a noncombustible dielectric medium. Such transformers shall be installed in accordance with the requirements of Article 450. Non-utility-owned premises distribution transformers shall not be permitted in an MDC.

(C) Power Transformers. Power transformers that supply power only to the MDC shall be permitted to be installed in the MDC equipment enclosure. Only dry-type transformers shall be permitted to be installed in the MDC equipment enclosure. Such transformers shall be installed in accordance with the requirements of Article 450.

646.12 Receptacles. At least one 125-volt ac, 15- or 20-ampere-rated duplex convenience outlet shall be provided in each work area of the MDC to facilitate the powering of test and measurement equipment that may be required during routine maintenance and servicing without having to route flexible power cords through or across doorways or around line-ups of equipment, or the like.

646.13 Other Electrical Equipment. Electrical equipment that is an integral part of the MDC, including lighting, control, power, HVAC (heating, ventilation, and air-conditioning), emergency lighting, alarm circuits, and the like, shall comply with the requirements for its use and installation and shall be listed and labeled.

646.14 Installation and Use. Listed and labeled equipment shall be installed and used in accordance with any instructions or limitations included in the listing.

III. Lighting

646.15 General Illumination. Illumination shall be provided for all workspaces and areas that are used for exit access and exit discharge. The illumination shall be arranged so that the failure of any single lighting unit does not result in a complete loss of illumination.

Informational Note: See NFPA 101®-2012, Life Safety Code, Section 7.8, for information on illumination of means of egress.

646.16 Emergency Lighting. Areas that are used for exit access and exit discharge shall be provided with emergency lighting. Emergency lighting systems shall be listed and labeled equipment installed in accordance with the manufacturer's instructions.

Informational Note: See NFPA 101®-2012, Life Safety Code, Section 7.9, for information on emergency lighting.

646.17 Emergency Lighting Circuits. No appliances or lamps, other than those specified as required for emergency use, shall be supplied by emergency lighting circuits. Branch circuits supplying emergency lighting shall be installed to provide service from storage batteries, generator sets, UPS, separate service, fuel cells, or unit equipment. No other equipment shall be connected to these circuits unless the emergency lighting system includes a backup system where only the lighting is supplied by battery circuits under power failure conditions. All boxes and enclosures (including transfer switches, generators, and power panels) for emergency circuits shall be marked to identify them as components of an emergency circuit or system.

IV. Workspace

646.18 General. Space about electrical equipment shall comply with 110.26.

646.19 Entrance to and Egress from Working Space.
For equipment over 1.8 m (6 ft) wide or deep, there shall be one entrance to and egress from the required working space not less than 610 mm (24 in.) wide and 2.0 m (6 1⁄2 ft) high at each end of the working space. The door(s) shall open in the direction of egress and be equipped with panic bars, pressure plates, or other devices that are normally latched but open under simple pressure. A single entrance to and egress from the required working space shall be permitted where either of the conditions in 646.19(1) or (2) is met.

(1) Unobstructed Egress. Where the location permits a continuous and unobstructed way of egress travel, a single entrance to the working space shall be permitted.

(2) Extra Working Space. Where the depth of the working space is twice that required by 110.26(1), a single entrance shall be permitted. It shall be located such that the distance from the equipment to the nearest edge of the entrance is not less than the minimum clear distance specified in Table 110.26(1) for equipment operating at that voltage and in that condition.

646.20 Working Space for ITE.
(A) Low-Voltage Circuits. The working space about ITE where any live parts that may be exposed during routine servicing operate at not greater than 30 volts rms, 42 volts peak, or 60 volts dc shall not be required to comply with the workspace requirements of 646.19.

(B) Other Circuits. Any areas of ITE that require servicing of parts that are greater than 30 volts rms, 42 volts peak, or 60 volts dc shall comply with the workspace requirements of 646.19.

Informational Note No. 1: For example, field-wiring compartments for ac mains connections, power distribution units, and the like.

Informational Note No. 2: It is assumed that ITE operates at voltages not exceeding 600 volts.

646.21 Work Areas and Working Space Around Batteries.
Working space around a battery system shall comply with 110.26. Working clearance shall be measured from the edge of the battery rack.

646.22 Workspace for Routine Service and Maintenance.
Workspace shall be provided to facilitate routine servicing and maintenance (those tasks involving operations that can be accomplished by employees and where extensive disassembly of equipment is not required). Routine servicing and maintenance shall be able to be performed without exposing the worker to a risk of electric shock or personal injury.

Informational Note: An example of such routine maintenance is cleaning or replacing an air filter.

Reasons:
This new Article added to the 2014 National Electrical Code addresses an emerging trend in Modular Data Center architecture. Including Article 646 as an amendment provides important, consistent electrical installation requirements for this relatively new approach to data centers.

Cost Impact:
New technology. Costs are associated with the choice to install this technology.

Approved in previous 2011 Code Adoption process: ☐ **YES** ☒ **NO**

ACTION TAKEN:

2015 Code Committee				Date: 1/14/16
☒ Approved as submitted	☐ Modified and approved	☐ Denied	☐ No action taken	
Development Advisory Board Technical Subcommittee				Date: 3/17/16
☒ Approved as submitted	☐ Modified and approved	☐ Denied	☐ No action taken	
Development Advisory Board				Date: 5/19/16
☒ Approved as submitted	☐ Modified and approved	☐ Denied	☐ No action taken	
Neighborhoods, Housing and Development Subcommittee				Date: 6/21/2016
☒ Approved as submitted	☐ Modified and approved	☐ Denied	☐ No action taken	
City Council Action				Date: 9/7/2016
☐ Approved as submitted	☐ Modified and approved	☐ Denied	☐ No action taken	

City of Phoenix
PLANNING & DEVELOPMENT DEPARTMENT

BUILDING CONSTRUCTION CODE CHANGE PROPOSAL

Proposed Amendments to 2011 National Electrical Code Section 680.21(C)

Submitted by: Electrical Section – Rob Runge, PE, Electrical Technical Lead

680.21(C) GFCI Protection. Outlets supplying pool pump motors connected to single-phase, 120 volt through 240 volt branch circuits, ~~rated 15 or 20 amperes,~~ whether by receptacle or by direct connection, shall be provided with ground-fault circuit-interrupter protection for personnel.

Reasons:
The 2014 National Electrical Code revised 680.21(C) to delete the circuit size limitation for requiring GFCI protection for pool motors. This amendment is intended to increase safety to prevent shock hazards at pools by matching the current published code addressing situations that call for a breaker larger than 20A.

Cost Impact:
Cost increase if breaker larger than 20A is selected.

Approved in previous 2011 Code Adoption process: ☐ **YES** ☒ **NO**

ACTION TAKEN:

2015 Code Committee				Date: 1/14/16
☒ Approved as submitted	☐ Modified and approved	☐ Denied	☐ No action taken	
Development Advisory Board Technical Subcommittee				Date: 3/17/16
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City of Phoenix
PLANNING & DEVELOPMENT DEPARTMENT

BUILDING CONSTRUCTION CODE CHANGE PROPOSAL

Proposed Amendments to 2011 National Electrical Code
Section 690.12

Submitted by: Electrical Section – Rob Runge, PE, Electrical Technical Lead

Amendment adds new Section 690.12 to address Rapid Shutdown of PV Systems.

690.12 Rapid Shutdown of PV Systems on Buildings.
PV system circuits installed on or in buildings shall include a rapid shutdown function that controls specific conductors in accordance with 690.12(1) through (5) as follows.

(1) Requirements for controlled conductors shall apply only to PV system conductors of more than 1.5 m (5 ft) in length inside a building, or more than 3 m (10 ft) from a PV array.

(2) Controlled conductors shall be limited to not more than 30 volts and 240 volt-amperes within 10 seconds of rapid shutdown initiation.

(3) Voltage and power shall be measured between any two conductors and between any conductor and ground.

(4) The rapid shutdown initiation methods shall be labeled as follows:

Buildings or structures with both utility service and a PV system, complying with 690.12, shall have a permanent plaque or directory including the following wording:

PHOTOVOLTAIC SYSTEM EQUIPPED
WITH RAPID SHUTDOWN

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

(5) Equipment that performs the rapid shutdown shall be listed and identified.

Reasons:
Elements of a PV (Photovoltaic) system remain energized after the service disconnect is opened. This condition presents potential hazards to first responders. A new Section was added to the 2014 National Electrical Code to require shutdown closer to the array. This rapid shutdown requirement provides a zone outside of which the potential for shock has been mitigated. Conductors more than 5 feet inside a building or more than 10 feet from an array will be limited to a maximum of 30 V and 240 VA within 10 seconds of activation of shutdown. 2014 NEC 690.12(4) references NEC 690.56(B) for labeling requirements for Rapid Shutdown. This labeling language is included in this amendment as part of 690.12(4).

Cost Impact:
Increased cost. Increased safety.

Approved in previous 2011 Code Adoption process: ☐ **YES** ☒ **NO**

ACTION TAKEN:

2015 Code Committee Date: 1/14/16

☒ Approved as submitted ☐ Modified and approved ☐ Denied ☐ No action taken

Development Advisory Board Technical Subcommittee				Date: 3/17/16
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Neighborhoods, Housing and Development Subcommittee				Date: 6/21/2016
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City Council Action				Date: 9/7/2016
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