

## Amendments to - 2016 California Electrical Code

### Proposed Existing Electrical Regulations

The City of San Diego proposes to adopt the 2016 California Electrical Code (CEC) with local amendments codified in chapter 14 Article 6 "Electrical Regulations". The proposed amendments are necessary due to local geological conditions and necessary for consistent code application as amended:

- **Issue 1.** Update division 1 to adopt the 2016 California Electrical Code. Also do not adopt Section 70512(D)(6) which will be deleted in the 2017 NFPA 70® National Electrical Code that will be adopted into the 2019 California electrical Code.
- **Issue 2.** Modify the time requirement for rapid shut down for solar pv from 10 seconds to 30 seconds based on updated requirements in the 2017 National Electrical Code that will be adopted into the 2019 California electrical Code.
- **Issue 3.** Add section to address center fed panels in residential buildings based on updated requirements in the 2017 National Electrical Code that will be adopted into the 2019 California electrical Code.

For questions or comments regarding the proposed amendments please contact Ali Fattah, Senior Research Engineer, at 619-446-5092 and via e-mail at [afattah@sandiego.gov](mailto:afattah@sandiego.gov). The Land Development Code encompasses chapters 11 through 15 of the San Diego Municipal Code and can be found at [www.sandiego.gov](http://www.sandiego.gov).

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*The proposed amendment to Chapter 14 of the Land Development Code (LDC) modifies Article 6 necessary to adopt and amend the 2016 California Electrical Code (CEC) for consistency with existing regulations.*

**1. Issue 1 : UPDATE DIVISION 1 TO ADOPT THE 2016 CEC**

**Text as it would appear in LDC**

**§146.0103 Interpretation of the Electrical Regulations**

- (a) The language used in this article and in the ~~2013~~ 2016 California Electrical Code which is made a part of this article by reference, is intended to convey the common and accepted meaning familiar to the electrical industry.

*Remainder of Section no change*

**§146.0104 Adoption of the California Electrical Code**

- (a) The ~~2013~~ 2016 California Electrical Code published and amended by the California Building Standards Commission (BSC) and as amended by the California Department of Housing and Community Development (HCD); the Division of the State Architect-Access Compliance (DSA/AC); the State Office of Statewide Planning and Development (OSHPD3); and the State Fire Marshal (SFM) is adopted by reference and made a part of this article as if fully set forth, except as otherwise provided in this article. The regulations so referenced are the standard for electrical installations regulated by this article. A

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copy of the ~~2013~~ 2016 California Electrical Code is on file in the office of the City Clerk as Document No. OO-XXXX-X.

- (b) When reference is made to the California Electrical Code, it shall be the ~~2013~~ 2016 California Electrical Code, California Code of Regulations Title 24, Part 3 as published by the California Building Standards Commission.
- (c) The Building Official is authorized to enforce only those amendments made by the following state agencies:
  - (1) ~~California Building Standards Commission.~~
  - (2) ~~(1)~~ The Department of Housing and Community Development (HCD , HCD 1/AC).
  - (3) ~~(2)~~ Division of the State Architect, Access Compliance (DSA/AC).
  - (4) ~~(3)~~ Office of the State Fire Marshal (SFM).
  - (5) ~~(4)~~ Office of Statewide Health, Planning and development (OSHDP3).
  - (6) ~~(5)~~ California Energy Commission (CEC).

**§146.0105 Portions of the California Electrical Code Not Adopted**

The following Sections or Subsections of the ~~2013~~ 2016 California Electrical Code are not adopted by the City of San Diego:

- (a) Article 230, Services, Section 43, Wiring Methods for 600 Volts, Nominal or Less, numbers (1) “Open Wiring on Insulators” and (7) “Service-entrance Cables” are not adopted.
- (b) Article 230, Services, Section 50, Protection of Open Conductors and Cables Against Damage – Above Ground; Section 51, Mounting Supports; and Section 52, Individual Conductors Entering Building or Other Structures; relating to

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protection and mounting of open wiring on insulators and service-entrance conductors are not adopted.

- (c) Article 705, Interconnected Electric Power Production Sources; Section 705.12 (D)(6), Wire Harness and Exposed Cable Arc-Fault Protection.

**§146.0106**     **Portions of the California Electrical Code Adopted With Modifications**

The following Sections or Subsections of the 2016 California Electrical Code are adopted by the City of San Diego with modifications:

- (a) Article 690, Solar Photovoltaic (PV) Systems, Section 690.12 (2) Rapid shutdown of PV Systems on Buildings.

**§146.0107**     **Portions of the California Electrical Code Adopted With Additions**

The following Sections or Subsections of the 2016 California Electrical Code are adopted by the City of San Diego with additions:

- (a) Article 705, Interconnected Electric Power Production Sources; Section 705.12(D)(2)(3)(e) Bus or Conductor Ampere Rating.

**Reason:** This is an editorial change to reference the 2016 edition adopted by the State of California.

Section §146.0104 (c) (1) corrects an error. Amendments by the California Building Standards Commission only apply to State owned and leased buildings.

Section 705.12 (D)(6) of the California Electrical Code is not proposed to be adopted pursuant to Tentative Interim Agreement (TIA) No. 14-11. The TIA was issued by publishers of the National Electrical Code that is adopted and amended by the State of California as the CEC. It was issued to correct a circumstance in which the revised NFPA Standard had resulted in an adverse impact on a product or method that was inadvertently overlooked in the total revision process or was without adequate technical (safety) justification

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for the action. When NEC Code Making Panel 4 (CMP4) approved this provision, the panel was led to believe that these products were available or would easily become available before the electrical code was to be enforced. As it turns out, few if any products exist that can meet this requirement, and discussions with electrical equipment manufacturers have revealed that there are no plans to develop such products for this market. In the absence of available products, all ac cables must be installed in a raceway. Since most small modular inverters have no means of being installed in raceway systems, this has created yet another set of field problems for contractors and enforcement.

The amendment to Section 690.12 (2) will be discussed in issue 2.

The amendment to Section 705.12(D)(2)(3)(e) will be discussed in issue 3.

**2. Issue 2: MODIFY THE CEC TO INCREASE THE TIME FOR RAPID SHUT DOWN TO COMMENCE FOR SOLAR PV SYSTEMS BASED ON 2017 NEC**

**Text as it would appear in California Electrical Code**

**(based on 2017 NFPA 70 National Electrical code)**

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**NFPA 70® 690.12 Rapid shut Down of PV Systems on Buildings.**

PV system circuits installed on or in buildings shall include a rapid shut down 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 1.5m (5 ft) in length inside a building, or more than 3 m (10ft) from a PV array.
- (2) Controlled conductors shall be limited to no more than 30 volts and 240VA within ~~40~~ 30 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 in accordance with 690.56(C).
- (5) Equipment that performs the rapid shutdown shall be listed and identified.

**Text as it would appear in LDC**

**§146.0208 Local Modifications and Additions to Article 690 Solar**

**Photovoltaic (PV) Systems of the California Electrical Code**

- (a) Article 690 California Electrical Code is adopted by reference with modifications pursuant to Section §146.0106 of the Land Development Code.
- (b) Section 690.12 Rapid shut Down of PV Systems on Buildings is adopted with modifications as follows:

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- (1) 690.12 Rapid shut Down of PV Systems on Buildings. PV system circuits installed on or in buildings shall include a rapid shut down function that controls specific conductors in accordance with subsections (A) through (E) as follows:
- (A) Requirements for controlled conductors shall apply only to PV system conductors of more than 1.5m (5 ft) in length inside a building, or more than 3 m (10ft) from a PV array.
  - (B) Controlled conductors shall be limited to no more than 30 volts and 240VA within 30 seconds of rapid shutdown initiation.
  - (C) Voltage and power shall be measured between any two conductors and between any conductor and ground.
  - (D) The rapid shutdown initiation methods shall be labeled in accordance with 690.56(C) of the California Electrical Code.
  - (E) Equipment that performs the rapid shutdown shall be listed and identified.

**Reason:** The proposed modification to the rapid shut down requirements in the CEC is pursuant to TIA #14-10 by NFPA that amends the electrical code to change the rapid shut down time from 10 seconds to 30 seconds. Article 690.12 in the 2014 NEC was originally written to require shutdown within 10 seconds. The length of time for shutdown has been increased to 30 seconds to avoid accidental PV system shutdowns during momentary fluctuations of utility power. The 30 second shutdown requirement has already been incorporated into the 2017 NEC that will be adopted into the 2019 California Electrical Code and UL Standard 1741.



It has been identified that certain utility-required grid-support functions of PV systems may be adversely affected by a 10-second shutdown time limit requirement. This is due to the fact that utilities are requesting that PV systems be capable of riding through grid disturbances for periods up to 20 seconds. Most PV systems will use the loss of utility voltage to initiate the rapid shutdown process to make it easier for emergency responders to use multiple methods to easily shutdown the PV system. Some designs will need extra time to make sure that the loss of utility power is not a momentary utility glitch before they proceed with the shutdown process. This waiting period may necessitate a delay in the rapid shutdown process.

California has significant new requirements for PV systems to continue to operate when the utility is having supply difficulties. The delays in PV system shutdown are to help to distinguish between a full shutdown of the ac supply for safety and intermittent problems with the utility supply.

**3. Issue 3: MODIFY THE CEC TO ADDRESS CENTER FED PANELS IN RESIDENTIAL BUILDINGS BASED ON 2017 NEC**

**Text as it would appear in California Electrical Code**

NFPA 70® **705.12 Point of Connection.** The output of an interconnected electric power source shall be connected as specified in 705.12(A), (B), (C), or (D).

**(A) Supply Side.** An electric power production source shall be permitted to be connected to the supply side of the service disconnecting means as permitted in 230.82(6). The sum of the ratings of all overcurrent devices connected to power production sources shall not exceed the rating of the service.

**(B) Integrated Electrical Systems.** The outputs shall be permitted to be interconnected at a point or points elsewhere on the premises where the system qualifies as an integrated electrical system and incorporates protective equipment in accordance with all applicable sections of Article 685.

**(C) Greater Than 100 kW.** The outputs shall be permitted to be interconnected at a point or points elsewhere on the premises where all of the following conditions are met:

- (1) The aggregate of non-utility sources of electricity has a capacity in excess of 100 kW, or the service is above 1000 volts.
- (2) The conditions of maintenance and supervision ensure that qualified persons service and operate the system.
- (3) Safeguards, documented procedures, and protective equipment are established and maintained.

**(D) Utility-Interactive Inverters.** The output of a utility interactive inverter shall be permitted to be connected to the load side of the service disconnecting means of the other source(s) at any distribution equipment on the premises. Where distribution equipment, including switchgear, switchboards, or panelboards, is fed simultaneously by a primary source(s) of electricity and one or more utility interactive inverters, and where this distribution equipment is capable of supplying multiple branch circuits or feeders, or both, the interconnecting provisions for the utility interactive inverter(s) shall comply with 705.12(D)(1) through (D)(6).

**(1) Dedicated Overcurrent and Disconnect.** The source interconnection of one or more inverters installed in one system shall be made at a dedicated circuit breaker or fusible disconnecting means.

**(2) Bus or Conductor Ampere Rating.** One hundred twenty-five percent of the inverter output circuit current shall be used in ampacity calculations for the following:

- (1) Feeders. Where the inverter output connection is made to a feeder at a location other than the opposite end of the feeder from the primary source

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overcurrent device, that portion of the feeder on the load side of the inverter output connection shall be protected by one of the following:

- (a) The feeder ampacity shall be not less than the sum of the primary source overcurrent device and 125 percent of the inverter output circuit current.
- (b) An overcurrent device on the load side of the inverter connection shall be rated not greater than the ampacity of the feeder.
- (2) Taps. In systems where inverter output connections are made at feeders, any taps shall be sized based on the sum of 125 percent of the inverter(s) output circuit current and the rating of the overcurrent device protecting the feeder conductors as calculated in 240.21(B).
- (3) Busbars. One of the methods that follows shall be used to determine the ratings of busbars in panelboards.

- (a) The sum of 125 percent of the inverter(s) output circuit current and the rating of the overcurrent device protecting the busbar shall not exceed the ampacity of the busbar.

- (b) Where two sources, one a utility and the other an inverter, are located at opposite ends of a busbar that contains loads, the sum of 125 percent of the inverter(s) output circuit current and the rating of the overcurrent device protecting the busbar shall not exceed 120 percent of the ampacity of the busbar. The busbar shall be sized for the loads connected in accordance with Article 220. A permanent warning label shall be applied to the distribution equipment adjacent to the back-fed breaker from the inverter that displays the following or equivalent wording:

WARNING:  
INVERTER OUTPUT CONNECTION;  
DO NOT RELOCATE THIS OVERCURRENT DEVICE.

The warning sign(s) or label (s) shall comply with 110.21(B).

- (c) The sum of the ampere ratings of all overcurrent devices on panelboards, both load and supply devices, excluding the rating of the overcurrent device protecting the busbar, shall not exceed the ampacity of the busbar. The rating of the overcurrent device protecting the busbar shall not exceed the rating of the busbar. Permanent warning labels shall be applied to distribution equipment that displays the following or equivalent wording:

WARNING:  
THIS EQUIPMENT FED BY MULTIPLE SOURCES.  
TOTAL RATING OF ALL OVERCURRENT DEVICES,  
EXCLUDING MAIN SUPPLY OVERCURRENT  
DEVICE,

(d) Connections shall be permitted on multiple-ampacity busbars or center-fed panelboards where designed under engineering supervision that includes fault studies and busbar load calculations.

(e) A connection at either end, but not both ends, of a center-fed panel board in dwellings shall be permitted where the sum of 125 percent of the power source(s) output circuit current and the rating of the overcurrent device protecting the busbar does not exceed 120 percent of the current rating of the busbar. Dwelling shall mean a dwelling as is defined in the California Residential Code or California Building Code when applicable.

**(3) Marking.** Equipment containing overcurrent devices in circuits supplying power to a busbar or conductor supplied from multiple sources shall be marked to indicate the presence of all sources.

**(4) Suitable for Backfeed.** Circuit breakers, if backfed, shall be suitable for such operation.

**(5) Fastening.** Listed plug-in-type circuit breakers backfed from utility-interactive inverters that are listed and identified as interactive shall be permitted to omit the additional fastener normally required by 408.36(D) for such applications.

**(6) Wire Harness and Exposed Cable Arc-Fault Protection.** A utility-interactive inverter(s) that has a wire harness or cable output circuit rated 240 V, 30 amperes, or less, that is not installed within an enclosed raceway, shall be provided with listed ac AFCI protection.

### Text as it would appear in LDC

#### **§146.0209 Local Modifications and Additions to Section 705.12 “Point of Connection” of the California Electrical Code**

- (a) Section 705.12 (D) (3) of the California Electrical Code is adopted with additions and modifications pursuant to Section §146.0106 and §146.0107 of the Land Development Code.
- (b) Section 705.12 (D) (3) “Bus or Conductor ampere Rating” is modified by adding subsection (e) as follows: (e) A connection at either end, but not both ends, of a center-fed panel board in dwellings shall be permitted where the sum of 125 percent of the power source(s) output circuit current and the rating of the

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overcurrent device protecting the busbar does not exceed 120 percent of the current rating of the busbar. Dwelling shall mean a dwelling as is defined in the California Residential Code or California Building Code when applicable.

**Reason:** The proposed amendment allows an alternative to submitting an engineering analysis prepared by a California licensed Electrical Engineer, that includes fault studies and bus bar load calculations, in accordance with Section 705.12 (D)(2)(3)(d) of the 2016 California Electrical Code.

The allowance for panelboards in dwellings to have a PV breaker and the service breaker equal a total 120% of the busbar rating dates back to the 1980s. When this allowance was extended to commercial systems in the 2008 NEC, an additional stipulation was added to place the PV breaker at the opposite end of the busbar from the utility feed. The opposite end of the busbar was intended to ensure that the current density on the busbar would never exceed the rating of the busbar. For simplicity, this opposite end stipulation was broadly applied to all applications, including dwellings although there were no documented cases in dwellings that suggested the opposite end was needed. In recent years it has become apparent that numerous center-fed panels exist in dwellings in the Western United States. This fact underlined the need to state that the method used for dwellings from 1987 to 2008 in the NEC was fine and should be clearly allowed in 705.12(D). Because of the fact that so few continuous loads exist in dwellings, the 120% rule, as it has become known in the industry, has proven to be a reasonable and conservative allowance for these panelboards.