2022 California Electrical Code Article 100 &-110

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Presentation Outline

- Electrical Definitions
- Multiwire branch circuits
- Labeling Requirements
- Clear workspace Requirements
- Intervening Code Updates (effective 7-1-2024)

ARTICLE 100 – DEFINITIONS

ARTICLE 100
Definitions

Scope. This article contains only those definitions essential to the application of this *Code*. It is not intended to include commonly defined general terms or commonly defined technical terms from related codes and standards. In general, only those terms that are used in two or more articles are defined in Article 100. Definitions are also found in XXX.2 sections of other articles.

Definition –Accessible

Accessible (as applied to equipment). Capable of being reached for operation, renewal, and inspection.

~~Admitting close approach:; not guarded by locked doors, elevation, or other effective means.~~

Accessible (as applied to wiring methods). Capable of being removed or exposed without damaging the building structure or finish or not permanently closed in by the structure or finish of the building.

314.29 Boxes, Conduit Bodies, and Handhole Enclosures to Be Accessible.

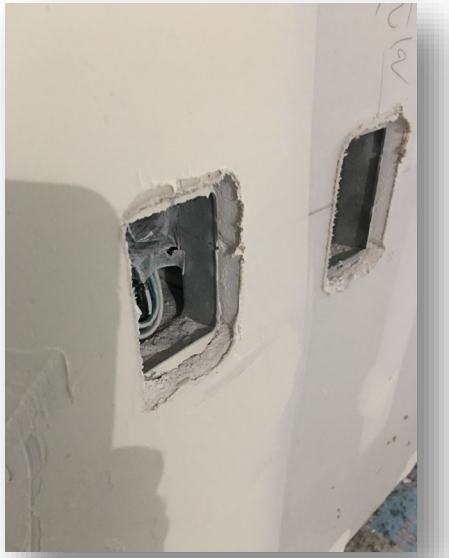
Definition – Readily Accessible

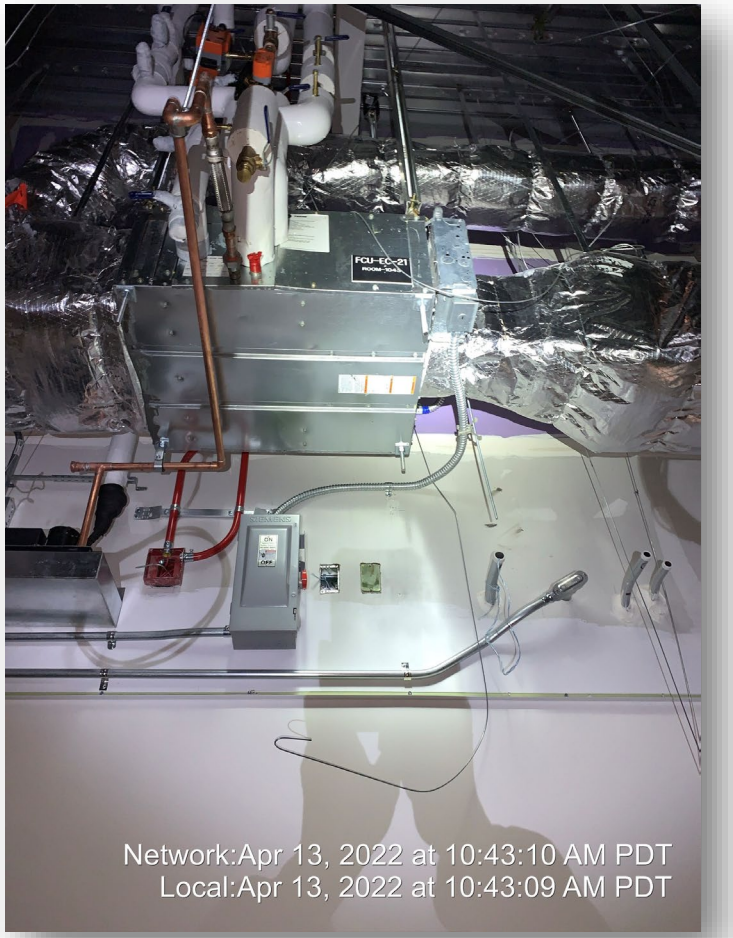
Accessible, Readily (Readily Accessible). Capable of being reached quickly for operation, renewal, or inspections without requiring those to whom ready access is requisite to take actions such as to use tools (other than keys), to climb over or under, to remove obstacles, or to resort to portable ladders, and so forth. (CMP-1)

Informational Note: Use of keys is a common practice under controlled or supervised conditions and a common alternative to the ready access requirements under such supervised conditions as provided elsewhere in the NEC.

Definitions - Concealed

Concealed. Rendered inaccessible by the structure or finish of the building. (CMP-1)





Note: equipment located above lay-in ceiling is considered accessible (i.e. not concealed).

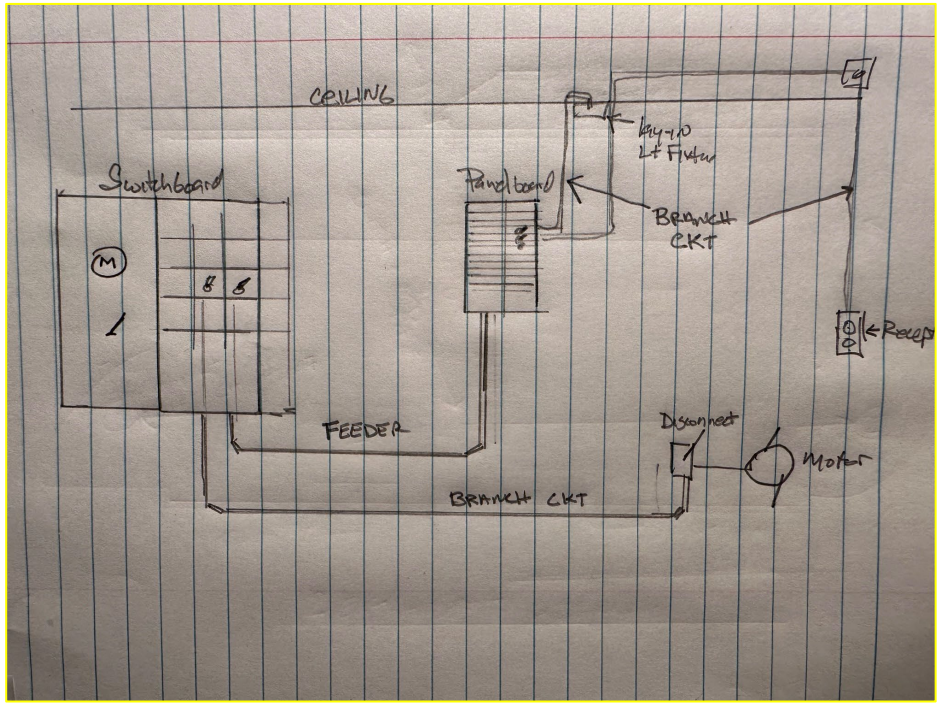
Definitions – Within Sight

In Sight From (Within Sight From, Within Sight). Where this *Code* specifies that one equipment shall be “in sight from,” “within sight from,” or “within sight of,” and so forth, another equipment, the specified equipment is to be visible and not more than 15 m (50 ft) distant from the other. (CMP-1)

Definitions - Feeder

Feeder. All circuit conductors between the service equipment, the source of a separately derived system, or other power supply source and the final branch-circuit overcurrent device. (CMP-10)

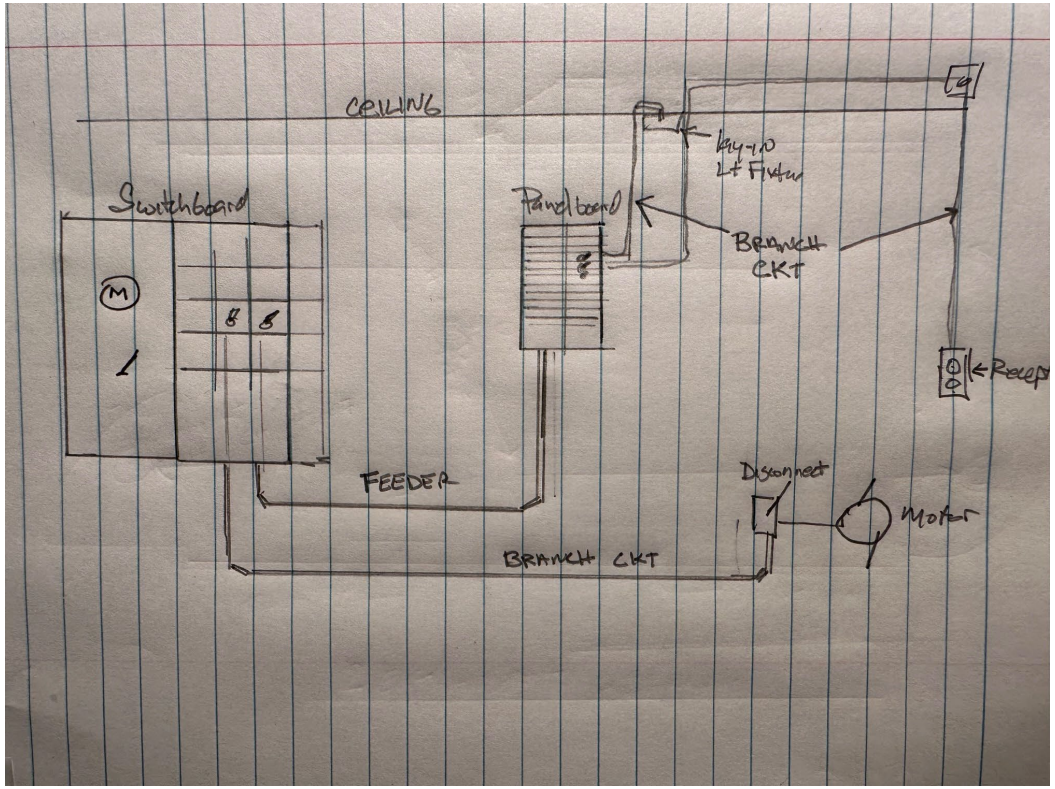
- From generator
- From xfmr



Definitions - Branch Circuit.

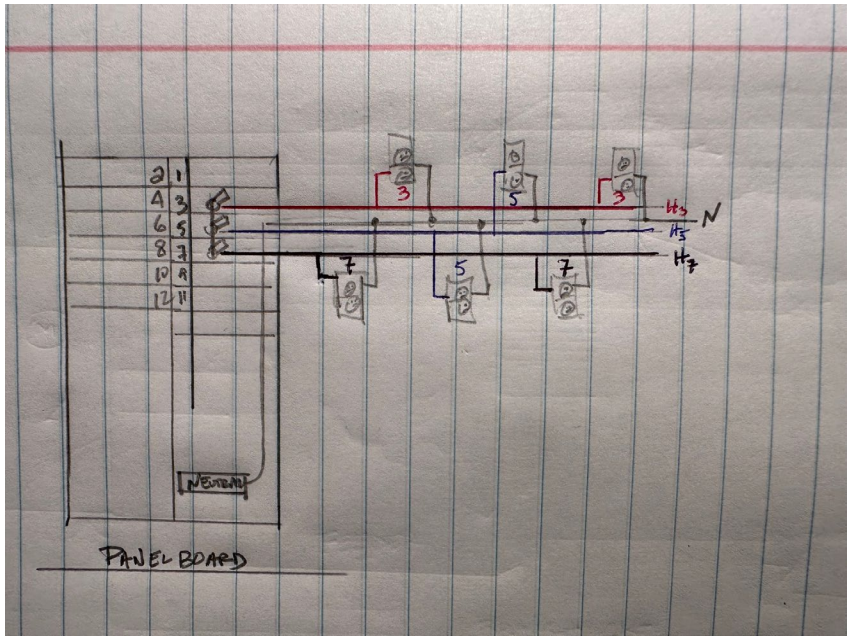
The circuit conductors between the final overcurrent device protecting the circuit and the outlet(s). (CMP-2)

- Appliance
- General
- Individual
- Motor
- Multiwire



Definition – Muti-wire Branch Circuit

Branch Circuit, Multiwire. A branch circuit that consists of two or more ungrounded conductors that have a voltage between them, and a grounded conductor that has equal voltage between it and each ungrounded conductor of the circuit and that is connected to the neutral or grounded conductor
of the system. (CMP-2)



Definition – Muti-wire Branch Circuit

CEC 517.18 Category 2 (General Care) Spaces - Branch circuits serving patient bed locations shall not be part of a multiwire branch circuit.

CEC 517.19 Category 1 (Acute Care) Spaces - Branch circuits serving patient bed locations shall not be part of a multiwire branch circuit.

CEC 700.19 Multiwire Branch Circuits. The branch circuit serving emergency lighting and power circuits shall not be part of a multiwire branch circuit.

CEC 210.4(B) - Each multiwire branch circuit shall be provided with a means that will simultaneously disconnect all ungrounded conductors at the point where the branch circuit originates.

Muti-wire Branch Circuit (Derating)

3 Hots and 3 Neutrals is 6 current carrying conductors

At 75C ampacity of THHN/THWN #12's is 30A @80% = 24A

½" conduit can accommodate up to 12 conductors

Δ Table 310.15(C)(1) Adjustment Factors for More Than Three Current-Carrying Conductors

Number of Conductors*	Percent of Values in Table 310.16 Through Table 310.19 as Adjusted for Ambient Temperature if Necessary
4–6	80
7–9	70
10–20	50
21–30	45
31–40	40
41 and above	35

*Number of conductors is the total number of conductors in the raceway or cable, including spare conductors. The count shall be adjusted in accordance with 310.15(E) and (F). The count shall not include conductors that are connected to electrical components that cannot be simultaneously energized.

Δ Table 310.16 Ampacities of Insulated Conductors with Not More Than Three Current-Carrying Conductors in Raceway, Cable, or Earth (Directly Buried)

Size AWG or kcmil	Temperature Rating of Conductor [See Table 310.4(A)]						Size AWG or kcmil
	60°C (140°F)	75°C (167°F)	90°C (194°F)	60°C (140°F)	75°C (167°F)	90°C (194°F)	
	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, XHWN, USE, ZW	Types TBS, SA, SIS, FEP, FEPB, MI, PFA, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, XHWN, XHWN-2, XHHN, Z, ZW-2	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, XHWN, USE	Types TBS, SA, SIS, THHN, THHW, THW-2, THWN-2, RHH, RHW-2, USE-2, XHH, XHHW, XHHW-2, XHWN, XHWN-2, XHHN	
	COPPER			ALUMINUM OR COPPER-CLAD ALUMINUM			
18*	—	—	14	—	—	—	—
16*	—	—	18	—	—	—	—
14*	15	20	25	—	—	—	—
12*	20	25	30	15	20	25	12*
10*	30	35	40	25	30	35	10*
8	40	50	55	35	40	45	8
6	55	65	75	40	50	55	6
4	70	85	95	55	65	75	4
3	85	100	115	65	75	85	3

Table C.1 Maximum Number of Conductors or Fixture Wires in Electrical Metallic Tubing (EMT) (Based on Chapter 9: Table 1, Table 4, and Table 5)

Type	Conductor Size (AWG/kcmil)	Trade Size (Metric Designator)												
		⅜ (12)	½ (16)	¾ (21)	1 (27)	1¼ (35)	1½ (41)	2 (53)	2½ (63)	3 (78)	3½ (91)	4 (103)	5 (129)	6 (155)
TW, THHW, THW, THW-2	14	—	8	15	25	43	58	96	168	254	332	424	—	—
	12	—	6	11	19	33	45	74	129	195	255	326	—	—
	10	—	5	8	14	24	33	55	96	145	190	243	—	—
	8	—	2	5	8	13	18	30	53	81	105	135	—	—
	2000	—	0	0	0	0	0	0	1	1	1	1	—	—
THHN, THWN, THWN-2	14	—	12	22	35	61	84	138	241	364	476	608	—	—
	12	—	9	16	26	45	61	101	176	266	347	443	—	—
	10	—	5	10	16	28	38	63	111	167	219	279	—	—
	8	—	3	6	9	16	22	36	64	96	126	161	—	—
	6	—	2	4	7	12	16	26	46	69	91	116	—	—

Definition – Disconnecting Means

Disconnecting Means. A device, or group of devices, or other means by which the conductors of a circuit can be disconnected from their source of supply. (CMP-1)

Definitions - Overcurrent Protection Device (OCPD)

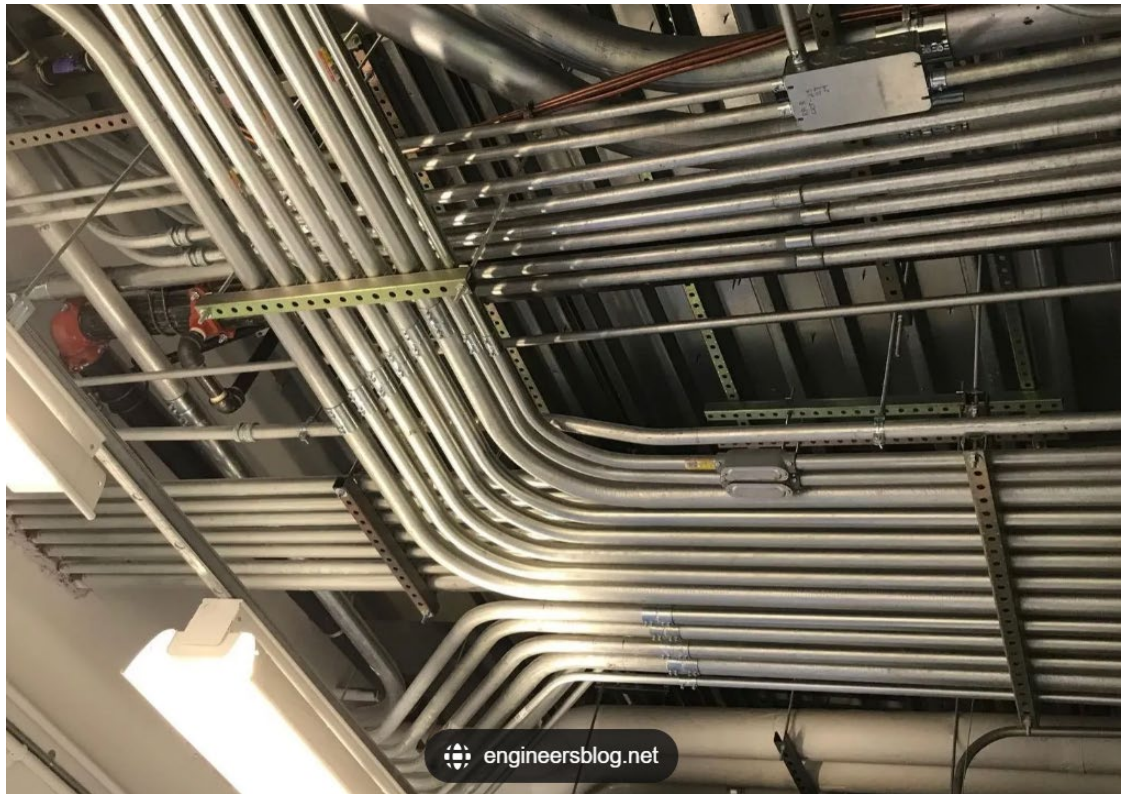
Device capable of providing protection for service, feeder, and branch circuits and equipment

Circuit Breaker. A device designed to open and close a circuit by nonautomatic means and to open the circuit automatically on a predetermined overcurrent without damage to itself when properly applied within its rating.

(CMP-10)

Fuse. An electrical safety device designed to open and close a circuit by nonautomatic means and to open the circuit automatically

ARTICLE 110 – GENERAL REQUIRMENTS FOR ELECTRICAL INSTALLATIONS



110.2 Approval.

The conductors and equipment required or permitted by this *Code* shall be acceptable only if approved.

Requires - suitability for installation in accordance with this *Code*. Suitability shall be determined by application of requirements that are compatible with this *Code*.

[OSHPD 1, 1R, 2, 3, 4 & 5] Equipment shall be approvable if the equipment meets the following requirements:

- *Equipment is approved, listed, labeled or certified for its use by a Nationally Recognized Testing Laboratory (NRTL) as recognized by the U.S. department of Labor, Occupational Safety and Health Administration.*
- *When field evaluated, equipment is evaluated and labeled by a Field Evaluation Body (FEB) that is accredited by International Accreditation Services (IAS) in accordance with NFPA 790.*
- *Equipment has special seismic certifications when required by Sections 1705.13.3 and 1705A.13.3 of California Building Code.*

https://www.iasonline.org

Accreditation #	Expires	Organization Name	City, State	Country	Program	Status
View Certificate FEB-112	Nov 1, 2024	**AC&E North America Inc.**	New York City, NY	US	Field Evaluation Bodies	Accredited
View Certificate FEB-111	Jul 1, 2025	**CSA America Testing & Certification LLC**	Independence, OH	US	Field Evaluation Bodies	Accredited
View Certificate FEB-119	Apr 1, 2025	**ESTEC Solutions, Inc.**	Georgetown, TX	US	Field Evaluation Bodies	Accredited
View Certificate FEB-116	Nov 1, 2025	**ETC - The Electrical Testing Company**	Hayward, CA	US	Field Evaluation Bodies	Accredited
View Certificate FEB-103	Feb 1, 2025	**ETI Conformity Services**	Santa Fe Springs, CA	US	Field Evaluation Bodies	Accredited

110.9 Interrupting Rating.

Equipment intended to interrupt current at fault levels shall have an interrupting rating at nominal circuit voltage at least equal to the current that is available at the line terminals of the equipment.

Circuit breakers 5,000AIC if not listed 240.83(C)

Fuses 10,000AIC if not listed 240.60(C)(3)

Amps Interrupting Capacity (AIC)

110.12 Mechanical Execution of Work.

Electrical equipment shall be installed in a neat and workman like manner.

(A) Unused Openings. Unused openings, other than those for the operation of equipment, those intended for mounting purposes, or those permitted as part of the design for listed equipment, shall be closed

(B) Integrity of Electrical Equipment and Connections. There shall be no damaged parts that may adversely affect safe operation or mechanical strength of the equipment such as parts that are broken; bent; cut; or deteriorated by corrosion, chemical action, or overheating.

110.13 Mounting and Cooling of Equipment.

(A) Mounting. Electrical equipment shall be firmly secured to the surface on which it is mounted.

(B) Cooling. Electrical equipment that depends on the natural circulation of air and convection principles for cooling of exposed surfaces shall be installed so that room airflow over such surfaces is not prevented by walls or by adjacent installed equipment. For equipment designed for floor mounting, clearance between top surfaces and adjacent surfaces shall be provided to dissipate rising warm air. Electrical equipment provided with ventilating openings shall be installed so that walls or other obstructions do not prevent the free circulation of air through the equipment.

Labeling Requirements (ANSI Z535.4)

110.16 (A)Arc-Flash Hazard Warning (All electrical equipment likely to require examination/adjustment/servicing)

110.16(B) Service equipment if 1200A or more
1)Voltage
2) Available fault current
3)Clearing time of OCPD based on AIC
4) Date label was applied.

110.22 ID of Disconnecting Means
1)Load served
2)ID of circuit source of power

110.75(E) Manhole covers shall have function marked “electrical”

200.4(B) – Neutral conductors in enclosure shall be marked with circuit (if more than 1)

210.5 Identification of branch circuits
(A) Grounded conductor (bare, green or green with yellow stripes
(B) Ungrounded conductors (- color coding 120/208V (typically black red blue & white) different than 277/480V (typically brown, orange yellow & gray)

Labeling Requirements (ANSI Z535.4)

230.66 Service equipment shall be marked to ID suitable for use as service equipment

230.70 Each service disconnect shall be permanently marked to indicate service disconnect

250.119 Equipment grounding conductors shall be bare or insulated with green wire. If larger than #4's , marking with green tape at terminations shall be sufficient.

314.30(D) Handhole covers shall have function marked "electrical"

314.72(E) Medium voltage boxes shall be marked "Danger-High Voltage-Keep Out"

408 Switchboards, Switchgear and Panelbords

408.4 Descriptions Required

(A) Circuit Directory or Circuit Identification. Every circuit and circuit modification shall be legibly identified as to its clear, evident, and specific purpose or use.

(B) Source of Supply. All switchboards, switchgear, and panelboards supplied by a feeder(s) in other than one- or twofamily dwellings shall be permanently marked to indicate each device or equipment where the power originates

409 Industrial Control Panels.

409.22 Short-Circuit Current Rating.

(A) Installation. An industrial control panel shall not be installed where the available fault current exceeds its short-circuit current rating as marked in accordance with 409.110(4). Exception to (4): Short-circuit current rating markings are not required for industrial control panels containing only control circuit components.

Labeling Requirements

410.10 Luminaires in Specific Locations.

(A) Wet and Damp Locations. Luminaires installed in wet or damp locations shall be installed such that water cannot enter or accumulate in wiring compartments, lampholders, or other electrical parts. All luminaires installed in wet locations shall be marked, “Suitable for Wet Locations.” All luminaires installed in damp locations shall be marked “Suitable for Wet Locations” or “Suitable for Damp Locations.”

517.18 & 19(A) The electrical receptacles or the cover plates for the electrical receptacles supplied from the life safety and critical branches shall have a distinctive color or marking so as to be readily identifiable.

517.31(C)(1)(a)Raceways, cables, or enclosures of the life safety and critical branch shall be readily identified as a component of the essential electrical system (EES). Boxes and enclosures (including transfer switches, generators, and power panels) shall be field- or factory-marked and identified as a compo-nent of the EES. Raceways and cables shall be field- or fac-tory-marked as a component of the EES at intervals not to exceed 7.6 m (25 ft).

110.16 Arc-Flash Hazard Warning.

(A) General. Electrical equipment, such as switchboards, switchgear, panelboards, industrial control panels, meter socket enclosures, and motor control centers, and is likely to require examination, adjustment, servicing, or maintenance while energized, shall be field or factory marked to warn qualified persons of potential electric arc flash hazards. The marking **shall be of sufficient durability** and shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

(B) Service Equipment. In addition to the requirements in 110.16(A), a permanent label shall be field or factory applied to service equipment rated 1200 amps or more. The label shall contain the following information:

(1) Nominal system voltage

(2) Available fault current at the service overcurrent protective devices

(3) The clearing time of service overcurrent protective devices based on the available fault current at the service equipment

(4) The date the label was applied

110.22 Identification of Disconnecting Means.

(A) General. Each disconnecting means shall be legibly marked to indicate its purpose unless located and arranged so the purpose is evident. The marking shall include the identification of the circuit source that supplies the disconnecting means. The marking shall be of sufficient durability to withstand the environment involved.

110.24 Available Fault Current.

(A) Field Marking. Service equipment shall be legibly marked in the field with the available fault current. The field marking(s) shall include the date the fault-current calculation was performed and be of sufficient durability to withstand the environment involved. The calculation shall be documented and made available to those authorized to design, install, inspect, maintain, or operate the system.

(B) Modifications. When modifications to the electrical installation occur that affect the available fault current at the service, the available fault current shall be verified or recalculated as necessary to ensure the service equipment ratings are sufficient for the available fault current at the line terminals of the equipment. The required field marking(s) in 110.24(A) shall be adjusted to reflect the new level of available fault current.

110.26 Spaces About Electrical Equipment.

Access and working space shall be provided and maintained about all electrical equipment to permit ready and safe operation and maintenance of such equipment.

(A)Working Space. Working space for equipment operating at 1000 volts, nominal, or less to ground and likely to require examination, adjustment, servicing, or maintenance while energized shall comply with: 110.26(A)(1) - Depth

110.26(A)(2) - Width

110.26(A)(3) - Height

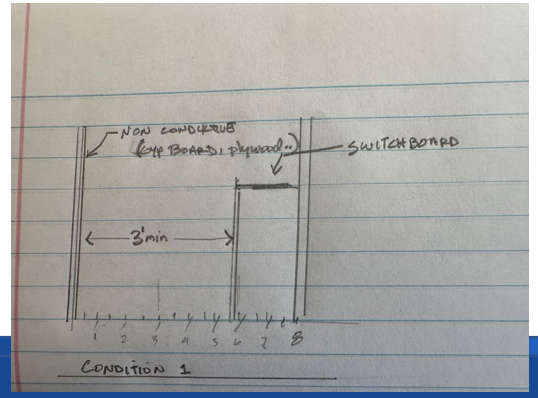
110.26(A)(4) – Limited Access

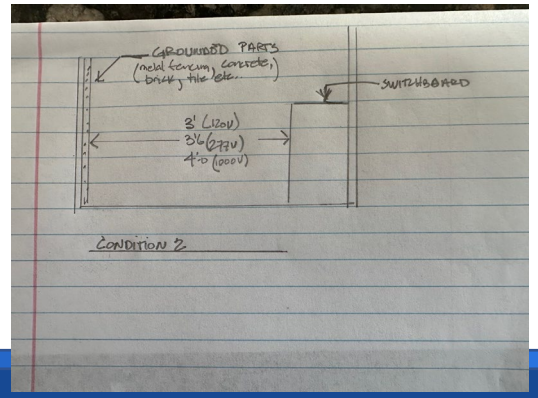
Applies to all panels (including fire alarm panels with 120v ckt) except low voltage panels, which can be approved by AHJ.

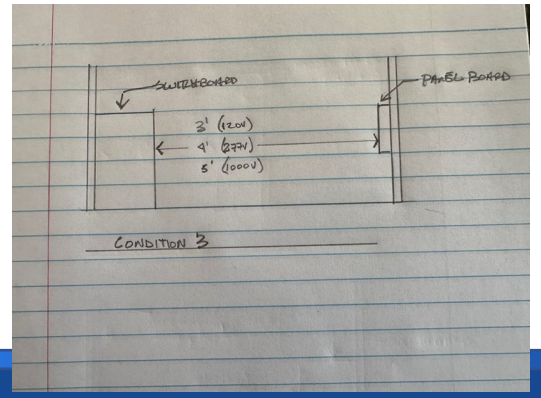
110.26(A)(1) Depth of Working Space

(1) Depth of Working Space. The depth of the working space in the direction of live parts shall not be less than that specified in Table 110.26(A)(1). Distances shall be measured from the exposed live parts or from the enclosure or opening if the live parts are enclosed.

Condition 1	Condition 2	Condition 3
0–150 9(3 ft)	(3 ft)	(3 ft)
151–600 (3 ft)	(3 ft 6 in.)	(4 ft)
601–1000 (3 ft)	(4 ft)	(5 ft)

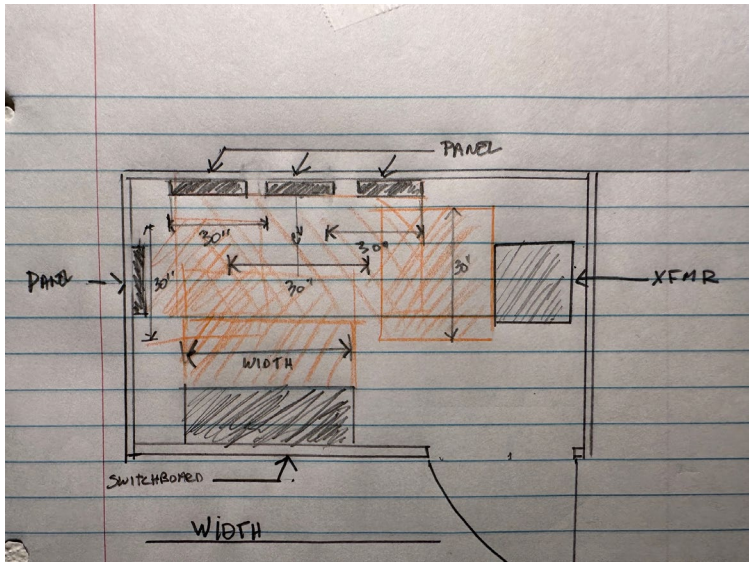






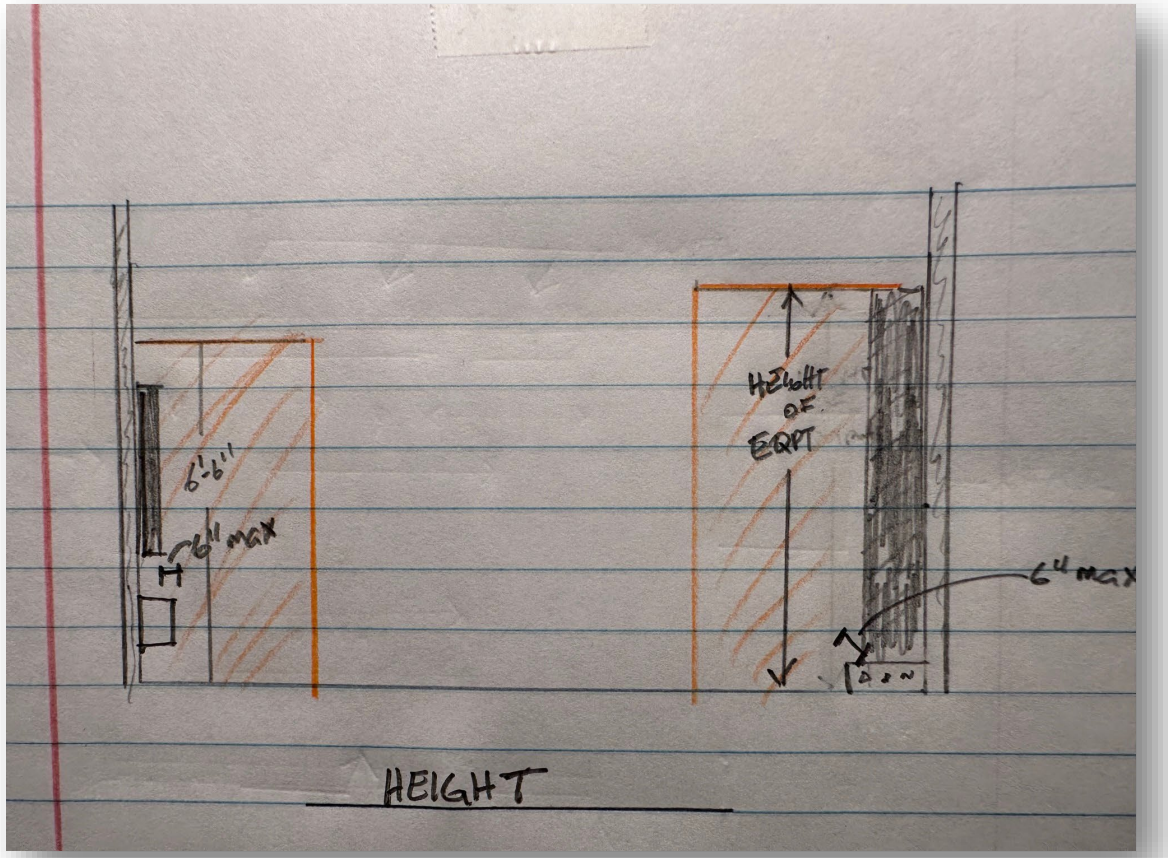
110.26 (A) **(2) Width of Working Space.**

- **(2) Width of Working Space.** The width of the working space in front of the electrical equipment shall be the width of the equipment or 762 mm (30 in.), whichever is greater. In all cases, the work space shall permit at least a 90 degree opening of equipment doors or hinged panels.



110.26 (A) **(3) Height of Working Space.**

The work space shall be clear and extend from the grade, floor, or platform to a height of 2.0 m (61⁄2 ft) or the height of the equipment, whichever is greater. Within the height requirements of this section, other equipment or support structures, such as concrete pads, associated with the electrical installation and located above or below the electrical equipment shall be permitted to extend not more than 150 mm (6 in.) beyond the front of the electrical equipment

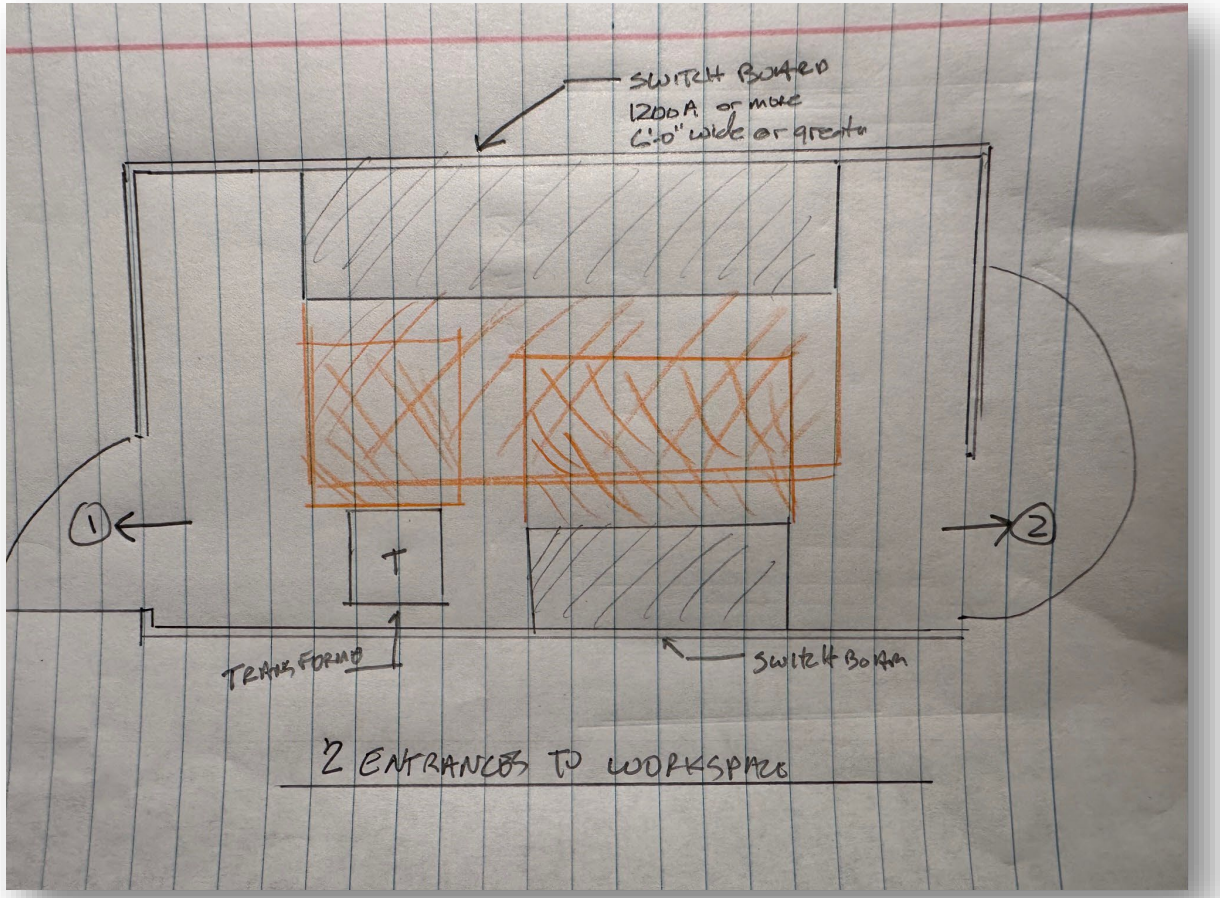


110.26 (C) Entrance to and Egress from Working Space.

(2) Large Equipment

For large equipment that contains overcurrent devices, switching devices, or control devices, there shall be one entrance to and egress from the required working space not less than 24 in. wide and 6½ ft high at each end of the working space.

- Large Equipment is considered equipment rated 1200 amperes or more and over (6 ft) wide.



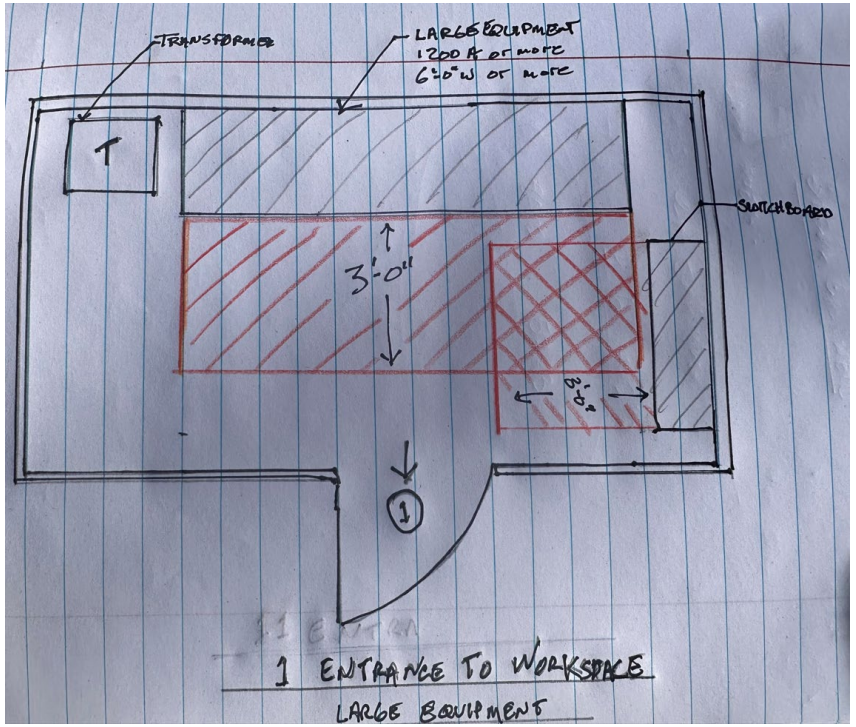
110.26 (C) Entrance to and Egress from Working Space.

(2) Large Equipment

A single entrance to and egress from the required working space shall be permitted where

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

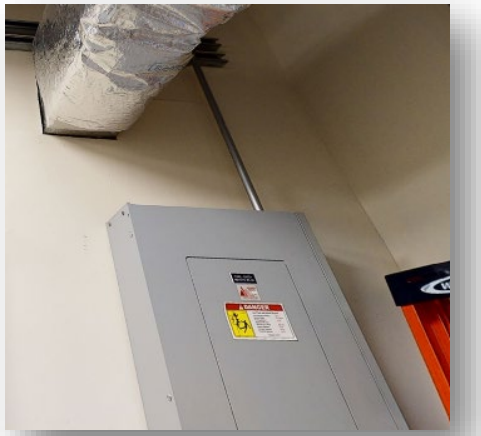
(b) *Extra Working Space*. Where the depth of the working space is twice that required by 110.26(A)(1), a single entrance shall be permitted. It shall be located such that the distance from the equipment to the nearest edge of the entrance is not less than the minimum clear distance specified in Table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

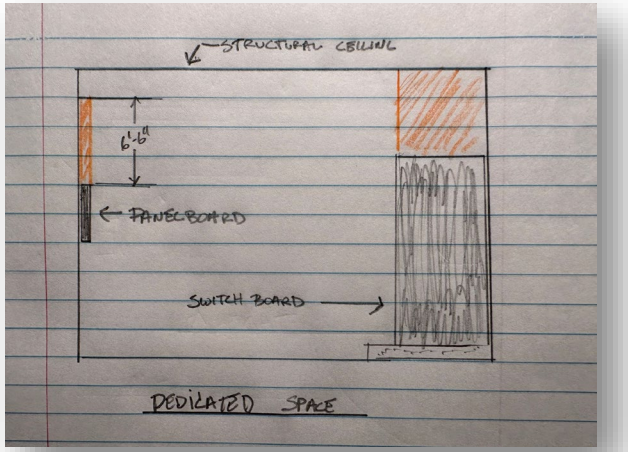


110.26 (E) Dedicated Equipment Space

(1) Indoor. Indoor installations shall comply with 110.26(E) (1)(a) through (E)(1)(d).

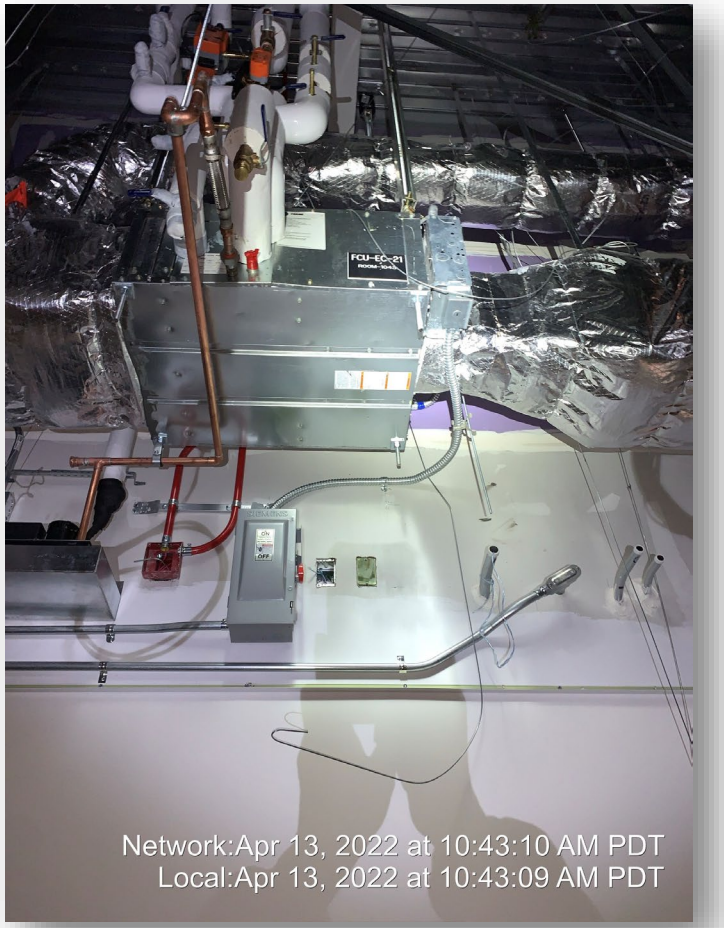
(a) *Dedicated Electrical Space.* The space equal to the width and depth of the equipment and extending from the floor to a height of 1.8 m (6 ft) above the equipment or to the structural ceiling, whichever is lower, shall be dedicated to the electrical installation. No piping, ducts, leak protection apparatus, or other equipment foreign to the electrical installation shall be located in this zone.
(b) *Foreign Systems.* **The area above the dedicated space required by 110.26(E)(1)(a) shall be permitted to contain foreign systems, provided protection is installed to avoid damage to the electrical equipment from condensation, leaks**, or breaks in such foreign systems.
(c) *Sprinkler Protection.* Sprinkler protection shall be permitted for the dedicated space where the piping complies with this section.
(d) *Suspended Ceilings.* A dropped, suspended, or similar ceiling that does not add strength to the building structure shall not be considered a structural ceiling.





110.26 (A) **(4) Limited Access.**

(1) Where equipment is installed above a lay-in ceiling, there shall be an opening not smaller than (22 in. × 22 in.), or in a crawl space, there shall be an accessible opening not smaller than (22 in. × 30 in.).
(2) The width of the working space shall be the width of the equipment enclosure or a minimum of (30 in.), whichever is greater.
(3) All enclosure doors or hinged panels shall be capable of opening a minimum of 90 degrees.
(4) The space in front of the enclosure shall comply with the depth requirements of Table 110.26(A)(1). The maximum height of the working space shall be the height necessary to install the equipment in the limited space. A horizontal ceiling structural member or access panel shall be permitted in this space.



Summary of Intervening code updates

2023 CEC	**220.40 General**	Feeder and Service Load Calculations - Receptacles in Category 1 and Category 2 Patient Care Spaces	1st 5,000 VA at 100% 5001-10000 VA at 50% Over 10,000 VA @ 25%
AB2511	**517.1 Scope. (B) OSHPD 2.**	AB 2511 requirments including definitions for microgrid, life saving equipment, oxygen generating devices (PIN 74)	
NFPA 99	***(C517.13 Equipment Grounding) Testing.***	*Grounding System testing in accordance with NFPA **99:** 6.3.3.1.*	
NFPA 99	**517.20 Wet Procedure Locations.**	Operating rooms shall be considered to be a wet procedure location unless a risk assessment conducted by the health care governing body determines otherwise.	
2023 CEC	**Type 1 - 517.30 Sources of Power.**	Healthcare microgrids acceptable source for Essential power - Hospitals	
Match NEC	517.31 Requirements for the Essential Electrical System. ... ... (E) Receptacle	Removed the requirment for red switches if fed by Essential Power	
clarification	**517.35 Equipment Branch**	autoclaving equipment at least one per building - shall be connected to essential power	
2023 CEC	**Type 2 - 517.41 Required Power Sources.**	Healthcare microgrids acceptable source for Essential power - SNF's	
Match NEC	**517.42 Essential Electrical Systems (E) Receptacle Identification.**	Removed the requirment for red switches if fed by Essential Power	
NFPA 99	**517.160 Isolated Power Systems**	Added LIM tests from NFPA 99	
clarification	**695.3 Power Source(s) for Electric Motor-Driven Fire Pumps**	Added surgical clarification that for OSHPD 3 facilities only surgical clinics require ATS with issolation bypass and OSHPD 5	
has been enforced, adding to code	**705.20 Disconnecting Means, Source.**	disconnecting means for on site energy producers	

QUESTIONS?