How do the new Title 24 Part 6 electrical distribution requirements for nonresidential buildings save energy?

I don't think this section is to save energy, I think it is to ensure that the electrical loads are balance.

using demand response and monitoring

It requires that the electric loads be put into separate categories, such as, HVAC loads, lighting loads, etc so they can be review for excess use and managed better.

Turn off electrical loads where possible.

I do not know

Energy Code Ace™
HELPING YOU PLAY YOUR CARDS RIGHT

Decoding Electrical Distribution™

Let's Talk Title 24 Part 6 Section 130.5

Host:
Gina Rodda
Gabel Associates, LLC

Guest Speaker:
Michael Scalzo
AAA Companies

SDGE A Sempra Energy utility®
SoCalGas A Sempra Energy utility®
Southern California Edison® An EDISON INTERNATIONAL® Company
PG&E Pacific Gas and Electric Company®

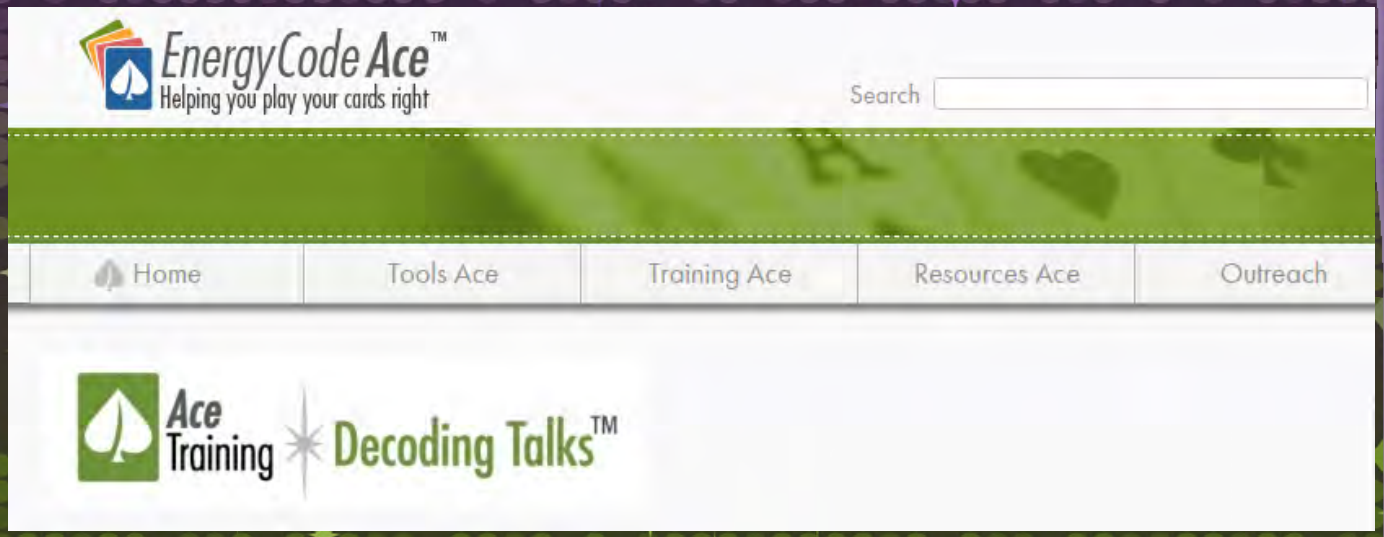
This program is funded by California utility customers under the auspices of the California Public Utilities Commission and in support of the California Energy Commission.

Welcome

- **Welcome**
  - Who are we?
  - Our goal today
  - More about you
- What We Heard From you
- Let's Talk
- Next Steps
- Wrap Up

Recording For Future Use

This session is being recorded.



Archives

Below you'll find recordings of prior Decoding Talks you can access anytime and anywhere you like.
Simply click on the title of the session you'd like to view.

Brought to you by…

California Statewide Codes & Standards

EnergyCode Ace™
Helping you play your cards right

SDGE A Sempra Energy utility®

SoCalGas A Sempra Energy utility®

Southern California Edison® An EDISON INTERNATIONAL® Company

PG&E Pacific Gas and Electric Company®

This program is funded by California utility customers under the auspices of the California Public Utilities Commission and in support of the California Energy Commission.

Who Are We?

Host

Gina Rodda, Gabel Associates, LLC

gina@gabelenergy.com

Gina Rodda, our host for the Decoding Talk series, is a Certified Energy Analyst (CEA), Certified Energy Plans Examiner (CEPE) and LEED Accredited Professional (AP).

She is involved in providing residential and non-residential energy calculations for a variety of building types throughout California; an instructor of full day trainings; and host of various webinars specific to Title 24 (Part 6) Building Energy Efficiency Standards.

Gina has been in the energy modeling field since 1991, through the course of seven California building energy code cycles.

GABEL ASSOCIATES, LLC
BUILDING ENERGY ANALYSIS & ENERGY CODE COMPLIANCE

Who Are We?

Co-Host

Michael Scalzo, AAA Companies

mscalzo@aaacompanies.com

Michael Scalzo, our co-host for Decoding Talk series, has been on the forefront of California's statewide implementation of the new Title 24, Part 6 2013 NR Standards.

Since 2012, he has been actively providing instruction and training courses for Title 24 2013 compliance as well as consulting services for numerous architects, engineers and general contractors.

In addition, as the Senior Project Manager of AAA Companies' Title 24 Division, Michael is extensively involved in compliance design, in energy calculations and in providing value engineering solutions to clients across the state. Michael is also a California Journeyman electrician.

Our Goal Today

Review the "new" nonresidential electrical distribution requirements under the 2013 Title 24 Part 6 "Energy Code":

- What needs to be included to meet the requirements at design
- What does that look like during construction and "value engineering"
- How do document installation for final occupancy permit

We Want To Hear From You

- Welcome
- **▶We Want To Hear from You**
  - Most common challenges
- Let's Talk
- Next Steps
- Wrap Up

Our Question To You

What are your top 3 concerns regarding the new Title 24 part 6 code section on electrical distribution (Sec 130.5)?

A lot of paper work for forms.
Voltage drop calcs could take awhile and provide more paper work.
Existing electrical distribution with newly added panels could cause metering concerns for C10.

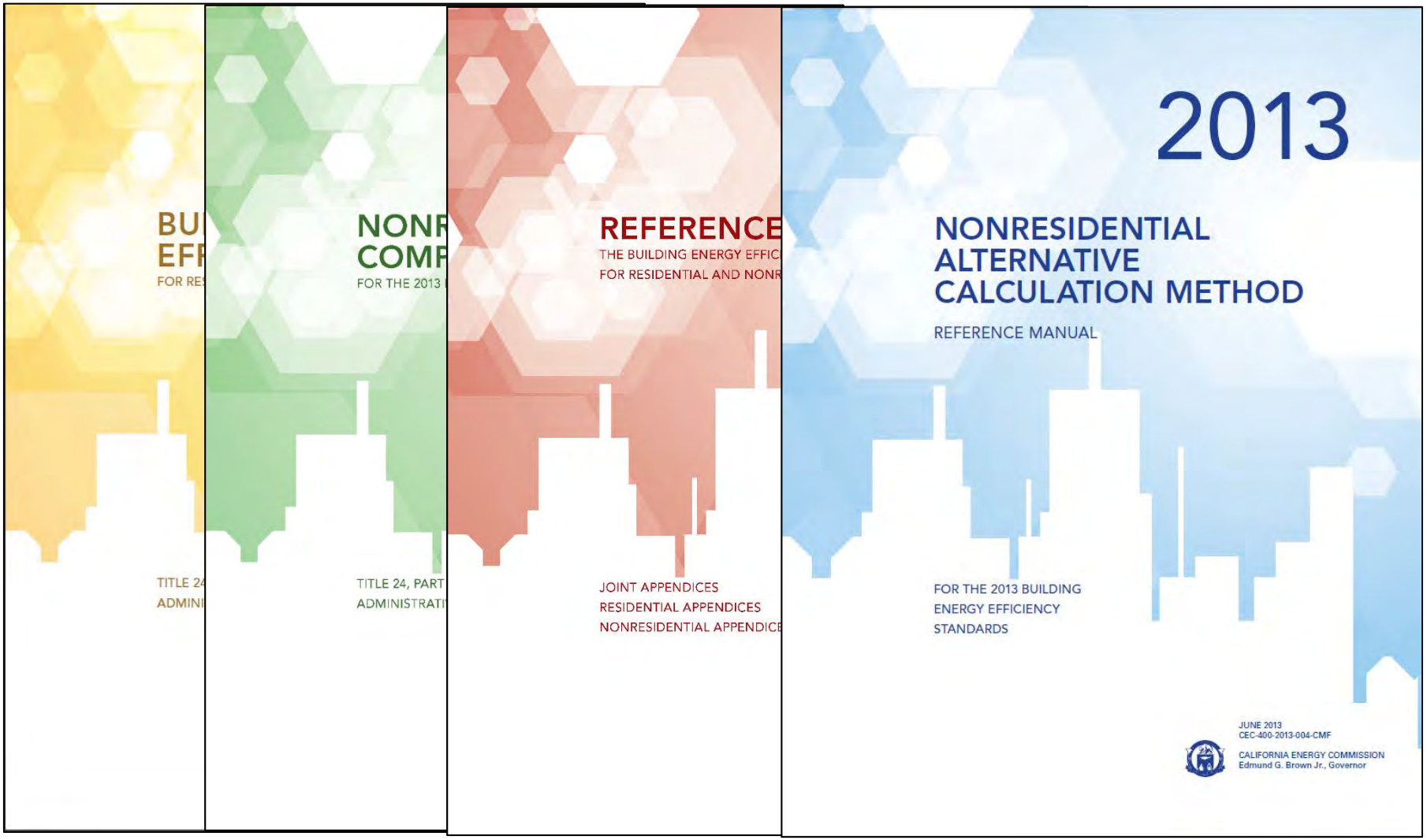
* too complicated
* too many relays required
* too many points of failure that eventually will be bypassed

Added and un-nessary costs to owners.

Understanding my role in the process

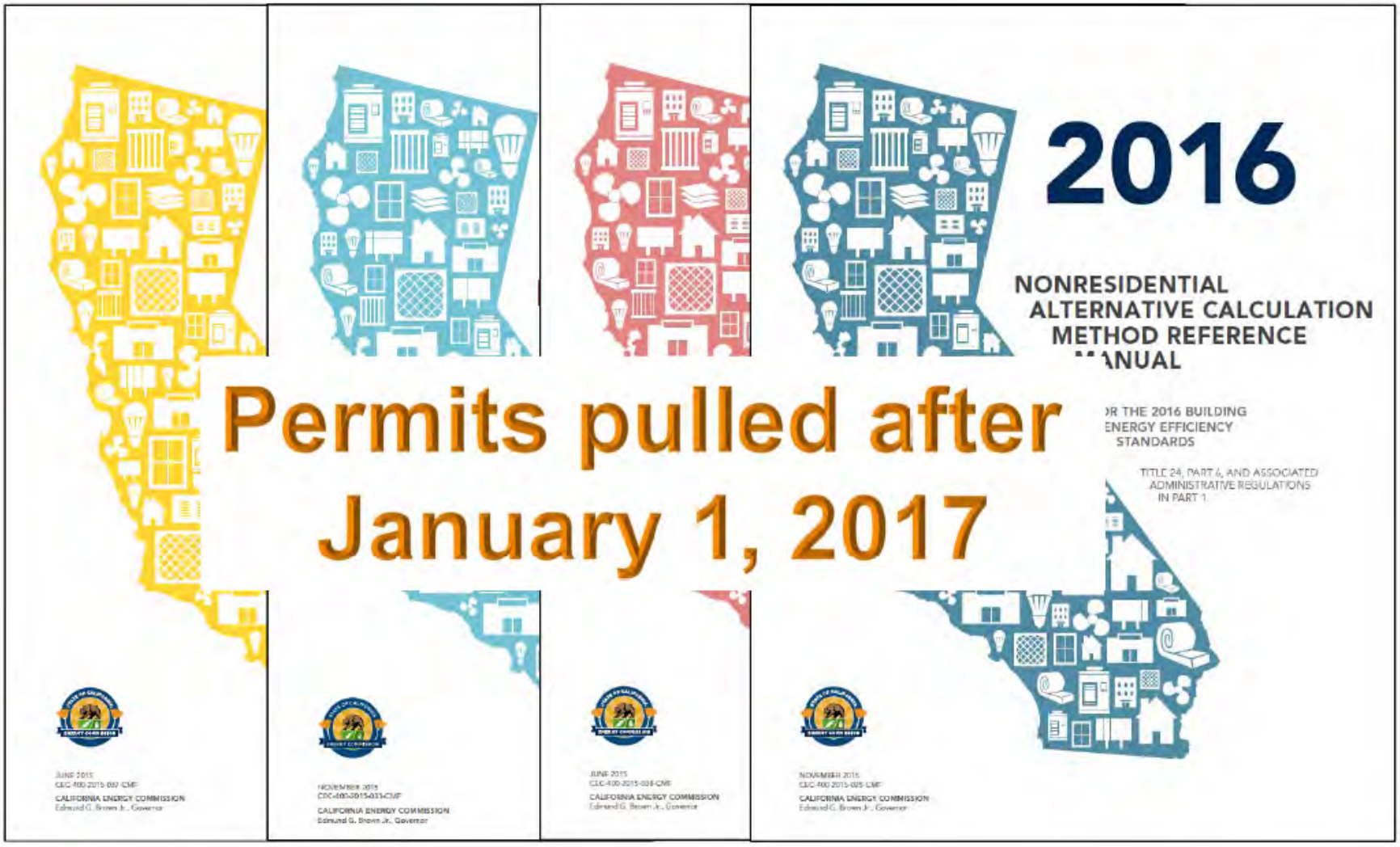
Not knowing how to fill the forms correctly.

Code: 2013 CEC Documents



http://energycodeace.com/content/reference-ace-2013-tool

Code: 2016 CEC Documents



http://www.energy.ca.gov/title24/2016standards/index.html

California Policy Goals

1978: Title 24, Part 6, California State Building Energy Efficiency Standards established; updates every 3 years

2006: AB32, Global Warming Solutions Act, adopted to reduce greenhouse gas emissions

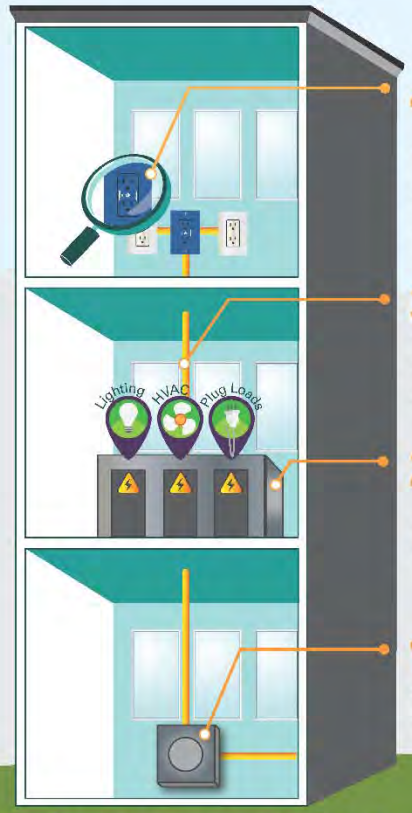
2008: California Energy Action Plan adopted; efficiency 1st choice in meeting future energy needs

2008: "Big Bold Strategies" adopted – nonresidential new construction zero net energy by 2030 is 1 of the 4

www.energycodeace.com
Infographic and Fact Sheet

2013 ENERGY CODE
Title 24 Part 6 Infographics
Nonresidential Electrical Power Distribution

Energy Code Ace™
HELPING YOU PLAY YOUR CARDS RIGHT



WATT'S HAPPENING HERE?
Electricity's Trip From the Ground Up

4 *When the electricity arrives at its final destination, it may need to be controlled.*

Circuit Controls
§130.5(d) In private offices, open office areas, reception lobbies, conference rooms, kitchenettes in office spaces, and copy rooms one controlled outlet must be within a 6-foot radius of any number of uncontrolled outlets.

3 *As electricity flows through the building's wires, voltage drops.*

Voltage Drop
§130.5(c) Design load calculated so that voltage drop is maximized at 2% for feeders and 3% for branch circuits (5% combined.)

2 *Once in the building, it must make a choice on where to go (e.g., HVAC, lighting, plug loads.)*

Disaggregation of Load
§130.5(b) Separate electric load so Building Owner can meter specific uses.

1 *The trip begins… electricity arrives at a building and knocks to get in.*

Service Metering
§130.5(a) Meter to allow Building Owner to monitor building electricity usage.

For more information see the Nonresidential EPD Fact Sheet found at EnergyCodeAce.com/content/resources_fact_sheets

SDGE A Sempra Energy utility® · SoCalGas A Sempra Energy utility® · Southern California Edison · Pacific Gas and Electric Company®

This program is funded by California utility customers under the auspices of the California Public Utilities Commission and in support of the California Energy Commission.

For example calculations and additional guidance on performing calculations, see Section 8.4 of the 2013 Nonresidential Compliance

+ DR controls and equipment shall be capable of receiving and automatically responding to at least one standards-based

Ace Resources — Title 24 Part 6 Fact Sheet

Nonresidential Electrical Power Distribution (EPD)

What is Electrical Power Distribution?

Electrical power distribution systems encompass electrical systems and equipment not specific to lighting. All measures in this code section are mandatory; per Section 130.5 of the 2013 Building Energy Efficiency Standards (Energy Standards). For additional guidance and example calculations and applications, see Sections 8.2- 8.6 of the 2013 Nonresidential Compliance Manual.

These requirements, which were new in the 2013 Standards, apply to all new construction, additions, and alterations for nonresidential, high rise residential and hotel/motel buildings.

Mandatory Measures

Electrical Service Metering Section 130.5 (a)

All newly installed electrical services (where electrical power from utility company or on-site generation enters a building) shall have a permanently installed user-accessible meter. The intent of the measure is that the service to every building be metered so that energy can be monitored by the user.

Requirements:
The meter must be able to:
+ Show the instantaneous power in kilowatts being used by the building
+ Reset and measure energy use in kilowatt-hours over a period set by the user
+ Be read by the building owner or occupant

Additional requirements must be met for larger services (see Table 130.5-A on NRCC-ELC-01-E, page 2)
+ For electrical services > 250 kVA: the meter must also record the historical peak demand in kilowatts.
+ For electrical services > 1000 kVA: the meter must also be able to report the kWh for a fixed rate period.

If utility company's revenue service meter can meet the above requirements, then an additional meter does not need to be provided. In general, smart meters will meet the measure requirements if they allow building owners to access the meter data.

If a new customer-owned meter needs to be installed, it can be less accurate than a typical utility company revenue-grade meter, since it is being used to determine building energy use for management purposes.

If a building is not connected to the grid, a customer-owned meter must be in place to monitor energy use. If a building has multiple services, only the service that provides regular electric power needs to meet the measure requirements, however it is recommended that back up power be metered as well.

Compliance Documentation: Complete project information on page 2 of NRCC-ELC-01-E.

Disaggregation of Electrical Circuits Section 130.5 (b)

EPD systems should be designed for disaggregated measurement of electrical load energy uses downstream from the service meter according to load type and service power (kVA). "Disaggregation" means to break down the total electrical use in the building into groups that allow power and energy use measurements to be taken.

Separate feeders and panels for lighting, plug and equipment loads, HVAC load, etc. will be required. This measure is designed to help building owners and managers get detailed end use data to target specific operational improvements.

The measure is triggered when a new switchboard, panelboard or subpanel are connected, or when new feeders are pulled, typically in a new building, major renovation or addition. In existing buildings, if existing switchboard, feeders, and panelboards remain "as-is," the project does not need to meet the measure requirements. The measure does not require installation of metering devices.

Requirements:
Disaggregation is progressive and not required until the service is greater than 50 kVA (unless it pertains to renewable power sources or electric vehicle charging stations). See Table 130.5-B of the Standards or page 4 of the NRCC-ELC-01-E for specific separation requirements. For most small buildings, this requirement will not apply.
+ For services >50 kVA - 250 kVA, the requirements are applied to some load groups regardless of actual load, and to other load groups when the group reaches a threshold value of 25 kVA
+ For services ≥ 250 kVA, lighting and plug loads are required to be disaggregated "*by floor, type or area*". All HVAC, DHW, elevators, and charging stations loads can be measured in aggregate, by load type

Options for compliance:
+ Separate switchboards, motor control centers, or panelboards to which are connected only the required load or group of loads; or
+ Subpanels of the above to which are connected only the required load or group of loads and for which the subpanel load can be independently measured in aggregate; or
+ Branch circuits, taps or disconnects requiring overcurrent protection devices rated 60 amperes or greater

Exceptions:
If a complete metering and measurement system is installed and meets the disaggregation requirements in Table 130.5-B of the Energy Standards.

Compliance Documentation: Complete project information on pages 3-4 of NRCC-ELC-01-E.

Voltage Drop Section 130.5 (c)

Following the limits in CA Electrical Code (Title 24, Part 3), the recommended voltage drop becomes mandatory. Voltage drop is the energy loss as heat in the electrical conductors.

Requirements:
+ The maximum voltage drop is 2% of the design load for feeders. Feeders are conductors carrying current from one switchboard or panelboard to another.
+ The maximum voltage drop is 3% of the design load for branch circuits. Branch circuits are conductors carrying current from a switchboard/panelboard to one or more connected loads.
+ The cumulative voltage loss adds up to 5% loss relative to the load at the end of the branch circuit.
+ Emergency power circuits are exempt.

Voltage drops can be calculated by hand or through an online or computer program calculator with a few inputs including feeder length and branch circuit lengths, wire gauge by type, and circuit amps. Since electrical loads vary, the calculations are based on design load.

EnergyCode Ace™ Helping you play your cards right

This program is funded by California utility customers under the auspices of the California Public Utilities Commission and in support of the California Energy Commission.

DOCUMENT 2015-01-04

Mandatory, Prescriptive, Performance: Defining the Difference

Mandatory Measures
Electrical Power Distribution Requirements are ALL MANDATORY

Prescriptive Approach

ENV	MECH	LTG
some tradeoff	no tradeoff	some tradeoff

No tradeoffs between ENV, MECH, and LTG

Performance Approach

Standard Design

Proposed Design

Tradeoffs

ENV ↔ MECH ↔ LTG *

* See notes for restrictions

Compliance Documentation

Some prescriptive requirements likely 'traded away' via performance method
Look for features that were **improved** to compensate for the "tradeoff"

Electrical Service

What is it per Title 24 Part 6?

- Per Article 110 of the Electrical Code (Title 24 Part 3):
  - The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
    - Does this code refer to where electricity enters the building, ***or*** where the "revenue meter" is?

Service is electric power provided at the meter.
That revenue meter ***may*** be also considered the service meter.

Let's Talk

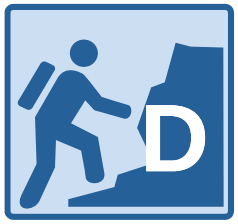
- Welcome
- What We Heard from You
- **Let's Talk**
  - Here, Now and Next
- Next Steps
- Wrap Up

Challenges (Phase of Project)

- **Challenge A: 130.5(a) Service Metering**

- **Challenge B: 130.5(b) Disaggregation of Load**

- **Challenge C: 130.5(c) Voltage Drop**



- **Challenge D: 130.5(d) 120 V Circuit Controls**

Our Question To You

How do you prepare for designing/installing/inspecting the section 130.5 electrical distribution requirements?

I only design. C10 install.
It is hard to have them learn new tricks.
The required controlled outlets really get to C10.

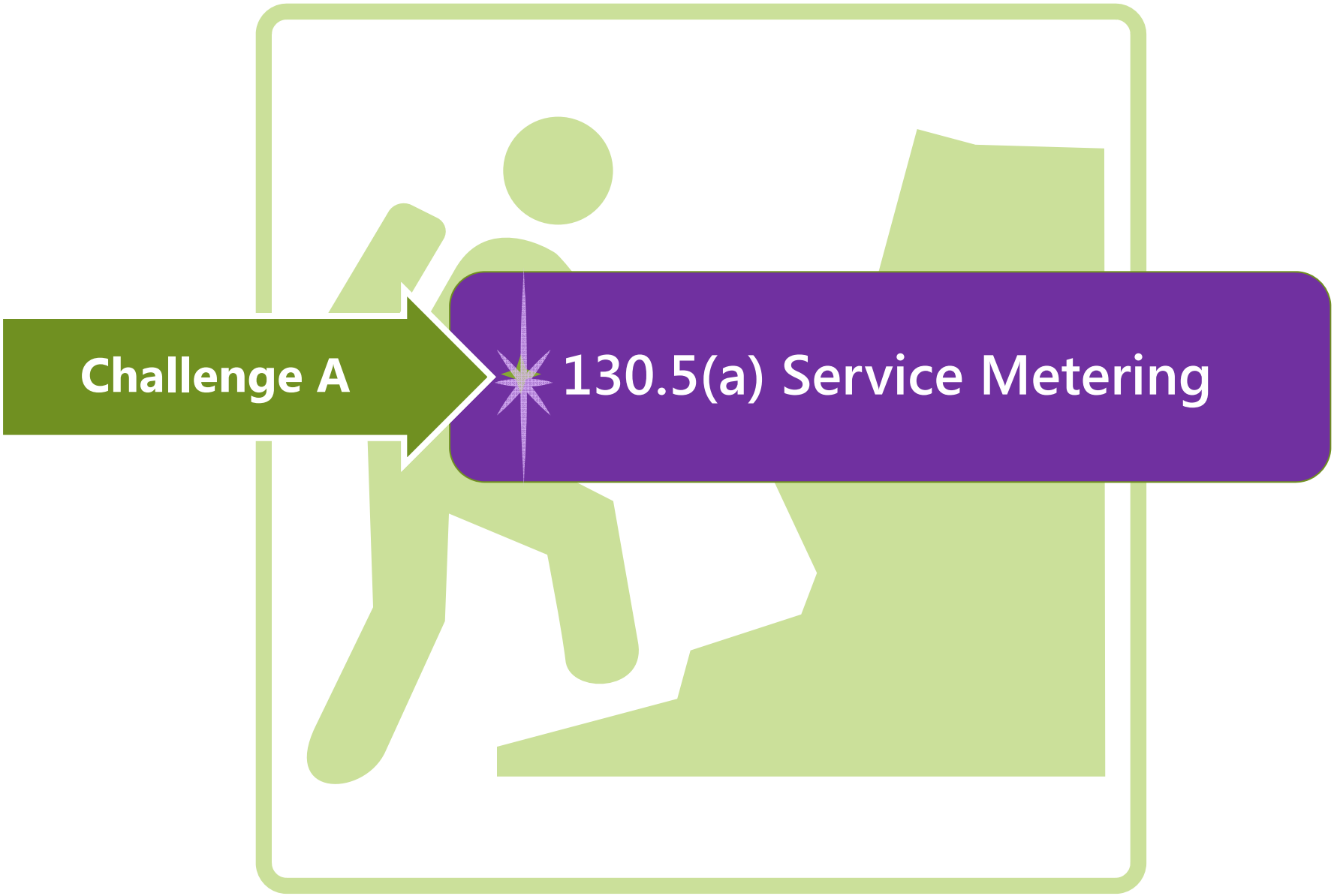
I'm a Mechanical Engineer so I mostly trust the electrical contractor or designer, but would like to get better.

Read materials available from energy ace

Review project scope of TI's in existing structures to determine applicability or exemption of section 130.5.

Try getting information from designer.

Challenge A



Section 130.5 Electrical Distribution

130.5(a)

- Service Metering

130.5(b)

- Disaggregation of Electrical Circuits

130.5(c)

- Voltage Drop

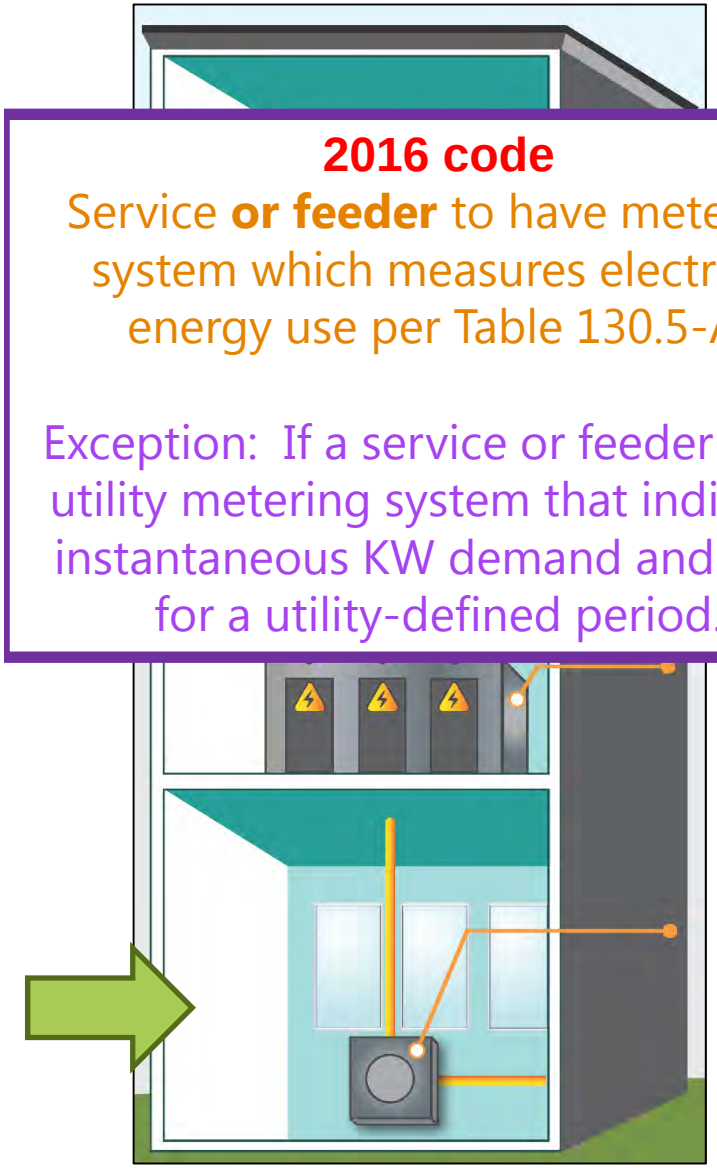
130.5(d)

- Circuit Controls for 120 volt Receptacles

Why Service Metering?

Require provisions
in a building's electrical distribution system
that will
ensure relatively easy implementation of advanced metering and control, including demand response and the "smart grid"

§130.5(a) – Service Metering



2016 code

Service **or feeder** to have metering system which measures electrical energy use per Table 130.5-A.

Exception: If a service or feeder has a utility metering system that indicates instantaneous KW demand and kWh for a utility-defined period.

- For any size service, meter to allow the building owner (or manager) to:
  - Read the instantaneous power in kilowatts being used by the building, and to
  - Be able to reset and measure energy use in kilowatt-hours over a period of his own choosing

And…

§130.5(a) – Service Metering

Table 130.5-A: MINIMUM REQUIREMENTS FOR METERING OF ELECTRICAL LOAD				
Meter Rating (kVA)	**50 kVA or less**	**More than 50 kVA and less than or equal to 250 kVA**	**More than 250 kVA and less than or equal to 1000 kVA**	**Services rated more than 1000 kVA**
Instantaneous (at the time) kW demand	Required	Required	Required	Required
Historical peak demand (kW)	Not required	Not required	Required	Required
Resettable kWh	Required	Required	Required	Required
kWh per rate period	Not required	Not required	Not required	Required

- **>250 kVA = be able to record historical peak demand in kilowatts**
  - Equivalent to:
    - 700 amps at 120/208 volts at 3 phase, or
    - >1,000 amps at 120/240 volt at single phase
- **>1,000 kVA = be able to report the kWh for a fixed period of time**
  - Equivalent to:
    - >2,700 amps at 120/240 volt at 3 phase, or
    - >4,000 amps at 120/240 volt at single phase

When Is It Required?

2016 code
No Change

- Occupancy Type
  - Nonresidential
  - High-Rise Residential
  - Hotel/Motel

2013 Triggers

- New Construction
  - Service meter to be user accessible and permanent. If utility meter satisfies requirements, no additional meter required.
- Additions
  - When service meter is added, it must meet these requirements
- Alterations
  - When the service is modified (as with a new switchboard), or when sections are added or new feeders pulled.
  - As long as the existing service switchboard, existing feeders and existing panelboards remain "as-is", these requirements are not triggered.

Electrical Service

What if…

- **Building not connected to utility?**
  - Such as a off the grid, customer owned, or bulk power purchase.
    - Each building, or structure, must meet the requirements of 130.5

- **Building has multiple services?**
  - The intent of 130.5 is to allow "general" energy use measurement for management purposes and only required for services that *regularly* provide electrical power to building.
    - *Metering not required for systems NOT regularly providing service such as emergency systems and standby systems.*

NRCC-ELC-01-E (Page 1)

STATE OF CALIFORNIA
Electrical Power Distribution

CERTIFICATE OF COMPLIANCE

Electrical Power Distribution

Project Name: Happy Manufacturing

A. General Information

Project Address:	Climate Zo
100 Happy Dr. Happy Land, CA	12

Building Type:	☑ Nonresidential	☐ High-Rise Residential	☐ Hotel/Motel
☐ Schools	☐ Relocatable Public Schools	☐ Conditioned Spaces	☐ Unconditioned Spaces
Phase of Construction:	☑ New Construction	☐ Addition	

B. Electrical Service Metering

☐ Each newly installed electrical service (in both existing and newly constructed buildings) is which is reproduced below.
☐ Fill out a separate line for each electrical service that is connected to the building.

Electrical Service Schedule	Electrical Service Rating	Metering Capab					
A	B	C					
Designation/location in building/description	kVA	Instantaneous (at the time) kW demand	H pea				
Main meter from utility	100	☑	☐	☑	☐	☐	☐

Add Row | Remove Last

Project Description:

- General Information
- You only have to fill in once now!! New "smart" forms available on CEC website:

http://www.energy.ca.gov/title24/2013standards/nonres_compliance_forms

Electrical Service Metering:

- Describe service size and metering features to be provided.
  - Size of service load dictates service meter features.
- You can now PICK how many rows you need in these new "smart" forms

MS1

Design Examples

Specification

(Courtesy of TES Engineering)

A. SERVICE METERING

1. METERING SHALL BE IN COMPLIANCE OF TITLE 24 SECTION 130.5(A)
2. MINIMUM METERING REQUIREMENTS SHALL COMPLY PER TITLE 24 TABLE 130.5-A
3. METER TYPES REQUIRED:

   ALL SERVICE SIZES:
   a) INSTANTANEOUS (AT THE TIME) KW DEMAND
   b) RESETTABLE kWh
   FOR SERVICE >250 Kva:
   a) HISTORICAL PEAK DEMAND (KW)
   b) KWh PER RATE PERIOD

4. SERVICE METER NOT REQUIRED TO BE PROVIDED FOR BUILDING WHERE UTILITY COMPANY PROVIDES A METER FOR OCCUPANT OR USER USE THAT INDICATES INSTANTANEOUS kW DEMAND AND KWh FOR A USER-RESETTABLE PERIOD.

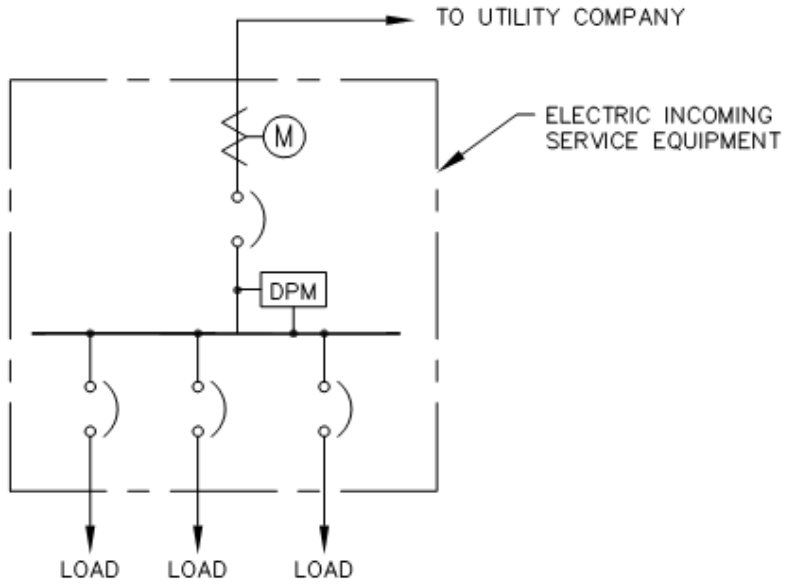
Slide 28

MS1 Michael Scalzo, 2/4/2016

Design Examples

Electrical Drawing

480/277V-3Ø-4W-1000KVA+ *(Courtesy of EDS Engineering)*



DPM = DIGITAL POWER METER

- INSTANTANEOUS (AT THE TIME) KW DEMAND
- RESETTABLE KWH
- HISTORICAL PEAK DEMAND
- KWH PER RATED PERIOD

DIGITAL POWER METER FOR SERVICE RATED MORE THAN 1000KVA

SCALE: NONE

TITLE - 24 SECTION 130.5A COMPLIANT - POWER METER

What Does This Look Like?

Installation Options

(Courtesy of Leviton and Eaton)

Utility Meter

Smart Meter

Intelligent Panel

Cost Engineering

What may happen to designed features to save money

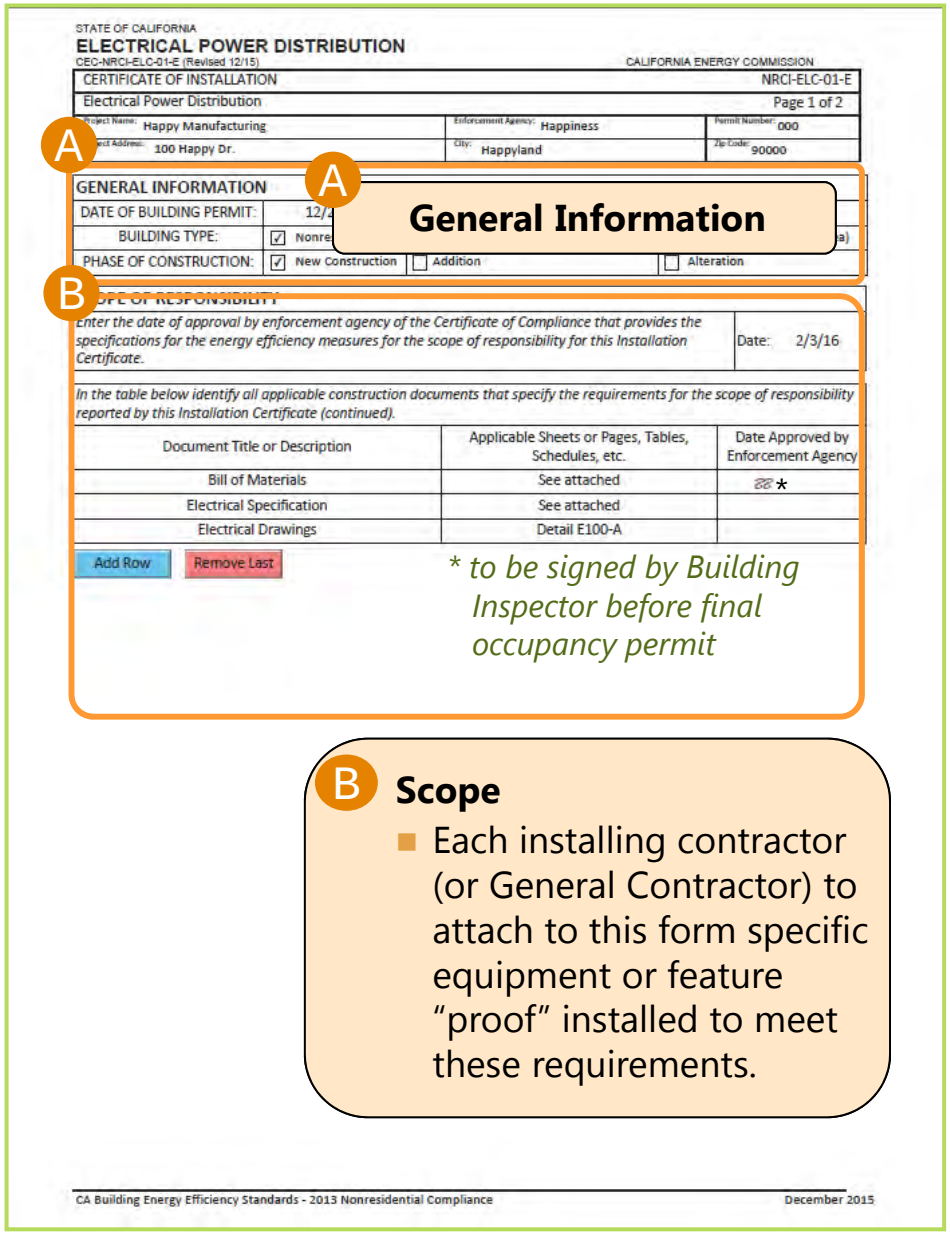
Meter is smart

- **Smart Meter**
  - Panel is still required
  - Meets all of the requirements
  - Additional labor cost-$$
  - *Optional features with the added cost of equipment.*
- **Intelligent Panel/Smart Meter**
  - Additional cost of material-$$
  - Meets all of the requirements
  - *Optional features with the added cost of equipment.*

Meter is NOT smart

- **Utility Meter:**
  - What are the capabilities?
  - Are the standards met based on service size?
  - Coordination with Utility company to verify compliance will need to be done.
- Value Engineering out additional metering systems may save $$ in equipment and/or labor cost, but might not meet the Basis of Design requirements.
- Who will enforce and verify that all of the requirements are met?

Final Permit Documentation



STATE OF CALIFORNIA
ELECTRICAL POWER DISTRIBUTION
CEC-NRCI-ELC-01-E (Revised 12/15) CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF INSTALLATION		NRCI-ELC-01-E
Electrical Power Distribution		Page 1 of 2
Project Name: Happy Manufacturing	Enforcement Agency: Happiness	Permit Number: 000
Project Address: 100 Happy Dr.	City: Happyland	Zip Code: 90000

A

General Information

GENERAL INFORMATION			
DATE OF BUILDING PERMIT:	12/		
BUILDING TYPE:	☑ Nonre		a)
PHASE OF CONSTRUCTION:	☑ New Construction	☐ Addition	☐ Alteration

B

Enter the date of approval by enforcement agency of the Certificate of Compliance that provides the specifications for the energy efficiency measures for the scope of responsibility for this Installation Certificate. Date: 2/3/16

In the table below identify all applicable construction documents that specify the requirements for the scope of responsibility reported by this Installation Certificate (continued).

Document Title or Description	Applicable Sheets or Pages, Tables, Schedules, etc.	Date Approved by Enforcement Agency
Bill of Materials	See attached	*
Electrical Specification	See attached	
Electrical Drawings	Detail E100-A	

Add Row Remove Last

** to be signed by Building Inspector before final occupancy permit*

CA Building Energy Efficiency Standards - 2013 Nonresidential Compliance December 2015

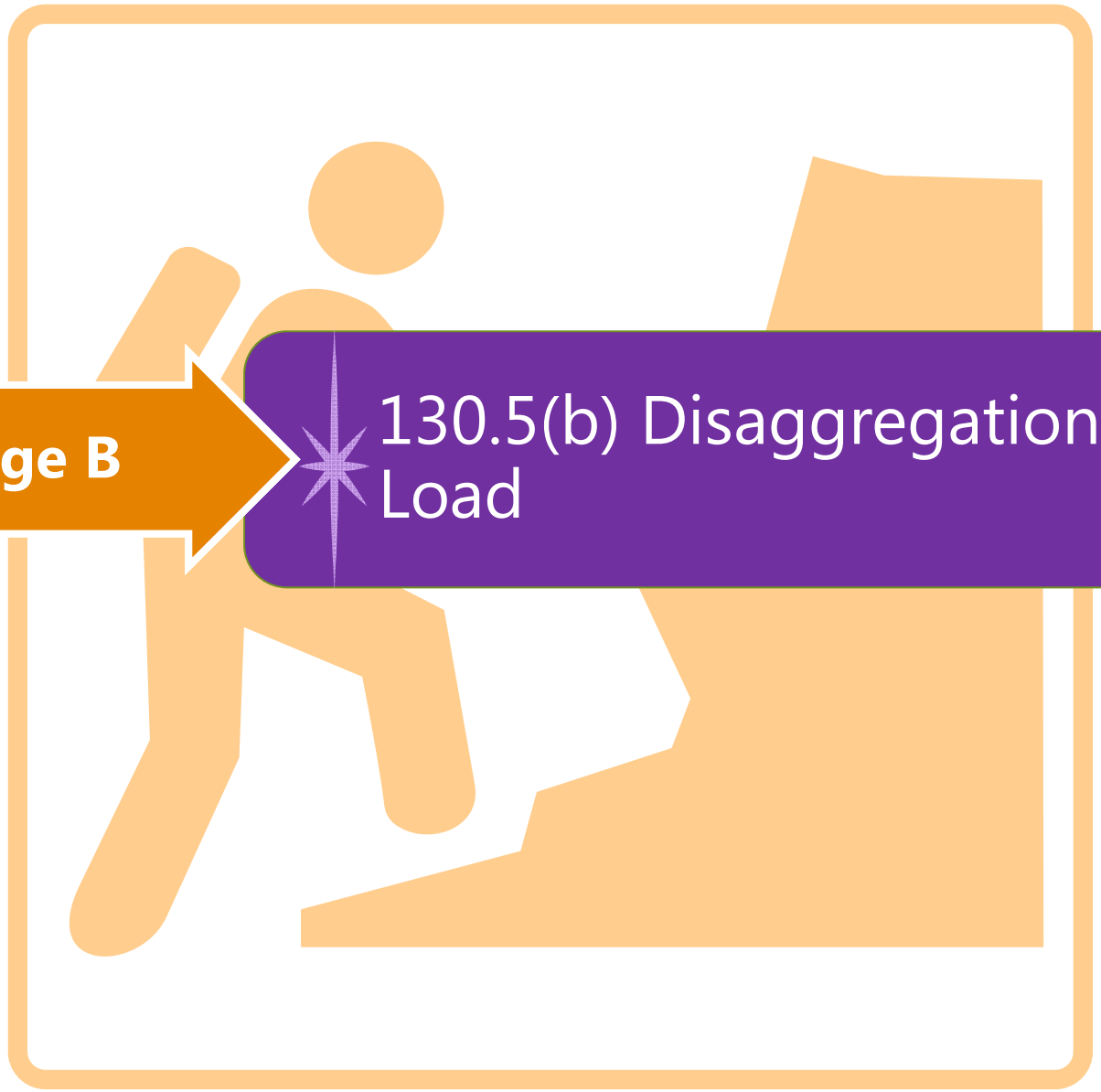
B Scope

- Each installing contractor (or General Contractor) to attach to this form specific equipment or feature "proof" installed to meet these requirements.

NRCI-ELC-01-E: Service Metering

- Examples:
  - "Bill of Materials" could be a good resource to verify equipment installed per design document requirements.
- *Best Practice:*
  - *All installation and operating manuals MUST be provided for each device installed, now is a good time to put them together*

Challenge B



Challenge B

130.5(b) Disaggregation of Load

Section 130.5 Electrical Distribution

130.5(a)

- Service Metering

130.5(b)

- Disaggregation of Electrical Circuits

130.5(c)

- Voltage Drop

130.5(d)

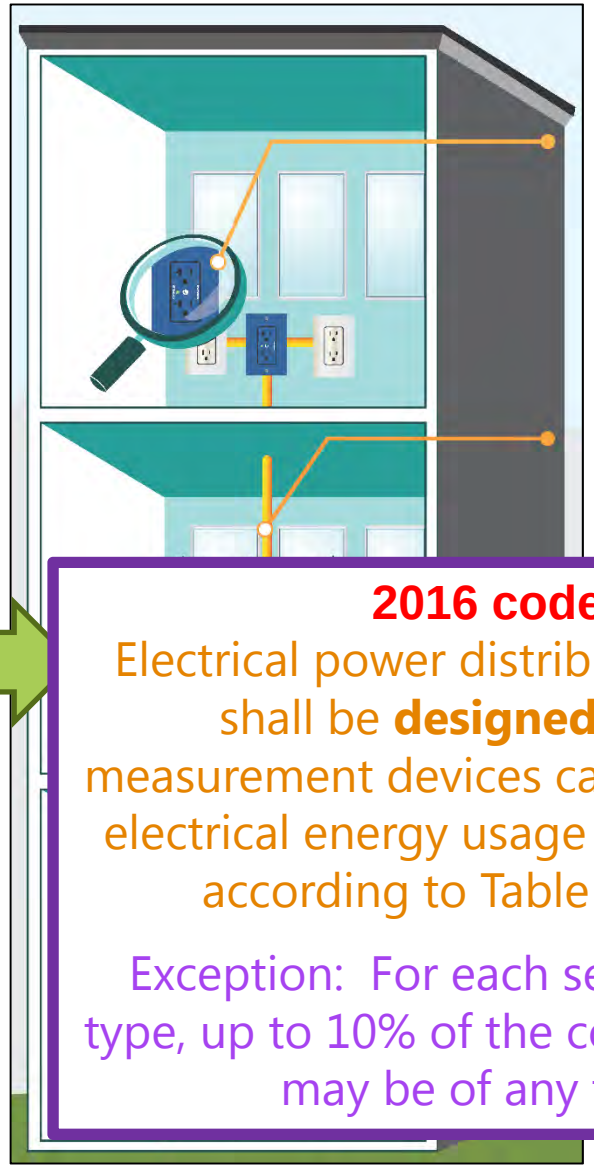
- Circuit Controls for 120 volt Receptacles

Why Disaggregation?

The intent is to have a single feeder or breaker with each type of load (such as lighting) on it, such that a meter could be placed on the feeder to report energy use by that load type.

Note that this is a wiring requirement only, and the providing of meters is optional.

§130.5(b) – Disaggregation of Load

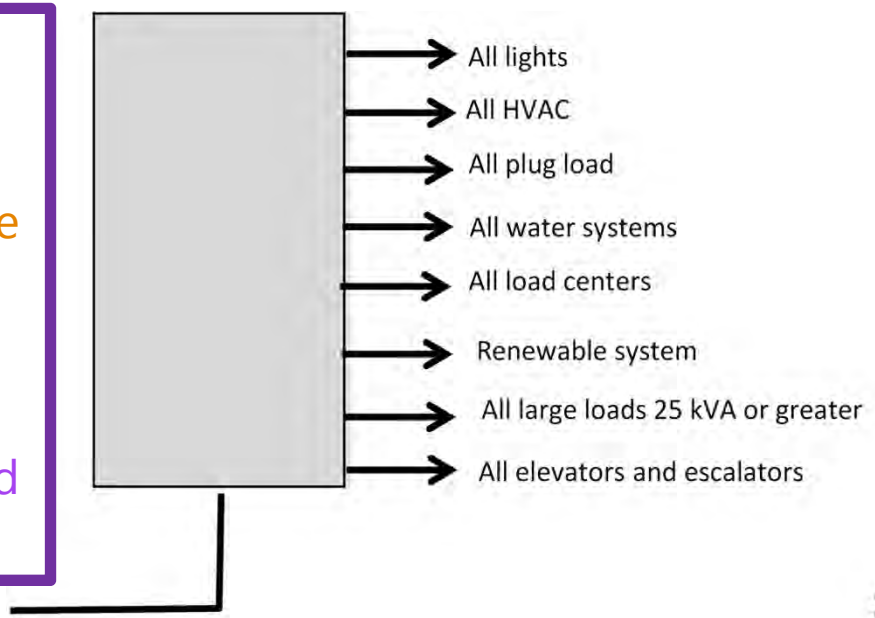


- Designed to permit disaggregated measurement of electrical load
  - Downstream from the service meter
  - Per Table 130.5-B (according to size of service)

2016 code

Electrical power distribution system shall be **designed** so that measurement devices can monitor the electrical energy usage of load types according to Table 130.5-B.

Exception: For each separate load type, up to 10% of the connected load may be of any type.



§130.5(b) – Table 130.5-B

Disaggregation escalates as loads get larger

Services rated more than 50kVA and less than or equal to 250 kVA	Services rated more than 250 kVA and less than or equal to 1000kVA	Services rated more than 1000kVA
All lighting in aggregate	All lighting disaggregated by floor, type or area	All lighting aggregated by floor, type or area
All HVAC in aggregate	All HVAC in aggregate and each HVAC load rated at least 50 kVA	All HVAC in aggregate and each HVAC load rated at least 50kVA
All loads in aggregate	All loads in aggregate	All loads in aggregate
All plug load in aggregate Groups of plug loads exceeding 25 kVA connected load in an area less than 5000 sf	All plug load separated by floor, type or area Groups of plug loads exceeding 25 kVA connected load in an area less than 5000 sf	All plug loads separated by floor, type or area. All groups of plug loads exceeding 25 kVA connected load in an area less than 5000 sf
All loads in aggregate	All loads in aggregate	All loads in aggregate
All	Each	Each
All	Each	Each
Each group	Each group	Each group
All loads in aggregate	All loads in aggregate	All loads in aggregate
All loads in aggregate	All loads in aggregate	All loads in aggregate

When Is It Required?

2016 code

For entirely new or complete replacement of electrical power distribution systems, the entire system shall meet the applicable requirements of Section 130.5(b).

- Occupancy Type
  - Nonresidential
  - High-Rise Residential
  - Hotel/Motel

2013 Triggers

- New Construction
  - Newly constructed spaces
- Additions and Alterations
  - Service distribution switchboards or panelboards
  - Feeders
  - Motor control centers or panelboards

NRCC-ELC-01-E (Page 2-3)

C. Disaggregation of Electrical Circuits

☐ Each newly installed switchboard, panel, and motor control center (in both existing and newly constructed buildings) is required to be disaggregated according to the requirements of Table 130.5-B, shown on the next page.
☐ Individual branch circuits, taps, or disconnects that require overcurrent protection devices rated 60A or greater.
☐ As an alternative, current transformers can be added for additional branch circuits and loads throughout the building, and a permanent measurement system can be installed. In this case, disaggregated wiring would not be required as long as the metering system allows the equivalent disaggregated measurements.
☐ Fill out a separate line for each switchboard, motor control center, panelboard and subpanel.

			Field Inspector	
Switchboard, motor control center, panelboard or subpanel	Electrical Service that supplies that switchboard or panel	Electrical Service Rating	Pass	Fail
A	B	C	D	
Designation/location in building/description	Designation/location in building/ description	kVA		
Main electrical room	HVAC	75	☐	☐
"	Lighting	25	☐	☐
"	Plug Loads	30	☐	☐

Add Row Remove Last

Elevators, escalators, moving walks, and transit systems	Not required	All loads in aggregate	All loads in aggregate	All loads in aggregate
Other individual non-HVAC loads or appliances rated 25kVA or greater	Not required	All	Each	Each
Industrial and commercial load centers 25 kVA or greater including theatrical lighting installations and commercial kitchens	Not required	All	Each	Each
Renewable power source (net or total)	Each group	Each group	Each group	Each group
Loads associated with renewable power source	Not required	All loads in aggregate	All loads in aggregate	All loads in aggregate
Charging stations for electric vehicles	All loads in aggregate	All loads in aggregate	All loads in aggregate	All loads in aggregate

Disaggregation of Electric Circuits:

- Describe services being separated and kVA associated with that load to meet Table
  - May reference electrical drawings
  - May reference specification
  - May list specific disaggregated load criteria

Examples

Specification

(Courtesy of TES Engineering)

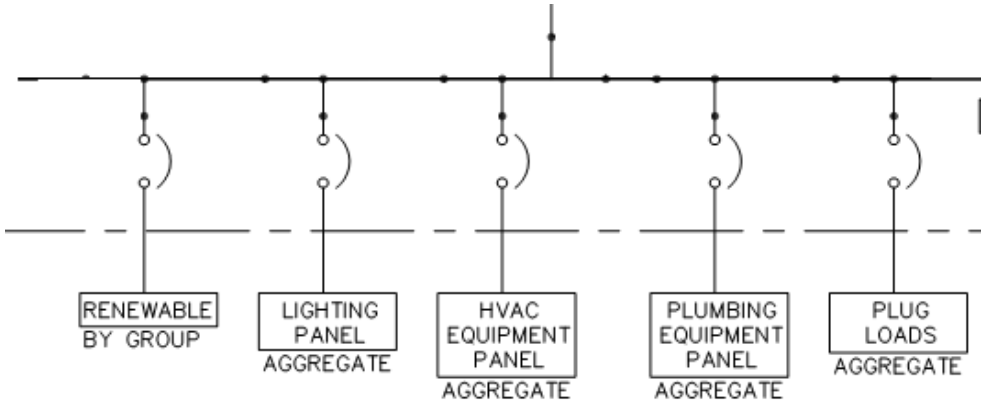
B. DISAGGREGATION OF ELECTRICAL CIRCUITS

1. ELECTRICAL POWER DISTRIBUTION SYSTEM SHALL ALLOW FOR DISAGGREGATED MEASUREMENT OF ELECTRICAL LOAD ENERGY.
2. MEASUREMENTS FOR LOAD SHALL BE DOWNSTREAM FROM SERVICE METERING PER TABLE 130.5-B.
3. DISAGGREGREGATION SHALL BE ACHIEVED VIA THE FOLLOWING METHODS:
   a. SEPARATE SWITCHBOARDS, MOTOR CONTROL CENTERS, OR PANELBOARDS TO WHICH ARE CONNECTED ONLY THE REQUIRED LOAD OR GROUP OF LOADS.
   b. SUBPANELS WHERE ONLY THE CONNECTED LOADS OR GROUP OF LOADS MAY BE INDEPENDENTLY MEASURED.
   c. BRANCH CIRCUITS, TAPS OR DISCONNECTS REQUIRING OVERCURRENT PROTECTION DEVICES RATED 60 AMPERES OR GREATER.
4. DISAGGREGATION OF SERVICE NOT REQUIRED FOR THE FOLLOWING:
   d. BUILDINGS THAT HAVE A COMPLETE METERING AND MEASUREMENT SYSTEM THAT AT A MINIMUM MEASURES AND REPORTS LOADS PER TABLE 130.5-B.
   e. ALTERATION OF BUILDING FOLLOWING CONDITIONS EXIST:
      i. THE EXISTING EQUIPMENT REMAINS IN PLACE FOR SERVICE DISTRIBUTION SWITCHBOARDS, PANELBOARDS, FEEDERS AND MOTOR CONTROL CENTER OR PANELBOARDS.
      ii. EXISTING EQUIPMENT INCLUDED IN i.(ABOVE) REMAINS UNALTERED EXCEPT FOR CHANGES TO LOAD CIRCUIT CONNECTIONS; OR CHANGES TO THE QUANTITY OF OUTGOING OVERCURRENT PROTECTION DEVICES; OR CHANGES TO THE AMPACITY OF OUTGOING OVERCURRENT PROTECTION DEVICES.

What Does This Look Like?

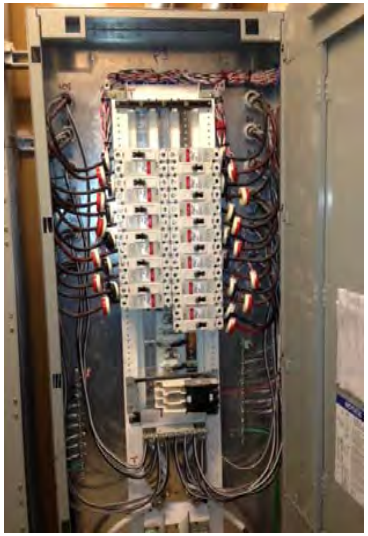
Installation Options

Split Buss Panel



Dedicated Panels

Intelligent Panel



Smart Meter

?

Future Technology

(Courtesy of Eaton and Leviton)

Cost Engineering

What may happen to designed features to save money

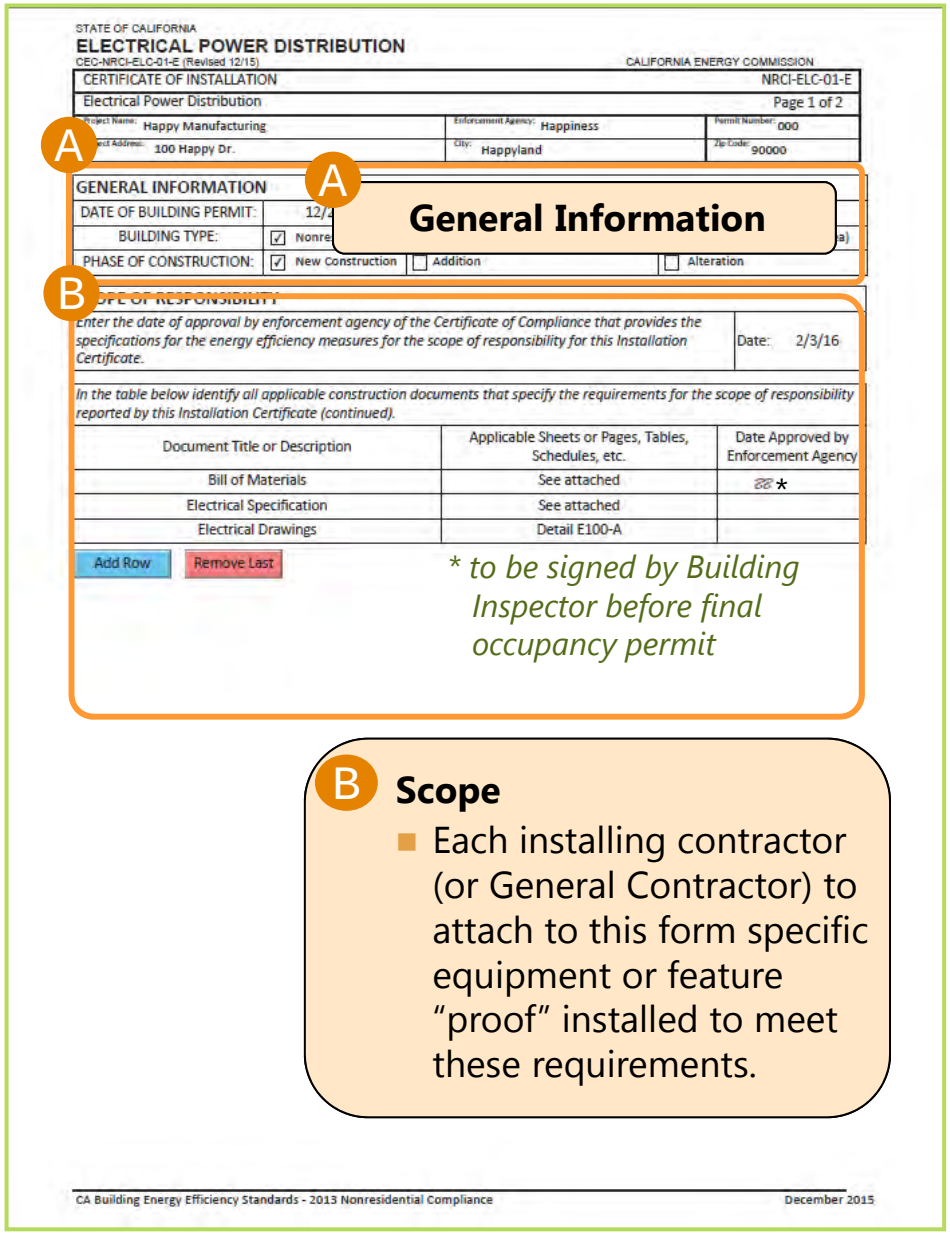
Panels

- **5 Panels; Power, Lighting, HVAC, etc.**
  - Labor for 5 installations
  - Material for 5 panels
  - Usually readily available
- **Split Buss**
  - Labor of only 1 panel
  - Material cost can reach 2-3 times the cost of a single panel.
  - Lead time can be an issue

Metering

- **Intelligent Panel/Smart Meter**
  - Labor of only 1 panel
  - Material cost can reach 3 times the cost of a single panel.
  - Generally custom made with a lead time
- **Smart Meter**
  - Labor for one panel and meter
  - Material for one panel and one meter
  - Material cost range 1-2 times the panel cost for a meter.
  - Shorter lead times on non-spec items

Final Permit Documentation



STATE OF CALIFORNIA
ELECTRICAL POWER DISTRIBUTION
CEC-NRCI-ELC-01-E (Revised 12/15) CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF INSTALLATION			NRCI-ELC-01-E
Electrical Power Distribution			Page 1 of 2
Project Name: Happy Manufacturing		Enforcement Agency: Happiness	Permit Number: 000
Project Address: 100 Happy Dr.		City: Happyland	Zip Code: 90000

A

General Information

GENERAL INFORMATION			
DATE OF BUILDING PERMIT:	12/		
BUILDING TYPE:	☑ Nonre		a)
PHASE OF CONSTRUCTION:	☑ New Construction	☐ Addition	☐ Alteration

B

Enter the date of approval by enforcement agency of the Certificate of Compliance that provides the specifications for the energy efficiency measures for the scope of responsibility for this Installation Certificate. Date: 2/3/16

In the table below identify all applicable construction documents that specify the requirements for the scope of responsibility reported by this Installation Certificate (continued).

Document Title or Description	Applicable Sheets or Pages, Tables, Schedules, etc.	Date Approved by Enforcement Agency
Bill of Materials	See attached	*
Electrical Specification	See attached	
Electrical Drawings	Detail E100-A	

Add Row Remove Last

** to be signed by Building Inspector before final occupancy permit*

B Scope

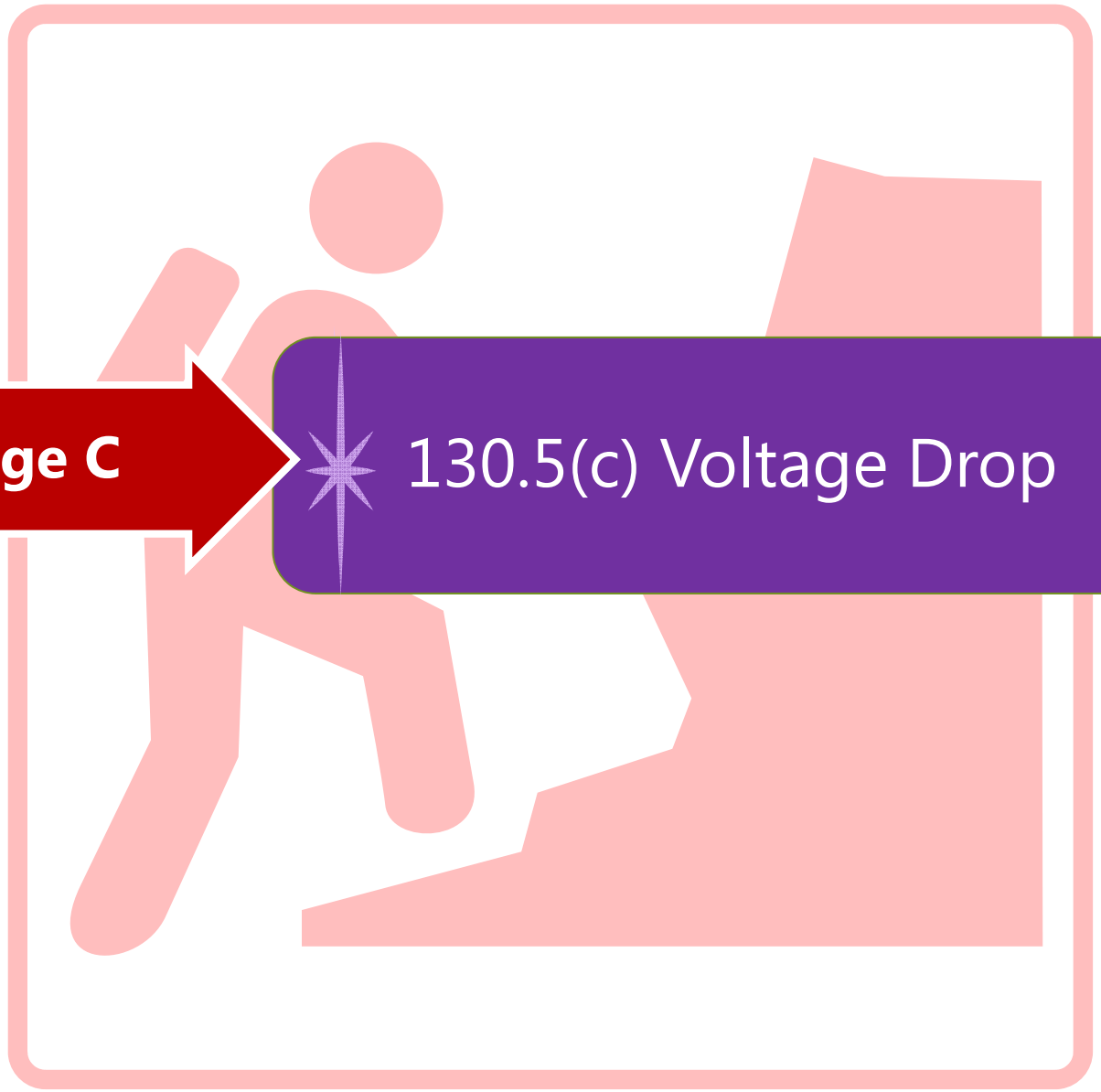
- Each installing contractor (or General Contractor) to attach to this form specific equipment or feature "proof" installed to meet these requirements.

CA Building Energy Efficiency Standards - 2013 Nonresidential Compliance December 2015

NRCI-ELC-01-E: Disaggregation

- Examples:
  - "Bill of Materials" could be a good resource to verify equipment installed per design document requirements.
- *Best Practice:*
  - *All installation and operating manuals MUST be provided for each device installed, now is a good time to put them together*

Challenge C



Challenge C

130.5(c) Voltage Drop

Section 130.5 Electrical Distribution

130.5(a)

- Service Metering

130.5(b)

- Disaggregation of Electrical Circuits

130.5(c)

- Voltage Drop

130.5(d)

- Circuit Controls for 120 volt Receptacles

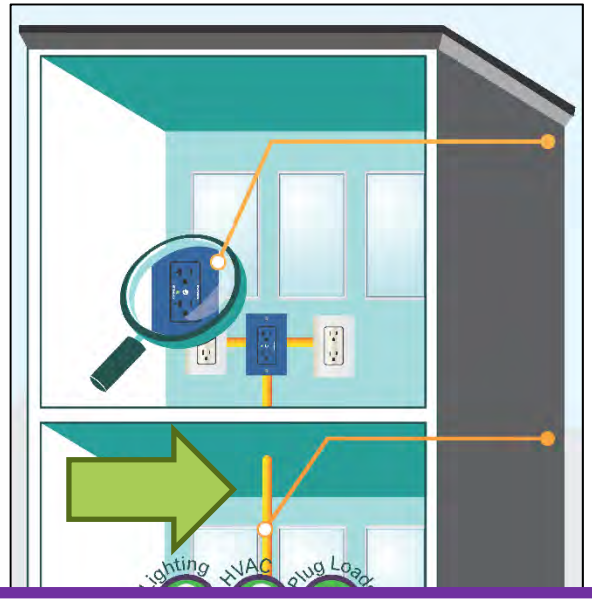
Why Voltage Drop?

Voltage drop represents energy loss as heat in the electrical conductors. It is advantageous to distribute utilization power at the highest practical voltage to reduce current to each load.

With rising prices of copper and the heavy demand for it in developing countries, there will be continued pressure to use aluminum alloy and copper clad aluminum for typical projects in the US.

In practice, larger gauge aluminum and copper clad aluminum conductors will be required to reduce the voltage drop.

§130.5(c) – Voltage Drop



2016 code

Max. combined voltage drop on both **installed** feeder conductors and branch circuit conductors to the farthest connected load or outlet shall not exceed 5%.

Exception: Voltage drop permitted by CA Electrical Code Sections 647.4, 695.6, 695.7

- Max Voltage Drop
  - **Feeders:** *Conductors carrying current from one switchboard or panelboard to another.*
    - Sized for V drop ≤ 2% @ design load of total length
  - **Branch Circuits:** *Conductors carrying current from a switchboard or panelboard to one or more connected load.*
    - Sized for V drop ≤ 3% @ design load for maximum length

130.5(c)Voltage Drop Calculations

Feeders (2%)

- Determine Load Current
  - *Loads to use volt-amperes (VA), not watts. VA=Watts/power factor (pf) per Table 8-2*
- Resistance versus Impedance
  - ***Resistance (R) @ 25°C***
    - Impedance (Z) not applicable to these calculations
- Feeder Calculations
  - *Length to include lateral and vertical conduit lengths (~10%)*
  - *Assume design load per panelboard load calcs as shown on plans, or*
    - *80% of panelboard rated ampacity*

Branch Circuits(3%)

- Determine the length
  - *Individual loads: Using both lateral and vertical distances from power source to the load.*
  - *Multiple loads: Use "centroid of the load" (weighted central location of the group of loads)*

Length of wire is TWICE the distance, as current must flow to the load and back

- Determine voltage drop: E = IR = Amps x Resistance per 1000' x length(ft)/1000 =
  - *Individual loads: Assume 100% of rated load, do not use derating factors.*
  - *Multiple loads: Use **Table 8-3** for load factors, do not use derating factors*

§130.5(c): Calculations - Feeders

Table 8-2 Typical Power Factors for Voltage Drop Calculations

Load Type	Default Power Factor at 120 volts	Default Power Factor at 277 volts	Note
Fluorescent lighting	0.95	0.95	------
Compact fluorescent lighting	0.9 (hardwired) 0.5 (GU-24)	0.9 (hardwired) 0.3 (GU-24)	NPF magnetic ballasts use GU-24 values
LED lighting	0.7	0.5	May be higher if specifications call for high power factor drivers
Incandescent lighting	1.0	1.0	------
HID lighting	0.9	0.9	May be lower if NPF ballasts are specified
HVAC packages	0.85	0.9	------
Other motors <5 HP	0.8	0.8	------
Other motors >5 HP	0.85	0.85	------
Kitchen equipment	0.9	N/A	------
Receptacles	0.6	N/A	For dedicated receptacles, may be rated according to the load
Electric heating including hot water	1.0	1.0	------
Other	0.85	0.85	------

In an ideal world, the watts and VA of a load would be equal (pf = 1.0 or 100%). But many LED lighting and electronic branch circuit loads have poor power factor (80% or less). Poor power factor means that the load draws current but does not use all of the power, in essence storing the energy and returning it to the circuit unused.

§130.5(c): Calculations – Branch Circuits

Table 8-3 Branch Circuit Load Factor

Load type	Percentage of Code connected load to be used	Notes and Special Exceptions
Lighting	100%	
Receptacles	75%	100% of all equipment loads using cord and plug connection
Combined lighting and receptacle	100% of lights and 75% of receptacles	------
Tapped circuits	75% of receptacles 100% of all other loads	For circuits tapped downstream to supply mixed loads

Note: as a convenience, the calculation may assume the allowed branch circuit capacity. In general, this is 80% of the rating of the overcurrent protection device, e.g. 16 amps for a 20-amp circuit. This is especially recommended for lighting and receptacle branch circuits that might have additional loads connected later.

Example

E = IR = Amps x Resistance per 1000' x length(ft)/1000 =

Single Load (from NRCM)

A package HVAC unit running on 208 volts, three-phase has a full load amp (FLA) rating of 10.5 amps and locked rotor amps (LRA) of 45 amps. The engineer specified #12 wires and a 20 amp 3-pole breaker. The physical distance is 200 feet on a 208 volt line-to-line circuit.

- **Allowed branch circuit voltage drop is 3%, or (208*.03) = 6.24 volts.**
  - 1. Load Current = 10.5 amps
  - 2. Resistance = The resistance of solid copper #12 wire is 1.62 ohms/1000 ft at 25° C
  - 3. Length = 200 feet X 2 = 400 feet
- The voltage drop in this circuit is:
  - E = IR = 10.5*1.62 *(400/1000) = **6.84** volts

FAIL: This circuit will require #10 wires.

When Is It Required?

2016 code

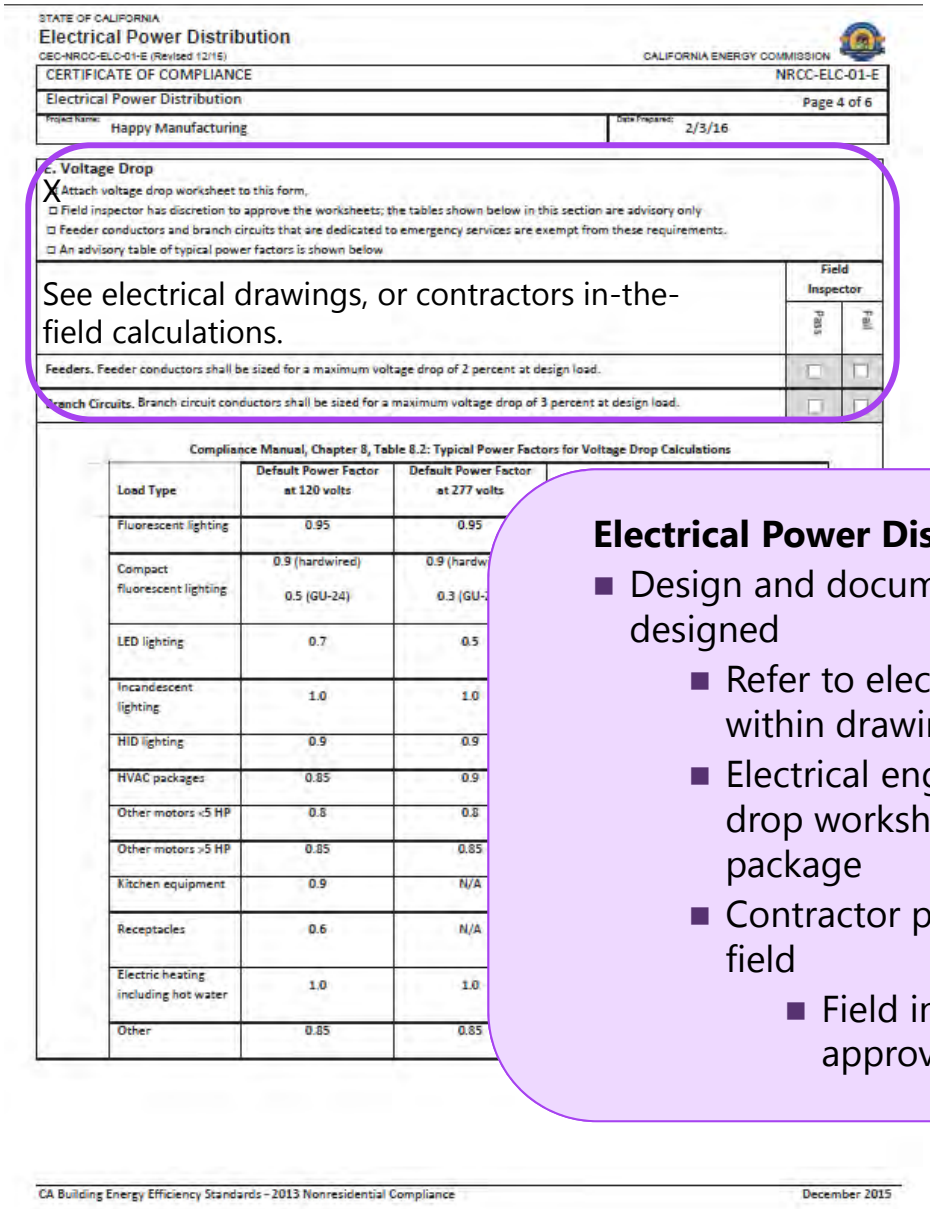
*Addition, modification or replacement of **BOTH** feeders and branch circuits trigger code for altered circuits*

- Occupancy Type
  - Nonresidential
  - High-Rise Residential
  - Hotel/Motel

2013 Triggers

- New Construction
  - Newly constructed spaces
- Additions/Alterations
  - New conductors must meet the voltage drop requirements set out in Section 130.5(c) of the Standards. Existing conductors are not subject to these requirements.

NRCC-ELC-01-E (Page 4)



STATE OF CALIFORNIA
Electrical Power Distribution
CEC-NRCC-ELC-01-E (Revised 12/15) CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE	NRCC-ELC-01-E
Electrical Power Distribution	Page 4 of 6
Project Name: Happy Manufacturing	Date Prepared: 2/3/16

E. Voltage Drop

X Attach voltage drop worksheet to this form.
☐ Field inspector has discretion to approve the worksheets; the tables shown below in this section are advisory only
☐ Feeder conductors and branch circuits that are dedicated to emergency services are exempt from these requirements.
☐ An advisory table of typical power factors is shown below

See electrical drawings, or contractors in-the-field calculations.

	Field Inspector Pass	Field Inspector Fail
Feeders. Feeder conductors shall be sized for a maximum voltage drop of 2 percent at design load.	☐	☐
Branch Circuits. Branch circuit conductors shall be sized for a maximum voltage drop of 3 percent at design load.	☐	☐

Compliance Manual, Chapter 8, Table 8.2: Typical Power Factors for Voltage Drop Calculations

Load Type	Default Power Factor at 120 volts	Default Power Factor at 277 volts
Fluorescent lighting	0.95	0.95
Compact fluorescent lighting	0.9 (hardwired) 0.5 (GU-24)	0.9 (hardw 0.3 (GU-2
LED lighting	0.7	0.5
Incandescent lighting	1.0	1.0
HID lighting	0.9	0.9
HVAC packages	0.85	0.9
Other motors <5 HP	0.8	0.8
Other motors >5 HP	0.85	0.85
Kitchen equipment	0.9	N/A
Receptacles	0.6	N/A
Electric heating including hot water	1.0	1.0
Other	0.85	0.85

CA Building Energy Efficiency Standards – 2013 Nonresidential Compliance December 2015

Electrical Power Distribution:

- Design and document *how* voltage drop is designed
  - Refer to electrical voltage drop design within drawing package
  - Electrical engineer attach voltage drop worksheet to compliance package
  - Contractor provide documentation in field
    - Field inspector has discretion to approve the worksheets

Examples

Specification

(Courtesy of TES & EDS Engineering)

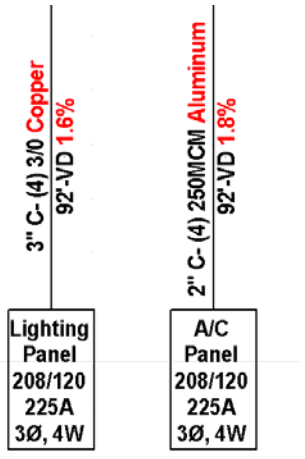
C. VOLTAGE DROP

1. FEEDER CONDUCTORS SHALL BE SIZED FOR A MAXIMUM VOLTAGE DROP OF 2 PERCENT AT DESIGN LOAD.
2. BRANCH CIRCUITS CONDUCTORS SHALL BE SIZED FOR A MAXIMUM VOLTAGE DROP OF 3 PERCENT AT DESIGN LOAD.
3. VOLTAGE DROP CALCULATIONS ARE NOT REQUIRED FOR FEEDER CONDUCTORS AND BRANCH CIRCUITS THAT ARE DEDICATED TO EMERGENCY SERVICES.

Electrical Drawing

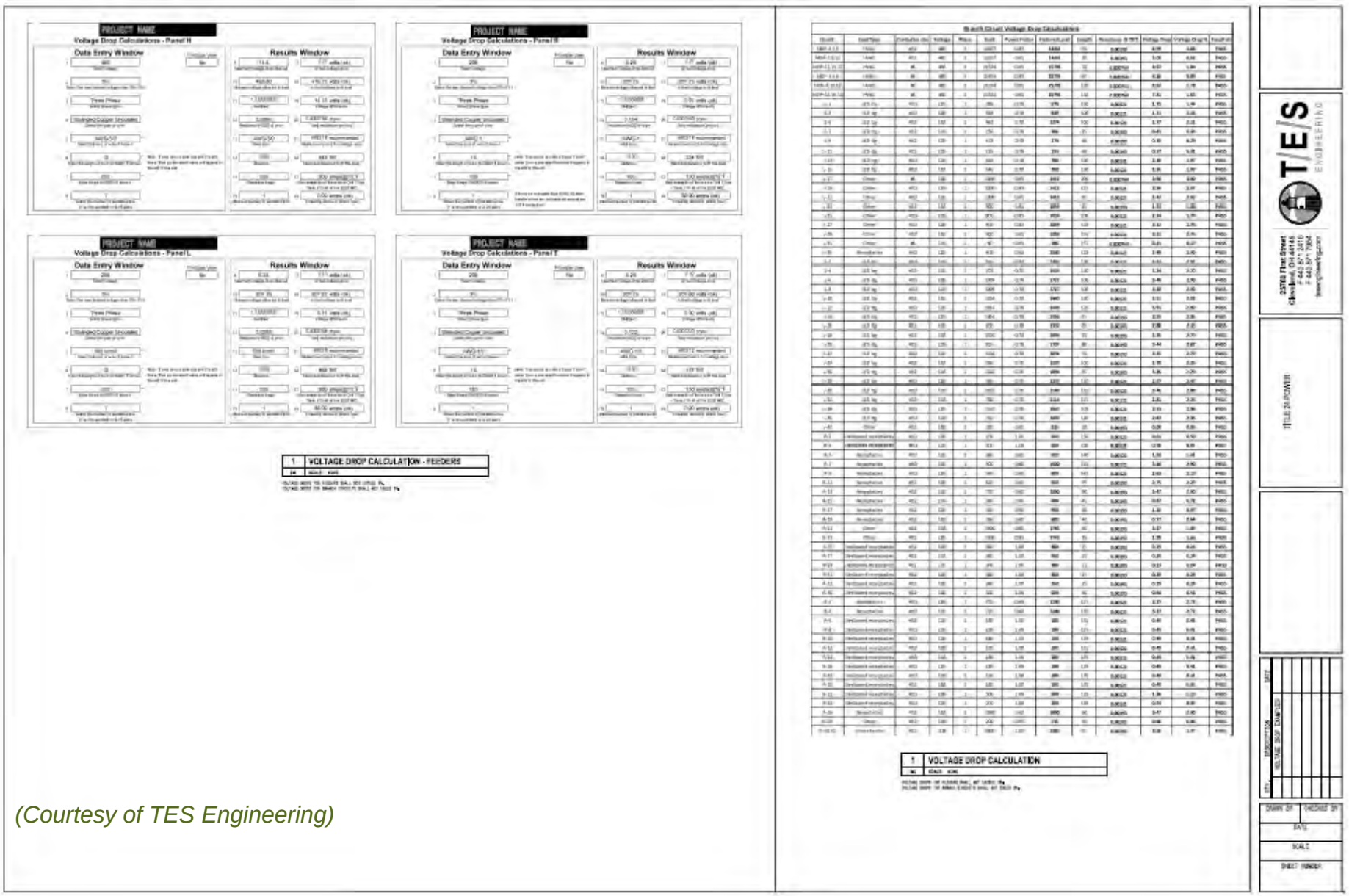
1	VOLTAGE DROP CALCULATION - FEEDERS
E-X	SCALE: NONE

VOLTAGE DROPS FOR FEEDERS SHALL NOT EXCEED 2%.
VOLTAGE DROPS FOR BRANCH CIRCUITS SHALL NOT EXEED 3%.



Examples

Electrical Drawing



(Courtesy of TES Engineering)

Cost Engineering

What may happen to designed features to save money

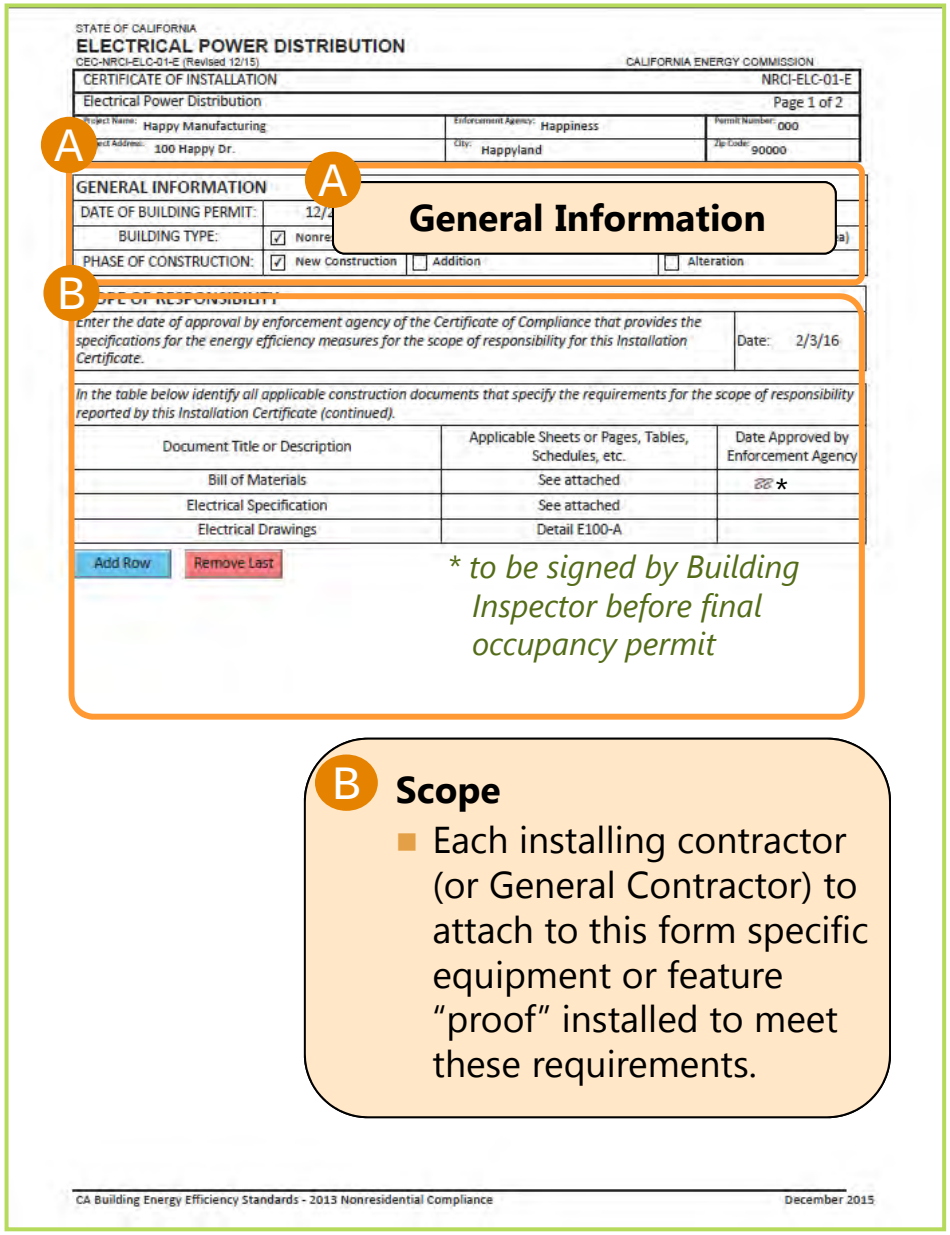
Shorter Paths

- **Copper feeders** will utilize a smaller conductor reducing labor, but it will have a more expensive material cost.
- **Underground**- Can have a lower labor and material cost
- **Combining circuits-** Lower material and labor cost

Concerns

- **Aluminum**-Can save on materials but installation and connections are be more critical.
- **Underground**- Unforeseeable conditions can have major cost impacts
  - Contaminated soil
  - Structural issue
  - Utility pathways

Final Permit Documentation



STATE OF CALIFORNIA
ELECTRICAL POWER DISTRIBUTION
CEC-NRCI-ELC-01-E (Revised 12/15) CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF INSTALLATION			NRCI-ELC-01-E
Electrical Power Distribution			Page 1 of 2
Project Name: Happy Manufacturing		Enforcement Agency: Happiness	Permit Number: 000
Project Address: 100 Happy Dr.		City: Happyland	Zip Code: 90000

A

General Information

GENERAL INFORMATION			
DATE OF BUILDING PERMIT:	12/		
BUILDING TYPE:	☑ Nonre		a)
PHASE OF CONSTRUCTION:	☑ New Construction	☐ Addition	☐ Alteration

B

Enter the date of approval by enforcement agency of the Certificate of Compliance that provides the specifications for the energy efficiency measures for the scope of responsibility for this Installation Certificate. Date: 2/3/16

In the table below identify all applicable construction documents that specify the requirements for the scope of responsibility reported by this Installation Certificate (continued).

Document Title or Description	Applicable Sheets or Pages, Tables, Schedules, etc.	Date Approved by Enforcement Agency
Bill of Materials	See attached	*
Electrical Specification	See attached	
Electrical Drawings	Detail E100-A	

Add Row Remove Last

** to be signed by Building Inspector before final occupancy permit*

B Scope

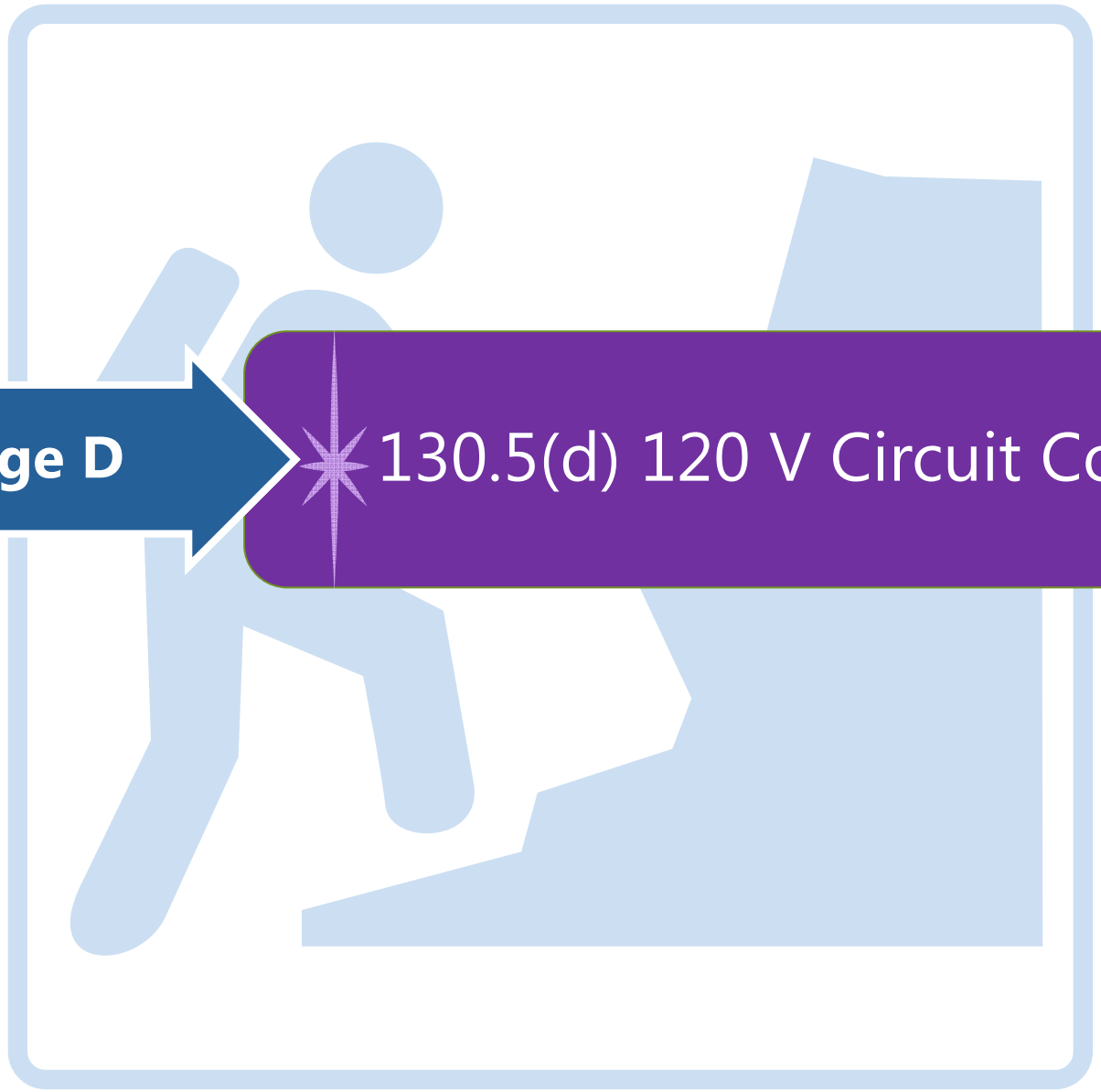
- Each installing contractor (or General Contractor) to attach to this form specific equipment or feature "proof" installed to meet these requirements.

CA Building Energy Efficiency Standards - 2013 Nonresidential Compliance December 2015

NRCI-ELC-01-E: Voltage Drop

- Examples:
  - Voltage drop calculations required. Can reference to drawings if already provided in design documents.
- *Best Practice:*
  - *All installation and operating manuals MUST be provided for each device installed, now is a good time to put them together*

Challenge D



Challenge D

130.5(d) 120 V Circuit Controls

Section 130.5 Electrical Distribution

130.5(a)

- Service Metering

130.5(b)

- Disaggregation of Electrical Circuits

130.5(c)

- Voltage Drop

130.5(d)

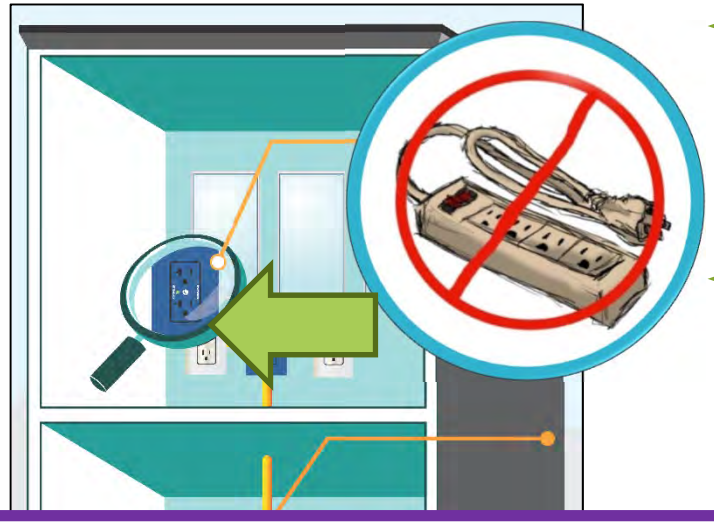
- Circuit Controls for 120 volt Receptacles

Why Circuit Controls?

The primary reason is to permit simple control of furniture mounted task lights and other plug loads. Office plug loads are now the largest power density loads in most office buildings.

Despite penetration of newer and more efficient technologies, this electricity end-use is steadily increasing as the use of personal computers and other electronics devices in offices continues to grow. Forecasts by the Energy Information Administration's 2010 annual energy outlook predict a 36% increase in energy consumption by office personal computer (PC) equipment from 2010 to 2030, and a 65% increase for those by non-PC office equipment.

§130.5(d) – Circuit Controls for 120 volt Receptacles



2016 code

Office areas, lobbies, conference rooms, kitchen areas in office spaces and copy rooms

When an automatic time switch control is installed it shall incorporate an override control that allows the controlled receptacle to remain ON for no more than 2 hours when an override is initiated and then resumes the normally scheduled operation.

- ***Private office, open office area, reception lobby, conference room, kitchenette in office spaces, and copy rooms:***
- Requires both controlled and uncontrolled 120-volt receptacles.
  - The controlled outlets must be permanently marked different from uncontrolled.
  - The two principal ways to comply include:

1. For each uncontrolled outlet, provide a controlled outlet within 6 feet; or,
2. Use split wired duplex receptacles, with one uncontrolled and one controlled.

§130.5(d) – Circuit Controls for 120 volt Receptacles

- ***For hotel and motel guest rooms***:
  - 1/2 of the 120-volt receptacles in each guest room shall be controlled receptacles
  - Electric circuits serving controlled receptacles shall have:
    - Captive card key controls,
    - Occupancy sensing controls, or
    - Automatic controls such that, no longer than 30 minutes after the guest room has been vacated, power is switched off.

When Is It Required?

2016 code

Entirely new or complete replacement of electrical power distribution system triggers code for circuit controls

- Occupancy Type
  - Nonresidential
  - Hotel/Motel

2013 Triggers

- New Construction
  - Newly constructed spaces
- Additions/Alterations
  - New or altered outlets to meet these requirements.
  - For each uncontrolled outlet, provide a controlled outlet within 6 feet; or,
  - Use split wired duplex receptacles, with one uncontrolled and one controlled

NRCC-ELC-01-E (Page 5-6)

STATE OF CALIFORNIA
Electrical Power Distribution
CEC-NRCC-ELC-01-E (Revised 12/15) CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE	NRCC-ELC-01-E
Electrical Power Distribution	Page 5 of 6
Project Name: Happy Manufacturing	Date Prepared: 2/3/16

Circuit Controls for 120-Volt Receptacles

X Controlled 120 volt receptacles shall be provided, as required by Section 130.5(d) of the Standards.

☐ In open office areas, controlled circuit receptacles are not required if, at time of final permit, workstations are installed, and each workstation is equipped with an occupant sensing control that is permanently mounted in each workstation, and which controls a hardwired, nonresidential-rated power strip. Plug-in strips and other plug-in devices that incorporate an occupant sensor shall not be used for this exception.

☐ Receptacles that are only for the following purposes are exempt:
-Receptacles specifically for refrigerators and water dispensers in kitchenettes.
-Receptacles located a minimum of six feet above the floor that are specifically for clocks.
-Receptacles for network copiers, fax machines, A/V and data equipment other than personal computers in copy rooms.

		Field	
	• Conference rooms • Kitchenettes in office spaces • Copy room		
2.	Electric circuits serving controlled receptacles are equipped with automatic shut-OFF controls following the requirements prescribed in Section 130.1(c)1 through 5 (in many cases this will mean that the receptacles are connected to the same automatic shut-OFF system as the general lighting of the space).	☐	☐
3.	Controlled receptacles shall have a permanent marking to differentiate them from uncontrolled receptacles.	☐	☐
4.	For open office areas, controlled circuits shall be provided and marked to support installation and configuration of office furniture with receptacles that comply with Section 130.5(d) 1, 2, and 3.	☐	☐
5.	For hotel and motel guest rooms at least one-half of the 120-volt receptacles in each guest room are controlled receptacles that comply with Section 130.5(d)1, 2, and 3 (see numbers 1,2 and 3 above). Electric circuits serving controlled receptacles have captive card key controls, occupancy sensing controls, or automatic controls such that, no longer than 30 minutes after the guest room has been vacated, power is switched off.	☐	☐
6.	Plug-in strips and other plug-in devices that incorporate an occupant sensor are not used to comply with any of these requirements.	☐	☐

Circuit Controls:

- Check boxes that controls are integrated into design documents

STATE OF CALIFORNIA
Electrical Power Distribution
CEC-NRCC-ELC-01-E (Revised 12/15) CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE	NRCC-ELC-01-E
Electrical Power Distribution	Page 6 of 6
Project Name: Happy Manufacturing	Date Prepared: 2/3/16

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT

1. I certify that this Certificate of Compliance documentation is accurate and complete.

Documentation Author Name: Gina Rodda	Documentation Author Signature: GINA RODDA
Company: Gabel Associates	Signature Date: 2/3/16
Address: 1818 Harmon St.	CEA/ HERS Certification Identification (If applicable): N/A
City/State/Zip: Berkeley CA 94703	Phone: 510-428-0803

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Compliance is true and correct.
2. I am eligible under Division 3 of the Business and Professions Code to accept responsibility for the building design or system design identified on this Certificate of Compliance (responsible designer).
3. The energy features and performance specifications, materials, components, and manufactured devices for the building design or system design identified on this Certificate of Compliance conform to the requirements of Title 24, Part 1 and Part 6 of the California Code of Regulations.
4. The building design features or system design features identified on this Certificate of Compliance are consistent with the information provided on other applicable compliance documents, worksheets, calculations, plans and specifications submitted to the enforcement agency for approval with this building permit application.
5. I will ensure that a completed signed copy of this Certificate of Compliance shall be made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a completed signed copy of this Certificate of Compliance is required to be included with the documentation the builder provides to the building owner at occupancy.

Responsible Designer Name: Michael Scalzo	Responsible Designer Signature: MICHAEL SCALZO
Company: AAA	Date Signed: 2/3/16
Address: HappyLand	License: C1000000
City/State/Zip: Happyland	Phone: 000-000-0000

Declaration Statements:

- Signatures

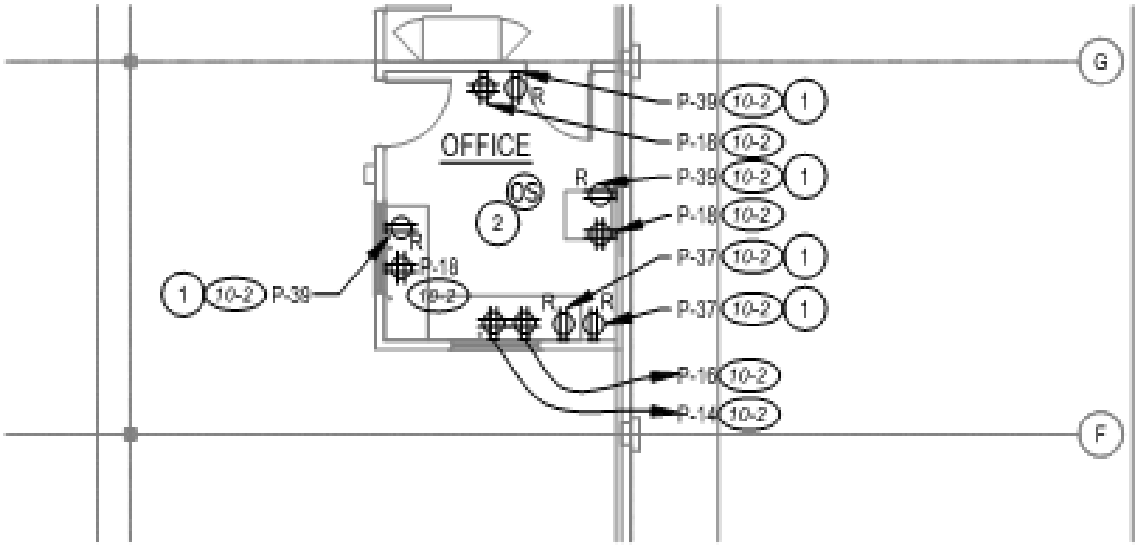
Examples

Electrical Drawing

Specification (typically on plans)

1 20A 120 VOLT RECEPTACLE "R" MOUNTED AT 15" AFF U.O.N. CONTROLLED BY LOCAL OCCUPANCY SENSOR. PROVIDE COVERPLATE WITH BLACK SCREENED LETTERS "SWITCHED".

2 PROVIDE CEILING MOUNTED DUAL RELAY OCCUPANCY SENSOR FOR CONTROL OF OCCUPANCY RECEPTACLES. PROVIDE POWER PACKS AS REQUIRED FOR A COMPLETE SYSTEM. THIS OCCUPANCY SENSOR IS IN ADDITION TO THE LIGHTING OCCUPANCY SENSOR.



(Courtesy of TES Engineering)

Examples

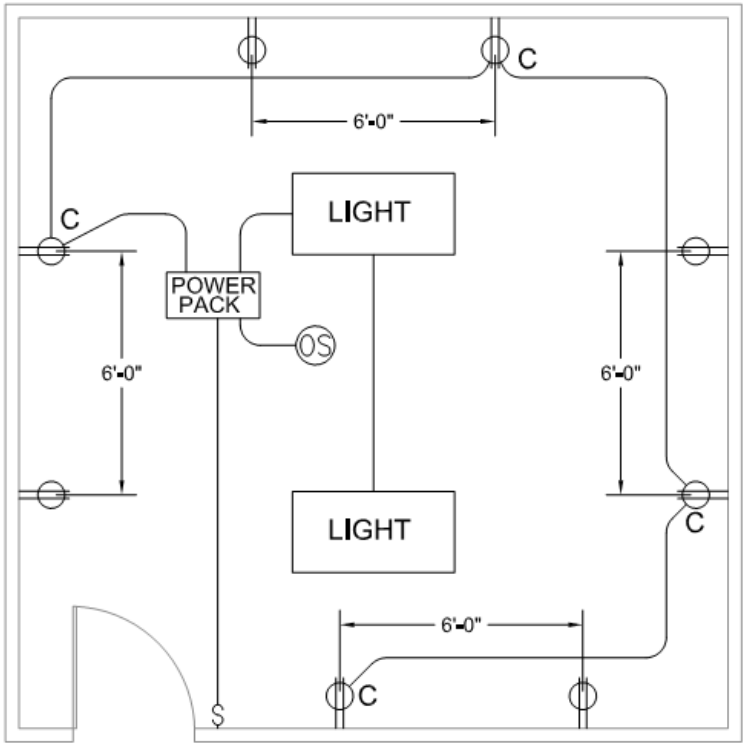
Specification (typically on plans)

(Courtesy of TES)

RECEPTACLES SHALL BE SPLIT DEVICES IN THE MANAGER'S OFFICE. MOUNTED WITHIN (6) FEET FROM EACH UNCONTROLLED RECEPTACLE. WIRE UN-SWITCHED OUTLET TO INDICATED CIRCUIT. THE SWITCHED OUTLETS SHALL ALL BE WIRED TO CIRCUIT P-38 AND SHALL BE CONTROLLED VIA OCCUPANCY SENSOR MOUNTED NEAR THE MANAGER'S DESK. REFER TO SHEET E-X FOR OCCUPANCY SENSOR LOCATION.

LEGEND FOR PLAN

- UNCONTROLLED RECEPTACLE
- C OCCUPANCY SENSOR CONTROLLED RECEPTACLES WITHIN 6 FT OF UNCONTROLLED RECEPTACLES
- $ SWITCH
- OS OCCUPANCY SENSOR SWITCH, CEILING MOUNTED

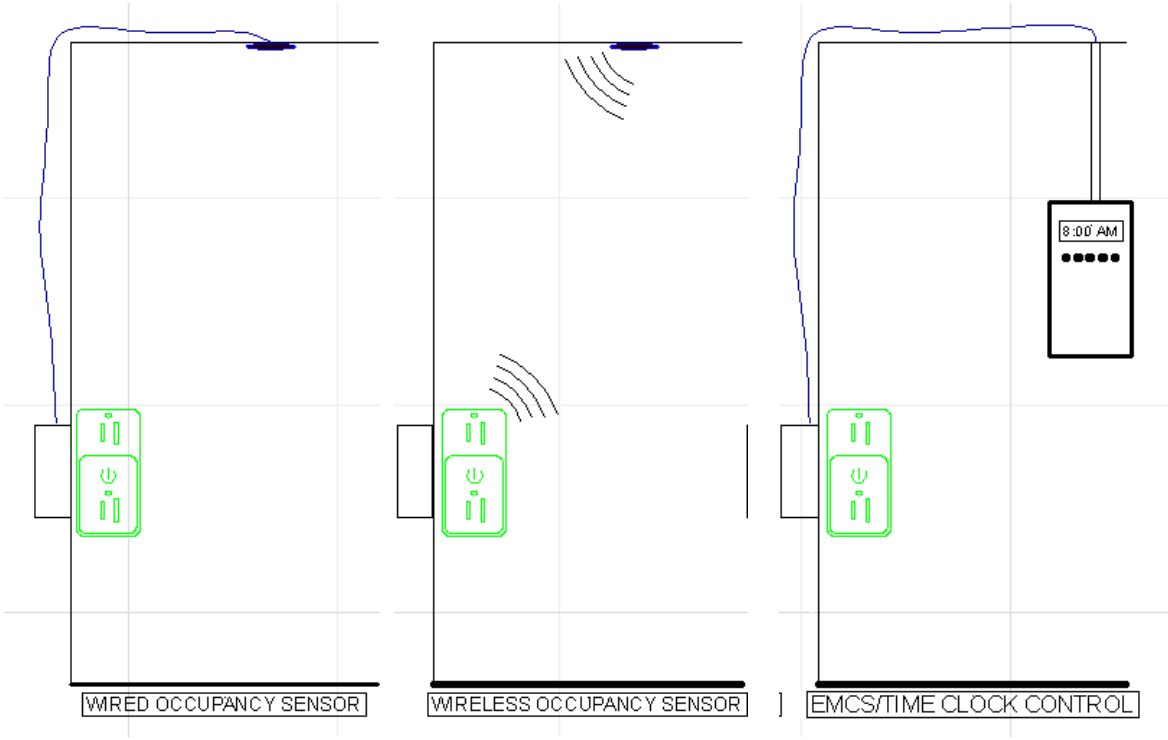


Electrical Drawing

(Courtesy of TES Engineering)

What Does This Look Like?

Installation Options



Cost Engineering

What may happen to designed features to save money

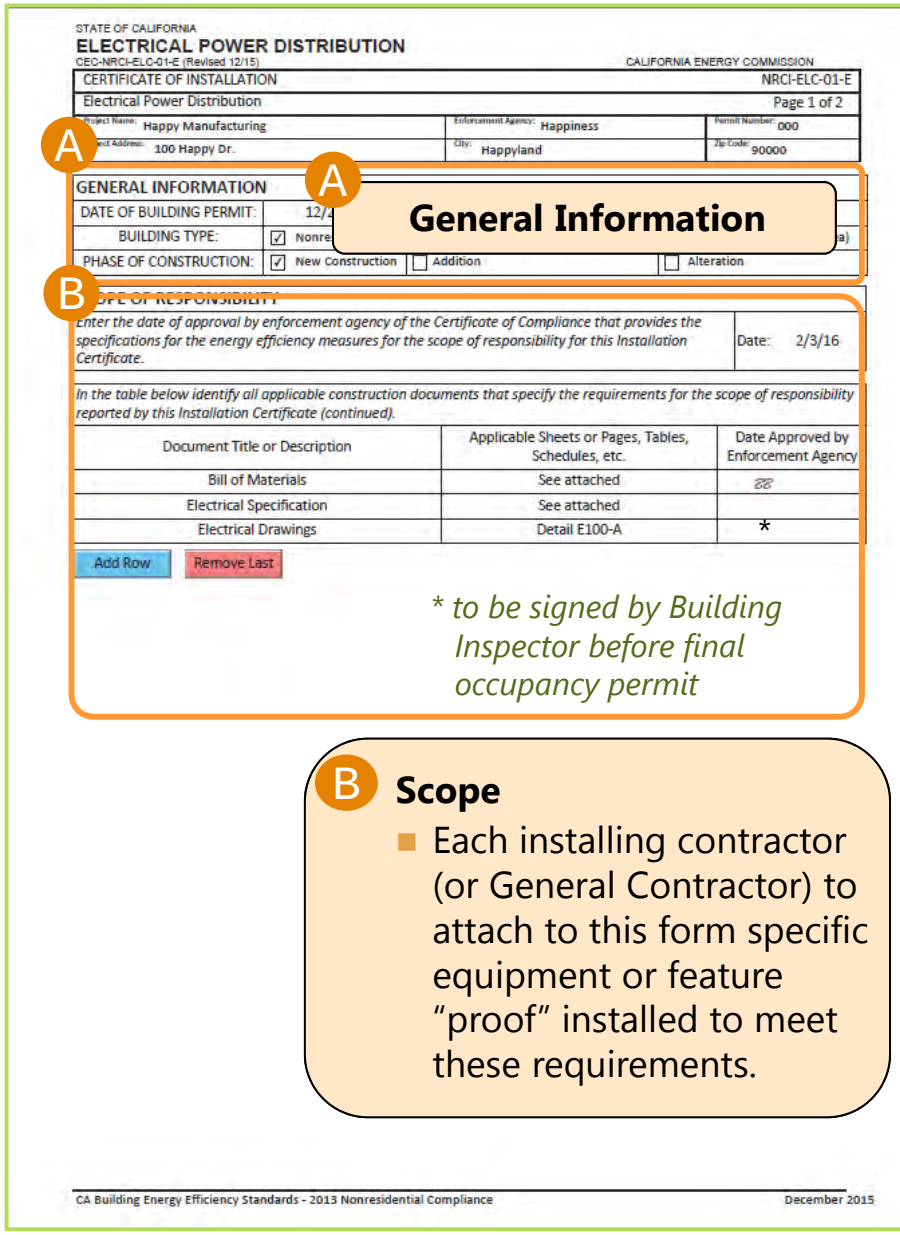
Additions & Alterations

- Labor and material trade offs will be a consideration when working with existing conditions:
  - **Time Clock/EMCS-** Will labor cost rise working with existing conditions or would the extra cost of wireless controls offset the labor cost
  - **Wired controls-Cost** impacts of demo to install new controls vs wireless
  - **Wireless**-The savings in materials could be a factor if wireless controls are not necessary

New Construction

- Proper selection of lighting controls scheme can greatly impact the cost of a project; an example for a simple TI project
- **Wired to Time Clock/EMCS**
  - Labor $$-Material $ to $$
  - Length of run impacts
- **Wired to Occupancy Sensor**
  - Labor $$-Material $$
- **Wireless Occupancy Sensor**
  - Labor $-Material $$$

Final Permit Documentation



STATE OF CALIFORNIA
ELECTRICAL POWER DISTRIBUTION
CEC-NRCI-ELC-01-E (Revised 12/15) CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF INSTALLATION			NRCI-ELC-01-E
Electrical Power Distribution			Page 1 of 2
Project Name: Happy Manufacturing		Enforcement Agency: Happiness	Permit Number: 000
Project Address: 100 Happy Dr.		City: Happyland	Zip Code: 90000

A

General Information

GENERAL INFORMATION			
DATE OF BUILDING PERMIT:	12/		
BUILDING TYPE:	☑ Nonre		a)
PHASE OF CONSTRUCTION:	☑ New Construction	☐ Addition	☐ Alteration

B

Enter the date of approval by enforcement agency of the Certificate of Compliance that provides the specifications for the energy efficiency measures for the scope of responsibility for this Installation Certificate. Date: 2/3/16

In the table below identify all applicable construction documents that specify the requirements for the scope of responsibility reported by this Installation Certificate (continued).

Document Title or Description	Applicable Sheets or Pages, Tables, Schedules, etc.	Date Approved by Enforcement Agency
Bill of Materials	See attached	
Electrical Specification	See attached	
Electrical Drawings	Detail E100-A	*

Add Row Remove Last

** to be signed by Building Inspector before final occupancy permit*

B Scope

- Each installing contractor (or General Contractor) to attach to this form specific equipment or feature "proof" installed to meet these requirements.

CA Building Energy Efficiency Standards - 2013 Nonresidential Compliance December 2015

NRCI-ELC-01-E: Controlled Circuits

- Examples:
  - "Bill of Materials" could be a good resource to verify equipment installed per design document requirements.
- *Best Practice:*
  - *All installation and operating manuals MUST be provided for each device installed, now is a good time to put them together*

But What About…..

130.5(e) Demand Response & 130.5(f) EMCS

130.5(e) Demand Response

- Demand responsive controls and equipment ***shall be capable*** of:
  - Receiving and automatically responding to at least one standards based messaging protocol which enables demand response after receiving a demand response signal.
- Demand responsive controls and equipment ***is needed*** to comply with other sections of the Standards (when applicable):

2016 code

When demand response controls and equipment are installed, *then* they must meet code requirements.

130.5(f) EMCS

- An EMCS ***may be*** installed to comply with the requirements of lighting controls and HVAC thermostats if it meets the minimum code requirements

2016 code

This has been removed from this section and has been moved to Section 130.0

Next Steps

- Welcome
- What We Heard from You
- Let's Talk
- **▶Next Steps**
  - Best Practices
  - Improvements
- Wrap Up

Our Question To You

If you could wave your magic wand, electrical distribution section 130.5 documentation would include _____ to make your job easier?

A thoroughly knowledgeable person readily available to help me design a new system at no charge to my company

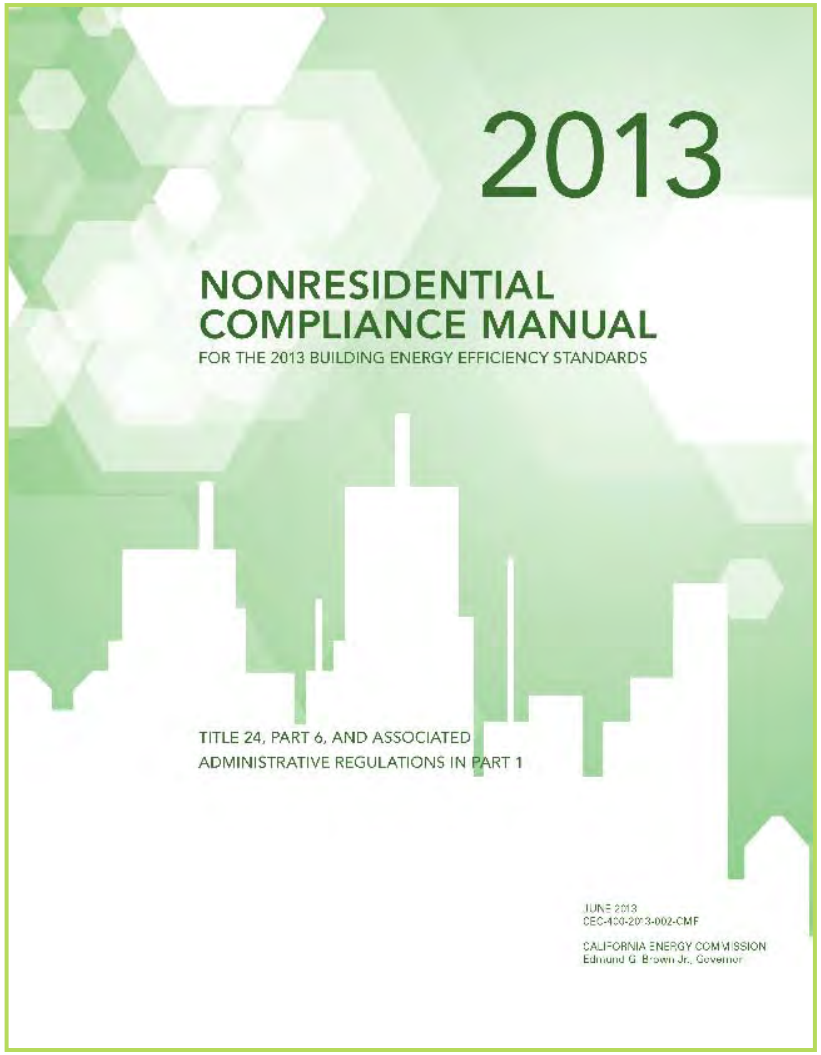
images of exisitng non-government non-public works projectsof compliant installations.

Hands on training with Watt Stopper and Lutron building controls design, installation and post occupancy testing and user training

Clear identification on the Electrical Power Plan to indicate the location of controlled outlets, the method of control, (general or specific sensor control) and the mounting location of control sensors.

It would go away altogether

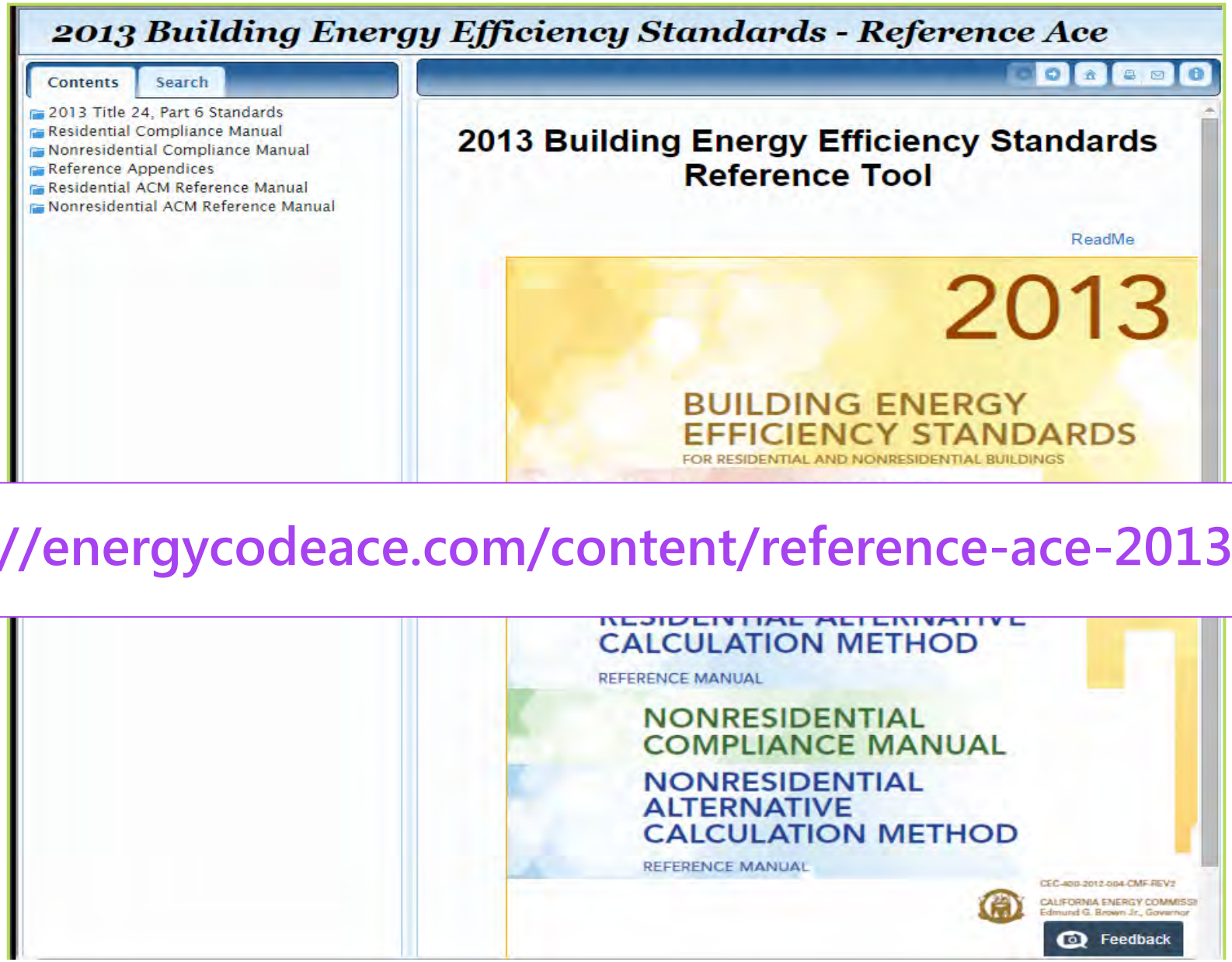
Nonresidential Manual



Chapter 8

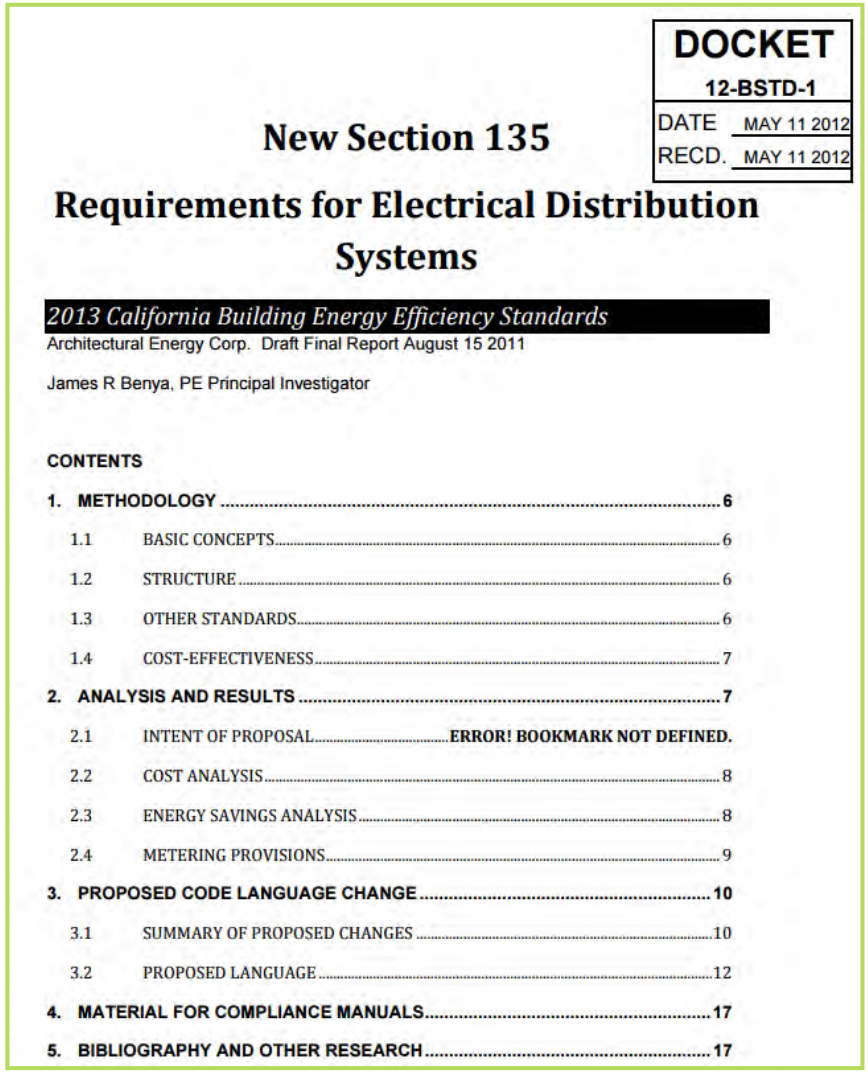
- Guidance on code intent
- Code language turned into full sentences (*understandable*)
- Pictures of equipment that do and do not meet code requirements
- Voltage drop calculation guidance
- EXAMPLES of how code can be interpreted
- Building department guidance on documentation criteria

Reference Ace



http://energycodeace.com/content/reference-ace-2013-tool

CASE Report



DOCKET
12-BSTD-1
DATE MAY 11 2012
RECD. MAY 11 2012

New Section 135

Requirements for Electrical Distribution Systems

2013 California Building Energy Efficiency Standards

Architectural Energy Corp. Draft Final Report August 15 2011

James R Benya, PE Principal Investigator

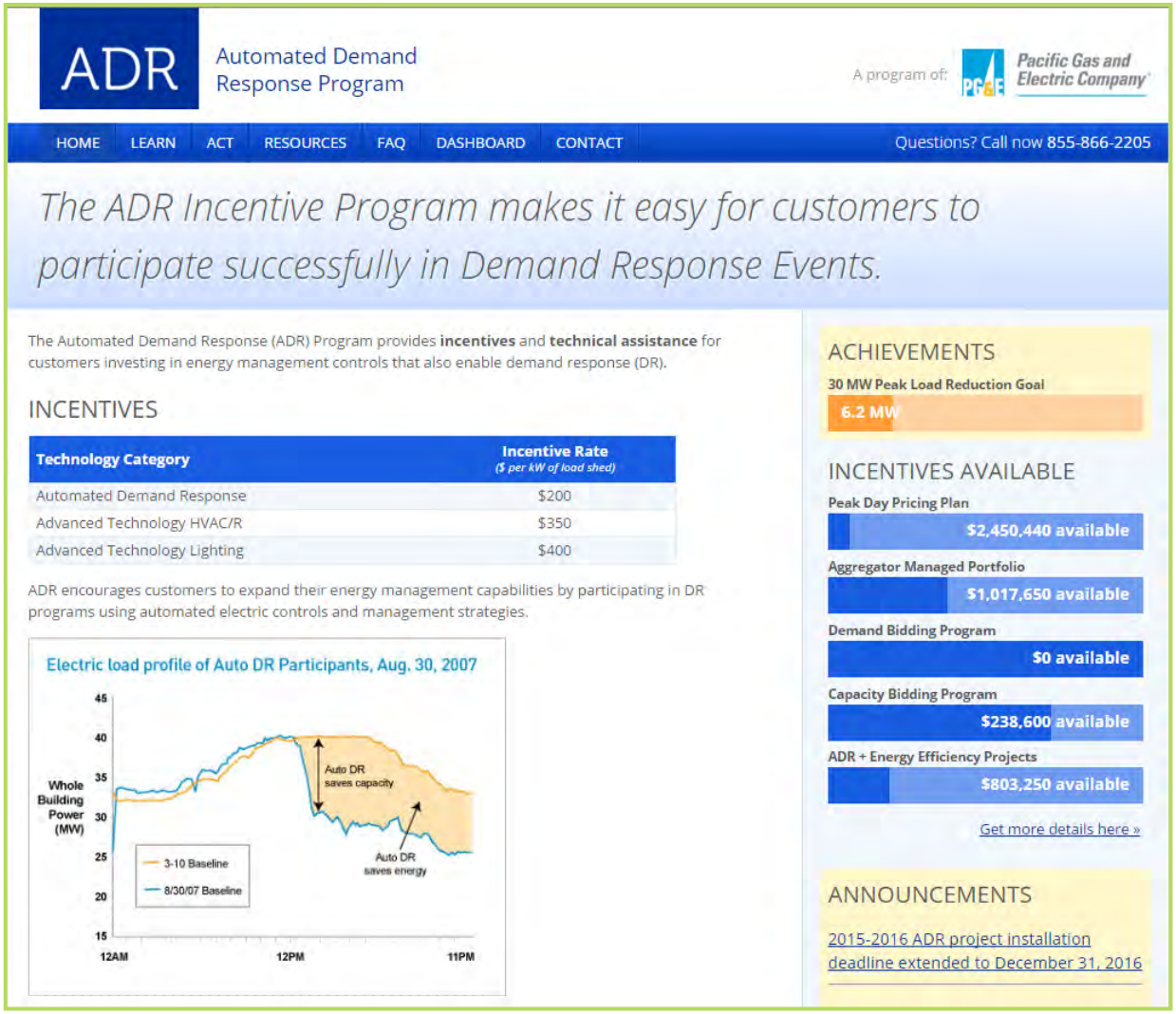
CONTENTS

Codes and Standards Enhancement (CASE) Initiative

http://www.energy.ca.gov/title24/2013standards/rulemaking/documents/public_comments/45-day/2012-05-11_New_Section_135_Requirements_for_Electrical_Dist._Systems_TN-65189.pdf

- The "why" behind the code
- Cost effective study of the code
- Proposed language to code (which became code in the 2013 standards)
- Proposed language to Nonresidential Manual

Demand Response Programs

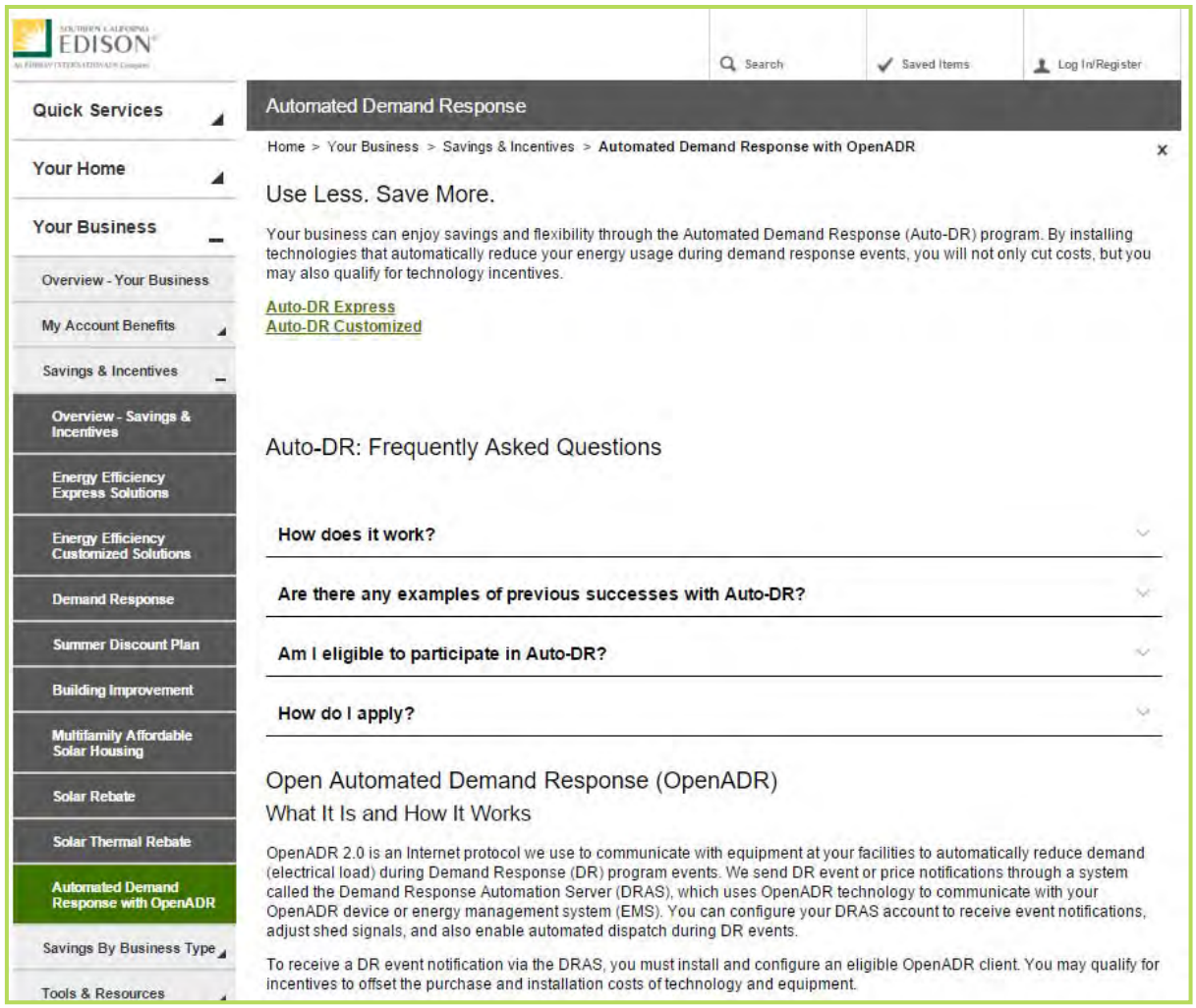


PG&E

- More information of the benefits of demand response
- Criteria to being eligible
- Incentive information

http://pge-adr.com/

Demand Response Programs



SCE

- More information of the benefits of demand response
- Criteria to being eligible
- Incentive information

https://www.sce.com/wps/portal/home/business/savings-incentives/Automated-Demand-Response-with-Open-ADR/

Explore

Home / Other Calculators / Voltage Drop Calculator

Voltage Drop Calculator

This is a calculator for the estimation of the voltage drop of an electrical circuit based on the wire size, distance, and anticipated load current. Please note this calculator assume the circuit is operate in a normal condition—room temperature with normal frequency. The actual voltage drop can vary depend on the condition of the wire, the conduit being used, the temperature, the connector, the frequency etc. It is recommended that the voltage drop should be less than 5% under the fully loaded condition.

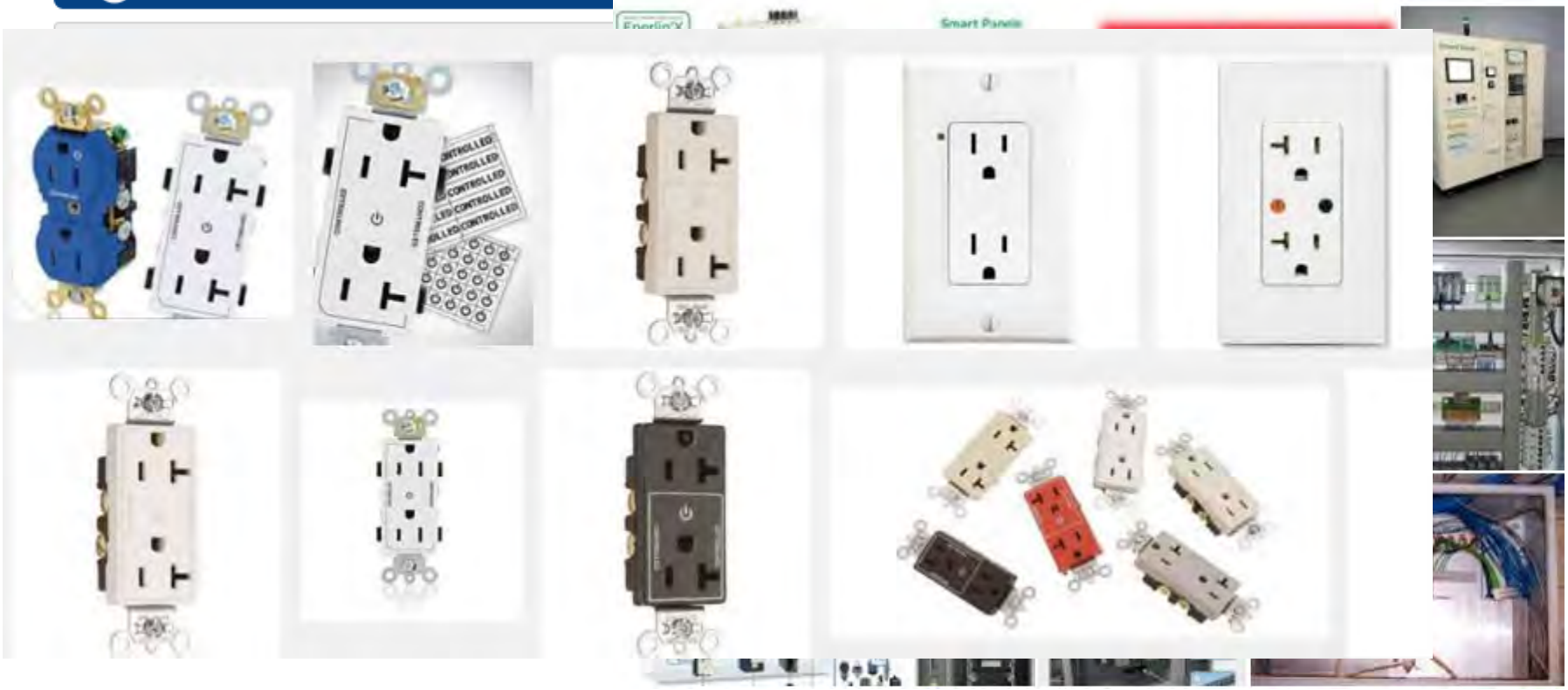
Modify the values and click the Calc

I Love The Internet

- Look around, see what you can find!

Images for electrical smart panels

Report images



EnergyCode Ace™

Helping you play your cards right

A new website developed by the Statewide Codes & Standards Program to help you meet the requirements of Title 24, Part 6

We offer **FREE**

Ace Tools™

A variety of tools to help you identify the forms, installation techniques, and building energy standards relevant to building projects in California

Ace Training™

Classroom and online trainings on Title 24, Part 6.

Ace Resources™

Fact Sheets, Trigger Sheets, Checklists, and FAQs to help you understand when Title 24, Part 6 is "triggered" and how to correctly comply when it is

visit us at

www.EnergyCodeAce.com

Wrap Up

- Welcome
- What We Heard from You
- Let's Talk
- Next Steps

▶Wrap Up

- Thank you!
- Questions?
- CEUs

Thank you!

Contact	Role	Email	Phone
Gina Rodda	Presenter	gina@gabelenergy.com	(510) 428-0803 ext 204
Michael Scalzo	Co-Presenter	mscalzo@aaacompanies.com	(661) 705-7731
Kathryn Fortin	eLearning Technology & Design Consultant	kfortin@fortech.net	(510) 825-3508
Energy Code Ace	Webinar Registration	decoding.request@energycodeace.com	
CEC Hotline	Energy Standards Hotline	title24@energy.ca.gov	(800) 772-3300
Jill Marver	PG&E Course Manager	JKZ1@pge.com	(925) 415-6844

HELPING YOU PLAY YOUR CARDS RIGHT