Lobby Question

What industry roles (i.e. design engineer, commissioning authority, inspectors, etc.) do you think will be most instrumental in implementing the 2013 commissioning requirements?

Design, because they will bring the owner along, educating them as to the value & need.

All must work together to implement this successfully. You cannot and should not rely on just one entity.

For us it seems the commissioning authority is the most vital component, however the contractor must be committed to the effort for it to be successful

All of the above (the entire team).

Owner, who writes the checks

Energy Code Ace™
HELPING YOU PLAY YOUR CARDS RIGHT

Decoding CXR

Let's Talk Non Residential Commissioning Under the 2013 Title 24 Part 6 Energy Standards

Host:
Gina Rodda
Gabel Associates, LLC

Guest Speaker:
Sally Blair
NORESCO

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Southern California Edison An EDISON INTERNATIONAL™ Company
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Welcome

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

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?

Guest Speaker

Sally Blair, NORESCO

Sblair@noresco.com

Sally works for NORESCO, where she has gained more than a decade of experience in energy and sustainability consulting. During this time she managed commissioning scope from concept design through functional testing on energy efficiency building projects. She has worked closely with building owners/ facility managers and NORESCO's in house commissioning agents while facilitating the commissioning process for both complex and simple systems.

She holds a BS in mechanical engineering, and an MBA. Over the past few years, she has been fortunate to work for the IOU Codes and Standards team, focusing on Title 24, Part 6 compliance improvement.

NORESCO

United Technologies

Our Goal Today

Review commissioning measures under the 2013 energy standards:

- When they are required
- What they entail
- Tips and tricks
- Any specific questions you may have

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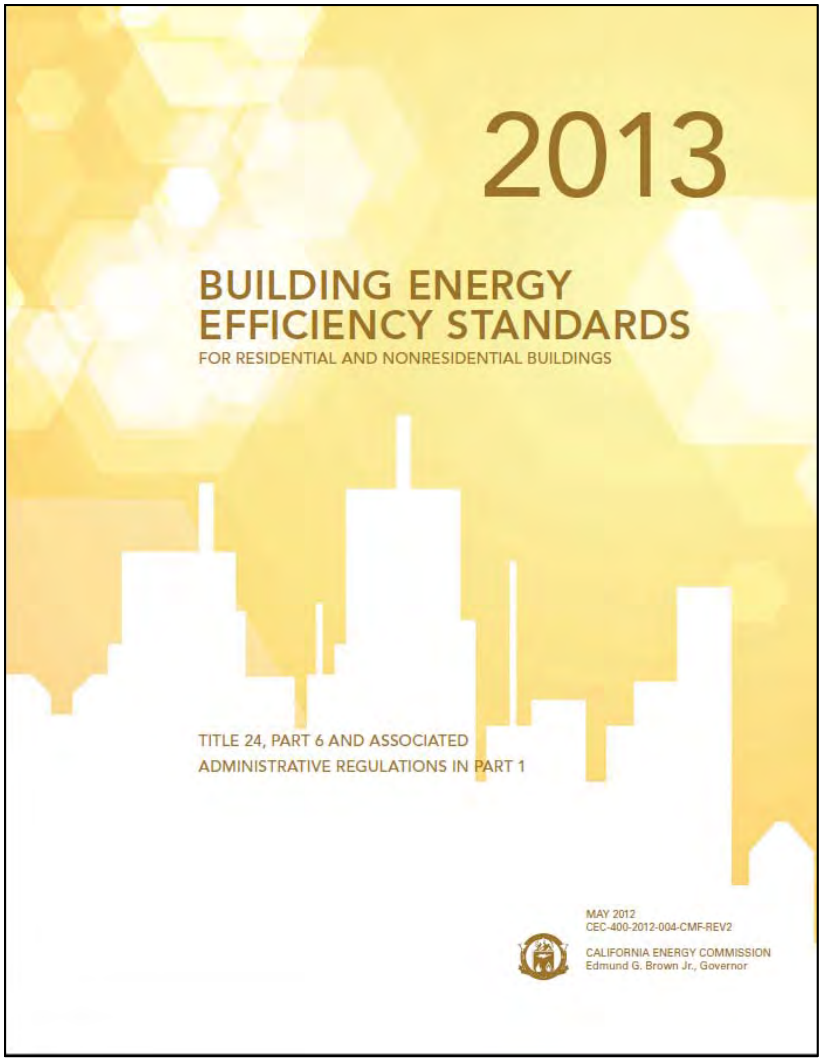
CEC Documents

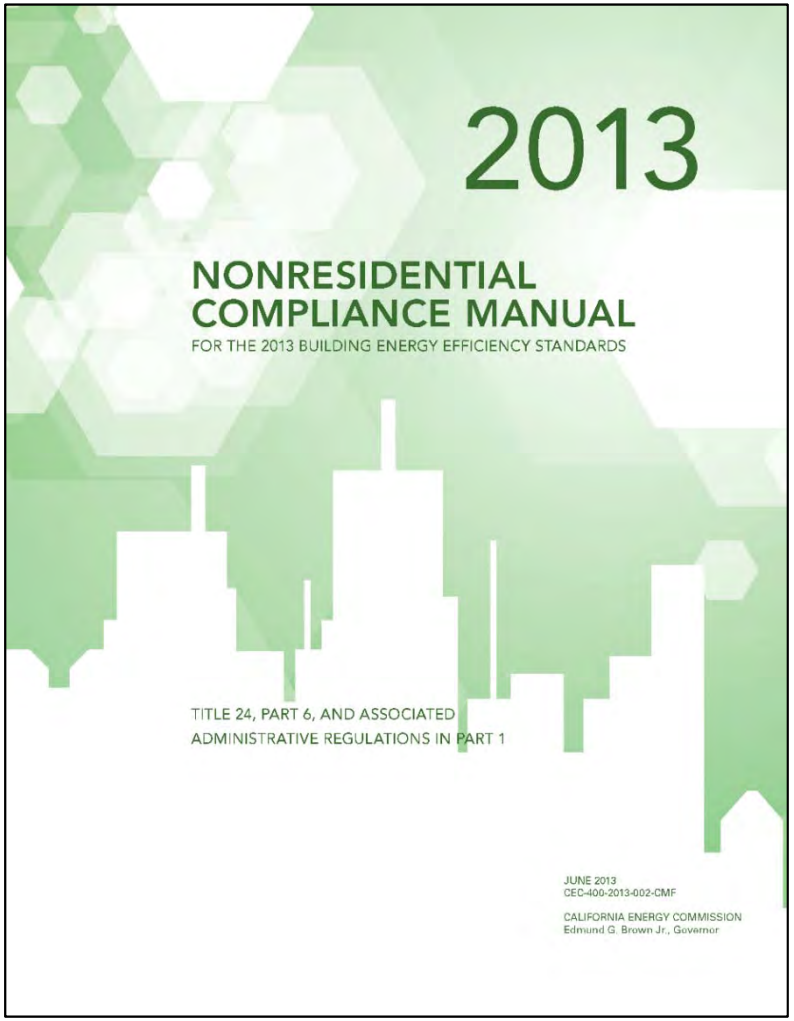


Energy Standards: §120.8

- (a) Summary of Commissioning Requirements
- (b) Owner's or Owner Representative's Project Requirements (OPR)
- (c) Basis of Design (BOD)
- (d) Design Phase Design Review
- (e) Commissioning measures shown in the construction documents (Commissioning Specifications)
- (f) Commissioning Plan
- (g) Functional performance testing
- (h) Documentation and training
- (i) Commissioning report

http://www.energy.ca.gov/title24/2013standards/index.html

CEC Documents



Chapter 12

- Building Commissioning Guide
  - Triggers
  - Exceptions
  - Requirements
  - Documentation

CEC Documents

Nonresidential Appendix NA7

- Installation and Acceptance Requirements
  - NA7.4: Envelope
  - NA7.5: Mechanical
  - NA7.6: Lighting
    - 7.7 Indoor
    - 7.8 Outdoor
    - 7.9 Signs

Defining the Difference: Compliance

Mandatory Measures

Cx is MANDATORY for all *new nonresidential* buildings

Prescriptive Approach

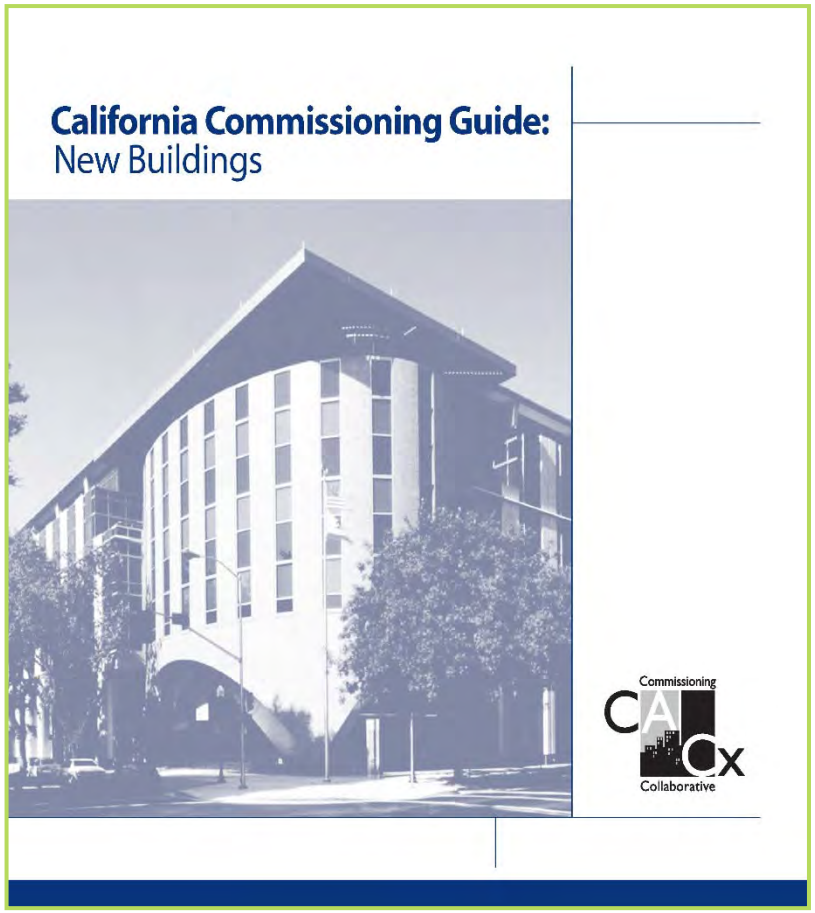
Cx is mandatory and there are no prescriptive requirements

Performance Approach

Cx is mandatory and there are no performance options

Compliance Documentation

What is Cx?



www.cacx.org

- The California Commissioning Collaborative defines commissioning as:

  "The process of ensuring that systems are designed, installed, functionally tested and capable of being operated and maintained according to the owner's operational needs."

When Is Cx Required?

BLUEPRINT — CALIFORNIA ENERGY COMMISSION • PAGE 1

CALIFORNIA ENERGY COMMISSION

BLUEPRINT

EFFICIENCY DIVISION

Issue 107 January - February 2015

In This Issue

- Cool Roofs & Condensation
- QII Compliance Credit for Insulated Headers
- Approved Acceptance Test Technician Certification Providers for Lighting Controls
- Free Training Opportunities
- Q&A
  - Commissioning
  - Nonresidential Economizers
  - Residential Reroof Projects
  - Luminaire Modifications-in-Place

Cool Roofs & Condensation

A cool roof is a roofing material with high thermal emittance and high solar reflectance, or low thermal emittance and exceptionally high solar reflectance that reduces heat gain through the roof. Because cool roofs gain and retain less heat than traditional roofs, less heat is transferred through the envelope into the building's interior. By lowering internal temperatures, cool roofs reduce occupant demand for air conditioning, allowing for building cooling cost savings.

The temperature of the cool roof is reduced to such an extent that moisture no longer evaporates as it would with a traditional roof. When cool roofs are not installed properly, moisture condenses and becomes trapped within the roofing materials. The trapped moisture can lead to mold growth and damage to the roofing materials or supporting elements.

To prevent the trapping of moist air, it is essential to follow proper air sealing procedures as outlined in Section 110.7 of the 2013 Building Energy Efficiency Standards (Energy Standards). Proper installation may require the installation of: air barriers, vapor barriers, insulation above the roof deck, and additional ventilation.

For more information on cool roofs, please review the U.S. Department of Energy's *Energy Saver* article "Cool Roofs" at: http://www.energy.gov/energysaver/articles/cool-roofs.

Quality Insulation Installation (QII) Compliance Credit for Insulated Headers

The 2013 Energy Standards provide Quality Insulation Installation (QII) compliance credit for R-2 insulated headers as indicated in Section RA3.5.6.2.9 of the 2013 Reference Residential Appendices (RA). Insulation or wood must fill the cavities, leaving no air gaps in or around the header. To obtain QII credit, use compliance document CF2R-ENV-21-H. Compliance with the R-2 insulated header requirement is verified in Section C, number 13 of this compliance document.

Three options meet the R-2 insulated header requirement:

1. Two-member header with insulation in between. The header and insulation must fill the wall cavity. Example: a 2x4 wall with two 2x nominal headers, or a 2x6 wall with a 4x nominal header and a 2x nominal header. Insulation is required to fill the wall cavity and must be installed between the headers.

Trigger

All **new** nonresidential buildings

- *This does not include additions and alterations*
- *This does not include high-rise residential or hotel/motel buildings*
  - Includes all mandatory, prescriptive and performance features covered under Part 6 for **conditioned spaces**
    - ***EXCEPT covered process*** *(§120.6 and §140.9)*
      - New nonresidential buildings with conditioned pace **≥10,000 ft² trigger all Cx** requirements
      - **<10,000 ft²:** NRCC-CXR forms and Cx specifications and Acceptance Testing (NRCA forms) only

Part 6 vs. Part 11

- Title 24 Part 11
  - Renewable Energy Systems
  - Landscape Irrigation Systems
  - Water Reuse Systems
  - Building with occupancy "I" (Institutional) and "L" (Laboratories)

What's The Difference?

- Title 24 Part 6 (all building systems and components covered by Sections 110.0, 120.0, 130.0 and 140.0 excluding covered process) with occupancy group "A, B, E, F, H, M, R S, and U"
  - Ventilation
  - Space-Conditioning Systems and Controls
  - Water Heating Systems and Controls
  - Lighting Systems and Controls
  - Electrical Power Distribution
  - Envelope (insulation, fenestration, cool roof, etc.)
  - Acceptance Testing

Who is Involved?

- **Owner or Owner's Representative -** The individual or entity holding title to the property on which the building is constructed, or acting on the owner's behalf.

- **Commissioning Authority (i.e. Cx Agent)–** The person who plans, schedules and coordinates the commissioning team to implement the commissioning process. This can be *either* a third-party commissioning provider *or* an experienced member of the design team or owner's staff.

- **Design Reviewer** – Conducts the design review (qualifications later).

- **Acceptance Test Technician-** a Field Technician as defined in Section 10-102 who is certified by an authorized Acceptance Test Technician Certification Provider pursuant to the requirements of Sections 10-103-A or 10-103-B.

- **Contractor-** Coordinates and includes testing on site with Commissioning Authority, subcontractors, Acceptance Test Technicians and Building Inspector in addition to reviewing test objectives, procedures and gathering the correct forms & equipment

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 questions or concerns regarding nonresidential commissioning requirements under the 2013 Title 24 Part 6 energy standards?

What are the requirements at each phase of the project?

Triggers, triggers, triggers.

How to "sell" value of commissioning to Owners. They hate the idea in my experience.

What is expected from reports?

Who can provide commissioning?

Let's Talk

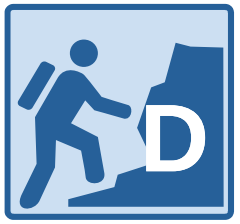
- Welcome
- What We Heard from You
- **▶Let's Talk**
  - Challenge A: Design
  - Challenge B: Plan Review
  - Challenge C: Build & Functional Testing
  - Challenge D: Final
- Next Steps
- Wrap Up

Challenges (Phase of Project)

- **Challenge A**
  - Design

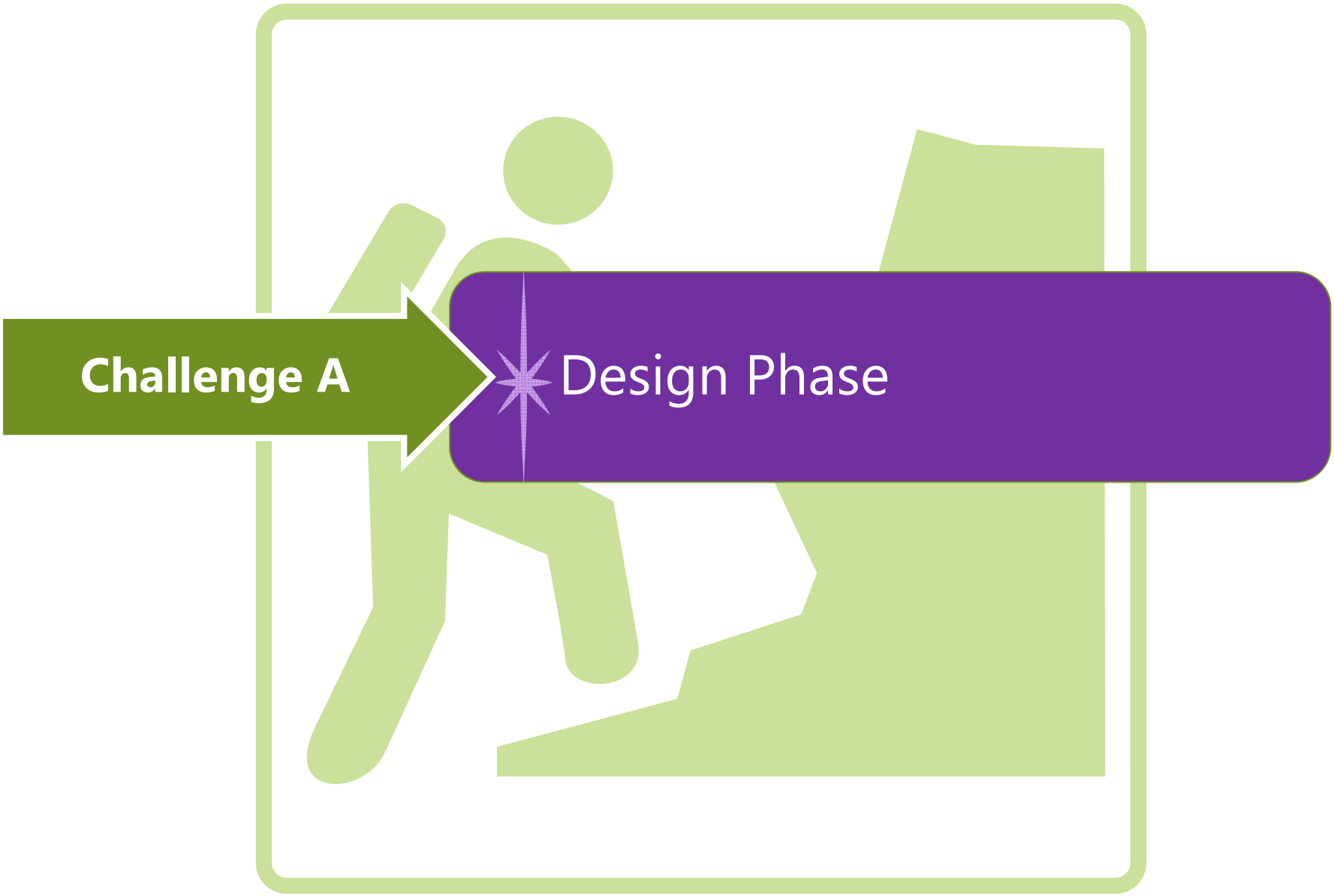
- **Challenge B**
  - Plan Review

- **Challenge C**
  - Construction & Functional Testing



- **Challenge D**
  - Occupancy

Challenge A



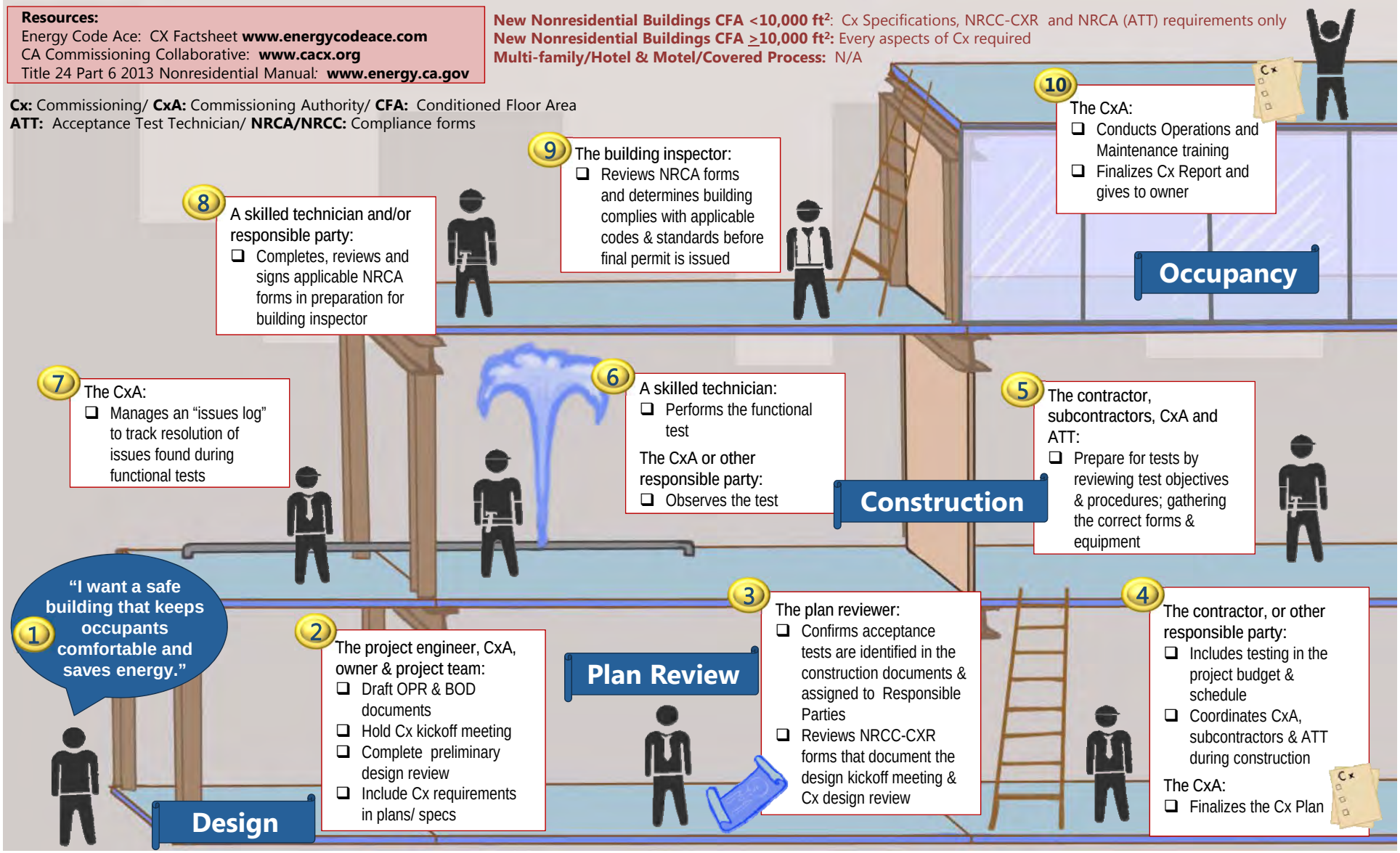
Title 24 Part 6 Infographics — Nonresidential Commissioning

Energy Code Ace™ — HELPING YOU PLAY YOUR CARDS RIGHT

Resources:
Energy Code Ace: CX Factsheet **www.energycodeace.com**
CA Commissioning Collaborative: **www.cacx.org**
Title 24 Part 6 2013 Nonresidential Manual: **www.energy.ca.gov**

New Nonresidential Buildings CFA <10,000 ft²: Cx Specifications, NRCC-CXR and NRCA (ATT) requirements only
New Nonresidential Buildings CFA ≥10,000 ft²: Every aspects of Cx required
Multi-family/Hotel & Motel/Covered Process: N/A

Cx: Commissioning/ **CxA:** Commissioning Authority/ **CFA:** Conditioned Floor Area
ATT: Acceptance Test Technician/ **NRCA/NRCC:** Compliance forms



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Ace Resources | Title 24 Part 6 Fact Sheet

Building Commissioning

Commissioning in the Energy Code

Commissioning requirements for all newly constructed nonresidential buildings are included in the 2013 update to Title 24, Part 6- California's Building Energy Efficiency Standards (Standards). Many of these requirements were moved from CalGreen (Title 24, Part 11), where commissioning was originally incorporated into state building code in 2008.

Commissioning requirements apply to all newly constructed nonresidential buildings, though the extent of the requirements depends on whether the conditioned floor area is less than 10,000 square feet or 10,000 square feet and greater.

The Standards define "newly constructed" as "a building that has never been used or occupied for any purpose" in Section 100.1.

The commissioning requirements in Part 6 do not apply to residential projects (including high-rise residential), do not apply to additions or alterations and do not apply to newly constructed nonresidential buildings that are unconditioned.

Commissioning is critical to realizing the energy savings during building operation that were intended by the building design. Closely related to acceptance testing, commissioning involves functional testing during construction, but also includes activities during design that will ensure the building systems and associated controls will meet the owner's energy and operating efficiency goals.

***Title 24, Part 6 defines commissioning as,** "a systematic quality assurance process that spans the entire design and construction process, including verifying and documenting that building systems and components are planned, designed, installed, tested, operated and maintained to meet the owner's project requirements."*

Commissioning Requirements

Commissioning requirements are included in Section 120.8 of the Standards, and the table below illustrates which requirements apply based on conditioned floor area. Additional resources are listed that may provide valuable detail on how to properly implement these requirements.

Commissioning Requirements in Part 6	Conditioned Space <10k ft²	Conditioned Space ≥ 10k ft²
OPR (§120.8(b))		X
BOD (§120.8(c))		X
Design Review (§120.8(d))	X	X
Commissioning in Construction Docs (§120.8(e))	X	X
Commissioning Plan (§120.8(f))		X
Functional Performance Tests (§120.8(g))		X
O&M Training (§120.8(h))		X
Commissioning Report (§120.8(i))		X

Table 1. Commissioning Requirements in Title 24, Part 6

Additional Resources

The following resources may be helpful in addition to the Standards language to understand the commissioning requirements:

- Building Commissioning Guide in Nonresidential Compliance Manual: This guide outlines both an intent and compliance method for each requirement in Section 120.8.

Roles and Responsibilities

Because commissioning spans the entire building delivery proc from pre-design through occupancy, many parties are invol making communication and coordination paramount. Below is a of who may need to participate in the commissioning process, at time or another during the project.

- Owner, owner's representative or facility operator
- Designers (architect and MEP)
- Design Reviewer (see table below)
- Plans Examiner
- General Contractor*
- Key Subcontractors (HVAC, controls, TAB, etc.)*
- Acceptance Test Technician*
- Commissioning Agent*
- Building Inspector*

* These parties are generally only involved for buildings with conditioned area 10,000 square feet or greater when §120.8(f) - §120.8(i) are required

Who is most appropriate to fill each of these roles is dependent u the experience and expertise of the project team. There are requirements in the Standards that designate who Commissioning Authority must be. However, for both the De Reviewer and Acceptance Test Technician, there are restriction who can fill these roles.

Building Size	< 10,000 ft²	10,000 - 50,000 ft²	> 50,000 ft²	Comple systems in Bldgs >10,00
Allowed Design Reviewer	Any licensed professional engineer including the engineer of record	A licensed professional engineer in-house to the design firm but not associated with the building project; or a third party licensed engineer	A third party licensed professional engineer	A third p licensed professi engine

Table 2. Who can act as the Design Reviewer, per §120.8(d)

Information on becoming a certified Acceptance Test Technician c be found on the California Energy Commission's Acceptance Test Technician Certification Provider webpage.

Additional Resources

The following resources may be helpful to understand roles rel to the commissioning and acceptance testing process:

- Building Commissioning Guide in Nonreside Compliance Manual: Section 12.1 of this guide outl roles and information on how to find a qual Commissioning Authority.
- California Commissioning Collaborative: This organiz includes a Provider List that may be valuable w searching for a Commissioning Authority.
- Section 10-103(a)1: This section in the Standards indic that the Design Reviewer must be a licensed professi engineer.

Commissioning Process

Understanding and assigning who does what and when early during the process is key to success. For all newly constructed nonresidential projects, the Standards dictate that the commissioning process starts in early design, and compliance forms verifying this must be submitted to the building department with the project's application for permit.

Additional Resources

- Energy Code Ace Commissioning Infographic: This visual provides an outline of the commissioning tasks by when they occur during a typical project delivery process.
- Energy Design Resources e-news #96: This e-news titled Commissioning for Compliance was issued to help practitioners understand and implement the commissioning requirements of the Standards. It includes tips and tricks and a handy graphic that shows when during project delivery the commissioning requirements should be implemented.

Functional Performance Test Procedures

Commissioning is similar to acceptance testing in that functional performance tests are performed to "demonstrate the correct installation and operation of each component, system and system-to-system interface." Section 120.8(g) says that functional testing performed to satisfy the commissioning requirements should be performed in accordance with acceptance testing procedures outlined in other sections of the Standards.

Note that the functional performance tests which are needed for commissioning are based on the systems documented in the OPR and BOD documents and may be more comprehensive than the project's required acceptance tests. A system not being included in the OPR/BOD does not exempt it from acceptance test requirements outlined in other sections of the Standards.

Additional Resources

The following resources may be helpful to better define functional performance testing requirements:

- Chapter 13 Acceptance Requirements in the Nonresidential Compliance Manual: An overview of acceptance testing requirements, the process and the forms are further detailed in Chapter 13. Table 13-1 includes a list of certificate of acceptance forms by building component.
- Nonresidential Reference Appendices NA7: This Section of the Nonresidential Appendices includes test procedures, roles and responsibilities and other details related to acceptance testing.

"Simple" Systems include:
- (a) Unitary or packaged equipment listed in Tables 110.2-A, 110.2-B, 110.2-C and 110.2-E that each serve one zone; OR
- (b) Two-pipe, heating only systems serving one or more zones

"Complex" Systems include:
- (a) Fan systems each serving multiple thermostatically controlled zones; OR
- (b) Built-up air handler systems (non-unitary or non-packaged HVAC equipment); OR
- (c) Hydronic or steam heating systems; OR
- (d) Hydronic cooling systems

Figure 1. "Simple" vs. "Complex" HVAC Systems

Commissioning Documents

In addition to the compliance forms (see below), there are documents that are required by Section 120.8 for buildings with conditioned floor area 10,000 sf and greater. These documents are used both to facilitate and document the commissioning activities:

- Owner's Project Requirements (OPR)
- Basis of Design (BOD)
- Commissioning Specifications
- Commissioning Plan
- Functional Performance Tests
- Operation and Maintenance Training Documents
- Commissioning Report

Additional Resources

The following resources may be helpful to produce these required documents:

- Energy Design Resources e-news #96: The Commissioning for Compliance e-news provides more pragmatic detail and tips on each document listed.
- Building Commissioning Guide in Nonresidential Compliance Manual: This guide provides an intent and compliance method for each document.
- California Commissioning Collaborative: Templates and sample documents are provided by this organization to facilitate commissioning in California.

Compliance Forms

All newly constructed nonresidential projects are required to complete the design review certificates of compliance, regardless of project size (See Table 1). At a minimum, the NRCC-CXR-01-E and NRCC-CXR-02-E must be completed. The project then uses the NRCC-CXR-03-E for "simple" HVAC systems, and the NRCC-CXR-04-E for "complex" HVAC systems (See Figure 1). The NRCC-CXR-05-E is also completed for all projects requiring compliance with Section 120.8.

Although there are no commissioning forms other than the certificates of compliance, the NRCA forms (certificates of acceptance) are used to document functional performance tests for the inspector to review.

Additional Resources

The following resources may be helpful to prepare the project team for completing compliance forms, and the enforcement agencies for reviewing them:

- Energy Design Resources e-news #96: This e-news includes more detail on each compliance form, including when it should be completed.
- Building Commissioning Guide in Nonresidential Compliance Manual: Section 12.10 of this guide has detailed instructions on completing the compliance forms associated with commissioning.
- NRCA forms: The certificates of acceptance themselves are useful to understand required documentation.

Don't Forget About CALGreen!

Title 24, Part 11 (CALGreen) also includes requirements for commissioning in Chapter 5- Nonresidential Mandatory Measures. These requirements are complimentary to the Energy Code requirements, but be sure to read through them as additional systems such as renewable energy, landscape irrigation and water reuse systems are covered here.

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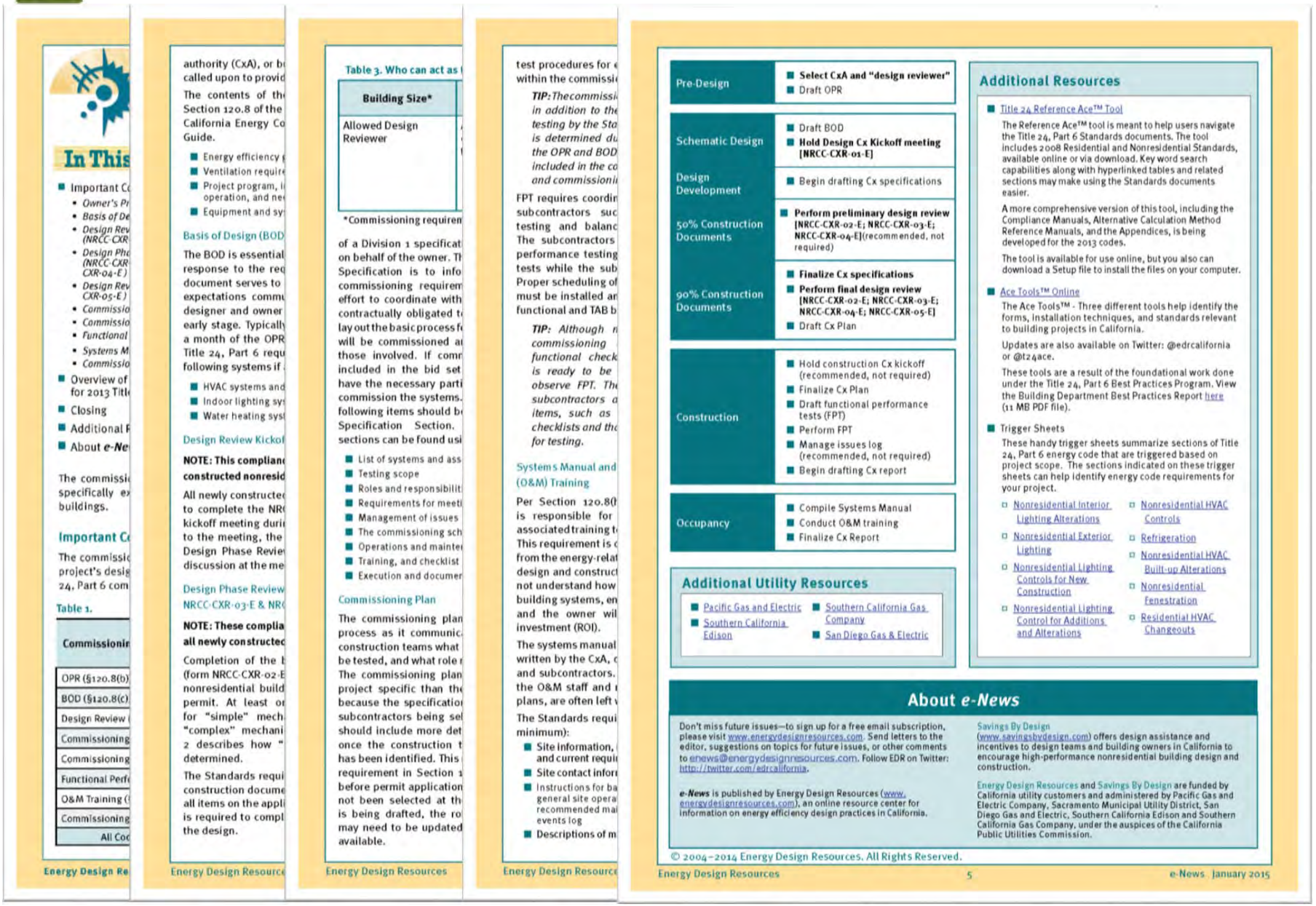
Energy Design Resources "e-news"



Pre-Design	■ Select CxA and "design reviewer" ■ Draft OPR
Schematic Design	■ Draft BOD ■ Hold Design Cx Kickoff meeting [NRCC-CXR-01-E]
Design Development	■ Begin drafting Cx specifications
50% Construction Documents	■ Perform preliminary design review [NRCC-CXR-02-E; NRCC-CXR-03-E; NRCC-CXR-04-E](recommended, not required)
90% Construction Documents	■ Finalize Cx specifications ■ Perform final design review [NRCC-CXR-02-E; NRCC-CXR-03-E; NRCC-CXR-04-E; NRCC-CXR-05-E] ■ Draft Cx Plan
Construction	■ Hold construction Cx kickoff (recommended, not required) ■ Finalize Cx Plan ■ Draft functional performance tests (FPT) ■ Perform FPT ■ Manage issues log (recommended, not required) ■ Begin drafting Cx report
Occupancy	■ Compile Systems Manual ■ Conduct O&M training ■ Finalize Cx Report

Additional Resources

- Title 24 Reference Ace™ Tool

  The Reference Ace™ tool is meant to help users navigate the Title 24, Part 6 Standards documents. The tool includes 2008 Residential and Nonresidential Standards, available online or via download. Key word search capabilities along with hyperlinked tables and related sections may make using the Standards documents easier.

  A more comprehensive version of this tool, including the Compliance Manuals, Alternative Calculation Method Reference Manuals, and the Appendices, is being developed for the 2013 codes.

  The tool is available for use online, but you also can download a Setup file to install the files on your computer.

- Ace Tools™ Online

  The Ace Tools™ - Three different tools help identify the forms, installation techniques, and standards relevant to building projects in California.

  Updates are also available on Twitter: @edrcalifornia or @t24ace.

  These tools are a result of the foundational work done under the Title 24, Part 6 Best Practices Program. View the Building Department Best Practices Report here (11 MB PDF file).

- Trigger Sheets

  These handy trigger sheets summarize sections of Title 24, Part 6 energy code that are triggered based on project scope. The sections indicated on these trigger sheets can help identify energy code requirements for your project.

  - Nonresidential Interior Lighting Alterations
  - Nonresidential Exterior Lighting
  - Nonresidential Lighting Controls for New Construction
  - Nonresidential Lighting Control for Additions and Alterations
  - Nonresidential HVAC Controls
  - Refrigeration
  - Nonresidential HVAC Built-up Alterations
  - Nonresidential Fenestration
  - Residential HVAC Changeouts

Additional Utility Resources

- Pacific Gas and Electric
- Southern California Gas Company
- Southern California Edison
- San Diego Gas & Electric

About *e-News*

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e-News is published by Energy Design Resources (www.energydesignresources.com), an online resource center for information on energy efficiency design practices in California.

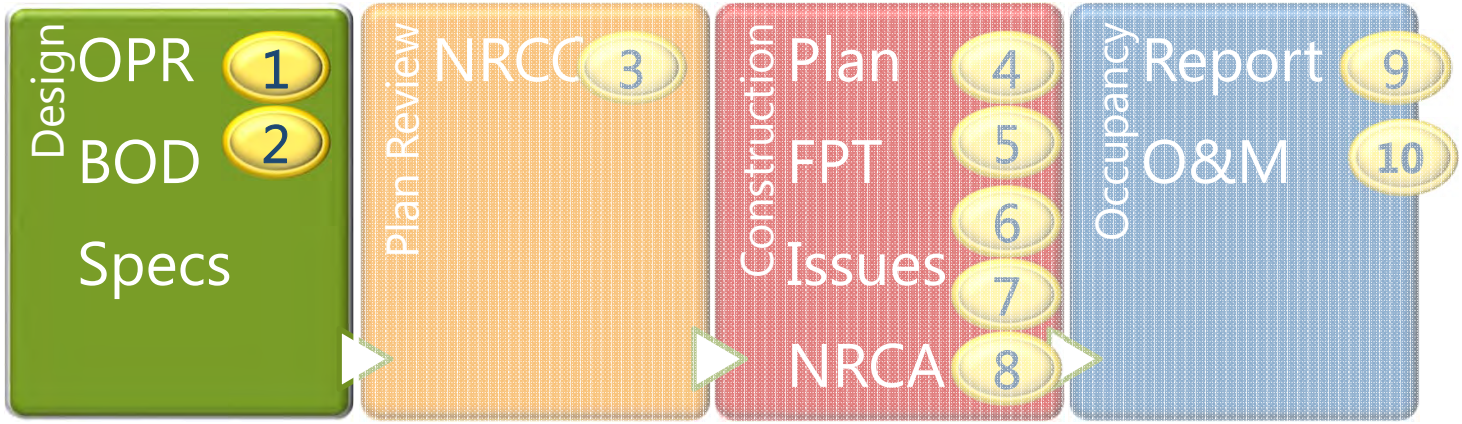
Savings By Design (www.savingsbydesign.com) offers design assistance and incentives to design teams and building owners in California to encourage high-performance nonresidential building design and construction.

Energy Design Resources and Savings By Design are funded by California utility customers and administered by Pacific Gas and Electric Company, Sacramento Municipal Utility District, San Diego Gas and Electric, Southern California Edison and Southern California Gas Company, under the auspices of the California Public Utilities Commission.

Design Phase: TRIGGERS

Design

- Select CxA and "design reviewer"
- Owner's Project Requirements (OPR)
- Basis of Design (BOD)
- Cx Specifications



Decide To Build!

Where did this come from?

- "The term commissioning comes from shipbuilding. A commissioned ship is one deemed ready for service. Before being awarded this title, however, a ship must pass several milestones.
  - Equipment is installed and tested, problems are identified and corrected, and the prospective crew is extensively trained.
  - A commissioned ship is one whose materials, systems, and staff have successfully completed a thorough quality assurance process."

From **The California Commissioning Collaborative** Guide.

Owner's Project Requirements (OPR) §120.8(b)

Commissioning Requirements in Part 6	Conditioned Space	
	<10k ft²	≥ 10k ft²
OPR (§120.8(b))		X
BOD (§120.8(c))		X
Design Review (§120.8(d))	X	X
Commissioning in Construction Docs (§120.8(e))	X	X
Commissioning Plan (§120.8(f))		X
Functional Performance Tests (§120.8(g))		X
O&M Training (§120.8(h))		X
Commissioning Report (§120.8(i))		X

Table 1. Commissioning Requirements in Title 24, Part 6

When is it required?

- **All new nonresidential buildings with conditioned space ≥10,000 ft²**
  - Should be developed early in the design process

Owner's Project Requirements (OPR) §120.8(b)

What is this?

- **The purpose of the OPR is to define and document the owner's energy-related expectations and requirements for the system designers prior to the beginning of design.**

What should it include?

- Energy efficiency goals
- Ventilation requirements
- Project program, including facility functions and hours of operation, and need for after-hours operation
- Equipment and system expectations

Owner's Project Requirements (OPR) §120.8(b)

Who does it?

- **The OPR should be developed early in the design process by the owner and/or the owner's representative.**
  - The design reviewer, commissioning authority (CxA), or building operations manager often are called upon to provide this assistance.

Basis of Design (BOD) 120.8(c)

Commissioning Requirements in Part 6	Conditioned Space	
	<10k ft²	≥ 10k ft²
OPR (§120.8(b))		X
BOD (§120.8(c))		X
Design Review (§120.8(d))	X	X
Commissioning in Construction Docs (§120.8(e))	X	X
Commissioning Plan (§120.8(f))		X
Functional Performance Tests (§120.8(g))		X
O&M Training (§120.8(h))		X
Commissioning Report (§120.8(i))		X

Table 1. Commissioning Requirements in Title 24, Part 6

When is it required?

- **All new nonresidential buildings with conditioned space ≥10,000 ft2**
  - Typically, this document is developed within a month of the OPR's issuance.

Basis of Design (BOD) 120.8(c)

What is this?

- **The BOD is essentially the system designer's documented response to the requirements laid out in the OPR.**
  - The document serves to outline the approach for meeting the expectations communicated in the OPR and allows the designer and owner to work through design issues at an early stage.

Basis of Design (BOD) 120.8(c)

Who does it?

- **Designer and the Owner**

What should it include?

- HVAC systems and controls
- Indoor lighting systems and controls
- Water heating systems and controls

Cx Specifications: 120.8(e)

Commissioning Requirements in Part 6	Conditioned Space	
	<10k ft²	≥ 10k ft²
OPR (§120.8(b))		X
BOD (§120.8(c))		X
Design Review (§120.8(d))	X	X
Commissioning in Construction Docs (§120.8(e))	X	X
Commissioning Plan (§120.8(f))		X
Functional Performance Tests (§120.8(g))		X
O&M Training (§120.8(h))		X
Commissioning Report (§120.8(i))		X

Table 1. Commissioning Requirements in Title 24, Part 6

When is it required?

- **All new nonresidential buildings regardless the size**

Cx Specifications: 120.8(e)

VOLUME 1

DIVISION 1 GENERAL REQUIREMENTS

01450	Mock-up Requirements
01500	Temporary Facilities
01510	Temporary Utilities
01520	Construction Equipment and Aids
01530	Barriers and Enclosures
01560	Temporary Controls
01590	Field Offices and Sheds
01600	Material and Equipment
01700	Contract Close-Out
01710	Cleaning
01714	Construction Waste Management and Removal
01720	Project Record Documents
01730	Operating and Maintenance Data
01740	Commissioning Requirements

What is this?

- **Commissioning measures (requirements) be included in the issued construction documents**
  - **<10,000 ft²**
    - The construction documents should include all necessary documentation for the design reviewer to perform the design review.
      - This does not include "in-the-field" test requirements.
      - This does not exclude projects from acceptance testing requirements.
  - **≥10,000 ft²**
    - To inform bidding contractors of the commissioning requirements so they can include the effort to coordinate with a CxA within their bid, and be contractually obligated to participate.

Cx Specifications: 120.8(e)

Who does it?

- **Usually in the form of a Division 1 specification section provided by the CxA on behalf of the owner.**

What should it include?

- List of systems and assemblies commissioned
- Testing scope
- Roles and responsibilities of contractors
- Requirements for meetings
- Management of issues
- The commissioning schedule
- Operations and maintenance manual development
- Training, and checklist and test form development
- Execution and documentation

Check your understanding

Compliance Path

Cx is a …

Mandatory Measures

Prescriptive Approach

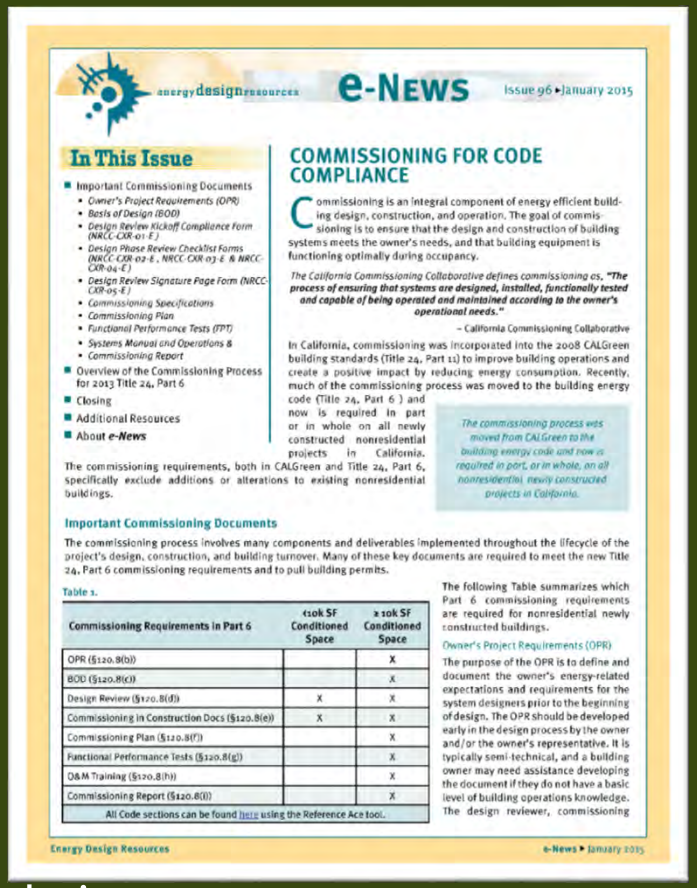
Performance Approach

a) Mandatory requirement
b) Prescriptive requirement
c) Performance requirement
d) All of the above

Resources

Where can you find…

a) CEC website
b) Energy Code Ace website
c) Energy Design Resources Website
d) CA commissioning Collaborative website



energydesignresources e-NEWS Issue 96 ▸ January 2015

In This Issue

- Important Commissioning Documents
  - *Owner's Project Requirements (OPR)*
  - *Basis of Design (BOD)*
  - *Design Review Kickoff Compliance Form (NRCC-CXR-01-E)*
  - *Design Phase Review Checklist Forms (NRCC-CXR-02-E, NRCC-CXR-03-E & NRCC-CXR-04-E)*
  - *Design Review Signature Page Form (NRCC-CXR-05-E)*
  - *Commissioning Specifications*
  - *Commissioning Plan*
  - *Functional Performance Tests (FPT)*
  - *Systems Manual and Operations & Commissioning Report*
- Overview of the Commissioning Process for 2013 Title 24, Part 6
- Closing
- Additional Resources
- About *e-News*

COMMISSIONING FOR CODE COMPLIANCE

Commissioning is an integral component of energy efficient building design, construction, and operation. The goal of commissioning is to ensure that the design and construction of building systems meets the owner's needs, and that building equipment is functioning optimally during occupancy.

The California Commissioning Collaborative defines commissioning as, ***"The process of ensuring that systems are designed, installed, functionally tested and capable of being operated and maintained according to the owner's operational needs."***

– California Commissioning Collaborative

In California, commissioning was incorporated into the 2008 CALGreen building standards (Title 24, Part 11) to improve building operations and create a positive impact by reducing energy consumption. Recently, much of the commissioning process was moved to the building energy code (Title 24, Part 6) and now is required in part or in whole on all newly constructed nonresidential projects in California. The commissioning requirements, both in CALGreen and Title 24, Part 6, specifically exclude additions or alterations to existing nonresidential buildings.

The commissioning process was moved from CALGreen to the building energy code and now is required in part, or in whole, on all nonresidential newly constructed projects in California.

Important Commissioning Documents

The commissioning process involves many components and deliverables implemented throughout the lifecycle of the project's design, construction, and building turnover. Many of these key documents are required to meet the new Title 24, Part 6 commissioning requirements and to pull building permits.

Table 1.

Commissioning Requirements in Part 6	<10k SF Conditioned Space	≥ 10k SF Conditioned Space
OPR (§120.8(b))		X
BOD (§120.8(c))		X
Design Review (§120.8(d))	X	X
Commissioning in Construction Docs (§120.8(e))	X	X
Commissioning Plan (§120.8(f))		X
Functional Performance Tests (§120.8(g))		X
O&M Training (§120.8(h))		X
Commissioning Report (§120.8(i))		X
All Code sections can be found here using the Reference Ace tool.		

The following Table summarizes which Part 6 commissioning requirements are required for nonresidential newly constructed buildings.

Owner's Project Requirements (OPR)

The purpose of the OPR is to define and document the owner's energy-related expectations and requirements for the system designers prior to the beginning of design. The OPR should be developed early in the design process by the owner and/or the owner's representative. It is typically semi-technical, and a building owner may need assistance developing the document if they do not have a basic level of building operations knowledge. The design reviewer, commissioning

Energy Design Resources e-News ▸ January 2015

OPR

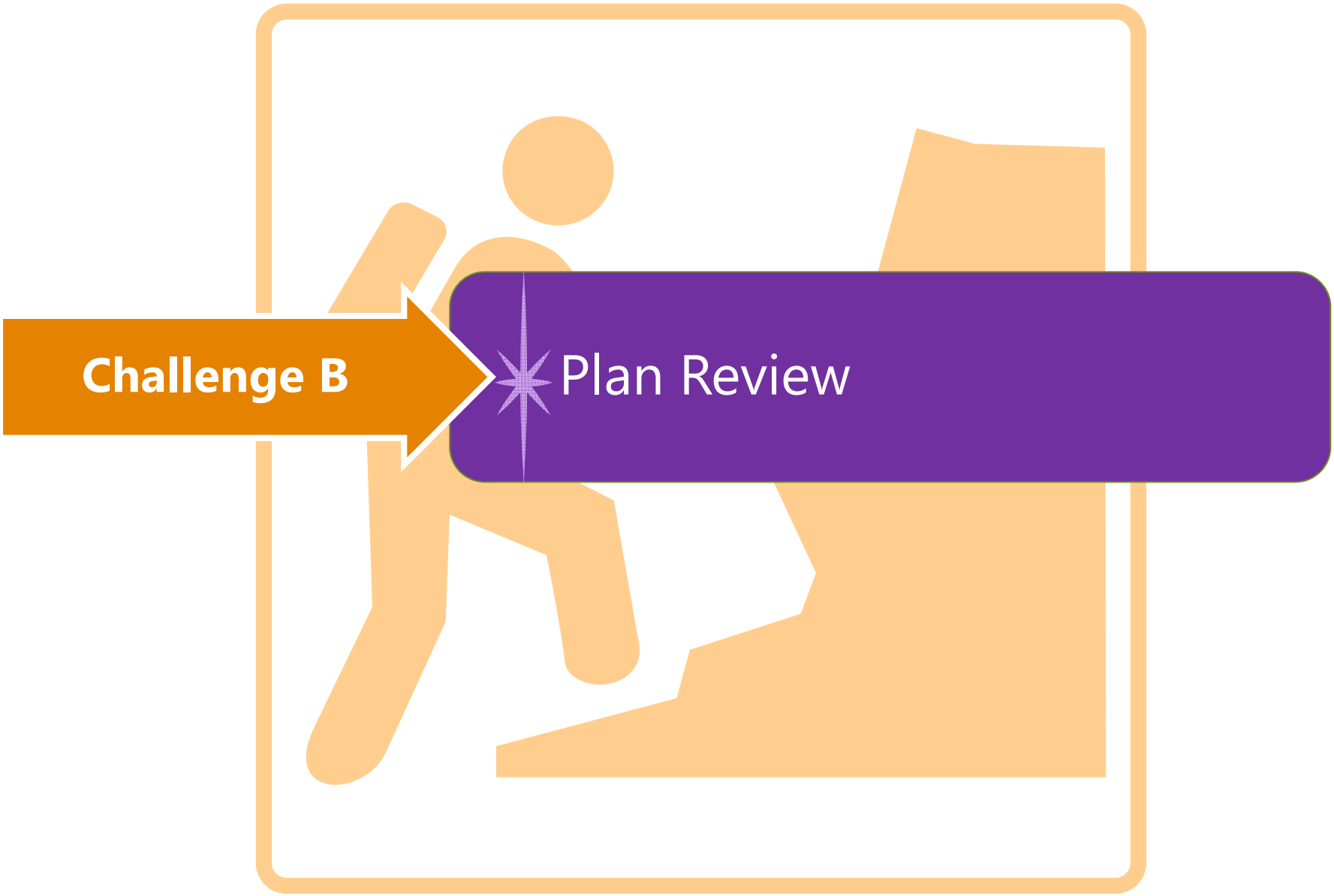
The OPR document is required when…

Commissioning Requirements in Part 6	Conditioned Space	
	<10k ft²	≥ 10k ft²
OPR (§120.8(b))		X
BOD (§120.8(c))		X
Design Review (§120.8(d))	X	X
Commissioning in Construction Docs (§120.8(e))	X	X
Commissioning Plan (§120.8(f))		X
Functional Performance Tests (§120.8(g))		X
O&M Training (§120.8(h))		X
Commissioning Report (§120.8(i))		X

Table 1. Commissioning Requirements in Title 24, Part 6

a) New and renovated buildings, any time
b) New nonresidential buildings ≥10,000 ft²
c) New nonresidential buildings, all sizes
d) New nonresidential buildings <10,000 ft²

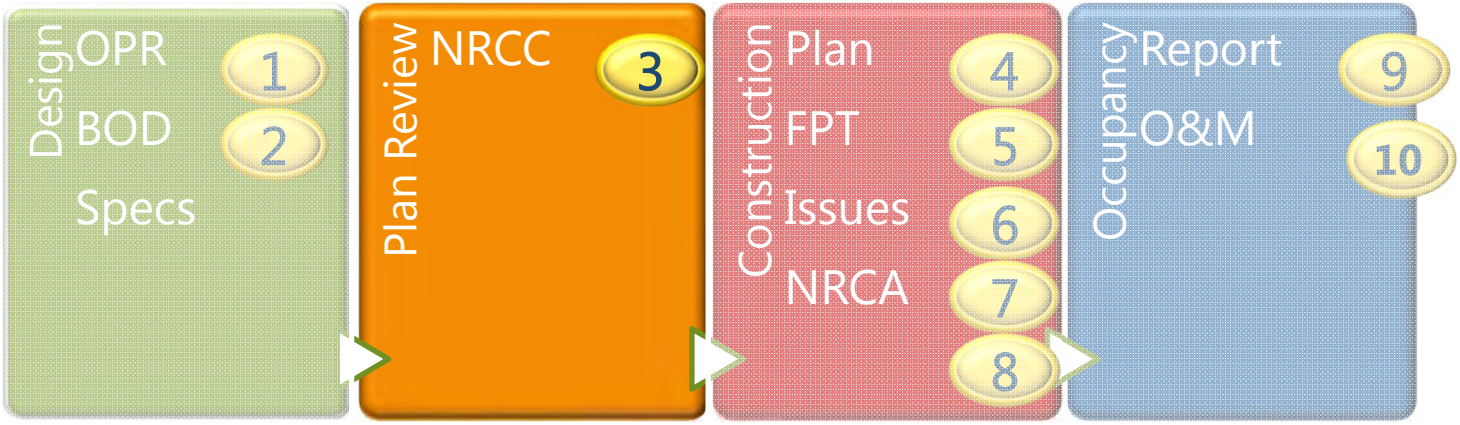
Challenge B



Design Phase: DOCUMENTS

Plan Review

- Schematic design
- Design development
- 50% and 90% construction documents
- Submit for building permit



Design Review (NRCC-CXR Forms) 120.8(d)

Commissioning Requirements in Part 6	Conditioned Space	
	<10k ft²	≥ 10k ft²
OPR (§120.8(b))		X
BOD (§120.8(c))		X
Design Review (§120.8(d))	X	X
Commissioning in Construction Docs (§120.8(e))	X	X
Commissioning Plan (§120.8(f))		X
Functional Performance Tests (§120.8(g))		X
O&M Training (§120.8(h))		X
Commissioning Report (§120.8(i))		X

Table 1. Commissioning Requirements in Title 24, Part 6

When is it required?

- **All new nonresidential buildings regardless the size**
  - NRCC-CXR-01-E
    - Design Review Kickoff
  - NRCC-CXR-02-E
    - Basic Review Checklist
  - NRCC-CXR-03-E
    - Simple HVAC Review Checklist
  - NRCC-CXR-04-E
    - Complex HVAC Review Checklist
  - NRCC-CXR-05-E
    - Design Review Signature Page

Design Review (NRCC-CXR Forms) 120.8(d)

What is this?

PRF	=	Performance approach
CXR	=	Commissioning
LTI	=	Indoor Lighting
LTO	=	Outdoor Lighting
LTS	=	Sign Lighting
SRA	=	Solar Ready
ENV	=	Envelope
MCH	=	Mechanical
ELC	=	Electrical
PLB	=	Plumbing (DHW)
PRC	=	Covered Process
STC	=	Solar Thermal

NRCC-CXR-01-E

Document Type

Certificates of…

CC = Compliance

CI = Installation

CA = Acceptance

CV = Verification

Primary user

E = Enforcement agency

H = HERS Rater

F = Field Technician (Contractor)

A = Acceptance Test Tech

Design Review (NRCC-CXR Forms) 120.8(d)

Who does it?

- **Depends on size of building**

Building Size	< 10,000 ft²	10,000 - 50,000 ft²	> 50,000 ft²	Complex systems in Bldgs >10,000 ft²
Allowed Design Reviewer	Any licensed professional engineer, including the engineer of record	A licensed professional engineer in-house to the design firm but not associated with the building project, or a third party licensed engineer	A third party licensed professional engineer	A third party licensed professional engineer

Table 2. Who can act as the Design Reviewer, per §120.8(d)

Check your understanding

Compliance Path

NRCC forms are required for..

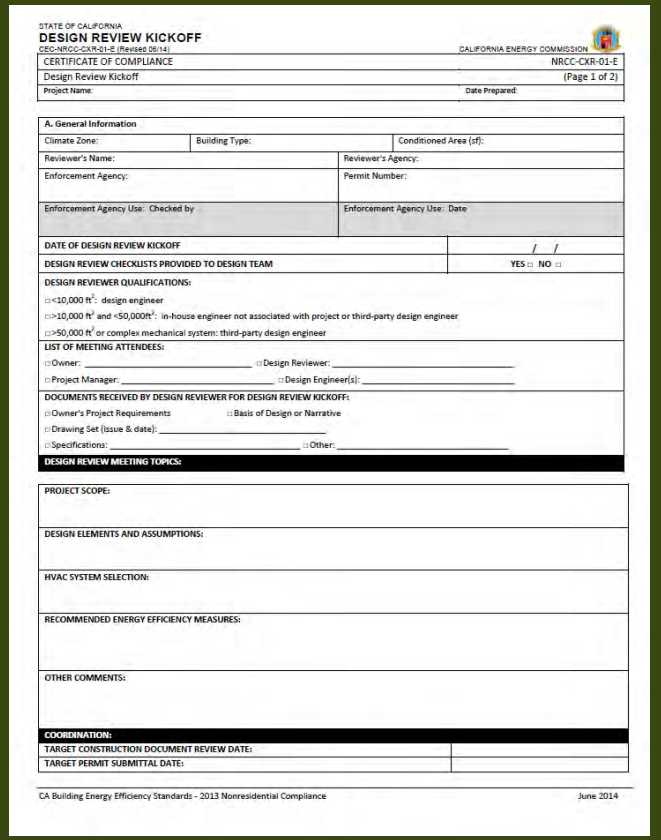
NRCC-CXR-01-E

a) New and renovated buildings, any time
b) New nonresidential buildings ≥10,000 ft^2
c) New nonresidential buildings, all sizes
d) New nonresidential buildings <10,000 ft^2

Resources

NRCC-CXR forms are initialized at what point of the project?

a) Pre-design
b) Plan Review
c) Construction
d) Occupancy



STATE OF CALIFORNIA
DESIGN REVIEW KICKOFF
CEC-NRCC-CXR-01-E (Revised 06/14) — CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE — NRCC-CXR-01-E
Design Review Kickoff — (Page 1 of 2)
Project Name: — Date Prepared:

A. General Information

Climate Zone:	Building Type:	Conditioned Area (sf):
Reviewer's Name:		Reviewer's Agency:
Enforcement Agency:		Permit Number:
Enforcement Agency Use: Checked by		Enforcement Agency Use: Date

DATE OF DESIGN REVIEW KICKOFF	/ /
DESIGN REVIEW CHECKLISTS PROVIDED TO DESIGN TEAM	YES □ NO □

DESIGN REVIEWER QUALIFICATIONS:
□ <10,000 ft²: design engineer
□ >10,000 ft² and <50,000ft²: in-house engineer not associated with project or third-party design engineer
□ >50,000 ft² or complex mechanical system: third-party design engineer

LIST OF MEETING ATTENDEES:
□ Owner: _____ □ Design Reviewer: _____
□ Project Manager: _____ □ Design Engineer(s): _____

DOCUMENTS RECEIVED BY DESIGN REVIEWER FOR DESIGN REVIEW KICKOFF:
□ Owner's Project Requirements □ Basis of Design or Narrative
□ Drawing Set (Issue & date): _____
□ Specifications: _____ □ Other: _____

DESIGN REVIEW MEETING TOPICS:

PROJECT SCOPE:

DESIGN ELEMENTS AND ASSUMPTIONS:

HVAC SYSTEM SELECTION:

RECOMMENDED ENERGY EFFICIENCY MEASURES:

OTHER COMMENTS:

COORDINATION:

TARGET CONSTRUCTION DOCUMENT REVIEW DATE:	
TARGET PERMIT SUBMITTAL DATE:	

CA Building Energy Efficiency Standards - 2013 Nonresidential Compliance — June 2014

OPR

The Cx specification document is required for…

Commissioning Requirements in Part 6	Conditioned Space	
	<10k ft²	≥ 10k ft²
OPR (§120.8(b))		X
BOD (§120.8(c))		X
Design Review (§120.8(d))	X	X
Commissioning in Construction Docs (§120.8(e))	X	X
Commissioning Plan (§120.8(f))		X
Functional Performance Tests (§120.8(g))		X
O&M Training (§120.8(h))		X
Commissioning Report (§120.8(i))		X

Table 1. Commissioning Requirements in Title 24, Part 6

a) New and renovated buildings, any time
b) New nonresidential buildings ≥10,000 ft²
c) New nonresidential buildings, all sizes
d) New nonresidential buildings <10,000 ft²

Our Question To You

How do you typically include/verify the commissioning measures when starting/completing/inspecting a project?

UC Davis has our own Cx process administrated by our Design and Construction Dept. via a commissioning analyst in our office.

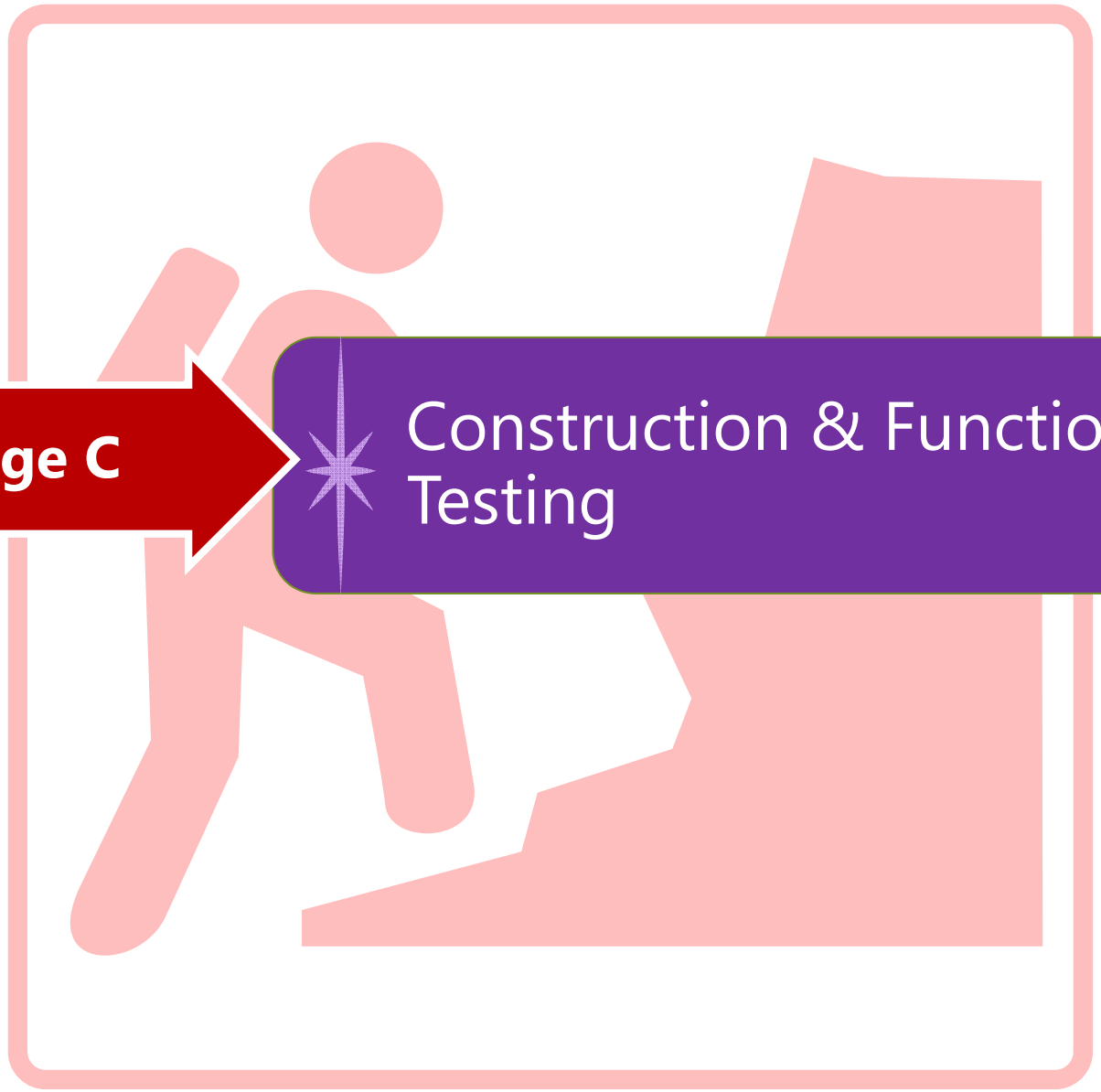
We have a process in place that was developed as a result of LEED

As an architect, construction contract administration is included in my services.

We don't. We don't know who is going to do it.

As a certified ACG commissioning authority I follow their standards for every project.

Challenge C



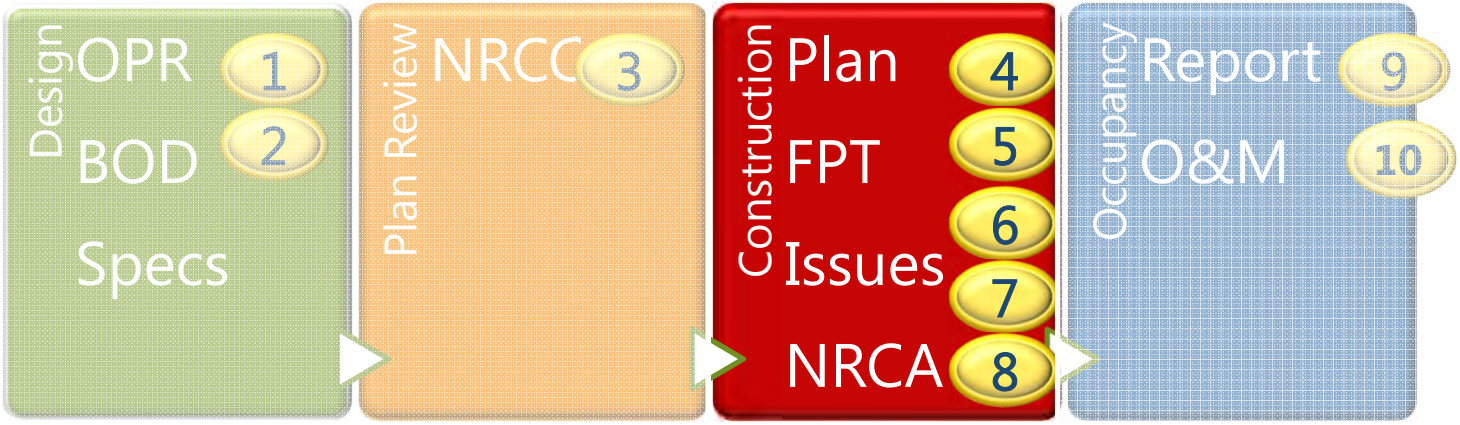
Challenge C

Construction & Functional Testing

Construction & Functional Testing: COMMUNICATION

Construction & Functional Testing

- Cx kickoff meeting & Cx Plan
- Pre-functional checklists and start-up procedures
- Issues report
- NRCA Compliance Forms



Cx Plan: 120.8(f)

Commissioning Requirements in Part 6	Conditioned Space	
	<10k ft²	≥ 10k ft²
OPR (§120.8(b))		X
BOD (§120.8(c))		X
Design Review (§120.8(d))	X	X
Commissioning in Construction Docs (§120.8(e))	X	X
Commissioning Plan (§120.8(f))		X
Functional Performance Tests (§120.8(g))		X
O&M Training (§120.8(h))		X
Commissioning Report (§120.8(i))		X

Table 1. Commissioning Requirements in Title 24, Part 6

Tip: It's up to the local Bldg. Dept. to determine if a draft Cx Plan needs to be submitted with plan check documents.

When is it required?

- **To be written before permit application.**
  - If relevant subcontractors have not been selected at the time the commissioning plan is being drafted, the roles and responsibilities section may need to be updated once this information becomes available.

Cx Plan: 120.8(f)

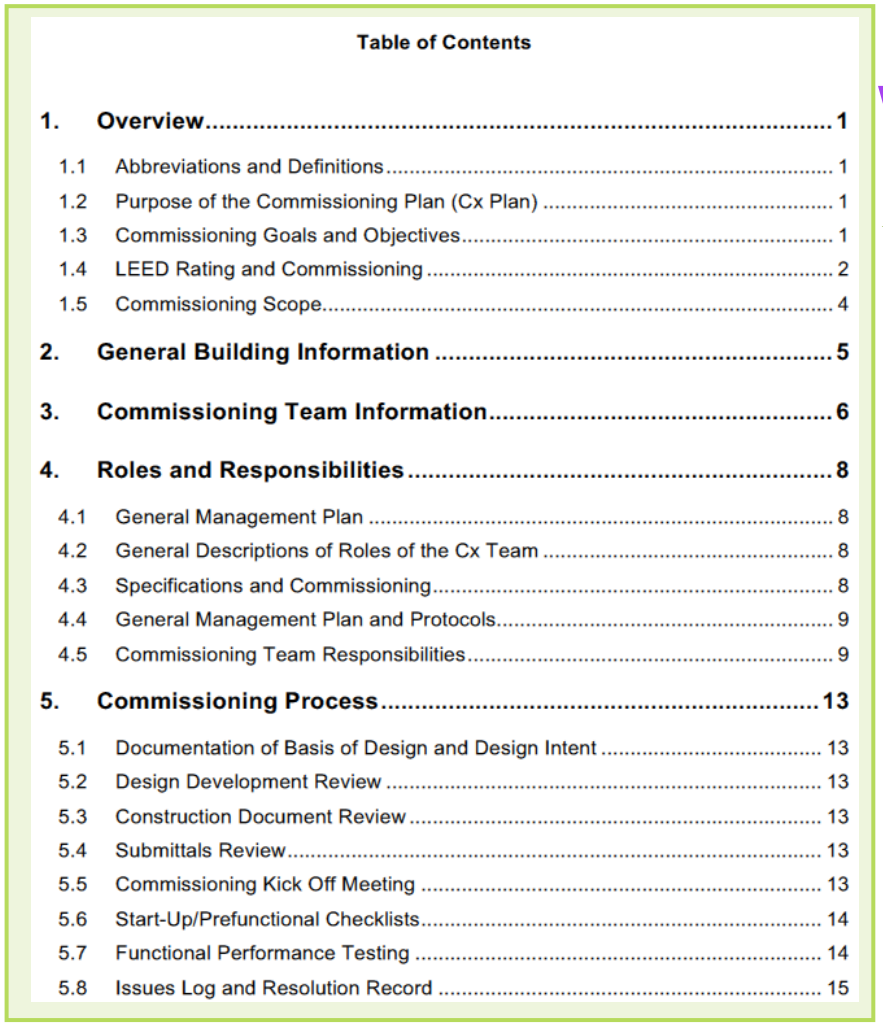


Table of Contents

Photo Courtesy of NORESCO

What is this?

- **The commissioning plan is vital to the commissioning process as it communicates to the owner, design, and construction teams what to expect from the CxA, what will be tested, and what role members of the teams must play.**
  - The commissioning plan typically is more detailed and project specific than the commissioning specifications, because the specifications often are written prior to the subcontractors being selected.

Cx Plan: 120.8(f)

Who does it?

- **The CxA typically takes the lead**

What should it include?

- The commissioning plan should include more detail on roles and responsibilities once the construction team (including subcontractors) are awarded the job. Before permit, this plan will just be a draft
- There are specific requirements in Section 120.8 for what needs to be covered in the Cx Plan

Functional Performance Tests: 120.8(g)

Commissioning Requirements in Part 6	Conditioned Space	
	<10k ft²	≥ 10k ft²
OPR (§120.8(b))		X
BOD (§120.8(c))		X
Design Review (§120.8(d))	X	X
Commissioning in Construction Docs (§120.8(e))	X	X
Commissioning Plan (§120.8(f))		X
Functional Performance Tests (§120.8(g))		X
O&M Training (§120.8(h))		X
Commissioning Report (§120.8(i))		X

Table 1. Commissioning Requirements in Title 24, Part 6

When is it required?

- **Need to prepare for tests by writing & reviewing test procedures & typically doing pre-function checklists**

Functional Performance Tests: 120.8(g)

What is this?

- **Functional performance testing (FPT) is used to demonstrate that relevant equipment has been installed and is operating as designed.**
  - They are used to meet the Cx requirements and the Acceptance Testing requirements

Functional Performance Tests: 120.8(g)

Who does it?

- **Collaboration! CxA, ATT and relevant subs will likely all be involved**
  - The CxA does not always DO the functional testing, they may just observe.

Tip: Who does what should be specified in "Roles & Responsibilities" section of Cx Plan.

Issues Log

Commissioning Requirements in Part 6	Conditioned Space	
	<10k ft²	≥ 10k ft²
OPR (§120.8(b))		X
BOD (§120.8(c))		X
Design Review (§120.8(d))	X	X
Commissioning in Construction Docs (§120.8(e))	X	X
Commissioning Plan (§120.8(f))		X
Functional Performance Tests (§120.8(g))		X
O&M Training (§120.8(h))		X
Commissioning Report (§120.8(i))		X

Table 1. Commissioning Requirements in Title 24, Part 6

When is it required?

- **Typically used during construction to keep track of open issues.**
  - This is not required by Title 24 Part 6, but is strongly recommended.
  - Acceptance forms are an aspect of this process for functional testing, which IS required.

Issues Log

Issues Log

Project Name:

No.	*Equipment*	*Description*	*Date Identified*	*Action Required*	*Expected Date Resolved*	*Responsibility*	*Notes*
4	HWP-1,2	Unecessary throtte on pump discharge valves results in excess electrical demand on pumps.	7/2/2007	Remove throttle from valves and instead program speed limits into VFDs		MC	

Photo Courtesy of NORESCO

What is this?

- **Provides a summary of items found during FPT which did not meet design intent or operational requirements.**

Issues Log

Who does it?

- **The CxA is the author and "keeper" of the issues log.**
  - Requires coordination with subs, ATT and others involved in issue resolution.
  - Acceptance forms provided by contractor and/or ATT.

Acceptance Forms

What is this?

PRF	=	Performance approach
CXR	=	Commissioning
LTI	=	Indoor Lighting
LTO	=	Outdoor Lighting
LTS	=	Sign Lighting
SRA	=	Solar Ready
ENV	=	Envelope
MCH	=	Mechanical
ELC	=	Electrical
PLB	=	Plumbing (DHW)
PRC	=	Covered Process
STC	=	Solar Thermal

NRCA-MCH-02-A

Document Type

Certificates of…

CC = Compliance

CI = Installation

CA = Acceptance

CV = Verification

Primary user

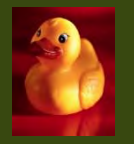
E = Enforcement agency

H = HERS Rater

F = Field Technician (Contractor)

A = Acceptance Test Tech

Check your understanding



Commissioning Plan

Which of the following is NOT included in the Cx Plan?

a) Roles & Responsibilities
b) Issues log showing resolution of identified issues
c) List of equipment to be commissioned
d) Functional Performance Tests

Functional Performance Tests

Functional Performance Tests for Cx should be conducted by whom?

a) Subcontractor
b) Professional Engineer
c) The person defined under "roles & responsibilities" in Cx Plan
d) Commissioning Agent

Issues Log

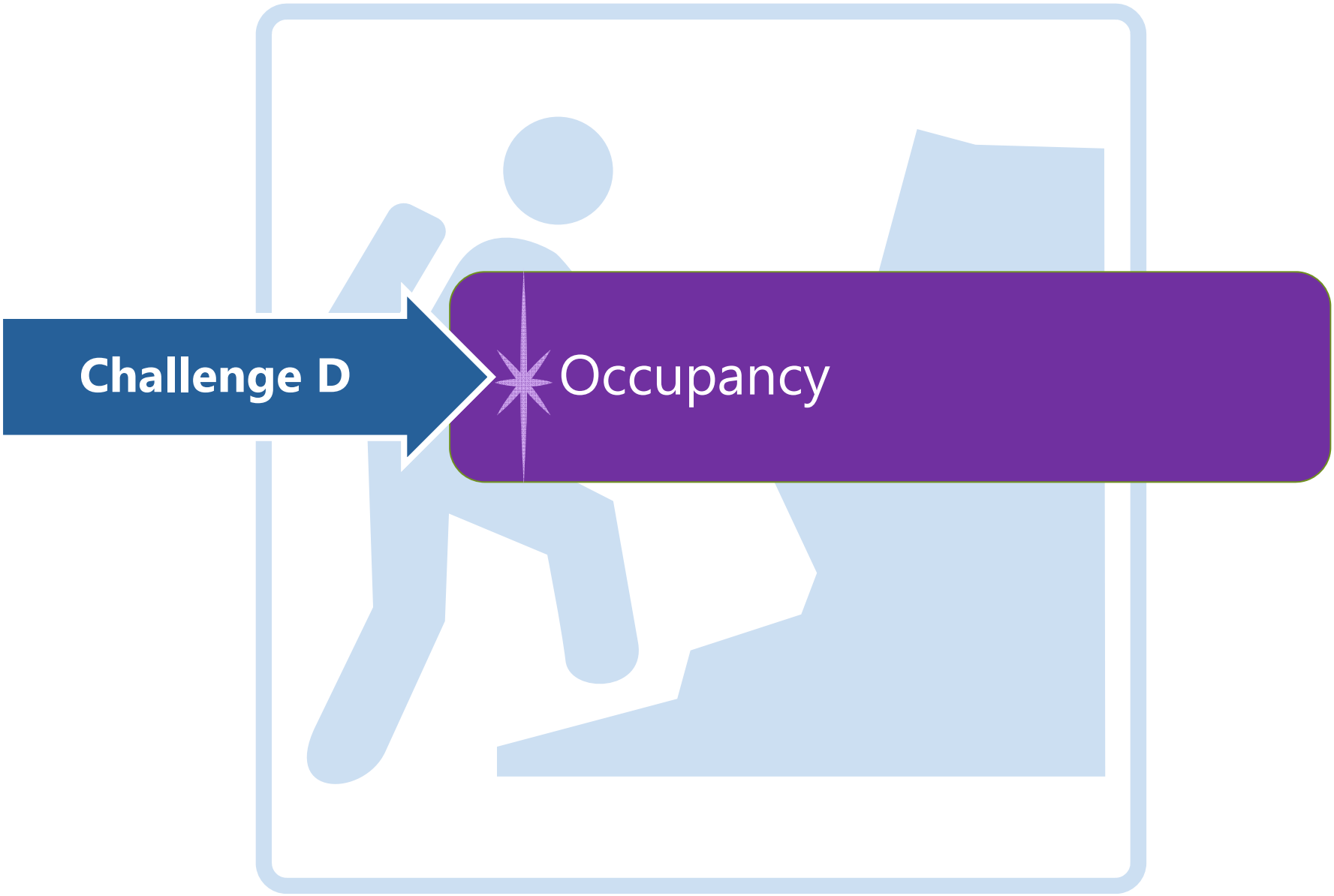
Which projects require an issues log per the Standards?

Commissioning Requirements in Part 6	Conditioned Space	
	<10k ft²	≥ 10k ft²
OPR (§120.8(b))		X
BOD (§120.8(c))		X
Design Review (§120.8(d))	X	X
Commissioning in Construction Docs (§120.8(e))	X	X
Commissioning Plan (§120.8(f))		X
Functional Performance Tests (§120.8(g))		X
O&M Training (§120.8(h))		X
Commissioning Report (§120.8(i))		X

Table 1. Commissioning Requirements in Title 24, Part 6

a) Nonresidential additions
b) Nonresidential projects > 10,000 sf
c) Nonresidential projects < 10,000 sf
d) Not required per the Standards

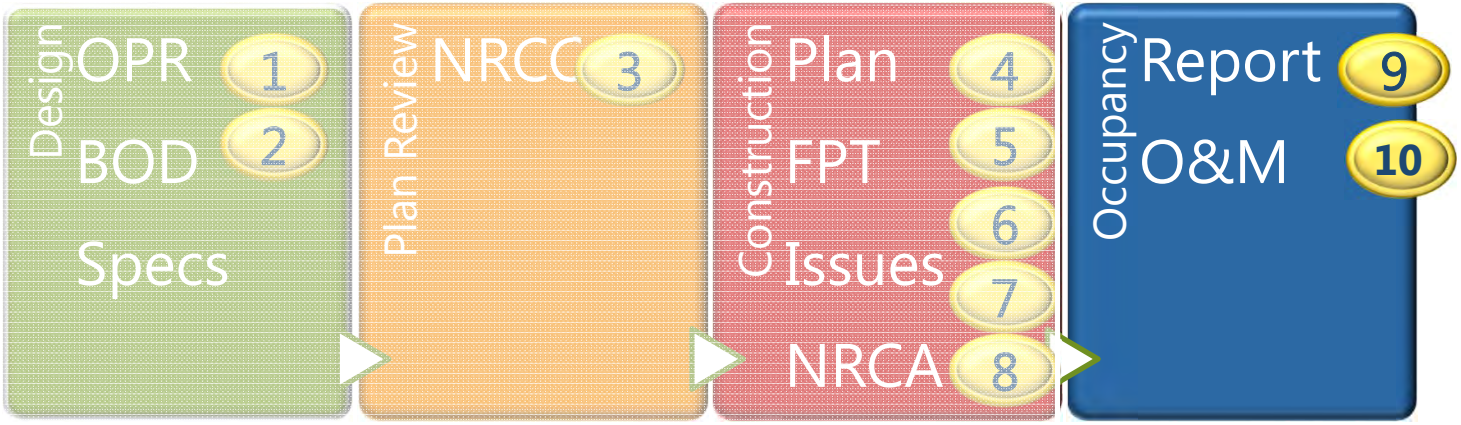
Challenge D



Final: HAND IT OVER

Occupancy

- Inspect (Building Department)
- Occupancy (O&M Training)



Inspection

What is this?

- **Before a Certificate of Occupancy can be issued, inspectors visually inspect building components to confirm compliance.**

When is it required?

- **After FPT, but before permit final**

Who does it?

- **The building inspector of course!**
  - Contractor should have NRCA forms posted onsite for inspector to review

O&M Training 120.8 (h)

Commissioning Requirements in Part 6	Conditioned Space	
	<10k ft²	≥ 10k ft²
OPR (§120.8(b))		X
BOD (§120.8(c))		X
Design Review (§120.8(d))	X	X
Commissioning in Construction Docs (§120.8(e))	X	X
Commissioning Plan (§120.8(f))		X
Functional Performance Tests (§120.8(g))		X
O&M Training (§120.8(h))		X
Commissioning Report (§120.8(i))		X

Table 1. Commissioning Requirements in Title 24, Part 6

Tip: A great time to do O&M training is during the FPT.

What is this?

- **The CxA is responsible for providing a systems manual and associated training to building operation staff.**

When is it required?

- **Projects that require "in the field" Cx**
  - Occurs during building turnover

O&M Training 120.8 (h)

Who does it?

- **The Cx Agent is responsible for the O&M training**
  - However, the both are really a collaboration between CxA and contractors

Cx Report 120.8(i)

Commissioning Requirements in Part 6	Conditioned Space	
	<10k ft²	≥ 10k ft²
OPR (§120.8(b))		X
BOD (§120.8(c))		X
Design Review (§120.8(d))	X	X
Commissioning in Construction Docs (§120.8(e))	X	X
Commissioning Plan (§120.8(f))		X
Functional Performance Tests (§120.8(g))		X
O&M Training (§120.8(h))		X
Commissioning Report (§120.8(i))		X

Table 1. Commissioning Requirements in Title 24, Part 6

What is this?

- **The Cx Report is the final deliverable in the Cx process**

When is it required?

- **Projects that require "in the field" Cx**
  - Occurs during building turnover

Cx Report 120.8(i)

Who does it?

- **The Cx Agent is responsible for compiling the Cx Report**

What should it include?

- The commissioning report should be a compilation of all the documents produced during the Cx process.
- It should also include a description of the process, and any major findings.

Check your understanding

Inspection

Which compliance forms should be provided to the inspector to document proper system functionality?

a) NRCC forms
b) NRCI forms
c) NRCA forms
d) None of the above

O&M Training

Who is the audience for O&M Training?

a) Subcontractor
b) Building Operation Staff
c) Designer
d) Commissioning Agent

Commissioning Report

Which of the following should be included in the Cx Report?

a) OPR/ BOD documents
b) Description of Cx process
c) O&M Training Materials
d) All of the above

Next Steps

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

Our Question To You

What would make your job easier when implementing and/or inspecting the 2013 commissioning requirements?

Having a checklist. Detailed requirements, settings, parameters.

Clear guidelines as to if required, how much of it, when and where

Standardization on the functional side of commissioning. The forms that have been created through design are great. It would be nice to see something similar during construction, so everything is consistent.

Software program or app.

A COMPLETED BUILDING

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.

Learning Portal Coming Soon!

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

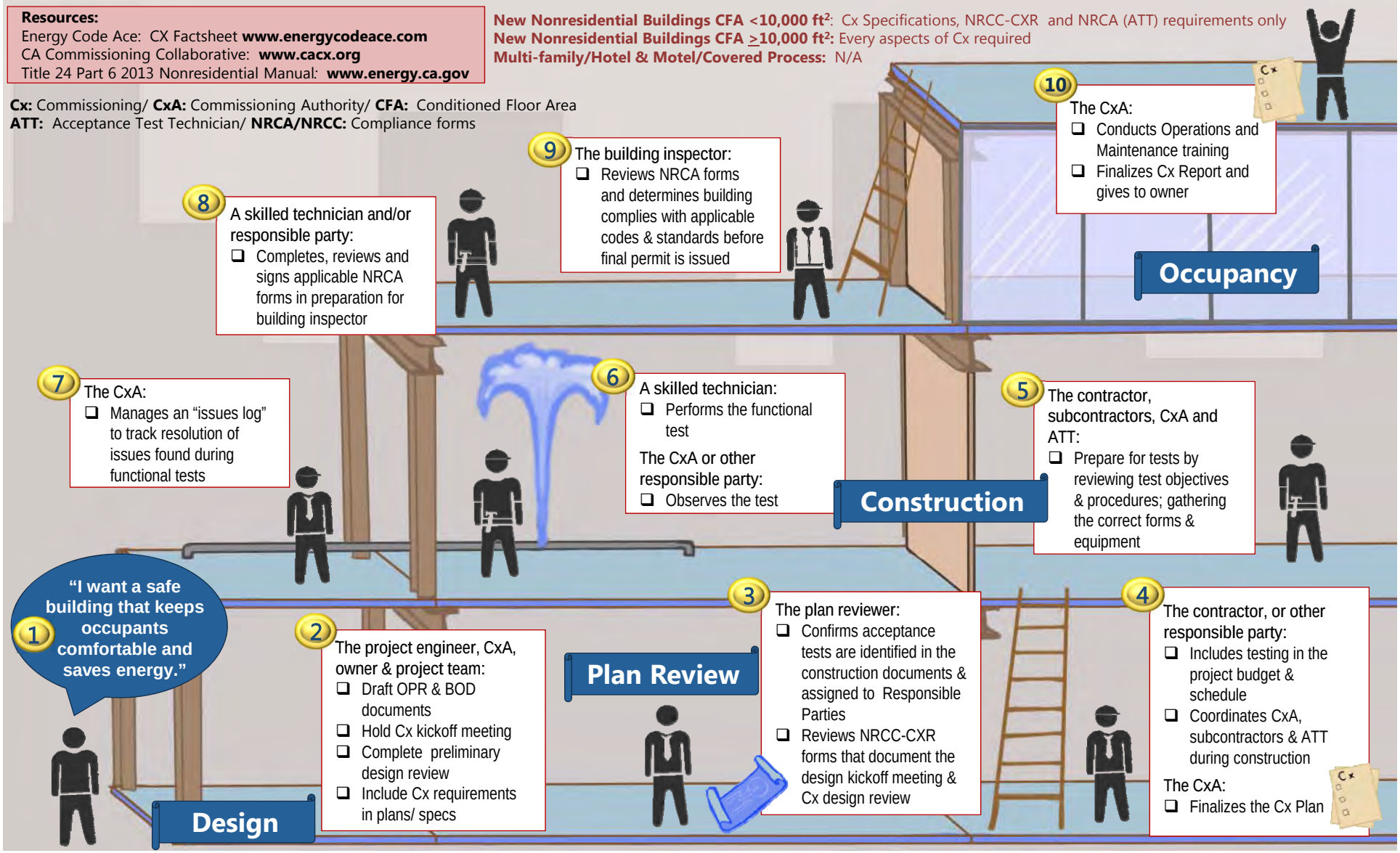
Title 24 Part 6 Infographics — Nonresidential Commissioning

Energy Code Ace™ — HELPING YOU PLAY YOUR CARDS RIGHT

Resources:
Energy Code Ace: CX Factsheet **www.energycodeace.com**
CA Commissioning Collaborative: **www.cacx.org**
Title 24 Part 6 2013 Nonresidential Manual: **www.energy.ca.gov**

New Nonresidential Buildings CFA <10,000 ft²: Cx Specifications, NRCC-CXR and NRCA (ATT) requirements only
New Nonresidential Buildings CFA ≥10,000 ft²: Every aspects of Cx required
Multi-family/Hotel & Motel/Covered Process: N/A

Cx: Commissioning/ **CxA:** Commissioning Authority/ **CFA:** Conditioned Floor Area
ATT: Acceptance Test Technician/ **NRCA/NRCC:** Compliance forms



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Ace Resources | Title 24 Part 6 Fact Sheet

Building Commissioning

Commissioning in the Energy Code

Commissioning requirements for all newly constructed nonresidential buildings are included in the 2013 update to Title 24, Part 6- California's Building Energy Efficiency Standards (Standards). Many of these requirements were moved from CalGreen (Title 24, Part 11), where commissioning was originally incorporated into state building code in 2008.

Commissioning requirements apply to all newly constructed nonresidential buildings, though the extent of the requirements depends on whether the conditioned floor area is less than 10,000 square feet or 10,000 square feet and greater.

The Standards define "newly constructed" as "a building that has never been used or occupied for any purpose" in Section 100.1.

The commissioning requirements in Part 6 do not apply to residential projects (including high-rise residential), do not apply to additions or alterations and do not apply to newly constructed nonresidential buildings that are unconditioned.

Commissioning is critical to realizing the energy savings during building operation that were intended by the building design. Closely related to acceptance testing, commissioning involves functional testing during construction, but also includes activities during design that will ensure the building systems and associated controls will meet the owner's energy and operating efficiency goals.

***Title 24, Part 6 defines commissioning as,** "a systematic quality assurance process that spans the entire design and construction process, including verifying and documenting that building systems and components are planned, designed, installed, tested, operated and maintained to meet the owner's project requirements."*

Commissioning Requirements

Commissioning requirements are included in Section 120.8 of the Standards, and the table below illustrates which requirements apply based on conditioned floor area. Additional resources are listed that may provide valuable detail on how to properly implement these requirements.

Commissioning Requirements in Part 6	Conditioned Space <10k ft²	Conditioned Space ≥ 10k ft²
OPR (§120.8(b))		X
BOD (§120.8(c))		X
Design Review (§120.8(d))	X	X
Commissioning in Construction Docs (§120.8(e))	X	X
Commissioning Plan (§120.8(f))		X
Functional Performance Tests (§120.8(g))		X
O&M Training (§120.8(h))		X
Commissioning Report (§120.8(i))		X

Table 1. Commissioning Requirements in Title 24, Part 6

Additional Resources

The following resources may be helpful in addition to the Standards language to understand the commissioning requirements:

- Building Commissioning Guide in Nonresidential Compliance Manual: This guide outlines both an intent and compliance method for each requirement in Section 120.8.

Roles and Responsibilities

Because commissioning spans the entire building delivery proc from pre-design through occupancy, many parties are invol making communication and coordination paramount. Below is a of who may need to participate in the commissioning process, at time or another during the project.

- Owner, owner's representative or facility operator
- Designers (architect and MEP)
- Design Reviewer (see table below)
- Plans Examiner
- General Contractor*
- Key Subcontractors (HVAC, controls, TAB, etc.)*
- Acceptance Test Technician*
- Commissioning Agent*
- Building Inspector*

* These parties are generally only involved for buildings with conditioned area 10,000 square feet or greater when §120.8(f) - §120.8(i) are required

Who is most appropriate to fill each of these roles is dependent u the experience and expertise of the project team. There are requirements in the Standards that designate who Commissioning Authority must be. However, for both the De Reviewer and Acceptance Test Technician, there are restriction who can fill these roles.

Building Size	< 10,000 ft²	10,000 - 50,000 ft²	> 50,000 ft²	Comple systems in Bldgs >10,00
Allowed Design Reviewer	Any licensed professional engineer including the engineer of record	A licensed professional engineer in-house to the design firm but not associated with the building project; or a third party licensed engineer	A third party licensed professional engineer	A third p licensed professi engine

Table 2. Who can act as the Design Reviewer, per §120.8(d)

Information on becoming a certified Acceptance Test Technician c be found on the California Energy Commission's Acceptance Test Technician Certification Provider webpage.

Additional Resources

The following resources may be helpful to understand roles rel to the commissioning and acceptance testing process:

- Building Commissioning Guide in Nonreside Compliance Manual: Section 12.1 of this guide outl roles and information on how to find a qual Commissioning Authority.
- California Commissioning Collaborative: This organiz includes a Provider List that may be valuable w searching for a Commissioning Authority.
- Section 10-103(a)1: This section in the Standards indic that the Design Reviewer must be a licensed professi engineer.

Commissioning Process

Understanding and assigning who does what and when early during the process is key to success. For all newly constructed nonresidential projects, the Standards dictate that the commissioning process starts in early design, and compliance forms verifying this must be submitted to the building department with the project's application for permit.

Additional Resources

- Energy Code Ace Commissioning Infographic: This visual provides an outline of the commissioning tasks by when they occur during a typical project delivery process.
- Energy Design Resources e-news #96: This e-news titled Commissioning for Compliance was issued to help practitioners understand and implement the commissioning requirements of the Standards. It includes tips and tricks and a handy graphic that shows when during project delivery the commissioning requirements should be implemented.

Functional Performance Test Procedures

Commissioning is similar to acceptance testing in that functional performance tests are performed to "demonstrate the correct installation and operation of each component, system and system-to-system interface." Section 120.8(g) says that functional testing performed to satisfy the commissioning requirements should be performed in accordance with acceptance testing procedures outlined in other sections of the Standards.

Note that the functional performance tests which are needed for commissioning are based on the systems documented in the OPR and BOD documents and may be more comprehensive than the project's required acceptance tests. A system not being included in the OPR/BOD does not exempt it from acceptance test requirements outlined in other sections of the Standards.

Additional Resources

The following resources may be helpful to better define functional performance testing requirements:

- Chapter 13 Acceptance Requirements in the Nonresidential Compliance Manual: An overview of acceptance testing requirements, the process and the forms are further detailed in Chapter 13. Table 13-1 includes a list of certificate of acceptance forms by building component.
- Nonresidential Reference Appendices NA7: This Section of the Nonresidential Appendices includes test procedures, roles and responsibilities and other details related to acceptance testing.

"Simple" Systems include:
- (a) Unitary or packaged equipment listed in Tables 110.2-A, 110.2-B, 110.2-C and 110.2-E that each serve one zone; OR
- (b) Two-pipe, heating only systems serving one or more zones

"Complex" Systems include:
- (a) Fan systems each serving multiple thermostatically controlled zones; OR
- (b) Built-up air handler systems (non-unitary or non-packaged HVAC equipment); OR
- (c) Hydronic or steam heating systems; OR
- (d) Hydronic cooling systems

Figure 1. "Simple" vs. "Complex" HVAC Systems

Commissioning Documents

In addition to the compliance forms (see below), there are documents that are required by Section 120.8 for buildings with conditioned floor area 10,000 sf and greater. These documents are used both to facilitate and document the commissioning activities:

- Owner's Project Requirements (OPR)
- Basis of Design (BOD)
- Commissioning Specifications
- Commissioning Plan
- Functional Performance Tests
- Operation and Maintenance Training Documents
- Commissioning Report

Additional Resources

The following resources may be helpful to produce these required documents:

- Energy Design Resources e-news #96: The Commissioning for Compliance e-news provides more pragmatic detail and tips on each document listed.
- Building Commissioning Guide in Nonresidential Compliance Manual: This guide provides an intent and compliance method for each document.
- California Commissioning Collaborative: Templates and sample documents are provided by this organization to facilitate commissioning in California.

Compliance Forms

All newly constructed nonresidential projects are required to complete the design review certificates of compliance, regardless of project size (See Table 1). At a minimum, the NRCC-CXR-01-E and NRCC-CXR-02-E must be completed. The project then uses the NRCC-CXR-03-E for "simple" HVAC systems, and the NRCC-CXR-04-E for "complex" HVAC systems (See Figure 1). The NRCC-CXR-05-E is also completed for all projects requiring compliance with Section 120.8.

Although there are no commissioning forms other than the certificates of compliance, the NRCA forms (certificates of acceptance) are used to document functional performance tests for the inspector to review.

Additional Resources

The following resources may be helpful to prepare the project team for completing compliance forms, and the enforcement agencies for reviewing them:

- Energy Design Resources e-news #96: This e-news includes more detail on each compliance form, including when it should be completed.
- Building Commissioning Guide in Nonresidential Compliance Manual: Section 12.10 of this guide has detailed instructions on completing the compliance forms associated with commissioning.
- NRCA forms: The certificates of acceptance themselves are useful to understand required documentation.

Don't Forget About CALGreen!

Title 24, Part 11 (CALGreen) also includes requirements for commissioning in Chapter 5- Nonresidential Mandatory Measures. These requirements are complimentary to the Energy Code requirements, but be sure to read through them as additional systems such as renewable energy, landscape irrigation and water reuse systems are covered here.

EnergyCode Ace™ Helping you play your cards right

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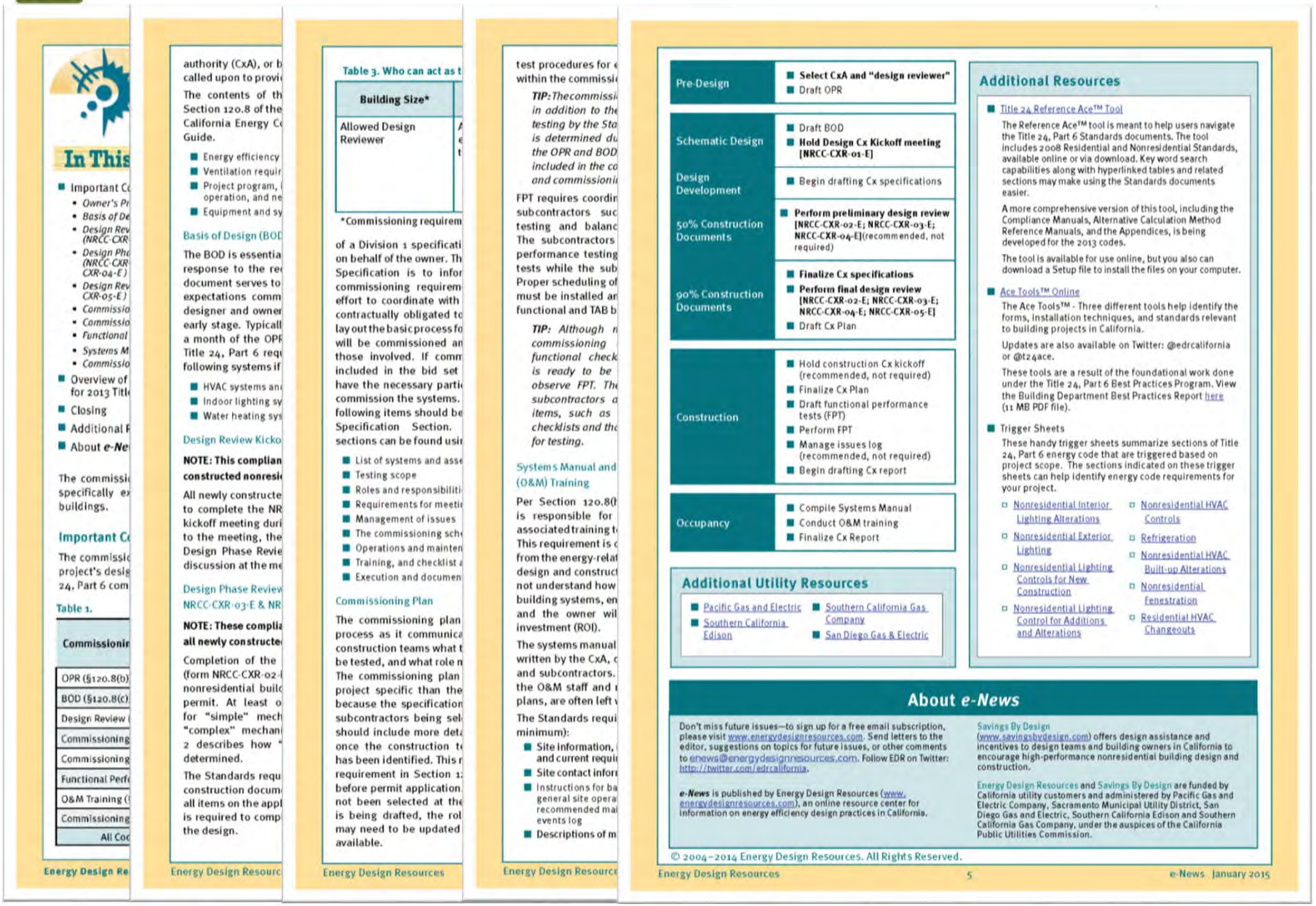
Energy Design Resources "e-news"



Pre-Design	■ **Select CxA and "design reviewer"** ■ Draft OPR
Schematic Design	■ Draft BOD ■ **Hold Design Cx Kickoff meeting [NRCC-CXR-01-E]**
Design Development	■ Begin drafting Cx specifications
50% Construction Documents	■ **Perform preliminary design review [NRCC-CXR-02-E; NRCC-CXR-03-E; NRCC-CXR-04-E]** (recommended, not required)
90% Construction Documents	■ **Finalize Cx specifications** ■ **Perform final design review [NRCC-CXR-02-E; NRCC-CXR-03-E; NRCC-CXR-04-E; NRCC-CXR-05-E]** ■ Draft Cx Plan
Construction	■ Hold construction Cx kickoff (recommended, not required) ■ Finalize Cx Plan ■ Draft functional performance tests (FPT) ■ Perform FPT ■ Manage issues log (recommended, not required) ■ Begin drafting Cx report
Occupancy	■ Compile Systems Manual ■ Conduct O&M training ■ Finalize Cx Report

Additional Utility Resources

- Pacific Gas and Electric
- Southern California Gas Company
- Southern California Edison
- San Diego Gas & Electric

Additional Resources

- Title 24 Reference Ace™ Tool

  The Reference Ace™ tool is meant to help users navigate the Title 24, Part 6 Standards documents. The tool includes 2008 Residential and Nonresidential Standards, available online or via download. Key word search capabilities along with hyperlinked tables and related sections may make using the Standards documents easier.

  A more comprehensive version of this tool, including the Compliance Manuals, Alternative Calculation Method Reference Manuals, and the Appendices, is being developed for the 2013 codes.

  The tool is available for use online, but you also can download a Setup file to install the files on your computer.

- Ace Tools™ Online

  The Ace Tools™ - Three different tools help identify the forms, installation techniques, and standards relevant to building projects in California.

  Updates are also available on Twitter: @edrcalifornia or @t24ace.

  These tools are a result of the foundational work done under the Title 24, Part 6 Best Practices Program. View the Building Department Best Practices Report here (11 MB PDF file).

- Trigger Sheets

  These handy trigger sheets summarize sections of Title 24, Part 6 energy code that are triggered based on project scope. The sections indicated on these trigger sheets can help identify energy code requirements for your project.

  - Nonresidential Interior Lighting Alterations
  - Nonresidential Exterior Lighting
  - Nonresidential Lighting Controls for New Construction
  - Nonresidential Lighting Control for Additions and Alterations
  - Nonresidential HVAC Controls
  - Refrigeration
  - Nonresidential HVAC Built-up Alterations
  - Nonresidential Fenestration
  - Residential HVAC Changeouts

About *e-News*

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e-News is published by Energy Design Resources (www.energydesignresources.com), an online resource center for information on energy efficiency design practices in California.

Savings By Design (www.savingsbydesign.com) offers design assistance and incentives to design teams and building owners in California to encourage high-performance nonresidential building design and construction.

Energy Design Resources and Savings By Design are funded by California utility customers and administered by Pacific Gas and Electric Company, Sacramento Municipal Utility District, San Diego Gas and Electric, Southern California Edison and Southern California Gas Company, under the auspices of the California Public Utilities Commission.

www.cacx.org

Commissioning Tools and Templates

Commissioning Sample Documents and Templates

	Description	Source	Date	Type
Project Intent Workshop	Guide to Organization a Project Intent Workshop	CA Dept. of General Services	2003	Guide
Scope of Work	Statement of Work: Commissioning Authority Services for a LEED certified 65,000 sq ft. laboratory	PECI	2002	Sample
Cx Plan	Model Commissioning Design Phase Plan	PECI	1998	Sample
Cx Plan	Model Commissioning Construction Phase Plan	PECI	1998	Sample
Cx Plan	Commissioning Plan: Construction Phase for a Healthcare Facility	Energy Desig Resources		Template
Cx Plan	Commissioning Plan Outline	Energy Design Resources		Template
Cx Plan	Design Intent and Basis of Design of Energy and Comfort Related Systems	PECI	1998	Template
Issues Log	Issues Log	PECI		Sample
Issues Log	HVAC QA Issues Log	PG&E		Sample
Final Report	Final Report for an administrative/morgue space	PECI	2002	Sample
Final Report	Final Report for a fire station	PECI	2003	Sample
Systems Manual	Systems Manual	PG&E		Sample
Sequence of Operations	Cx Assistant Sequences of Operations (1.8 mb)	Energy Design Resources		Sample
RFP	Request for Proposal: long form	Energy Design Resources		Template
RFP	Request for Proposal: short form	Energy Design Resources		Template

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
Sally Blair	Co-Presenter	sblair@noresco.com	(303) 459-7420
Kathryn Fortin	eLearning Technology & Design Consultant	kfortin@fortech.net	(510) 825-3508
Energy Code Ace	Webinar Registration	online.training@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

Title 24 Part 6 Infographics | Nonresidential Commissioning

Energy Code Ace™
HELPING YOU PLAY YOUR CARDS RIGHT

Resources:
Energy Code Ace: CX Factsheet **www.energycodeace.com**
CA Commissioning Collaborative: **www.cacx.org**
Title 24 Part 6 2013 Nonresidential Manual: **www.energy.ca.gov**

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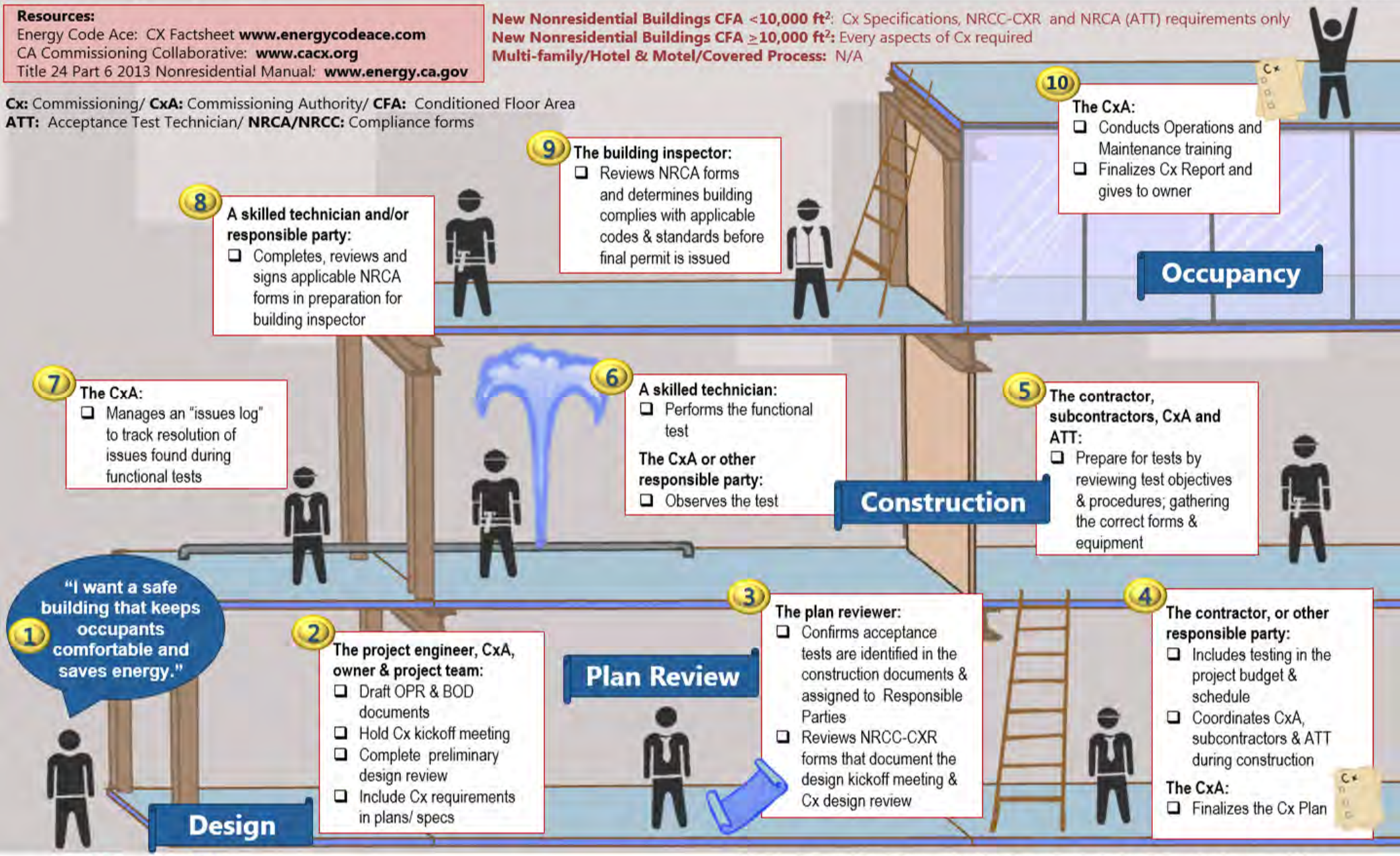

"I want a safe building that keeps occupants comfortable and saves energy."

Design

2 The project engineer, CxA, owner & project team:
- ❑ Draft OPR & BOD documents
- ❑ Hold Cx kickoff meeting
- ❑ Complete preliminary design review
- ❑ Include Cx requirements in plans/ specs

Plan Review

3 The plan reviewer:
- ❑ Confirms acceptance tests are identified in the construction documents & assigned to Responsible Parties
- ❑ Reviews NRCC-CXR forms that document the design kickoff meeting & Cx design review

Construction

4 The contractor, or other responsible party:
- ❑ Includes testing in the project budget & schedule
- ❑ Coordinates CxA, subcontractors & ATT during construction

The CxA:
- ❑ Finalizes the Cx Plan

5 The contractor, subcontractors, CxA and ATT:
- ❑ Prepare for tests by reviewing test objectives & procedures; gathering the correct forms & equipment

6 A skilled technician:
- ❑ Performs the functional test

The CxA or other responsible party:
- ❑ Observes the test

7 The CxA:
- ❑ Manages an "issues log" to track resolution of issues found during functional tests

8 A skilled technician and/or responsible party:
- ❑ Completes, reviews and signs applicable NRCA forms in preparation for building inspector

9 The building inspector:
- ❑ Reviews NRCA forms and determines building complies with applicable codes & standards before final permit is issued

Occupancy

10 The CxA:
- ❑ Conducts Operations and Maintenance training
- ❑ Finalizes Cx Report and gives to owner

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Ace Resources | Title 24 Part 6 Fact Sheet

Building Commissioning

Commissioning in the Energy Code

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Title 24, Part 6 defines commissioning as, *"a systematic quality assurance process that spans the entire design and construction process, including verifying and documenting that building systems and components are planned, designed, installed, tested, operated and maintained to meet the owner's project requirements."*

Commissioning Requirements

Commissioning requirements are included in Section 120.8 of the Standards, and the table below illustrates which requirements apply based on conditioned floor area. Additional resources are listed that may provide valuable detail on how to properly implement these requirements.

Commissioning Requirements in Part 6	Conditioned Space	
	<10k ft²	≥ 10k ft²
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Design Review (§120.8(d))	X	X
Commissioning in Construction Docs (§120.8(e))	X	X
Commissioning Plan (§120.8(f))		X
Functional Performance Tests (§120.8(g))		X
O&M Training (§120.8(h))		X
Commissioning Report (§120.8(i))		X

Table 1. Commissioning Requirements in Title 24, Part 6

Additional Resources

The following resources may be helpful in addition to the Standards language to understand the commissioning requirements:

- Building Commissioning Guide in Nonresidential Compliance Manual: This guide outlines both an intent and compliance method for each requirement in Section 120.8.

Roles and Responsibilities

Because commissioning spans the entire building delivery process from pre-design through occupancy, many parties are involved, making communication and coordination paramount. Below is a list of who may need to participate in the commissioning process, at one time or another during the project.

- Owner, owner's representative or facility operator
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- Design Reviewer (see table below)
- Plans Examiner
- General Contractor*
- Key Subcontractors (HVAC, controls, TAB, etc.)*
- Acceptance Test Technician*
- Commissioning Agent*
- Building Inspector*

* These parties are generally only involved for buildings with conditioned floor area 10,000 square feet or greater when §120.8(f) - §120.8(i) are required.

Who is most appropriate to fill each of these roles is dependent upon the experience and expertise of the project team. There are no requirements in the Standards that designate who the Commissioning Authority must be. However, for both the Design Reviewer and Acceptance Test Technician, there are restrictions on who can fill these roles.

Building Size	< 10,000 ft²	10,000 - 50,000 ft²	> 50,000 ft²	Complex systems in Bldgs >10,000 ft²
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DOCUMENT 2015-03-06

Commissioning Process

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Figure 1. "Simple" vs. "Complex" HVAC Systems

Commissioning Documents

In addition to the compliance forms (see below), there are documents that are required by Section 120.8 for buildings with conditioned floor area 10,000 sf and greater. These documents are used both to facilitate and document the commissioning activities:

- Owner's Project Requirements (OPR)
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- Commissioning Specifications
- Commissioning Plan
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- Operation and Maintenance Training Documents
- Commissioning Report

Additional Resources

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Title 24, Part 11 (CALGreen) also includes requirements for commissioning in Chapter 5- Nonresidential Mandatory Measures. These requirements are complimentary to the Energy Code requirements, but be sure to read through them as additional systems such as renewable energy, landscape irrigation and water reuse systems are covered here.

energy design resources e-News Issue 96 ▸ January 2015

In This Issue

COMMISSIONING FOR CODE COMPLIANCE

Commissioning is an integral component of energy efficient building design, construction, and operation. The goal of commissioning is to ensure that the design and construction of building systems meets the owner's needs, and that building equipment is functioning optimally during occupancy.

The California Commissioning Collaborative defines commissioning as, ***"The process of ensuring that systems are designed, installed, functionally tested and capable of being operated and maintained according to the owner's operational needs."***

– California Commissioning Collaborative

In California, commissioning was incorporated into the 2008 CALGreen building standards (Title 24, Part 11) to improve building operations and create a positive impact by reducing energy consumption. Recently, much of the commissioning process was moved to the building energy code (Title 24, Part 6) and now is required in part or in whole on all newly constructed nonresidential projects in California. The commissioning requirements, both in CALGreen and Title 24, Part 6, specifically exclude additions or alterations to existing nonresidential buildings.

The commissioning process was moved from CALGreen to the building energy code and now is required in part, or in whole, on all nonresidential newly constructed projects in California.

Important Commissioning Documents

The commissioning process involves many components and deliverables implemented throughout the lifecycle of the project's design, construction, and building turnover. Many of these key documents are required to meet the new Title 24, Part 6 commissioning requirements and to pull building permits.

Table 1.

Commissioning Requirements in Part 6	<10k SF Conditioned Space	≥ 10k SF Conditioned Space
OPR (§120.8(b))		**X**
BOD (§120.8(c))		X
Design Review (§120.8(d))	X	X
Commissioning in Construction Docs (§120.8(e))	X	X
Commissioning Plan (§120.8(f))		X
Functional Performance Tests (§120.8(g))		X
O&M Training (§120.8(h))		X
Commissioning Report (§120.8(i))		X
All Code sections can be found here using the Reference Ace tool.		

The following Table summarizes which Part 6 commissioning requirements are required for nonresidential newly constructed buildings.

Owner's Project Requirements (OPR)

The purpose of the OPR is to define and document the owner's energy-related expectations and requirements for the system designers prior to the beginning of design. The OPR should be developed early in the design process by the owner and/or the owner's representative. It is typically semi-technical, and a building owner may need assistance developing the document if they do not have a basic level of building operations knowledge. The design reviewer, commissioning

authority (CxA), or building operations manager often are called upon to provide this assistance.

The contents of the OPR document are prescribed in Section 120.8 of the Standards and further outlined in the California Energy Commission's Building Commissioning Guide.

- Energy efficiency goals
- Ventilation requirements
- Project program, including facility functions and hours of operation, and need for after-hours operation; and
- Equipment and system expectations

Basis of Design (BOD)

The BOD is essentially the system designer's documented response to the requirements laid out in the OPR. The document serves to outline the approach for meeting the expectations communicated in the OPR and allows the designer and owner to work through design issues at an early stage. Typically, this document is developed within a month of the OPR's issuance. In order to comply with Title 24, Part 6 requirements, the BOD must include the following systems if applicable (at a minimum):

- HVAC systems and controls
- Indoor lighting systems and controls
- Water heating systems and controls

Design Review Kickoff Compliance Form (NRCC-CXR-01-E)

NOTE: This compliance form is required for all newly constructed nonresidential buildings.

All newly constructed nonresidential projects are required to complete the NRCC-CXR-01-E form at a design review kickoff meeting during the schematic design phase. Prior to the meeting, the OPR & BOD (if required), and blank Design Phase Review Checklists should be provided for discussion at the meeting.

Design Phase Review Checklist Forms (NRCC-CXR-02-E , NRCC-CXR-03-E & NRCC-CXR-04-E)

NOTE: These compliance forms are potentially required for all newly constructed nonresidential buildings.

Completion of the basic design phase review checklist (form NRCC-CXR-02-E) is required for all newly constructed nonresidential buildings in California to pull a building permit. At least one additional checklist is required for "simple" mechanical systems (NRCC-CXR-03-E) or "complex" mechanical systems (NRCC-CXR-04-E). Table 2 describes how "simple" or "complex" systems are determined.

The Standards require that a design reviewer, review the construction documents for Title 24, Part 6 compliance for all items on the applicable checklists. The design reviewer is required to complete the review prior to finalization of the design.

***TIP:** Although the CEC's Building Commissioning Guide recommends this review occur at around 90 percent construction documents (CDs), generally this will be too late to make adjustments without impacting the project schedule or requiring re-design. Project teams should consider having the design reviewer perform a preliminary review much earlier (closer to 50 percent CDs), so there is still time to make adjustments if necessary. In this case, a final review would need to be conducted to complete the appropriate NRCC-CXR checklist form.*

Table 2. "Simple" and "complex" mechanical systems.

"Simple" Systems include:

(a) Unitary or packaged equipment listed in Tables 110.2-A, 110.2-B, 110.2-C and 110.2-E that each serve one zone; OR

(b) Two-pipe, heating only systems serving one or more zones

"Complex" Systems include:

(a) Fan systems each serving multiple thermostatically controlled zones; OR

(b) Built-up air handler systems (non-unitary or non-packaged HVAC equipment); OR

(c) Hydronic or steam heating systems; OR

(d) Hydronic cooling systems

Design Review Signature Page Form (NRCC-CXR-05-E)

NOTE: This compliance form is required for all newly constructed nonresidential buildings.

Completion of the design review signature page form is required for all newly constructed nonresidential buildings in California to be able to pull a building permit. This form simply documents that a design review kickoff occurred, and that the design phase review checklists were completed.

The Standards dictate who can complete these forms as the design reviewer. The appropriate party is determined by the building size, as shown in Table 3.

Commissioning Specifications

Section 120.8(e) of the Standards requires that the commissioning measures (requirements) be included in the issued construction documents. For buildings less than 10,000 sf, the construction documents should include all necessary documentation for the design reviewer to perform the design review. This does not include "in-the-field" testing requirements, as Section 120.8 does not require "in-the-field" testing for buildings ‹ 10,000 sf. This does not exclude projects from acceptance testing requirements that are specified in other sections of Part 6.

For projects › 10,000 sf, this is typically done in the form

Table 3. Who can act as the "design reviewer"

Building Size*	≤ 10,000 sf	Between 10,000 and 50,000 sf	≥ 50,000 sf	Complex buildings ≥ 10,000 sf
Allowed Design Reviewer	Any licensed engineer, including the engineer of record	A licensed engineer in-house to the design firm but not associated with the building project, or a third party licensed engineer	A third party licensed engineer	A third party licensed engineer

*Commissioning requirements only apply to nonresidential newly constructed buildings.

of a Division 1 specification section provided by the CxA on behalf of the owner. The purpose of the Commissioning Specification is to inform bidding contractors of the commissioning requirements so they can include the effort to coordinate with a CxA within their bid, and be contractually obligated to participate. The specifications lay out the basic process for commissioning, which systems will be commissioned and roles and responsibilities of those involved. If commissioning specifications aren't included in the bid set of drawings, the CxA will not have the necessary participation in the field to properly commission the systems. According to the Standards, the following items should be included in the Commissioning Specification Section. Many example specification sections can be found using an internet search engine.

- List of systems and assemblies commissioned
- Testing scope
- Roles and responsibilities of contractors
- Requirements for meetings
- Management of issues
- The commissioning schedule
- Operations and maintenance manual development
- Training, and checklist and test form development
- Execution and documentation

Commissioning Plan

The commissioning plan is vital to the commissioning process as it communicates to the owner, design, and construction teams what to expect from the CxA, what will be tested, and what role members of the teams must play. The commissioning plan typically is more detailed and project specific than the commissioning specifications, because the specifications often are written prior to the subcontractors being selected. The commissioning plan should include more detail on roles and responsibilities once the construction team (including subcontractors) has been identified. This may be challenging based on the requirement in Section 120.8(f) that the plan be written before permit application. If relevant subcontractors have not been selected at the time the commissioning plan is being drafted, the roles and responsibilities section may need to be updated once this information becomes available.

TIP 1: *Although not required by Title 24, Part 6, the commissioning plan is usually reviewed with the owner, architect, design engineers, general contractor, and relevant subcontractors during a commissioning kickoff meeting led by the CxA. This meeting typically occurs during early construction and serves to establish expectations, deliverables, and timelines with all the parties that will be involved in construction phase commissioning activities.*

TIP 2: *Whether the commissioning plan is required as part of the plan check submittal package is at the discretion of the local building department. If you are unsure whether the building department having jurisdiction requires a copy of the commissioning plan, be sure to contact them prior to submitting for plan review.*

The commissioning plan must contain the following to comply with Section 120.8(f) of the Standards:

- General project information
- Commissioning goals
- Systems to be commissioned
- Plans to test systems and components, which include:
  - An explanation of the original design intent
  - Equipment and systems to be tested, including the extent of tests
  - Functions to be tested
  - Conditions under which the test is performed
  - Measurable criteria for acceptable performance
  - Commissioning team staff and experience
  - Commissioning process activities, schedules, and responsibilities
  - Plans for the completion of commissioning requirements listed in Sections 120.8(g) through 120.8(i) shall be included

Functional Performance Tests (FPT)

Functional performance testing is used to demonstrate that the relevant equipment has been installed and is operating as designed. Where applicable, the functional performance tests and checklists are developed in accordance with the acceptance testing requirements as specified in the Standards (for more information on acceptance testing, see sidebar). Compliance with the FPT requirement is fulfilled by developing and implementing

test procedures for each piece of equipment and controls within the commissioning scope.

> ***TIP:*** *The commissioning scope may include equipment in addition to the equipment requiring acceptance testing by the Standards. The commissioning scope is determined during the design phase based on the OPR and BOD, and the equipment list should be included in the commissioning specification section and commissioning plan.*

FPT requires coordination between the CxA and relevant subcontractors such as the mechanical, electrical, testing and balance (TAB), and controls contractors. The subcontractors must participate in the functional performance testing, as the CxA typically observes the tests while the subcontractors actually do the testing. Proper scheduling of the FPT are critical, as the equipment must be installed and operable, including controls being functional and TAB being completed.

> ***TIP:*** *Although not required by the Standards, commissioning authorities typically use "pre-functional checklists" to ensure the equipment is ready to be tested before coming onsite to observe FPT. These checklists are completed by subcontractors and often include verification of items, such as completed control point-to-point checklists and that the equipment will be accessible for testing.*

Systems Manual and Operations & Maintenance (O&M) Training

Per Section 120.8(h) of the 2013 Standards, the CxA is responsible for providing a systems manual and associated training to the owner's building operation staff. This requirement is critical to realize the savings resulting from the energy-related capital investments in the building design and construction. If the building operation staff do not understand how to properly operate and maintain the building systems, energy savings will diminish drastically, and the owner will not see the expected return on investment (ROI).

The systems manual is typically a compilation of materials written by the CxA, design engineers, owner, contractors, and subcontractors. This manual is the basis for training the O&M staff and multiple copies, along with 'as-built' plans, are often left with staff for reference.

The Standards require the systems manual includes (at a minimum):

- Site information, including facility description, history, and current requirements.
- Site contact information
- Instructions for basic operations & maintenance, including general site operating procedures, basic troubleshooting, recommended maintenance requirements, and a site events log
- Descriptions of major systems

Acceptance testing is required by the energy code to ensure that equipment, controls, and systems operate as required by the standards. Similar to commissioning, the acceptance testing process includes visual inspection of equipment and the functional testing of equipment per the prescribed testing procedures found in the standards. The systems covered by the acceptance testing requirement are detailed in Sections 120.5, 120.6, 130.4 and 140.9. While the acceptance testing requirements may overlap, the Commissioning requirements may go beyond the acceptance test requirements.

- Site equipment inventory and maintenance notes
- A copy of all special inspection verifications required by the enforcing agency or the Standards

Commissioning Report

The Cx report is a culmination of all work done throughout the commissioning effort. The report documents the commissioning activities and reports recommendations to the owner for post-construction completion. Section 120.8(i) in the Standards outlines the minimum required content for the commissioning report.

> ***TIP:*** *Although not required by the Standards, commissioning often includes seasonal testing to verify systems are operating as designed during different seasons. This may only be relevant to select climate zones in California. If your commissioning scope includes seasonal testing, or end of warranty review, the commissioning report will not be completed until up to a year after building occupancy.*

Overview of the Commissioning Process for 2013 Title 24, Part 6

As indicated above, the commissioning process starts in pre-design and continues into the occupancy phase. The following graphic outlines the basic process and where the documents described above fit into each phase. **Bolded items apply to all nonresidential newly constructed projects.**

Closing

The building commissioning requirements for nonresidential projects in California have changed as of July 1, 2014, and require changes to the typical design and construction processes to which industry professionals are accustomed. These requirements are meant to ensure that permitted buildings are safe, deliver savings from good design decisions and energy reducing capital investments, and are operated by well-informed staff.

Pre-Design	■ **Select CxA and "design reviewer"** ■ Draft OPR
Schematic Design	■ Draft BOD ■ **Hold Design Cx Kickoff meeting [NRCC-CXR-01-E]**
Design Development	■ Begin drafting Cx specifications
50% Construction Documents	■ **Perform preliminary design review [NRCC-CXR-02-E; NRCC-CXR-03-E; NRCC-CXR-04-E]**(recommended, not required)
90% Construction Documents	■ **Finalize Cx specifications** ■ **Perform final design review [NRCC-CXR-02-E; NRCC-CXR-03-E; NRCC-CXR-04-E; NRCC-CXR-05-E]** ■ Draft Cx Plan
Construction	■ Hold construction Cx kickoff (recommended, not required) ■ Finalize Cx Plan ■ Draft functional performance tests (FPT) ■ Perform FPT ■ Manage issues log (recommended, not required) ■ Begin drafting Cx report
Occupancy	■ Compile Systems Manual ■ Conduct O&M training ■ Finalize Cx Report

Additional Utility Resources

- Pacific Gas and Electric
- Southern California Edison
- Southern California Gas Company
- San Diego Gas & Electric

Additional Resources

■ Title 24 Reference Ace™ Tool

The Reference Ace™ tool is meant to help users navigate the Title 24, Part 6 Standards documents. The tool includes 2008 Residential and Nonresidential Standards, available online or via download. Key word search capabilities along with hyperlinked tables and related sections may make using the Standards documents easier.

A more comprehensive version of this tool, including the Compliance Manuals, Alternative Calculation Method Reference Manuals, and the Appendices, is being developed for the 2013 codes.

The tool is available for use online, but you also can download a Setup file to install the files on your computer.

■ Ace Tools™ Online

The Ace Tools™ - Three different tools help identify the forms, installation techniques, and standards relevant to building projects in California.

Updates are also available on Twitter: @edrcalifornia or @t24ace.

These tools are a result of the foundational work done under the Title 24, Part 6 Best Practices Program. View the Building Department Best Practices Report here (11 MB PDF file).

■ Trigger Sheets

These handy trigger sheets summarize sections of Title 24, Part 6 energy code that are triggered based on project scope. The sections indicated on these trigger sheets can help identify energy code requirements for your project.

- Nonresidential Interior Lighting Alterations
- Nonresidential Exterior Lighting
- Nonresidential Lighting Controls for New Construction
- Nonresidential Lighting Control for Additions and Alterations
- Nonresidential HVAC Controls
- Refrigeration
- Nonresidential HVAC Built-up Alterations
- Nonresidential Fenestration
- Residential HVAC Changeouts

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In This Issue

Cool Roofs & Condensation

A cool roof is a roofing material with high thermal emittance and high solar reflectance, or low thermal emittance and exceptionally high solar reflectance that reduces heat gain through the roof. Because cool roofs gain and retain less heat than traditional roofs, less heat is transferred through the envelope into the building's interior. By lowering internal temperatures, cool roofs reduce occupant demand for air conditioning, allowing for building cooling cost savings.

The temperature of the cool roof is reduced to such an extent that moisture no longer evaporates as it would with a traditional roof. When cool roofs are not installed properly, moisture condenses and becomes trapped within the roofing materials. The trapped moisture can lead to mold growth and damage to the roofing materials or supporting elements.

To prevent the trapping of moist air, it is essential to follow proper air sealing procedures as outlined in Section 110.7 of the 2013 Building Energy Efficiency Standards (Energy Standards). Proper installation may require the installation of: air barriers, vapor barriers, insulation above the roof deck, and additional ventilation.

For more information on cool roofs, please review the U.S. Department of Energy's *Energy Saver* article "Cool Roofs" at: http://www.energy.gov/energysaver/articles/cool-roofs.

Quality Insulation Installation (QII) Compliance Credit for Insulated Headers

The 2013 Energy Standards provide Quality Insulation Installation (QII) compliance credit for R-2 insulated headers as indicated in Section RA3.5.6.2.9 of the 2013 Reference Residential Appendices (RA). Insulation or wood must fill the cavities, leaving no air gaps in or around the header. To obtain QII credit, use compliance document CF2R-ENV-21-H. Compliance with the R-2 insulated header requirement is verified in Section C, number 13 of this compliance document.

Three options meet the R-2 insulated header requirement:

1. Two-member header with insulation in between. The header and insulation must fill the wall cavity. Example: a 2x4 wall with two 2x nominal headers, or a 2x6 wall with a 4x nominal header and a 2x nominal header. Insulation is required to fill the wall cavity and must be installed between the headers.

2. Single-member header, less than the wall width, with insulation on the interior face. The header and insulation must fill the wall cavity. Example: a 2x4 wall with a 3 1/8" wide header, or 2x6 wall with a 4x nominal header. Insulation is required to fill the wall cavity and must be installed to the interior face of the wall.

3. Single-member header, same width as wall. The header must fill the wall cavity. Example: a 2x4 wall with a 4x nominal header or a 2x6 wall with a 6x nominal header. No additional insulation is required because the header fills the cavity.

Please see the graphic description at: http://www.energy.ca.gov/efficiency/blueprint/documents/Headers.pdf.

Approved Acceptance Test Technician Certification Providers for Lighting Controls

The Energy Commission has approved the California Advanced Lighting Controls Training Program (CALCTP) and National Lighting Contractors Association of America (NLCAA) as Lighting Controls Acceptance Test Technician Certification Providers.

This action gives the CALCTP and NLCAA authorization to train and certify qualified individuals and employers beyond the interim period established by the 2013 Energy Standards. Individuals interested in becoming a Certified Lighting Controls Acceptance Test Technician or employer can apply to either of these providers.

Links to both providers' websites are posted on the Energy Commission's web page at: http://www.energy.ca.gov/title24/attcp.

Free Training Opportunities

Free utility sponsored training on the 2013 Energy Standards and compliance software is available across the state.

For upcoming training opportunities, please check the following websites:

- http://energycodeace.com/
- https://pge-web.ungerboeck.com/classcalendar/Search.aspx
- www.sdge.com/eic
- www.sce.com/wps/portal/home/business/consulting-services/energy-education-centers
- https://www.smud.org/en/business/education-safety/workshops-and-training/index.htm
- http://socalgas.com/innovation/energy-resource-center/

To receive regular information about training and software updates, please sign-up for the Blueprint, Building Standards, and Efficiency list servers at: www.energy.ca.gov/efficiency/listservers.html.

Q&A

Commissioning

Do the commissioning requirements apply to additions and alterations?

No, commissioning applies only to newly constructed nonresidential buildings (see Section 120.8). A newly constructed building is defined in Section 100.1 as: "*A building that has never been used or occupied for any purpose.*"

Do the commissioning requirements apply to tenant improvements (first time build-outs) for multi-tenant buildings such as a strip mall?

Possibly, it depends on the local enforcement agency's policy. Commissioning may be completed for the entire building prior to tenant improvements, or for each individual tenant improvement. Check with your local enforcement agency for their commissioning policies for multi-tenant buildings.

Do the commissioning requirements apply to unconditioned nonresidential buildings?

No, the scope of the 2013 Energy Standards does not include commissioning (Section 120.8) for unconditioned nonresidential buildings in Section 100.0(e)2C.

Is third party design review required for buildings with complex systems that serve less than 10,000 square feet?

No, the licensed professional engineer who completes and signs the Design Review Kickoff Certificate(s) of Compliance, and the Construction Document Design Review Checklist Certificate(s) of Compliance does not need to be a third party (see Section 10-103(a)1).

Are covered processes required to meet the commissioning requirements?

No, covered processes are excluded from the commissioning requirements (see Section 120.8).

Covered processes can be included in the Basis of Design document (see Section 120.8(c)), however it is not required. Please note that the Energy Standards require acceptance testing for certain systems and controls serving covered processes.

For additional information on the commissioning process and requirements, please review the Nonresidential Compliance Manual and Energy Design Review's *e-News* #96 "Commissioning for Code Compliance".

Nonresidential Economizers

The 2013 Energy Standards state that each cooling fan system with a total mechanical cooling capacity over 54,000 Btu/hr shall have either an air economizer or a water economizer. Is the term "cooling fan system" referring to the condensing unit (see Section 140.4(e)1)?

No, the term "cooling fan system" is referring to the evaporator coil and fan, not the condensing unit.

I have a variable refrigerant flow (VRF) air conditioning system, which has four 24,000 Btu/hr fan coils connected to a single 96,000 Btu/hr condensing unit. Is an economizer required in this scenario?

In this scenario, an economizer is not required because each cooling fan system is 24,000 Btu/hr. An economizer is only required for each cooling fan system, including a VRF, which has a total mechanical cooling capacity over 54,000 Btu/hr.

Residential Reroof Projects

Are cool roof requirements triggered for residential reroof projects?

Cool roof requirements are triggered when more than 50 percent of the exterior surface of the roof is replaced on steep-sloped roofs in Climate Zones 10 through 15, and low-sloped roofs in Climate Zones 13 and 15 (see Section 150.2(b)1H).

For steep-sloped roofs in Climate Zones 10 through 15, a cool roof must be installed with a minimum aged solar reflectance of 0.20 and a minimum thermal emittance of 0.75, or a minimum solar reflectance index (SRI) of 16.

Exceptions to the cool roof requirements for steep-sloped roofs include:

- Air-space of 1.0 inch (25 mm) is provided between the top of the roof deck to the bottom of the roofing product; or
- The installed roofing product has a profile ratio of rise to width of 1 to 5 for 50 percent or greater of the width of the roofing product; or
- Existing ducts in the attic are insulated and sealed according to Section 150.1(c)9; or
- Buildings with at least R-38 ceiling insulation; or
- Buildings with a radiant barrier in the attic meeting the requirements of Section 150.1(c)2; or
- Buildings that have no ducts in the attic; or
- R-4 or greater insulation above the roof deck.

For low-sloped roofs in Climate Zones 13 and 15, a cool roof must be installed with a 3-year aged solar reflectance equal to or greater than 0.63 and a thermal emittance equal to or greater than 0.75, or a minimum SRI of 75.

Exceptions to the cool roof requirements for low-sloped roofs include:

- Buildings that have no ducts in the attic; or

- The aged solar reflectance can be met by using insulation at the roof deck specified in TABLE 150.2-A.

Luminaire Modifications-in-Place

When are Luminaire Modification-in-Place requirements triggered?

Luminaire Modification-in-Place requirements, as outlined in TABLE 141.0-F, are triggered when 40 or more luminaires are modified in a building space within a twelve month period, and 10 percent or more of the existing luminaires in an enclosed space are modified.

Compliance with TABLE 141.0-F is not required if less than 40 luminaires are modified in the building space.

A building space is defined in TABLE 141.0-F as: a complete single story building; a complete floor of a multi floor building; the entire space in a single tenant under a single lease; or all of the common space in a single building.

An enclosed space is a space that is substantially surrounded by solid surfaces, including walls, ceilings or roofs, doors, fenestration areas, and floors or ground.

I am doing a Luminaire Modification-in-Place project for 40 or more luminaires in a building space. If the luminaires were modified to reduce the wattage and are not dimmable, do the multi-level lighting control requirements apply?

Yes, multi-level lighting controls are required for each enclosed space where 10 percent or more of the luminaires are modified. Multi-level lighting controls are only applicable to the modified luminaires. Two level lighting control can be used if the resulting lighting power is 85 percent or less of the allowed lighting power. Two level lighting control requires each luminaire to have at least one control step between 30 percent and 70 percent of design lighting power in a manner providing reasonably uniform illumination (see TABLE 141.0-F). Alternatively, the multi-level lighting control requirements in Section 130.1(b) can be met.

If the lighting power were greater than 85 percent of the allowed lighting power, then the requirements in Section 130.1(b) would have to be met.

I am doing a Luminaire Modification-in-Place project for 40 or more luminaires in a building space. In some of the enclosed spaces, 10 percent or more of the luminaires are modified. What are the applicable control requirements for those enclosed spaces?

If the lighting power is 85 percent or less of the allowed lighting power, per Section 140.6, area controls and shut-off controls are required in the enclosed space(s). Additionally, multi-level lighting controls are required only for luminaires which are Modified-in-Place.

If the lighting power is more than 85 percent of the allowed lighting power, area controls and shut-off controls are required in the enclosed space(s). Additionally, multi-level lighting controls and automatic daylight controls are required only for luminaires which are Modified-in-Place.

The California Energy Commission welcomes your feedback on *Blueprint*. Please contact Andrea Bailey at Title24@energy.ca.gov.

CALIFORNIA ENERGY COMMISSION

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