Guide to the California Green Building Standards Code – Non-Residential (Commissioning)

CALGreen Section: 5.410.2 Commissioning. For new buildings 10,000 square feet and over, building commissioning shall be included in the design and construction processes of the building project to verify that the building systems and components meet the owner's or owner representative's project requirements. Commissioning shall be performed in accordance with this section by trained personnel with experience on projects of comparable size and complexity. Commissioning requirements shall include:
1. Owner's Project Requirements
2. Basis of Design
3. Commissioning measures shown in the construction documents
4. Commissioning Plan
5. Functional Performance Testing
6. Documentation & Training
7. Commissioning Report

All building systems and components covered by Title 24, Part 6, as well as process equipment and controls, and renewable energy systems shall be included in the scope of the Commissioning Requirements.

Introduction:
The purpose of this code is to improve public health, safety and general welfare by enhancing the design and construction of buildings through the use of concepts that reduce negative and increase positive environmental impacts. Commissioning is a vital element in this effort.

Definitions used in the CALGreen CX Guide:

Acronyms

BOD	Basis of Design
Cx	Commissioning
FPT	Functional Performance Test
HVAC	Heating Ventilating and Air-Conditioning
O&M	Operations and Maintenance
OPR	Owner's Project Requirements

Glossary

Acceptance Criteria - The conditions that must be met for systems or equipment to meet defined expected outcomes.

Commissioning (Cx) - Building commissioning as required in this code involves a quality assurance process that begins during design and continues to occupancy. Commissioning verifies that the new building operates as the owner intended and that building staff are prepared to operate and maintain its systems and equipment.

Owner - The individual or entity holding title to the property on which the building is constructed.

Commissioning Coordinator - The person who coordinates the commissioning process. This can be either a third-party commissioning provider or an experienced member of the design team or owner in-house staff member.

Commissioning Team - The key members of each party involved with the project designated to provide insight and carry out tasks necessary for a successful commissioning project. Team

members may include the commissioning coordinator, owner or owner's representative, building staff, design professionals, contractors or manufacturer's representatives, and testing specialists.

Independent Third-Party Commissioning Professional - A commissioning consultant contracted directly by the owner who is not responsible to, or affiliated with any other member of the design and construction team.

Operation and Maintenance (O&M) Manuals - Documents that provide information necessary for operating and maintaining installed equipment and systems.

Owner Representative – An individual or entity assigned by the owner to act and sign on the owner's behalf.

Process Equipment - Energy-using equipment and components that are not used for HVAC, Electrical, Plumbing and Irrigation operations.
Such devices would include but are not limited to heat transfer, water purifying, air cleaning, air vacuum and air compressing.

Sequence of Operation – A written description of the intended performance and operation of each control element and feature of the equipment and systems.

Selecting Trained Personnel for (Commissioning)
This code requires that "Commissioning shall be performed in accordance with this section by trained personnel with experience on projects of comparable size and complexity." The trained personnel manage and facilitate the commissioning process. The trained personnel develop and implement the commissioning tasks and documentation identified in sections 5.410.2.1 through 5.410.2.7. Trained personnel may include appropriate members of owner staff, contractor and design team as well as independent commissioning professionals.
It is essential that there is a single person designated to lead and manage the commissioning activities. In practice, this individual has been referenced by various identifiers such as commissioning authority, agent, provider, coordinator, lead, etc. In this guide the term "commissioning coordinator" is used.
The designated commissioning coordinator may be an independent third-party commissioning professional, a project design team member (e.g. engineer or architect), an owner's engineer or facility staff, contractor or specialty sub-contractor. Methods of evaluating the designated commissioning coordinator and trained personnel include review of the following:

1. Technical knowledge
2. Relevant experience
3. Potential conflict of interest concerns
4. Professional certifications and training
5. Communication and organizational skills
6. Reference and sample work products

Selection of "trained", qualified personnel is required by this Code. In order to meet this requirement, the commissioning provider should be evaluated via the methods discussed above. In addition, various organizations have training and certification programs that may be a source for identification of qualified commissioning providers.

For information about enforcement and compliance of each commissioning element see sections 5.410.2.1 through 5.410.2.7.

See (Part 4) for forms and templates.

1. Owner's Project Requirements

CALGreen Section: 5.410.2.1 Owner's or Owner representative's Project Requirements (OPR). The expectations and requirements of the building appropriate to its phase shall be documented before the design phase of the project begins. This documentation shall include the following:
1. Environmental and Sustainability Goals
2. Energy Efficiency Goals
3. Indoor Environmental Quality Requirements
4. Project program, including facility functions and hours of operation, and need for after hours operation
5. Equipment and Systems Expectations
6. Building Occupant and O&M Personnel Expectations

Intent:
The Owner's Project Requirements (OPR) documents the functional requirements of a project and expectations of the building use and operation as it relates to systems being commissioned. The document describes the physical and functional building characteristics desired by the owner and establishes performance and acceptance criteria. The OPR is most effective when developed during pre-design and used to develop the Basis of Design (BOD) during the design process. The level of detail and complexity of the OPR will vary according to building use, type and systems.

Existing Law or Regulation:
No existing law or regulation. Review local ordinances for any applicable commissioning OPR requirement.

Compliance Method:
Compliance is demonstrated by the owner or owner's representative developing and/or approving the Owner's Project Requirements (OPR) document and can be defined as follows:

1. *Environmental and Sustainability Goals* – Establish environmental project goals and objectives exceeding the code for the project's sustainability which may include:
    a) CALGreen voluntary measures or Tiers sought, or other specific green building rating system or program credits and/or level of certification sought
    b) Specific environmental or sustainability goals such as water efficiency, water reuse, CO2 monitoring, xeriscaping, etc.
2. *Energy Efficiency Goals* – Establish goals and targets affecting energy efficiency which may include:
    a) Overall energy efficiency less than the California Energy Code performance approach energy budget by __%)
    b) Lighting system efficiency (less than the California Energy Code performance approach energy budget by __%)
    c) HVAC equipment efficiency & characteristics
    d) Any other measures affecting energy efficiency desired by owner
        - Building orientation and siting
        - Daylighting
        - Facade, envelope and fenestration
        - Roof
        - Natural ventilation
        - Onsite renewable power generation and net-zero energy use
        - Landscaping and shading
3. *Indoor Environmental Quality Requirements* - For each program space describe indoor environmental requirements including intended use and anticipated schedule
    a) Lighting
    b) Temperature and humidity
    c) Acoustics
    d) Air quality, ventilation and filtration
    e) Desired adjustability of system controls
    f) Accommodations for after-hours use

g) Other owner requirements including natural ventilation, operable windows, daylight, views, etc.

4. *Project Program, Including facility functions and hours of operation, and need for after hours operation* – Describe primary purpose, program and use of proposed project
   a) Building size, number of stories, construction type, occupancy type and number
   b) Building program areas including intended use and anticipated occupancy schedules
   c) Future expandability and flexibility of spaces
   d) Quality and/or durability of materials and building lifespan desired
   e) Budget or operational constraints
   f) Applicable codes
5. *Equipment and Systems Expectations* – Describe the following for each system commissioned:
   a) Level of quality, reliability, equipment type, automation, flexibility, maintenance and complexity desired
   b) Specific efficiency targets, desired technologies, or preferred manufacturers for building systems, acoustics and vibration
   c) Degree of system integration, automation and functionality for controls; i.e., load shedding, demand response, energy management

6. *Building Occupant and O&M Personnel Expectations* – Describe the following:
   a) How building will be operated and by whom
   b) Level of training and orientation required to understand, operate and use the building systems for building operation and maintenance staff, as well as occupants
   c) Building operation and maintenance staff location and capabilities

See (Part 4) for forms and templates.

Enforcement:

At their discretion, the building official confirms demonstrated compliance at *Plan Intake* by:

a) Receipt of a copy of the OPR document, or
b) Receipt of a form signed by the owner or owner representative attesting that the OPR has been completed and approved by the owner.

See (Part 4) for forms and templates.

2. Basis of Design (BOD)

CALGreen Section: 5.410.2.2 Basis of Design (BOD). A written explanation of how the design of the building systems meets the OPR shall be completed at the design phase of the building project, and updated as necessary during the design and construction phases. The Basis of Design document shall cover the following systems:
1. Heating, Ventilation, Air Conditioning (HVAC) Systems and Controls
2. Indoor Lighting System and Controls
3. Water Heating System
4. Renewable Energy Systems
5. Landscape Irrigation Systems
6. Water Reuse Systems

Intent:
The Basis of Design (BOD) describes the building systems to be commissioned and outlines design assumptions not indicated in the design documents. The design team develops the BOD to describe how the building systems design meets the Owner's Project Requirements (OPR), and why the systems were selected. The BOD is most effective when developed early in the project design and updated as necessary throughout the design process.

Existing Law or Regulation:
No existing law or regulation. Review local ordinances for any applicable commissioning BOD requirement.

Compliance Method:
Compliance requires the completion of the BOD document and should include the following where applicable:

1. *Heating, Ventilation, Air Conditioning (HVAC) Systems and Controls*
    a) Provide narrative description of system – system type, location, control type, efficiency features, outdoor air ventilation strategy, indoor air quality features, environmental benefits, other special features.
    b) Describe reasons for system selection – why chosen system is better than alternatives, issues such as comfort, performance, efficiency, reliability, flexibility, simplicity, cost, owner preference, site constraints, climate, maintenance, acoustics
    c) Provide design criteria including the following:
        - Load calculation method/software
        - Summer outdoor design conditions(__°F drybulb and __°F wetbulb)
        - Winter outdoor design conditions (__°F drybulb and __°F wetbulb)
        - Indoor design conditions (__°F drybulb cooling, __%RH cooling; __°F drybulb heating, __%RH heating)
        - Applicable codes, guidelines, regulations and other references used
        - Load calculation assumptions
    d) Sequence of Operations – operating schedules, setpoints, may refer to plans or specifications if sequence indicated within permit documents
    e) Describe how system meets the OPR
2. *Indoor Lighting System and Controls*
    a) Provide narrative description of system – type of fixtures, lamps, ballasts, controls
    b) Describe reason for system selection – why chosen system better than alternatives, issues such as visual comfort, performance, efficiency, reliability, cost, flexibility, owner preference, color rendering, integration with daylighting, ease of control
    c) Provide design criteria for each type of space including the following:
        - Applicable codes, guidelines, regulations and other references used
        - Illumination design targets (footcandles) and lighting calculation assumptions
    d) Provide lighting power design targets for each type of space
        - Title 24 lighting power allowance and lighting power design target (watts/ft^2)
    e) Describe how system meets the OPR
3. *Water Heating System*
    a) Provide narrative description of system – system type, control type, location, efficiency features, environmental benefits, other special features

b) Describe reason for system selection – why chosen system is better than alternatives, issues such as performance, efficiency, reliability, space constraints, cost, utility company incentives, owner preference, ease of maintenance
c) Water heating load calculations
d) Describe how system meets the OPR

4. *Renewable Energy Systems*
   a) Provide narrative description of system – type, performance, control type, energy savings, payback period
   b) Describe reason for system selection – why chosen system is better than alternatives, issues such as performance, efficiency, reliability, flexibility, simplicity, expandability, cost, payback period, utility company incentives, owner preference,
   c) Sequence of Operation – operating schedules, setpoints, storage capacity
   d) Describe how system meets the OPR
5. *Landscape Irrigation Systems*
   a) Provide narrative description of system – type, performance, water usage
   b) Describe reason for system selection – why chosen system is better than alternatives, issues such as performance, efficiency, reliability, flexibility, expandability, cost, owner preference, simplicity
   c) Sequence of Operation – operating schedules, setpoints
   d) Describe how system meets the OPR
6. *Water Reuse Systems*
   a) Provide narrative description of system – type, performance, capacity, reuse purpose
   b) Describe reason for system selection – why chosen system is better than alternatives, issues such as performance, efficiency, reliability, flexibility, expandability, cost, owner preference, simplicity
   c) Sequence of Operation – operating schedules, setpoints
   d) Describe how system meets the OPR

See (Part 4) for forms and templates.

Enforcement:

At their discretion, the building official confirms demonstrated compliance at *Plan Intake* by:

a) Receipt of a copy of the BOD document, or
b) Receipt of a form signed by the architect, engineer or designer of record, attesting that the BOD has been completed and meets the requirements of the OPR.

See (Part 4) for forms and templates.

3. Commissioning measures shown in the construction documents

CALGreen Section: 5.410.2 Commissioning. For new buildings 10,000 square feet and over, building commissioning shall be included in the design and construction processes…. Commissioning requirements shall include:
1. Owner's Project Requirements
2. Basis of Design
3. Commissioning measures shown in the construction documents
4. Commissioning Plan
5. Functional Performance Testing
6. Documentation & Training
7. Commissioning Report

This section provides details for element 3: *Commissioning measures shown in the construction documents.*

Intent:
Include commissioning measures or requirements in the construction documents (plans and specifications). Commissioning measures or requirements should be clear, detailed and complete to clarify the commissioning process.

Existing Law or Regulation:
Title 24 Part 6 requires that specific functional test procedure forms be included in the construction documents. These test forms create a subset of the broader CalGreen commissioning requirements described herein. Review local ordinances for additional applicable requirements.

Compliance Method:
Compliance is achieved by including commissioning requirements in the project specifications. The commissioning specifications should include the following:

1. Primary (and optionally all) commissioning requirements are included in the general specification division (typically Division 1) and clear cross references of all commissioning requirements to and from the general division are included to ensure all subcontractors are held to them
2. A list of the systems and assemblies covered by the commissioning requirements.
3. Roles and responsibilities of all parties including:
   - General contractor and subcontractors, vendors, construction manager
   - Commissioning provider lead
   - Owner, facility staff
   - Architect and design engineers
   - Including the non-contractor parties in the construction specifications is for information only to provide the contractor with context for their work
   - Include who writes checklists and tests, who reviews and approves test forms, who directs tests, who executes tests, who documents test results and who approves completed tests. These roles may vary by system or assembly.
4. Meeting requirements
5. Commissioning schedule management procedures
6. Issue and non-compliance management procedures
7. Requirements for execution and documentation of installation, checkout and start up, including controls point-to-point checks and calibrations
8. Specific testing requirements by system, including:
   - Monitoring and trending
   - Opposite season or deferred testing requirements, functions and modes to be tested
   - Conditions of test
   - Acceptance criteria, and any allowed sampling
   - Include details of the format and rigor of the test forms required to document test execution
   - Including example forms is recommended
9. Submittal review requirements and approval process.
10. Content, authority and approval process of the commissioning plan.
11. Commissioning documentation and reporting requirements.

12. Facility staff training requirements and verification procedures.
13. O&M manual review and approval procedures.
14. System's manual development and approval requirements and procedures.
15. Definitions section.

See (Part 4) for forms and templates.

Enforcement:

At their discretion, the building official confirms demonstrated compliance at *Plan Intake* by:

a) Receipt of a copy of the commissioning specifications, or
b) Receipt of a form signed by the owner or owner representative or designer of record attesting that the owner-approved commissioning specifications are included in the construction documents.

See (Part 4) for forms and templates.

4. Commissioning plan. Prior to permit issuance a commissioning plan shall be completed to document how the project will be commissioned and shall be started.

CALGreen Section: 5.410.2.3 Commissioning plan. Prior to permit issuance a commissioning plan shall be completed to document how the project will be commissioned and shall be started during the design phase of the building project. The Commissioning Plan shall include the following:

1. General project information
2. Commissioning goals
3. Systems to be commissioned**.** Plans to test systems and components shall include:
   a. An explanation of the original design intent
   b. Equipment and systems to be tested, including the extent of tests
   c. Functions to be tested
   d. Conditions under which the test shall be performed
   e. Measurable criteria for acceptable performance
4. Commissioning team Information
5. Commissioning process activities, schedules and responsibilities. Plans for the completion of commissioning requirements listed in Section 5.410.4.4 through 5.410.4.6 shall be included.

Intent:

The Commissioning Plan (Cx Plan) establishes the commissioning process guideline for the project and commissioning team's level of effort by identifying the required Cx activities to ensure that the Owner's Project Requirements (OPR) and the Basis of Design (BOD) are met. The Cx Plan also includes a commissioning schedule from design to occupancy.

Existing Law or Regulation:

No previous existing State of California laws or regulations. Review local county, city or jurisdiction ordinances for any applicable commissioning planning requirements.

Compliance Method:

Compliance is demonstrated by preparation of a project specific Cx Plan that includes the elements listed in the code section above. The following gives guidance for developing the components of the Commissioning Plan:

1. General project information - Provide project identifying information including but not limited to the following:
- -Project Name, Owner, Location,
- -Building type, Building area,
- -Project Schedule
- -Contact information of individual/company providing the commissioning services

2. Commissioning Goals – Document the commissioning goals, including, but not limited to:
- -Meeting CALGreen code requirements for commissioning
- -Meeting OPR and BOD requirements
- -Carrying out requirements for commissioning activities as specified in plans and specifications

3. Systems to be commissioned – See BOD

a. An explanation of the original design intent - Document the performance objectives and design intent for each system listed to be commissioned in a written narrative
- -Refer to the OPR and BOD documents

b. Equipment and systems to be tested, including the extent of tests
- -Provide a list of equipment and systems to be tested
- -Describe the range and extent of tests to be performed for each system component, and interface between systems

c. Functions to be tested - Provide example functional test procedures to identify the level of testing detail required
- -See (section 5.410.2.4) FPT guidance for more information

d. Conditions under which the test shall be performed - Identify the conditions under which the major operational system functions are to be tested, including:
- -Normal operations and part-load operations
- -Seasonal testing requirements
- -Restart of equipment and systems after power loss
- -System alarm confirmations

e. Measurable criteria for acceptable performance - Include measurable criteria for acceptable performance of each system to be tested

4. Commissioning Team Information - Provide a contact list for all Commissioning team members, including but not limited to:

-Owner, owner's representative
-Architect, Engineers
-Designated commissioning representative
-General contractor, sub-contractors, and construction manager

5. Commissioning process activities, schedules and responsibilities

-Establish prescribed commissioning process steps and activities to be accomplished by the Cx team throughout the design to occupancy
-For each phase of the work, define the roles and responsibilities for each member of the Cx team
-List the required Cx deliverables, reports, forms and verifications expected at each stage of the commissioning effort
-Include the confirmation process for the O&M manual, systems manual and the facility operator and maintenance staff training

See (Part 4) for forms and templates.

Enforcement:

At their discretion, the building official confirms demonstrated compliance at *Plan Intake* by:

a) Receipt of a copy of the Commissioning Plan, or
b) Receipt of a form signed by the owner or owner representative attesting that the Cx Plan has been completed.

See (Part 4) for forms and templates.

5. Functional performance testing

CALGreen Section: 5.410.2.4 Functional performance testing. Functional performance tests shall demonstrate the correct installation and operation of each component, system, and system-to-system interface in accordance with the approved plans and specifications. Functional performance testing reports shall contain information addressing each of the building components tested, the testing methods utilized, and include any readings and adjustments made.

Intent:
Develop and implement the functional performance tests to document, as set forth in the Commissioning Plan, that all components, equipment, systems and system-to-system interfaces were installed as specified, and operate according to the Owner's Project Requirements, Basis of Design, and plans and specifications.

The following systems to be functionally tested are listed in the Basis of Design (5.410.2.2 of the Code):

1. Heating, Ventilation, Air Conditioning (HVAC) Systems and Controls
2. Indoor Lighting System and Controls
3. Water Heating System
4. Renewable Energy Systems
5. Landscape Irrigation Systems
6. Water Reuse Systems

Existing Law or Regulation:
Title 24 Acceptance Testing requirements call for functional testing of some systems and equipment required to be commissioned by CALGreen. Refer to Title 24 and Nonresidential Compliance Manual For California's 2008 Energy Efficiency Standards.
http://www.energy.ca.gov/title24/2008standards/nonresidential_manual.html

Note: CALGreen Functional Performance Tests are not intended to replace the Title 24 Section 6 Acceptance Tests. Instead, the T24 acceptance tests, which focus on energy efficiency, can be part of the broader scope of testing forms and procedures required for CALGreen compliance.

Review local ordinances for any applicable requirements.

Compliance Method:
Compliance is demonstrated by developing and implementing test procedures for each piece of commissioned equipment and interfaces between equipment and systems according to the building-specific Commissioning Plan. Tests should include verification of proper operation of all equipment features, each part of the sequence of operation, overrides, lockouts, safeties, alarms, occupied and unoccupied modes, loss of normal power, exercising a shutdown, startup, low load through full load (as much as is possible) and back, staging and standby functions, scheduling, energy efficiency strategies and loop tuning.

Elements of acceptable test procedures include:

1. *Date and Party* -- Identification of the date of the test and the party conducting the test.
2. *Signature Block* **--** Signature of the designated commissioning lead and the equipment installing contractor attesting that the recorded test results are accurate.
3. *Prerequisites* -- Any conditions or related equipment checkout or testing that needs to be completed before conducting this test.
4. *Precautions* -- Identification of the risks involved to the test team members and the equipment and how to mitigate them.
5. *Instrumentation* **--** Listing of the instrumentation and tools necessary to complete the test.
6. *Reference* – In each procedure item, identify the source for what is being confirmed (e.g., sequence of operation ID, operating feature, specification requirement, etc.).
7. *Test Instructions* **--** Step-by-step instructions of how to complete the test, including functions to test and the conditions under which the tests should performed.
8. *Acceptance Criteria* **--** Measurable pass / fail criteria for each step of the test, as applicable.
9. *Results* **--** Expected system response and space to document the actual response, readings, results and adjustments.
10. *Return to Normal* **--** Instructions that all systems and equipment are to be returned to their as-found state at the conclusion of the tests.

11. *Deficiencies* -- A list of deficiencies and how they were mitigated.

See (Part 4) for forms and templates.

Enforcement:

At their discretion, the building official confirms demonstrated compliance during *Onsite Enforcement* by:

a) Receipt of a copy of completed and signed Functional Performance Tests and corrected deficiencies, or

b) Receipt of a form signed by the owner, owner representative or commissioning coordinator attesting that the Functional Performance Tests have been completed and any deficiencies corrected.

See (Part 4) for forms and templates.

6. Documentation and training

CALGreen Section: 5.410.2.5 Documentation and training. A Systems Manual and Systems Operations Training are required, including Occupational Safety and Health Act (OSHA) requirements in California Code of Regulations (CCR), Title 8, Section 5142, and other related regulations.

See sections* 5.410.2.5.1 and 5.410.2.5.2 *below.

CALGreen Section: 5.410.2.5.1 Systems manual. Documentation of the operational aspects of the building shall be completed within the Systems Manual and delivered to the building owner or representative and facilities operator. The Systems Manual shall include the following:
1. Site information, including facility description, history and current requirements.
2. Site contact information
3. Basic operations & maintenance, including general site operating procedures, basic troubleshooting, recommended maintenance requirements, site events log
4. Major systems
5. Site equipment inventory and maintenance notes
6. A copy of all special inspection verifications required by the enforcing agency or this code
7. Other resources and documentation.

Intent:
The Systems Manual documents information focusing on the operation of the building systems. This document provides information needed to understand, operate, and maintain the equipment and systems and informs those not involved in the design and construction of the building systems. This document is in addition to the record construction drawings, documents, and the Operation & Maintenance (O&M) Manuals supplied by the contractor. The Systems Manual is assembled during the construction phase and available during the contractors' training of the facility staff.

Existing Law or Regulation:
No existing law or regulation. Review local ordinances for any applicable Systems manual requirement.

Compliance Method:
Compliance is demonstrated by providing the Systems Manual. The information in the Systems Manual includes the following information:

1. *Site information, including facility description, history and current requirements*
   a) Site Information
      i. Location of property - Address
      ii. Site acreage
      iii. Local utility information
         -Water service provider
         -Natural/LPG gas service provider
         -Electrical service provider
         -Telecommunications service provider
         -Other service providers
   b) Facility Description
      i. Use/Function
      ii. Square footage
      iii. Occupancy Type
      iv. Construction Type
      v. Basis of design
      vi. Location of major systems & equipment
   c) Project History
      i. Project requirements
         -Owner's Project Requirements (OPR)
         -Basis of Design (BOD)
      ii. Project undocumented events

iii. Record Drawings & Documents
iv. Final control drawings and schematics
v. Final control sequences
vi. Construction documents - Location or delivery information
-Mechanical & electrical drawings
-Specifications
-Submittals
-Project change orders and information

d) Current requirements
i. Building operating schedules
ii. Space temperature, humidity, & pressure, CO2 setpoints
iii. Summer and winter setback schedules
iv. Chilled & hot water temperatures
v. As-built control setpoints and parameters

2. *Site contact information*
a) Owner information
b) Emergency contacts
c) Design Team: Architect, Mechanical, Engineer, Electrical Engineer, etc.
d) Prime Contractor contact information
e) Subcontractor information
f) Equipment supplier contact information

3. *Basic operation & maintenance, including general site operating procedures, basic trouble shooting, recommended maintenance requirements site events log*

a) Basic operation
i. Written narratives of basic equipment operation
ii. Interfaces, interlocks and interaction with other equipment and systems
iii. Initial maintenance provide by contactor

b) General site operating procedures
i. Instructions for changes in major system operating schedules
ii. Instructions for changes in major system holiday & weekend schedules

c) Basic troubleshooting
i. Cite any recommended troubleshooting procedures specific to the major systems and equipment installed in the building.
ii. Manual operation procedures
iii. Standby/Backup operation procedures
iv. Bypass operation procedures
v. Major system power fail resets and restarts
vi. Trend log listing

d) Recommended maintenance events log
i. HVAC air filler replacement schedule & log
ii. Building control system sensor calibration schedule & log

e) Operation & Maintenance Manuals - Location or delivery information

4. *Major systems*
a) HVAC systems & controls
i. Air conditioning equipment (chillers, cooling towers, pumps, heat exchanges, thermal energy storage tanks, etc)
ii. Heating equipment (boilers, pumps, tanks, heat exchanges, etc.)
iii. Air distribution equipment (fans, terminal units, accessories, etc.)
iv. Ventilation equipment (fans, accessories, and controls)
v. Building automation system (workstation, servers, panels, variable frequency drives, local control devices, sensors, actuators, thermostats, etc.)

b) Indoor lighting systems & controls
i. Lighting control panels
ii. Occupancy sensors
iii. Daylight harvesting systems

c) Renewable energy systems
i. Photovoltaic panels & inverters
ii. Wind powered electrical generators & inverters

d) Landscape irrigation systems
i. Water distribution diagrams
ii. Control system

e) Water reuse systems

i. Reclaimed water system for indoor use
ii. Reclaimed water for irrigation use

5. *Site equipment inventory and maintenance notes*
   a) Spare parts inventory
   b) Frequently required parts and supplies
   c) Special equipment required to operate or maintain systems
   d) Special tools required to operate or maintain systems

6. *A copy of all special inspection verifications required by the enforcing agency of this code*
7. *Other resources and documentation*

See (Part 4) for forms and templates.

Enforcement:

At their discretion, the building official confirms demonstrated compliance during *Onsite Enforcement* by:

a. Receipt of a copy of the Systems Manual, or
b. Receipt of a form signed by the owner or owner representative attesting that the System's Manual has been completed.

See (Part 4) fort forms and templates.

CALGreen Section: 5.410.2.5.2 Systems operations training. The training of the appropriate maintenance staff for each equipment type and/or system shall be documented in the commissioning report and shall include the following:
1. System/equipment overview (what it is, what it does and with what other systems and/or equipment it interfaces)
2. Review and demonstration of servicing/preventive maintenance
3. Review of the information in the Systems Manual
4. Review of the record drawings on the system/equipment

Intent:
The systems operation training verifies that a training program is developed to provide training to the appropriate maintenance staff for each equipment type and/or system and that this training program is documented in the commissioning report. The systems operations training program is specified in the project specifications for the major systems listed. The System Manual, Operation and Maintenance (O&M) documentation, and record drawings are prepared and available to the maintenance staff prior to implementation of any training or the development of a written training program. The training program is to be administered when the appropriate maintenance staff is made available to receive training.

Existing Law or Regulation:
No existing law or regulation. Review local ordinances for any applicable Systems Operation Training requirement.

Compliance Method:
The written training program includes: (a) learning goals and objectives for each session, (b) training agenda, topics, and length of instruction for each session, (c) instructor information and qualifications, (d) location of training sessions (onsite, off-site, manufacturer's or vendor's facility), (e) attendance forms, (f) training materials, and (g) description on how the training will be archived for future use.

1. *Systems/equipment overview*
    a) Review OPR and BOD related to the major systems and equipment
    b) Describe system type and configuration
    c) Explain operation all major systems and equipment and how it interfaces with other systems and equipment
    d) Describe operation of critical devices, controls and accessories
    e) Review location of the major systems and equipment
    f) Describe operation of control system for each system, location of critical control elements, and procedures to properly operate control system
    g) Review recommendations for implementation to reduce energy and water use
2. *Review and demonstration of servicing/preventive maintenance*
    a) Explain location or delivery contact of the Operation & Maintenance manuals
    b) Review of all manufacturer's recommended maintenance activities to maintain warranty
    c) Review and demonstrate frequent maintenance activities (air filter replacement, lubrication, fan belt inspection and/or replacement, condenser water treatment, etc.), and suggested schedule.
    d) Review and demonstrate typical servicing procedures and techniques (electrical current, pressure, and flow readings, etc; calibration procedures, point trending, power fail restart procedures, etc.)
    e) Locate, observe and identify major equipment, systems, accessories and controls
    f) Review emergency shut-offs and procedures
3. *Review of the information in the Systems Manual*
    a) Describe use of System Manual
    b) Review elements of System Manual
    c) Explain how to update and add revisions to System Manual

4. *Review record drawings on the systems/equipment*
    a) Explain location or delivery contact of the record drawings
    b) Review record drawings, revisions, and changes to original design drawings.
    c) Review equipment schedules and compare with actual installed systems

See (Part 4) for forms and templates.

Enforcement:

At their discretion, the building official confirms demonstrated compliance during *Onsite Enforcement* by:

1. In the event appropriate maintenance staff is made available to receive training for each equipment type and/or system installed in the building.

    a. Receipt of a copy of the written training program and completed attendance forms, or
    b. Receipt of a form signed by the owner or owner representative attesting that the training program and delivery of training has been completed

2. In the event appropriate maintenance staff are unavailable to receive training for each equipment type and/or system installed in the building.

    a. Receipt of a copy of the training program provided to the owner or owner's representative, or
    b. Receipt of a form signed by the owner or owner representative attesting that the written training program has been provided.

See (Part 4) for forms and templates.

7. Commissioning report

CALGreen Section: 5.410.2.6 Commissioning report. A complete report of commissioning process activities undertaken through the design, construction and reporting recommendations for post-construction phases of the building project shall be completed and provided to the owner or representative.

Intent:
The Commissioning Report documents the commissioning process and test results. The report includes confirmation from the commissioning agent verifying that commissioned systems meet the conditions of the Owner's Project Requirements (OPR), Basis of Design (BOD), and Contract Documents.

Existing Law or Regulation:
No existing law or regulation. Review local ordinances for any applicable Commissioning Report requirement.

Compliance Method:
The Components of the Commissioning Report include the following and are defined as follows:

1. Executive summary of process and results of commissioning program – including observations, conclusions and any outstanding items.
2. History of any system deficiencies and how resolved
   a) Include outstanding deficiencies and plans for resolution
   b) Include plans for seasonal testing scheduled for a later date
3. System performance test results and evaluations
4. Summary of training process completed and scheduled
5. Attach commissioning process documents
   a) Commissioning Plan
   b) Owners Project Requirements (OPR)
   c) Basis of Design (BOD)
   d) Executed installation checklists
   e) Executed Functional Performance Test (FPT) forms
   f) Recommendations for end-of-warranty review activities

See (Part 4) for forms and templates.

Enforcement:
At their discretion, the building official confirms demonstrated compliance during *Onsite Enforcement* by:

a) Receipt of a copy of the Commissioning Report, or
b) Receipt of a form signed by the owner or owner representative attesting that the Cx Report has been completed.

See (Part 4) for forms and templates.

CALGreen Section: 5.410.4 Testing and adjusting. Testing and adjusting of systems shall be required for buildings less than 10,000 square feet.
5.410.4.2 Systems. Develop a written plan of procedures for testing and adjusting systems. Systems to be included for testing and adjusting shall include at a minimum, as applicable to the project:

1. HVAC systems and controls
2. Indoor and outdoor lighting and controls
3. Water heating systems
4. Renewable energy systems
5. Landscape irrigation systems
6. Water reuse systems.

5.410.4.3 Procedures. Perform testing and adjusting procedures in accordance with industry best practices and applicable standards on each system as determined by the building official.
5.410.4.3.1 HVAC balancing. In addition to testing and adjusting, before a new space-conditioning system serving a building or space is operated for normal use, the system shall be balanced in accordance with the procedures defined by the Testing Adjusting and Balancing Bureau National Standards; the National Environmental Balancing Bureau Procedural Standards; or Associated Air Balance Council National Standards or as approved by the building official.
5.410.4.4 Reporting. After completion of testing, adjusting and balancing, provide a final report of testing signed by the individual responsible for performing these services.
5.410.4.5 Operation and maintenance (O & M) manual. Provide the building owner or representative with detailed operating and maintenance instructions and copies of guaranties/warranties for each system. O & M instructions shall be consistent with OSHA requirements in CCR, Title 8, Section 5142, and other related regulations.
5.410.4.5.1 Inspections and reports. Include a copy of all inspection verifications and reports required by the enforcing agency.

Intent:
For construction projects less than 10,000 square feet testing and adjusting the building systems can ensure maximum efficiency of the equipment operation as well improve the indoor air quality for occupants. Additionally, testing and adjusting building system can prolong the life of the systems and maximize the equipment intended design parameters.

Existing Law or Regulation:
There is **NO** current law or regulation for this code provision.

Compliance Method:
Design Team: Specify the systems in the project to be tested and adjusted; the testing team members and their qualifications, and the procedures, including those recommended by the manufacturer, as well as the report forms to be used in testing and adjusting.

Contractor: Maintain evidence of the qualifications of the testing and adjusting team and install the specified building systems in accordance with the plans and specifications. Examine systems for functional deficiencies that cannot be adjusted and report deficiencies discovered before and during testing and adjusting.
Prepare a testing and adjusting plan with step by step procedures and perform testing and adjusting of systems according to those procedures. Remedy any deficiencies that are discovered during testing. For HVAC systems use the balancing procedures defined by the organizations listed in the regulations, and perform additional testing and balancing as required to verify that balanced conditions are being maintained.
Complete testing and adjusting reports as required.
Prepare the O & M manual for turning over to the owner to encourage proper maintenance and optimum performance of the systems after Certificate of Occupancy.

Enforcement:
Plan Intake: Confirm that the testing and adjusting requirements are specified for the applicable building systems.

On-Site Enforcement: The inspector will collect copies of the testing, adjusting and balancing reports after all functional testing has been completed.

Part 4 – Suggested Forms and Templates

CALGreen Compliance Template- Owner's Project Requirements (OPR)

DRAFT CALGreen Std. BSC-5.4-X 10-08-10

[The Owner's Project Requirements (OPR) is a step of commissioning required for compliance with the 2010 CALGREEN Code, section 5.410.2.1, for newly constructed buildings greater than 10,000 sq. ft. This template is a guide to collecting the information recommended for the OPR. The information should be developed by the project team in collaboration with the Owner.]

Owner and User Requirements

a) [Typically already covered in Project Scope as described in the building program. Includes primary purpose, program and use of project. May also describe future expansion needs, flexibility, quality of materials, construction and operation costs.]

Environmental and Sustainability Goals

a) Project shall meet performance requirements required by the owner.
b) Other Owner requirements: *[e.g. Owner priorities among CALGREEN Code or other areas]*

Energy Efficiency Goals

a) Project shall comply with Title 24 building energy efficiency standards, or achieve increased level of efficiency determined by owner.
b) Lighting systems offer cost effective energy savings potential, and lighting fixtures and/or controls shall be selected to exceed Title 24 minimum efficiency requirements by level determined by owner.
c) High efficiency HVAC equipment offers cost effective energy savings, and HVAC equipment shall be selected that exceeds Title 24 minimum efficiency requirements by level determined by owner.
d) Additional energy efficiency measures that provide cost effective energy savings shall be included wherever feasible.
e) Other Owner requirements: *[e.g. orientation, siting, daylighting, cool roof, natural ventilation, landscaping]*

Indoor Environmental Quality Requirements

a) Indoor lighting requirements: *[List any specific non-standard requirements. E.g. pendant-mounted lighting, illumination requirements, special applications.]*
b) Occupant lighting control requirements: *[List any non-standard requirements. E.g. multi-mode controls for assembly spaces]*
c) Thermal comfort requirements: *[List any non-standard temperature or humidity requirements]*
d) Ventilation and filtration requirements: *[List any non-standard requirements]*

e) Occupancy HVAC control requirements: *[List any non-standard requirements. E.g. integration with existing control systems]*

f) Acoustic environment requirements: *[List any non-standard requirements. E.g. local noise sources requiring mitigation, spaces such as classrooms that require low background noise and short reverberation times]*

g) Other Owner requirements: *[E.g. natural ventilation, operable windows, daylight, views]*

Equipment and Systems Expectations

a) Special HVAC equipment requirements: *[E.g. equipment type, quality, reliability, efficiency, control system type, preferred manufacturers, maintenance requirements]*

b) Unacceptable HVAC system types or equipment: *[List if applicable]*

c) Special lighting equipment requirements: *[E.g. list preferred lamp and ballast types that comply with Owner standards if applicable]*

d) Other system requirements:

Building Occupant and O&M Personnel Expectations

Day-to-day HVAC operation by: *[occupants, operating staff]*

Periodic HVAC maintenance performed by: *[building occupants, operating staff, service company, Owner staff, other]*

Lighting system maintenance will be performed by: *[building occupants, operating staff, service company, Owner staff, other]*

Training required for building occupants: *[e.g. demonstration, instruction documents]*

Training required for operating and maintenance staff: *[e.g. demonstration, classroom training, instruction documents]*

Other Owner requirements:

CALGreen Compliance Form- Owner's Project Requirements (OPR)	DRAFT CALGreen Std. BSC-5.4-X 10-08-10

The following form may be required to be printed on the permit set of construction drawings or submitted separately. Italicized text indicates direct or partial quotes from the CALGreen Code.

CALGreen Commissioning Requirement 5.410.2.1-Owner's Project Requirements (OPR)

5.410.2.1 Owner's Project Requirements (OPR). The expectations and requirements of the building appropriate to its phase shall be documented before the design phase of the project begins. The OPR includes the checked elements listed below and have been approved by the Owner or Owner Representative.

	OPR Elements	**Included**
1.	Environmental and Sustainability Goals.	☐
2.	Energy Efficiency Goals.	☐
3.	Indoor Environmental Quality Requirements.	☐
4.	Project program, including facility functions and hours of operation, and need for after hours operation.	☐
5.	Equipment and Systems Expectations.	☐
6.	Building Occupant and O&M Personnel Expectations.	☐

_____ _____

Owner / Owner Representative Signature Date

CALGreen Compliance Template- Basis of Design (BOD)	DRAFT CALGreen Std. BSC-5.4-X 10-08-10

[Documentation of the Basis of Design (BOD) is a step required for compliance with 2010 CALGREEN Code, section 5.410.2.1, for newly constructed buildings greater than 10,000 sq. ft. This template is a guide for use by the design team.]

1. HVAC System

1.1. Narrative Description of System

A. [System type(s), location, control type, efficiency features, outdoor air ventilation strategy, indoor air quality features, noise reduction features, environmental benefits, other special features]

B. [Describe how system meets any special requirements listed in the Owner's Project Requirements document.]

1.2. Reasons for System Selection

A. [Reasons that the selected system is a better choice than alternatives. E.g. comfort performance, efficiency, reliability, flexibility, simplicity, cost, owner preferences, site constraints, climate, availability of maintenance, acoustics]

1.3. Load Calculations

A. Load calculation method/software: _____

B. Summer outdoor design conditions: __°F drybulb, __°F wetbulb

C. Winter outdoor design conditions: __°F drybulb

D. Indoor design conditions: __°F, __%RH cooling; __°F heating

E. Internal heat gain assumptions:

Space	Lighting Load	Plug Load	Occupant Load	Infiltration Load	Other:

F. Calculated cooling loads and system size:

System/ Air Handler ID	Calculated Peak Cooling Load	Selected System Cooling Capacity	Reasons for difference between calculated load and selected system capacity

G. Other load calculation assumptions:

1.4. Sequence of Operations

A. [Operating schedules, setpoints, etc. May refer to plans and/or specifications if sequence of operations is included there.]

2. Indoor Lighting System

2.1. Narrative Description of System

A. Fixture type(s)

B. Lamp and ballast type

C. Control type

D. [Describe how system meets any special requirements listed in the Owner's Project Requirements document.]

2.2. Reasons for System Selection

A. [Reasons that the selected lighting system is a better choice than alternatives. E.g. visual comfort performance, efficiency, reliability, flexibility, simplicity, cost, owner preferences, color rendering, integration with daylighting, ease of maintenance, etc.]

2.3. Lighting Design Criteria

Space ID	Space Type	Illumination Design Target (footcandles)	Source of Target (e.g. IES Standard, Owner Requirement)	Other Lighting Design Criteria: [e.g. CRI, CCT]

2.4. Lighting Power Design Targets

Space Type	Title 24 Lighting Power Allowance (watts/ft^2)	Lighting Power Design Target (watts/ft^2)

3. Water Heating System

3.1. Narrative Description of System

A. [System type(s), location, control type, efficiency features, environmental benefits, other special features]

B. [Describe how system meets any special requirements listed in the Owner's Project Requirements document.]

3.2. Reasons for System Selection

A. [Reasons that the selected water heating system is a better choice than alternatives. E.g. performance, efficiency, reliability, simplicity, space constraints, cost, owner preferences, ease of maintenance, utility company incentives, etc.]

3.3. Water Heating Load Calculations

A. [Describe sizing calculation method, assumptions, and results]

4. Renewable Energy Systems

4.1. Narrative Description of System

A. [System type(s), location, inverter type, control type, performance, efficiency, energy savings, payback period]

B. [Describe how system meets any special requirements listed in the Owner's Project Requirements document.]

4.2. Reasons for System Selection

A. [Reasons that the selected renewable energy systems are a better choice than alternatives. E.g. performance, efficiency, reliability, flexibility, simplicity, expandability, cost, payback period, utility company incentives, owner preference, space constraints, cost, owner preferences, ease of maintenance, etc.]

4.3. Renewable Energy System Generation Calculations

A. [Describe sizing calculation method, assumptions, and results]

5. Landscape Irrigation Systems

5.1. Narrative Description of System

A. [System type(s), location, control type, performance, efficiency, water savings]

B. [Describe how system meets any special requirements listed in the Owner's Project Requirements document.]

5.2. Reasons for System Selection

A. [Reasons that the selected landscape irrigation systems are a better choice than alternatives. E.g. performance, efficiency, reliability, flexibility, simplicity, expandability, cost, payback period, utility company incentives, owner preference, cost, owner preferences, ease of maintenance, etc.]

5.3. Landscape Irrigation System Calculations

A. [Describe sizing calculation method, assumptions, and results]

6. Water Reuse Systems

6.1. Narrative Description of System

A. [System type(s), location, space requirements, equipment requirements, control type, performance, efficiency, potable water savings, payback period]

B. [Describe how system meets any special requirements listed in the Owner's Project Requirements document.]

6.2. Reasons for System Selection

A. [Reasons that the selected water reuse systems are a better choice than alternatives. E.g. performance, efficiency, reliability, flexibility, simplicity, expandability, cost, payback period, utility company incentives, owner preference, space constraints, cost, owner preferences, ease of maintenance, etc.]

6.3. Water Reuse System Calculations

[Describe sizing calculation method, assumptions, and results]

CALGreen Compliance Form- **Commissioning Measures in the Construction Documents**	**DRAFT** **CALGreen** **Std. BSC-5.4-X** **10-08-10**

The following form may be required to be printed on the permit set of construction drawings or submitted separately. Italicized text indicates direct or partial quotes from the CALGreen Code.

CALGreen Commissioning Requirement 5.410.2-Commissioning Measures in the Construction Documents

5.410.2. Commissioning measures shall be shown in the construction documents. The commissioning measures shown in the construction documents include the checked elements listed below and have been approved by the Owner, Owner Representative or Designer of record.

	Commissioning Measure Elements	**Included**
1.	Measures shown in the specifications and cross referenced	☐
2.	List of commissioned equipment and systems	☐
3.	Cx roles and responsibilities of all parties	☐
4.	Meeting requirements	☐
5.	Commissioning schedule management procedures	☐
6.	Procedures for addressing outstanding issues or non-compliance	☐
7.	Requirements for execution and documentation of installation and equipment start up	☐
8.	Specific testing requirements for each system type1	☐
9.	Submittal review and approval requirements	☐
10.	Contents and approval process of the commissioning plan	☐
11.	Cx documentation and reporting requirements	☐
12.	Facility staff training requirements and verification procedures	☐
13.	O&M manual review and approval procedures	☐
14.	Systems manual development and approval procedures	☐
15.	Definitions	☐

1These are not the detailed step-by-step test procedures, but are lists of features, elements, modes and conditions of tests for specific equipment.

_____ _____

Owner / Owner Representative or Designer of Record Signature

Date

CALGreen Compliance Form- **Commissioning Plan**	**DRAFT** **CALGreen** **Std. BSC-5.4-X** **10-08-10**

The following form may be required to be printed on the permit set of construction drawings or submitted separately. Italicized text indicates direct or partial quotes from the CALGreen Code.

CALGreen Commissioning Requirement 5.410.2.3-Commissioning Plan

5.410.2.3 Prior to permit issuance a commissioning plan shall be completed to document how the project will be commissioned and shall be started during the design phase of the building project. The commissioning plan includes the checked elements listed below and has been approved by the Owner or Owner Representative.

	Commissioning Plan Elements	**Included**
1.	General project information	☐
2.	Commissioning goals	☐
4.	An explanation of original design intent	☐
5.	Equipment and systems to be commissioned and tested, including extent of tests	☐
6.	Functions to be tested and conditions of tests1	☐
7.	Measurable performance criteria	☐
8.	Cx team information	☐
9.	Cx activities, schedules and responsibilities	☐

1These are not the detailed step-by-step test procedures, but are lists of features, elements, modes and conditions of tests for specific equipment.

_____ _____

Owner / Owner Representative Signature Date

CALGreen Compliance Form- **Functional Performance Testing**	**DRAFT** **CALGreen** **Std. BSC-5.4-X** **10-08-10**

Italicized text indicates direct or partial quotes from the CALGreen Code.

CALGreen Commissioning Requirement 5.410.2.4-Functional Performance Testing

5.410.2.4 Functional performance tests shall demonstrate the correct installation and operation of each component, system, and system-to-system interface in accordance with the approved plans and specifications. Functional performance testing reports shall contain information addressing each of the building components tested, the testing methods utilized, and include any readings and adjustments made. Test forms have been developed for each piece of commissioned equipment and system and include the checked elements listed below. These tests have been executed with deficiencies corrected.

	Functional Test Elements	**Included**
1.	Date and parties participating	☐
2.	Signature block attesting test is complete and accurate	☐
3.	Prerequisites	☐
4.	Precautions	☐
5.	Instrumentation required	☐
6.	Reference to the source of what is being confirmed (sequences, packaged features, etc.)	☐
7.	Detailed step-by-step test instructions	☐
8.	Acceptance criteria	☐
9.	Results	☐
10.	Confirmation of returning to normal	☐
11.	Deficiency list	☐

_____ _____

Cx Coordinator Signature Date

CALGreen Compliance Form- **Systems Manual**	**DRAFT** **CALGreen** **Std. BSC-5.4-X** **10-08-10**

Italicized text indicates direct or partial quotes from the CALGreen Code.

CALGreen Commissioning Requirement 5.410.2.5.1 Documentation and Training-Systems Manual

5.*410.2.5.1 Systems Manual. Documentation of the operational aspects of the building shall be completed within the Systems Manual and delivered to the building owner or representative and facilities operator. The Systems Manual includes the checked elements listed below.*

	System Manual Elements	**Included**
1.	Site information including facility description, history and current requirements	☐
2.	Site contact information	☐
3.	Basic operations and maintenance and troubleshooting	☐
4.	Systems covered include major systems listed under the BOD.	☐
5.	Site equipment inventory and maintenance notes	☐
6.	Special inspection verifications	☐
7.	Other resources and documentation	☐

_____ _____

Owner or Owner Representative Signature Date

CALGreen Compliance Form- **Training**	**DRAFT** **CALGreen** **Std. BSC-5.4-X** **10-08-10**

Italicized text indicates direct or partial quotes from the CALGreen Code.

CALGreen Commissioning Requirement 5.410.2.5.2 Documentation and Training-Training

5.410.2.5.2 Systems Operations Training. The training of the appropriate maintenance staff for each equipment type and/or system shall be documented in the commissioning report. The written training program includes the checked elements listed below.

	Training Program Elements	**Included**
1.	System/equipment overview (what it is, what it does and with what other systems and/or equipment it interfaces)	☐
2.	Review and demonstration of servicing & preventive maintenance	☐
3.	Review of the information in the Systems Manual	☐
4.	Review of the record drawings on the system/equipment	☐

The Owner or Owner Representative attest that when the appropriate maintenance staff are made available prior to certificate of occupancy that the written training program was executed with these staff. Or, that if appropriate maintenance staff are not available, that the written training program was submitted and approved by the Owner or Owner Representative.

_____ _____

Owner or Owner Representative Signature Date

CALGreen Compliance Form- **Commissioning Report**	**DRAFT** **CALGreen** **Std. BSC-5.4-X** **10-08-10**

Italicized text indicates direct or partial quotes from the CALGreen Code.

CALGreen Commissioning Requirement 5.410.2.6-Commissioning Report

5.410.2.6 Commissioning Report. A complete report of commissioning process activities undertaken through the design, construction and reporting recommendations for post-construction phases of the building project shall be completed and provided to the owner or representative. The commissioning report includes the checked elements listed below and has been approved by the Owner or Owner Representative.

	Commissioning Report Elements	**Included**
1.	Executive summary with conclusions and outstanding issues	☐
2.	History of system deficiencies and resolution	☐
3.	Summary of system functional test results	☐
4.	Summary of training completion	☐
5.	Attachments of Commissioning plan, OPR, BOD, executed (filled in) installation checklists, executed functional tests, recommendations for end-of-warranty review	☐

_____ _____

Owner / Owner Representative Signature Date

Appendix A: Commissioning Project Sample(s) and Additional Forms and Templates

This appendix is supplemental to the Guide to the California Green Building Standards Code – Non-Residential (Commissioning), and is intended to provide additional resources for commissioning.

1. Commissioning sample project(s):
   http://www.documents.dgs.ca.gov/bsc/CALGreen/CX-SAMPLE-PROJECT.pdf

2. Commissioning sample Performance and Functional Testing (FPT) Template:
   http://www.documents.dgs.ca.gov/bsc/CALGreen/FTP-SAMPLE-TEMPLATE.pdf

Appendix B: Additional Commissioning Resources

This appendix is supplemental to the Guide to the California Green Building Standards Code – Non-Residential (Commissioning), and is intended to provide additional resources for commissioning.

Building Commissioning Cost Benefit Assessment report by the Lawrence Berkeley National Laboratory
http://cx.lbl.gov/2009-assessment.html

California Commissioning Collaborative
http://cacx.org