

#### AABC Commissioning Group AIA Provider Number 50111116

#### **Commissioning in the Building Codes**

Course Number: CXENERGY1921

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### An Overview Of Building Commissioning in Codes

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#### International Code Council

## Overview

- Codes and Standards
- Commissioning Provisions in the 2012, 2015 and 2018 IECC and 2010, 2013 and 2016 ASHRAE 90.1
- Commissioning Provisions in the 2012 and 2015 IgCC and 2011 and 2014 ASHRAE 189.1
- Commissioning Provisions in the 2018 IgCC (ANSI/ASHRAE/ICC/USGBC/IES 189.1-2017)



## Objectives

Upon completion of this presentation, participants will be able to:

- Describe an overview of the code required commissioning (Cx) process.
- Identify key provisions relating to commissioning contained in the International Energy and Green Codes and ASHRAE Energy and Green standards.
- Identify the referenced industry standards and guidelines for commissioning.



Part I

#### **Codes and Standards**

### **Codes and Standards**

- "Codes" are documents that are adopted by the legal authority in your jurisdiction and:
  - Establish minimum performance requirements to achieve life safety and property protection
  - Are written in "mandatory" language indicating what must be done
- "Standards" are documents referenced in the codes and indicate *how* to achieve what must be done







# International Building Code

- Applies to activities that require a permit
- Applies to construction activities that don't require a permit
- Other I-Codes are a subset





#### 15 Published 2018 I-Codes

- IZC
- ICCPC
- IGCC





#### Standards

- Referenced standard is version specific
- Last chapter of I-Codes





#### **Standards**

2012, 2015 and 2018 IBC reference A117.1-2009

 2009 and 2006 IBC reference A117.1-2003





### Conflicts

- Conflicts within the Code
  - Section 102.1
    - More Restrictive
    - General vs. Specific Requirements
- Conflict with another ordinance
- Conflict with a standard



## What are Codes?

- Model Code versus Law
- Local Ordinances
- Other Laws



#### **Example Adoption Ordinance**

- International Building Code, 2015 edition including appendix chapters E, F, G, I, J, and K
  - 903.2.8 This provision of the IBC is <u>not adopted</u>.
  - 1013.1.1 Exit Signs. Exit signs <u>shall not be located</u> more than 4 feet above exit door.
- Other 2015 ICC codes adopted by ordinance
  - IECC, IEBC, IRC, IPC, IMC, IFGC, ISPSC and IFC
- Other Codes adopted by ordinance
  - 2014 NEC (Chapter 35)
  - 2015 Life Safety Code



#### Jurisdiction Standards Adopted by Reference

- International Building Code
  - Chapter 9
    - NFPA 13-2013
    - NFPA 72-2013
  - Chapter 11
    - ICC A117.1-2009
  - Chapter 27
    - NFPA 70-2014
- International Energy Conservation Code
  - ASHRAE 90.1-2013



## **Other Laws**

- Local Ordinances
  - Zoning laws
  - Other adopted codes
- Other Laws
  - Americans with Disabilities Act
  - Federal Energy Conservation Acts



### **Cx Standards**

- ASHRAE 202-2018: Cx Process for Buildings and Systems
- ASHRAE Guideline 1.1-2007
- ASTM E 2813 Standard Practice for Building Enclosure Cx
- ICC G4-2012: Guideline For Commissioning



## **ASHRAE 202 Cx Process**

- Standard 202-2018 describes how to plan, conduct, and document commissioning of a project.
- Informative appendices provide sample documentation, including checklists, systems manual, reports, training plan, and more.
- Provides specifics of the overall Cx process
- Provides details within each activity of the Cx process



#### **ASHRAE 202-2018**

Activities and Deliverables	
Initiate Cx	Roles and Responsibilities
Decide Project Requirements	Owner Project Requirements
Develop Cx Plan	Cx Plan
Design Approach to Requirments	Basis of Design
Set Contractor Cx Requirements	Cx Specifications
Review Design to Requirements	Design Review Report
Review Submittals	Submittal Review Report
Observe and Test	Construction Checklist and Reports
Resolve Issues	Issues and Resolution Log
Assemble Systems Manual	Systems Manual
Conduct Training	Training Plans and Records
Postoccupancy Operation	End of Warranty Cx Progress Report
Assemble Cx Progress Report	Cx Progress Report



# **Owners Project Req. (OPR)**

**Documents the expectations and requirements:** 

- 1. Building use and operation
- 2. Project goals
- 3. Measurable performance criteria
- 4. Cost considerations
- 5. Benchmarks
- 6. Success criteria
- 7. Training



# **Basis of Design (BOD)**

#### **Documentation of**

- Concepts
- Calculations
- Decisions and product selections used to meet the OPR and to satisfy code and standard requirements
- It includes a narrative and a list of items that support the design



#### International Energy Conservation Code (IECC) and ASHRAE 90.1 Energy Standard Commissioning Provisions





#### **2012 IECC Definition** BUILDING COMMISSIONING (C202)

"A process that verifies and documents that the selected building systems have been designed, installed, and function according to the owner's project requirements and construction documents, and <u>to minimum</u> <u>code requirements</u>."



#### **2012 IECC Definition** BUILDING COMMISSIONING (C202)

"A process that verifies and documents that the selected building systems have been designed, installed, and function according to the <u>owner's project requirements</u> and construction documents, and to minimum code requirements."



- Mechanical
  - Commissioning Plan (C408.2.1)
    - Narrative
    - Equipment
    - Function to be tested
    - Conditions



# 2012 IECC / 202 Deliverables

C 408.2.1 Deliverables

**Roles and Responsibilities** 

**Owner Project Requirements** 

Cx Plan

**Basis of Design** 

**Cx Specification** 

**Design Review Report** 

**Submittal Review Report** 



- Mechanical
  - Threshold is 480 MBH cooling / 600 MBH heating
    - Excludes simple systems serving dwelling units



- Mechanical
  - Systems Adjusting and Balancing (C408.2.2)
    - Air
    - Hydronic
  - Functional Performance Testing (C408.2.3)
    - Equipment
    - Controls
    - Economizer
  - Preliminary Commissioning Report (C408.2.4)
    - Acceptance of Report
    - Copy of Report



### 2012 IECC / 202 Deliverables

#### C 408.2.2 and C408.2.3 Deliverables

**Construction checklist and reports** 

**Issues and resolution logs** 



- Mechanical
  - Preliminary Commissioning Report (C408.2.4)
    - Acceptance of Report
    - Copy of Report
  - Documentation Requirements (C408.2.5)
    - Construction documents
    - Manuals
    - System balancing report
    - Final Commissioning Report



## 2012 IECC / 202 Deliverables

#### C 408.2.4 and C408.2.5 Deliverables

**Construction checklist and reports** 

**Issues and resolution logs** 



- Mechanical
  - Documentation Requirements (C408.2.5)
    - Construction documents
    - Manuals
    - System balancing report
    - Final Commissioning Report



## 2012 IECC / 202 Deliverables

#### C 408.2.5 Deliverables

**Systems Manuals** 



- Lighting
  - Lighting System Functional Testing (C408.3)
    - Functional testing requirement
    - Construction document requirement
    - Report requirement is at the discretion of the code official



- Mechanical
  - Threshold is 480 MBH cooling / 600 MBH <u>combined service water-heating and space-</u> <u>heating</u>



- Lighting
  - Lighting System Functional Testing (C408.3)
    - Prescriptive functional testing <u>requirements added</u>
      - Occupant sensor controls
      - Time-switch controls
      - Daylight responsive controls



- General
  - Operations and maintenance manuals



- Lighting
  - Lighting System Functional Testing (C408.3)
    - Prescriptive functional testing <u>for required automatic</u> <u>controls</u>
    - Construction document requirements added
    - Operating manual requirements added
    - Report of functional testing requirement added



- Air Leakage Test (Optional)
  - ASTM E 779 (C402.4.1.2.3)
- Service Water Heating
  - Recirculation Pumps



- Mechanical
  - Completion requirements
    - Record drawings
    - Manuals
  - System balancing
    - Commissioning (6.7.2.4)
      - Controls testing and calibration
      - Final Commissioning Report



- Lighting
  - Lighting System Functional Testing (9.4.4)
    - Functional testing requirement
    - Construction document requirement
    - Report requirement is at the discretion of the code official



- Lighting
  - Lighting System Functional Testing (9.4.3)
    - Prescriptive functional testing <u>specific requirements</u> added
      - Occupant sensor controls
      - Time-switch controls
      - Daylight responsive controls
      - Independent testing



- Building Thermal Envelope
  - Air leakage verification (5.9.2.1)
    - Design review required
    - Nonconformity list generated



### International Green Construction Code (IgCC) and ASHRAE 189.1





- 901.1 Scope.
  - The provisions of chapter 9 are intended to facilitate pre- and post-occupancy commissioning, operation and maintenance of buildings and structures
- 902.1 Approved agency.
  - An approved agency shall provide all of the information necessary for the *code official* to determine that the agency meets the applicable requirements.
  - The code official shall be permitted to be the approved agency.



- 902.1.1 Independence.
  - An approved agency shall be objective, competent and independent from the contractor responsible for the work being inspected.
  - An approved agency shall have adequate equipment to perform the required commissioning.
  - An approved agency shall employ experienced personnel educated in conducting, supervising and evaluating tests and commissioning.



- 903.1 General.
- The registered design professional in responsible charge or approved agency shall perform commissioning during construction and after occupancy as required by Table 903.1.
- The approved agency shall be qualified and shall demonstrate competence, to the satisfaction of the *code* official.
- The registered design professional in responsible charge and engineers of record involved in the design of the project are permitted to act as the approved agency.



# 2012 IgCC Cx Report Ch. 9

- 903.1.1 Preoccupancy report requirement.
  - The approved agency shall keep records of the commissioning required by Table 903.1. The approved agency shall furnish commissioning reports to the owner and the registered design professional in responsible charge and, upon request, to the code official.
  - Prior to the issuance of a Certificate of Occupancy, a final commissioning report shall be submitted to and accepted by the code official.

#### 903.1.2 Post-occupancy report requirement.

 Post-occupancy commissioning shall occur as specified in the applicable sections of this code. A post-occupancy commissioning report shall be provided to the owner within 30 months after the Certificate of Occupancy is issued for the project and shall be made available to the *code official* upon request.

#### **Commissioning IgCC**

- Chapter 9 Table 903.1
  - Site Development and Land Use
  - Material Resource and Efficiency
  - Energy (chapter 6)
  - Lighting
  - Water Resource Conservation, Quality, & Efficiency
  - Indoor Environmental Quality & Comfort
- Re-Commissioning (Post Occupancy)
  - Required within 30 months of occupancy
  - Report is provided to the owner with no action required by the code official





#### **BUILDING OPERATIONS AND MAINTENANCE**

#### 904.1 General.

- Building operations and maintenance documents in accordance with Section 904.3 shall be submitted to the owner prior to the issuance of the Certificate of Occupancy.
- The building owner shall file a letter with the *code official* certifying the receipt of record documents and building operations and maintenance documents.
- 904.2 Record documents. Record documents shall include all of the following:
  - 1. Copies of the *approved* construction documents, including plans and specifications.
  - 2. As-built plans and specifications indicating the actual locations of



- 904.2 Record documents.
  - 3. For sites that have previously been copies of engineering and institutional control information shall be provided.
  - 4. A copy of the Certificate of Occupancy.
- 904.3 Building operations and maintenance documents.
  - The building O&M documents shall consist of:
  - The manufacturer's specifications and recommendations,
  - Programming procedures illustrating to the owner how the building, site and systems are intended to be maintained and operated.
  - The information listed in items 1-6 of this section shall be included in the materials, as applicable to the specific project:



CH. 6 ENERGY SYSTEMS COMMISSIONING AND COMPLETION

- All of the following items are consistent with '15 IECC except post-occupancy recommissioning
  - 611.1 Mechanical systems commissioning
  - 611.1.1 Commissioning plan.
  - 611.1.2 Systems adjusting and balancing.
  - 611.1.3 Functional performance testing.
  - 611.1.4 Preliminary commissioning report.
  - 611.1.5 Completion requirements.
  - 611.1.5.4 Final commissioning report.
  - 611.1.5.5 Post-occupancy recommissioning.



- Energy Systems Commissioning (611)
  - Mandatory
    - Mechanical
    - Lighting
    - Mandatory building thermal envelope air tightness test (605.1.2)



- Energy Systems Commissioning (611)
  - Mandatory
    - Mechanical
    - Lighting
    - Mandatory building thermal envelope air tightness test
    - Domestic hot water equipment and systems



#### CONSTRUCTION AND PLANS FOR OPERATION

- 10.1 Scope.
  - This <u>section</u> specifies requirements for construction and plans for operation, <u>including the *commissioning process*</u>.
- 10.3 Mandatory Provisions
- 10.3.1 Construction
- 10.3.1.1 Building Acceptance Testing.
  - Acceptance testing shall be performed on all buildings using generally accepted engineering standards and handbooks acceptable to the AHJ.
  - An acceptance testing process shall be incorporated into the design and construction of the *building project*



- Energy Systems Commissioning (10.3)
  - Mandatory
    - Acceptance testing (10.3.1.1)
      - Mechanical systems
      - Lighting systems
      - Fenestration control systems
      - Renewable energy systems
      - Water measuring devices
      - Energy measuring devices
    - Building Commissioning (10.3.1.2)



- Energy Systems Commissioning (10.3)
  - Mandatory
    - Acceptance testing (10.3.1.1)
      - Mechanical systems
      - Lighting systems
      - Fenestration control systems
      - Renewable energy systems
      - Water measuring devices
      - Energy measuring devices
    - Building Commissioning (10.3.1.2)
      - OPR
      - BOD



- Energy Systems Commissioning (10.3)
  - Mandatory
    - Acceptance testing (10.3.1.1)
      - Mechanical systems
      - Lighting systems
      - Fenestration control systems
      - Renewable energy systems
      - Water measuring devices
      - Energy measuring devices
    - Building Commissioning (10.3.1.2)
      - OPR
      - BOD



#### Commissioning ASHRAE 2011 Standard 189.1

**Building Project Commissioning – Section 10** 

Buildings exceeding 5000 ft<sup>2</sup> of gross floor area

- a. Mech systems: HVAC, IAQ, and refrigeration systems
- b. Lighting systems: daylighting controls, occupancy sensing devices, and, automatic shut-off controls
- c. Fenestration Control Systems: Automatic controls for shading devices and dynamic glazing.
- d. Renewable energy systems.
- e. Water measurement devices
- f. Energy measurement devices
- Re-Commissioning (Post Occupancy)



- 10.3.1.2 Building Project Commissioning.
  - Buildings that exceed <u>5000 ft2</u> (500 m2), commissioning shall be performed using <u>generally accepted engineering standards</u>
  - Buildings complying with commissioning process will be deemed to comply with the requirements "Building Acceptance Testing."
  - A commissioning process shall be incorporated into the predesign, design, construction, and first year occupancy of the building project that verifies that the components, assemblies, and systems comply with the <u>documented OPR</u>.
  - Procedures, documentation, tools, and training shall be provided to the building op.erating staff



- 10.3.1.2.1 Activities Prior to Building Permit.
- Designate a project *commissioning authority* (CxA)
- The owner, in conjunction with the design team as necessary, shall develop the OPR during predesign.
- The design team shall develop the BOD.
- The CxA shall review both the OPR and BOD.
- Construction phase commissioning requirements shall be incorporated into project specifications and other construction documents developed by the design team.
- The CxA shall conduct two focused OPR reviews
- Develop and implement a *commissioning plan* containing



#### 10.3.1.2.2 Activities Prior to Building Occupancy.

- Verify the installation and performance of the systems to be commissioned, including completion of the *construction checklist* and *verification*.
  - Exception to 10.3.1.2.2(a): Systems that, because their operation is seasonally dependent,
- It shall be verified that the owner requirements for the training of operating personnel and building occupants is completed..
- Complete preliminary commissioning report.
- Verify a system manual has been prepared that includes O&M documentation



- 10.3.1.2.3 Post-Occupancy Activities.
  - Complete any commissioning activities called out in the commissioning plan
  - Verify the owner requirements for training operating personnel and building occupants are completed.
  - Complete a final commissioning report.
- 10.3.1.2.4 Systems. The following systems, if included in the building project, shall be commissioned:
  - Heating, ventilating, air-conditioning, IAQ, and refrigeration systems (mechanical and/or passive) and associated controls.
  - Building envelope systems, components, and assemblies to verify the thermal and moisture integrity.



- 10.3.1.2.4 Systems cont'd
  - Building envelope pressurization for air-tightness
  - Lighting systems.
  - Automatic controls for fenestration shading devices and *dynamic* glazing.
  - Service water heating systems, Irrigation and plumbing
  - Domestic and process water pumping and mixing systems.
  - Renewable energy systems.
  - Water measurement devices, as required in Section 6.3.3.
  - Energy measurement devices, as required in Section 7.3.3.
- 10.3.1.2.5 Documentation. Owner shall retain the System Manual and Final Commissioning Report.



#### 2018 IgCC Commissioning (ANSI/ASHRAE/ICC/USGBC/IES 189.1-2017)

- Functional Performance Testing
- Commissioning references ASHRAE 202



# Summary

- Commissioning Process
  - IECC/90.1
    - Prescriptive
    - No referenced standards
  - IGCC/189.1
    - Prescriptive
    - Larger scope
    - No referenced standards
  - 2018 IgCC (ANSI/ASHRAE/ICC/USGBC/IES 189.1-2017)
    - Prescriptive
    - References ASHRAE 202



#### **Questions & Answers**

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