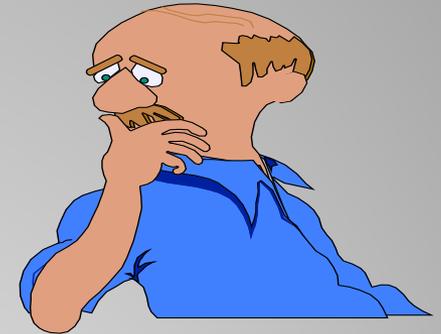


Codes and Standards - Commissioning Application

**Gerald J. Kettler, PE,
CCP, CPMP, BEMP, LEED Fellow**

**Facility Performance Associates - CCA
Dallas, Texas**

Commissioning Process Requirements



- Requirements Documented
- Design Meets Requirements
- Construction Meets Design Documents
- Systems Tested to Verify Performance
- Operators Trained
- Documentation and Records

ASHRAE Guideline 0-2013

- Pre-Design- Owner's Project Requirements (Design intent), Commissioning Plan, Scope and Budget for Commissioning
- Design- Basis of Design, Plans and Specifications, Commissioning Plan for Specific Project, Training Requirements.
- Construction - Procedures, Submittals, Verification, Functional Testing, Documentation, Systems Manuals, Training
- Occupancy and Operations- Retesting, Remodeling, Maintenance, Seasonal Testing

ASHRAE Standard 202-2013

Title: "The Commissioning Process for Buildings and Systems"

- Process Document
- Minimum Requirements for the commissioning process using ASHRAE Guideline 0-2005 as the base process
- Consensus Development

ASHRAE Standard 202-2013

What Standard 202 will NOT do:

- Define specific types of projects such as existing building projects
- Define qualifications of commissioning providers
- List building size, type or usage
- List systems or assemblies
- Include enforcement provisions

ASHRAE Standard 202 Organization

- Process listed by functional steps and not by project phase
- Each of 13 functional steps has deliverables
- The main body of the standard has 17 chapters
- There will be 15 annexes showing outlines of the deliverables.

ASHRAE Standard 202 - 2013

Activity

Deliverable

Initiate Commissioning
Process



Roles and Responsibilities

Project Requirements



Owner's Project
Requirements (OPR)

Develop Commissioning
Plan



Commissioning Process
Plan (CxP)

Design Approach to
Requirements (BOD)



Basis of Design

ASHRAE Standard 202-2013

Activity

Deliverable

Set Contractor Cx
Requirements



Cx Specifications

Design Review



Design Review Report

Review Submittals



Submittal Review
Report

Observation
& Testing



Construction Checklists
& Reports

ASHRAE Standard 202-2013

Activity

Deliverable

Issues Resolution



Issues Log

Assemble Systems Manual



Systems Manual

Conduct Training



Training Plans and
Records

Post Occupancy Operation



End of Warranty Cx
Report

I. Commissioning Process
Report

Cx Process Report

Commissioning Process Utilization

- LEED® Green Building Process
- ASHRAE Standards
 - 62.1 Ventilation for Acceptable IAQ
 - 90.1 Energy Standard
 - 189.1 Design of Green Buildings
- ICC Codes – Building and Mechanical Codes
 - IECC –Energy Conservation Code
 - IGCC- Green Construction Code

Commissioning Process Utilization

- National Institute of Building Sciences (NIBS) Guideline 3 – Building Enclosures
- ASTM – 2813-12 Standard Practice for Building Enclosure Commissioning
- Illuminating Engineering Society (IES) – Commissioning Guideline, DG-29-11
- NFPA - Standard 3 and 4 – Commissioning and Integrated Testing
- ASPE – Plumbing Commissioning

LEED Commissioning Process Fundamental – 2009 (Version 3)

- Appoint Commissioning Authority
- Owner's Project Requirements and Basis of Design
- Commissioning Requirements in Construction Documents
- Develop Commissioning Plan
- Verification Installation and Performance Testing, and Documentation
- Provide Commissioning Report

LEED Commissioning Process Enhanced - 2009 (Version 3)

- Independent Commissioning Authority
- Design Review @ Design Development
- Design Review @ Construction Documents
- Review Selected Submittals
- Develop Systems Manuals including Recommissioning Management Process
- Verify Training of Operating Personnel
- Post Occupancy 10 Month Review

LEED Fundamental Commissioning Process - v4 Changes

- Moves design review to Fundamental Cx
- References ASHRAE Guidelines 0, 1.1 and NIBS Guideline 3
- Includes building enclosure Cx in OPR and BOD requirements
- Prepare a CFR and O&M Plan
- Modify Cx Authority requirements

LEED Enhanced Commissioning Process - v4 Changes

- Points for Enhanced Cx (3 points)
 - Develop an on-going Cx Plan
 - Verify Systems Manuals and Training Requirements in documents and performance
- Monitoring Based Commissioning +1 point
 -
- Provide Building Enclosure Cx (+2 points)

ASHRAE Standards

- ASHRAE 55-2010, Thermal Environmental Conditions for Human Occupancy
- Chapter 6, Design Compliance and Chapter 7 Evaluation of Comfort includes: Measurement, Documentation and Validation Requirements but does not call it the Commissioning Process

ASHRAE Standards

ASHRAE 62.1-2013, Ventilation for Acceptable Indoor Air Quality

- Chapter 7 requires Air Balancing per ASHRAE Standard 111 or equal, testing of drain pans and OA dampers, and Systems Manual information
- Chapter 8, O&M requires an O&M manual, operation per design, and maintenance of ventilation system components

ASHRAE Standards

ASHRAE 90.1- 2013

- Paragraph 6.7.2.3 requires System Balancing to accepted engineering standards with written report
- Paragraph 6.7.2.4 requires HVAC control systems be tested.
- For buildings > 50Ksf HVAC Commissioning is required by ASHRAE Guideline 1-2007

ANSI/ASHRAE/USGBC/IES Standard 189.1-2011

Acceptance Testing – All Buildings per Accepted Engineering Standards and Handbooks

- Before Building Permit: Designate Project 'Acceptance Representative' in Construction Documents and Detail Tests to be Performed
- Before Building Occupancy: Verify Proper Installation, Perform Acceptance Tests, Complete Test Form with Signature and License Number of Performing Party, Verify Systems Manual
- Systems Include: Mechanical, Lighting, Renewable Energy, Energy and Water Measurement Devices

ANSI/ASHRAE/USGBC/IES Standard 189.1-2011

Commissioning – All Buildings over 5,000 Sq. Ft.

- Prior to Building Permit: Designate Commissioning Authority, Develop the 'Owner's Project Requirements' and 'Basis of Design', CxA to Review OPR and BOD, Include Commissioning Requirements in the Specifications, Develop a Commissioning Plan, CxA to Conduct two Plan Reviews.
- Prior to Building Occupancy: Verify installation and Performance of Systems, Verify Systems Manuals, Verify Training of Operators, Complete Commissioning Report
- During Post-Occupancy: Complete Commissioning for Operations, Added Training, and Final Updated Commissioning Report
- Systems Include: HVAC, Building Envelope Thermal, Moisture and Pressurization, Lighting, Irrigation, Plumbing, Renewable Energy, Water and Energy Measurement

Building Code – IBC 2015

International Building Code - 2015 includes Special Inspector Requirements 'to verify proper commissioning of Smoke Control Systems' in Section 909.3.

Commissioning shall be by accepted engineering practice and published standards.
1703 Approved agency qualifications include: independence, adequate calibrated equipment, experienced personnel

No ASHRAE Standards are referenced

International Mechanical Code – 2015

*Section 513.3 refers to special inspection to verify proper Commissioning of Smoke Control Systems as in IBC section 909

*Commissioning shall be IAW generally accepted engineering practice and published standards.

*ASHRAE Standards referenced = 15, 34, 62.1, 170, 180

International Energy Conservation Code – 2009

- 5.3.2.9 HVAC System Completion- Prior to Certificate of Occupancy, design professional shall provide evidence of system completion
 - 503.2.9.1 Each supply air outlet and zone terminal shall be equipped with means for air balancing per IMC
 - 503.2.9.2 Individual hydronic coils shall be equipped with means for balancing
 - 503.2.9.3 Construction documents shall require O&M manuals

International Energy Conservation Code – 2012

- C408 System Commissioning- **Prior to Final Inspection**, Registered Design Professional shall provide evidence of system (HVAC and Lighting) Commissioning and completion including:
 - Construction documents include commissioning
 - Commissioning Plan by RDP or Approved Agency
 - Air & Hydronic Systems Balancing and Reports
 - Functional Performance Testing
 - Documentation – O&M
 - Preliminary Commissioning Report with written Owner Acceptance
 - Final Commissioning Report within 90 days

International Energy Conservation Code – 2015

- C408 System Commissioning- **Adds:**
 - Service Water Heating
 - Approved agency approval of mechanical commissioning
 - Lighting and daylighting testing
 - Documentation

IGCC – International Green Construction Code - 2012

Chapter 9 - **Commissioning, Operation and Maintenance**

Commissioning Definition:

- A process that verifies and documents that the selected building and the site systems have been designed, installed and function in accordance with the owner's project requirements, and construction documents, and minimum code requirements.
- *Similar in IECC 2015*

IGCC – International Green Construction Code - 2012

- Section 903 – Commissioning
- The Registered Design Professional in Responsible Charge or Approved Agency Shall Perform Commissioning during Construction and After Occupancy per 903.1
 - **Approved Agency:** (AHJ to approve Qualifications)
 - Objective, Competent and Independent from Contractor
 - Adequate, Calibrated Equipment
 - Experienced, Educated Personnel

IGCC – International Green Construction Code - 2012

- Pre-Occupancy Report “Prior to the issuance of a certificate of occupancy, a final Commissioning Report shall be submitted to and accepted by the code official”
- Post-Occupancy Commissioning Report shall be provided to the owner within 30 months after Certificate of Occupancy

IGCC – International Green Construction Code - 2012

Table 903.1 Commissioning Plan includes:
Construction or Systems requiring verification
and commissioning of all the building systems
in IGCC plus other items.

Cal Green / Title 24

Building Commissioning - 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.

Cal Green / Title 24

5.410.2 Commissioning required for buildings over 10,000 Sq.Ft. by trained and experienced personnel.

Requirements include:

- Owner's Project Requirements
- Basis of Design
- Cx Requirements in Construction Documents
- Commissioning Plan
- Functional Performance Testing
- Documentation and Training
- Commissioning Report

Green Globes

Green Building Initiative Program

- Successor to BREEAM in UK.
- All voluntary points program. Number of points determine number of Globes earned.
- Commissioning not required but points are awarded for a Commissioning Plan.
- Construction Commissioning is mentioned as part of the verification process.

CHPS – Collaborative for High Performance Schools

- Similar Point System to LEED for Schools with Easier Certification
- Requires Fundamental “Building Systems Testing and Training”
- CxA in CHPS is called “Independent Verification Service Provider”
- “Qualified District Official” can do Cx
- Training and Documentation must be provided

CHPS – Collaborative for High Performance Schools

- IPVSP or QDO must satisfy BCA Essential Attributes and have Relevant Experience
- Systems include HVAC, Controls, Lighting and Domestic Water
- Enhanced Process (Points) includes: Commissioning Plan, DID, BOD, Specs, Verification, Functional Performance, Training, Documentation and Commissioning Report

NIBS Guideline 3 - 2012

ANNEXES: *Focus on Exterior Enclosure*

- B - Commissioning Process Flowchart
- C - Costs and Benefits
- D - Documentation and Responsibilities
- F - Roles and Responsibilities - Cx Team Members
- J - Owner's Project Requirements
- K - Basis of Design
- L - Specifications
- M - Construction Checklists
- O - Systems Manual
- R - Integration Requirements
- S - Interference and Coordination with other Systems
- U - Exterior Enclosure Testing Procedures
- Z - List of Example Calculation Procedures and Tools

Annexes A, E, G, H, I, N, P, T, V, W, X, Y are not used, see GL0

NIBS Guideline 3 – 2012

Building Enclosure Commissioning Process

Annex U: Exterior Enclosure Testing Procedures

Sub-Annex Ua: Laboratory Testing

- Sub-Annex Ua1: Laboratory Testing Case Study Example

Sub-Annex Ub: Field Testing

- Sub-Annex Ub1: Field Testing Case Study Example
- Sub-Annex Ub2: Recommended Practice for Incremental Field Air and Water Testing

Sub-Annex Uc: Resources for Testing

- Sub-Annex Uc1: Reference Standards for Field Testing
- Sub-Annex Uc2: Technical information
- Sub-Annex Uc3: Testing Resources by wall Assembly

ASTM E 2813-12

“Standard Practice for Building Enclosure Commissioning”

- References ASHRAE Guideline 0 and NIBS Guideline 3
- Utilizes same project phases as Guideline 0
- Requires an OPR to address: Energy, Environment, Safety, Security, Durability, Sustainability and Operations

ASTM E 2813-12

- Standard is divided into Fundamental and Enhanced processes.
- Requires four independent, third party, design peer reviews of design.
- Includes six pages of ASTM standards that must be tested and/or complied with.

Illuminating Engineering Society

Commissioning Guideline DG-29-11

“The Commissioning Process Applied to Lighting and Control System”

References and utilizes the same phases as
ASHRAE Guideline 0

IES Commissioning Guideline

DG-29-11

- Annex A: Example of Design Related to Lighting and Control
- Annex B: Design Criteria for Lighting and Control Systems
- Annex C: Construction Checklists for Lighting and Control Systems
- Annex D: Sample Performance Testing Procedures for Daylighting and Lighting Control Systems

National Fire Protection Association – Standard 3 - 2012

- **“Recommended Practice for Commissioning and Integrated Testing of Fire Protection and Life Safety Systems”**
- Written as: a QA/QC process, best practices, project management, and administration.
- Not written in mandatory language.

National Fire Protection Association – Standard 3 - 2012

- Commissioning and Integrated Systems chapters use similar phases as Gdl-0
- An application handbook has been published
- This guideline will be separated into a revised Guideline 3 on commissioning practice and a new Guideline 4, Standard on Integrated Testing

NFPA Codes

- NFPA 72-2013 Fire Alarm Code
 - Chapter 14 – Inspection, Testing and Verification
 - 14.2.10.2 – System Commissioning Testing
- NFPA 90A-2012 – HVAC Systems
 - Chapter 7 – Acceptance Testing
- NFPA 92 – Smoke Control Systems
 - Chapter 7 – Smoke Control Systems Documentation
 - Requires report of initial commissioning of the systems be included in the O&M Manual

-

International Code Council

G4-2012 Guideline for Commissioning

Ch 3. Standards for Compliance with
Building Commissioning

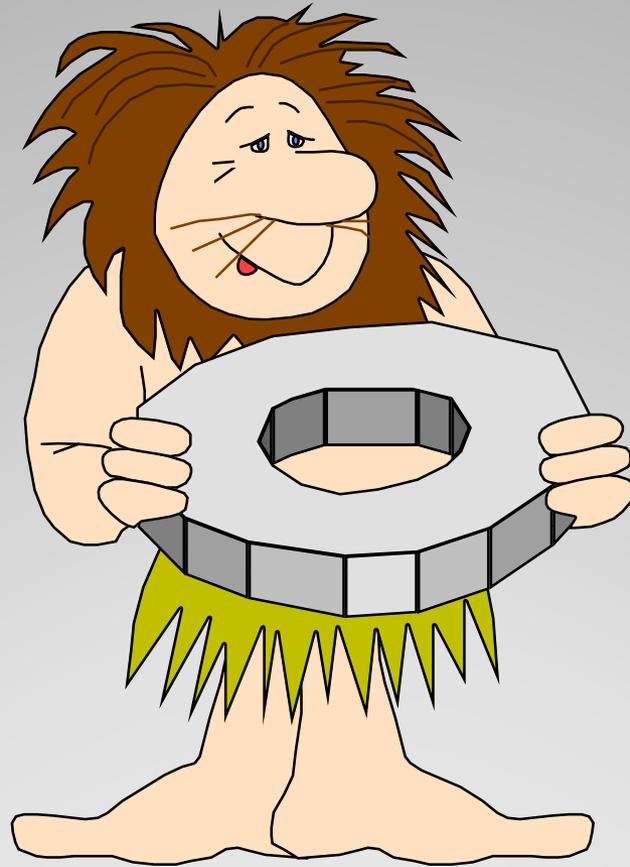
Ch 4. Compliance Templates and Forms

Ch 5. Required Skills and Minimum
Requirements

Ch 6. Functional Systems Checklist

International Code Council

- Standard 1000 - Commissioning
 - Now in public review



QUESTIONS

GJKETTLER@ATT.NET