Total Building Commissioning, Re/Retro-Commissioning & Energy Audits: Perception v Reality

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Course Training Objectives

- Commissioning / Retro-Commissioning Process
- Standards, References, Benefits
- Case Study – B27 (“RCx” Lite)
- Commissioning & Sustainability
Introductions

• Instructor: Woody Thompson

• Attendees:
  – Owners / Owner Representatives
  – Designers, A/E
  – General Contractors, Subcontractors
  – Facility / O&M Managers
  – Commissioning Agents & Specialists
POP QUIZ!

• What is **YOUR** definition of Commissioning?
• What **VALUE** does Commissioning provide, **IF ANY?**
What Cx /RCx IS NOT!

• Construction Administration / Quality Control
• Bunch of Tests at the End of Construction
• Test and Balance / PVT
• Maintenance Contract
• Energy Audit / Study
The Commissioning Process

“The Commissioning Process is a quality-focused process for enhancing the delivery of a project by verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owner’s Project Requirements.”

-- ASHRAE Guideline 0-2013: The Commissioning Process
What is Cx? RCx? ReCx?

• **Commissioning** is performed specifically to ensure that the finished facility operates in accordance with the owner’s documented project requirements (OPR) and the construction documents (BOD).

• **Retro-Commissioning** is the commissioning process as applied to an existing facility that has never been commissioned. Focus is on building performance and how to improve utility/energy consumption.

• **Re-Commissioning** is the commissioning process as applied to an existing building that had been commissioned but no longer meets owner’s current operational need.
More Definitions

• **Commissioning Authority / Agent**
  – Helps Commissioning Team Implement Cx Process
  – Leads, Plans, Schedules, & Coordinates Commissioning Team
  – Hired by Owner (Ideally)

• **Commissioning Team**
  – Owner, DoR, GC & Subs, CxA & Specialists
  – All Stakeholders that Implement Commissioning Process
What Can Be Commissioned?

• HVAC system and associated controls
• Electrical lighting and power
• Plumbing systems
• Building envelope
• Renewable energy systems
• Refrigeration systems
• Industrial process system
• Life safety & fire protection systems
• Security systems
• JUST ABOUT ANYTHING!
Cx / RCx References

- ASHRAE Standard 202-2013
- ASHRAE Guideline 0-2013 (replaced 0-2005)
- ANSI / ASHRAE Standard 189.1-2011
- EISA 2007 & EPACT 2005
- EO’s 13423, 13514, 13693
- Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings
- UFC 1-200-2 High Performance & Sustainable Building Rqts.
- IECC 2015
Cx / RCx References (Cont.)

- NIBS Guideline 3-2012 (envelop)
- IES DG-29-11 (lighting)
- Whole Building Design Guide
- ACG Commissioning Guideline
- NEBB Procedural Standards for Building Systems Commissioning & Retro-Commissioning
- SMACNA HVAC Commissioning Guideline
- Portland Energy Conservation, Inc. (PECI)
- *NUMEROUS OTHERS!
The Retro-Commissioning (RCx) Process

Process applied to a building that was **NEVER COMMISSIONED**.
The retro-commissioning process involves activities that are integrated into every phase of the project . . .

**NOT A MAINTENANCE CONTRACT!**

**NOT JUST AN ENERGY STUDY!**
The Retro-Commissioning Process: Overview

- **Project Inception**
- **Pre-planning & Planning Phase**
- **Investigation Phase**
- **Implementation Phase**
- **Hand-off & Persistence Phase**
Retro-Commissioning: Pre-Planning / Contract Phase

- Clearly Define Scope of RCx
- Direct Consulting Service: Discovery & Recommendations
- Turn-Key: Discovery & Repair
Retro-Commissioning: Pre-Planning / Contract Phase (Cont.)

- Initial Site Tour: Identify Possible Candidate Buildings
  - General Conditions
  - Access to Equipment
  - Availability of Existing Documentation
  - Involvement / Availability of Owner O&M Staff

- Proposal Development

- Contract
Retro-Commissioning: Planning / Pre-Site Investigation Phase

- Collect All Available Documentation
- Review
  - Plans, Specs, O&M Docs
  - Utility Bills
  - Work Orders
  - Maintenance Lists
  - Controls Trend & Alarm Logs
  - Contractor Service Invoices
- Understand Current Facility Requirements (CFR)
Retro-Commissioning: Planning / Pre-Site Investigation Phase (Cont.)

- Develop RCx Plan
- Analyze Utility Usage
- Conduct Management, Maintenance, and Occupant Staff Interviews.
- Review and Modify Current Facility Requirements (CFR)
What is a CFR?

• May be Created from the Original OPR
• Developed by Owner and RCxA (like an OPR)
• Functional Requirements of Existing Building:
  – Building Use & Occupancy
  – Sustainability
  – Energy & Efficiency
  – Envelope
  – HVAC&R
  – Electrical / Lighting
  – Water Usage: Plumbing & Landscape
  – O&M
Retro-Commissioning:
Investigation / Analysis Phase

- In Depth Examination and Tests of Building Systems
- Analyze Issues Found & Provide Recommendations
- Confirms and/or Modifies CFR
- Owner’s O&M Staff SHOULD Assist
Retro-Commissioning: Investigation Phase (Cont.)

• Site Dataloggers Utilized
  – Temperature & Humidity
  – Lighting Levels
  – Determine Scheduled/Timed Events

• Design Calculations / Studies
  – Energy Load Calcs
  – Power and Lighting
  – Water Usage
  – Fire & Life Safety
Retro-Commissioning: Investigation Phase (Cont.)

- Functional Tests Performed
- “Quick Fixes” MAY be Performed
- Define and Analyze Issues
- Recommend Problem Resolution
- Develop and Present an Investigation (Corrective Action) Report
What is an Investigation Report?

- Recommended Solutions for Owner Consideration
- Evaluates Costs & Benefits of each Recommendation
- Report Contents
  - Issue Description
  - Recommended Solution
  - Budgetary Cost of Solution
  - Anticipated Savings or Results
  - Sustainability Impact of Solution (ECM)
  - Priority of the Recommendation
  - Anticipated Implementation Schedule
Retro-Commissioning: Implementation Phase

- Corrective Action Phase
- Owner Decides What (if any) Recommendations areImplemented
- Implementation
  - Owner Staff
  - Design/Build
  - Design/Bid/Build
Retro-Commissioning: Implementation Phase (Cont.)

• Remedial Design (as needed)

• Construction

• Commissioning (by original RCx team)
  – Design Phase
  – Construction Phase
  – Acceptance Phase
  – Warranty Phase
Retro-Commissioning: Hand-Off Phase

• Validates Performance after Corrective Actions are Made
• Conduct “Lessons Learned” Workshop
• Verify O&M Personnel Training
• Conduct Periodic Performance Evaluations of Systems & Assemblies
• Deliver Final Retro-Commissioning Report & Systems Manual
What is a Final RCx Report?

• Presented to the Owner at the end of RCx Services
• Can be presented at end of Investigation, Implementation, or Hand-Off Phase
• Includes:
  – Project CFR
  – RCx Plan
  – Interview Records
  – Data Logs
  – Investigation Report
  – Implementation Report
  – All Test Results
  – Issues Logs
  – Training Documentation
  – Re-Commissioning Plan and Recommendations
What is an Energy Audit / Survey?

• It serves the purpose of identifying where a building or plant facility uses energy and highlights energy conservation opportunities (ECOs). – Albert Thumann

• Detailed examination and analysis of how a facility uses energy.
• Identifies what the facility pays for that energy.
• Recommends a program for changes in operational practices and / or energy consuming equipment.
Audits vs. Retro-Commissioning
Similar but NOT the Same

Audits - Often Performed in “Older” Facilities
• Investigate what’s there. Determine how it is performing. Determine if it can be improved economically (Energy & Maintenance Savings offset capital investment – ECMs / ECOs)
• Product is an Implementation Document – Similar to RCx Plan.

RCx – Performed on Existing Buildings, relatively new or old
• Goal – Make facility perform “As Owner Intended”. Owners contractor/ maintenance staff usually performs corrective action.
• Product - Properly operating building, with documentation proving same. Some investment might be necessary.
“RCx” Case Study - ISSUES

Bldg 26 - Natatorium
LEED v3 Gold Certified

- Excessive Humidity and Thermal Loads
- Deficient Performance of HVAC
- Negative Effects on Air & Pool Water Temperature
- Controls Issues
- Air & Water Balance Issues
“RCx” Case Study - ACTIONS

Bldg 26 – Natatorium

- Detailed Analysis of Existing Systems Performance – Functional Testing
- Thorough Audit of HVAC Systems
- Interviewing Occupants
- Data Collection of Zone Temp/Humidity
- “Forensic” Engineering
“RCx” Case Study - SOLUTIONS

Bldg 26 – Natatorium

RECOMMENDATIONS

- Design of Replacement AHU
- Refining Sequence of Operation
- Resolving Other Found Issues previously Unknown
- Complete Air & Hydronic Rebalance
Lessons Learned = **SUCCESS**

- Everyone is a Stake-Holder (Owner, DoR, GC, Subs & CxA)
- Clear OPRs, SOWs & Concise Contracts **MANDATORY**
- Ambiguity is **THE ENEMY**
- Top-Down Instructions (OPR, BoD, Specs)
- Universal Communication
- Owner’s Interest is Paramount
UFC 1-200-02  High Performance & Sustainable Building Requirements

- New Building Cx, Par 2-2.2 – Follow ASHRAE 189.1, Par 10.3.1.2
  - All Phases: Pre-Planning thru Warranty
  - Total Building
    - HVAC & Controls (BMS, EMCS, etc.)
    - Envelop – Thermography & Pressurization Tests
    - Lighting & Fenestration Control
    - Irrigation
    - Plumbing
    - Domestic & Heating Hot Water
    - Renewable Energy Systems
    - Water & Energy Measurement Systems (M&V)
RCx, Par 3-2.2 – Optimize Performance
All Phases: Pre-Planning thru Warranty
Total Building w/ same Systems as New Bldg Cx

RCx, Par 4-2.2
Compliance w/ High Performance and Sustainable Building Rqmts.
ASHRAE Standard 189.1 & UFC

- Key Reference for compliance of UFC for Sustainability and Cx/RCx.
- In 2002, both organizations entered into a Partnering Agreement and the ASHRAE GreenGuide was developed to assist USGBC in their efforts at promoting sustainable design.
- DO NOT confuse w/ LEED (Structure is similar).
- For Cx/RCx, Chapter 10 and Appendix H provide guide for compliance.
POP QUIZ! – Review Answers

Would you change your answers to the questions below?

• What is **YOUR** definition of Commissioning?

• What **VALUE** does Commissioning provide, **IF ANY**?
OPEN DISCUSSION & QUESTIONS

THANK YOU!

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