THE TOTAL BUILDING RETRO-COMMISSIONING PROCESS

PERCEPTION VS REALITY

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Course Training Objectives

- Retro-Commissioning Process
- Standards, References, Benefits
- Case Study – B27 ("RCx" Lite)
- Commissioning & Sustainability UFC
Introductions

» Instructor: Woody Thompson

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

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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

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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
Benefits

» Higher Quality Product that Leads to Better Owner, Designer, & Contractor Reputations

» Confident O&M Staff in Maintaining Facility

» Budget Savings in Capital & Operations

» Healthy Building which Improves Occupant Productivity

» **Less Conflicts / Litigation**
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!

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Cx / RCx References

» ASHRAE Standard 202-2013

» ASHRAE Guideline 0-2013 (replaced 0-2005)

» ASHRAE Guideline 1.1-2007 (replaced 1-1996)

» 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.
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
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

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Retro-Commissioning: Pre-Planning Phase

PRE-PLANNING PHASE

Identify Possible Candidate Buildings
Collect Utility Data & Evaluate Possible Candidates
Generate EPA Energy Performance Rating

Define Project Goals & Objectives (OPR)
Select Candidate Building

RESOLVE ISSUE

ACCEPTANCE

PLANNING PHASE
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)
Retro-Commissioning: Planning Phase

- RCx Team Formed
- Confirm Project Goals & Objectives (OPR)
- Perform Facility Interviews and Walk-through
- Owner Reviews Draft RCx Plan
- Finalize RCx Plan
- Submit Final RCx Plan
- Submit Draft RCx Plan
- Owner Reviews Draft RCx Plan
- Bldg. Good Candidate for RCX?
- Resolve Issue
- Acceptance
- Investigation Phase
- Pre-Planning Phase
- Planning Phase
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

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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

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Retro-Commissioning: Investigation Phase

INVESTIGATION PHASE

- RCx Plan Presented to Key Facility Staff
- Conduct In-Depth Building Investigation
- Submit Findings Log & Energy Savings Calculations to Owner
  - Submit RCx Investigation Report w/ Recommendations for Implementation of Selected Measures
  - Owner Reviews Findings Log & Selects Measures to Implement

RESOLVE ISSUE

ACCEPTANCE

IMPLEMENTATION PHASE

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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 are Implemented

» 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: Implementation Phase

**IMPLEMENTATION PHASE**

- Owner Selects Implementation Approach
- Submit Implementation Plan
- Owner Reviews Implementation Plan

**ACCEPTANCE**

- Owner Reviews Implementation Report
- Submit Implementation Report
- Operational Improvements are Implemented

**RESOLVE ISSUE**

- RESOLVE ISSUE

**HAND-OFF & PERSISTENCE PHASE**

- ACCEPTANCE
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


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Retro-Commissioning: Hand-Off Phase

HAND-OFF & PERSISTENCE PHASE

1. Submit Final RCx Report
2. Owner Reviews Final RCx Report
3. Submit Re-Commissioning Plan
4. Owner Reviews Re-Commissioning Plan
5. Verify Training of Key Building Staff
6. Review Training Materials Provided to Owner
7. RESOLVE ISSUE
8. ACCEPTANCE
9. Conduct Project Closeout Meeting
10. PROJECT COMPLETE
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.
Energy Audit / Survey Process

» Data Collecting & Analyzing of Facility Operation & Utility Bills

» Interviewing O&M and User Staff

» Reviewing & Assessing Equipment Operation

» Developing Energy Conservation Measures / Opportunities (ECMs / ECOs) & Identifying Cost Benefit

» Creating Action Plan to Implement ECMs/ECOs.

» Various Levels of Audits: ASHRAE has 3
ASHRAE Energy Audits

• **Level 1 :** Lowest Cost – Walk-Through Analysis, Preliminary Opportunity Assessment (POA)
  - Walk through site visit
  - Review of Energy Bills (consumption, costs, rate structure)
  - Report includes list of Low cost / No cost Opportunities

• **Level 2 :** Energy Survey & Analysis, includes Level 1, plus
  - Energy use breakdown by system and energy source
  - O& M practices, Constraints, Economic criteria
  - List of ECMs recommended for further detailed quantification and analysis

• **Level 3 :** Detailed Analysis of Capital-Intensive Modifications
  - Detailed site visit, system performance data gathering
  - Level 2 list of ECMs are evaluated in detail. Current costs, potential savings, paybacks
  - High level of confidence in economics and schedule of each ECM
Energy Audit Overall Benefits

• Planning Tool to Develop Future Capital Investment Budget
• Prioritize Which Facilities Need The Most Attention: Finding the ENERGY PIGS!
• Identify the Immediate Impact on Facility O&M Budget
• Step in the Retro-Commissioning Process
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

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“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

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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)
UFC 1-200-02  High Performance & Sustainable Building Requirements

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.
UFC & ASHRAE Standard 189.1

» Key Reference for UFC compliance 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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