Retro-Commissioning
“Optimize the Performance of Your Facility”

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Agenda

• Commissioning (Cx)

• Retro-Commissioning (RCx)

• Research Findings

• Frequently Asked Questions

• Case Studies

• Q&A
What is Commissioning?

• A planned, documented, and managed engineering approach to the start-up and turnover of facilities, systems, and equipment that results in a safe and functional environment that meets established design requirements and stakeholder expectations.

• Management of the “Completion of Construction” process.
Why Commission?

Building System Complexity
- Building systems comprised of many different components
- Energy efficiency and redundancy design strategies result in complex Building Automation Systems

Procurement Philosophies
- Multiple parties responsible for design, fabrication and installation of systems
- Trend towards pre-purchase equipment
- Break up of single source trades
- Acceleration of activities to meet schedule
- Value engineering resulting in system component compromises

Transfer of Knowledge
- Training and turn-over is critical to post occupancy operations
What is Retro-Commissioning?

- A systematic, documented process to identify low cost operational and maintenance improvements for existing buildings, while meeting the design requirements of current use.

- Focuses on energy-using equipment and related controls to optimize system performance, rather than major equipment replacement.
Why Retro-Commission?

- Optimize System Performance
- Energy Savings
- Cost Savings
- HVAC = ~ 60% of Energy Usage
- Reduced Carbon Footprint
- Attractive ROI

- Potential to significantly reduce overall energy consumption with minimal financial investment.
Cx and RCx Process Overview

Commissioning

- Pre-Design Phase
  - Select a commissioning lead
  - Pre-Design Phase commissioning meeting
  - Begin developing Owner’s Project Requirements
  - Develop initial Commissioning Plan outline

- Design Phase
  - Design Phase commissioning meeting (If Pre-Design meeting didn’t occur)
  - Perform commissioning-focused design review
  - Update Commissioning Plan
  - Develop commissioning requirements for the specification
  - Begin planning for verification checklists, functional tests, Systems Manual, and training requirements
  - Construction Phase kick-off meeting
  - Review submittals, monitor development of Shop and Coordination Drawings
  - Review O&M Manuals
  - Perform ongoing construction observation
  - Perform verification checks
  - Perform diagnostic monitoring
  - Perform functional testing
  - Develop Commissioning Report and Systems Manual
  - Develop Recommissioning Plan
  - Verify and review training of owner’s staff
  - Resolve outstanding commissioning issues
  - Perform seasonal/deferred testing
  - Perform near warranty-end review

- Construction Phase

- Occupancy and Operations Phase

Retro-Commissioning

- Planning Phase
  - Select the project
  - Set project objectives and obtain support
  - Select a commissioning lead
  - Document the current operating requirements
  - Perform an initial site walk-through
  - Develop the Retrocommissioning Plan
  - Assemble the retrocommissioning team
  - Hold a project kick-off meeting

- Investigation Phase
  - Review facility documentation
  - Perform diagnostic monitoring
  - Perform functional tests
  - Perform simple repairs
  - Develop Master List of Findings
  - Prioritize and select operational improvements

- Implementation Phase
  - Develop Implementation Plan
  - Implement selected operational improvements
  - Verify results

- Hand-Off Phase
  - Develop Final Report
  - Compile a Systems Manual
  - Develop Recommissioning Plan
  - Provide training
  - Hold close-out meeting
  - Implement persistence strategies
RCx Process Overview

• **Phase I & II  Planning & Investigation**
  o Establish Operating Requirements
  o Field Investigation & Design Review
  o Report – Develop Energy Conservation Measures (ECMs), implementation strategies, costs and return on investment.

• **Phase III  Implementation**
  o Select ECMs
  o Perform repairs, changes and adjustments as agreed upon in Phase I

• **Phase IV  Hand Off (Turnover)**
  o Final Report (Results)
  o Training
  o Recommissioning Plan
Research Findings

- Research conducted by Lawrence Berkley National Laboratory (Evan Mills, Ph.D)
- Report Prepared for The California Energy Commission (Public Interest Energy Research (PIER))
- New and Existing Building Commissioning
- Analysis of 643 Buildings
- Over 99 Million SF
- 26 States Represented
- www.green.ca.gov
Research Findings

Wide Diversity of Reasons to Commissioning Projects

• Ensure System Performance
• Obtain Energy Savings
• Improve Thermal Comfort
• Indoor Air Quality
Research Findings

Number of Deficiencies

Frequency of Deficiencies

- Combined heating/cooling
- Cooling plant
- Heating plant
- Thermal distribution
- Terminal units
- Lighting
- Envelope
- Plug loads
- Facility-wide (e.g., controls, energy mg't system, or utility related)
- Other
- Unknown

Number of deficiencies discovered

% of sites with deficiency

Existing Buildings
New Buildings
Key Findings

• Average Costs:
  o Existing Buildings $0.30/sf
  o New Buildings $1.16/sf (0.4% of total construction costs)

• Average Energy Savings:
  o Existing Buildings 16%
  o New Buildings 13%

• Average ROI:
  o Existing Buildings 1.1 years
  o New Buildings 4.2 years
Can Retro-Commissioning be done in stages to minimize cost impact to budgets?

**Answer:** Yes

With careful planning for the implementation of the selected Energy Conservation Measures (ECMs), today’s healthcare facilities can be successfully commissioned system by system.
How will Retro-Commissioning benefit my HealthCare Facility?

Answer:
Ensure building systems perform effectively and efficiently to meet your current operating requirements. This yields a number of benefits for your business:

- Return Equipment to its Proper Operational State
- Extend Equipment Service Life
- Reduce Maintenance and Repair Costs
- Improve Occupant Comfort and Reduce Complaints
- Improve Outside Air Control and Indoor Air Quality
- Adjust Equipment Operating Schedules
Case Study 1

120,000 sq ft Facility; 53,000 sq ft Laboratory

- Lab HVAC Costs = $800,000 ($15.10 per sq ft) per year
- Five 100% OA AHUs, common header
- Five main exhaust fans, common header
- 200,000 CFM main air system capacity
- No heat recovery
- Old company ventilation standard: 12 ACH
- New ventilation standard: 8 ACH
## Case Study 1

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### ECMs:
- Airflow Reduction
- VFD Control to Pumps
- AHU Static Pressure Reset
- Operational Deficiencies (Controls, Over-Ventilation)

### Savings:
- Occupied Mode: $274,000 per year
- Unoccupied Mode: $114,000 per year
- Less than one year ROI
175,000 gsq ft Office Building

- 14 AHUs
- 225,000 CFM main air system capacity
- No heat recovery
- Electric Reheat
- Significant Comfort Issues
  - Humidity
  - Temperature
- BAS Overrides on Setpoints / Controls
- OA Airflow Issues
Case Study 2

**ECMs:**

- Reduced Supply Airflow by 58,000 CFM (26%)
- Optimized OA Airflow
- BAS Thermostat Audit
- Modified Control Sequences for AHU Temp / RH

**Savings:**

- Per Year of $70,000
Three Things to Take Away…

• HVAC uses 60% of a building’s energy, so it should be the prime focus of building energy reduction efforts.

• Retro-Commissioning saves energy by ensuring the building is operating to optimal efficiency.

• Many buildings are currently over-ventilated due to adherence to obsolete standards and can have their airflows reduced resulting in considerable additional energy savings.
Acronym List

ACHI – Air Changes per Hour
AHU – Air Handling Unit
BAS – Building Automation System
CFM – Cubic Feet per Minute
Cx – Commissioning
ECMs – Energy Conservation Measures
OA – Outside Air
RCx – Retro-Commissioning
ROI – Return on Investment
RH – Relative Humidity
VFD – Variable Frequency Drive