Commissioning vs. Recommissioning for Energy Efficiency and Improving Overall Building Performance

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Questions & Solutions Engineering

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Agenda

- Buildings & Business
- Commissioning Overview
- Recommissioning Overview
- Typical Energy Conservation Opportunities
- Costs
- Benefits
Buildings & Business

- Why do you have buildings?
  - Shelter people?
  - Shelter processes?
  - Shelter product?
  - Other?
Buildings & Business

- Why do you have Mechanical & Electrical Systems?
  - Lighting?
  - Comfort?
  - Safety?
  - Process / Production
  - Other?
Buildings & Business

How does Building Performance Impact your Bottom Line?

- Personnel productivity?
- Production quality?
- Customer perception?
- Inventory preservation?
- Energy costs?
- Maintenance costs?
- Other?
Buildings & Business

- Commissioning & Recommissioning Focus on:
  - Systems Performance
  - Systems Efficiency
Commissioning Overview

- **What is Commissioning?**
  - Systematic process of assuring by verification and documentation, from the design phase to a minimum of one year after construction, that all building facility systems perform interactively in accordance with the design documentation and intent, and in accordance with the owner’s operational needs, including preparation of operation personnel.
Commissioning Overview

- Pre-Design Phase Activities

Commissioning Plan → Owner’s Project Requirements Document
Commissioning Overview

- Design Phase Activities
  - Design Reviews
  - O&M Manuals & Training Planning
  - Commissioning Specification
Commissioning Overview

- Early Construction Phase Activities
  - Scheduling
  - Shop Drawing Review
  - O&M Manual Review
  - Training Plans
Commissioning Overview

- Testing & Training Phase Activities

- Equipment Training
- Prefunctional Checklists
- Functional Performance Testing
- Systems Manual & Training
- Commissioning Report
Commissioning Overview

- Occupancy & Operations Phase Activities

- Recommissioning Plan
- Deferred Testing
- Late Warranty Checkup
- Amend Commissioning Report
Commissioning Overview

- Systems
  - HVAC
  - Normal and Emergency Power
  - Life Safety
  - Lighting Controls
  - Plumbing
  - Blackout (Integrated Systems) Testing
  - Building Enclosure
Recommissioning Overview

- Also Known As . . .
  - Retro-Commissioning
  - Existing Building Commissioning
  - On-going Commissioning
Recommissioning Overview

- Process can Begin Anytime after the Original Design and Construction Team are off the Job
  - One day later
  - One year later
  - Many years later
Recommissioning Overview

- Recommissioning is:
  - A process by which existing facility system performance is evaluated against the owner’s needs and adjusted and optimized to meet the functional performance criteria.
  - A process that focuses on DYNAMIC system operation instead of STATIC equipment installation.

  **COVID-19 Note**

  - A process that focuses on DYNAMIC system operation instead of STATIC equipment installation.
Recommissioning Overview

- **Recommissioning** is verifying systems perform as effectively as desired
  - Environmental controls
  - Ventilation
    - COVID-19 Note
  - Life safety systems
  - Lighting
  - Electrical power
  - Energy management
  - Process
Recommissioning Overview

- Recommissioning is Verifying Systems Perform as Efficiently as Possible
  - Minimizing run times
  - Adjusting setpoints
  - Controlling outside air ventilation
    • COVID-19 Note
  - Optimizing equipment staging
  - Sensor calibration
  - Valve & damper performance
  - Etc.
Recommissioning Overview

Operational Criteria
Documentation

Information Gathering
- Documentation reviews
- Interviews
- Field observation

Dynamic System Testing & Monitoring

Report & Recommendations
- Gap analysis
- Fine tuning
- Capital projects

Implementation

Measurement & Verification
Recommissioning Overview

- Systems
  - HVAC
  - Lighting Controls
  - Plumbing
Typical Energy Conservation Opportunities

- COVID-19
- Operating Equipment more than Required
- Outside Air Control
  - Too much
  - Too little
- Ventilating Unoccupied Spaces
Typical Energy Conservation Opportunities

- Air-Side Economizers
  - Malfunctioning dampers
  - Dry-bulb vs. enthalpy control
  - Mixed air temperature control vs. discharge air temperature control
  - Sensor calibration
  - Malfunctioning rooftop controllers
Typical Energy Conservation Opportunities

- Pumping more Water than Required
- Supplying more Air than Required
- Simultaneous Heating & Cooling
Typical Energy Conservation Opportunities

- Conditioning Unoccupied Spaces
- Maintaining Tighter Temperature Control than Required
- Heating with 100% Outside Air Units
Typical Energy Conservation Opportunities

- Failed Hardware
  - Valves leaking past
  - Dampers not closing
  - Sensors out of calibration
Cost of Commissioning

- **Major Projects (≥ $10,000,000)**
  - 0.5-1.0% of Total Construction Cost
  - 2-4% of Construction Cost of Systems being Commissioned

- **Small Projects**
  - Higher %
Cost of Commissioning

- "Shifted" instead of "Additional" Costs
  - Shift costs to design phase
  - Shift costs to commissioning process

Without Commissioning:

- Design
- Construction

With Commissioning:

- Design and Cx
- Construction

Project Costs over Time

First Year of Operation
Fine-tuning
Contractor Callbacks
Cost Commissioning & Recommissioning

<table>
<thead>
<tr>
<th></th>
<th>Cost per Sq. Ft.</th>
<th>Energy Savings</th>
<th>SPB in years</th>
<th>Non-Energy Benefits (per Sq.Ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing Buildings</td>
<td>$0.27</td>
<td>15% of whole building energy</td>
<td>0.07</td>
<td>$0.18</td>
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<tr>
<td>New Construction</td>
<td>$1.00</td>
<td>No before measurement possible</td>
<td>4.8</td>
<td>$1.24</td>
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## Cost of Recommissioning

<table>
<thead>
<tr>
<th>Project Type</th>
<th>Size (1,000 sq ft)</th>
<th>Cost ($/sq ft)</th>
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</thead>
<tbody>
<tr>
<td>Laboratory</td>
<td>10</td>
<td>1.00</td>
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<tr>
<td>Office</td>
<td>20</td>
<td>0.25</td>
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<tr>
<td>Laboratory</td>
<td>30</td>
<td>2.50</td>
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<tr>
<td>Office</td>
<td>60</td>
<td>0.42</td>
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<tr>
<td>Office</td>
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<td>0.27</td>
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<tr>
<td>Office with TES</td>
<td>160</td>
<td>1.25</td>
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<tr>
<td>Multi-Building</td>
<td>360</td>
<td>0.17</td>
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<tr>
<td>Office</td>
<td>390</td>
<td>0.10</td>
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<tr>
<td>Office</td>
<td>400</td>
<td>0.19</td>
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Association of State Energy Research Technology Transfer Institutions and the U. S. Department of Energy
# Cost of Recommissioning

<table>
<thead>
<tr>
<th>Building</th>
<th>Cost</th>
<th>Savings/Year</th>
<th>Payback (Years)</th>
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<tbody>
<tr>
<td>Highrise Office</td>
<td>$12,745</td>
<td>$8,145</td>
<td>1.6</td>
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<tr>
<td>Medical Facility</td>
<td>$24,000</td>
<td>$63,502</td>
<td>0.4</td>
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<tr>
<td>Computer/Office</td>
<td>$28,000</td>
<td>$30,385</td>
<td>0.9</td>
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<tr>
<td>Retail</td>
<td>$52,336</td>
<td>$42,500</td>
<td>1.2</td>
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</table>

E-source study of 44 building ranging from 80,000 to 887,000 sq ft. Includes investigation, report, and implementation costs.
Cost of Recommissioning

- Recommissioning Rebates
  - CenterPoint Energy
  - Xcel Energy
- Study Rebates
- Implementation Rebates
Benefits of Commissioning

- Improve Building Turnover Process from Contractor to Operator
- Verify System Performance
- Reduce Contractor & Designer Call-Backs
- Long Term Proper Operation
- Energy Conservation
Benefits of Recommissioning

- Optimized System Operation
  - Proper system performance
  - Energy conservation
- Systems Documentation & Training
- Sustained Efficient Operation
Discussion

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Thanks for attending!