Commissioning for Federal Buildings Guidebook and e-learning

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Energy Technology Program Specialist
DOE, Federal Energy Mgmt Program

O&M First!
Learning Objectives

1. Familiarization with FEMP’s Cx Guide
2. How to use the e-learning web-based training
Guidebook Objectives

Provide an introduction to commissioning approaches to a variety of professionals involved with the management, operation, and maintenance of Federal buildings.

Illustrate case histories, including cautionary lessons learned. Provide guidance on commissioning best practices.

Demonstrate how commissioning can help Federal facility managers meet energy efficiency goals and LEED certification requirements.

Demonstrate how commissioning can be integrated in facility management and O&M programs to make those programs more efficient and effective.

Demonstrate how different types of commissioning (such as retro commissioning and continuous commissioning) can be incorporated into a variety of building types and applications, above and beyond the most commonly understood commissioning approaches.
Chapter 1 – Cx Goals
Chapter 2 – Types of Cx
Chapter 3 – Costs and benefits of Cx
Chapter 4 – Building Mgmt Support for Cx
Chapter 5 – The Cx Process
Chapter 6 – The Retro-Cx Process
Chapter 7 – The Re-Cx Process
Chapter 8 – The Continuous Cx Process
Chapter 9 – Sustainable Cx
Goals of Commissioning

Provide a safe and healthy facility
Improve energy performance and minimize energy consumption
Reduce operating costs
Ensure adequate O&M staff orientation and training
Improve systems documentation.
Why Bother with Cx? 10 Good Reasons

To meet Owner expectations
For project cost control
For improved system and equipment reliability
To improve energy performance
To ensure equipment accessibility
For the performance testing of complex systems
For the transfer of knowledge to building operators and engineers
To prevent premature failure
To ensure integration of building systems
For the documentation
Common Problems Addressed by Cx

Outside air dampers stuck in the always open or always closed position.
Adjustable speed drives that no longer adjust properly.
Unconnected flexible ductwork.
Malfunctioning control systems components that do not properly respond to their prescribed control sequences.
Incorrect sequences of operation.
Energy management systems that have not been updated to reflect system modifications.
Changed facility uses that affect personnel loading and partition configuration changes that affect air flow.
Controls sensors that are out of calibration.
Controls that are permanently overridden.
Heating and cooling systems that fight each other.
Thermostats and other control devices that are improperly placed.
What Type of Commissioning?

<table>
<thead>
<tr>
<th>My building is…</th>
<th>Consider…</th>
</tr>
</thead>
<tbody>
<tr>
<td>… going to be undergoing a major renovation in the next year.</td>
<td>Commissioning - Ideal for new construction or major renovation, and best implemented through all phases of the construction project.</td>
</tr>
<tr>
<td>… old and experiencing a lot of equipment failures.</td>
<td>Retro commissioning - Ideal for older facilities that have never been through a commissioning process.</td>
</tr>
<tr>
<td>… relatively new and was commissioned during its construction, but our energy costs have been climbing recently.</td>
<td>Re-commissioning - Ideal to tune up buildings that have already been commissioned, bring them back to their original design intent and operating/energy efficiency</td>
</tr>
<tr>
<td>… large and complex. We have a metering system and a preventive maintenance program, but will still struggle with high energy costs and tenant complaints.</td>
<td>Continuous Commissioning - Ideal for facilities with building automation systems (BAS), advanced metering systems, and advanced O&amp;M organizations.</td>
</tr>
</tbody>
</table>
Building Commissioning


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Report Prepared for:
California Energy Commission
Public Interest Energy Research (PIER)

July 21, 2009
## Costs and Benefits of Cx

Table 1. Examples of existing-building commissioning project costs and savings.

<table>
<thead>
<tr>
<th>Target</th>
<th>Location</th>
<th>Sites</th>
<th>Energy Savings</th>
<th>Peak Demand savings</th>
<th>RX Cost ($/sf)</th>
<th>Payback time (years)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local government buildings</td>
<td>California</td>
<td>11 sites; 1.5 MSf</td>
<td>14.3% source energy (11% electric; 34% gas)</td>
<td></td>
<td>1.01</td>
<td>3.5</td>
<td>Amarananti et al (2005); Amaranati and Roberts (2006); Pierce and Amaranati (2006)</td>
</tr>
<tr>
<td>Offices and hotels</td>
<td>New York</td>
<td>6 sites; 6 MSf</td>
<td>10%</td>
<td></td>
<td>0.34</td>
<td>2.0</td>
<td>Lonihan (2007) - projected</td>
</tr>
<tr>
<td>Offices</td>
<td>Connecticut</td>
<td>5 buildings; 2 MSf</td>
<td>8.5% electricity (3% to 20%)</td>
<td></td>
<td></td>
<td>0.5</td>
<td>Building Operating Management (2006)</td>
</tr>
<tr>
<td>Class A Offices</td>
<td>Connecticut</td>
<td>3 bldgs; 1.2 MSF</td>
<td>7.3% electric</td>
<td></td>
<td>0.62</td>
<td>1.37</td>
<td>McIntosh (2008)</td>
</tr>
<tr>
<td>Mixed commercial</td>
<td>Colorado</td>
<td>27 buildings; 10 MSF</td>
<td>7% elect</td>
<td>4.2% (0-26%)</td>
<td>0.185</td>
<td>1.51</td>
<td>Francoli et al. (2005)</td>
</tr>
<tr>
<td>Three offices + hospital</td>
<td>Colorado</td>
<td>4 buildings; 1.8 MSF</td>
<td></td>
<td>6%</td>
<td>0.026</td>
<td>0.38</td>
<td>Mueller et al. (2004)</td>
</tr>
<tr>
<td>University buildings</td>
<td>California</td>
<td>26 buildings; 3.4 MSF</td>
<td>10% total source (2-25%)</td>
<td>4% (3-11%)</td>
<td>1.00</td>
<td>2.5</td>
<td>Mills &amp; Matthew (2009)</td>
</tr>
<tr>
<td>Elementary schools</td>
<td>Michigan</td>
<td>4 schools</td>
<td></td>
<td></td>
<td>0.38</td>
<td>2.5</td>
<td>Freidman (2004)</td>
</tr>
<tr>
<td>Supermarkets</td>
<td>Central California</td>
<td>10 stores; 0.5 MSF</td>
<td>12.1% elect (4.3-18.3%)</td>
<td></td>
<td>0.14</td>
<td>0.25</td>
<td>Zazzara and Ward (2004); Emerson (2004)</td>
</tr>
<tr>
<td>Mixed commercial</td>
<td>Northwest</td>
<td>8 buildings</td>
<td></td>
<td></td>
<td>0.221</td>
<td>1.2</td>
<td>Tso et al (2003)</td>
</tr>
<tr>
<td>Mixed commercial</td>
<td>Oregon</td>
<td>76 projects</td>
<td>10-15% electric (5%-40%)</td>
<td></td>
<td>0.175</td>
<td>1.24</td>
<td>Peterson (2004)</td>
</tr>
<tr>
<td>Mixed commercial and educational</td>
<td>California</td>
<td>All California Programs (2007-2008)</td>
<td>1.7-8.1% electric</td>
<td></td>
<td>0.40</td>
<td>3.0</td>
<td>PECI and Summit Building Engineers (2007) - estimates</td>
</tr>
<tr>
<td>Total or simple average values</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>186</td>
<td>~10-15%</td>
<td>~7% 0.41 1.8</td>
</tr>
</tbody>
</table>

Notes: All impacts shown using local energy prices and commissioning costs; averages are floor-area-weighted averages.
To take the FEMP on-line Cx Course

The on-line course is free for federal employees and federal contractors.

http://www3.eere.energy.gov/femp/elearn/Common/Login.asp
Thank-you!

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