FEDERAL UTILITY PARTNERSHIP WORKING GROUP SEMINAR

May 18-19, 2016
Cincinnati, OH

Commissioning
Otto Van Geet, PE
NREL

Hosted by:

FEMP
Federal Energy Management Program

DUKE ENERGY
Why Commission?

• Commissioning (Cx) of systems has its roots in ship building
  – first used to ensure a ship was seaworthy and ready for service.
• Cx is a specialized application of quality assurance.
• Good cx involves extensive testing and:
  – early planning,
  – continuous coordination,
  – comprehensive documentation, and
  – thorough O&M training.

An analogy to a ship’s sea trials or “shake-down” cruise
Commissioning Background

• The **goals of commissioning** are to:
  – Improve energy performance and minimize energy consumption.
  – Reduce operating costs.
  – Ensure adequate O&M staff orientation and training.
  – Improve systems documentation.

  – **Specific to UESC:**
    – “Performance assurance” rather than “savings guarantee” assists keeping costs reasonable and appropriate to the project size/ ECM
    – Use a consistent set of procedures/activities to monitor, adjust, and report on ECM performance.
    – utility/agency monitoring, comparison to baseline, makes improvement recommendations, and agency makes adjustments
Role of Commissioning within a long-term Performance Assurance Plan

1. Cycle of ECM performance assurance
2. Baseline /compare: Existing equipment/system performance and O&M procedures and logs
3. Design & install /adjust: improve equipment/system performance and update O&M procedures and logs
4. Pre-acceptance commissioning: prove performance meets design
5. On going O&M: updated O&M procedures and logs
6. Post-acceptance commissioning: monitor, adjust, assure long-term optimal performance
Commissioning Comes in a Number of Styles

Ongoing operation & commissioning

Technical steps and techniques

UESC ECM Set Commissioning

Existing Building (Retro) commissioning

Field Experience

Design Intent

Operating Experience

Operating Experience
Cx Activities for UESC

• Re-commissioning
  – Performed 5 to 10 years after previously commissioned
  – Used to help identify deferred maintenance
• Retro-commissioning (RCx)
  – Performed to existing buildings not previously commissioned
  – Usually instigated due to high energy bills or poor occupant comfort
• Monitoring-Based Commissioning (MBCx)
• Continuous-commissioning (CCx)
  – Ongoing process to resolve operating problems, optimize energy use and identify retrofits
Development phase Commissioning Activity

Data for the graph courtesy Karl Stum; Summit Engineering
Construction Commissioning Activity

Design Development Phase

Develop:
- Cx plan
- Cx specs
- Draft tests
- Cx budget
- Training plan

Begin Cx focused design review

Data for the graph courtesy Karl Stum; Summit Engineering
Construction Commissioning Activity

<table>
<thead>
<tr>
<th>Activity Level</th>
<th>Time</th>
<th>Activity</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Design Phase</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Construction Document Phase</td>
<td>Finalize Cx documents; Continue Cx focused design review</td>
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<tr>
<td></td>
<td>Construction Phase</td>
<td></td>
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<tr>
<td></td>
<td>100%</td>
<td>Warranty</td>
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Construction Commissioning Activity

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Data for the graph courtesy Karl Stum; Summit Engineering
Agency fully responsible phase - Commissioning

Data for the graph courtesy Karl Stum; Summit Engineering
Commissioning Activity

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• **Monitoring-Based Commissioning (MBCx):** Use monitored data to assess equipment operation (new or existing buildings), typically ongoing.

• **Automated Fault Detection and Diagnostics (AFDD):** Analytical software that detects specific issues in operation, enabling MBCx.
Studies show that 25% of RCx savings on average can be lost over 4 years without ongoing attention.
Issues/opportunities that can be detected:

• **Air-Side Opportunities**
  Equipment scheduling, ventilation/economizer control optimization, pressurization and temperature optimization

• **Ideal VAV System Operation**
  Duct static pressure and discharge air temperature optimization, morning warm-up control, minimum VAV box flow reduction

• **Water Side Opportunities**
  Temperature optimization (chilled water, condenser water, heating water), water-side economizer control, pump and pressure control, equipment staging
Fault Detection & Diagnostics (FDD)

Detailed analytics down to the equipment level

Analytics provide information for action

Meter Data

Weather Data

BAS Data

Any device with a “pulse”

Cloud based or local software
Fault Detection & Diagnostics (FDD)

- Data points constantly monitored and stored
- Programmed “rules” automatically detect “faults” or issues over all time
- One way communication – *provides information that requires human action*
Growing number of tools, not as many as EIS

Examples:

- Purchased as a license: Sky Foundry SkySpark
- SAAS cloud hosted: Climetrics, Analytika, Ezenics, KGS Buildings, Clockworks, SciEnergy, EnergyScape and more...
- Built in to BAS: Growing number of options
Example Fault - Scheduling

Example rule: “AHU ON During Scheduled Unocc” (Equipment ON when it should be OFF)

AHU-1-1 operating 24/7 from 30%-50% fan speed