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Measurement and Verification for Commissioning Projects: Challenges and Opportunities

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Opportunities...

- The objective of Commissioning is to ensure and document proper building performance.
- The objective of Measurement and Verification is to document proper building performance.
- Surely there must be some synergy here!

...and Challenges

- Many utility programs require IPMVP
- A more specific and appropriate requirement is needed for commissioning programs

Overview of Presentation

- Describe Commissioning of Existing Buildings in the context of other energy efficiency programs
- Discuss the measurement and verification opportunities unique to commissioning
- Identify the challenges to measurement and verification in commissioning
- Propose some new approaches

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Measurement of Energy Savings

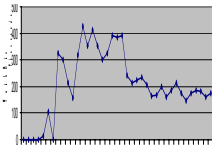
- International Performance Measurement and Verification Protocol
- ASHRAE Guideline 14-2002: Measurement of Energy and Demand Savings
- FEMP Guidelines



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Energy Savings is an Abstract Concept

- It's not something you can meter...
- ...but you know it when you see it!
- It's an agreement between the service provider and the service receiver
- The intention of measuring savings is to equitably share the risk
- Measuring savings requires an agreed-upon plan for measurements and calculations that will take place, and financial consequences that are based on them.



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Four Options for “Measuring” Savings

- Partially Measured Retrofit Isolation
- Retrofit Isolation
- Whole Building
- Calibrated Simulation

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What are the real objectives of M&V?

- Ensure ongoing accountability
- Verify that improvements perform as expected initially
- Validate energy savings of the improvement initially
- Monitor persistence of the performance over time

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Commissioning

- Innovative energy-saving process
- Significant opportunities for savings
- Anecdotal evidence that these savings are real
- Little in the technical literature to definitively document the savings
- It can be difficult for owners to determine savings, although still a good value

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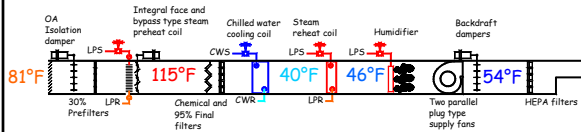
What is a Commissioning "Measure"?

- an intervention designed to repair or improve operation of existing equipment or systems
 - fix broken economizer (programming, linkages, sensors)
 - trim pump impeller to reduce flow
 - eliminate coincident heating and cooling due to controls or design flaws
- training, documentation, ongoing diagnostics

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Example of a Commissioning Opportunity

The space is under control so everything's fine, right?



- Clean room conditions on spec at 68°F, 1/-1-1/2°F, 45% +/-3% relative humidity.

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Commissioning is *NOT* a Measure

- More probabilistic
- More of an informational program than a definable engineering intervention
- More of a process than an outcome
- Hard to identify exactly what changed as a result of the project

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Challenges and Opportunities

- A more specific and appropriate requirement is needed for commissioning programs

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Opportunity: Taking Advantage of M&V Activities Already Conducted

- Commissioning includes testing
 - Run the system through its paces
- Commissioning is a measurement-centric activity
 - EMCS trend data including performance and operating parameters
 - Trend and datalogger data from functional tests

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Challenge: Programs Requiring Independent Measurement

- Independence ensures:
 - quality
 - accountability
 - impartiality

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Challenge: Accommodating a Wide Range of Measures

- Define calculation and documentation requirements for expected measures
- Define more general guidelines documenting for unexpected measures
- Require a range of types of documentation (trend and spot data, observation, tracking, photos, inspection notes...)



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Challenge: Defining the Intervention

- Significant measures
- Minor measures
- Abstract measures



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Challenge: Distinguishing between RCx and a Retrofit

- If CxP identifies issue, and helps define solution, RCx should get some credit
- If the project is eligible for rebate, how do you draw the line?
- What is the baseline?
- Do they need to be distinguished?

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Challenge: Measuring Operational Measures

- Easier to 'undo'
- System vs. component
- CxP is in a good position to understand system and system-wide impacts

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Challenge: Accomplishing Measurement Cost Effectively

- Define metrics or proxies to make sure you're measuring what is likely to go wrong
- Document baseline
- Verify performance
- Value savings
- Monitoring persistence

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Challenge: Having Enough Time for Collecting Baseline Data

- RCx will "run the system through its paces" so that CxP can collect data for multiple operating modes
- Build in time and budget for some baseline data collection
- But...minimize implementation delays

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Challenge: Ensuring that Savings Persistence

- Operational measures require special attention to ensure persistence
- Include program elements designed to ensure persistence
- Monitor metrics that capture persistence
- (Remember, capital measures have persistence issues as well!)

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Solution: Defining the Role of Evaluator

- Verification by CxP, quality control by evaluator
- Spot check calculations, measurements, documentation
- Visit subset of facilities
- Some of the EM&V budget should be in the program for the CxP
- Define verification guidelines

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Solution: Defining Verification Guidelines

Measure	Method for Finding the Problem / M&V Strategy	Guidance on Calculating Energy Demand, and Cost Savings	Evidence of Implementation for Incentive Payment	Persistence Tracking Requirements
<p>Controls Problem: Eliminating simultaneous heating and cooling reduces both the electricity required for heating, as well as the cooling required to offset the heat. Calculation methods for sensor thermostat calibration and hysteresis and loop tuning are not easily generalized due to the wide range of potential failure modes.</p>				
(1) Simultaneous heating and cooling	<p>Problem Identification: Trending is required to verify the extent of the problem. Trend air temperature before the probe at coil, after the probe at coil, and after the cooling coil.</p> <p>V&V Data: Prove that the result is not necessary by showing that maximum coil-to-coil flow settings are too high or that all boxes are reheating and the OAT setpoint is too low.</p> <p>Recommended Baseline Documentation: For electric heat, trend reheat current. For gas heat, hot water coil differential temperature. For both, trend coil for cooling.</p>	<p>Identify both the wasted heating energy and the wasted cooling energy. For gas heat, determine the load on the heating coil and use the boiler efficiency at part load to determine the wasted gas. The wasted cooling energy is equal to the excess heating energy. The cooling electrical energy is calculated using the cooling plant efficiency.</p> <p>Peak Demand: opportunity for peak demand reduction depends on time of simultaneous heating and cooling.</p>	<p>Baseline: trends from baseline</p>	<p>Measurement: For electric heat: reheat current. For gas heat, hot water coil differential temperature. For both, trend coil for cooling.</p> <p>Tracking System Logs: For both, determine the hours of simultaneous heating and cooling, and compare to an allowable number of hours based on the appropriate system type.</p>

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Calculation in M&V

Kristin's Four Principles of Calculation in M&V

- ✓ Validate inputs with measured data
- ✓ Validate outputs with measured data
- ✓ Document and justify all assumptions
- ✓ Document all calculations in a reviewable format

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Challenges for New Construction

- No baseline
- Interventions may be subtle

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Conclusions

- Commissioning is a new "breed" of program
- Many opportunities for synergy
- Development needs
 - research common methods
 - develop guidelines for evaluation that are specific to RCx
 - develop methods for verifying savings for some of the most common measures

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