Fundamentals for High-Performance Operators

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Outline

- High-Performance Outcomes
- What Operators need to do
- What Operators need to know
- How we teach and train
Logic Model

BUILDING OUTCOMES

OPERATOR BEHAVIORS

OPERATOR COGNITION
“Begin with the end in mind”
- Stephen Covey

What do we expect of Building Operating Engineers?

- Operate equipment, systems and buildings
  - Safely
  - Effectively (ie - IEQ outputs)
  - Efficiently (ie - energy and water inputs)
  - For reliability and extended life
High-Performance Outcomes

- Low energy use
- Superior IEQ
- Measured and Verified

New Behaviors, Skills & Knowledge

- Energy management & system optimization
- Pro-active indoor environment monitoring
- Measurement and quantification
SEC. 2. TRAINING OF FEDERAL BUILDING PERSONNEL.

IDENTIFICATION OF CORE COMPETENCIES. Not later than 18 months after the date of enactment of this Act, and annually thereafter, the Administrator of General Services, in consultation with representatives of relevant professional societies, industry associations, and apprenticeship training providers, and after providing notice and an opportunity for comment, shall identify the core competencies necessary for Federal personnel performing building operations and maintenance, energy management, safety, and design functions to comply with requirements under Federal law. The core competencies identified shall include competencies relating to building operations and maintenance, energy management, sustainability, water efficiency, safety (including electrical safety), and building performance measures.

- Intro HR 5112, S3250
Market-driven

**Market Need** - Ratings, Labels - *Documented Performance*

**Learning & Skills Development Objectives**

**Class Materials & Practical Projects**

**Evaluate Learning & Application**
Behaviors

• Fix

• Inspect and maintain

• Monitor inputs, outputs, outcomes
  – What and how to measure
  – Interpretation -- performance issues

• Respond and adjust
Acquire Data

- Energy units, meters & bills
- Hand-held instruments & data-loggers
- BAS trend logs

Progression of Cognitive Skill Levels in Use of Instrumentation
Acquire Data

- Energy units, meters & bills
- Hand-held instruments & data-loggers
- BAS trend logs

Comfort with Spreadsheets
Acquire Data

- Basic Measurements
  - Temperature
  - RH
  - Pressure
  - Flow
  - Light
  - Power
Acquire Data

- What system instrumentation?
  - Locate on *Schematics*
  - What’s missing
  - Use data-loggers
Interpret Data

- Benchmarks
- Graphical Plots
  - Time-series
  - Scatter
  - Histograms
- System-level energy and indicators
Interpret Data

– Understand relationships between fundamental dimensions
  • Flows, temperature and energy (heat balances)
  • Pressure, flow and power (pump/fan curves and power laws)
  • Use of graphs, charts, some basic calculations
A chilled water system is pumping 3,000 GPM through the secondary loop, with supply water at 54 dF and return water at 64 dF. The plant consists of three 1,000 ton chillers (12,000 btuh = 1 ton). How many chillers should be on-line to meet the load of the secondary loop?
Respond and Adjust

- Understand intent and dynamics
  - Equipment efficiency factors (combustion efficiency, refrigerant charge, steam traps)
  - Equipment sizing and part-load operations
  - Control sequences of operation
  - How systems and buildings respond
Respond and Adjust

- Understand intent and dynamics
  - Classroom and project activities to document types of systems and baseline operating conditions
    - Develop Schematics
    - System Narratives
    - Equipment Inventory
  - Identify and characterize improvement opportunities
Respond and Adjust

- Understand intent and dynamics
- Apply basic science principles to help understanding
  - Combustion
  - Change of state
    - steam, refrigerant, ice
  - Pressure, velocity and flow
    - Nozzles, fluid mixing, Power Laws
  - 1st law thermo - heat transfer
Respond and Adjust

- **Testing and Tuning**
  - Train to develop rigorous process
  - Baseline data
  - Careful observation & recording

- **Six Sigma**

Source: EPA “Teaming Up to Save Energy”
Summary & Conclusion

• Engineering basics can be usefully incorporated into education & training for building operators

• New expectations about building performance require it!
• Thank you for your attention.
• Questions?

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