Addressing Facility Operational Issues through Monitoring-Based Commissioning

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Annual Meeting

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Issues Facilities Face Today

Installation & Design

- No system manual
  - Design information not condensed for what operators need to know
  - Set up of controls and final set points not recorded, leaving operators guessing
  - Placing operations in fire fighting mode

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Issues Facilities Face Today

Maintaining/Improving Performance

- Operators and maintenance personnel focus

- No feedback loop to inform operators, health & safety officers, and management of performance issues

Case Study: Spelman Science Center

Auditorium: Albro Falconer Manley Science Center at Spelman College

Photo Credit: Spelman College

Case Study: Spelman Science Center

Commissioning During Construction

- Out of state designer
- Disconnect between designer's intent and control contractor's design
- Money ran out

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Case Study: Spelman Science Center

Commissioning Authority Performance

- Cx process consisted of troubleshooting + some start-up verification
- No functional testing
- No final set point documentation
- No system manual

Case Study: Spelman Science Center

Legacy System:

Vintage 1992 equipment with original manufacturer acquired by vendor in 1998 and installed in 1999.

Case Study: Spelman Science Center

Legacy System: Limited Capacity

- 3 Megabyte memory
- Modems at 19.2 Kbaud
- Processors at 16.7 MHz
- Proprietary field bus

Case Study: Spelman Science Center

Controls Firm

- Operates Facility
  - Design and construction information did not get transferred to operations
  - Firefighting mode operation
  - Performance issues since turnover

Case Study: Spelman Science Center

Monitoring Based Cx

- Define Current Facility Requirements
- Collects information and assessed performance
  - Original design intent
  - Assessment of bulding operation

Case Study: Spelman Science Center

Performance Assessment

- Building electrical and water metering installed were not reading correctly
  - Initial building metering data of no value
- No trending of system operation
- Established data collection criteria for assessment

Case Study: Spelman Science Center

Performance Assessment

- March 2009 through March 2012
  - Average energy intensity of Spelman campus ranged from 65 to 70 kBTUs/GSF* Yr
  - Science Center ranged from 154 to 158 kBTUs/GSF*Yr

Case Study: Spelman Science Center

Performance Issues

- Initial walk through
  - Large openings between outside air tunnel and mechanical room
    - 12,000 CFM of condition air short cycling back to the AHUs
    - Over pressurization of supply ducts – splits at supply duct joints
    - No discharge air set back

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Case Study: Spelman Science Center

Performance Issues

- Provide Illustrations & Narrative of Issues
  - People comfort focus rather than performance
    1. Overlapping sets between heating and cooling
       - » Simultaneous heating and cooling
    2. Setpoints outside of reasonable ranges
       - » Laboratories positively pressurized not negative as required by original design &CFR

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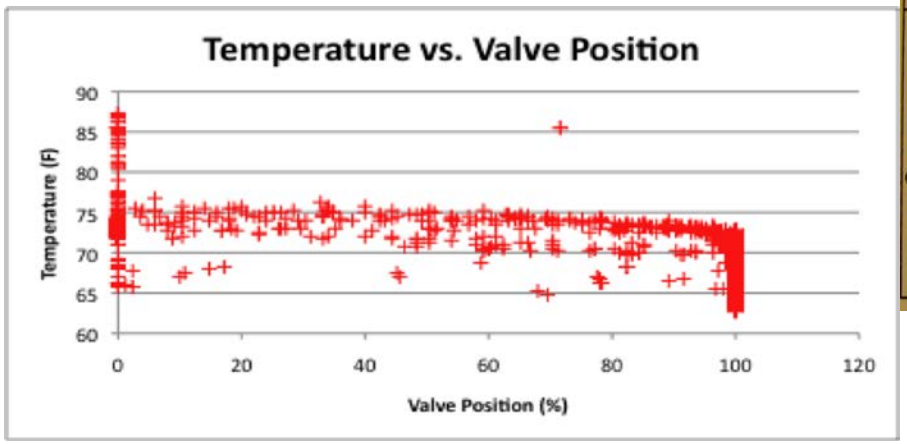
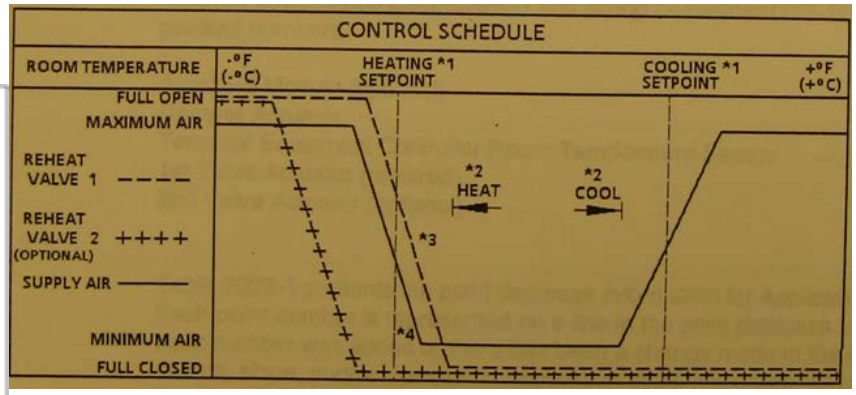
Case Study: Spelman Science Center

Performance Issues: Temperature Controls

Systems has high setpoints and 1 degree F separating heating and cooling



High setpoints producing constant reheat (reheat valve position)



Rapid switching between heating and cooling

Overlapping heating and cooling control ranges at 1F separation

Case Study: Spelman Science Center

Performance Issues: Monitoring

- Hood monitors are checked annually
- Laboratory flows are not checked
- 49 of 54 laboratories show flow issues:
  - *Low flows*
  - *High flows*
  - *Positive pressurization*
  - *Lack of control*
  - *Limited unoccupied scheduling*
  - *Component failures*

Case Study: Spelman Science Center

Performance Issues: Monitoring

Laboratory Airflow Example:

Single Lab two day sampling of flows:

- Neither airflow reaches designed flows
- Pressurization is positive (SA > EA)
- By design supply flow is to be slaved to exhaust flow (not exhaust flow setpoint)
- Exhaust air flow shows no scheduling
- Exhaust damper may have failed

Case Study: Spelman Science Center

Performance Issues

- VAV terminals box set points causing
  - Over heating, cooling, and pressurization
  - Short cycling
- No set back scheduling of non critical spaces
- Hot and chilled water valves streaming with no call for heating or cooling

Case Study: Spelman Science Center

Performance Issues

- Simultaneous heating and cooling
- Higher AHU static pressure than required
- Lower winter discharge temperature than needed requiring more reheat
- Component issues
  - Linkage malfunction - Incomplete stroking
  - Controller malfunction

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Case Study: Spelman Science Center

Corrective actions in progress

- Metering of utilities corrected
- Collaborative effort to develop corrective plan
- Implementation by control contractor
- Follow up monitoring to verify issues resolved

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MBCx Activities Reduce Issues

- Documentation of Current Facility Requirements

- Feedback Loop
  - Assessment of facility's performance
  - Identification of performance issue
  - Verification of correction

Summary

- Monitoring-Based Commissioning can help operations overcome:
  - Original Deficiencies
  - History of Problems
  - Provide feedback loop
  - Continuously improve building/campus performance

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Questions???

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