NEBBinar:
Retro-Commissioning for Comfort and Energy Efficiency

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Jim Huber is the President of Complete Commissioning. He has over 29 years of industry experience, is a Certified Energy Manager, and has extensive experience with BACNET, LON, MODBUS, and other building automation protocols and communication networks. He has programming, tuning, and testing experience with multiple systems and applications, as well as building systems commissioning, sound and vibration measurement, and testing and balancing.
Speaker

Dave McFarlane, Principal Project Director, Atkins

Dave McFarlane is a principal project director in the asset management practice and head of the Retro-Commissioning group for Atkins, one of the world’s leading engineering, design, and project management consultancies. Prior to joining Atkins, Dave was the president of Technical Commissioning, Inc. (Fort Myers, FL) and McFarlane, Inc. (Grand Forks, ND). He was a member of NEBB’s Commissioning Committee; he chaired the committee in 2003-2004 and rejoined in 2011. Dave serves as an instructor for NEBB’s courses in Commissioning and Retro-Commissioning. He speaks at conferences nationwide, and has written numerous articles for a variety of industry publications.
Agenda

What is Retro-Commissioning

Case study: Grand Forks ND County Office

Question and Answers
Retro-Commissioning

A systematic, documented process that identifies and implements low cost operational and maintenance improvements which improve building efficiency and allows the building to meet the current design requirements.
Retro-Commissioning

• Ensure that the building meets the Current Facility Requirements (CFR)

• Reduce energy usage

• Improve comfort
Agenda

What is Retro-Commissioning

Case study: Grand Forks ND County Office

Question and Answers
Grand Forks County Office
Retro-Commissioning
Grand Forks Country Office

- Seven story - 140,000 square feet
- Five floors office space w/conference rooms
- Meeting rooms on sixth floor
- Mechanical room on the 7th floor
Interior/exterior walls and conference rooms
Floors 1-5
Interior/exterior walls and conference rooms
Floor 6
Interior offices

Perimeter offices
County Commissioners Chambers
Perimeter link

Meeting room
Establish baseline

- Review the past 2-3 years energy bills
- Convert to MM BTU ft2/year
- Energy intensity is ~ 151,000 BTU/ft2/yr
Natural Gas

Premodification Gas Use
Compare baseline to typical

- For North Dakota typical energy intensity: 93,000 BTU/ft²/yr
- County office energy intensity: ~ 151,000 BTU/ft²/yr
- Projected savings achievable through retro-commissioning: $45,000 annually
Discovery phase

• Determine what is wrong
• Review documents, plans and specs
• Interview maintenance staff
Plans and specs showed

4 VAV air handlers

4 boilers

VAV boxes with 2-way valves
AHU Quadrants

Session 21 Energy Savings
Plans and specs showed

HW pumps and fans with VFD’s

Pump and fan VFD’s
Discovery and maintenance staff perspectives

• Building had electric baseboard supplement heat
• Too many occupant complaints about temperature controls
• Lack of understanding of Building Management System (BMS)
• Systems in overridden and in manual control
• BMS system not used to potential
Light shelves
Heating pumps

VFD 60 Hz

Leaking reheat valves

100%
Site investigations

- Fresh air dampers open on night set back
- Control sequence cooled building
- Building in occupied mode
- Occupied air flow: meeting/conference rooms
- Space stats not controlling within 1°F
- Occupants had full thermostat control
- Mixed air control set at a constant 55°F
Site investigations

• Equal occupied and unoccupied heating variable air volume (VAV) set points
• Min/max heating VAV set points are the same
• Equal unoccupied interior and exterior zones air flow
Site investigations

Boilers reset to 120 during summer months

Heat from dimmer switch
Site investigation

- Electric baseboard on whenever OA below 50 F
- Duct static pressure sensor set at 2” pressure
- Most VAV boxes call for reheat
- Most VAV boxes damper position 50-75% in summer
Site investigations

- Outdoor CO2 is 370 PPM. Indoor CO2 is 425 PPM
- Chiller energized at 50 F OAT
- Many VAV min / max set points had been occupant complaint adjusted
- Room registers read between .5 and 4.0 CFM / Ft2
- Building positive, then negative
RA fan and SA fan not tracking
Analysis phase

• Computer modeling

• Determine if we can predict the current energy usage before changes are made
Corrective action items

• Recalculate new air flows based on the actual people, lights, equipment, glass walls and roof loads.

• Use ASHRAE 98% design

• Use actual people loading for fresh air
Analysis phase

- Actual operating data
- Total fan air flow
- Actual fan static pressures
- Actual fan amperage readings
- System type, fan wheel type and fan speed
- Actual run times
Analysis phase

- Actual data
- Average Min / Max set points
- Occupied / unoccupied set points
- VAV occupied unoccupied set points
- Fan type and fan speed
- Run times
- Actual fresh air CFM
Analysis phase

- Actual operating data
- Total fan discharge temp
- Hot water temps
- Chilled water temps
- Space temp
- Type of fin tube heat and fin tube parameters
Analysis phase: actual space data

- Actual people, light load, equipment load
- Actual occupied times
- Actual space temperatures
- Actual glass area and parameters
- Actual roof area, wall area and parameters
Analysis phase: actual utility cost data

- Gas cost per therm
- KWH cost
- KW demand cost
- Auxiliary fuel costs
- Local degree days / bin temperatures
Analysis phase

- DOE 2 or Super DOE
- Crunch the numbers and compare
Natural Gas

Projected Gas Use
Premodification Gas Use
Annual Natural Gas Summary

- Premodification
- Projected
Annual Electrical KW Demand Summary

- Premodification
- Projected
Electrical Usage KWH

Projected KWH
Premodification KWH
Annual Electrical KWH Summary

- Premodification: 2,500,000
- Projected: 1,000,000
Office Energy Intensity

- Current Intensity is \( \sim 151,000 \) BTU/ft\(^2\)/yr
- Area Average \( \sim 93,000 \) BTU/ft\(^2\)/yr
- Computer modeling \( \sim 85,000 \) BTU/ft\(^2\)/yr
Corrective action items

• Make the corrections needed to obtain the results outlined in the modeling.

• Rebalance air and water flows to new ASHRAE 98% requirements
Repair leaky valves
Eliminate restrictive duct
Corrective action items

• Adjust throttling range and dead band on all VAV thermostats and AHU Controllers
Improper Control - Too tight
Improper Control - Too Loose
Proper Control
Adjust occupied/unoccupied sequence
Fixes and corrective actions

• Rezone for interior exterior zones
• Set VAV box up with different occupied/unoccupied min/max
• Set conference room VAV box to standby
• Unoccupied interior VAV set to zero air flow
• Set 6th floor conference room VAV’s to standby mode
Fixes and corrective actions

- Lock thermostats between 68 and 75F
- Reset discharge temperature on cooling
- Reset hot water 140 to 180F
- De-energize electric fin tube above 30 F
- De-energize the fin tube in the unoccupied mode
- Rotate the fin tube usage off for 1 of 5 minutes
- Shut boiler off at 40F unoccupied
Acceptance phase

- Energy Procedures
  - Winter temps-- 70-74 F
  - Summer temps-- 73-77 F
  - No space heaters
- Monitor usage for one year
Grand Forks County Office
Retro-Cx Results
Annual Electrical KW Demand Summary

- Premodification
- Projected
- Actual
Electrical Usage KWH

Projected KWH
Actual KWH
Premodification KWH
Annual Electrical KWH Summary

- Premodification
- Projected
- Actual
Yearly energy usage per square foot

Pre-modification
151,000 BTU/FT²

Typical
93,000 BTU/FT²

Modeling
85,000 BTU/FT²

Actual:
76,000 BTU/FT²
Energy levels have stayed at projected levels for the past eleven years.
Three years after RCx
Question and Answers
Contact information

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