Top Recommissioning Measures to Maintain Efficiency

Carl E. Lundstrom, P. E., CCP
E M C Engineers, Inc.

Retro-commissioning Road trip

- In any building or facility you'll find **numerous opportunities for building retro-commissioning activities**.
- Some of these activities are very common and can yield significant savings, while others are more obscure and offer variable savings.
- There are a handful of **retro-commissioning** measures that come up time-and-time again in facilities that garner the lion's-share of the savings
- Road map for a retro-commissioning road trip

Ten Stops on the Retro-commissioning Road Trip

10. Improve boiler efficiency/controls
9. Improve chiller sequencing & efficiency
8. Calibrate DDC instrumentation
7. Reset pressure setpoints (air and water)
6. Return VFDs to variable speed operation
5. Terminal unit tune-ups – dampers & valves
4. System level test, adjust, & balance
3. Optimize/restore economizer operation
2. Eliminate simultaneous heating and cooling
1. Turn off equipment when not needed

Retro-Commissioning

***Retro-commissioning* (retro-Cx)** is a systematic process for improving the current conditions and operations of an existing building, to ensure the functionality of equipment and systems and also to optimize how they operate together in order to reduce energy waste and improve building operation and comfort.

Recommissioning

Recommissioning (ReCx) applies only to buildings that have previously been commissioned or retro-commissioned. The original commissioning process documented that the building systems performed as intended at one point in time. The intent of recommissioning is to help ensure that the benefits of the initial commissioning process endure.

#10 – Improve Boiler Efficiency, Controls

Boiler Tune-up

- Cost of gas has increased 50% since Fall 2005 and 200% in the last 7 years
- We normally find combustion efficiencies from 64 to 78%, depending upon age, size of boiler.
- We were generally able to gain 2 to 5% efficiency improvements with boiler tune-ups
- Assume .25% gain in combustion efficiency for 1% improvement in excess oxygen

#10 – Improve Boiler Efficiency, Controls

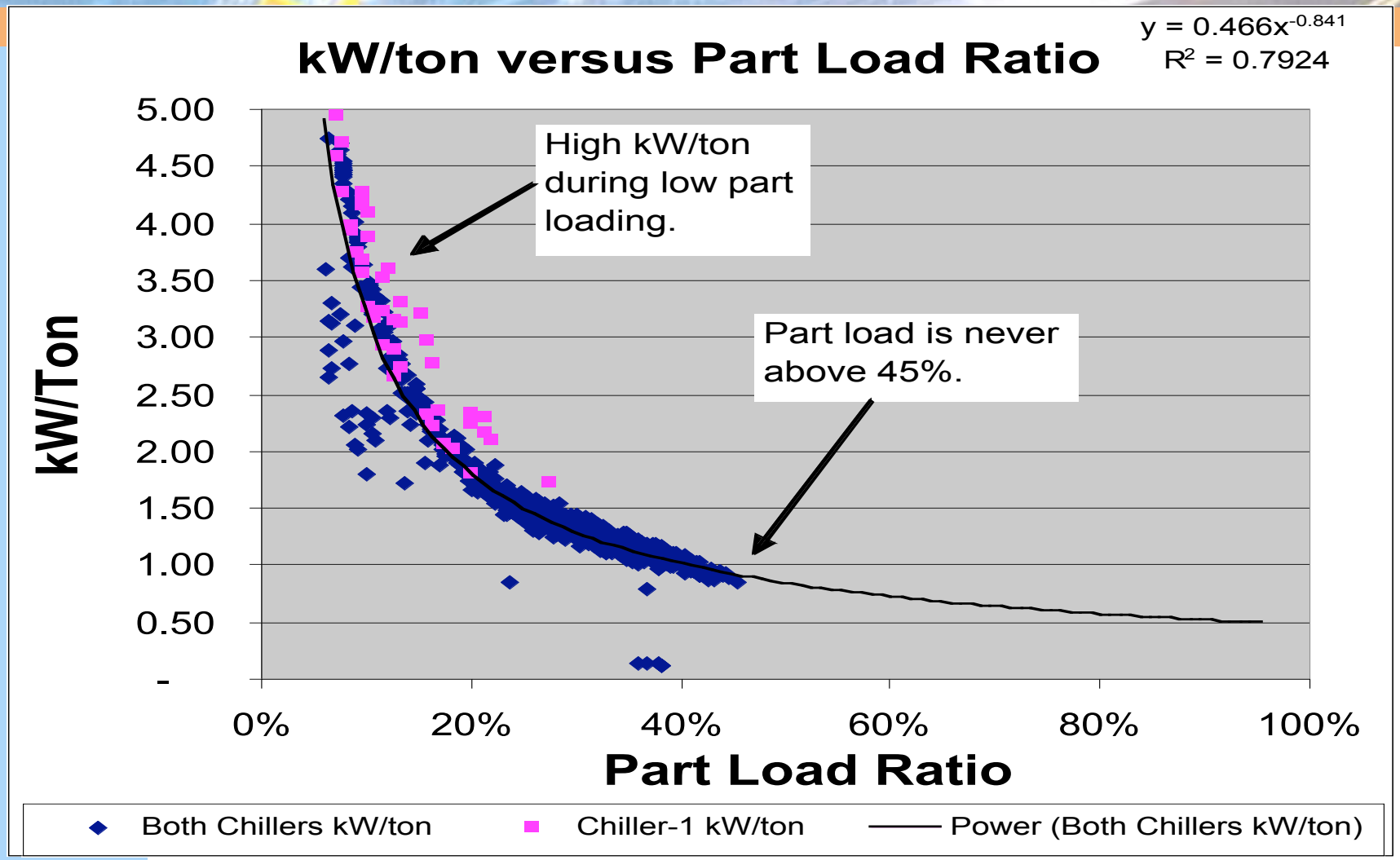
- Verify hot water system – outside air lockout temperatures
  - Minimizing boiler run time will reduce jacket losses, purge losses at start-up, stand-by losses, pipe system radiant losses, pumping energy and the part-load effect.
- Hot water temperature reset control
  - Condensing boiler…lower return HW temps get higher efficiency
    - 87% at 130 deg F inlet water temp[1]
    - 94% at 100 deg F inlet water temp[1]

[1]2004 ASHRAE Handbook, 27.4, figure 5

#9 – Improve Chiller Sequencing and Efficiency

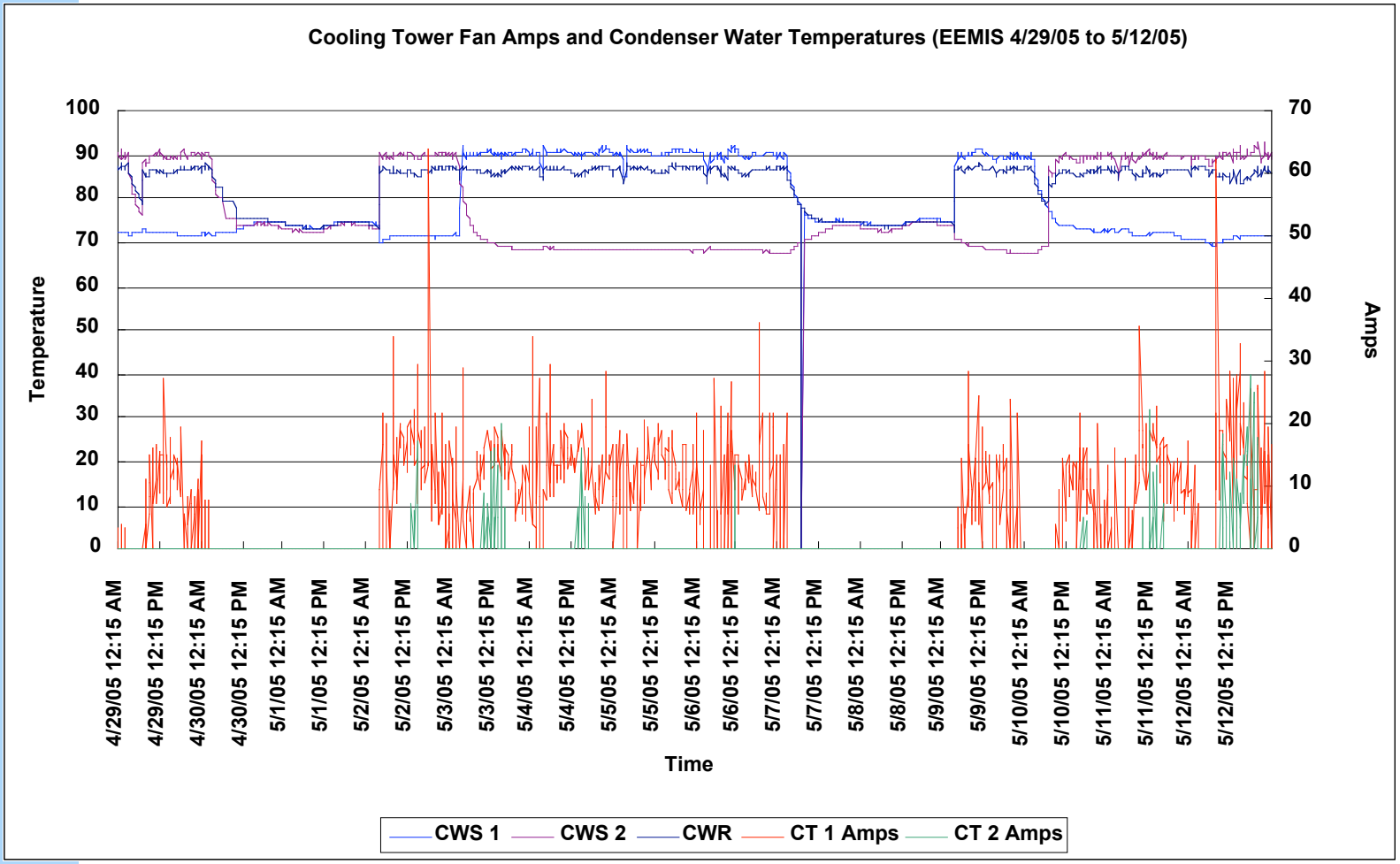
- Chiller plant improvements by:
  - Improving sequencing of chillers and pumps to meet load
  - Increase efficiency by lowering condenser water temperature setpoints

#9 - Improve Chiller Sequencing



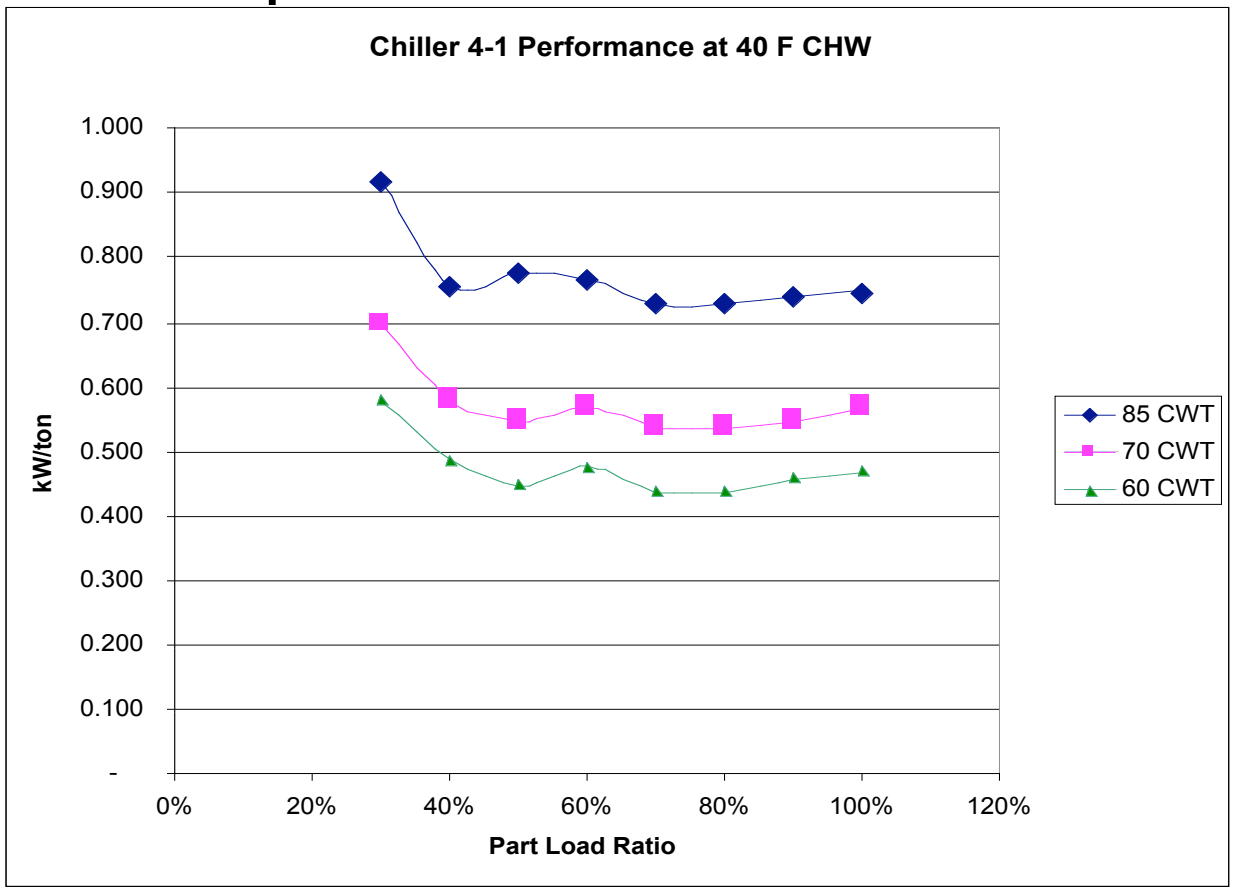
#9 – Low Condenser Water Temperature

Constant Condenser Water Temperature



#9 - Lower Condenser Water Temperature

Chiller Efficiency @ Various Condenser Water Temps.



#8 – Calibrate DDC Instrumentation

- Key temperature and pressure instrumentation drift, causing poor control
- It is critical to calibrate control loop instrumentation to obtain correct control and save energy:
  - Space temperatures
  - Discharge temperatures
  - Mix air temperatures
  - Return air temperatures
  - Supply air static pressure
  - Water diff. pressure

#7 - Reset Pressure Setpoint (Air and Water)

Air Handling Unit – Air Side

- Check the location where the static pressure sensor is located – relocate if needed
- What's the required minimum inlet pressure on the VAV terminal (check the manufacturer's data)
- Check the static pressure setpoint on VAV AHU systems – TAB contractors and O&M staff leave the setpoint too high
- Reset supply static pressure setpoint as low as possible to maintain minimum at inlet to terminal with the highest drop in supply

#7 - Reset Pressure Setpoints (Air and Water)

CHW & HW – Water Side

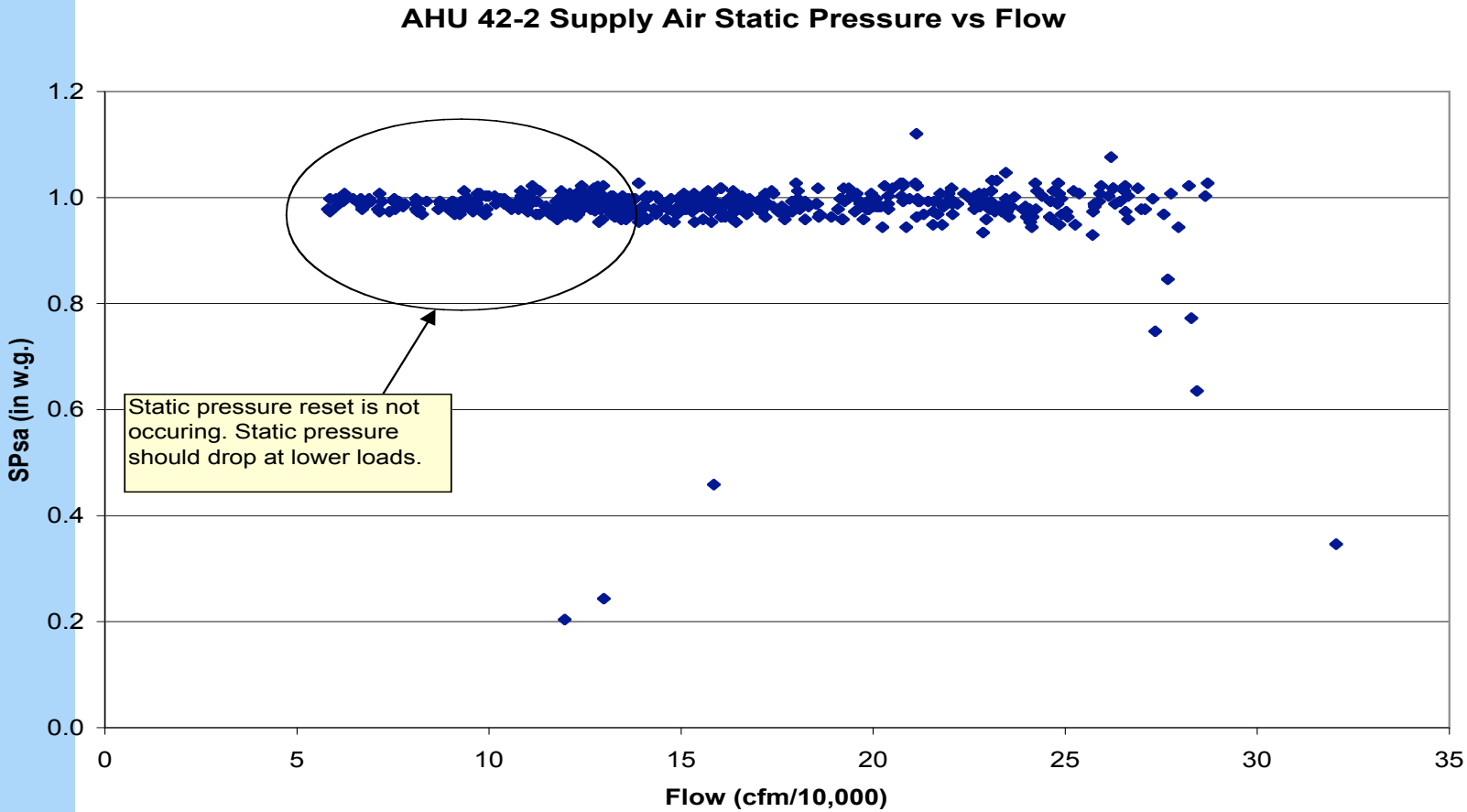
- Check where the differential pressure sensor is located in piping system
- Reset supply static pressure setpoint as low as possible to maintain flow through coils

#7 - Reset Supply Static Pressure Setpoint

- EMC's experience in retro-commissioning, finds air-side static pressure setpoints range from 1.8" w.c. to 2.5" w.c.
- Many HVAC systems can be adjusted to 1" w.c. or less

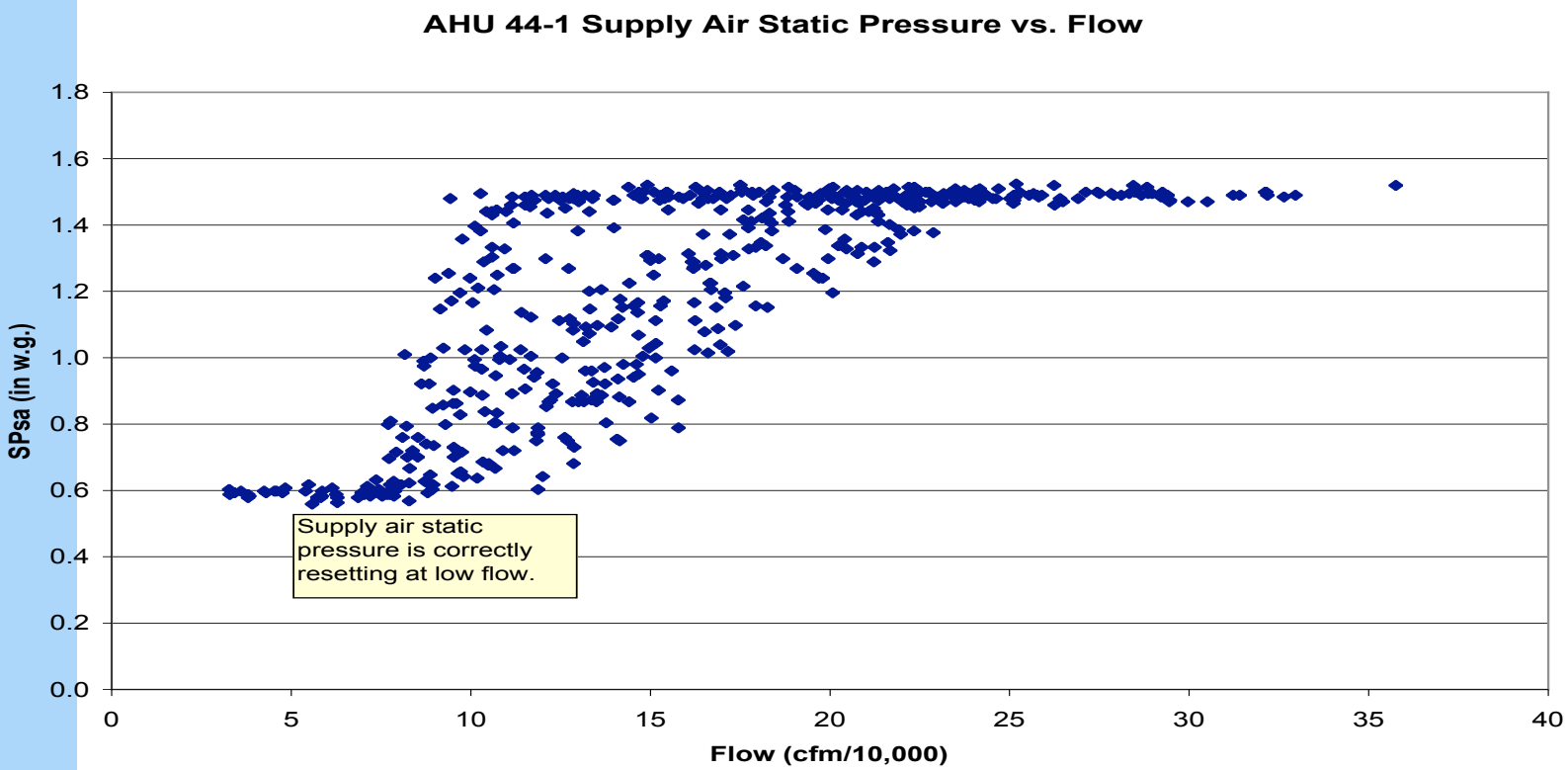
#7 - Reset Supply Static Pressure Setpoint

Constant Duct Static Pressure Control:



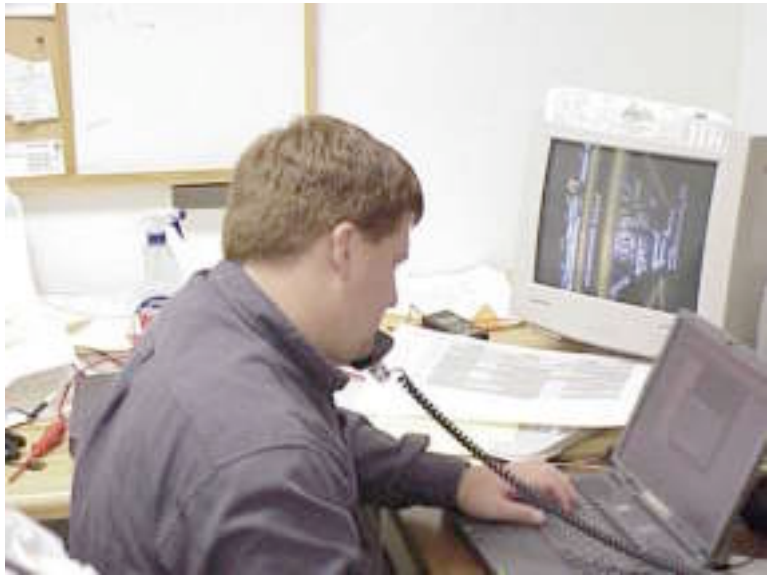
#7 - Reset Supply Static Pressure Setpoint

Variable Duct Static Pressure Control:



#6 - Return VFD to Variable Speed Operation

- Set variable speed systems from manual control back to automatic control.



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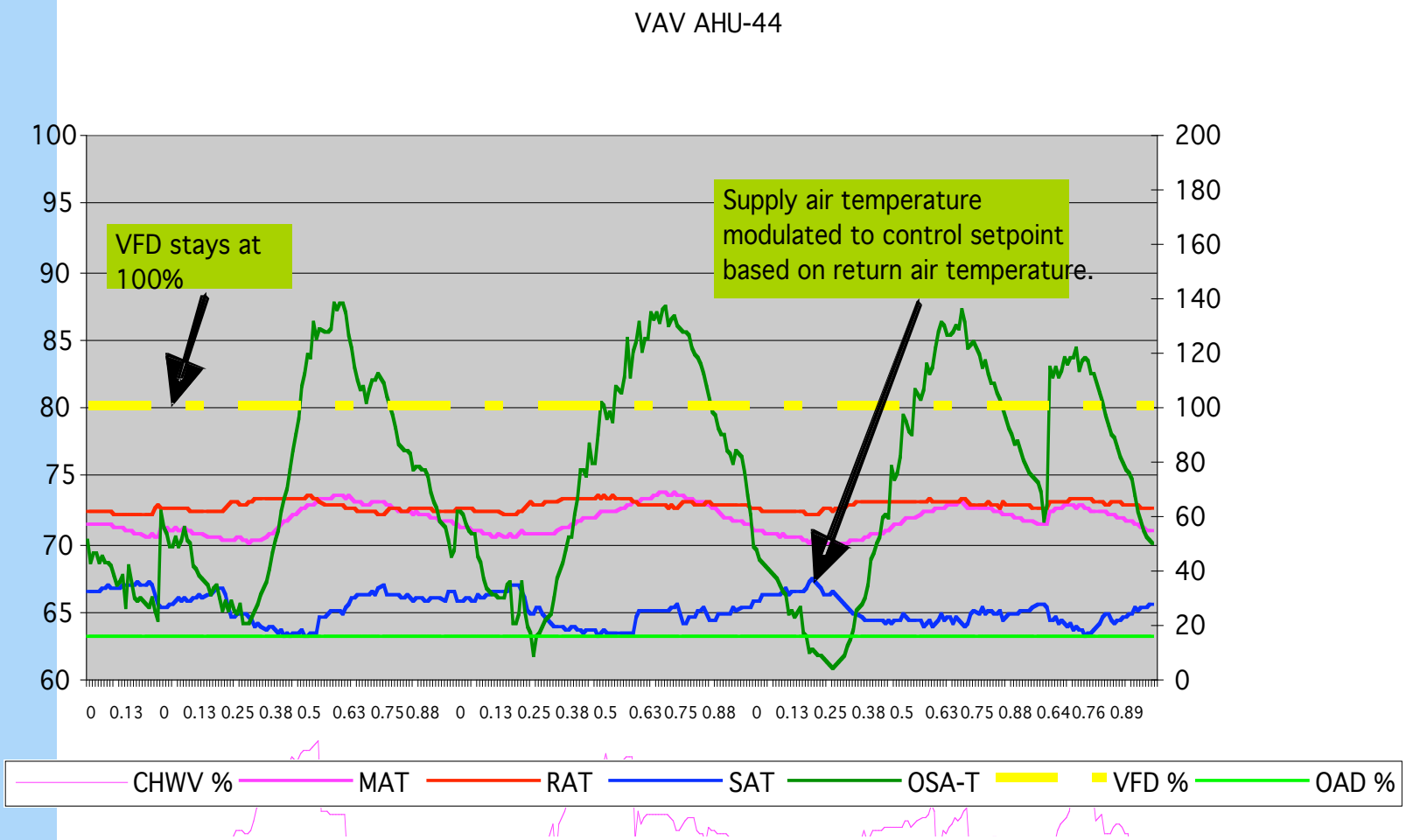

#5 – Review Terminal Unit Operation

Terminal Units – dampers & controllers

- Inoperative damper actuators
- Defective controllers
- Miscalibrated space temperature sensors
- Miscalibrated flow through flow ring
- Flow setpoints incorrect
- Leaking dampers
- Watch self-calibration mode
- Incorrect control algorithm-setpoints causing excessive reheat
- Insulated liner broken away

#5 – Review Terminal Unit Operation

Terminal Units – valves

- Valves stuck in position
- Valves leaking by
- Valves wired backwards
- Dirty heating coils

#4 – System Level Test, Adjust & Balance

For main AHUs & Pumping:

- Verify total flow (air & water) against design
- Verify pressure profiles across AHUs and pumps
- Look for throttling with dampers & valves, blockages, etc.
- Check by-pass control
- Check SF and RF tracking
- Set minimum OA damper position

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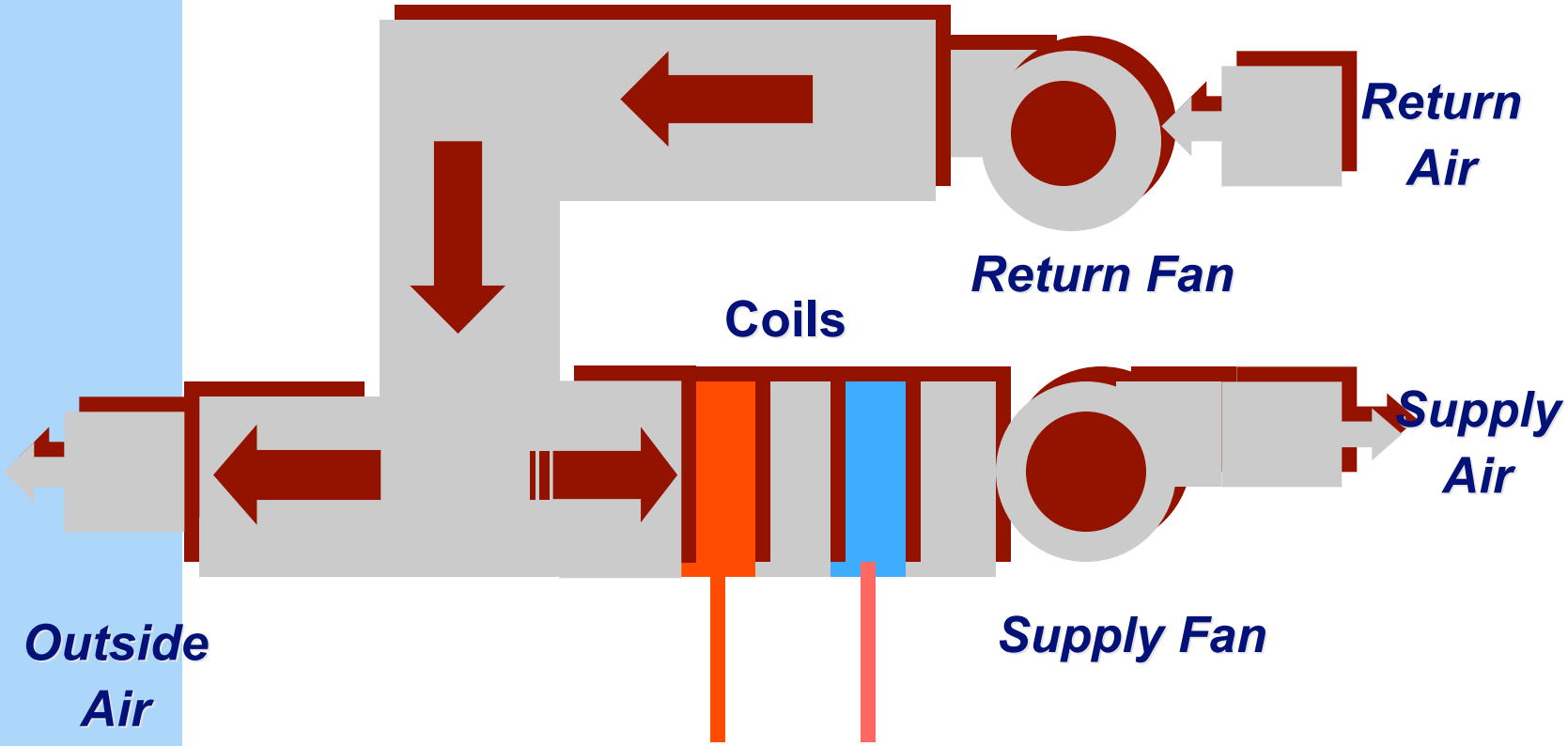
As-found conditions

- Contractor had "throttled the balance dampers closed"
- No balance of return air system
- Air flow not well distributed room-to-room
- Dirty OA filter
- Two rooms had return air ducting removed
- Some spaces had no-return air ducting

AHU-3, OA Air - Exhausting



Guthrie Ambulatory Health Care Clinic

Corrections made:

- New pulley to adjust fan rpms
- Rebalanced flow to rooms
- Connected RA ducting
- Adjusted temperature setpoints

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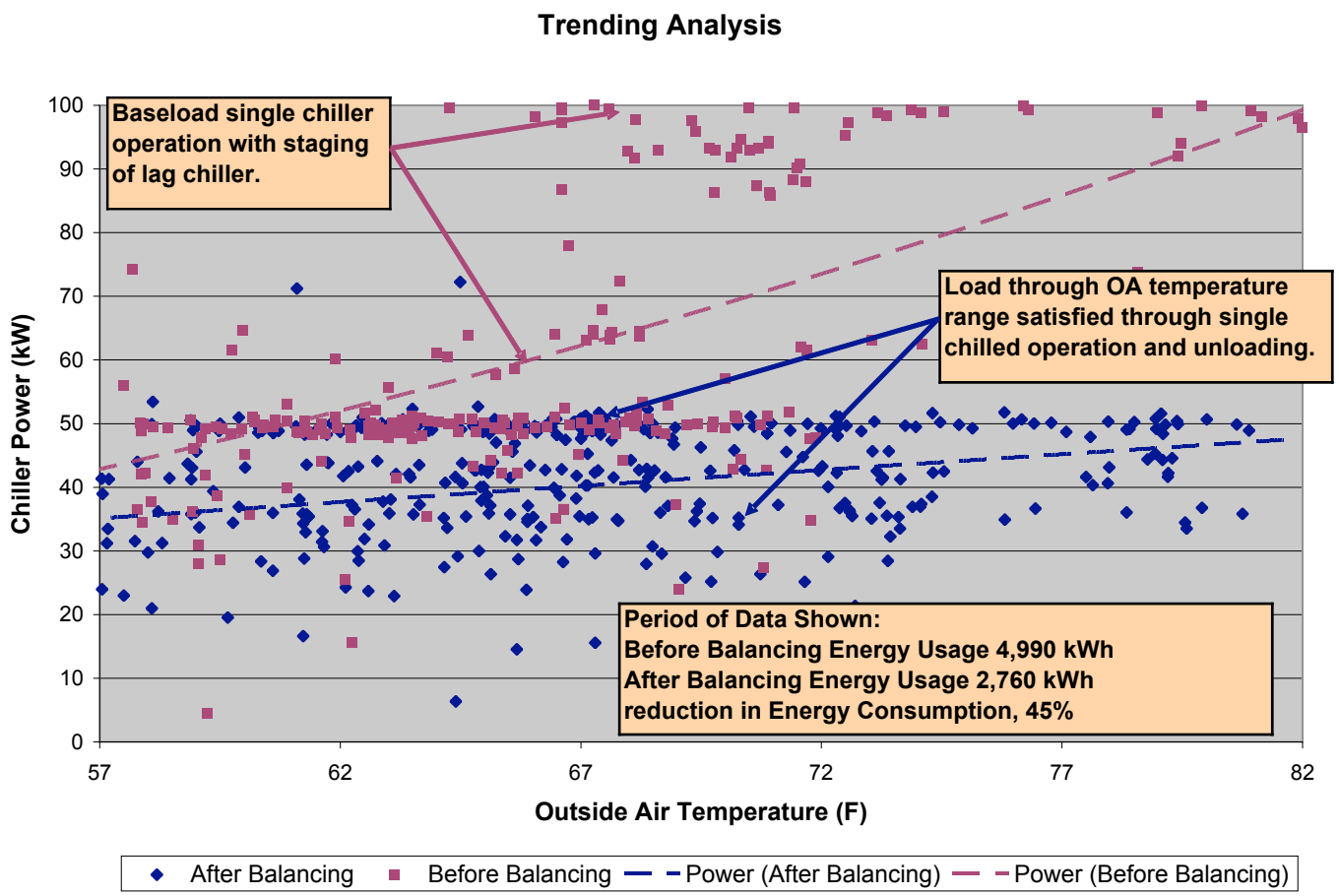
Results:

- Reduced supply air flow 60%
- Reduced sf fan amperage 20%
- Turned off return fan
- Improved space-zone conditions

#3 - Optimize Economizer Operation

- Ensure ventilation dampers are functional (dampers, actuators, transducers, programming)
- Set high limits appropriate for the climate
- Control economizer dampers to mixed air temp. setpoints
- Control economizer to follow AHU discharge air temperature or be used for stage-1 cooling
- Watch building pressure during varying economizer modes

#3 - Optimize Economizer Operation



#2 - Eliminate Simultaneous Heating & Cooling

- Check control sequences to eliminate simultaneous heating and cooling
- Examples:
  - Preheat, cooling, reheats
  - MAU cool to dehumidify & then reheat
  - VAV with no deadband between cooling and heating setpoints, causing excess reheat

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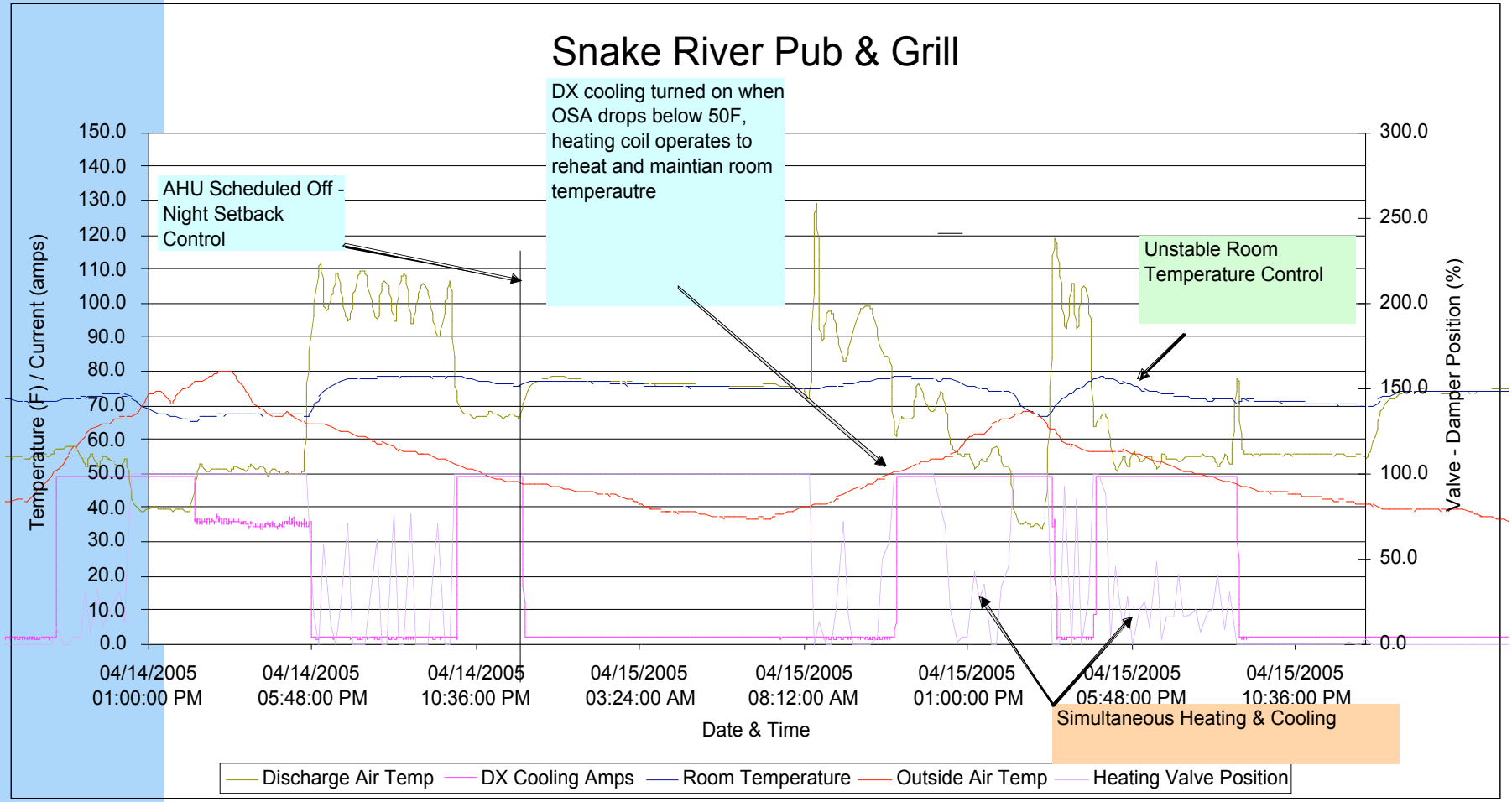


#1 - Turn Off Equipment When Not Needed

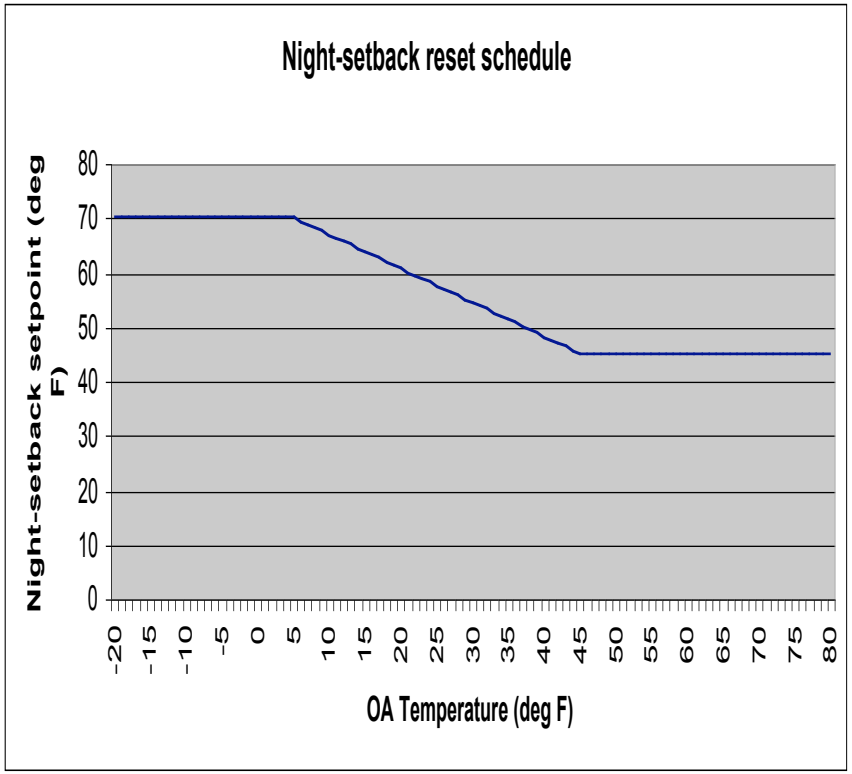
- Due to poor sequences, poor optimum start/stop control, undersized systems, or general disregard for energy, equipment time schedules are set to 24/7

#1 - Turn Off Equipment When Not Needed

- Set time schedules for systems
- Set lock-outs for systems
- Utilize optimum start/stop
- Close OA damper during warm-up
- Utilize free-cooling during cool-down
- Utilize building purge for climates with cool nights – hot days

#1 - Turn Off Equipment When Not Needed

- Use an OA temperature vs. heating setback reset schedule for "nightsetback – setpoint"



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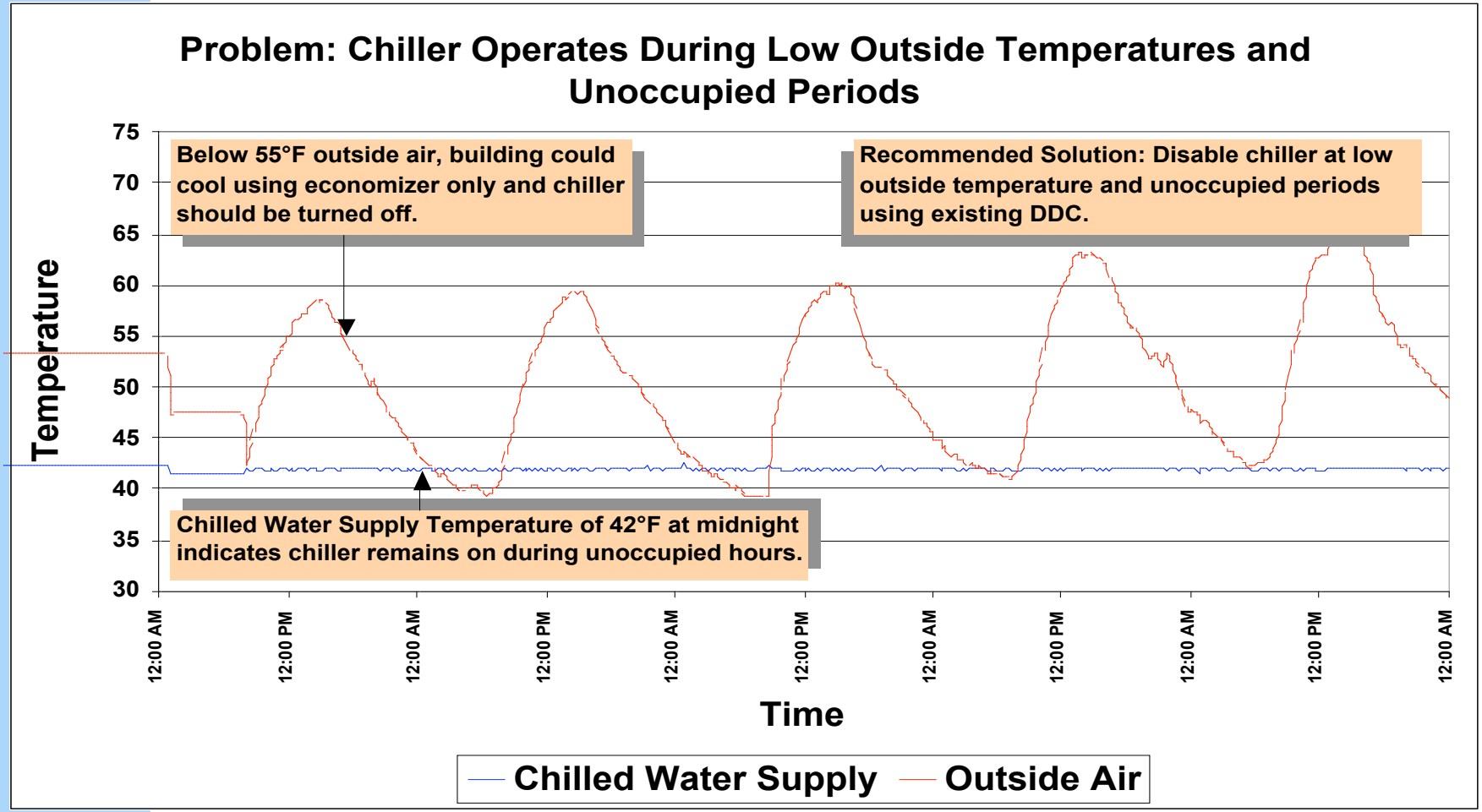

Resources

- **Building Commissioning Association, "www.bcxa.org"**
- **"Practical Guide to Commissioning Existing Buildings," Haasl & Sharp, 1999,**

  http://ateam.lbl.gov/mv/docs/RetroCommissioningGuide.pdf
- **ASHRAE, Guideline 1-1996, "The HVAC Commissioning Process," www.ashrae.org**
- **"Continuous Commissioning Guidebook for Federal Energy Managers" http://www.eere.energy.gov/femp/pdfs/ccg01_covers.pdf**
- **Portland Energy Conservation, Inc. (PECI), www.peci.org**

Retro-commissioning Road trip

- Applying the road map for retro-commissioning can provide facilities 10-20% savings
- **Start with the top 10 retro-commissioning**
- **Contact info:**
  - Carl E. Lundstrom, PE, CCP
  - EMC Engineers, Inc.
  - 678-254-1221
  - clundstrom@emcengineers.com
  - www.emcengineers.com