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· August 15-18, 2010 · Dallas, Texas ·
· Dallas Convention Center ·

Occupancy-based HVAC Temperature Control Strategy Demonstration

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Motivation

- HVAC represents 42% of building energy
  - 145 TBtu/yr in Federal buildings
  - 24 TBtu/yr in Navy buildings
- Some buildings have areas that are unoccupied for extended periods
  - Where schedule-based temperature reset controls are not appropriate
  - Occupancy-based temperature reset controls may offer potential energy savings

Occupancy-based Temperature Control

- Also called guest (room) energy management systems
  - Key card activated
  - Manual switch activated
  - Motion sensor activated
  - Hard wired or wireless options
  - Light and receptacle control options
  - Providers claim 25 to 45% energy savings in hotel/motel applications

Demonstration Objective

- Demonstrate in a Navy dormitory (BEQ)
- Identify design and installation issues
- Quantify energy savings
- Identify maintenance issues
  - durability, robustness
- Observe temperature and humidity variation
- Determine cost effectiveness

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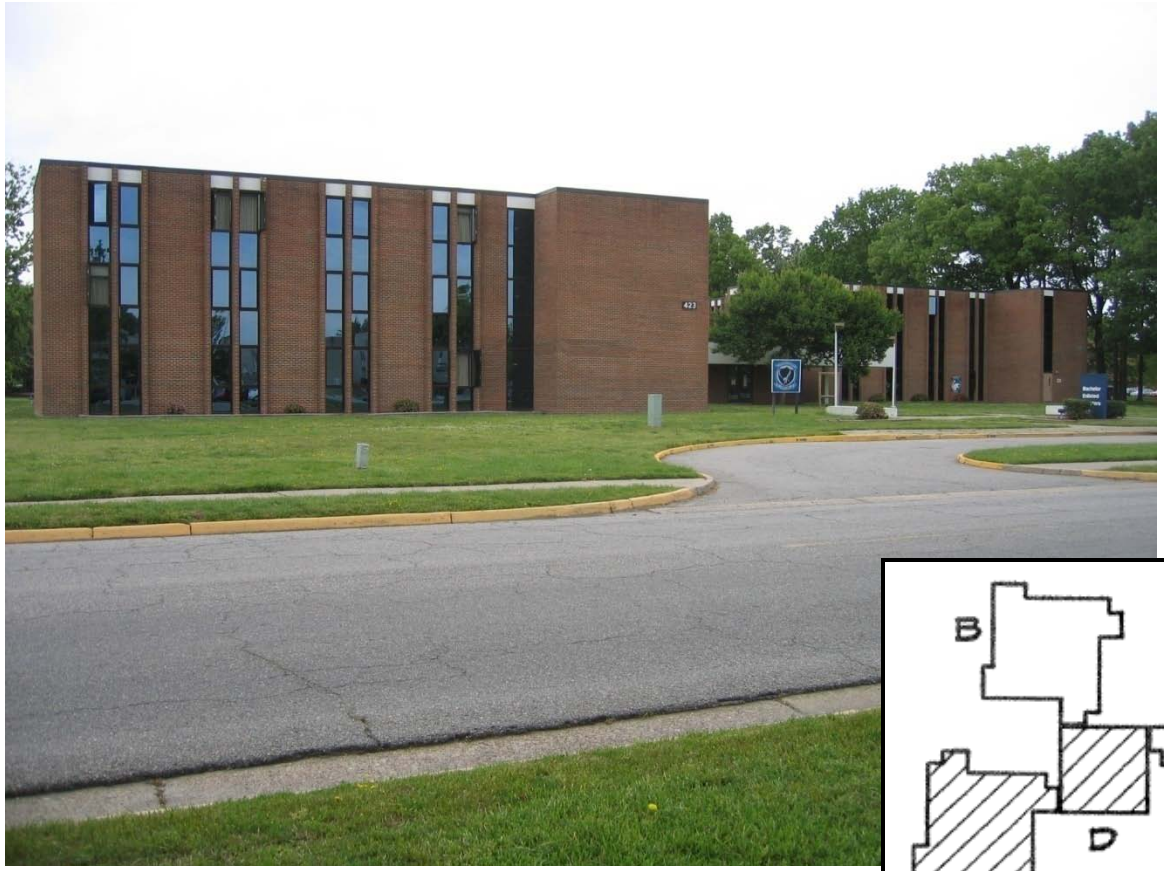
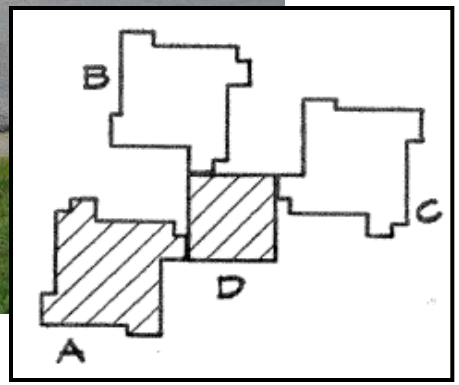




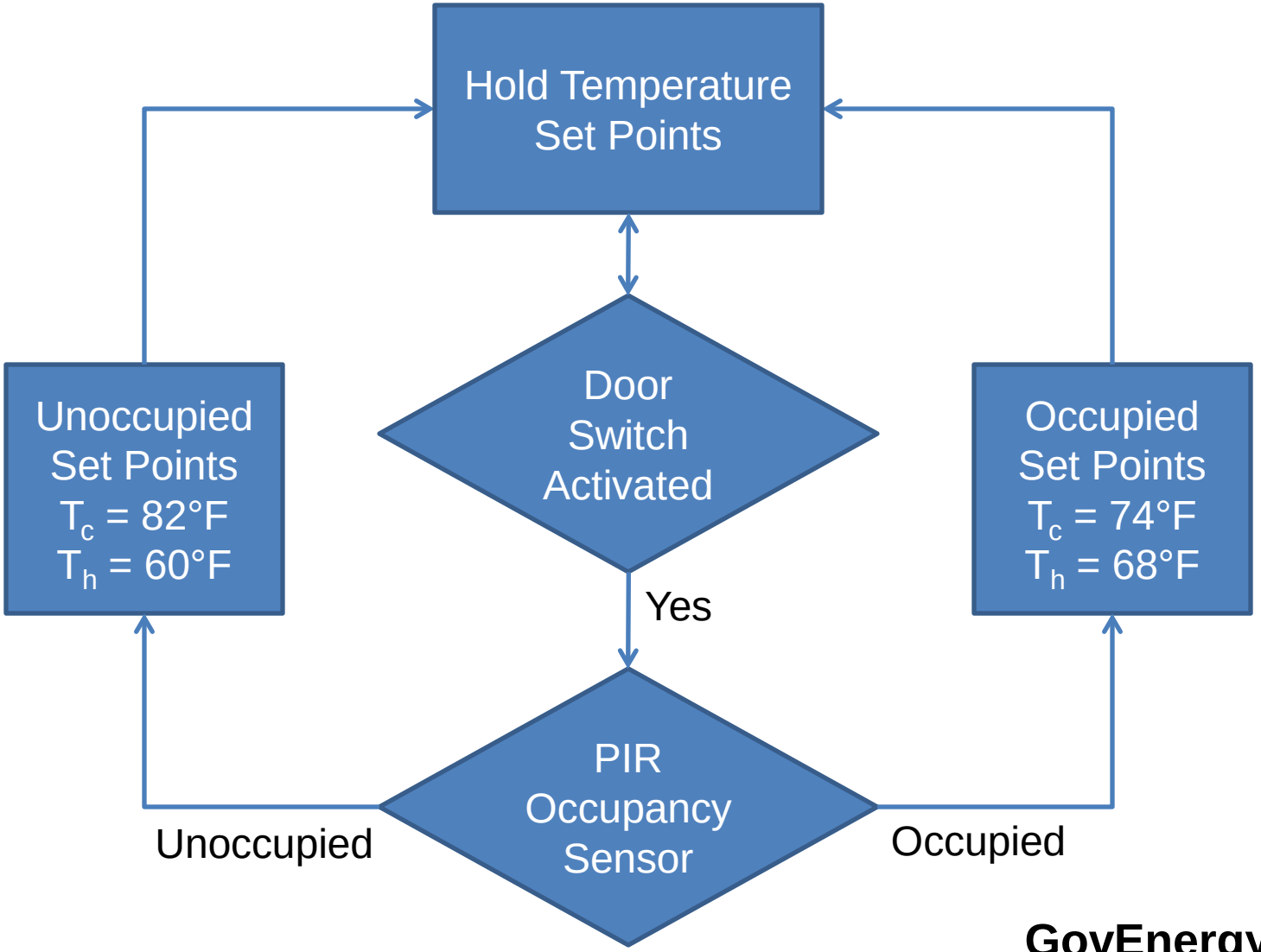
Building 423, NAS Oceana, VA

Dormitory, 93,000 square-foot, 102-room, 3-story, 3-wings, central mechanical room, 185-ton air-cooled rotary chiller, 114-individual 4-pipe fan coil units with a dedicated outside-air system for each wing, Trane Tracer Summit DDC system.

New Control Strategy

- Relay module and door switch wired to the passive-infrared sensor/controller
- Relay module connected to the fan coil unit control board
- Activated by door sensor
- Passive infrared sensor would determine occupancy status
- Occupancy status remains until door sensor activation

Control Operation



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Temperature Control Set Points

Status	Occupied	Unoccupied	Revised* Unoccupied
Cooling	74°F	82°F (+8°F)	82°F (+8°F)
Heating	68°F	65°F (-3°F)	60°F (-8°F)

* Temperature reset was revised and monitored for an additional heating season.

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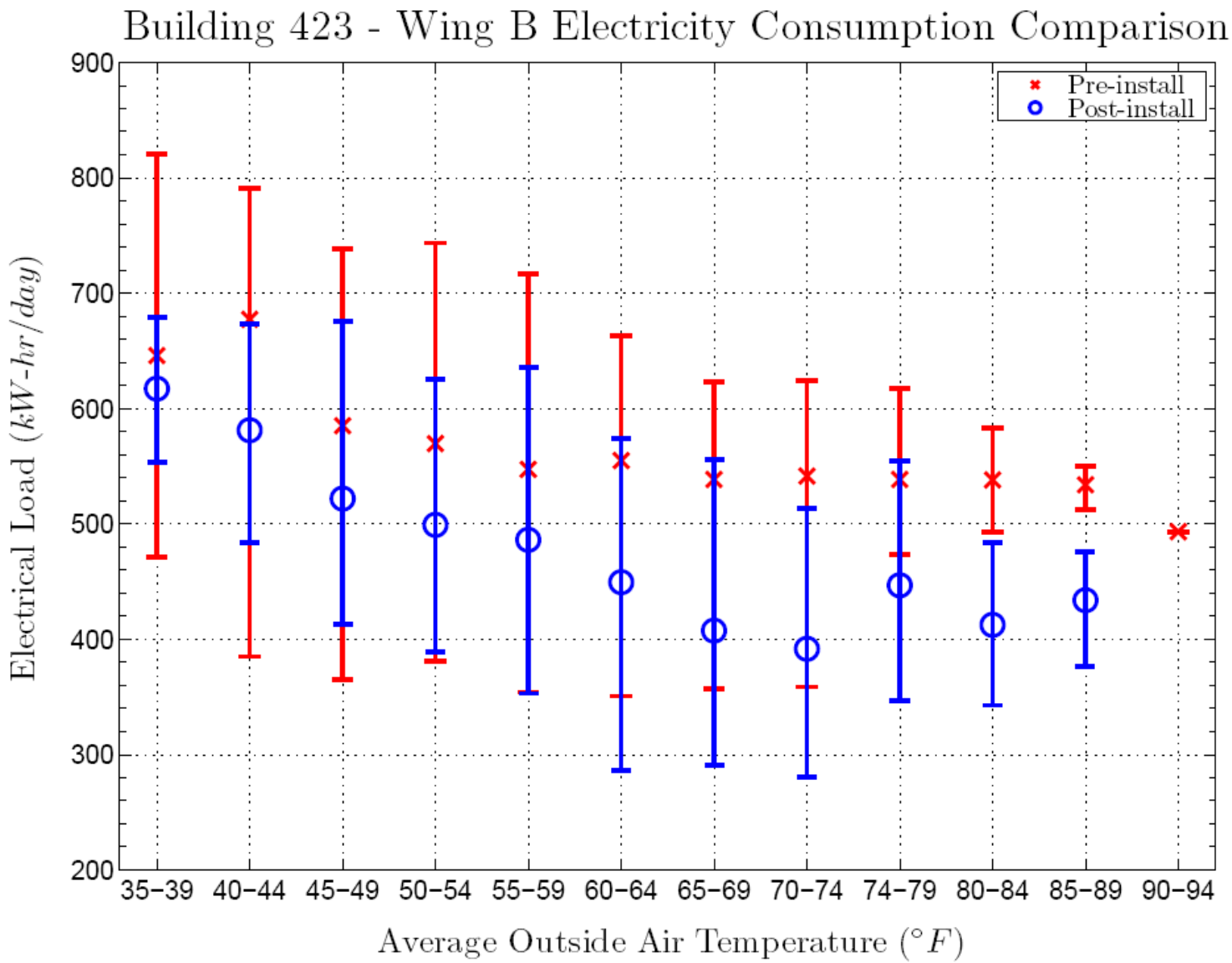
Data Monitored

- Chiller power
- Space cooling load to each wing
  - Space cooling load to DOAS-wing B
- Space heating load to each wing
  - Space heating load to DOAS-wing B
- Electric power to each floor for each wing
- Temperature and humidity sample rooms
- Building occupancy records

Monitoring Period

- Baseline
  - November 2006 to October 2007
- Post-installation
  - November 2007 to November 2008
- Post-modification
  - Revised heating season reset temperature
  - October 2009 to March 2010



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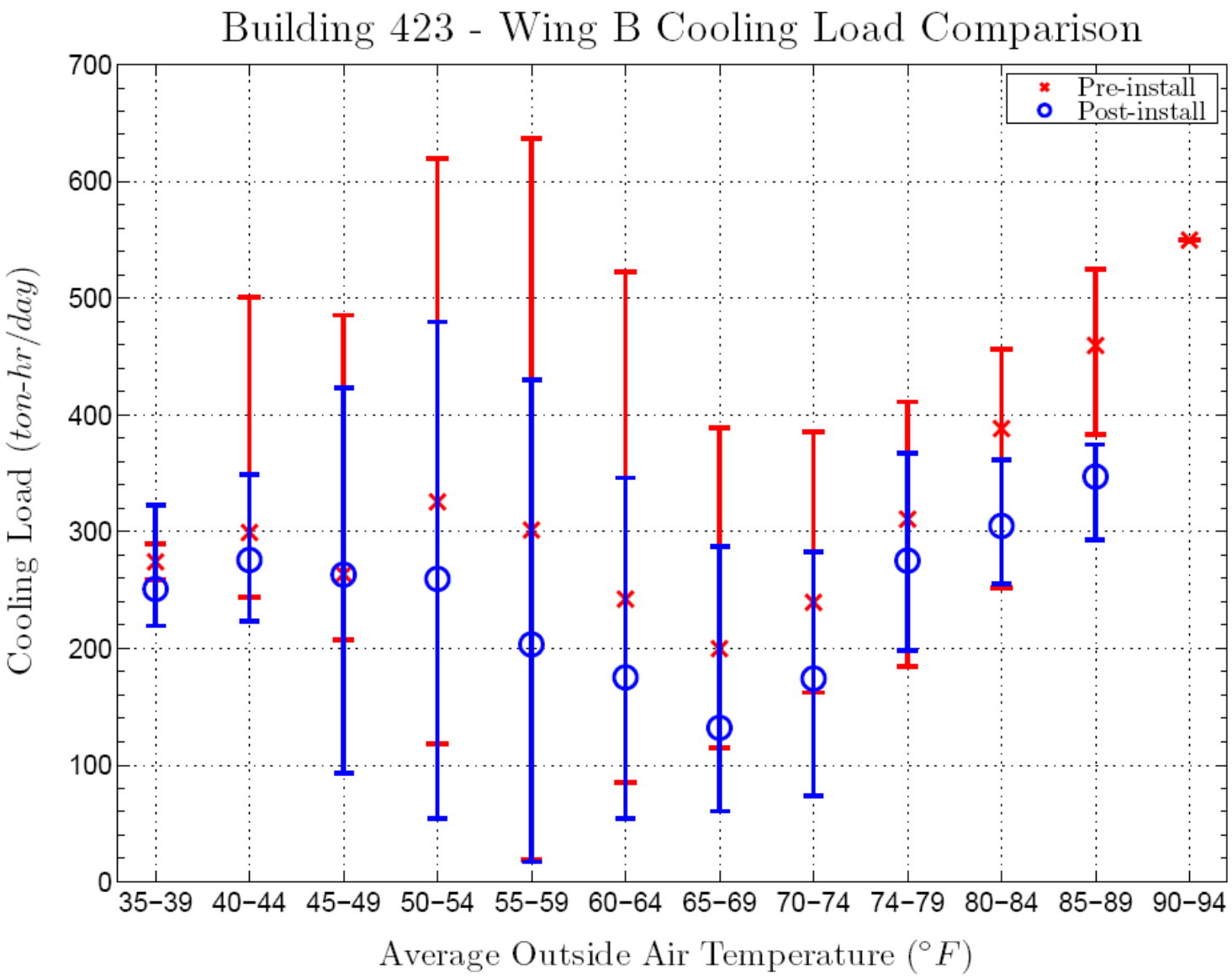

+8°F cooling temperature set point reset

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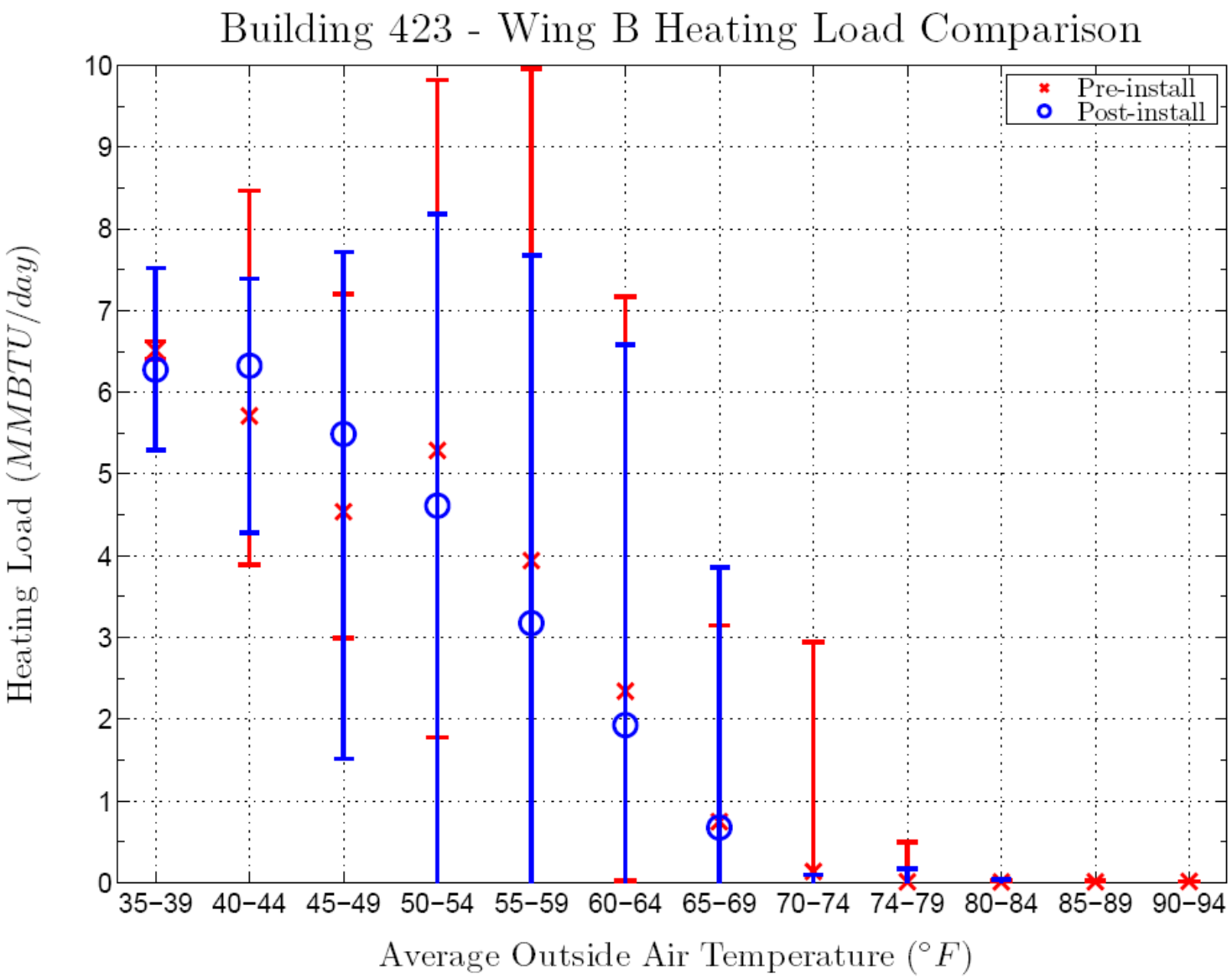

-3°F heating temperature set point reset

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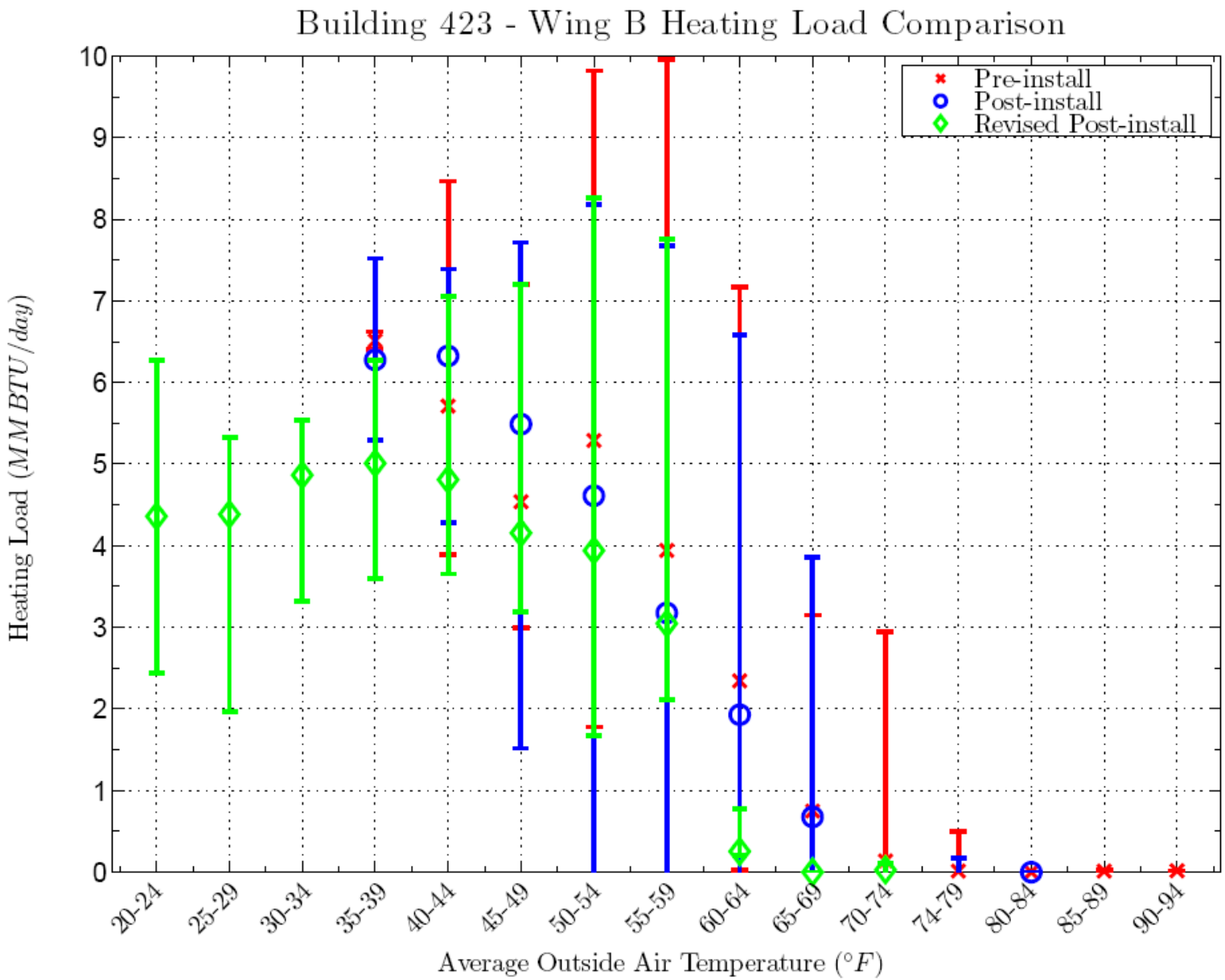

Blue: -3°F heating temperature set point reset
Green: -8°F heating temperature set point reset

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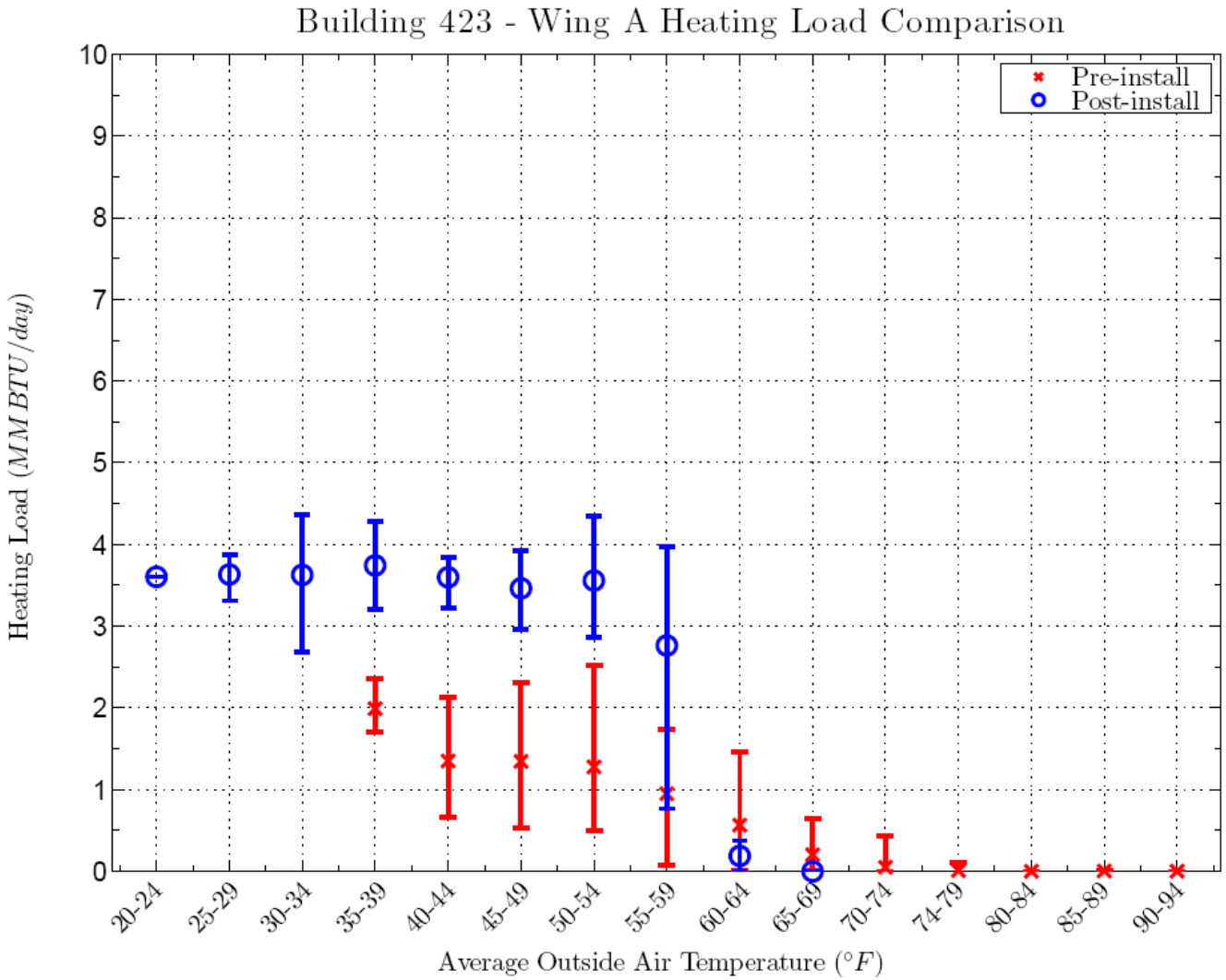
Not everything goes as planned



-8°F heating temperature set point reset

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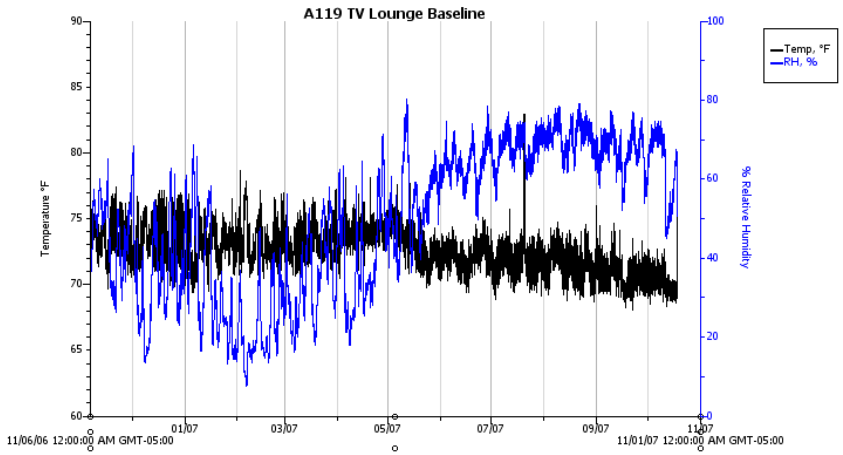
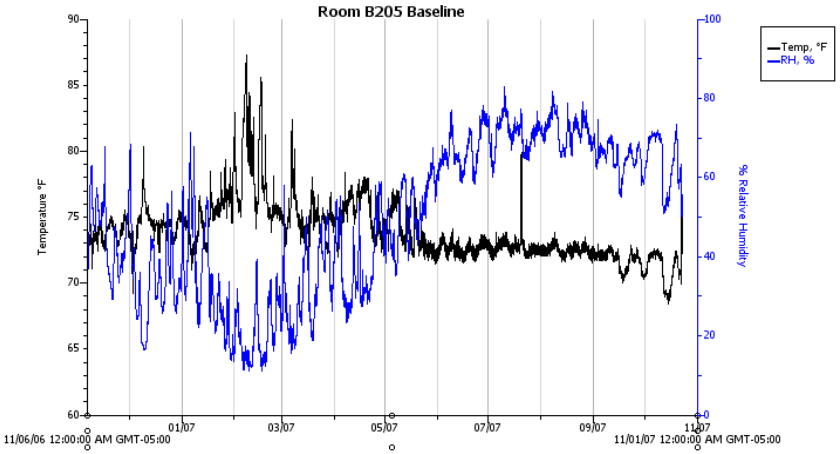
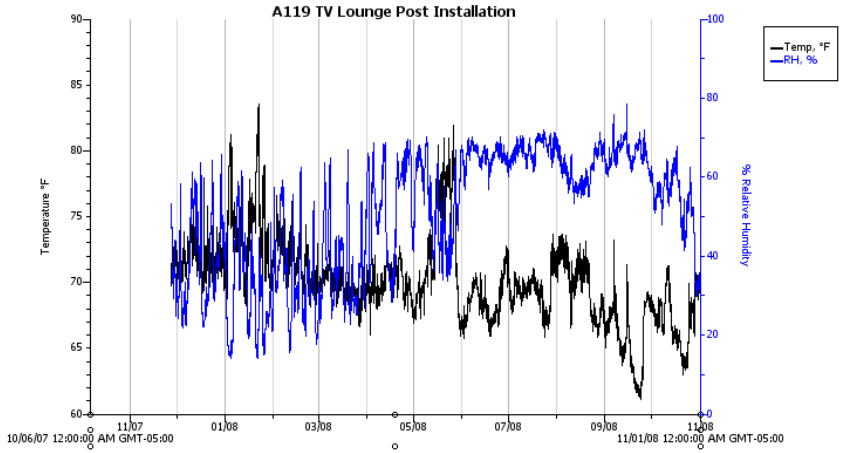
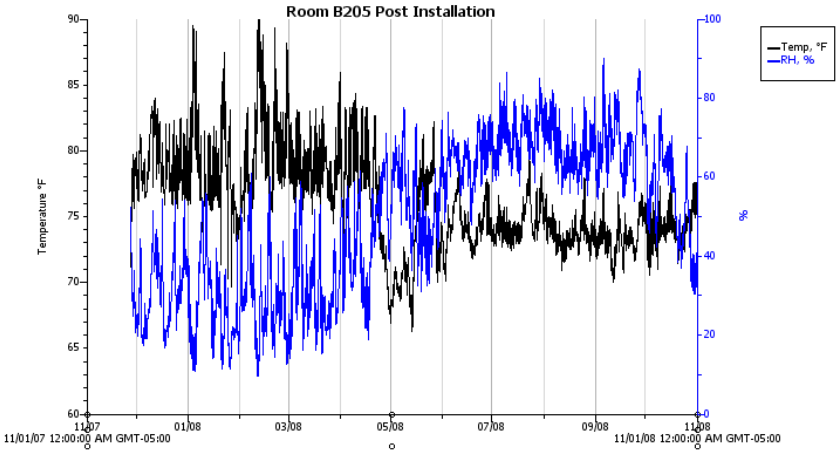
Temperature & RH Samples









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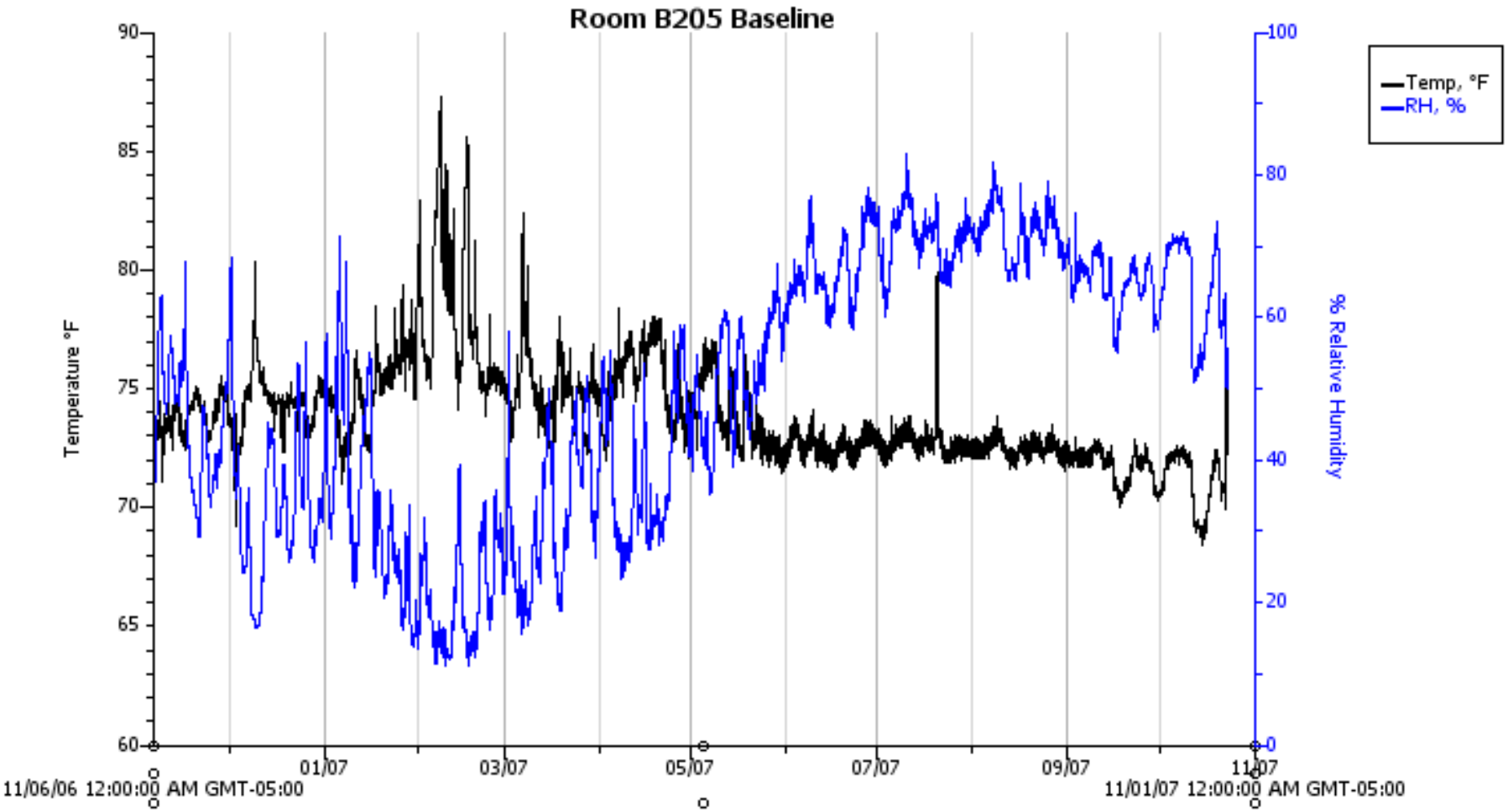

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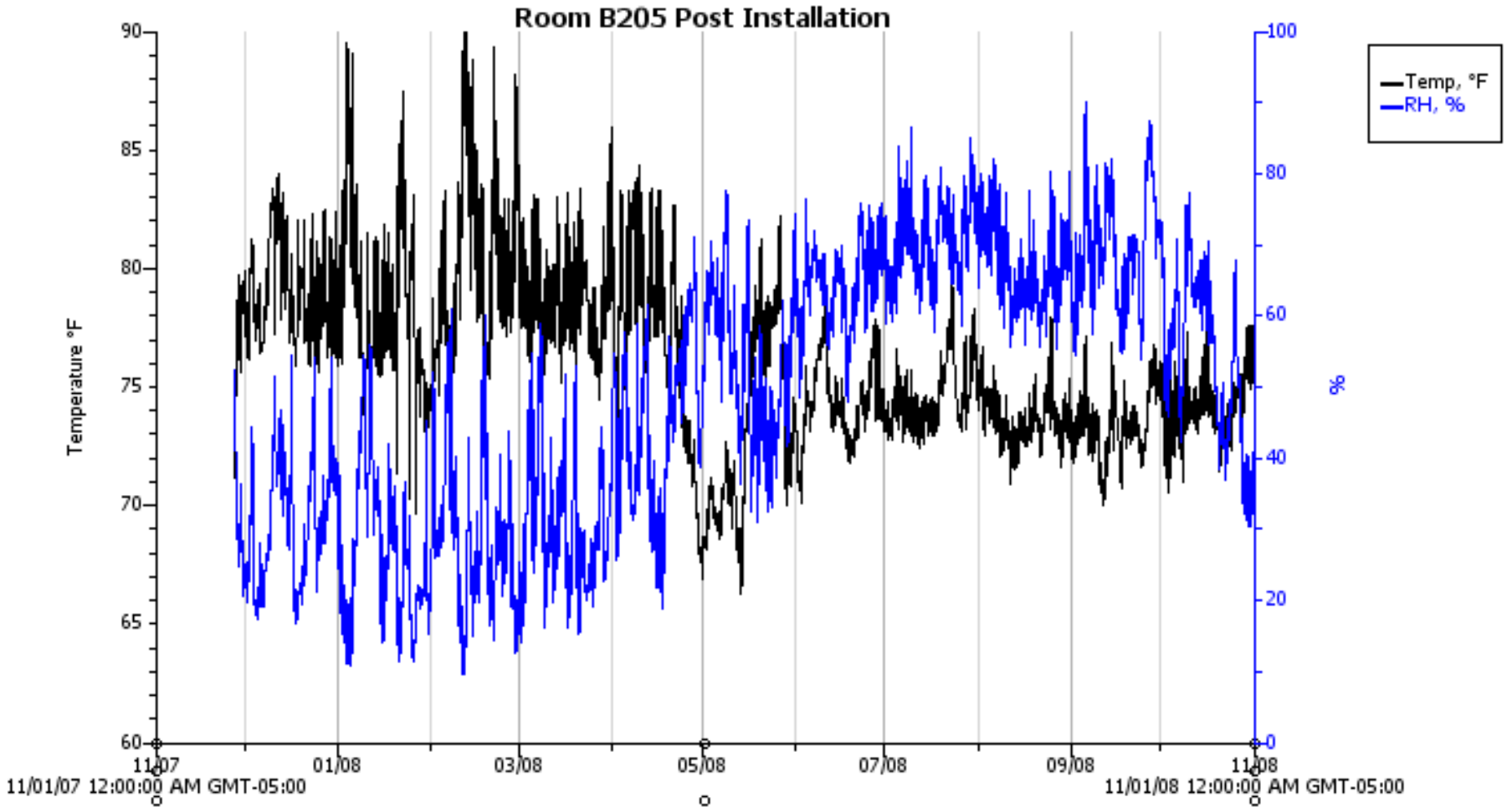

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Economic Projection

	Space Cooling (kWh/yr)	Space Heating* (therms/yr)	Cooling Cost ($/yr)	Heating Cost* ($/yr)	Total Cost ($/yr)
Baseline	347,403	41,693	24,318	44,195	68,513
Post-installation	303,814	40,746	21,267	43,191	64,458
Savings	43,589	947	$3,051	$1,004	$4,055
Percent Savings	12.5%	2.3%			
Installed Cost†					$43,248
Simple Payback					10.7 yr

* Based on the original reset temperature set points

† Wired sensors used in demonstration. Wireless would be less expensive for retrofit installation.

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Maintenance Issues

- After 4 months, site inspection of 46 rooms
  - 5 motion detectors did not sense motion
  - 2 detectors failed to trigger DDC system
  - 4 detectors abused by occupants
  - Total cost of inspection and repair, $2,000
- Individual rooms had operable windows
  - Humidity levels varied widely during baseline and post-installation
  - No recognized change in humidity variation

General Conclusions

- Technology is viable
  - Prefer room-level zone control
  - Higher temperature reset = more savings
  - Applicable where transient occupancy is the norm
  - Recovery not usually an issue
- Maintenance is a concern
  - Other technology approaches may improve results

The Techval Team

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