Improving Chiller Performance for Mission Critical Facilities – An EBCx Case Study

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Learning Objectives

1. Recognize the elements of a successful EBCx scope
2. Identify proper equipment and data for effective trend analysis
3. Establish facility requirements for mission critical facilities
4. Employ strategies for successful implementation and ongoing monitoring plans

Overview

- Facility Background
- Scoping development
- Investigation and Analysis
- Proposed Solutions
- Recommendations
- Best practices
  - Implementation
  - ongoing performance

Facility Background

- Multi-story, multi-building cleanroom facility
- 24 hour operation
- Aggressive temp/RH
- Failure was not an option = mission critical
- Low temp glycol chillers
- Multiple MAU and AHU equipment
- Dehumidification
- Lab reliability was a concern
- Environmental conditions were creeping out of tolerance
- Site walkthrough and multiple owner meetings

Project Goals

- Solution for reliable chiller operation
- Increase chiller life
- Reliability at low load conditions
- Maintain environmental conditions
- Clear path for implementation
- Stand the test of time
- Cost effective
- Plan for ongoing performance and persistence

Investigation and Analysis

- Development of investigation plan
  - Contents
- Request of trends – FPT not an option
- Operational data
  - Review original drawings – did design match current facility requirements
  - Sequence of operation
  - O&M records for chillers
- Determining root cause of operational issues
- Document unknown sequence parameters

Trend Data vs Data Logging

- Trend Data
  - Confidence in trend availability
  - Consider format of data
  - Storage capacity of BMCS
  - Sensor accuracy
  - Set up of adequate trend intervals
  - Can be accessed remotely
- Stand-alone data loggers
  - Flexibility
  - Tailored solution for investigation needs
  - Site access required
  - Can serve as a validation of BMCS sensors

Analysis and Findings

- Drawing review
- Field observation
- Trend review
- Alarm histories
- O&M records
- Operator interviews
- Manufacturer discussions

Document Review

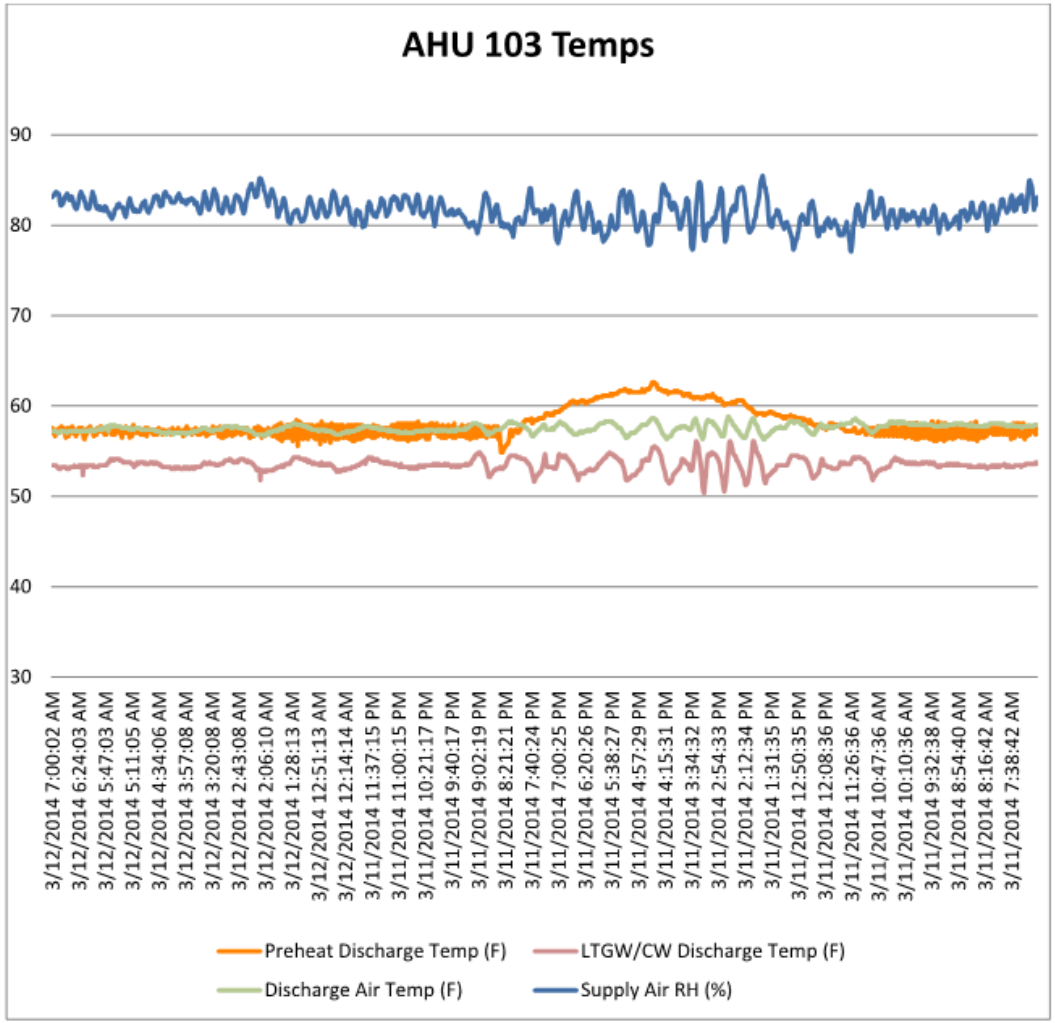
- 2- 400 ton chillers
- Constant volume primary, variable secondary pumps
- Designed for dehumidification loads
- 31 F CHWS temp
- Condenser serves reheat loads at AHU level
- Design – 30% winter RH, 40% summer RH
- Operation – 45% RH +/- 2%, 68 F
- AHU and MAU Configuration
- Site review – landlocked mechanical room
  - No room for added mechanical space
  - Exterior site constrains

Sequence and O&M Review

- refrigerant leaks, purge tank, circuit modules
- Overridden heat recovery sequence
- Chillers enable based on glycol coil demand
- Campus chilled water primary except on MAU
- OA preheat coil
- CHW and GCW maintain 50 F or 42 F based on room RH
- Reheat coil set point of 58 F, +/- 0.2 F
- Steam humidifier, 45%
- Need for re-calibration and AHU level re-commissioning

Trend and Operation Review

- Limited demand for glycol cooling during winter and shoulder season
- Low chiller Delta T
- No short cycling during trend period
- Low CHW demand
- Inefficient preheat coil operation
- Connected glycol coil load of 740 tons
- Connected load:
  - MAUs – 14%
  - Lab MAUs – 6%
  - Lab AHUs – 80%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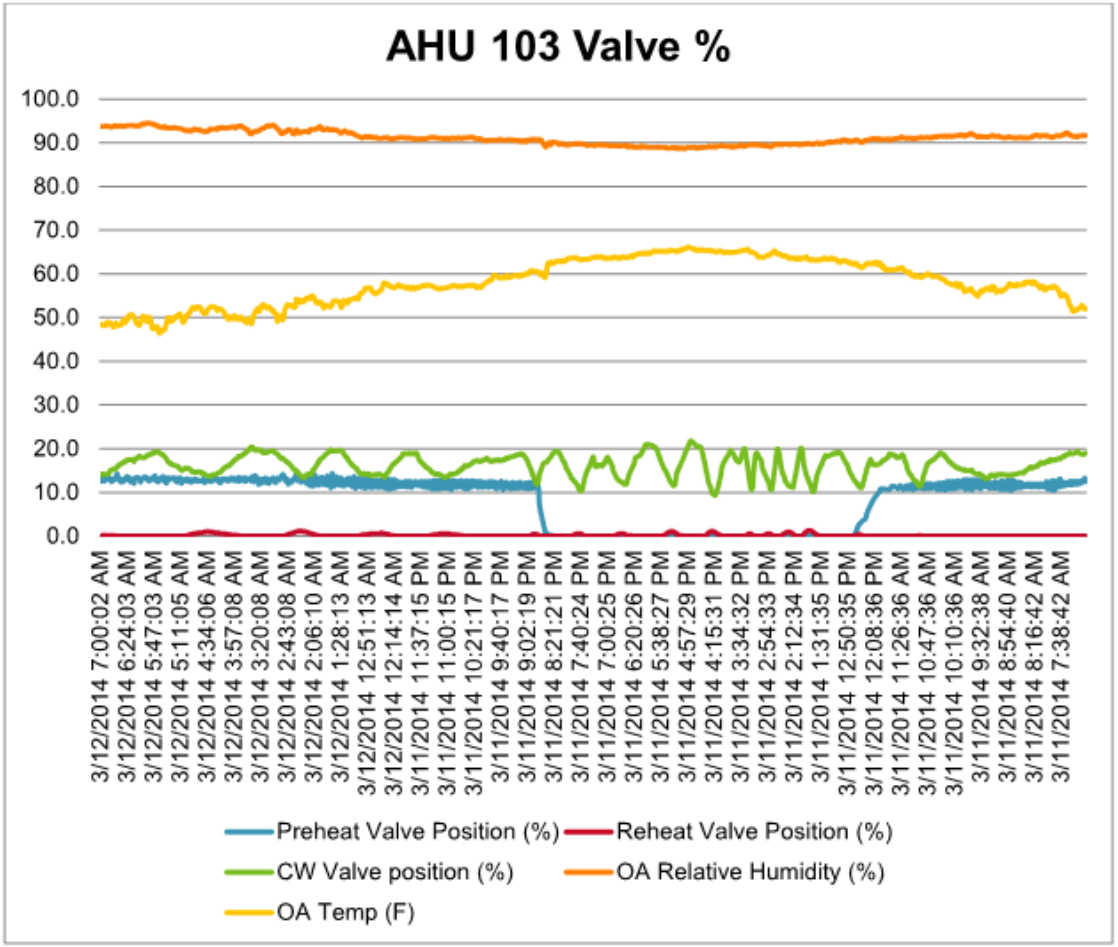
Discharge Air Temp (F)
Supply Air RH (%)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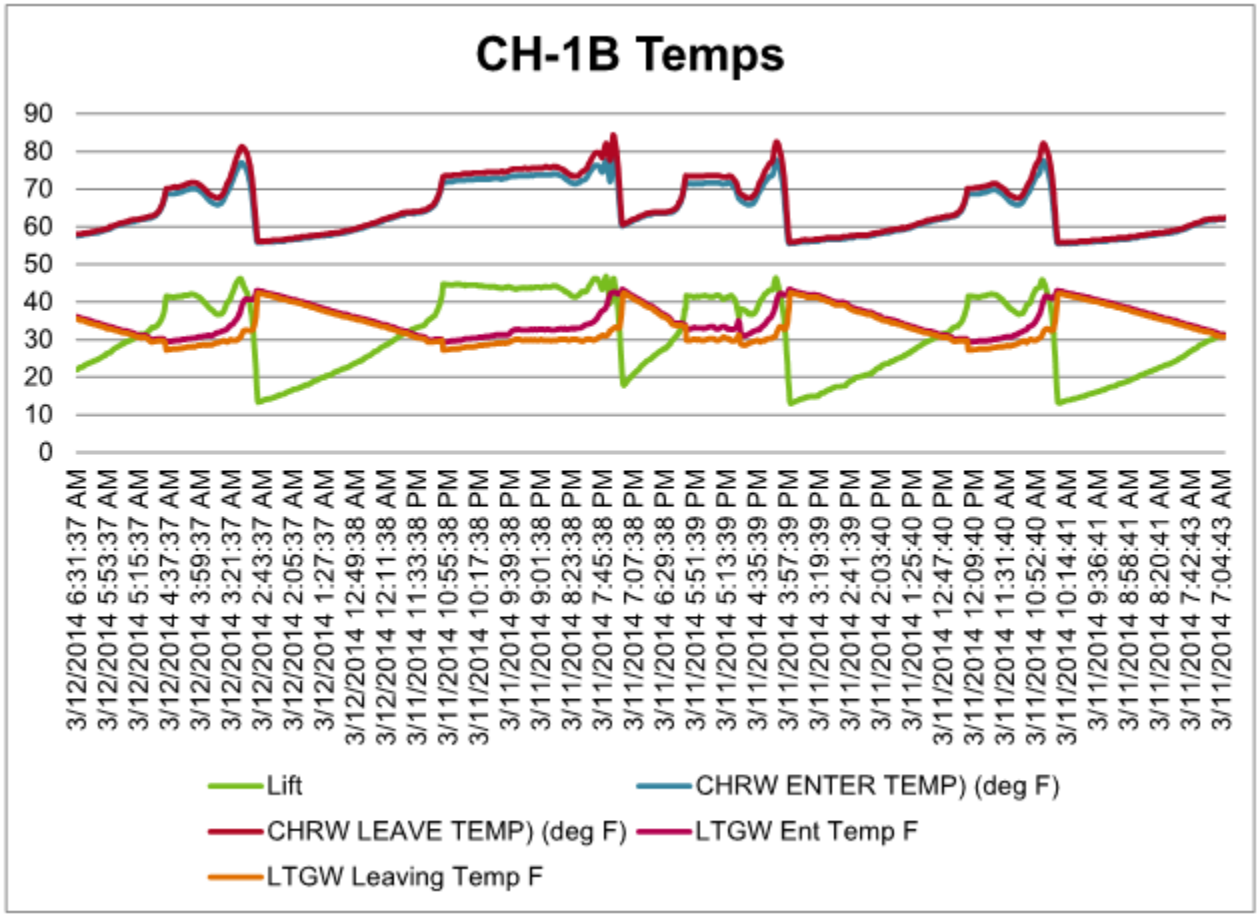
Reheat Valve Position (%)
CW Valve position (%)
OA Relative Humidity (%)
OA Temp (F)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CHRW ENTER TEMP) (deg F)
CHRW LEAVE TEMP) (deg F)
LTGW Ent Temp F
LTGW Leaving Temp F

Analysis and Findings

- Minimum loads conditions determined
  - Based on mild winter/should season temp
  - Operational load to prevent short cycling
  - Minimum flow maintained
- Opportunity for sequence modification
- False loading for low temp glycol demand
  - Campus CHW as source
- Same coils primary year round
- Need for accurate as-built sequence of operation
- Opportunity for summer/winter operational modes
  - Glycol coils secondary vs. primary control

Recommended Solutions

- Modify AHU CHW coil controls
- Install heat exchanger on glycol supply

Implementation Plan

- Recommendation for successful implementation
- Verification tests
- Ongoing monitoring plan
- Updates to training and systems manual
- Development of Key Performance Indicators
  - M&V
  - Maintain research conditions

Modify AHU CHW Coil Controls

- Program summer and winter sequence modes
- Winter = glycol primary, condenser heat recovery reheat
- Summer = plant CHW primary
- Above 80 F OSA temp
- Potential for implementation by in-house staff

Modify AHU CHW Coil Controls

- Estimated Implementation = $10,200
- 3 month completion schedule
- Verification tests
  - Control modes of operation
  - Trends
    - Discharge air, CHW, GCHW
    - Multiple load conditions
- Ongoing Performance
  - Test sequence semi-annually
  - Review trends during winter and shoulder season monthly
  - Track chiller performance monthly
  - Include on CMMS

Install Glycol Supply HX

- New 240 ton HX
- Lead/lag pumps
- Add load to chillers
- New control valves, pump, isolation valves, VFD
- Prevent short cycling and chiller surging
- Estimated Implementation = $153,255
- Sequence based on chiller delta T
- Winter mode operation

Install Glycol Supply HX

- Installation scheduling – 4 month timeline
- Maintain plant integrity
- Verification tests
  - HX and pump sequence verification, program screen shots
  - Trends – valves, glycol delta T, pump status
- Ongoing performance
  - Test sequences semi-annually
  - Review trends during winter and shoulder season on a monthly basis
  - Track chiller performance monthly
  - Include on CMMS

Keys for Successful EBCx

- Team approach
- Right sized scope and systems based
  - Expectations vs. budget
- Plan for information/data capture
- Include FPT in implementation scope
- Maintain ongoing performance
  - Set bar for minimum standard of care
  - Implement within PM/CMMS tasks

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