Pacific Northwest
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Large Commercial Buildings: Re-tuning for Efficiency

Building Walk Down

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Six Primary Steps of Re-Tuning

- Collecting Initial Building Information: Basic building information
- Pre-Re-Tuning Phase: Trend-data collection and analysis
- Re-Tuning: Identifying and correcting operations problems
- Building Walk Down: Getting to know the building
- Post Re-Tuning: Reporting re-tuning findings
- Savings Analysis: Determining and reporting the impacts

Building Walk Down: Purpose

- Get to know the building better
- Develop a general impression of:
  - Overall building condition
  - Overall building design
  - HVAC system design
- Collect some basic data on the building systems at a level of detail greater than the initial data collection
- Confirm/verify issues problems identified through trend analysis

Building Walk Down: Major Steps

- Review electrical and mechanical prints
- Walk the outside of the building
- Walk the inside of the building
- Walk down the roof
- Walk down the air handlers
- Walk down the plant area
- Review the DDC system (BAS) front end

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Review Electrical and Mechanical Prints

- Obtain electrical and mechanical prints
- Review mechanical prints
  - Air handlers of each style (variable air volume or constant volume)
  - Rough number and size of perimeter zones – can count the number of thermostats or the terminal box distribution
  - Rough number and size of the interior zones
- Review electrical prints
  - Identify individual electrical loads potentially worth controlling – greater than about 3.7 kW (5 hp)
  - Record these loads in table provided by PNNL

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Walk the Outside of the Building

- Windows
  - Estimate fraction of windows on each side of the building
  - Note the direction of each side of the building
  - Note the types of windows
  - If operable, note what percentage of windows are open
  - Note any significant shading by side of the building
- Purpose: Get a rough sense of the solar load on the perimeter zones

Walk the Outside of the Building

- Grills for HVAC systems
  - Estimate rough number of HVAC grills, their relative size and their locations
  - Distinguish between large grills for HVAC and small exhaust grills
  - Note any HVAC intakes near sources of auto or truck exhaust and possible short circuits for air between exhaust air and intakes
- Purpose: Identify potential sources of ventilation problems
- Look for weather damage of caulking, cracks, and seals around windows and doors

Walk the Outside of the Building

- Exterior doors
  - Estimate the numbers of door, their locations, and their uses (e.g., main entrance, side entrance, service door, etc.)
  - Listen for air leakage around doors
  - Look for doors slamming shut or staying open; this may be lack of positive pressure or too much positive pressure
- Purpose: identify potential sources of excess infiltration and exfiltration
- Outside lights and parking lot lights
  - On during daylight hours
  - Excess electric loads
- Electrical outlets
  - Note exterior outlets with poor seals, poor caulking or air noise

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Walk the Inside of the Building

- Lighting
  - Note type of lighting and kind of lamps predominantly used
  - Not directly related to re-tuning, but could identify a simple, cost-effective re-lamping retro-fit opportunity
- Hallways
  - For each, note whether comfortable, warm or cool
  - Note whether hallways are warmer, cooler, or about the same as the rooms they service

Sign of Problem with Zone Control!






Sign of Problem with Zone Control!

What's Wrong with this?

Thermostat

Walk the Inside of the Building

- Perimeter offices
  - Check one out of every few rooms by stepping in and observing
  - Type of heating
  - Discharge duct locations and whether registers are open, closed, covered with paper or cardboard, or treated in some other way
  - Measure the temperature of the discharge with an infrared (IR) gun
  - Measure the room air temperature with IR gun by measuring the temperature of interior walls – take a few readings – record them
  - Check if portable heaters are being used
    - Look under desks

Walk the Inside of the Building

- Perimeter offices (continued)
  - Thermostat locations
  - Over heat sources, such as computer monitors
  - Behind shelves or other obstructions
  - Properly located, unobstructed on interior walls
  - Purpose: determine whether location may influence over- or under-cooling or heating of a zone
  - Use of space
  - Note general use of space and any special ventilation or conditioning requirements
  - Corner offices
  - Note if two walls have glass – potential source of extra load
  - Note if corner offices are comfortable while nearby offices are not – corner office driving conditions

Walk the Inside of the Building

- Perimeter offices (continued)
  - Lighting occupancy sensors
  - Check whether they are used in each space
  - Note whether any are hidden or blocked so they won't work
  - Ask occupants whether they are comfortable, frequently hot or cold
  - Ask building staff about excessive hot and/or cold complaints in particular rooms, zones, or hallways
- Noise
  - Listen for unusual noise from equipment or air flow
  - Air flow noise could indicate high duct static pressure

Walk the Inside of the Building

- Interior offices
  - Heating, if any, and type, for interior zones
  - Note heat source – duct heat from ceiling, wall radiators, forced air from walls, induction heat, radiant heat, etc.
  - Purpose: determine whether heating is part of air-handling system
  - Discharge ducts
  - Note locations and whether they are open, closed, covered, etc.
  - Measure the temperature of the discharge with an IR gun and record it
  - Air temperature
  - Using IR gun, measure the temperature of the walls in a few spots to get a rough average for the room and record it

Walk the Inside of the Building

- Tenants
  - Talk to tenants
  - Satisfaction or complaints about space conditions
  - Discomfort at certain times of day or under certain weather conditions
  - Note the most common complaints, exceptions and other observations

- Owner or facility manager
  - Get a sense from them about types and volume of complaints over the course of 1 year

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Walk Down the Roof

- HVAC equipment condition
  - Missing panels and seals around access doors
  - Panels leaking
  - Missing condenser fans
  - General poor maintenance
  - Other conditions that might affect performance

- Exhaust fans
  - Count or estimate the number of exhaust fans of each general size (small, medium, large)
  - Ensure fans are exhausting
  - Large fans are candidates for control

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Walk Down the Air-Handling Units

- Ideally, all air-handlers should be inspected

- If there is a very large number,
  - A sample of 50% to 75% should be adequate
  - Try to randomly sample
    - different floors
    - disperse across low, mid-level, and high floors
  - If significant problems are found with the sample, all air-handlers need to be inspected

Walk Down the Air-Handling Units (continued)

- Inspect the following:
  - Record type of unit—Variable air volume, constant air volume, single zone, multiple zone
  - Variable frequency drives (VFD)
    - Current speed on drive display and current time
    - Watch speed variation
      - Should see some variation
      - Mo variation indicates it's probably overridden
    - Open access door
      - VFD should modulate
      - No modulation indicates that it is probably overridden
    - Check position of inlet vanes

Walk Down the Air-Handling Units (continued)

- Inspect the following (continued):
  - Coils, filters, dampers, belts, doors, and valves
    - Missing, dirty, plugged or collapsed filters
    - Dirty or plugged coils
    - Dampers
      - Damaged
      - Missing mechanical connectors
      - Leaking or missing seals
      - 2 x 4s or other obstructions between damper blades
    - Water leaks
    - Valves leaking from packing
    - Valves not opening fully
    - Valves not closing completely

Walk Down the Air-Handling Units (continued)

- Inspect the following (continued):
  - Direct digital controls (DDC)
    - Disconnected wires
    - Jumpers in place
    - Switches in hand
    - Record all abnormal conditions
  - Exposed ductwork in mechanical room
    - Gaps and leaks
    - Holes in flex couplings
    - Excessive vibrations

Walk Down the Air-Handling Units (continued)

- Inspect the following (continued):
  - Noise
    - Squeals – high air leakage from pin holes in ducts
    - Thumping
    - Any uncommon fan sound – overload to extremely quiet
  - Location of outdoor-air sensor

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Walk Down Plant Area

- Pumps
  - Use visual observation and touch
  - Determine and record whether each pump is running, leaking, hot or vibrating unusually – if you can't hold your hand on the pump, it's too hot
  - Record purpose of each system and parallel system – chilled water, hot water, condensate
  - Record number of pumping systems running at the time
  - For each pump,
    - Pump speed for VFDs
    - Running full speed or modulating
    - In override position

Walk Down Plant Area (continued)

- Pumps (continued)
  - Record temperature and pressure of the water loops
  - Pressure differences of more than 40 psi are abnormally high

- Chillers, boilers and cooling towers
  - Record type of equipment, status and general condition
  - Record number of units of each type running
  - Note chillers and boilers running at the same time
  - Inspect valves and record
    - Alignment (shaft position) - fully open, partially open or closed
    - Under automatic or manual control
    - Water flowing when not needed
    - Other unusual conditions

Walk Down Plant Area (continued)

- Chillers, boilers and cooling towers
  - Note systems in hand-mode (manual override)
  - Record current loads
    - Load on each unit running
    - Temperature difference across unit
- DDC controllers
  - Type and condition of DDC controls
  - Inside control panel note and record:
    - Disconnected wires
    - Jumpers in place
    - Switches in hand
    - Any abnormal conditions

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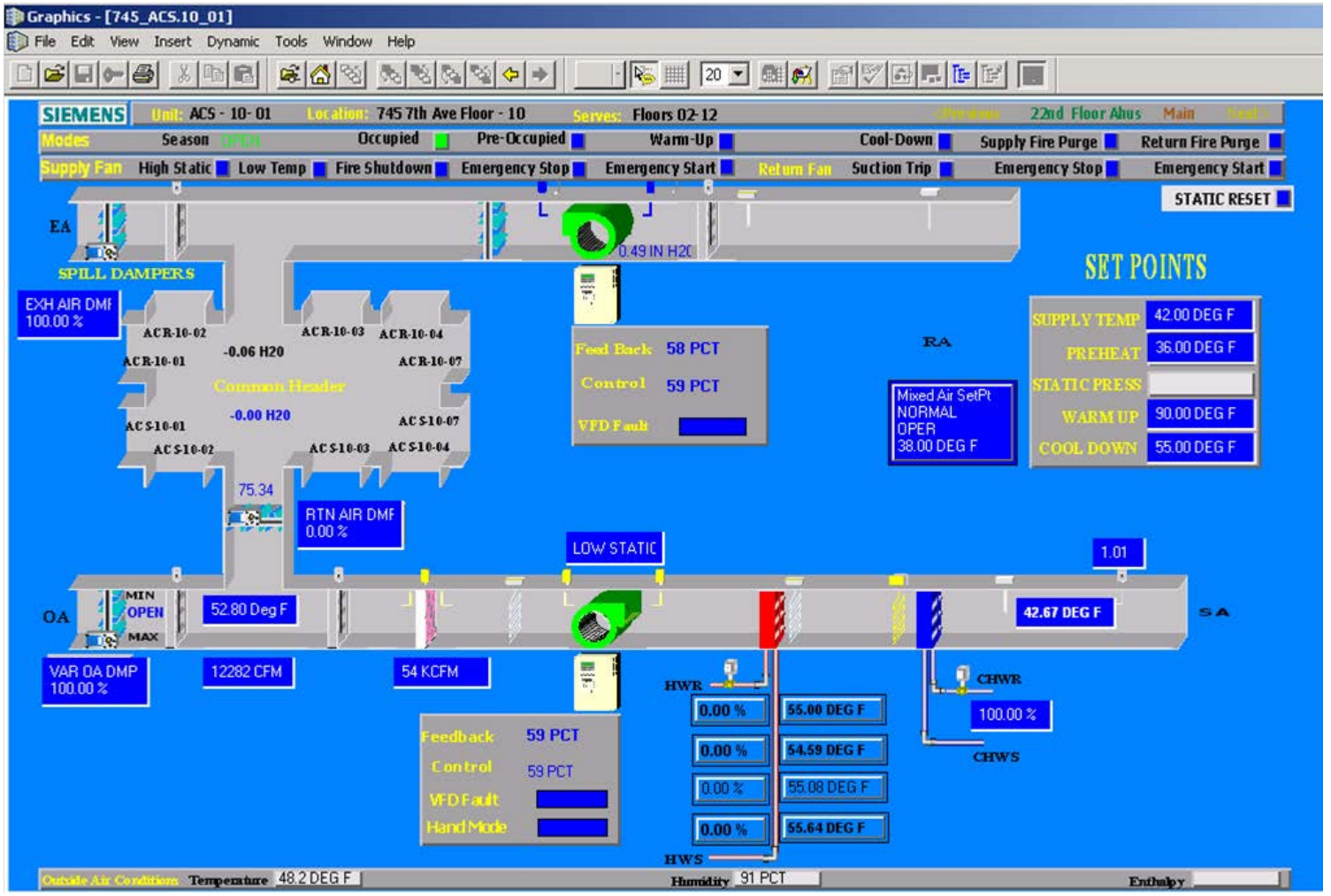
Review the DDC System Front End

- Offline points – scan for and record
- Alarms – scan for and record points currently alarming
- Disabled code – scan for and record disabled code blocks
- Accuracy of graphics – ensure consistency with observations of system design during walk down
- Building electric meter – if connected to building automation system, turn on trending and analyze the trends

Example of Air-Handling Unit Graphic



QUESTIONS?

www.pnnl.gov/buildingretuning