CHES Maritime Conference

Optimizing Air Handling Unit Performance in Healthcare Facilities

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November 2022

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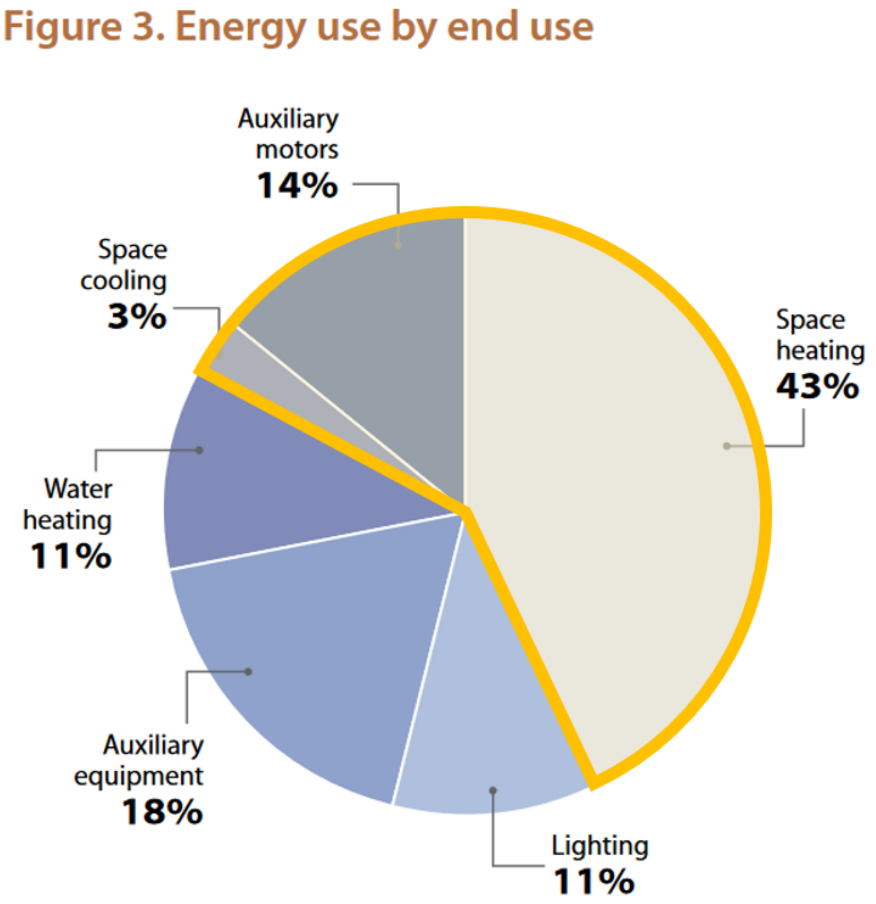
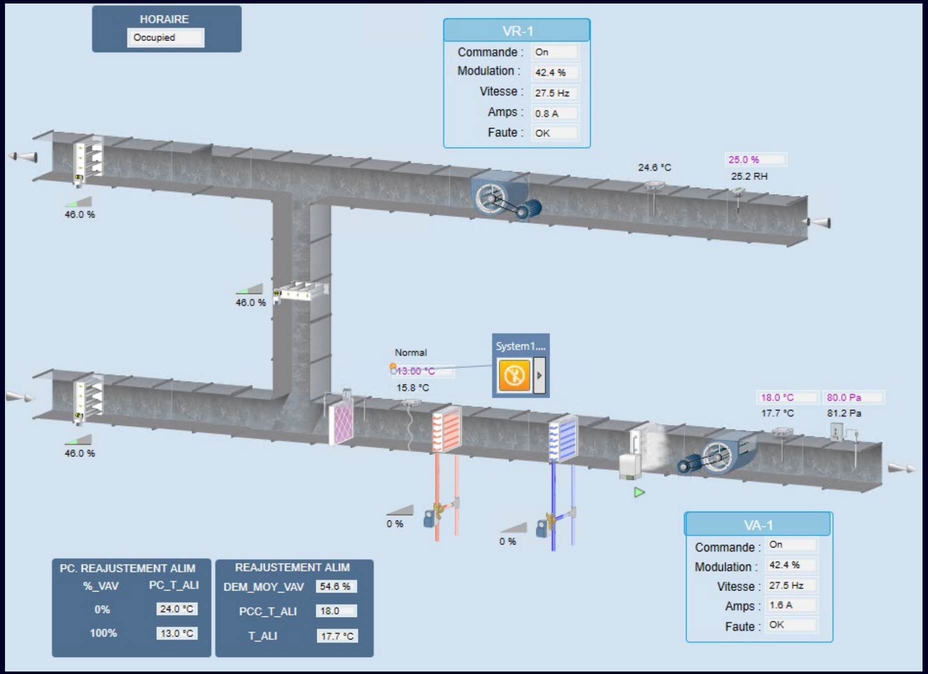
Introduction



https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/oee/buildings/pdf/NRCan_Hospital_e.pdf

- **Why focus on air handling?**
  - HVAC accounts for over 50% of a typical hospital's energy use!
  - Hospital ventilation systems require a lot of heating energy

Mixed-air Units



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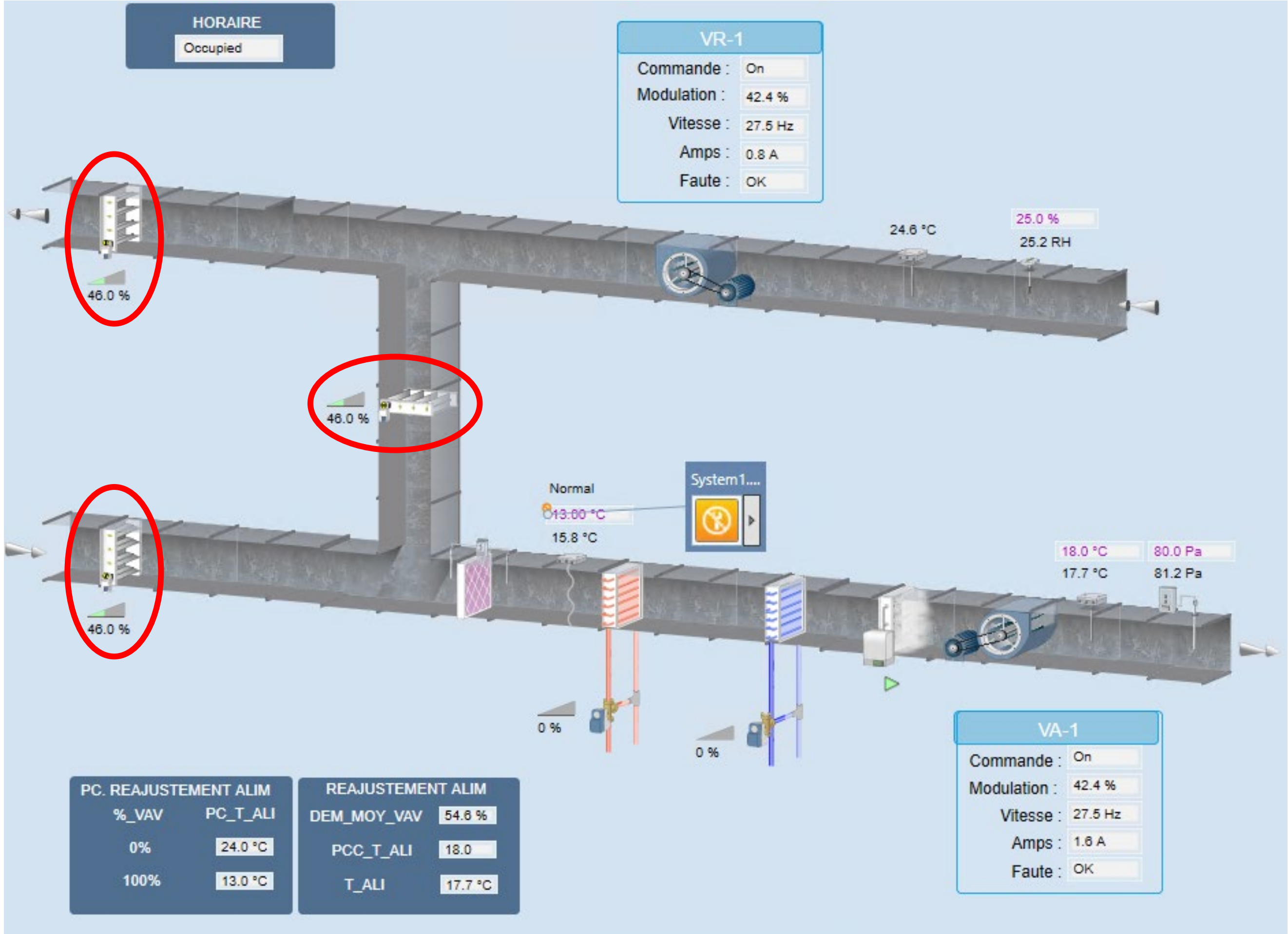
Economizer Control



- Dry bulb vs. enthalpy control
  - ➢ Dry bulb looks at only temperature; enthalpy uses temperature and humidity
- Fixed vs. differential control
  - ➢ Do we look at outdoor air conditions vs. fixed point, or outdoor vs. return?
- No one-size-fits-all!

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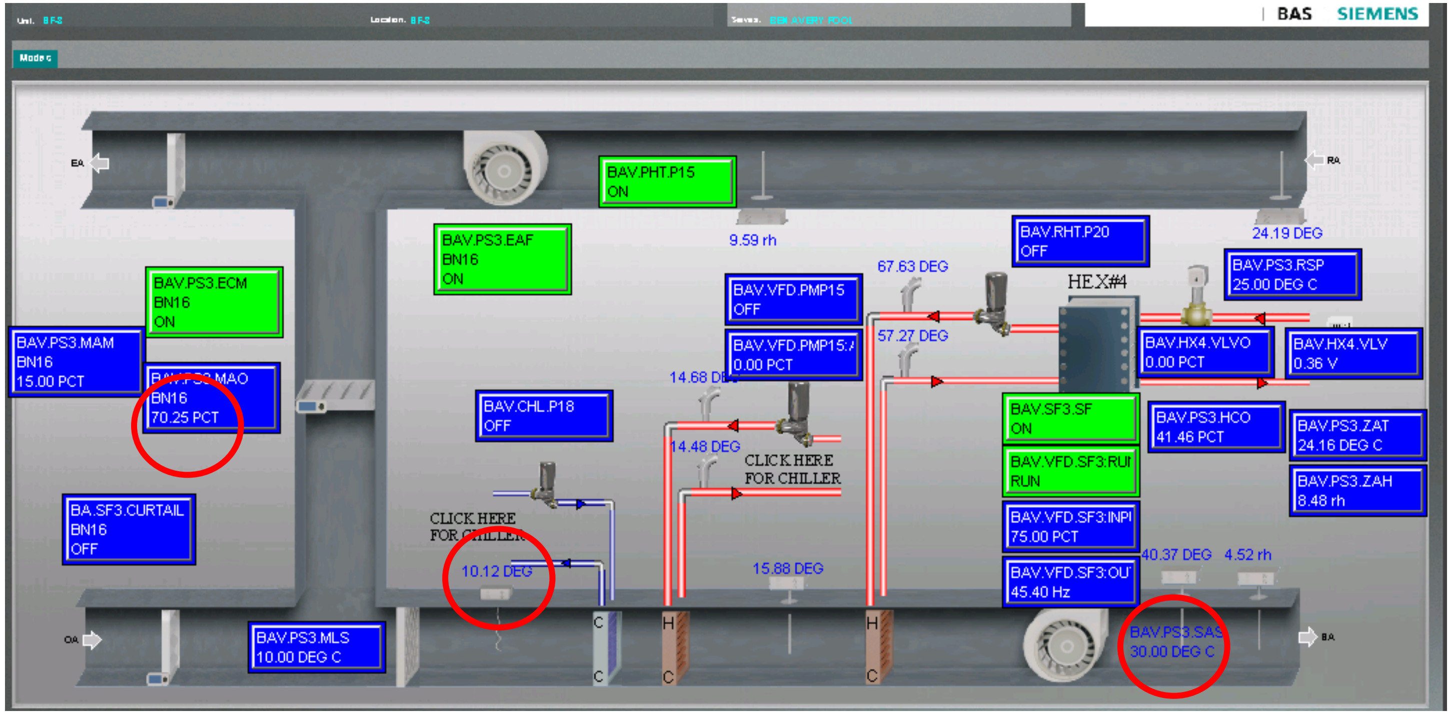
Optimal MAT Control



- Should the economizer control for SAT or MAT?
  - ➢ MAT control is very common, but…
  - ➢ SAT control wastes less heating energy!

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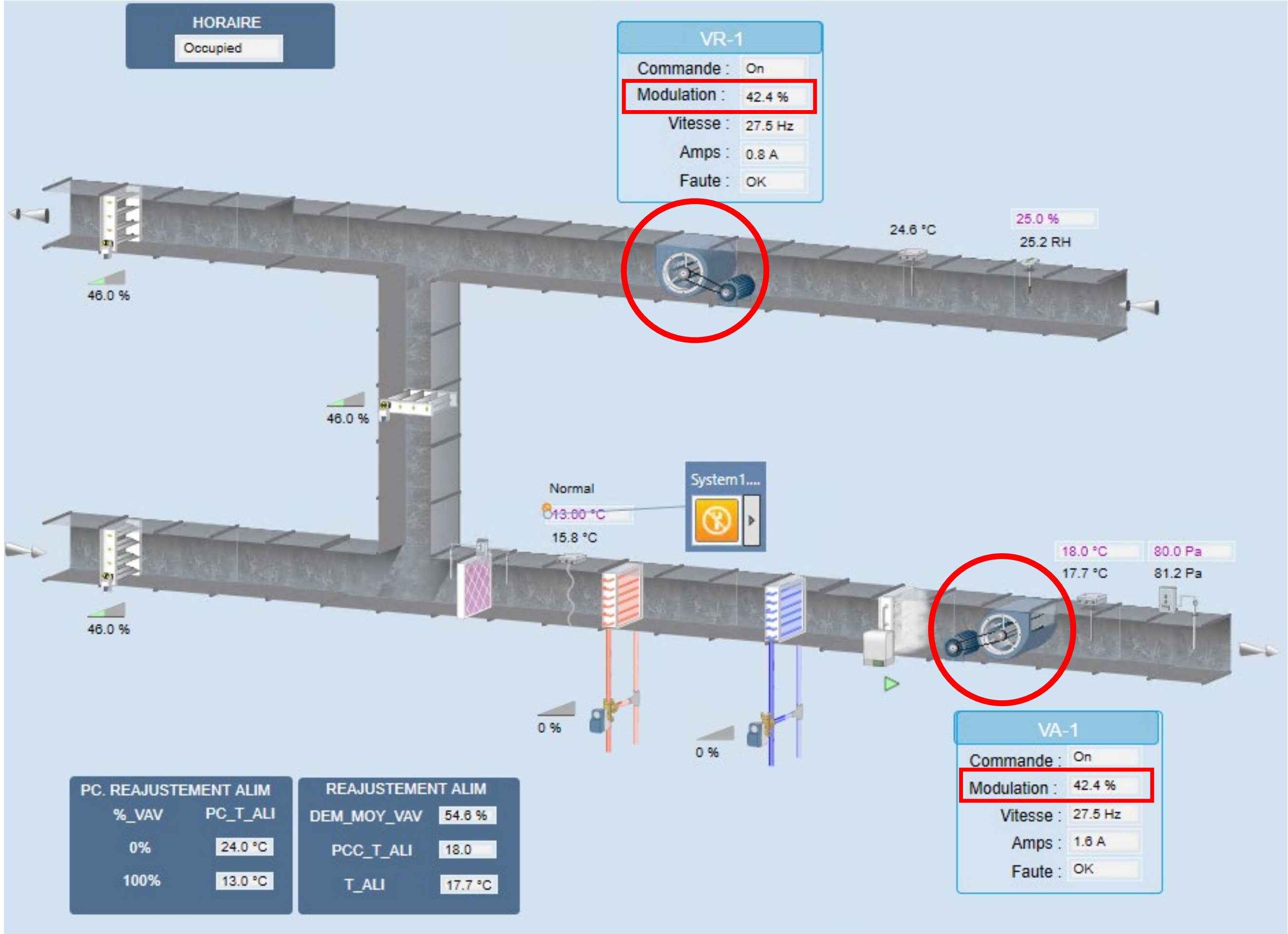
Optimal Fan Speed Control



- Static pressure control (VAV systems)

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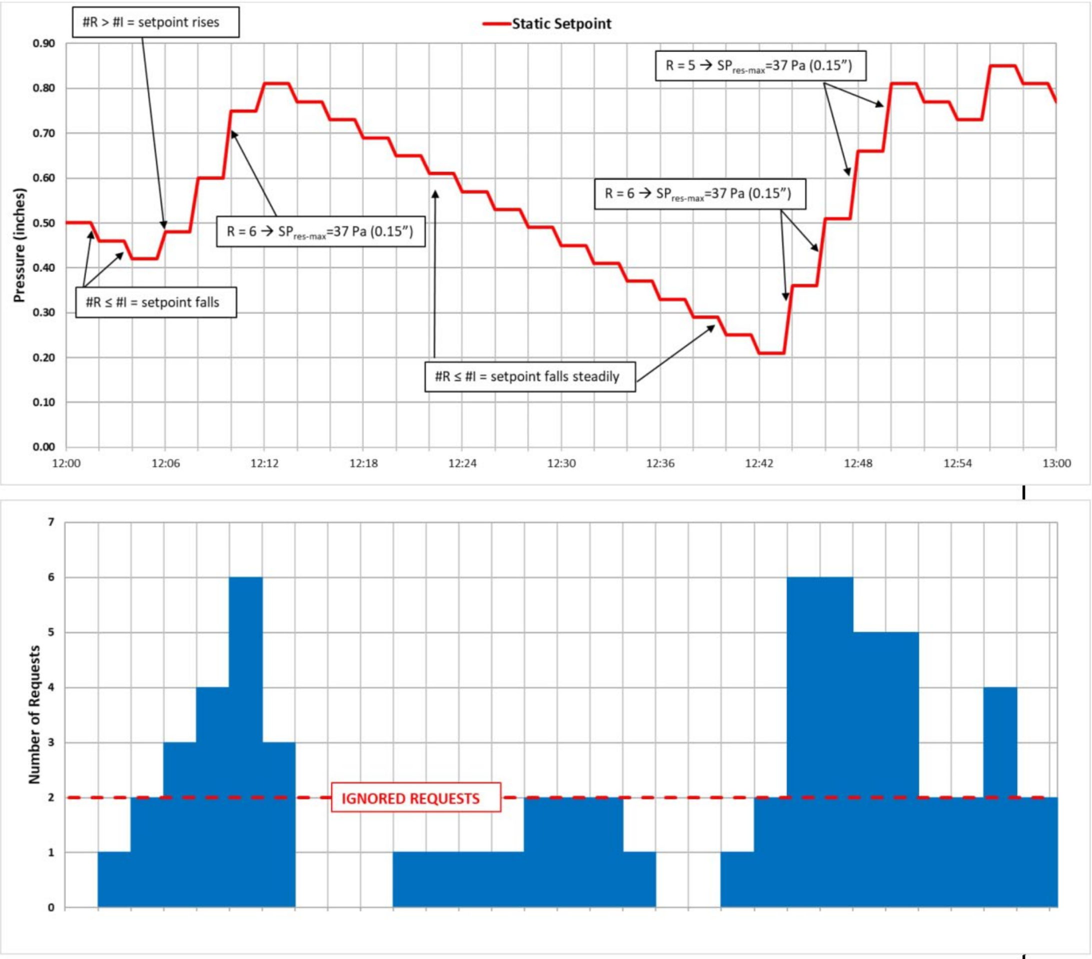
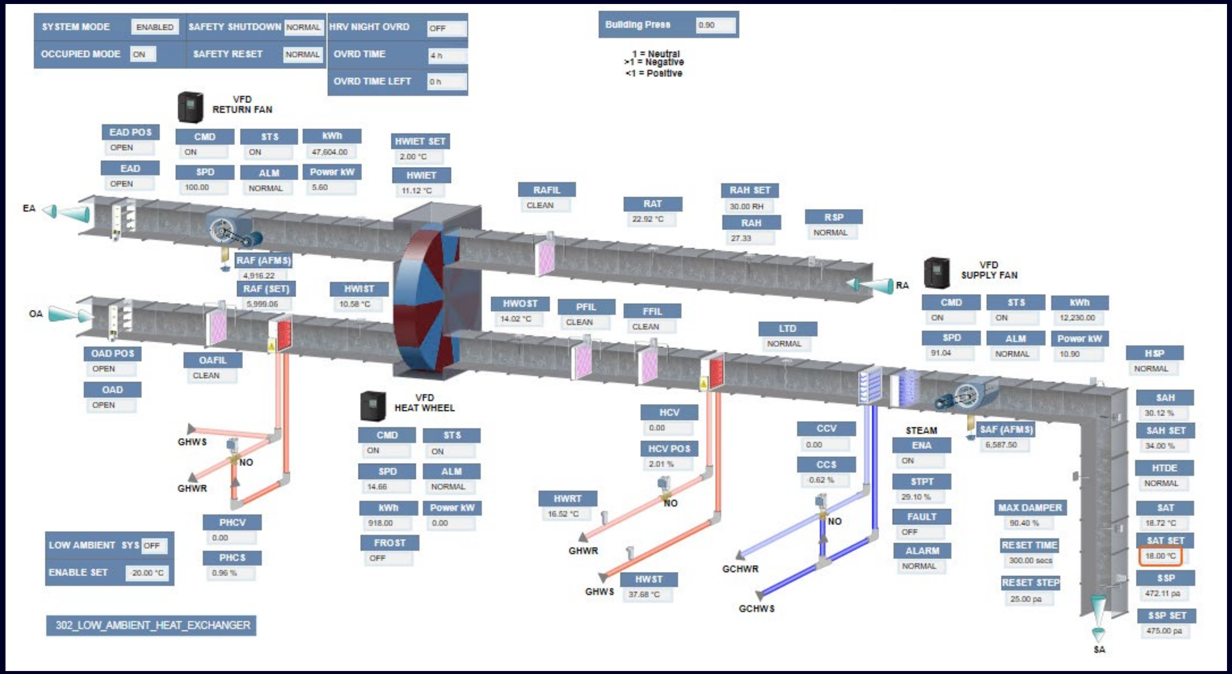
Example of Pressure Reset *(Trim & Respond)*



Informative Figure 5.1.14.4 Example sequence trend graph.

- ASHRAE Guideline 36
  - Pressure fluctuates throughout the day as demand changes

100% Outdoor Air Systems



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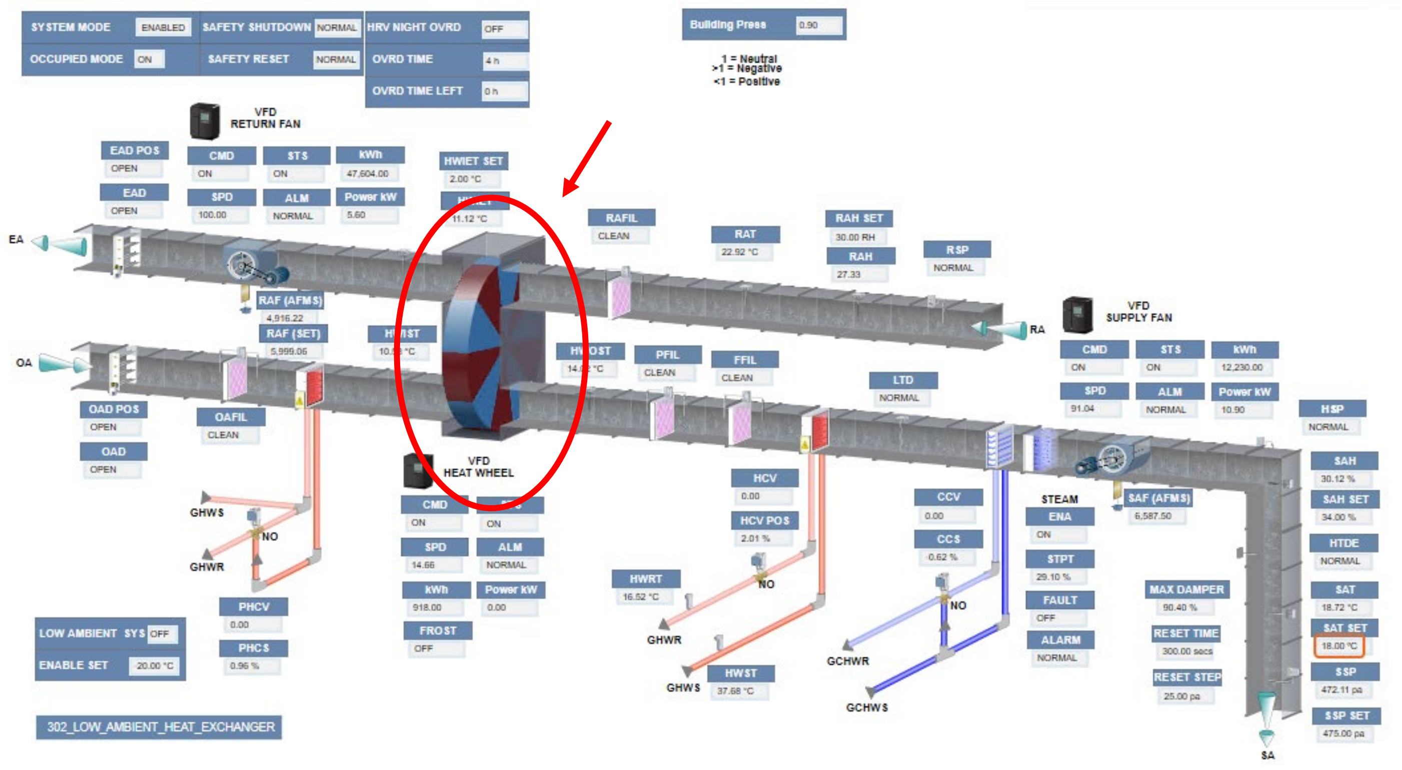
Heat Recovery



- When should heat recovery be enabled?
- How should it be controlled?
- How should we manage frost control?
- Can we use heat recovery for cooling?

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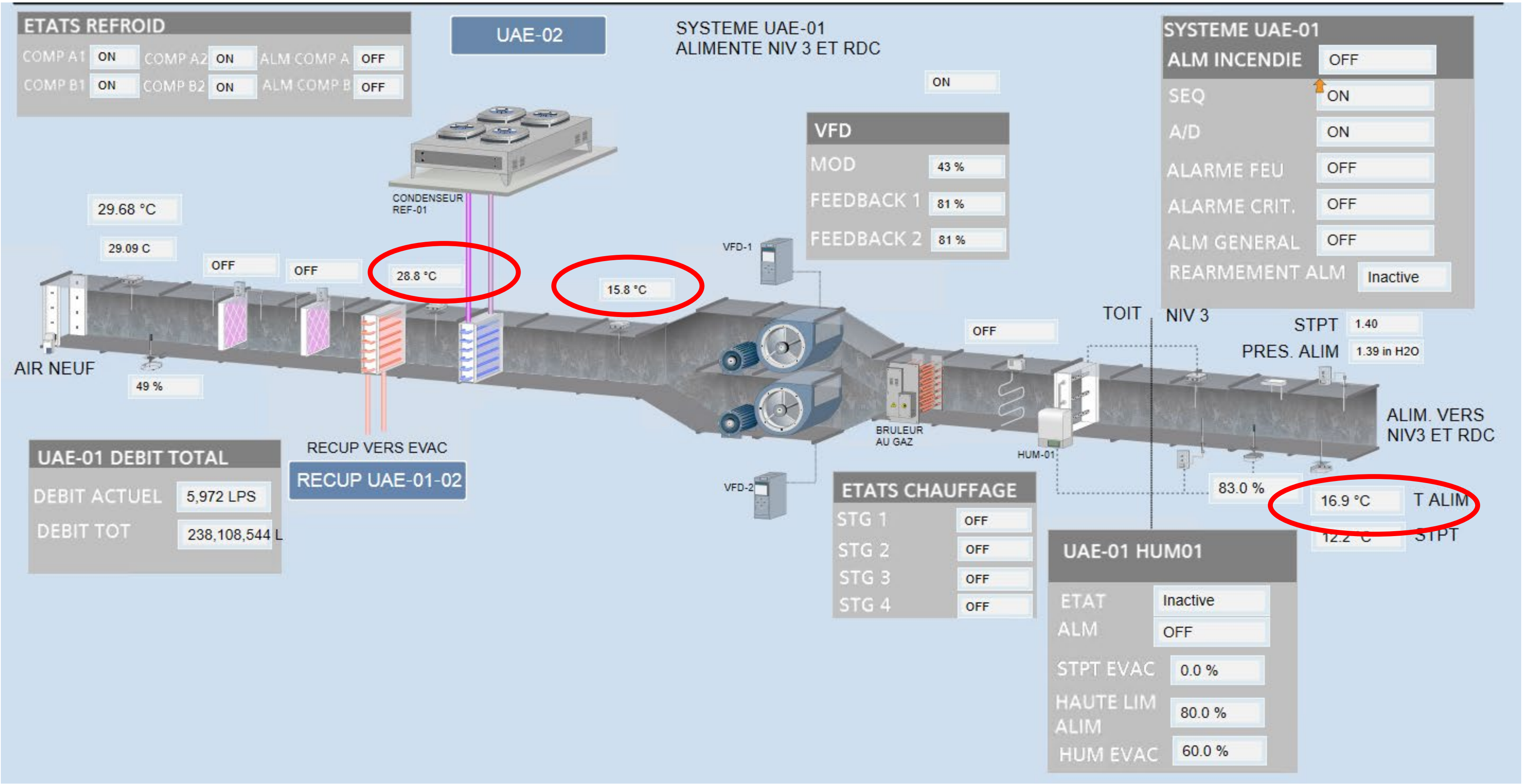
Heat Recovery in Cooling



Heat recovery disabled…

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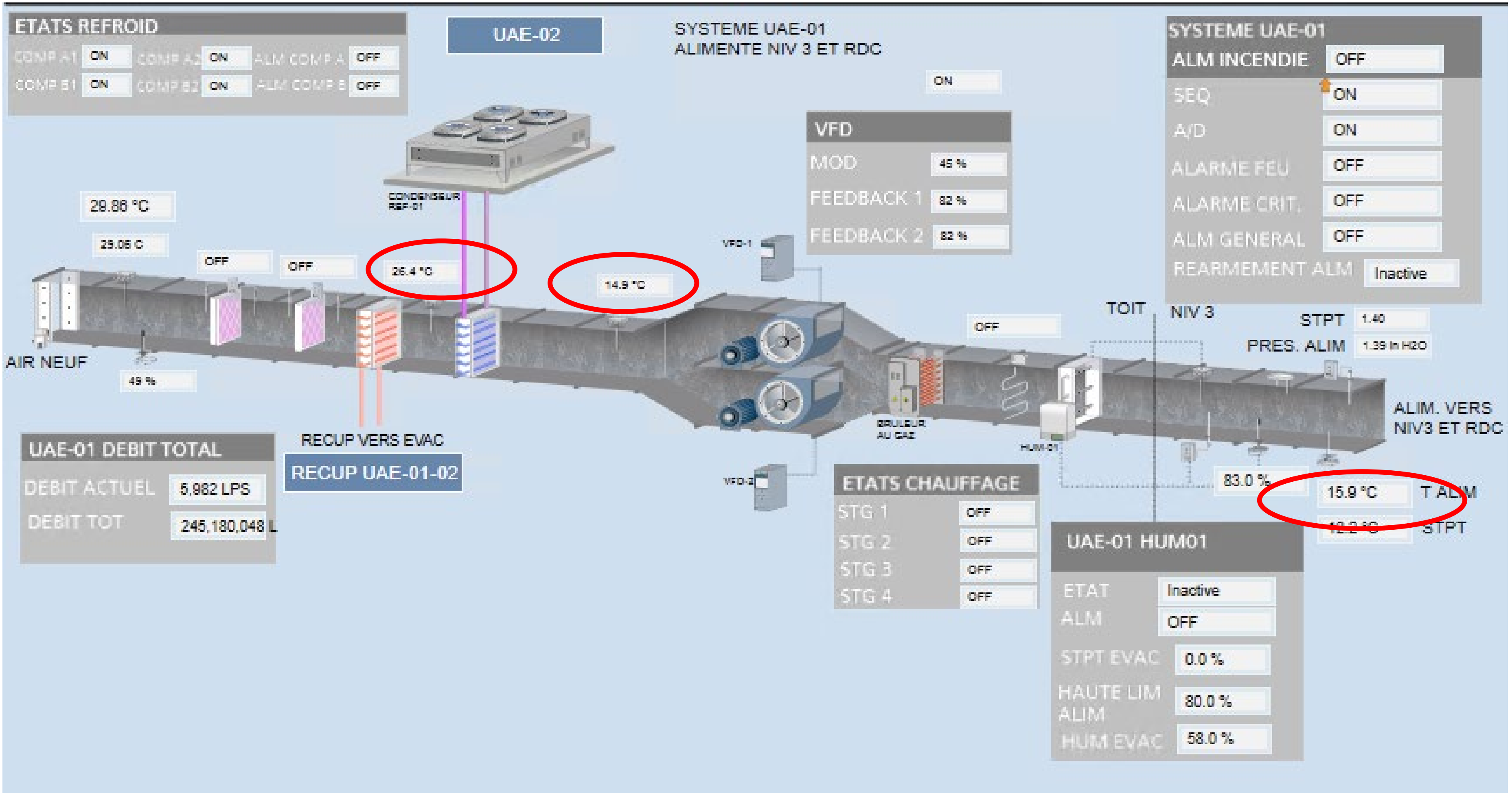
Heat Recovery in Cooling



Heat recovery enabled

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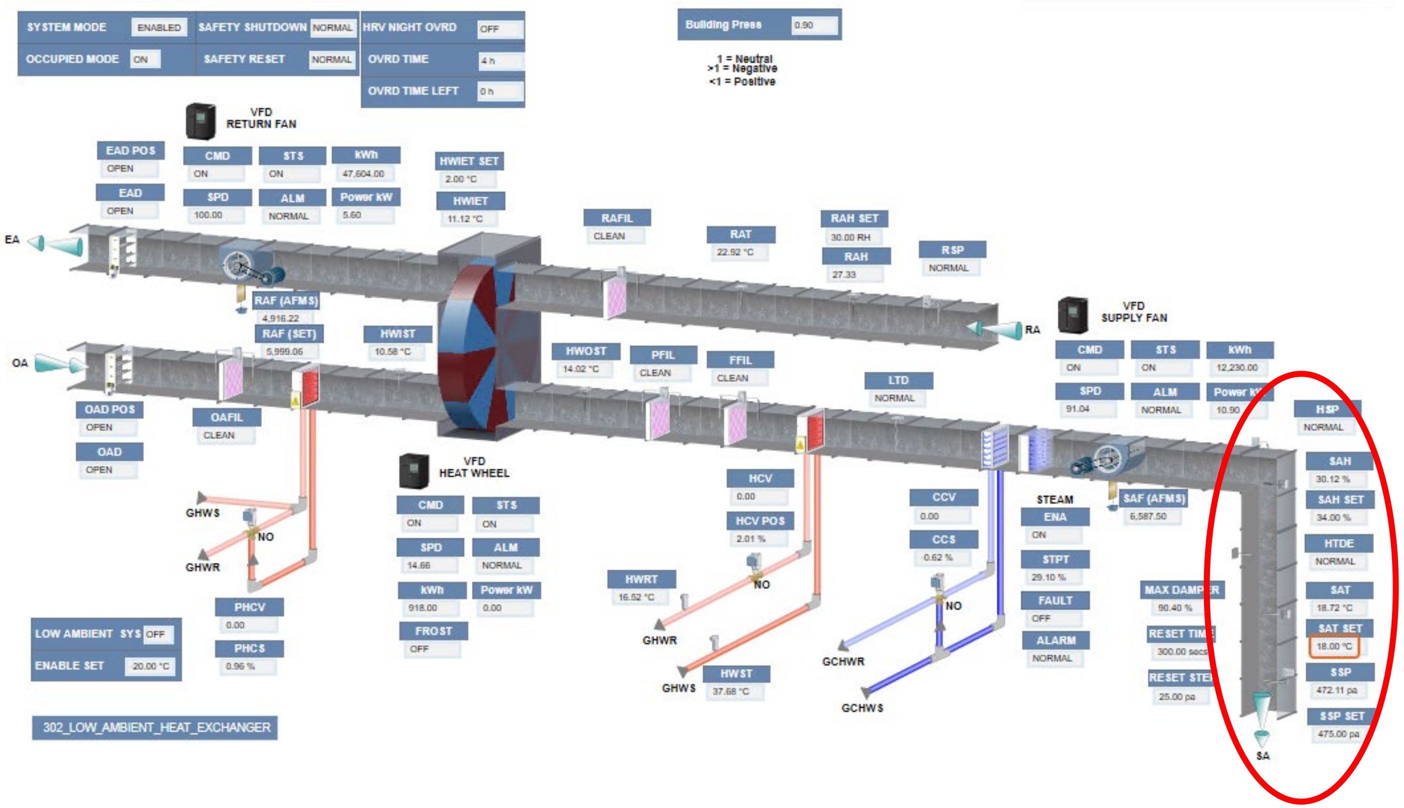
Optimal SAT Control



- RAT-based control
- Trim & Respond (T&R) according to feedback from spaces

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Demand-controlled Ventilation (DCV)

- What is it?
- How is it implemented?
- When it is appropriate?

Demand-Controlled Ventilation (DCV)
What does CSA Z317.2 say?

6.19.8 Demand-controlled ventilation

Except as otherwise specified in this Standard (e.g., for Type I and Type II areas), demand-controlled ventilation should be incorporated in areas where wide variations in occupancy are anticipated.

Note: *This Clause applies to areas without a specific health care function, such as conference rooms, classrooms, and public areas.*

- Occupancy-based control can be used in spaces with a healthcare function.

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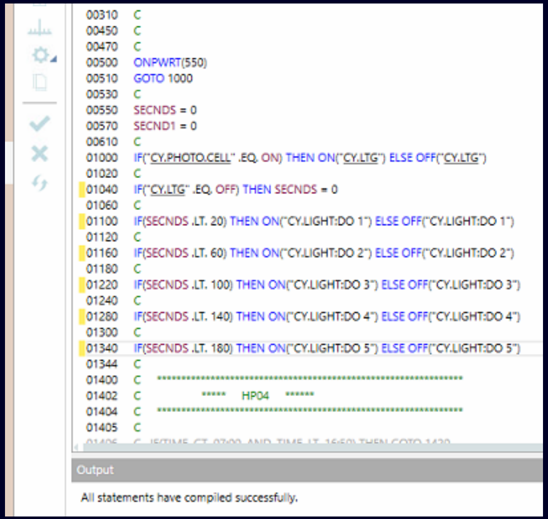
Common Opportunities — *Programming*



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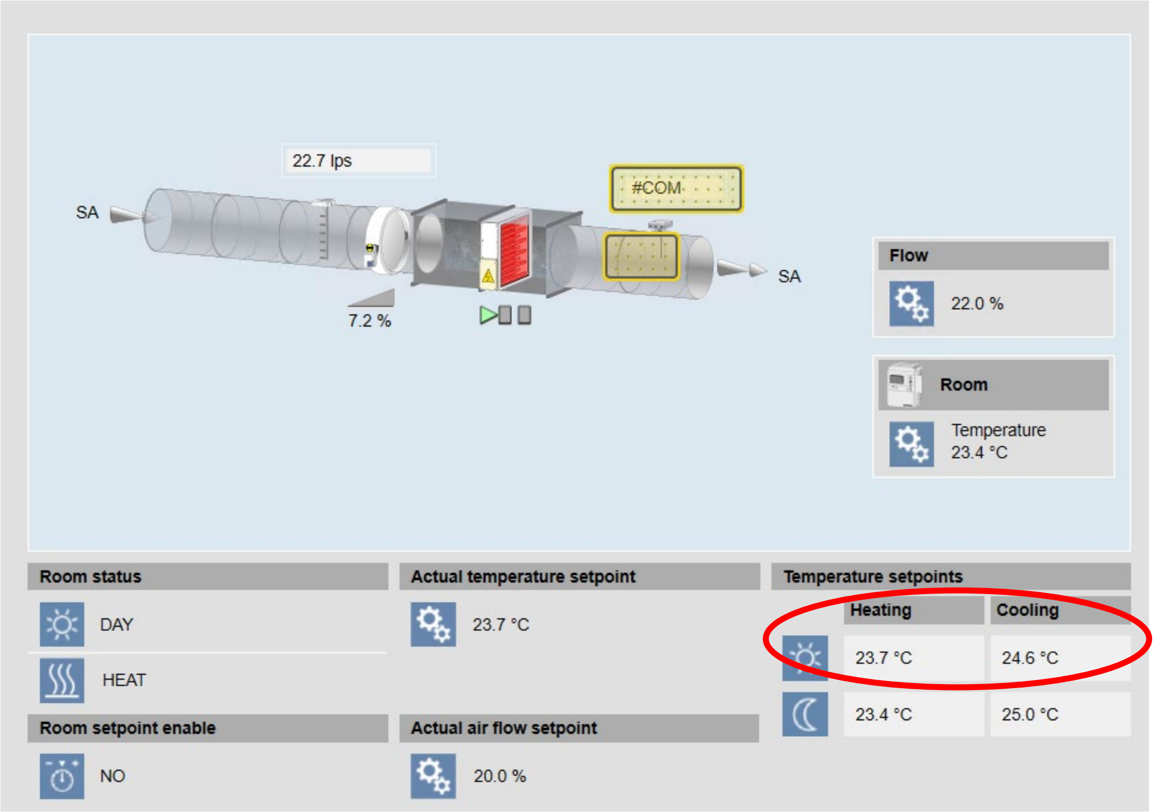
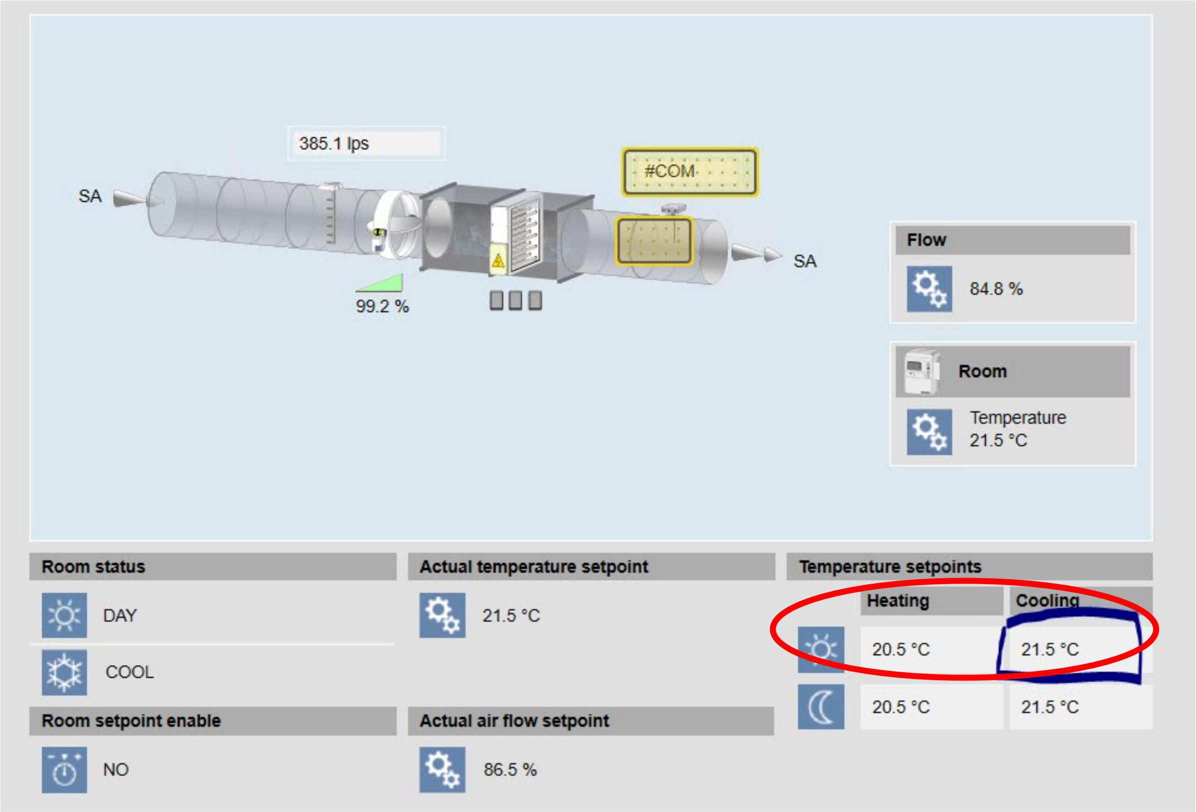
Terminal Equipment Control





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Common Opportunities — *Malfunctions*

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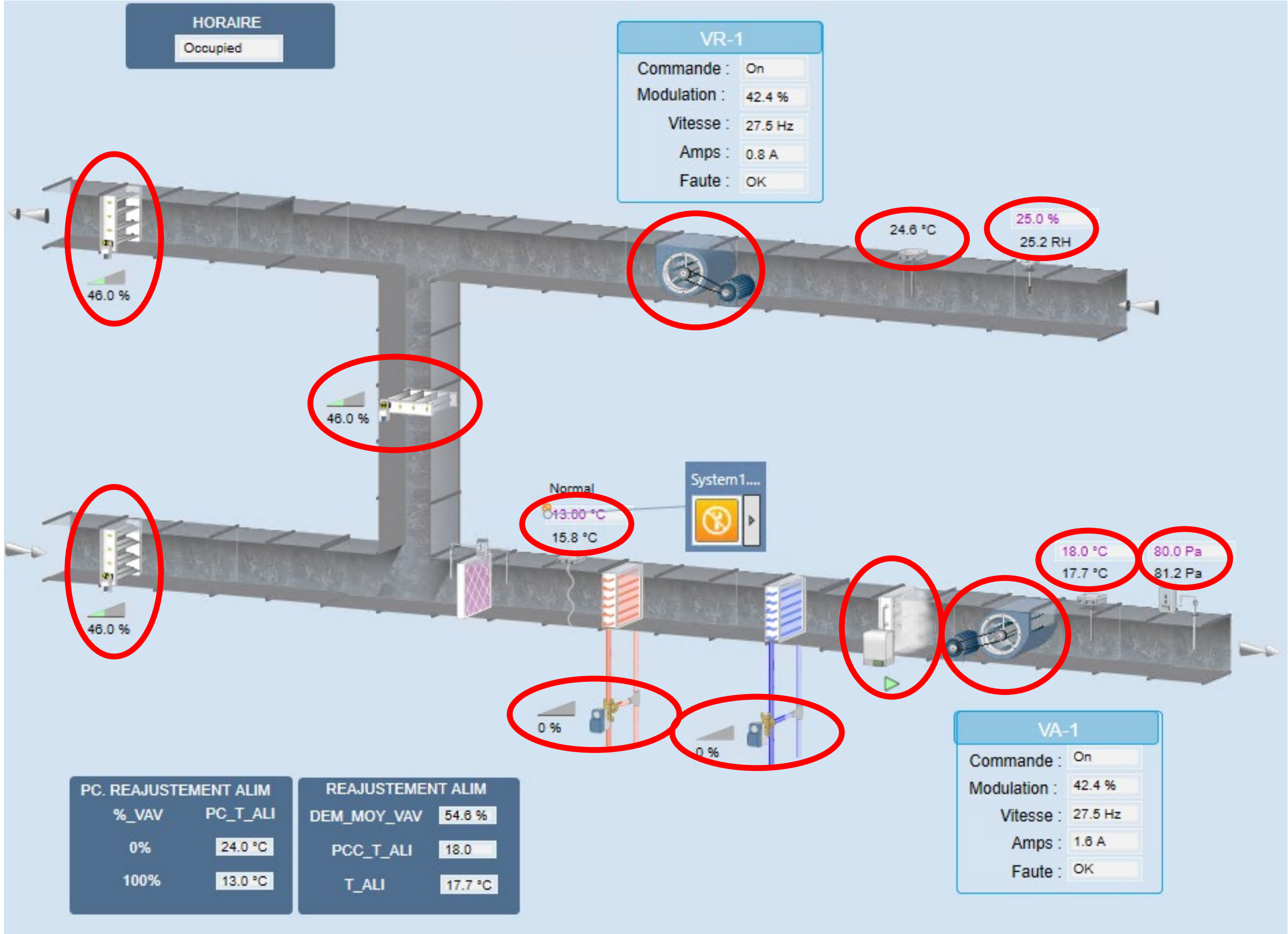
Common Malfunctions



- Heating/cooling coil valve leak
- Coil valves not responding
- Temperature/RH sensor calibration
- Stuck dampers
- OPER overrides left on

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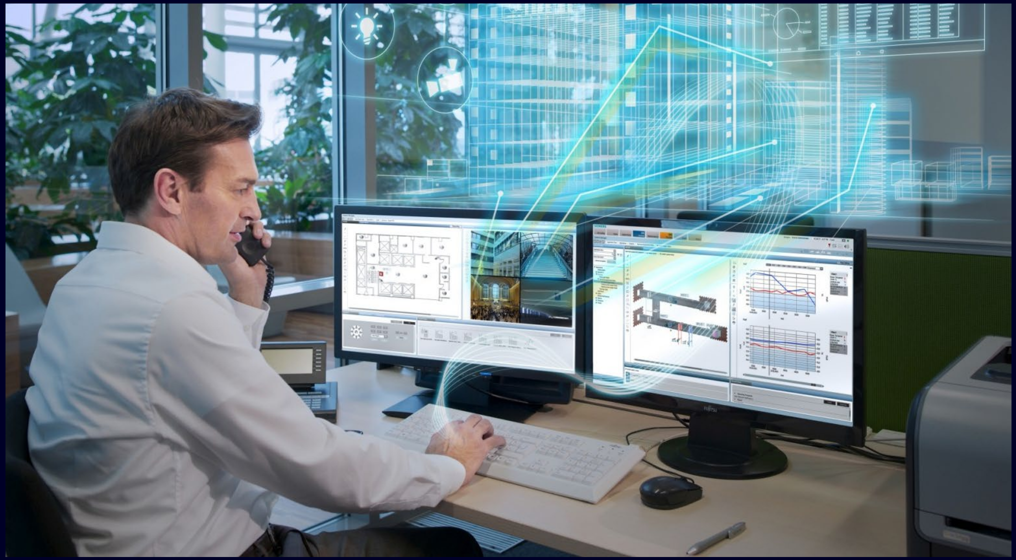
Digital Tools

— *For System Analysis*



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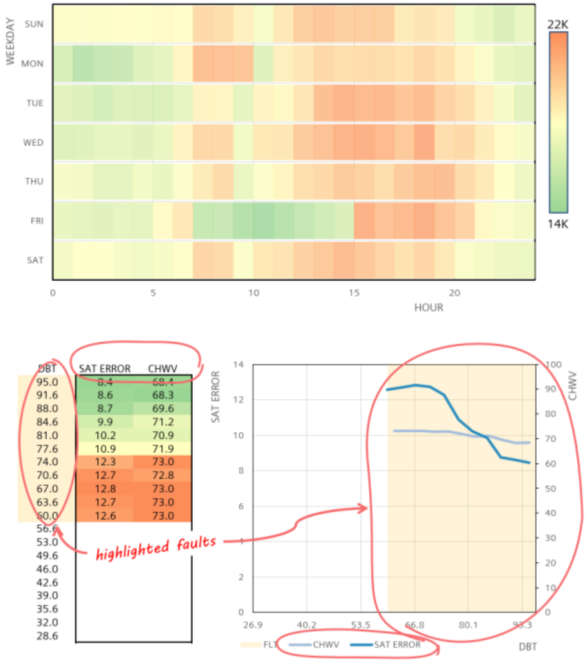
DataFox *(AHU Analysis)*

- ❑ Observation Matrix (for multiple AHU's)
- ❑ Findings Summary
- ❑ Data Quality Table
- ❑ Select Data Visualization of the Analysis Tests

Legend
- ✗ = test failed; investigation recommended
- ! = test partially failed; consider investigation
- ✓ = test passed; no action required
- ○ = insufficient data provided to apply test

SUPPLY FAN	NOAASD.AH.01.	NOAASD.AH.02.	NOAASD.AH.03.	NOAASD.AH.04.	NOAASD.AH.05.
SSP below STPT with 100% SF SPD	✓	✓	✓	✓	✓
Tune fan control loop	✗	✓	✓	✓	✓
SSP sensor OPER or FAILED	✓	✓	✓	✓	✓
Supply air CFM sensor OPER or FAILED	✓	✓	✓	✓	✓
Supply fan SPD in OPER	✓	✓	✓	✓	✓
SSP STPT in OPER	✗	○	✓	○	○



- Interprets trendlog data from BAS, outputting useful charts/tables
- Identify anomalies and faults in AHU operation
- Allows for diagnosis of root causes and suggestions to resolve
- Identify opportunities for more advanced control strategies

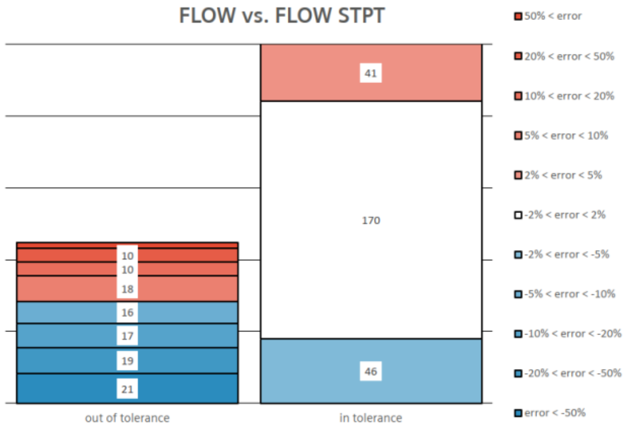
ZoneRX *(Terminal Equipment Analysis)*

Key Report Components:

- ❑ Zone Controller Operation Summary Table
- ❑ Data Visualization of the Analysis Tests
- ❑ Triaged Repair List

Zone Controller Operation Summary Table	
Item	**Count**
ZCs with temperature control issues	6
ZCs not controlling to room temperature (deviation >3°F)	5
ZCs with valve control issues	1
ZCs with airflow control issues	70
ZCs not controlling to flow setpoint (deviation >10%)	70
ZCs with dampers completely closed that still measure airflow	0
ZCs with configuration or network issues	35
ZCs showing factory default values for flow setpoint or calculation	25
ZCs with mismatched HTG and CLG minimum flow setpoints	9
Number of FLN devices that are failed	1
Number of FLN devices that failed to respond due to panel issues	0
Number of ZCs requiring field investigation[1]	93
Number of hot water reheat ZCs with no aux temp	0
Total number of ZCs evaluated	473

Energy Cost Impact		
Item	**Quantity [CFM]**	**Value**
[1] Excess airflow due to malfunctioning terminal equipment	**4,366**	$3,257
[2] Undetected leaking reheat valves	0	$0
[3] Increased minimum airflow due to configuration issues	4	$154



Zones Not Controlling to Flow Setpoint					
TEC	**MODE**	**FLOW**	**FLOW STPT**	**Deviation**	**Notes**
N.VAV.N05		205	2000	1795	DMPR: 100%
N.VAV.N118	COOL	254	1952	1698	
E.VAV.E134	COOL	1448	2985	1537	DMPR: 100%
W.VAV.W24	COOL	270	1800	1530	
W.VAV.W49	COOL	0	1500	1500	DMPR: 100%
W.CAV.W13	HEAT	3116	4500	1384	DMPR: 100%
E.VAV.E76	COOL	0	1300	1300	DMPR: 100%
C.CAV.C01	COOL	913	2200	1287	DMPR: 100%
E.VAV.E116	HEAT	0	1240	1240	DMPR: 100%
E.VAV.E15		1175	0	1175	DMPR: 0%

- Uses a snapshot of the building's zone controllers from BAS report
- Identifies faults & anomalies in terminal equipment behaviour
- Quantifies the energy cost impact ($) of current operation

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Fault Detection & Diagnostics (FDD)

FIM	Description
Outside air temp sensor deviation	Determines downstream HVAC system operation and schedule, and can deliver high energy savings depending on the system configuration
Boiler reset schedule deviation	This is often changed manually or not implemented, and adjustments can save up to 10% of facility energy consumption
Chiller performance visibility	Shows chiller plant performance and identifies the need for a conversation about complete a chiller optimization strategy
Supply air static pressure reset deviation	This demand-based system management can save up to 5% of facility energy consumption
Supply air temperature reset schedule deviation	This is the most commonly overridden parameter, and adjustment can deliver a 5-10% energy impact
Free cooling not enabled or not working	Improves economizer mode operation by using enthalpy-based operation, instead of straight dry bulb operation; this FIM can save 5-10% of energy spend
Simultaneous heating and cooling elimination	Prevents reheating and recooling air simultaneously, which can save up to 20% of facility energy consumption
Overventilation prevention	Prevents heating cold, outside air for no reason, and can save up to 18% of facility energy consumption

- Online service that uploads data from the building automation system
- Detects problems as they occur

Conclusion

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