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Continuous Optimization for Commercial Buildings Program

Recommissioning Report

Version	Updated on	Phase
1	July 17, 2022	Investigation phase. Draft for client review.

Prepared for:

School District 69

Ballenas Secondary School

135 Pym St

Parksville, BC

Project: BCH-07832

Prism Project: 2021300

Prepared by:

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saving you energy™

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1.0 Introduction

Prism Engineering is pleased to present the results of the Investigation Phase that was conducted as part of BC Hydro's Continuous Optimization for Commercial Buildings Program for Ballenas Secondary School. The objective of an Investigation is to identify deficiencies and improvements in the operation of a facility's mechanical equipment, lighting, and related controls, and determine opportunities for corrective action that reduce energy consumption and preserve the indoor environmental quality.

This document is a complete record of the work performed at this facility, including the in-depth investigation of the building systems and the implementation of selected measures to optimize building performance.

The Recommissioning Investigation Report provides an overview of the recommendations for the implementation of measures. This information is not considered a specification or detailed sequence of operations. The intent is to provide an overview of the recommendation that can be built upon during the implementation phase as part of any detailed design that may be required. Certain measures may require further investigation and specification for the correct implementation by the owner or the DDC contractor.

Eight recommended retrofits were identified as a part of this investigation. The proposed measures will be reviewed in a meeting with School District 69 and Prism Engineering representatives to determine which measures will be implemented.

Recommended retrofits for implementation include:

- Measure 1: Reheat coils
- Measure 2: Fan feedback sensors
- Measure 3: Morning schedule
- Measure 4: Night setback temperatures
- Measure 5: Holiday schedules
- Measure 6: Exhaust fans run outside occupied hours
- Measure 7: HV5 temps and heating coils
- Measure 8: Temperature sensors

These measures are presented in the Investigation Summary Table (see Appendix A).

While the investigation focuses on low-cost improvements with short paybacks, some capital improvement opportunities may also be identified. Major retrofit measures are beyond the scope of this program, but other BC Hydro and FortisBC programs provide a variety of incentives to complete the retrofits. Retrofits were identified as a part of this investigation that could potentially qualify for other BC Hydro and FortisBC programs, these measures are described in Section 6.

Retrofits include:

- Measure 9: Reversible heat pumps for existing DX coils
- Measure 10: Hydronic Air Source Heat Pump

2.0 Project Overview

Project Information	Complete cells this background colour		
RCx Project File #	**BCH-07832**		
Date of Workbook Update	20-Jun-2022		
Organization	School District 69		
Building Name	Ballenas Secondary School		
Building Type	Large School		
Location (City)	Parksville, BC		
Owner Contact	Phil Munro		
Investigation Phase start date	01-Feb-2022		
Participated in previous BCH RCx program?	No		
Previous RCx File #			
Previous RCx completion date			

Building Information			
Facility Area (ft2)	117,143		
Annual elec consumption (kWh)	588,484	5.0	kWh/ft^2
Annual elec costs ($)	$ 58,056	$ 0.10	Avg. $/kWh
Fuel type	Natural Gas		
Annual fuel consumption (GJ)	3,919	9.3	ekWh/ft^2
Annual fuel cost ($)	$ 47,505	$ 12.1	Avg. $/GJ
Total GHG emissions (tCO2e/yr)	202		
Total Energy Cost	$ 105,560	$ 0.90	$/ft^2
Energy Use Intensity (ekWh/ft2)	14.3		
Year for energy data above	2020		

3.0 Savings Summary

[Paste image of Savings Summary Table from the RCx Workbook – also **UPDATE after** Implementation**]**

Savings Summary	Previous, still working	New + Previous, rectify + Previous, documented					
		Identified		Selected		Implemented	
# of measures	0	9		8		8	
	Re-claim Savings	Total Savings	% Savings	Total Savings	% Savings	Total Savings	% Savings
Electrical savings (kWh/yr)	-	- 80,837	-13.7%	47,454	8.1%	47,454	8.1%
Fuel savings (GJ/yr)	-	2,629	67.1%	1,090	27.8%	1,090	27.8%
Cost savings ($)	$ -	$ 23,893	22.6%	$ 17,888	16.9%	$ 17,888	16.9%
GHG reduction (tCO2e/yr)	-	130.2	64.6%	54.8	27.2%	54.8	27.2%
# of Abandoned measures	**0**						

4.0 Brief Description of Existing System

This section contains a brief description of the existing HVAC and Controls system. The information is intended to provide a general overview only.

4.1 Facility Description

Ballenas Secondary School was built in 1976 with several later additions. The current floor area is 117,143 sqft. The building includes classrooms, administration offices, gym, theater, art studio, and technical teaching areas.

Table 1: Schedules

	Area	Days	From	To
Occupancy	Classrooms	All schooldays	8:40am	3:05pm
	Office hours	All school days	7:30am	4pm
Building Equipment	4.WS1	Monday-Friday	7am	4pm
		June/July	7am 1pm	9am 3pm
	Main schedule	Monday-Friday	7am	4pm (3:45pm Thu)
		Holidays	Off	

4.2 Heating System

Heating for the building is provided by three boilers, see Table 2.

Table 2: Boilers

Boiler	Area
B-1 B-2	Veissmann Vitocrossal 200 condensing boilers 1071 MBH (input)
B-3	Veissmann Vitorond 200 non-condensing 1096 MBH (input)

Figure 1: Boilers B-2 (left) and B-3. B-1 is the same make and model as B-2.

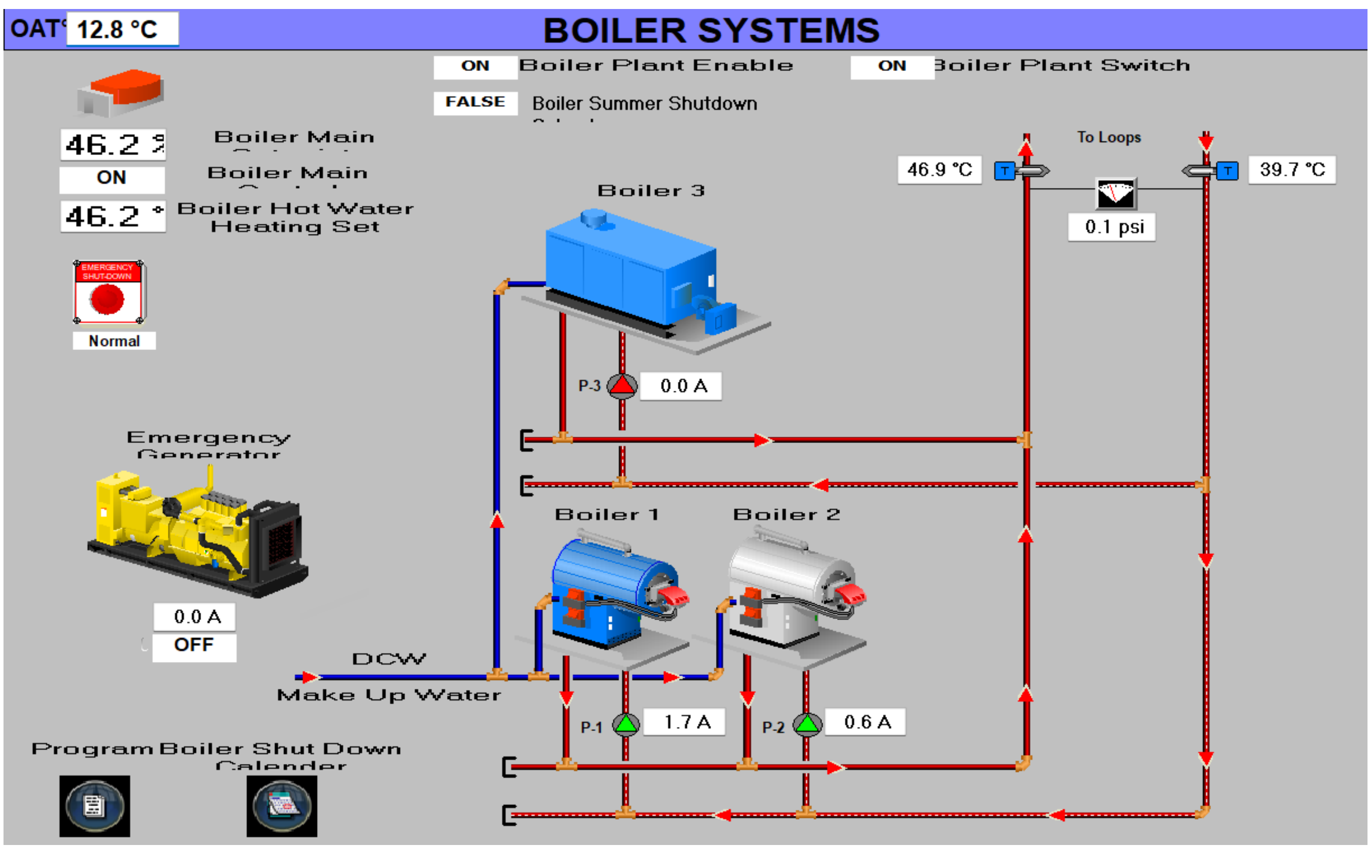


Figure 2: Boilers DDC Graphic

Heating water is distributed through six loops to air handlers, duct mounted reheat coils, fan coils, unit heaters, and radiant panels.

Table 3: Pumps

Tag	Serves	Size	Flow	Head (Ft)
P-1 P-2	Boiler pumps for B-1 and B-2			
P-3	Boiler pump for B-3	305W		
P-4	Woodshop	440W		
P-5	900 Wing	990W		
P-6	"main Loop"	1150W		
P-7	600 Wing	380W		
P-8	300 Wing	430W		
P-9	400 Wing	430W		
P-HV3	HV3 HC	1/6 HP	0.63 l/s	48 KPa
P-AHU3	AHU3 HC	144 W (estimate)		
P-AHU4	AHU4 HC	740 W (estimate)		
P-HV5	HV5 HC	500W	2.5 l/s	28 ft
P-HV8-P2	HV8AC8 loop	1/2 HP	2.27 l/s	51 kPa
P-HV8-P1	HV8AC8 HC	1/3 HP	1.5 l/s	60 kPa
P-HV13-PS	HV13 HC	1/12 HP	0.5 l/s	15 ft
P-HV14-PS	HV14 HC	1/12 HP	0.5 l/s	15 ft
P-DHWR	DHW Circulation	Unknown		

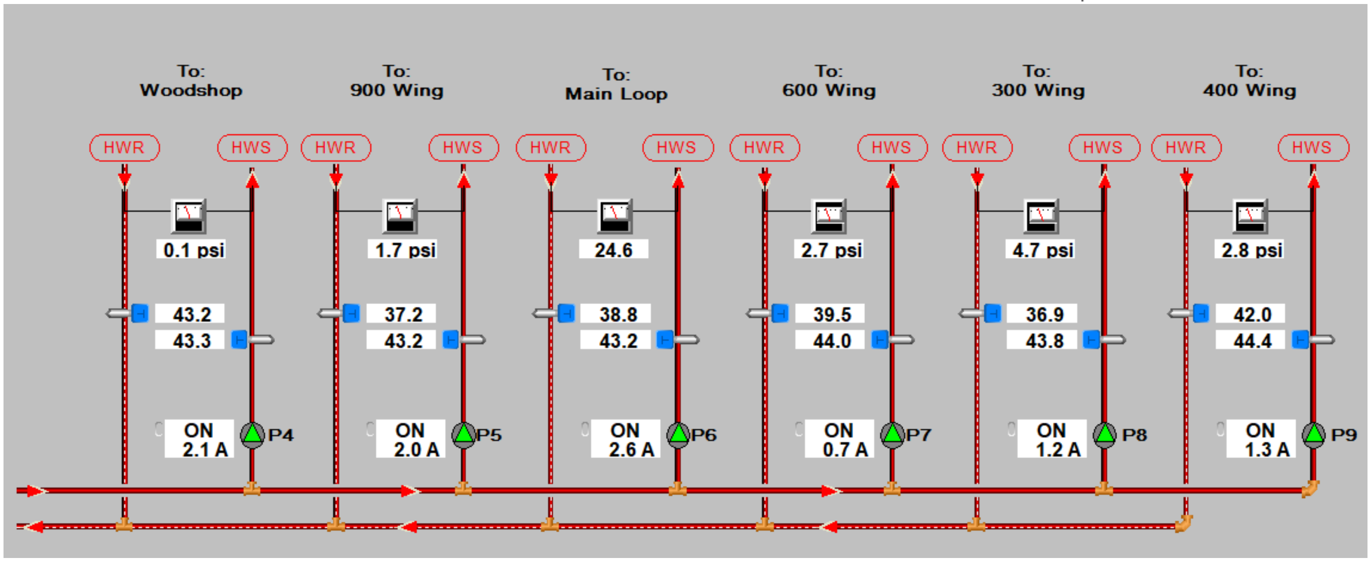


Figure 3: Main distribution loops

A glycol heating loop serves the heating coil in HV5; this is heated by heat exchanger HX-HV5, see Figure 4.

Figure 4: HX-HV5 heat exchanger

4.3 Cooling System

There is no central cooling system, but several air handlers have DX cooling, detailed in section 4.4, and there are smaller mini split units serving specific spaces, see **Error! Reference source not found.** for example.

Figure 5: Additional Fujitsu split unit above multi-use area.

4.4 Ventilation System

The building has 18 air handlers, see Table 4. Most are installed on the roof.

Table 4: Air Handling Units

Tag	Service	Airflow (cfm)	Supply Fan (HP)	Return Fan (HP)	Heating/cooling coils	Outdoor air	Schedule
HV1A	Multi-use space	21,405	15	7.5	Heating coil	Mix 30% Min	Matches 4.WS1 0% OA
HV2	Office and 200 Wing via reheats	9,464	7.5	3	DX cooling, 23 Ton	Mix 30% Min	1.WS1
HV2A	900 Wing	9,345	7.5	5	In-duct DX coils Heating coil	Mix 30% Min	1.WS1
AHU3	300 Wing	5,500	5 VSD	-	Heating coil	Mix 30% Min	1.WS1
HV3	Science	6,140	5	1.5	Heating coil.	Mix 30% Min	1.WS1
HV3A	900 West	11,260	7.5	5	In-duct DX coils Heating coil	Mix 30% Min	1.WS1
AHU4	Library 602 605	7,000	5 VSD	3 VSD	Heating coil.	Mix 30% Min	1.WS1
HV4	700 Block Art studio	2,000	1	-	DX cooling, 6 1/4 Ton Heating coil. Electric heat.	Mix 30% Min	1.WS1
AHU5	Shop Area	2,500	2 VSD	-	Heating coil	Mix 30% Min	

Tag	Service	Airflow (cfm)	Supply Fan (HP)	Return Fan (HP)	Heating/cooling coils	Outdoor air	Schedule
HV5	Wood Shop	9,000	7.5		Heating coil	Mix Min 10%	50200.SCH1 5am-4:30pm M-F
HV8AC8	400 Wing	10,299	7.5	5	DX cooling 2-stage, 28 Ton Heating coil	Mix Min 30%.	6am-4pm M-F 7am start Wed
HV9 (MUA)	Tech Lab	6000	3	-	None	100% OA	1.WS1
HV10	Auditorium	6,362	5	-	3 heating coils (one for each zone)	Mix 30% Min	6.WS6 8am-4pm M-F
HV11	Gym	10,600 (est.)	7.5	-	Heating coil	Mix 30% Min	6.WS6 8am-4pm M-F
HV11A	Weights / Gym Mezz	2400 cfm	1.5	-	DX cooling 2-stage, 12 Ton (estimated) Heating coil.	Mix 30% Min	6.WS6 8am-4pm M-F
HV12	Metal shop	9000 (est.)	7.5 (est.)	-	Heating coil	Mix 20% Min	50200.SCH 5am-4:30 M-F
HV13	Counselling	6000 cfm	5	1.5	Heating coil.	Mix 30% Min	1.WS1 CO2 sensor in return
HV14	800 Block	6000 cfm	5	1.5	Heating coil.	Mix 30% Min	1.WS1 CO2 sensor in return

Table 5: Exhaust fans

Tag	Service	Airflow (l/s)	Fan
EF1	Male washrooms	380	0.25 HP
EF2	Female washrooms	380	0.25 HP
EF3	Foods	1120	½ HP
EF4	EF805	1415	-
EF4A	Staff washrooms	94	123 W
EF5		300	10.4 Amps
EF5A	Multi-purpose storage	300	242 W
EF7	Male washroom	124	147 W
EF8	Female washroom	300	242 W
EF9	Gym change rooms		
EF10	Staff washrooms 400 wing		
EF1 CP301	-		
EF2 CP301	-		
EF3 CP301	-		

Tag	Service	Airflow (l/s)	Fan
SHOP EF1	-		VSD
SHOP EF2	-		VSD
SHOP EF4	-		VSD
EF 805	200 Wing staff washroom		10.4 Amps

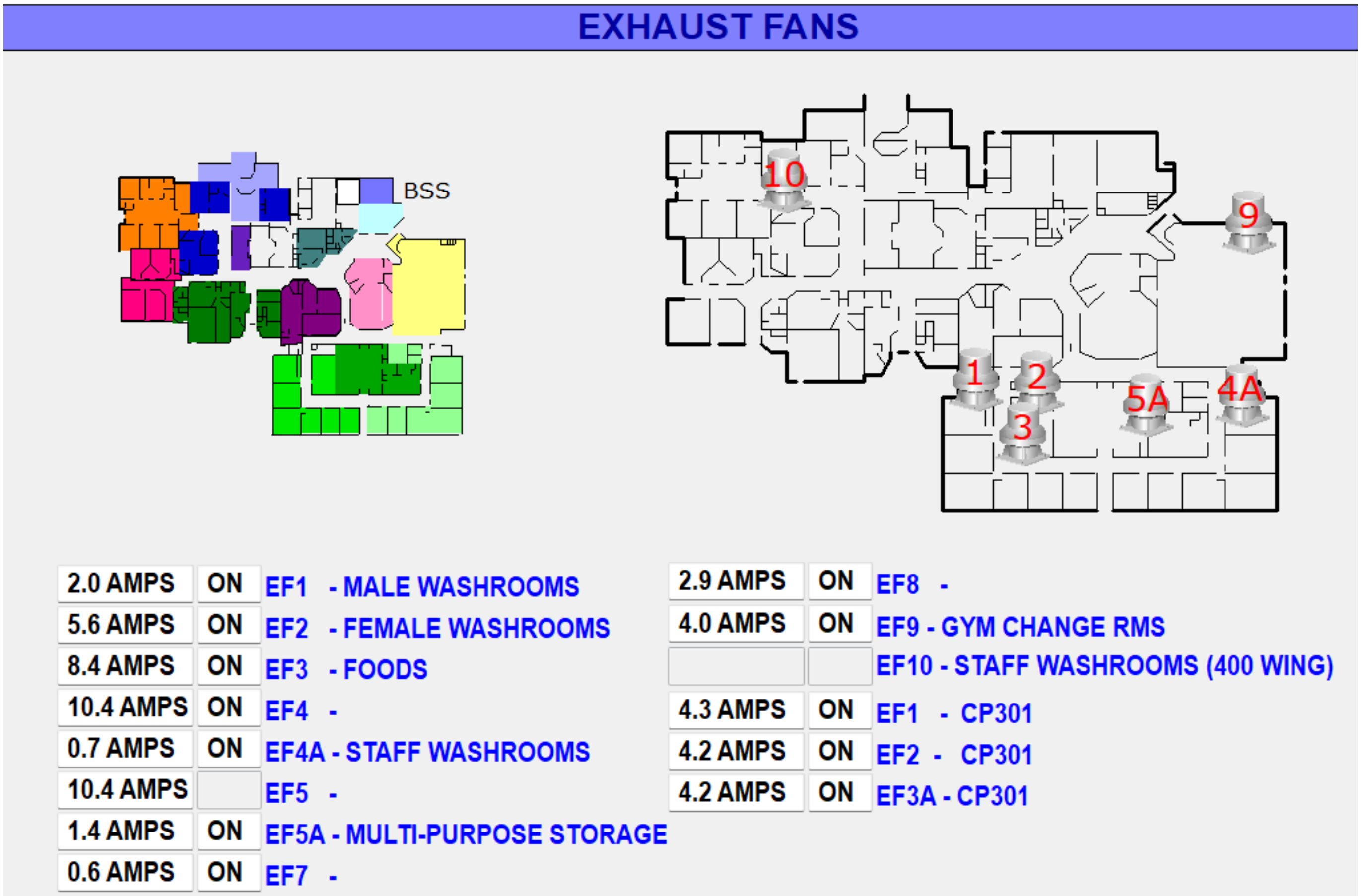


Figure 6: Exhaust fans in the DDC

4.5 Domestic Hot Water System

The school has two domestic hot water (DHW) systems, each serving part of the building. The first is a 199 MBH (input) 378 liter gas-fired tank heater, and recirculation pump.

The second is a 30 kW 420 liter electric water heater, with recirculation pump.

4.6 Controls System

The HVAC system is controlled by a Delta Controls DDC with ORCAView 3.40. Remote access to the system is available. Boilers, pumps, HV-5, HV8, HV-12 use the BACnet protocol. Other systems use the older "V2" protocol.

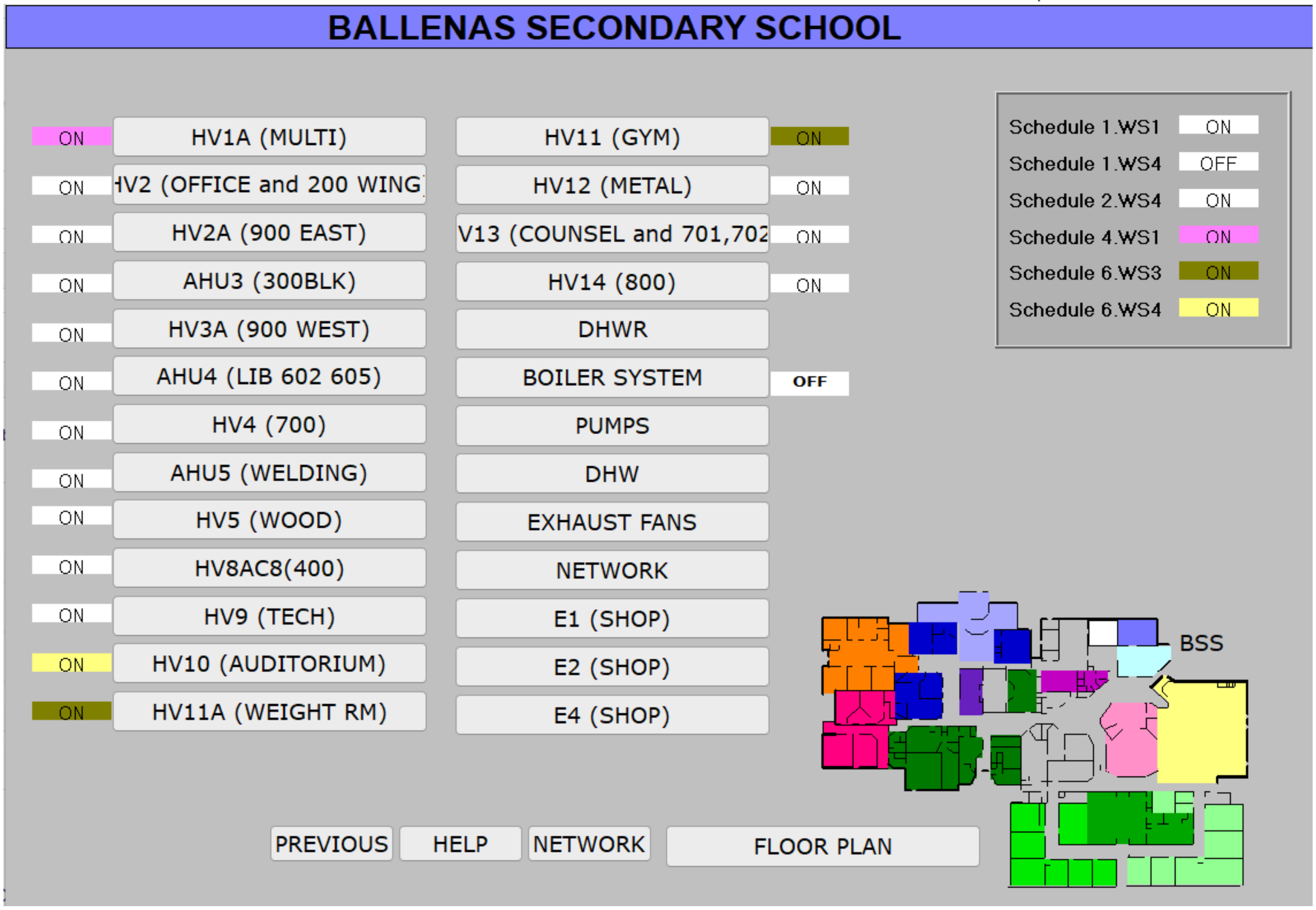


Figure 7: Main menu of the DDC system

5.0 Measures Selected for Implementation (Under C.Op. Program)

This section provides an overview of each measure, recommendations for implementation, and update after implementation.

For each measure, costs, savings, and payback calculations can be referenced in the *Investigation Summary Table* (see Appendix A).

5.1 *Measure 1: Reheat coils*

5.1.1 Description of Finding

Several reheat coils and their control valves were found to be blocked or passing, see Table 6.

Passing valves result in excessive zone heating. Blocked valves can also cause increased heating because the air handler needs a higher supply air temperature to maintain the setpoint in affected zones. This may result in overheating other zones which do not require extra heating.

Table 6: Reheat coil issues

Air handler	Blocked	Passing	Comments
HV1A		RM914B, RM914C	
HV2	RM203, RM116, COPY153, VP, PRINCIPAL, RM145		All reheats set manually to 50% RM201/2 reheats have failed SAT sensors
HV2A	RM908, RM911, RM913, RM915		
AHU3	303	301, 304	
HV3	LAB603, LAB OFF603, LOCKERS, CHEM STO.		All reheats set manually to 50%.
HV3A	RM904, RM906	RM901A, RM907	RM920 suspected blocked, RM919 suspected passing based on room temperatures.
AHU4	OFFICE605, CHEM605		BIO 601, LIB, LIB EAST also seem low. Valve position set to 50% in code.
HV8AC8	404B, 405		
HV10		Stage duct heating coil	
HV11A	Main AHU coil		
HV13	160, 162, 159	157	
HV14	801, 803, 804, 805		Only 803 is completely blocked

Documentation for reheat problems can be found in Appendix E: Reheat Coils.

AHU-3 reheat coil issues shown here as an example. AHU-3's supply air temperature is 17.3°C at the time Figure 8 was captured. Where reheat coil control valves are fully closed, the reheat coil supply air temperatures should equal the AHU-3 supply air temperature. However, reheat coil supply air temperatures for rooms 301 and 304 are 23.1 and 20.8°C respectively, despite the control valves being fully closed. This suggests the control valves are passing.

The reheat for room 303 is increasing the air temperature to 19.1°C but failing to meet the supply air setpoint (20.1°C) even with the valve almost fully open. AHU-3 is supplying air too hot for rooms 300 and 305. This may be due to Room 303 failing to meet setpoint.

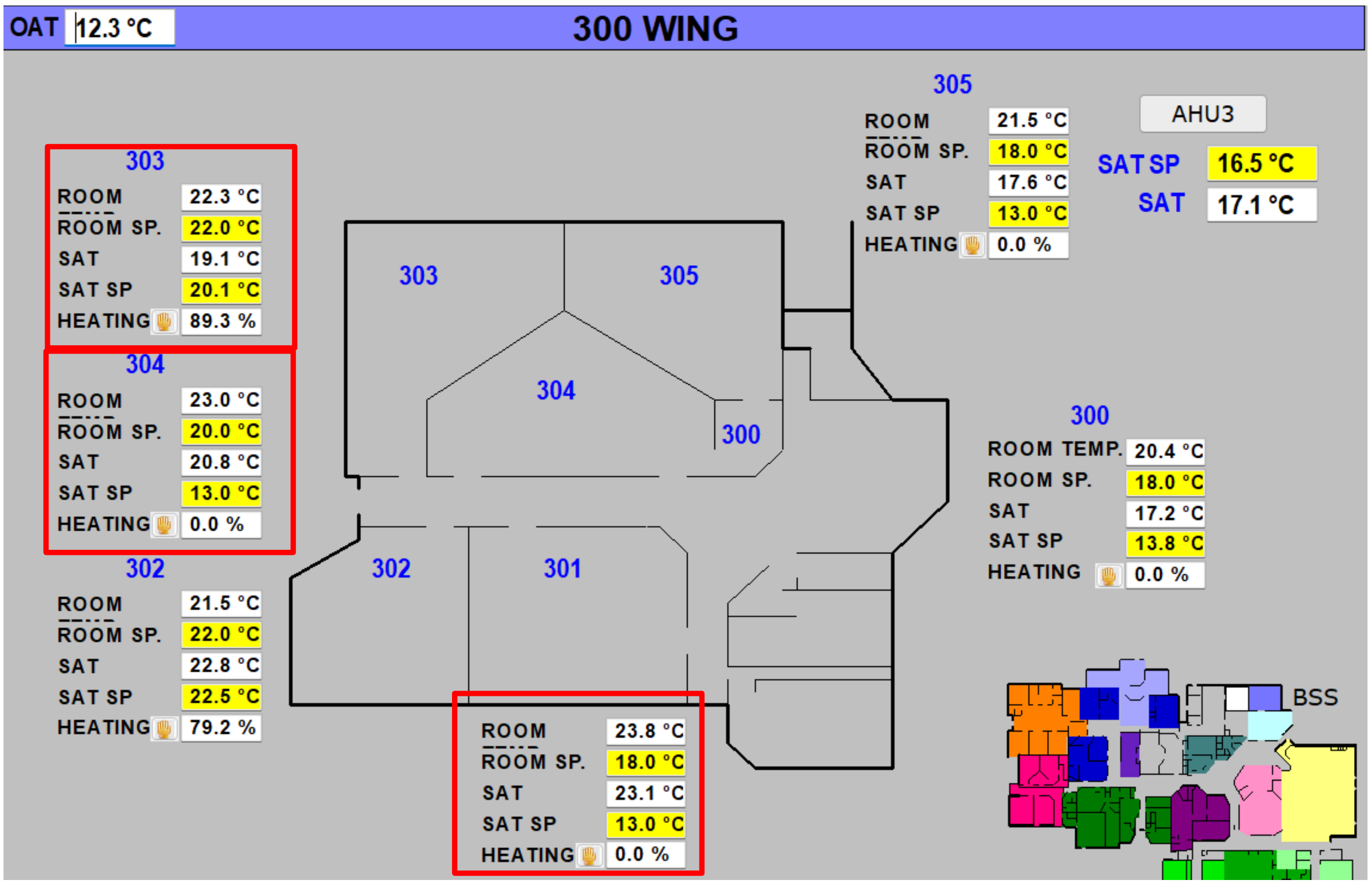


Figure 8: Reheats for 301 and 304 are passing. Reheat for 303 is partly blocked.

5.1.2 Measure Description

We recommend investigating of all reheat coils in the building to identify coils/valves with issues and diagnosing the issue (valve, coil, or actuator). Some cases may be solved with maintenance, but we expect some valves to need replacement.

This is a required measure since degrading or failing valves/coils will eventually lead to comfort issues.

5.1.3 Measure Implementation Update

[Provide confirmation details **AFTER** the measure is implemented and verified]

5.2 Measure 2: Fan feedback sensor

5.2.1 Description of Finding

The HV10 and HV11 supply fan feedback sensors report that the fans operate despite being commanded off, see Figure 9.

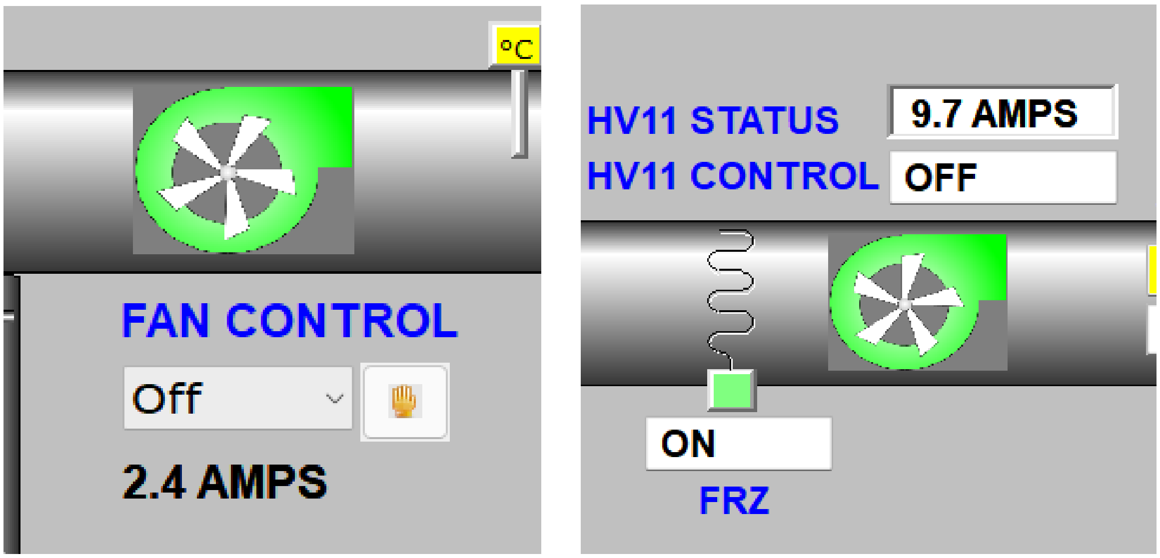


Figure 9: HV10 (left) and HV11 (right) supply fans

The HV10 supply fan sensor reports 2.4 A when commanded off. This triggers regular operation of the unit, including opening the MAD to its minimum setting (30%), and modulating the heating coils to maintain regular occupied setpoints in the auditorium.

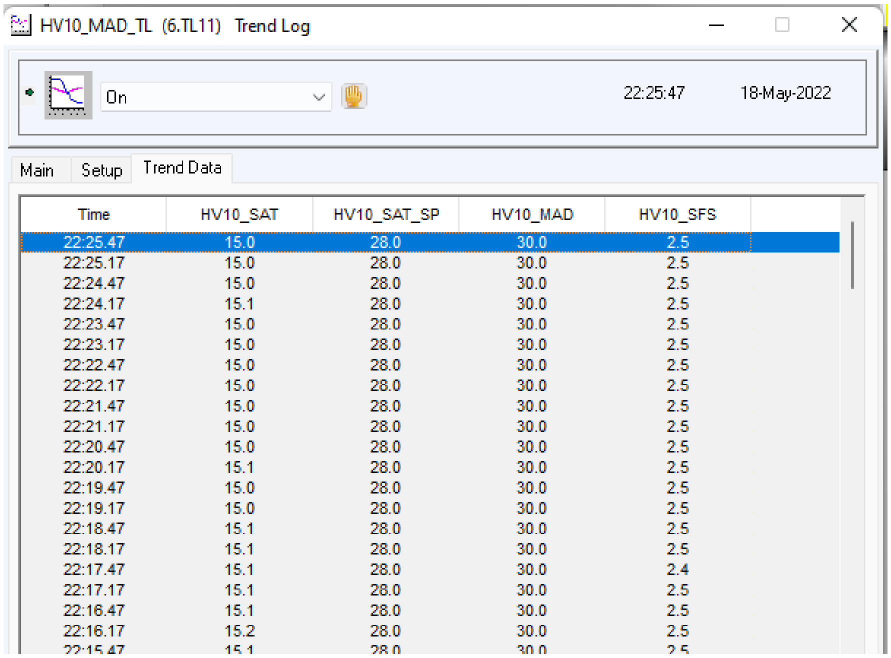
The sensor reports a similar current when the fan is commanded on, which indicates it may be operating continuously.

```
IF HV10_WS OR HV10_OVR OR BUILDING_FLUSH OR H10_ENHANCED_WS THEN
   HV10_SFC = ON
ELSE
   NSB_HV10 = SWITCH(NSB_HV10 , HV10_RT1 , NSB_SP , NSB_SP + 2 )
   HV10_SFC = NSB_HV10
ENDIF    HV10_SFC = OFF
```

Figure 10: HV10_SFC set to OFF

```
IF HV10_SFS > 1 THEN
  DO_EVER  HV10_SFS = 2.5
    HV10_MAD_RAMP = LIMIT(HV10_MAD_RAMP + (HV10_RAT - 18) , 0 , 100 )
  ENDDO
    H10_MAT_SP = 12
    HV10_MAD = HSEL(HV10_MAD_MIN , HV10_SAT_CO )
    HV10_MAD = LSEL(HV10_MAD , HV10_MAD_LL_CO , HV10_MAD_RAMP )
```

Figure 11: Fan feedback value HV10_SFS indicates significant current going to the fan



Time	HV10_SAT	HV10_SAT_SP	HV10_MAD	HV10_SFS
22:25.47	15.0	28.0	30.0	2.5
22:25.17	15.0	28.0	30.0	2.5
22:24.47	15.0	28.0	30.0	2.5
22:24.17	15.1	28.0	30.0	2.5
22:23.47	15.0	28.0	30.0	2.5
22:23.17	15.0	28.0	30.0	2.5
22:22.47	15.0	28.0	30.0	2.5
22:22.17	15.0	28.0	30.0	2.5
22:21.47	15.0	28.0	30.0	2.5
22:21.17	15.0	28.0	30.0	2.5
22:20.47	15.0	28.0	30.0	2.5
22:20.17	15.1	28.0	30.0	2.5
22:19.47	15.0	28.0	30.0	2.5
22:19.17	15.0	28.0	30.0	2.5
22:18.47	15.1	28.0	30.0	2.5
22:18.17	15.1	28.0	30.0	2.5
22:17.47	15.1	28.0	30.0	2.4
22:17.17	15.1	28.0	30.0	2.5
22:16.47	15.1	28.0	30.0	2.5
22:16.17	15.2	28.0	30.0	2.5
22:15.47	15.1	28.0	30.0	2.5

Figure 12: Value of HV10 fan feedback sensor

HV11 which serves the gym has the same issue. The sensor reports 9.8 Amp when commanded off, and 17.8 Amps when commanded on, so it is likely this is a sensor function or calibration issue.

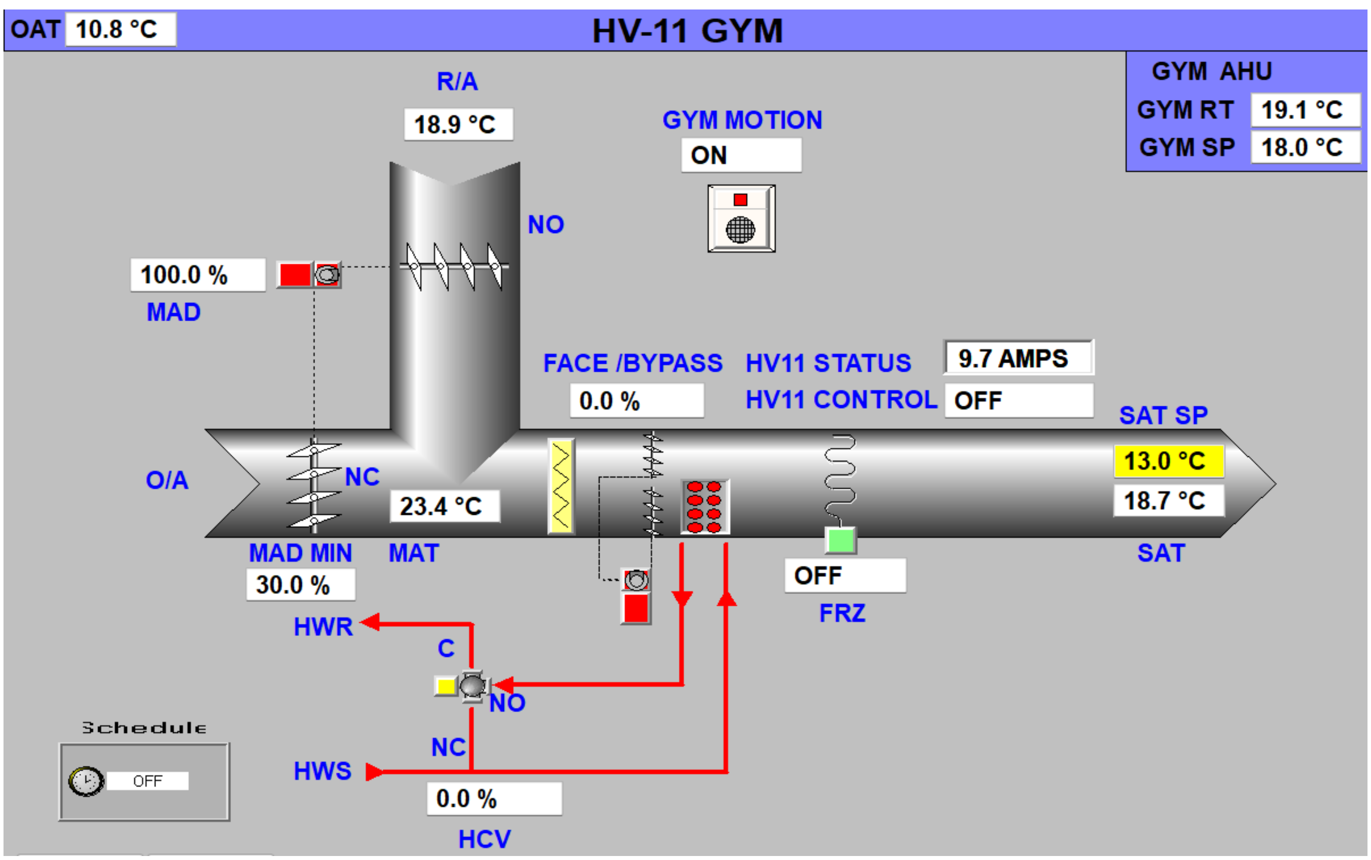


Figure 13: HV11 supply fan feedback is 9.7 Amps even when the fan is commanded off

The air handler operates as normal if the supply fan reports it's running, including opening the mixed air damper and heating valve, which can lead to heat losses even if there is no airflow.

```
IF GYM_SFS > 5 THEN
 DO_EVER GYM_SFS = 9.7
   GYM_MAD_RAMP = LIMIT(GYM_MAD_RAMP + (GYM_RAT - 17) , 0 , 100 )
 ENDDO
   GYM_MAT_SP = 8
   GYM_MAD_LL_CO.BIAS = 0
   GYM_MAD = HSEL(GYM_MAD , GYM_MAD_MIN , ((OCC_SAT_CO - 50) * 2) )
   GYM_MAD = LSEL(GYM_MAD , GYM_MAD_LL_CO , GYM_MAD_RAMP )

          [HEATING CONTROL]

   GYM_HCV = 100 - (OCC_SAT_CO * 2.1)
```

Figure 14: HV1 operates as normal if the supply fan feedback indicates the fan is running

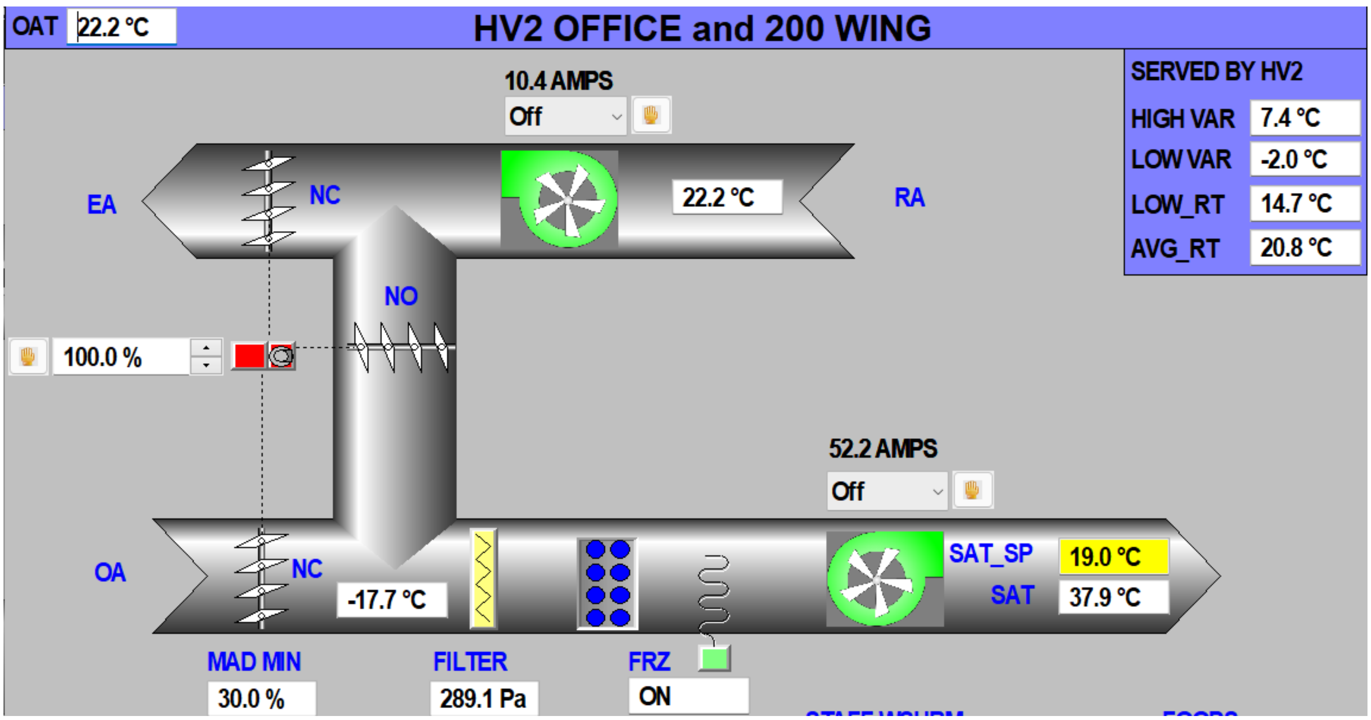


Figure 15: HV2 supply and return fans sensors both indicate fans are running when commanded off

5.2.2 Measure description

Verify the HV10 and HV11 supply fan feedback sensors correctly reports that status of the fan by manually checking fan status in the field while commanding the fans on and off.

Savings calculations assume the HV10 controller is faulty (i.e., HV10 operates when commanded off), and the HV11 fan sensor requires replacement.

5.3 Measure 3: Morning schedules

5.3.1 Description of Finding

Air handlers HV5, HV9, HV12 start at 5am, well before occupancy.

5.3.2 Description of Measure

Change start times of these air handlers to 7am, Monday to Friday. Ensure that units are operating correctly, including correcting HV5 heating coil and loop issues, see Measure 5.7.

5.4 Measure 4: Night setback temperatures

5.4.1 Description of Finding

Lowering room temperature setpoints during unoccupied periods (commonly known as "night setback") reduced heat losses without affecting comfort during occupied hours. Most night setback temperature setpoints in the building are around 19°C. This is too high to provide significant energy savings.

Table 7: Night setback temperatures

Tag	NSB (°C)
HV1A	19
HV2	15
HV2A	19 (NSB_SP)
AHU3	15
HV3	19
HV3A	19
AHU4	19
HV4	15
AHU5	19 (SHOP_NSB_SP)
HV5	20
HV8AC8	19 (NSB203_SP)
HV9	
HV10	19 (NSB_SP)
HV11A	0
HV11	14
HV12	14 (HV12_NSB_SP)
HV13	16 (P301_NSB)
HV14	16 (P303_NSB)

HV5 incorrectly uses the mixed air damper setpoint value in the night setback calculation, see Figure 16. Since this value is fixed to 30% (Figure 17), night setbacks are never enabled for HV5.

```
4 HV5_NSB = Switch ( HV5_NSB, HV5_DC_MAD_SP, HV5_NSB_SP - 1, HV5_NSB_SP)
```

Figure 16: HV5 night setback calculation

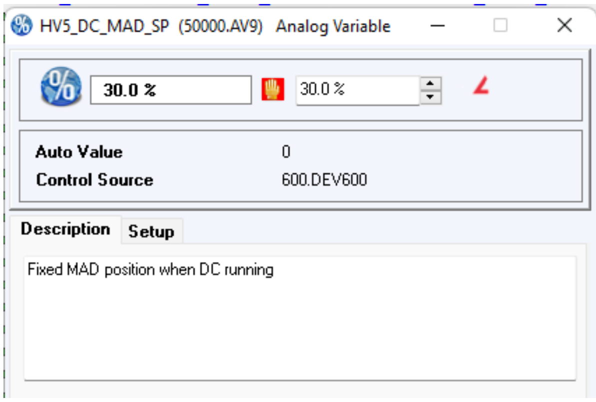


Figure 17: HV5 mixed air damper setpoint is manually set to 30%

5.4.2 Measure Description

Lower night setbacks to 15°C for all air handlers.

Correct HV5 night setback programming to use room temperature.

5.5 Measure 5: Holiday schedule

5.5.1 Description of Finding

The holiday schedules for spring and summer breaks do not match the actual school calendar. The spring break schedule is offset from actual weekdays. The summer break schedule only covers part of July and August.

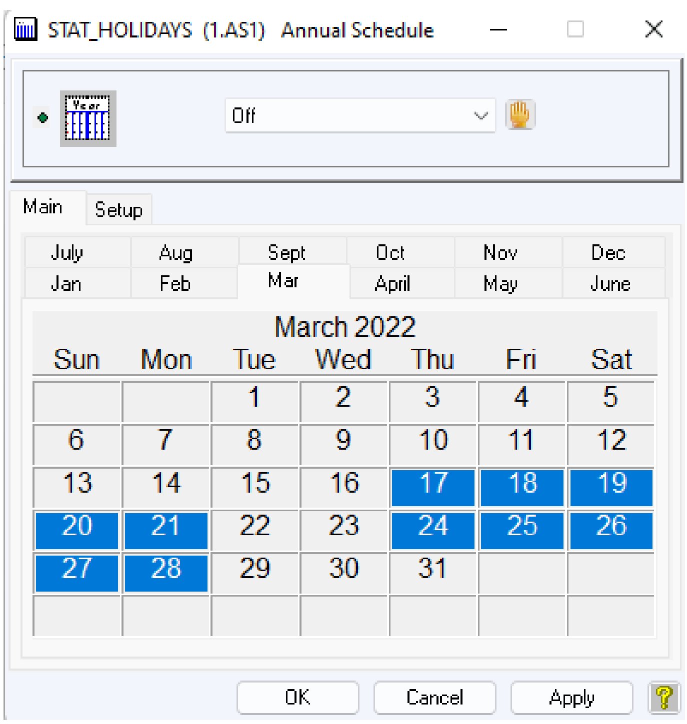


Figure 18: Spring break exception schedule

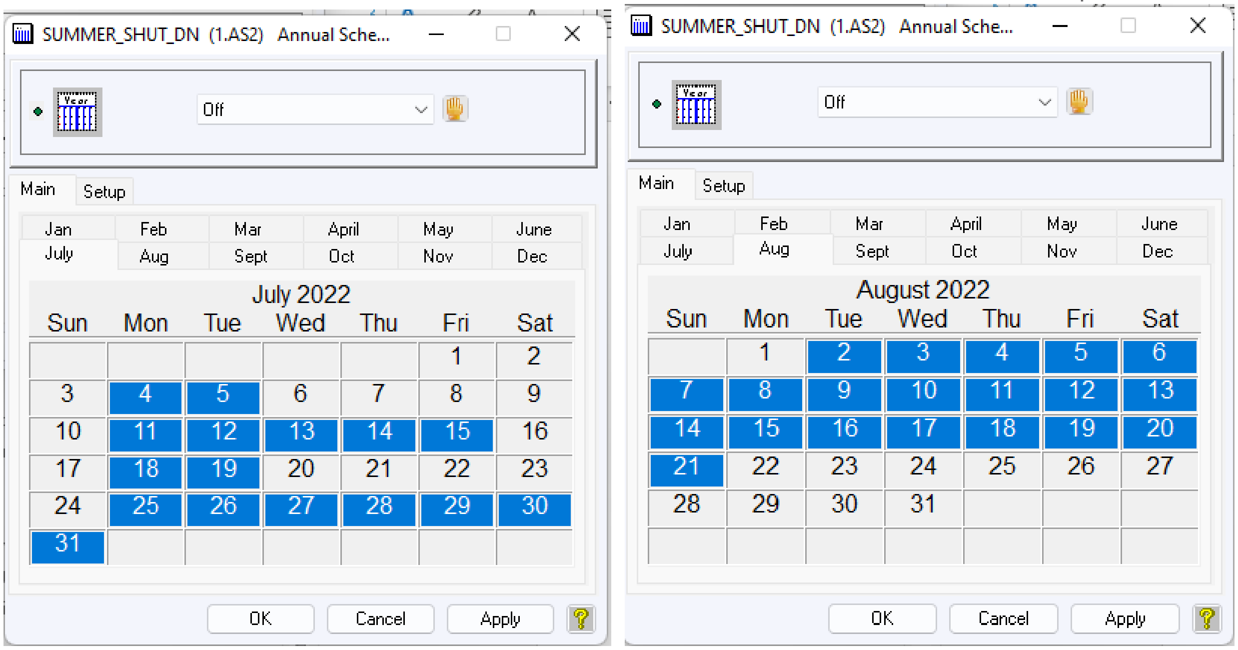


Figure 19: Summer break exception calendar

In comparison, Gym and Auditorium have summer break schedules that cover all of July and August, which saves energy during an unoccupied period.

5.5.2 Measure Description

Update holiday schedules for all air handlers to match school calendar on a regular basis.

5.5.3 Measure Implementation Update

[Provide confirmation details **AFTER** the measure is implemented and verified]

5.6 Measure 6: Exhaust Fans run outside occupied periods

5.6.1 Description of Finding

Several exhaust fans were found to be running while the building was unoccupied, see Figure 21. Unless there are specific needs, such as moisture/pollutant control, they should be switched off when the building is unoccupied.

EF1 and EF2 are overridden on. This causes them to operate continuously.

EF4, EF5, and EF9 feedback sensors show each operates when commanded off.

EF7 and EF8 are operating continuously. Both are programmed to operate per weekly occupancy schedules that no longer exist in the DDC as seen in Figure 20.

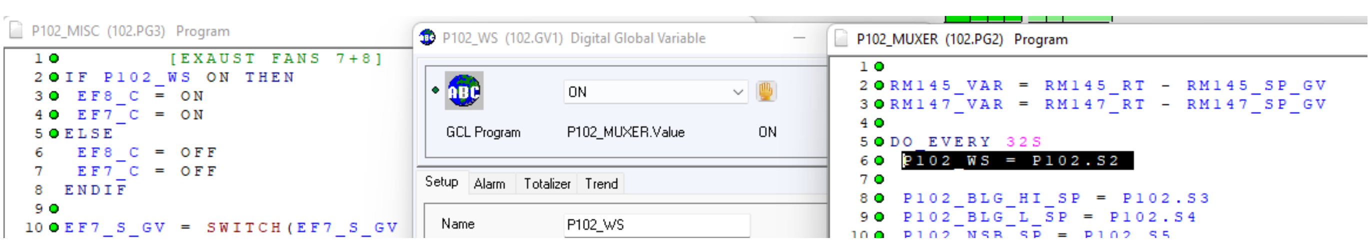


Figure 20: EF7 and EF8 calendar logic

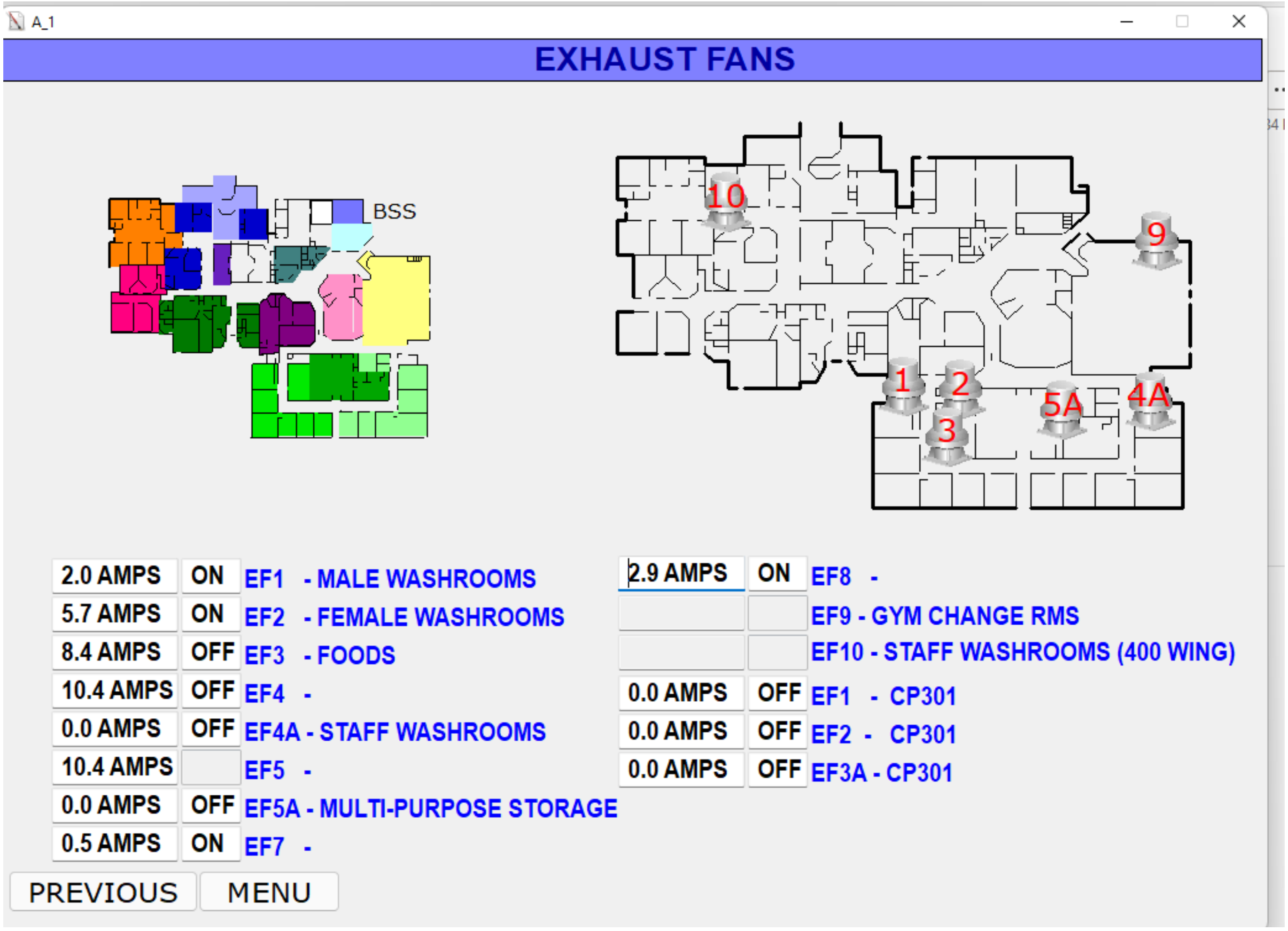


Figure 21: Exhaust fans overview, at 10:24pm on a Sunday

5.6.2 Measure Description

Remove overrides for EF1 and EF2. Correct schedule logic for EF7 and EF8.

Verify correct operation of EF4, EF5, and EF9 fans and the feedback sensors in the field. Replace the sensors or control wiring as indicated by field tests.

Predicted energy savings assume EF1, EF2, EF7, and EF8 currently operate continuously. Estimated measure costs assume EF4, EF5, and EF9 feedback sensors need to be replaced.

5.6.3 Measure Implementation Update

[Provide confirmation details **AFTER** the measure is implemented and verified]

5.7 Measure 7: HV5 temps and heating coils

5.7.1 Description of Finding

HV-5 is struggling to meet its supply air and zone temperature setpoints despite its heating coil control valve fully open as seen in Figure 22.

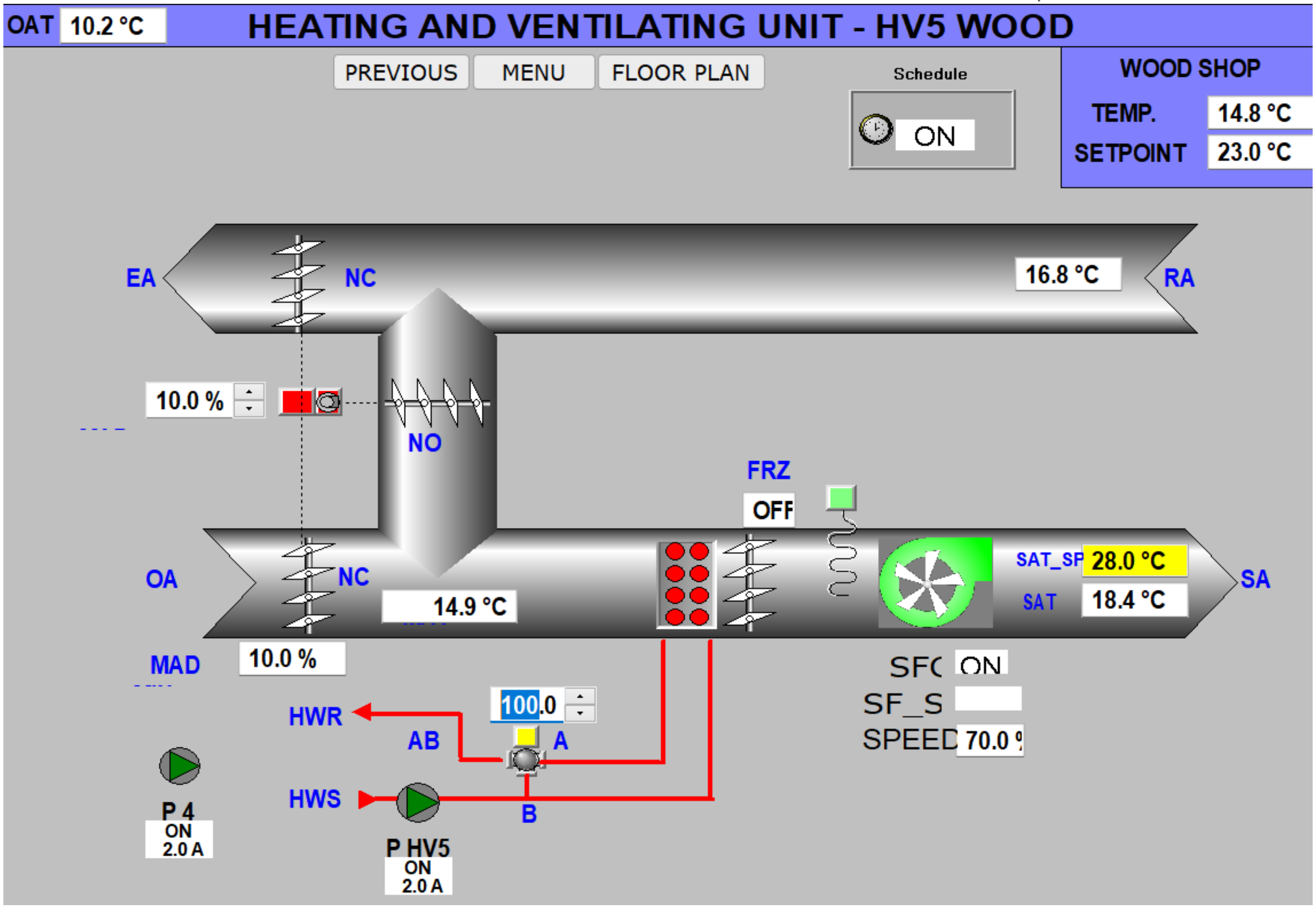


Figure 22: HV-5 has low supply air temperature even with heating valve fully open

5.7.2 Measure Description

Investigate HV5 heating loop and coil and confirm correct operation. Correct any issues.

5.7.3 Measure Implementation Update

[Provide confirmation details **AFTER** the measure is implemented and verified]

5.8 Measure 8: Temperature sensors

5.8.1 Description of Finding

Several supply air and room temperature sensors are providing incorrect readings, see Table 8.

Low supply air temperature readings can cause unnecessary reheat. Low room temperature readings can cause unnecessary reheat as well as overnight "night setback" operation of air handlers.

Table 8: Temperature Sensor Issues

Sensor	Issue / constant reading
RM201 supply air temperature	Constant value (-17.1°C)
RM202 supply air temperature	Constant value (-17.1°C)
RM203 supply air temperature	Constant value (-17.1°C)
RM201	Constant value (14.7°C)
RM202	Constant value (18.1°C)
RM203 room temperature	Constant value (22.7°C)
RM116 room temperature	Constant value (18.5°C)
ART ROOM room temperature	Constant value (23.3°C)
RM911 room temperature	Constant value (17.7°C)

.

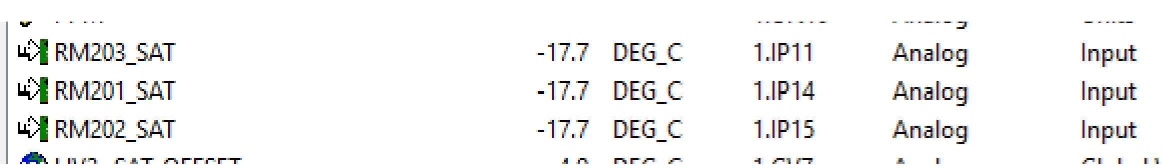
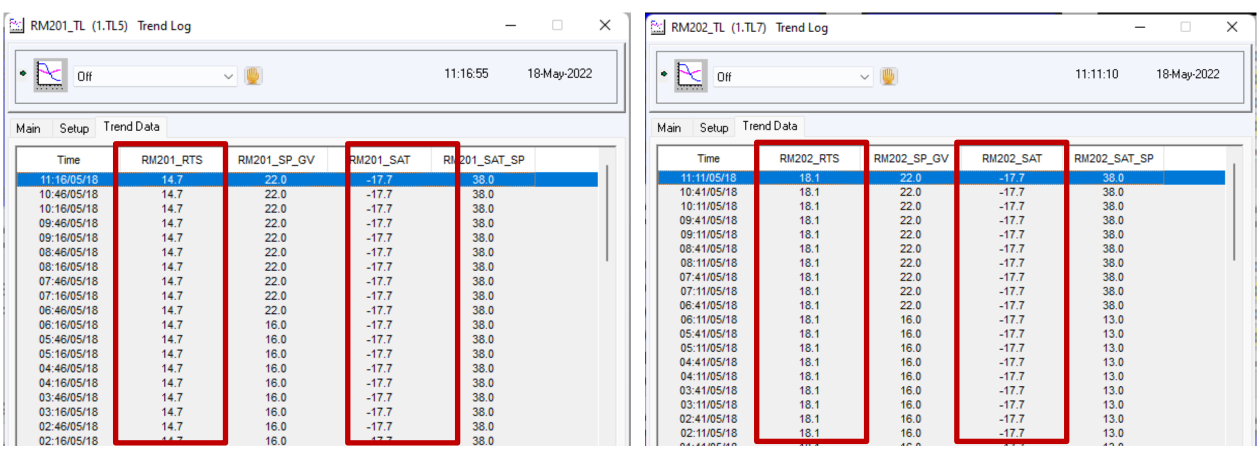


Figure 23: Supply air temperature sensor values



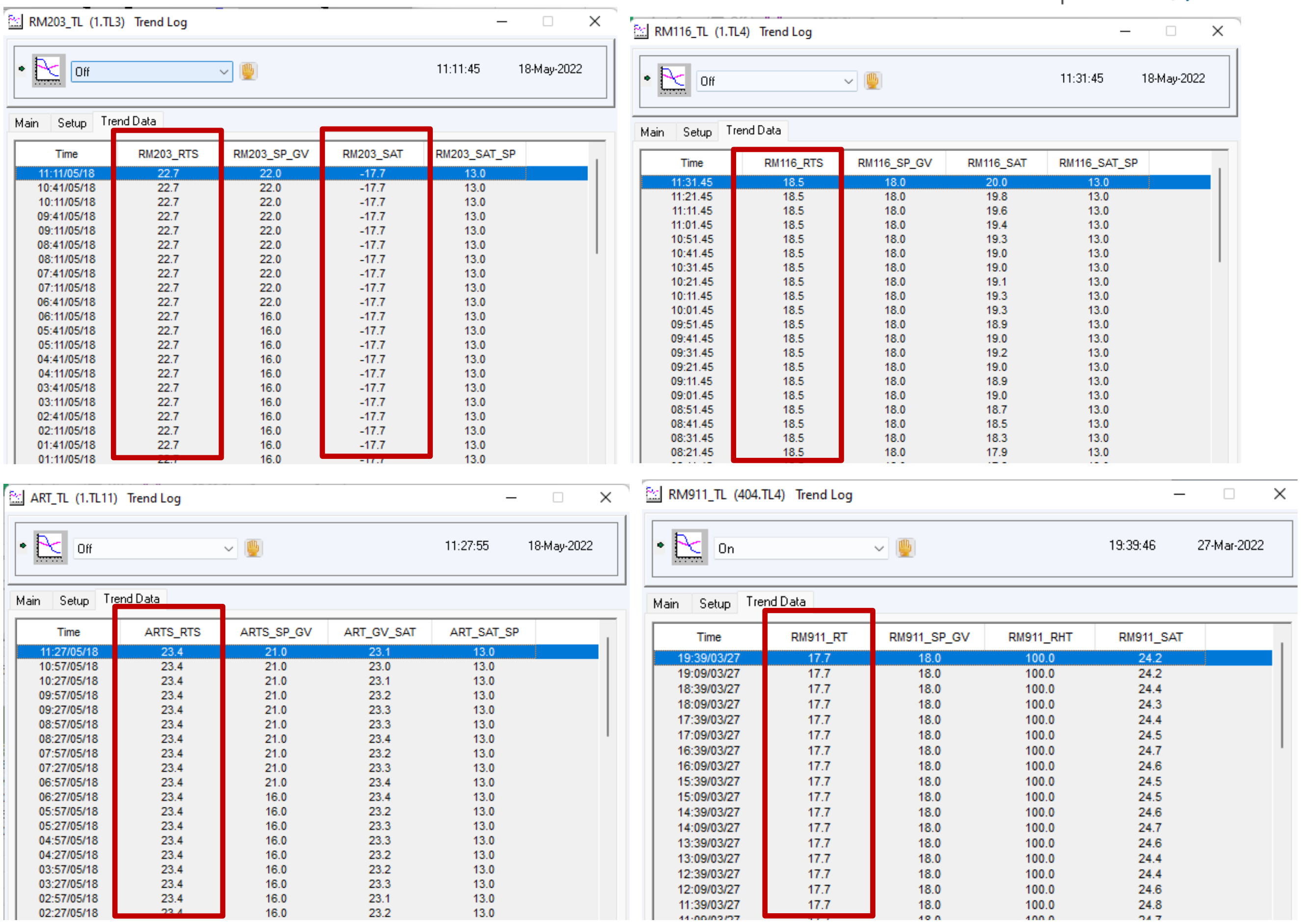


Figure 24: Failed room temperature and SAT sensors for RM201, 202, 203, 116, ART ROOM, 911

The RM911 room temperature sensor is stuck at 17.7°C which is lower than NSB SP (19°C). During the investigation period, the low RM911 room temperature was observed to trigger HV2A to run during unoccupied times.

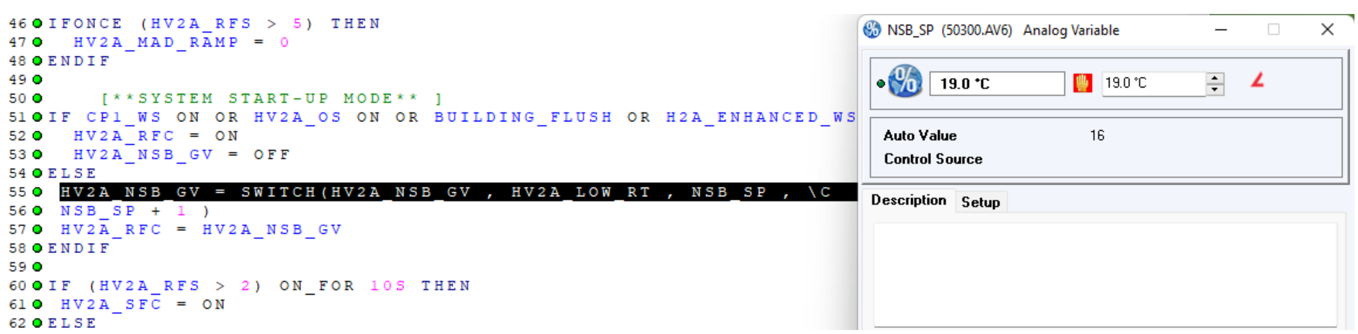


Figure 25: HV2A night setback logic

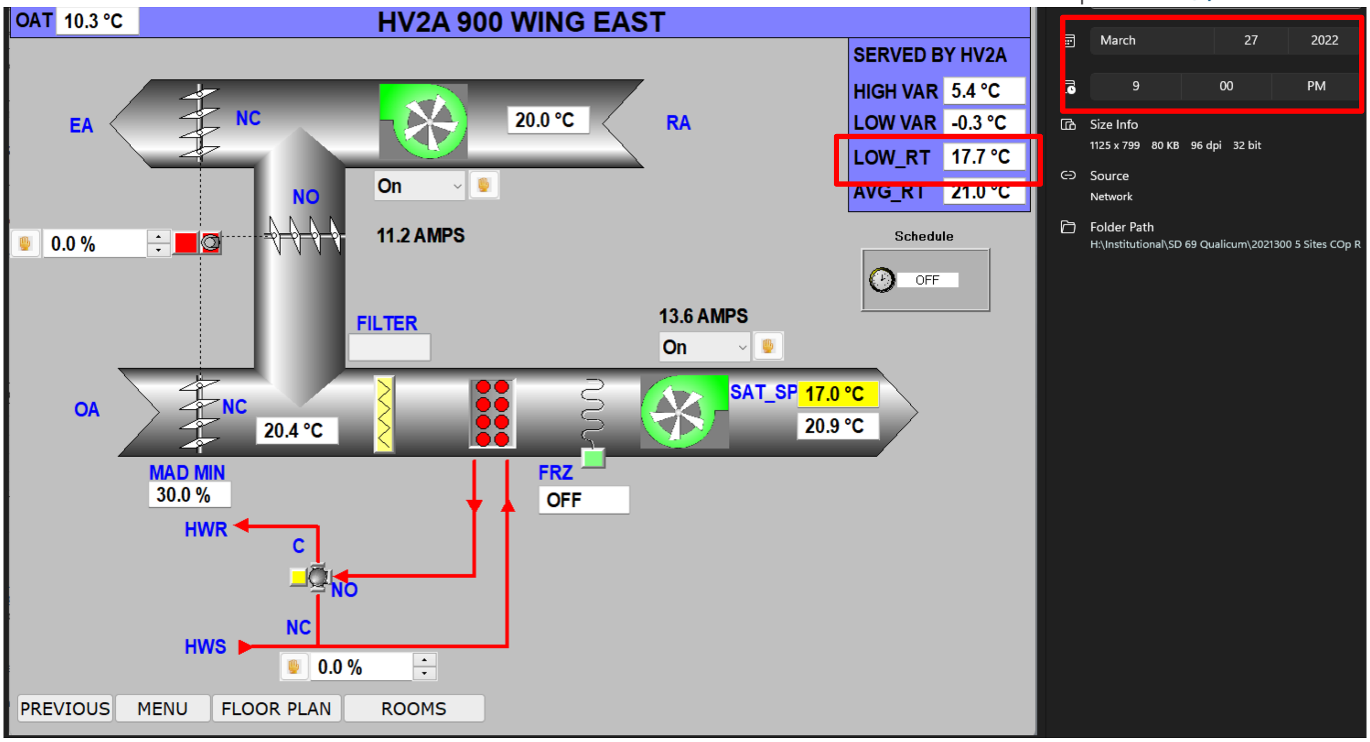


Figure 26: HV2A operating outside scheduled hours

5.8.2 Measure Description

Replace the problem temperature sensors.

5.8.3 Measure Implementation Update

[Provide confirmation details **AFTER** the measure is implemented and verified]

6.0 Measures to be considered for Future Implementation

This section provides an overview of each measure (that was identified but **was not selected** as part of this C. Op. project, but maybe considered for future implementation), recommendations for implementation, and the most suitable method for providing evidence of implementation. See Appendix A - Investigation Phase Summary Table for more details.

6.1 Measure 9: Reversible heat pumps for existing DX coils

Approximately 35% of the school has mechanical cooling from DX coils in air handlers and supply ducts.

When these DX systems reach end-of-life, they can be upgraded to reversible heat pumps of similar capacity. This will enable them to provide 1st stage heating, supplemented by heating coils like the existing ones. Our high-level estimate is that new replacement units would cover all the heating needs for areas served by these air handlers.

Table 9: Existing DX systems

Tag	Size	Age	Description	Replacement
HV2	23 Ton 9500 cfm	Pre-1996	Packaged roof-top unit (Lennox DMS4-275HW) with DX coil and hydronic heating coil	Similar sized unit with reversible heat pump
HV4	6 Ton 2000 cfm	2001	Packaged roof-top unit (Trane TFD075) with DX coil, hydronic heating coil	Similar sized unit with reversible heat pump
HV8AC8	28 Ton 10,000 cfm	1991	Air handler (Engineered Air FWA-285-C). Air inlet and outlets, condensing coils and fans are in a small courtyard. The rest of the unit is in a mechanical room.	Similar sized unit with external condensing unit.
HV11A	12 Ton 2,400 cfm		Packaged roof-top unit with DX coil and hydronic heating coil	Similar sized unit with reversible heat pump
CU-1 to CU-4	4 Ton condensing units	2001	Rooftop condensing units (Trane TTA048) with indoor coils in supply air ducts leading to four classrooms in 900 block.	Similar sized reversible units

Figure 27: HV2 and HV4 rooftop units with DX cooling

Figure 28: HV11A rooftop unit with DX cooling

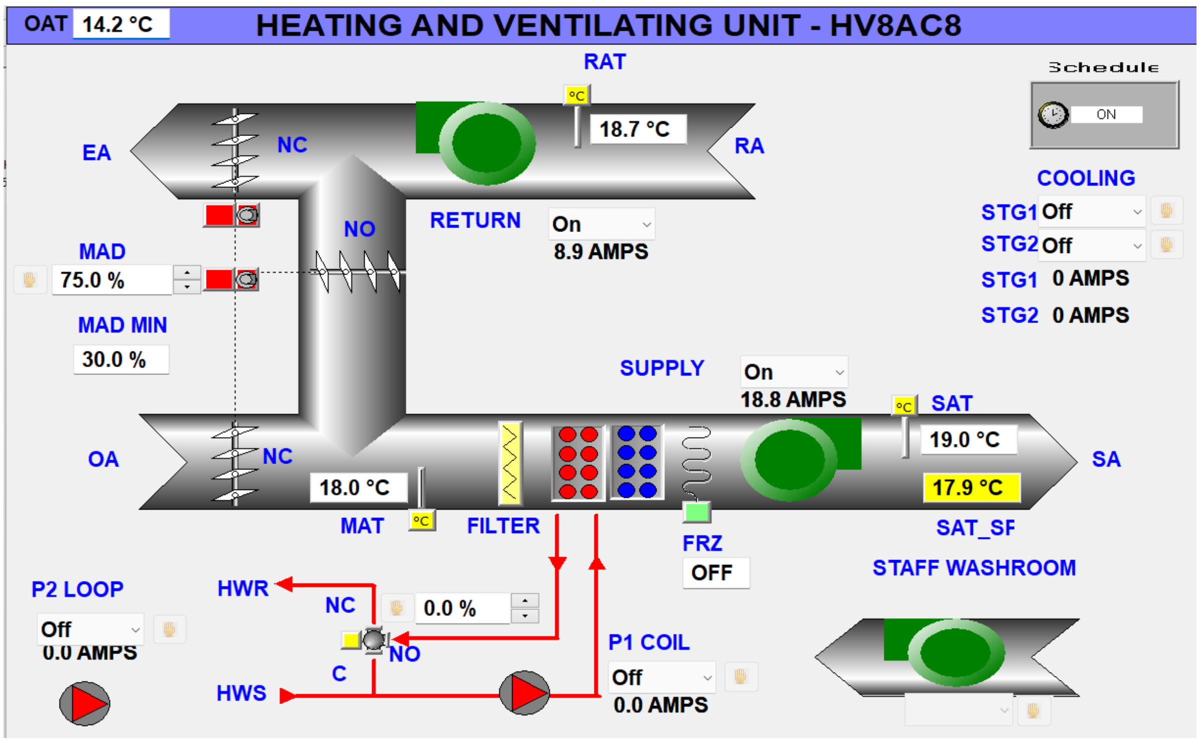


Figure 29: HV8AC8 in the DDC. The unit has two stages of cooling.

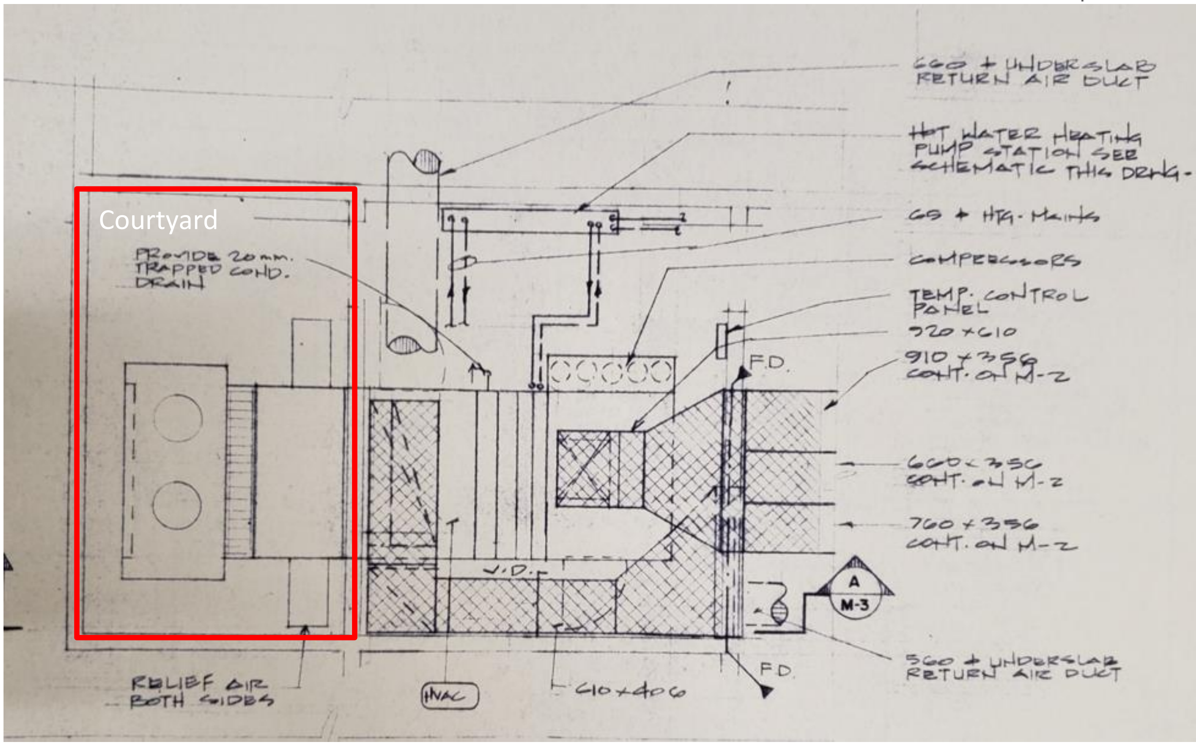


Figure 30: Drawing of HV8AC8. The main unit is inside Mechanical Room 110. The condensing unit is outside in a small courtyard area

Four 4-ton split systems provide cooling to classrooms 901, 903, 912, and 913 using dx coils in the ducts from HV2A and HV3A.

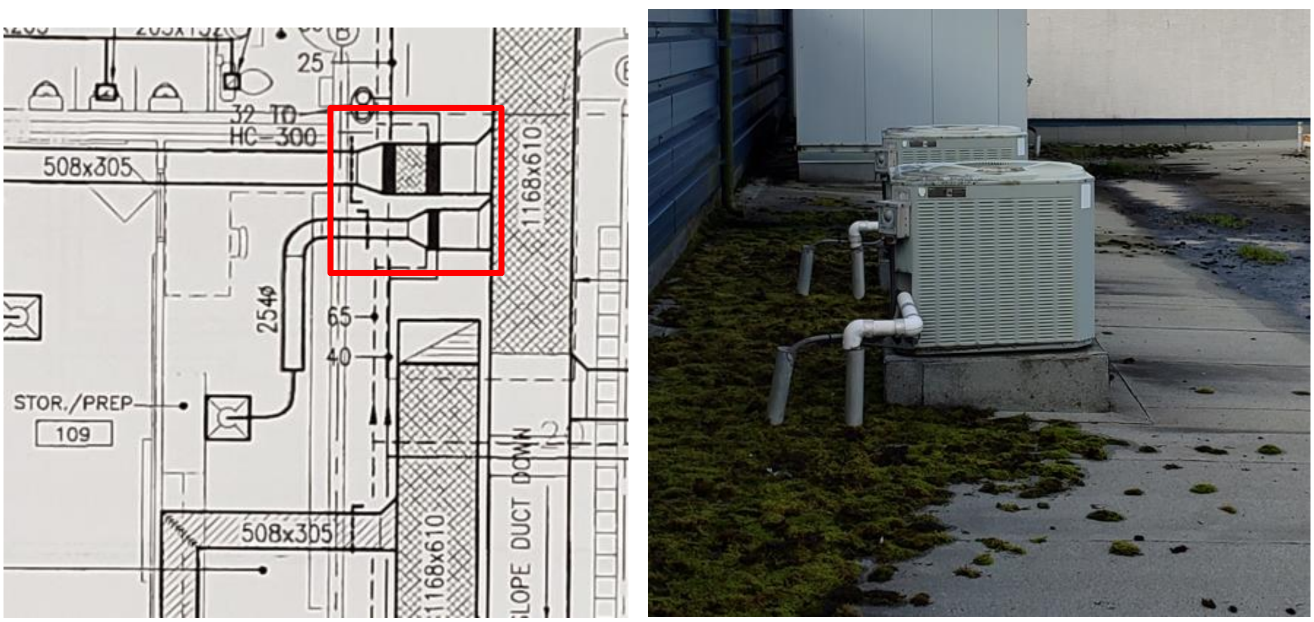


Figure 31: DX coils and outdoor units provide cooling to four rooms in the 900 Block.

CU-1 to CU-4 (Figure 31Figure 31: DX coils and outdoor units provide cooling to four rooms in the 900 Block.) would be relatively simple swaps with equivalent reversible units.

Estimated measure costs include all work required to replace each existing cooling system with a reversible heat pump. The base case cost (replacing the equipment like-for-like) may be similar. The ASHRAE life expectancy for air cooled condensers is 20 years, so these units should need to be replaced in 5 to 10 years.

A feasibility study is recommended as the next step to assessing the viability of this project. Mechanical and structural assessments are required to refine the cost and viability of the project.

The study can be expanded to consider the feasibility of adding DX coils to other air handlers in the school, including determining which units would provide the most cost-effective emissions reduction. One benefit of this solution is the addition of cooling to other parts of the school.

6.2 Measure 10: Hydronic Air Source Heat Pump

An alternative low carbon electrification strategy is to supplement the existing hydronic heating system with an air source heat pump. Commercially available air source heat pumps can heat water up to 50°C efficiently. With the current boiler control logic, the supply water would be too warm for the heat pumps to provide much heating once outdoor temperatures drop below 9.5°C. In the Qualicum climate, only 10% of heating needs occur above this temperature. In general, the system would need to operate with 50°C supply water temperatures down to 4°C outdoor temperatures to meet 50% of heating needs, and down to 0°C to meet 75% of heating needs.

We recommend testing lower supply water temperatures during the next heating season, after ensuring that all coils are performing as specified (see Measure 1: Reheat coils). Performing this test in different conditions or adding long term trending and analytics for continuous monitoring, will provide realistic data regarding the changes to the system (mainly upgrades to heating coils) that are required before heat pumps become a viable solution.

Adding heat pumps to the heating loop will only provide significant benefits if the hydronic system can be made to operate with water loop temperatures at 50°C (or less) down to freezing conditions, which covers approximately 75% of heating needs in the Qualicum climate.

7.0 Next Steps – Implementation Phase and Completion Phase

7.1 Implementation Phase

To continue in the program, the owner is responsible for implementing the selected bundle of measures that pay back in two years or less. Using the *Recommissioning Report* for implementation allows flexibility in how the selected measures are implemented. Options include: utilize in-house building staff, hire the C.Op Provider to implement or provide technical assistance, contract with outside service contractors, or any combination of the above.

7.2 Completion Phase

C.Op Service provider will follow up after implementation of the selected measures and **update** this *Recommissioning report and Recommissioning Workbook*.

The updated report for the implemented measures includes but not limited to: date of completion of each measure, new or improved sequences of operation, the energy savings impact of the measures, the requirements for ongoing maintenance and monitoring of the measures, and contact information for the service provider, in house staff, and contractors responsible for the implementation. When feasible, verification data should include trends or functional test results, though other methods, such as copies of invoices, site visit reports, and before/after photos, may be acceptable.

The C.Op Service Provider will conduct an in-house (teleconference) session for the Applicant and the appropriate building operations personnel covering the new documentation, measures that were implemented, and requirements for ongoing maintenance and monitoring. Document the attendance of the building operations staff.

The *updated Recommissioning Workbook* and *updated Recommissioning Report* will be submitted to the owner and the program for review. See Appendix B: Completion Phase Summary Table for more details on implemented measures.

Appendix A: Investigation Phase Summary Table

Investigation Phase Summary				Investigation Phase								
				Energy Savings			Cost Savings	Financial		Est. GHG Reduction		
ECM #	Measure Title	Measure History	Include cost	Demand (kW)	Electrical (kWh/yr)	Fuel (GJ)	Total ($/yr)	Estimated Measure Cost ($)	Simple Payback (yrs)	tonnes CO2e/yr	Enter "x" if DESELECT for implementation	
ECM-1	Reheat coils	New	1	-	-	394	$ 4,782	$ 14,400	3.0	19.7		
ECM-2	AHU Fan controls	New	1	-	18,896	179	$ 4,029	$ 800	0.2	9.1		
ECM-3	Morning schedule	New	1	-	5,606	81	$ 1,536	$ 600	0.4	4.1		
ECM-4	Night setbacks	New	1	-	-	172	$ 2,079	$ 1,100	0.5	8.6		
ECM-5	Holiday schedules	New	1	-	17,730	29	$ 2,100	$ 400	0.2	1.6		
ECM-6	Exhaust fans	New	1	-	5,222	235	$ 3,362	$ 1,400	0.4	11.8		
ECM-7	HV5 heating coil valve	New	1	-	-	-	$ -	$ 2,400	#DIV/0!	-		
ECM-8	Temperature sensors	New	1	-	-	-	$ -	$ 2,200	#DIV/0!	-		
ECM-9	Reversible heat pumps for existing DX coils	New	1	- 50	- 128,290	1,539	$ 6,005	$ 373,425	62.2	75.4	x	
			TOTAL (Previous, still working):	-	-	-	$ -	n/a	n/a	-		
			TOTAL (All potential measures for Implementation):	- 50	- 80,837	2,629	$ 23,893	$ 396,725	16.6	130.2		
			TOTAL (Selected measures only):	**-**	**47,454**	**1,090**	**$ 17,888**	**$ 23,300**	**1.3**	**54.8**		

Appendix B: Completion Phase Summary Table

[Paste image of Completion Summary Table from the RCx Workbook **AFTER** Implementation]

Appendix C: Sample Training Outline

[Completion Report AFTER Implementation]

The Commissioning Provider (C.Op Provider) may customize the outline for the training and developing the training materials. Before preparing the training outline and materials, the C.Op Provider should assess the related level of knowledge of the building operators, to set up the training accordingly. For reference, the Program provides the following sample outline for the training:

- Background on the energy use of this particular building
  - Present Energy Utilization Index
  - Describe Operating Schedules and Owner's operating requirements
- RCx investigation process used in this building
  - Describe the methods used to identify problems and deficiencies
  - Review the RCx Workbook
- Implementation process in this building
  - Describe the measures that were implemented and by whom
  - Walk around the building to look at any physical changes or step through the new control sequences at the operator workstation
  - Provide as many details about implementation as necessary to describe what was done
  - Describe improved performance that these measures will create (show trends if available)
- O&M requirements
  - Describe the O&M requirements needed to keep these improvements working
  - Describe how the staff can be aware of energy efficiency opportunities and begin looking for additional savings potential

The C.Op Provider should follow the outline to prepare materials, as necessary, to hand out at the training session.

Appendix D: Training Completion Form

Project ID

Facility Information

Company Name	Building Name(s)	
Facility Address	City	Province

Training Details

Location	Date
Commissioning Provider/Trainer	

Materials Attached

☐ Agenda
☐ Materials used for training
☐ List of individuals who attended

COMMISSIONING PROVIDER SIGNATURE

By signing this Training Completion Form, I verify that this training took place with the listed attendees.	
Commissioning Provider (print name):	
Signature:	Date:

FACSIMILE/SCANNED SIGNATURES: Facsimile transmission of any signed original document, and the retransmission of any signed facsimile transmission, shall be the same as delivery of the original signed document. Scanned original documents transmitted to BC Hydro as an attachment via electronic mail shall be the same as delivery of the original signed document. At the request of BC Hydro, C.Op Provider shall confirm documents with a facsimile transmitted signature or a scanned signature by providing an original document.

Targeted Documentation

O & M Manual

O & M Manual updated	☐	Describe updates below and attach copies of new or amended portions
O & M Manual not updated	☐	Province reasons below
Building has no O & M Manual	☐	

Building Plans ("as-builts")

Building Plans updated	☐	Describe below
Wiring diagrams updated	☐	Describe below
No plans or diagrams updated	☐	Describe below

EMS Programming

New sequences of operation on file	☐	Specify location of file and attach copy
Printed screenshots on file	☐	Specify location of file and attach copy

Equipment Manuals

Manuals for new equipment are on file	☐	Describe below (attach copy if applicable)

Checklist of subjects discussed at training

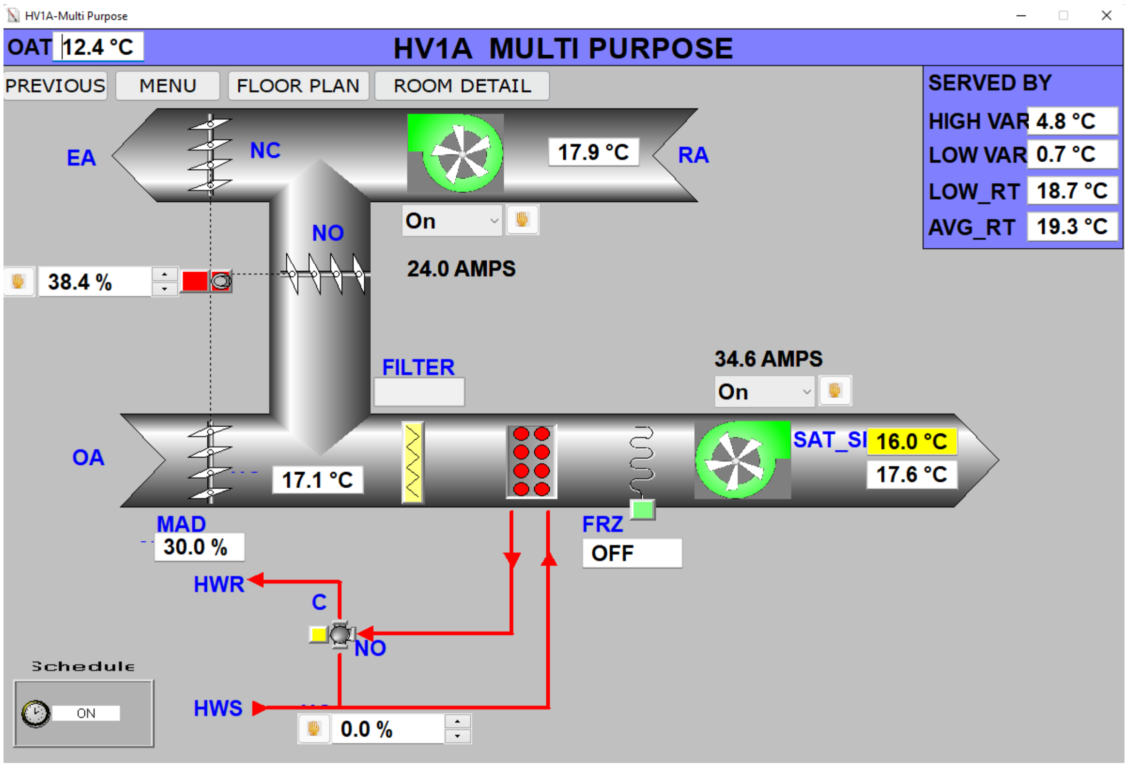
Explain investigation process and how measures were identified	☐
Describe implemented measures, and how they are reducing energy usage	☐
Building walkthrough to show implemented measures	☐
Describe methods for monitoring and maintaining optimum system performance related to implemented measures	☐
Describe scenarios where system setting changes would be required, and how to maintain optimum energy efficiency, e.g., seasonal-based manual adjustments to setpoints.	☐

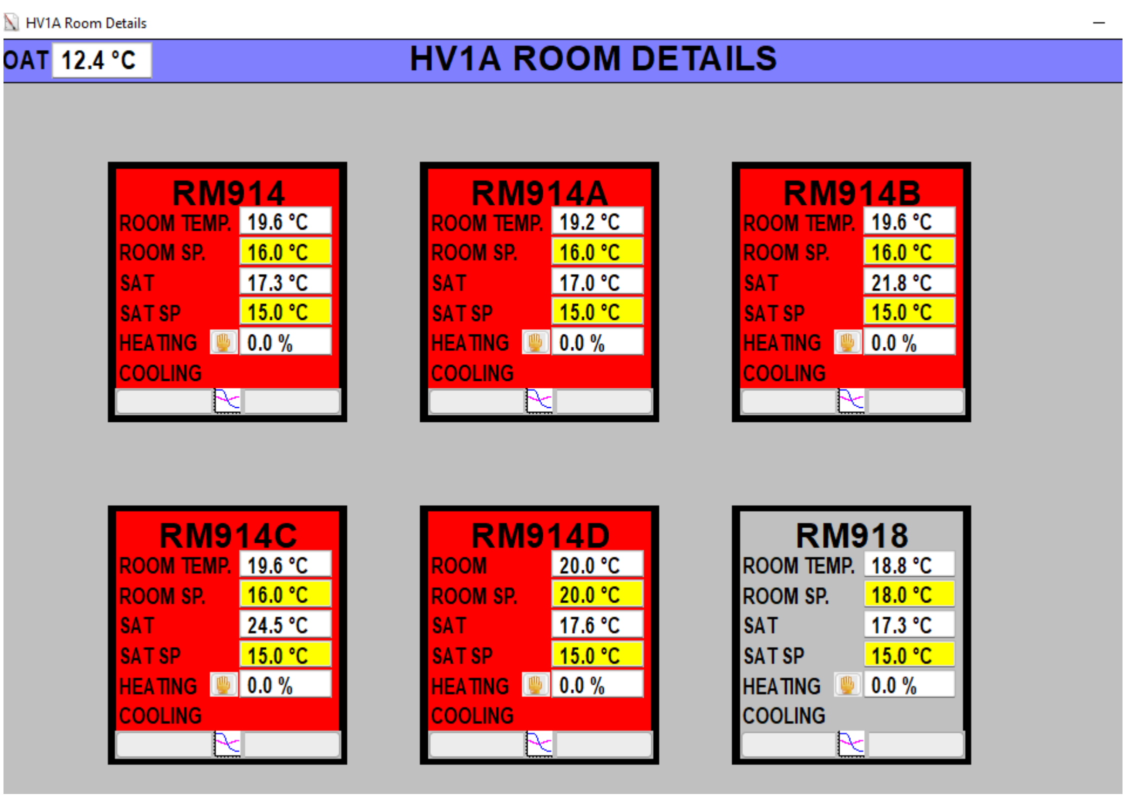
List of Individuals Who Attended

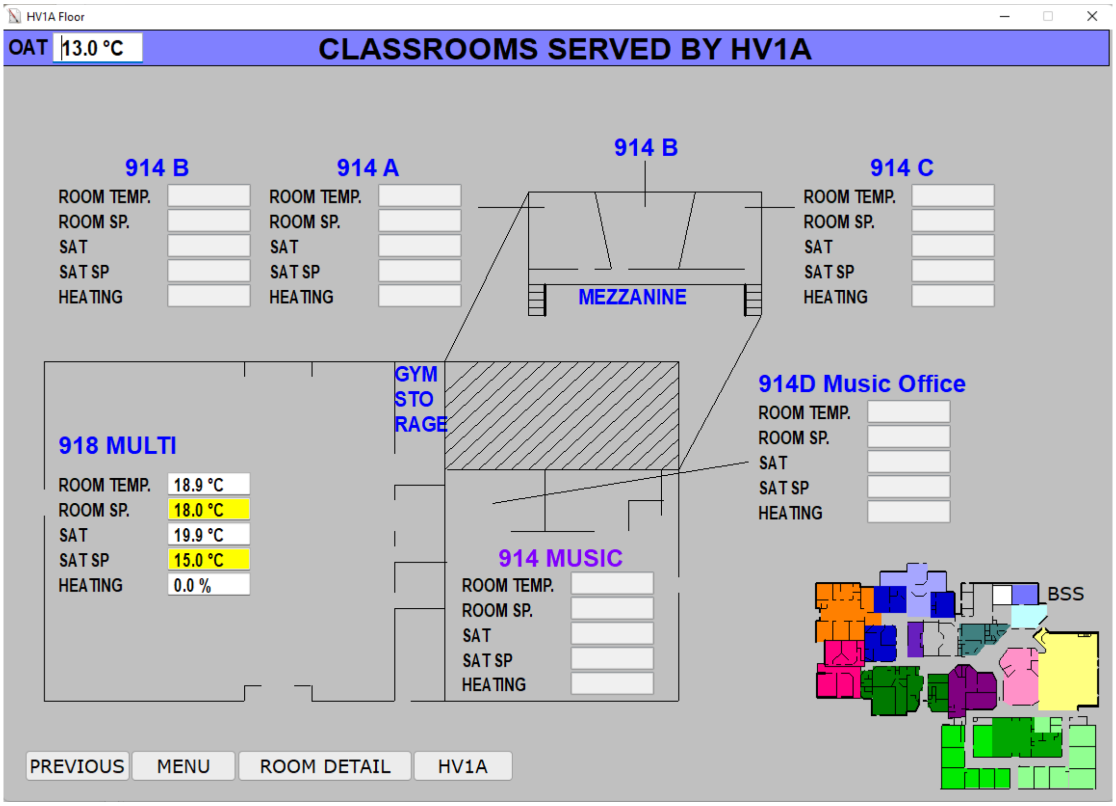
Name	**Title**	**Building (address or name)**	**Contact information (e-mail and/or phone number)**

Appendix E: Reheat Coils

HV1A

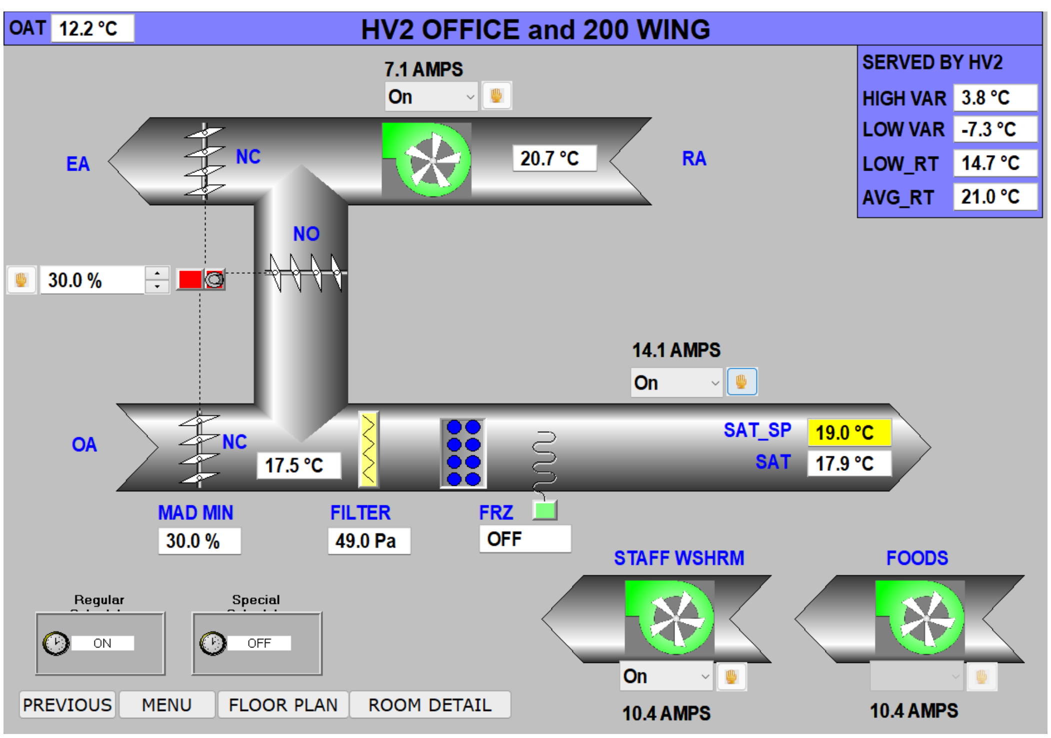


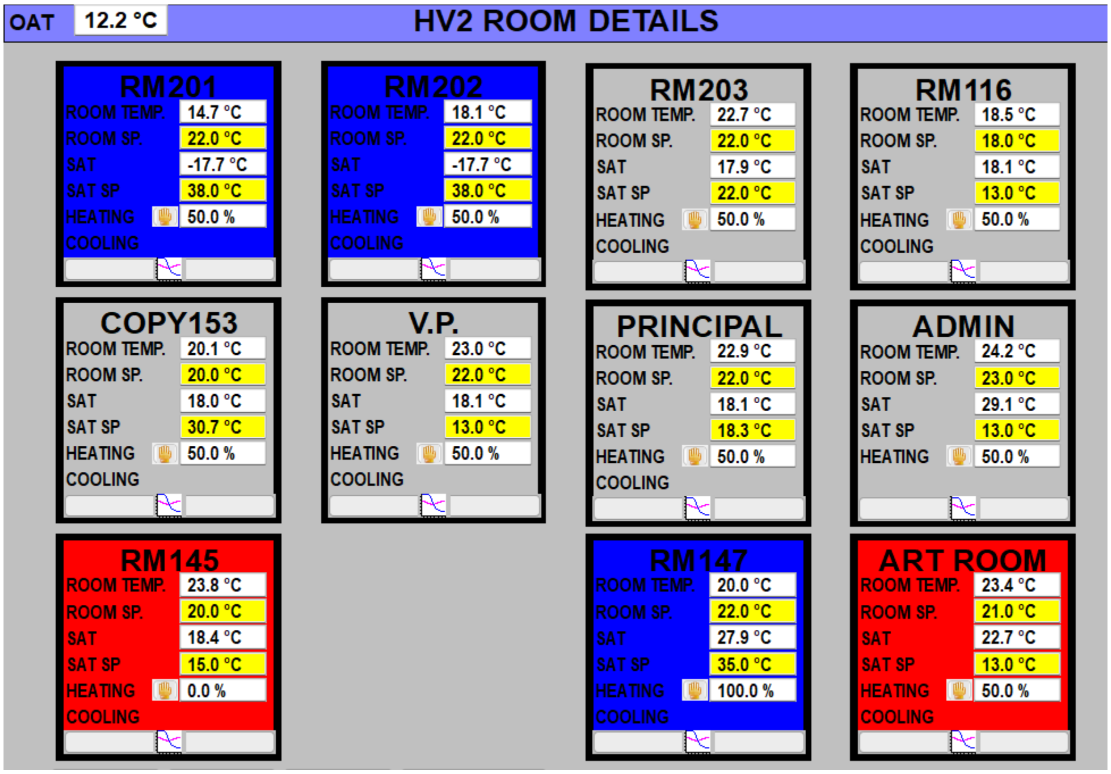


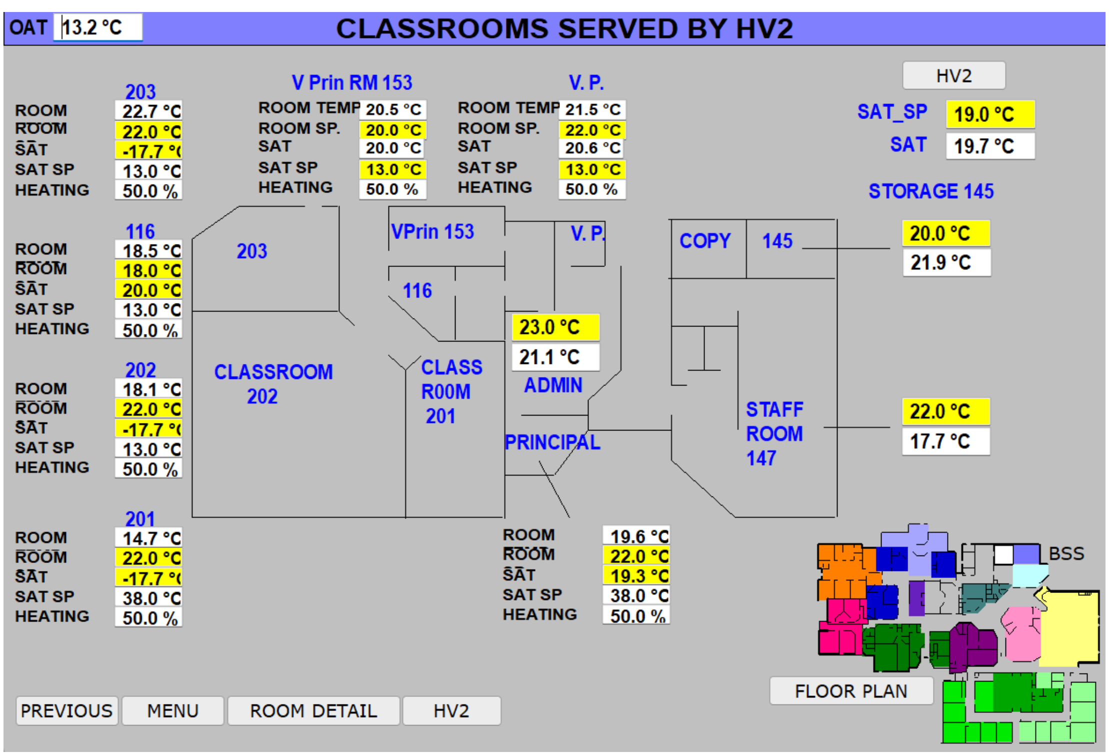


HV2

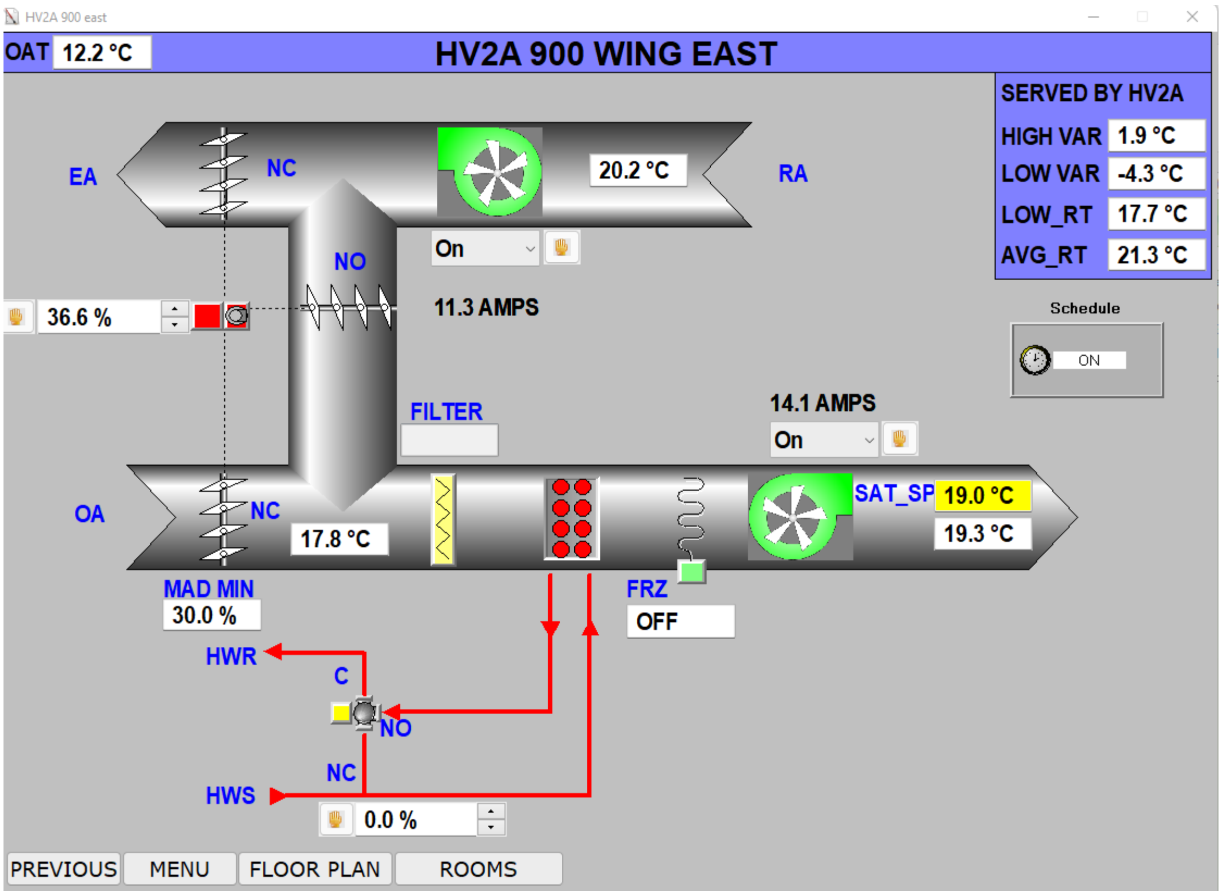
SAT from AHU 17.9C at time of review

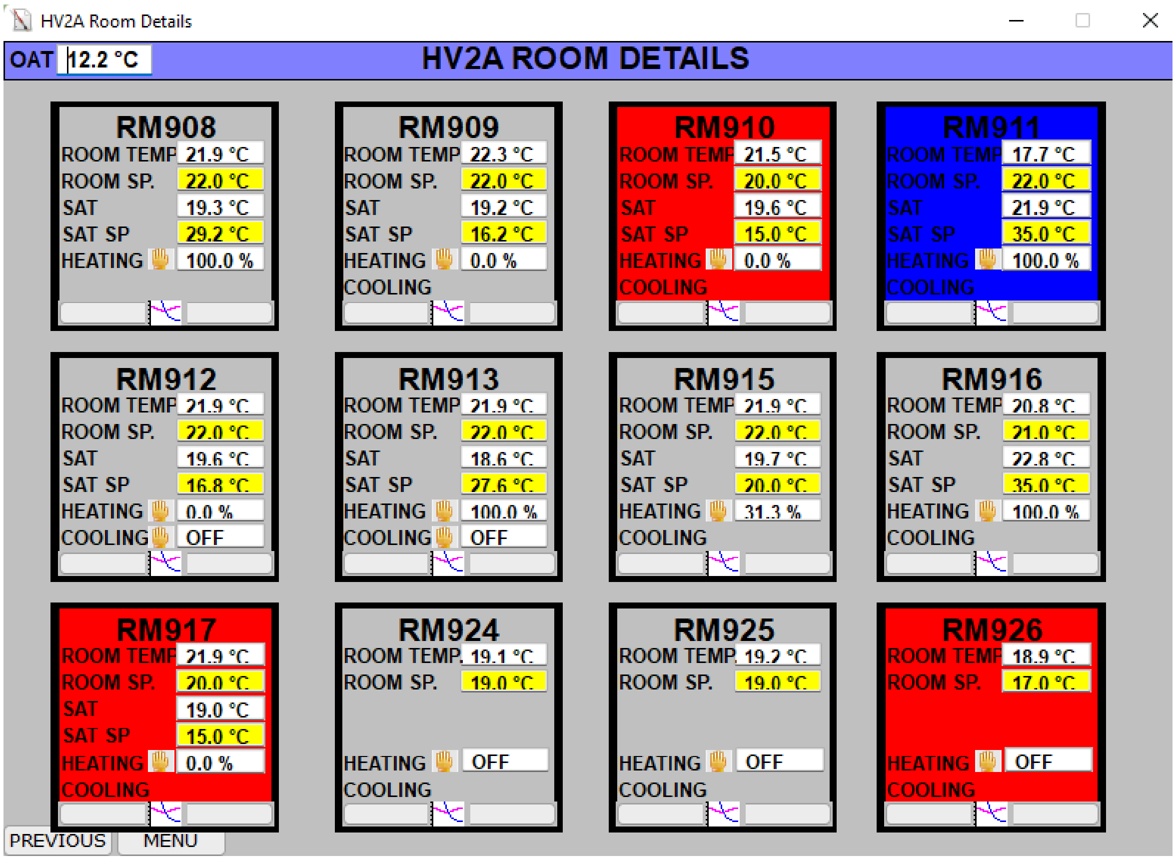



OAT 12.2 °C
HV2 ROOM DETAILS
RM201
ROOM TEMP. 14.7 °C
ROOM SP. 22.0 °C
SAT -17.7 °C
SAT SP 38.0 °C
HEATING 50.0 %
COOLING
RM202
ROOM TEMP. 18.1 °C
ROOM SP. 22.0 °C
SAT -17.7 °C
SAT SP 38.0 °C
HEATING 50.0 %
COOLING
RM203
ROOM TEMP. 22.7 °C
ROOM SP. 22.0 °C
SAT 17.9 °C
SAT SP 22.0 °C
HEATING 50.0 %
COOLING
RM116
ROOM TEMP. 18.5 °C
ROOM SP. 18.0 °C
SAT 18.1 °C
SAT SP 13.0 °C
HEATING 50.0 %
COOLING
COPY153
ROOM TEMP. 20.1 °C
ROOM SP. 20.0 °C
SAT 18.0 °C
SAT SP 30.7 °C
HEATING 50.0 %
COOLING
V.P.
ROOM TEMP. 23.0 °C
ROOM SP. 22.0 °C
SAT 18.1 °C
SAT SP 13.0 °C
HEATING 50.0 %
COOLING
PRINCIPAL
ROOM TEMP. 22.9 °C
ROOM SP. 22.0 °C
SAT 18.1 °C
SAT SP 18.3 °C
HEATING 50.0 %
COOLING
ADMIN
ROOM TEMP. 24.2 °C
ROOM SP. 23.0 °C
SAT 29.1 °C
SAT SP 13.0 °C
HEATING 50.0 %
RM145
ROOM TEMP. 23.8 °C
ROOM SP. 20.0 °C
SAT 18.4 °C
SAT SP 15.0 °C
HEATING 0.0 %
COOLING
RM147
ROOM TEMP. 20.0 °C
ROOM SP. 22.0 °C
SAT 27.9 °C
SAT SP 35.0 °C
HEATING 100.0 %
COOLING
ART ROOM
ROOM TEMP. 23.4 °C
ROOM SP. 21.0 °C
SAT 22.7 °C
SAT SP 13.0 °C
HEATING 50.0 %
COOLING

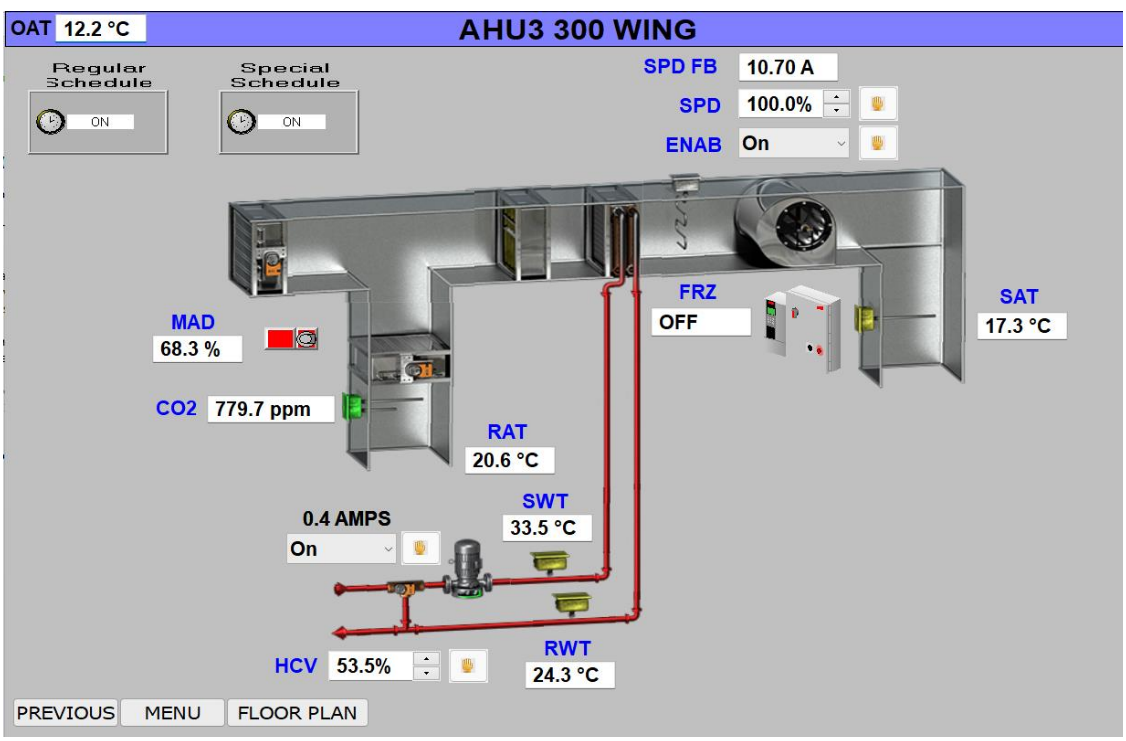

OAT 13.2 °C
CLASSROOMS SERVED BY HV2
203
ROOM 22.7 °C
ROOM 22.0 °C
SAT -17.7 °C
SAT SP 13.0 °C
HEATING 50.0 %
V Prin RM 153
ROOM TEMP 20.5 °C
ROOM SP. 20.0 °C
SAT 20.0 °C
SAT SP 13.0 °C
HEATING 50.0 %
V. P.
ROOM TEMP 21.5 °C
ROOM SP. 22.0 °C
SAT 20.6 °C
SAT SP 13.0 °C
HEATING 50.0 %
HV2
SAT_SP 19.0 °C
SAT 19.7 °C
STORAGE 145
116
ROOM 18.5 °C
ROOM 18.0 °C
SAT 20.0 °C
SAT SP 13.0 °C
HEATING 50.0 %
203
VPrin 153
V. P.
COPY
145
20.0 °C
21.9 °C
116
23.0 °C
21.1 °C
ADMIN
202
ROOM 18.1 °C
ROOM 22.0 °C
SAT -17.7 °C
SAT SP 13.0 °C
HEATING 50.0 %
CLASSROOM 202
CLASS ROOM 201
PRINCIPAL
STAFF ROOM 147
22.0 °C
17.7 °C
201
ROOM 14.7 °C
ROOM 22.0 °C
SAT -17.7 °C
SAT SP 38.0 °C
HEATING 50.0 %
ROOM 19.6 °C
ROOM 22.0 °C
SAT 19.3 °C
SAT SP 38.0 °C
HEATING 50.0 %
BSS
FLOOR PLAN
PREVIOUS
MENU
ROOM DETAIL
HV2

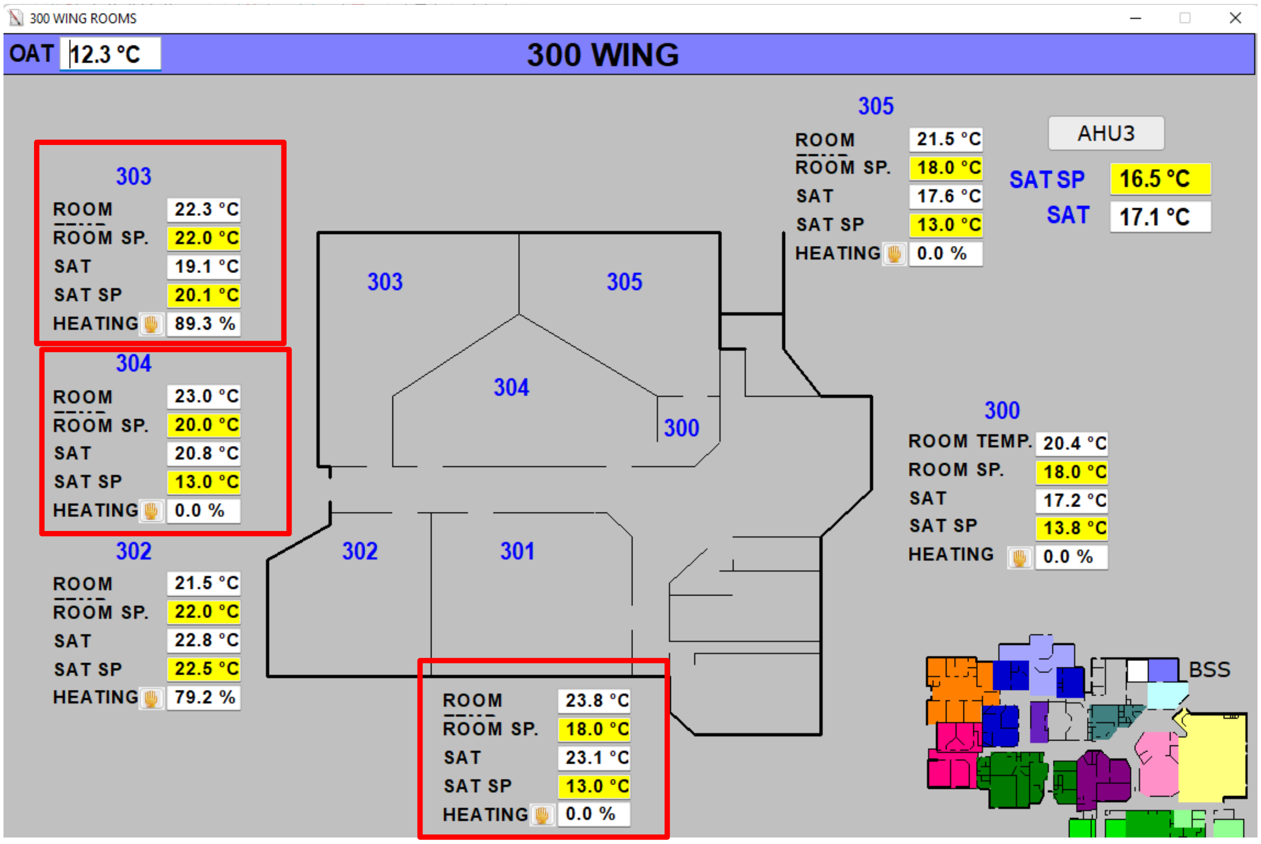
HV2A


HV2A 900 east
OAT 12.2 °C
HV2A 900 WING EAST
SERVED BY HV2A
HIGH VAR 1.9 °C
LOW VAR -4.3 °C
LOW_RT 17.7 °C
AVG_RT 21.3 °C
EA
NC
20.2 °C
RA
On
NO
36.6 %
11.3 AMPS
Schedule
ON
FILTER
14.1 AMPS
On
OA
NC
17.8 °C
SAT_SP 19.0 °C
19.3 °C
MAD MIN
30.0 %
FRZ
OFF
HWR
C
NO
NC
HWS
0.0 %
PREVIOUS
MENU
FLOOR PLAN
ROOMS

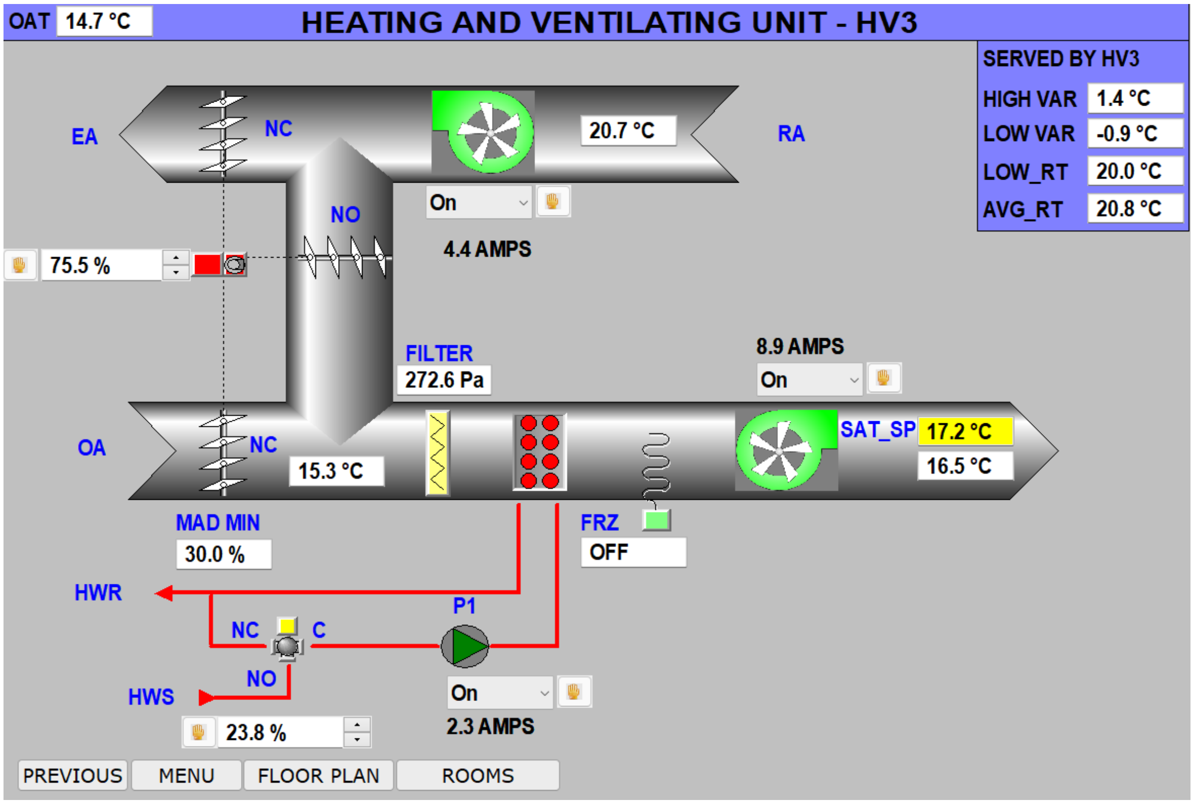

HV2A Room Details
OAT 12.2 °C
HV2A ROOM DETAILS
RM908
ROOM TEMP 21.9 °C
ROOM SP. 22.0 °C
SAT 19.3 °C
SAT SP 29.2 °C
HEATING 100.0 %
RM909
ROOM TEMP 22.3 °C
ROOM SP. 22.0 °C
SAT 19.2 °C
SAT SP 16.2 °C
HEATING 0.0 %
COOLING
RM910
ROOM TEMP 21.5 °C
ROOM SP. 20.0 °C
SAT 19.6 °C
SAT SP 15.0 °C
HEATING 0.0 %
COOLING
RM911
ROOM TEMP 17.7 °C
ROOM SP. 22.0 °C
SAT 21.9 °C
SAT SP 35.0 °C
HEATING 100.0 %
COOLING
RM912
ROOM TEMP 21.9 °C
ROOM SP. 22.0 °C
SAT 19.6 °C
SAT SP 16.8 °C
HEATING 0.0 %
COOLING OFF
RM913
ROOM TEMP 21.9 °C
ROOM SP. 22.0 °C
SAT 18.6 °C
SAT SP 27.6 °C
HEATING 100.0 %
COOLING OFF
RM915
ROOM TEMP 21.9 °C
ROOM SP. 22.0 °C
SAT 19.7 °C
SAT SP 20.0 °C
HEATING 31.3 %
COOLING
RM916
ROOM TEMP 20.8 °C
ROOM SP. 21.0 °C
SAT 22.8 °C
SAT SP 35.0 °C
HEATING 100.0 %
COOLING
RM917
ROOM TEMP 21.9 °C
ROOM SP. 20.0 °C
SAT 19.0 °C
SAT SP 15.0 °C
HEATING 0.0 %
COOLING
RM924
ROOM TEMP 19.1 °C
ROOM SP. 19.0 °C
HEATING OFF
COOLING
RM925
ROOM TEMP 19.2 °C
ROOM SP. 19.0 °C
HEATING OFF
COOLING
RM926
ROOM TEMP 18.9 °C
ROOM SP. 17.0 °C
HEATING OFF
COOLING
PREVIOUS
MENU

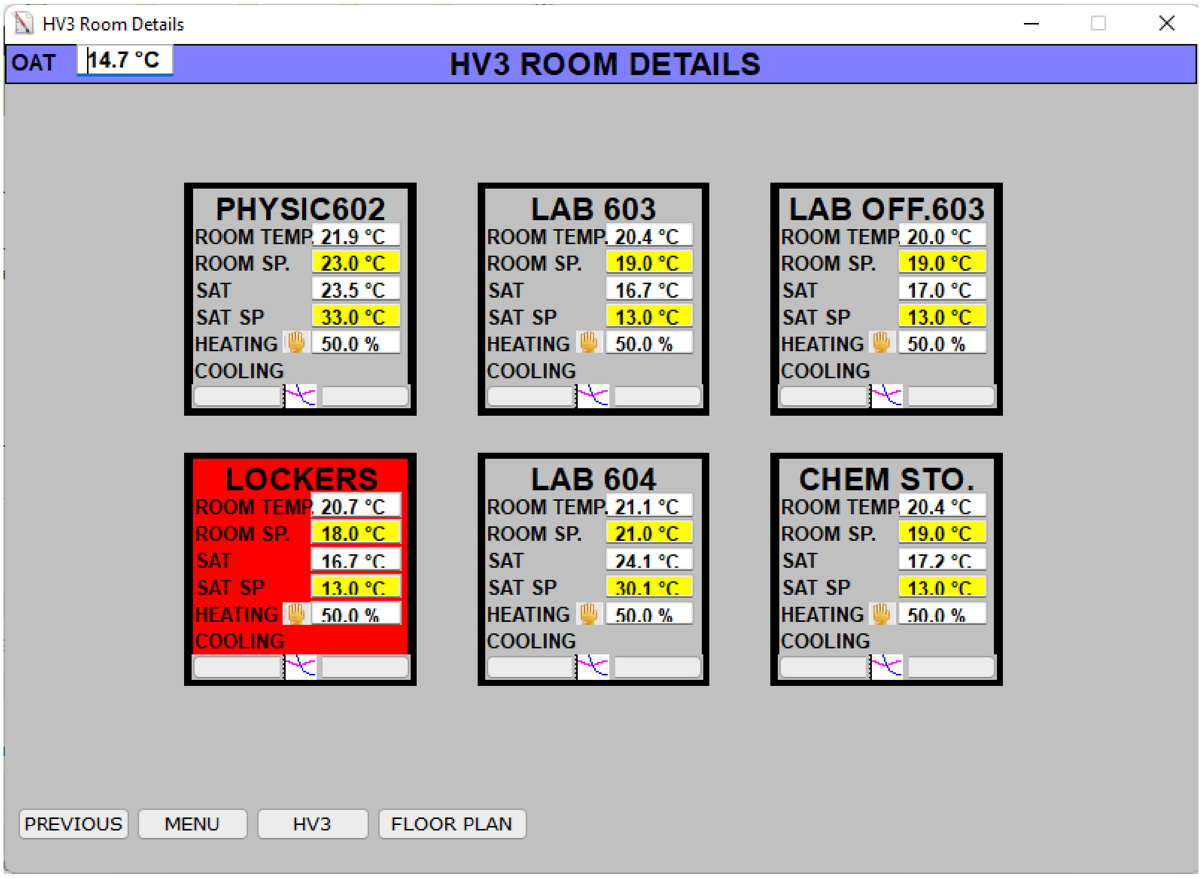
AHU3


OAT 12.2 °C
AHU3 300 WING
Regular Schedule
ON
Special Schedule
ON
SPD FB 10.70 A
SPD 100.0%
ENAB On
MAD
68.3 %
CO2 779.7 ppm
FRZ
OFF
SAT
17.3 °C
RAT
20.6 °C
0.4 AMPS
On
SWT
33.5 °C
HCV 53.5%
RWT
24.3 °C
PREVIOUS
MENU
FLOOR PLAN

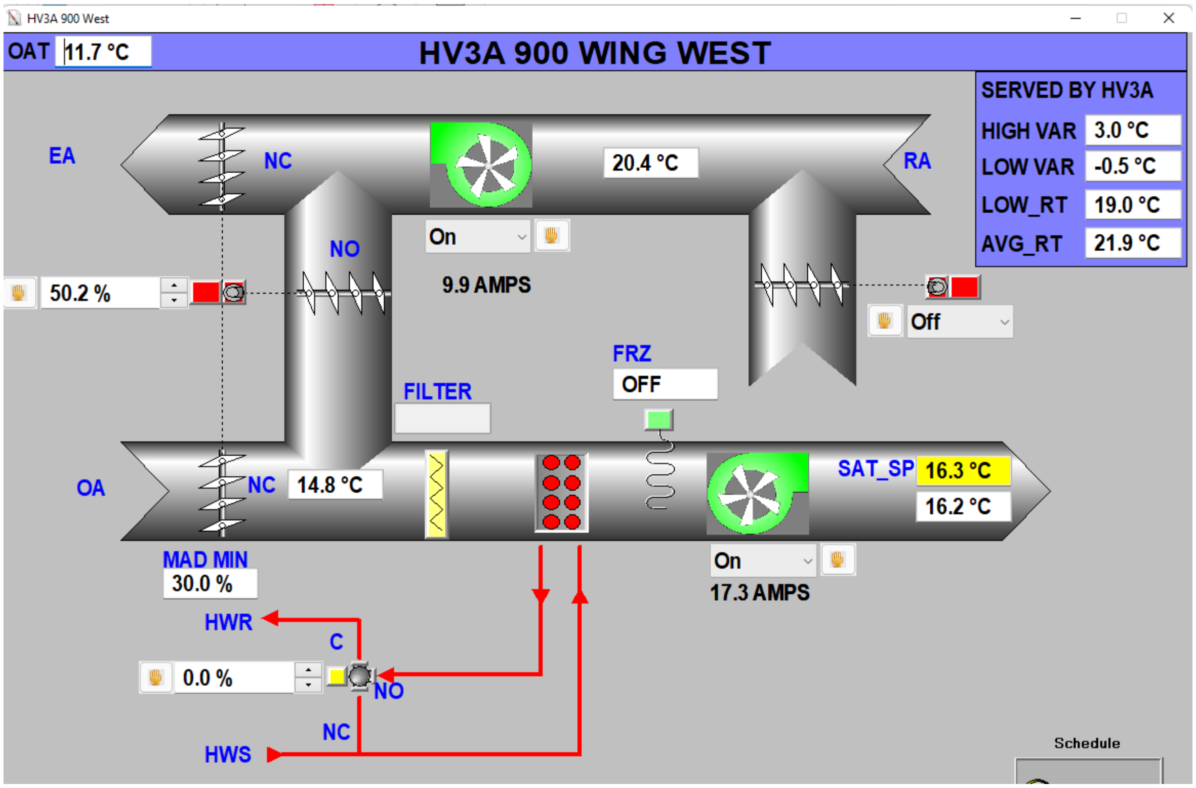

300 WING ROOMS
OAT 12.3 °C
300 WING
303
ROOM 22.3 °C
ROOM SP. 22.0 °C
SAT 19.1 °C
SAT SP 20.1 °C
HEATING 89.3 %
304
ROOM 23.0 °C
ROOM SP. 20.0 °C
SAT 20.8 °C
SAT SP 13.0 °C
HEATING 0.0 %
302
ROOM 21.5 °C
ROOM SP. 22.0 °C
SAT 22.8 °C
SAT SP 22.5 °C
HEATING 79.2 %
ROOM 23.8 °C
ROOM SP. 18.0 °C
SAT 23.1 °C
SAT SP 13.0 °C
HEATING 0.0 %
305
ROOM 21.5 °C
ROOM SP. 18.0 °C
SAT 17.6 °C
SAT SP 13.0 °C
HEATING 0.0 %
AHU3
SAT SP 16.5 °C
SAT 17.1 °C
303
305
304
300
302
301
300
ROOM TEMP. 20.4 °C
ROOM SP. 18.0 °C
SAT 17.2 °C
SAT SP 13.8 °C
HEATING 0.0 %
BSS

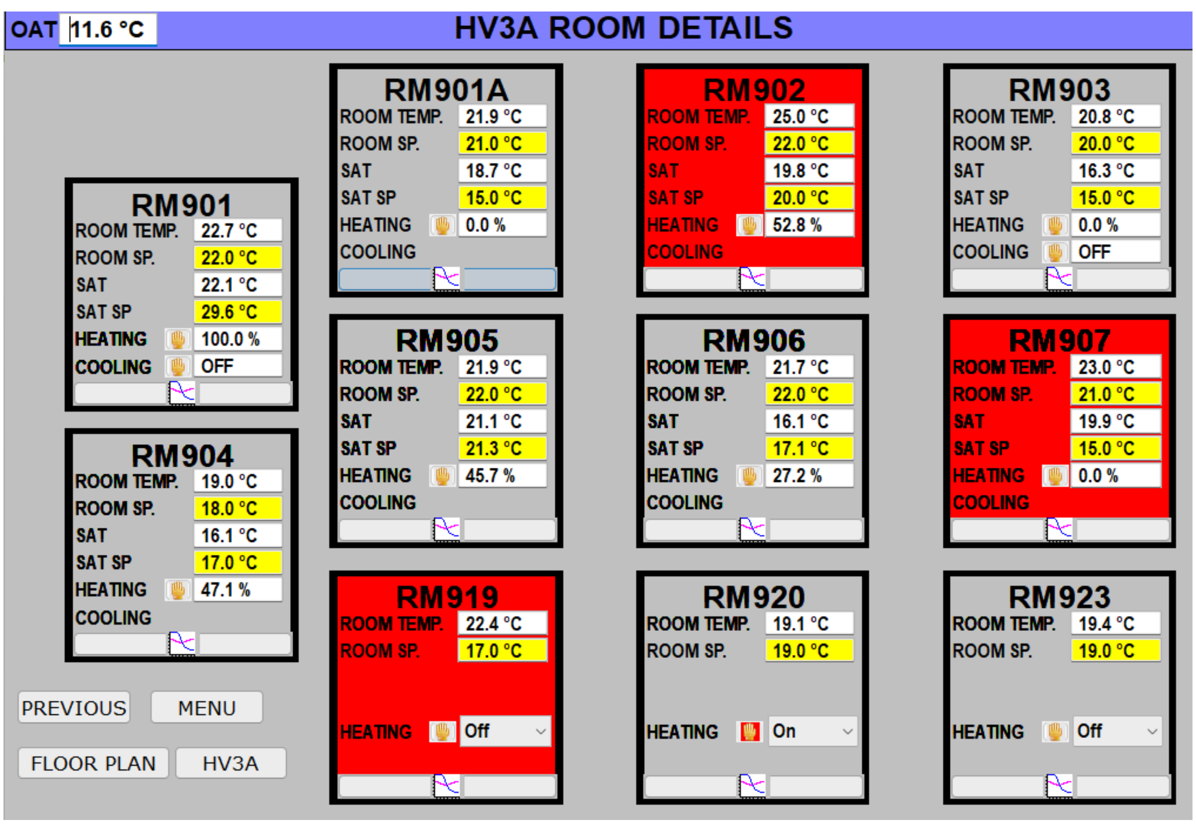
HV3

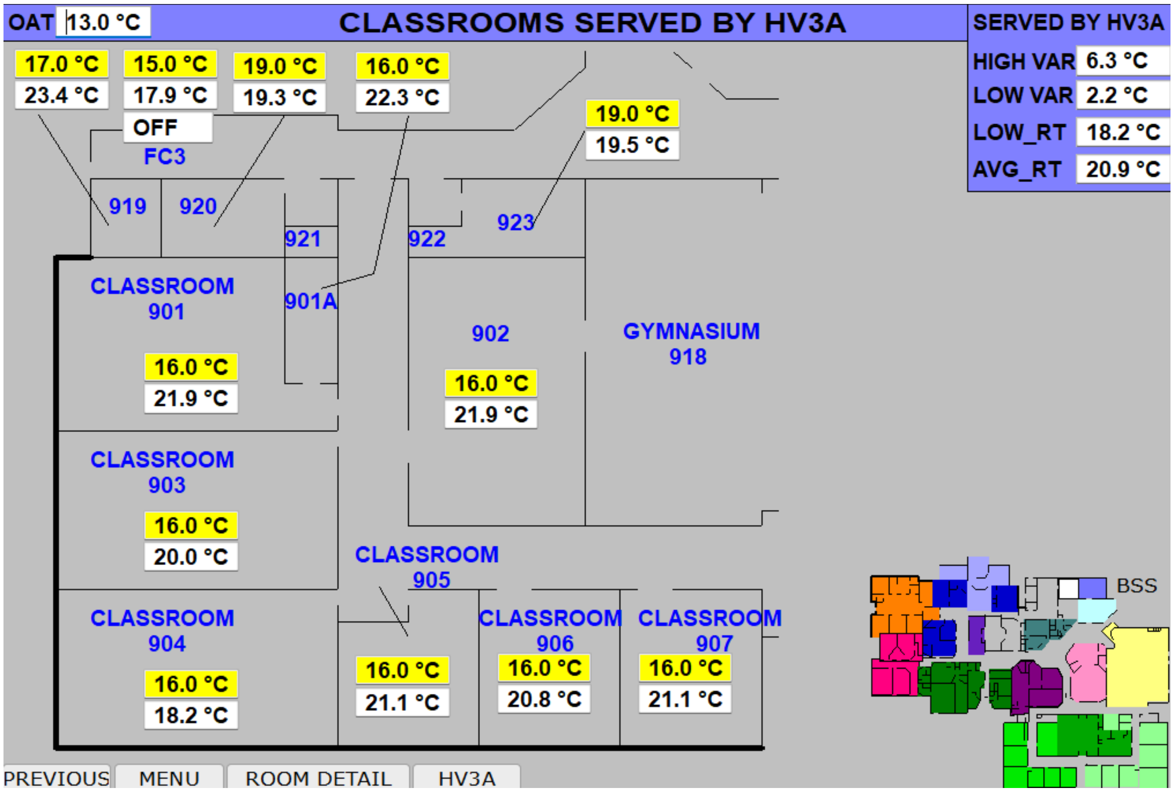

OAT 14.7 °C
HEATING AND VENTILATING UNIT - HV3
SERVED BY HV3
HIGH VAR 1.4 °C
LOW VAR -0.9 °C
LOW_RT 20.0 °C
AVG_RT 20.8 °C
EA
NC
20.7 °C
RA
On
NO
4.4 AMPS
75.5 %
FILTER
272.6 Pa
8.9 AMPS
On
OA
NC
15.3 °C
SAT_SP 17.2 °C
16.5 °C
MAD MIN
30.0 %
FRZ
OFF
HWR
P1
NC
C
NO
HWS
On
2.3 AMPS
23.8 %
PREVIOUS
MENU
FLOOR PLAN
ROOMS


HV3 Room Details
OAT 14.7 °C
HV3 ROOM DETAILS
PHYSIC602
ROOM TEMP. 21.9 °C
ROOM SP. 23.0 °C
SAT 23.5 °C
SAT SP 33.0 °C
HEATING 50.0 %
COOLING
LAB 603
ROOM TEMP. 20.4 °C
ROOM SP. 19.0 °C
SAT 16.7 °C
SAT SP 13.0 °C
HEATING 50.0 %
COOLING
LAB OFF.603
ROOM TEMP. 20.0 °C
ROOM SP. 19.0 °C
SAT 17.0 °C
SAT SP 13.0 °C
HEATING 50.0 %
COOLING
LOCKERS
ROOM TEMP. 20.7 °C
ROOM SP. 18.0 °C
SAT 16.7 °C
SAT SP 13.0 °C
HEATING 50.0 %
COOLING
LAB 604
ROOM TEMP. 21.1 °C
ROOM SP. 21.0 °C
SAT 24.1 °C
SAT SP 30.1 °C
HEATING 50.0 %
COOLING
CHEM STO.
ROOM TEMP. 20.4 °C
ROOM SP. 19.0 °C
SAT 17.2 °C
SAT SP 13.0 °C
HEATING 50.0 %
COOLING
PREVIOUS
MENU
HV3
FLOOR PLAN

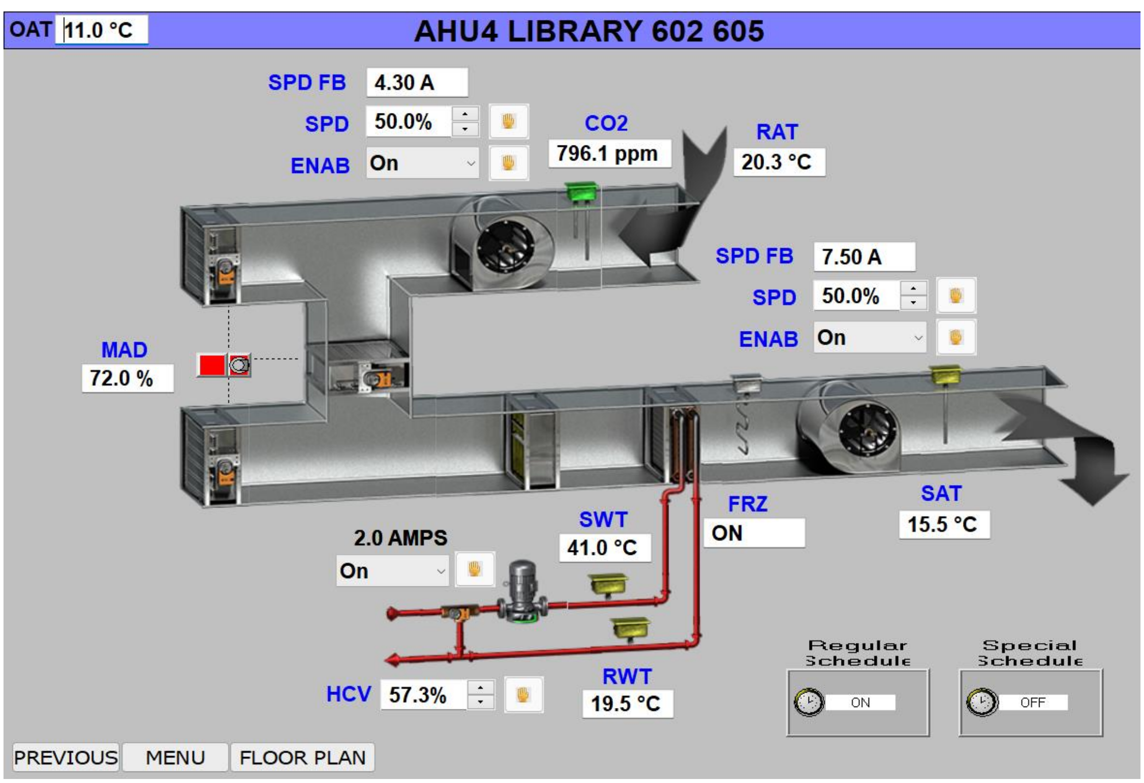
HV3A


HV3A 900 West
OAT 11.7 °C
HV3A 900 WING WEST
SERVED BY HV3A
HIGH VAR 3.0 °C
LOW VAR -0.5 °C
LOW_RT 19.0 °C
AVG_RT 21.9 °C
EA
NC
RA
20.4 °C
On
9.9 AMPS
NO
50.2 %
Off
FRZ
OFF
FILTER
OA
NC
14.8 °C
SAT_SP 16.3 °C
16.2 °C
On
17.3 AMPS
MAD MIN
30.0 %
HWR
C
0.0 %
NO
NC
HWS
Schedule


OAT 11.6 °C
HV3A ROOM DETAILS
RM901A
ROOM TEMP. 21.9 °C
ROOM SP. 21.0 °C
SAT 18.7 °C
SAT SP 15.0 °C
HEATING 0.0 %
COOLING
RM902
ROOM TEMP. 25.0 °C
ROOM SP. 22.0 °C
SAT 19.8 °C
SAT SP 20.0 °C
HEATING 52.8 %
COOLING
RM903
ROOM TEMP. 20.8 °C
ROOM SP. 20.0 °C
SAT 16.3 °C
SAT SP 15.0 °C
HEATING 0.0 %
COOLING OFF
RM901
ROOM TEMP. 22.7 °C
ROOM SP. 22.0 °C
SAT 22.1 °C
SAT SP 29.6 °C
HEATING 100.0 %
COOLING OFF
RM905
ROOM TEMP. 21.9 °C
ROOM SP. 22.0 °C
SAT 21.1 °C
SAT SP 21.3 °C
HEATING 45.7 %
COOLING
RM906
ROOM TEMP. 21.7 °C
ROOM SP. 22.0 °C
SAT 16.1 °C
SAT SP 17.1 °C
HEATING 27.2 %
COOLING
RM907
ROOM TEMP. 23.0 °C
ROOM SP. 21.0 °C
SAT 19.9 °C
SAT SP 15.0 °C
HEATING 0.0 %
COOLING
RM904
ROOM TEMP. 19.0 °C
ROOM SP. 18.0 °C
SAT 16.1 °C
SAT SP 17.0 °C
HEATING 47.1 %
COOLING
RM919
ROOM TEMP. 22.4 °C
ROOM SP. 17.0 °C
HEATING Off
RM920
ROOM TEMP. 19.1 °C
ROOM SP. 19.0 °C
HEATING On
RM923
ROOM TEMP. 19.4 °C
ROOM SP. 19.0 °C
HEATING Off
PREVIOUS
MENU
FLOOR PLAN
HV3A


OAT 13.0 °C
CLASSROOMS SERVED BY HV3A
SERVED BY HV3A
HIGH VAR 6.3 °C
LOW VAR 2.2 °C
LOW_RT 18.2 °C
AVG_RT 20.9 °C
17.0 °C
23.4 °C
15.0 °C
17.9 °C
OFF
FC3
19.0 °C
19.3 °C
16.0 °C
22.3 °C
19.0 °C
19.5 °C
919
920
921
922
923
CLASSROOM 901
16.0 °C
21.9 °C
901A
902
16.0 °C
21.9 °C
GYMNASIUM 918
CLASSROOM 903
16.0 °C
20.0 °C
CLASSROOM 905
CLASSROOM 904
16.0 °C
18.2 °C
16.0 °C
21.1 °C
CLASSROOM 906
16.0 °C
20.8 °C
CLASSROOM 907
16.0 °C
21.1 °C
BSS
PREVIOUS
MENU
ROOM DETAIL
HV3A

AHU4


OAT 11.0 °C
AHU4 LIBRARY 602 605
SPD FB 4.30 A
SPD 50.0%
ENAB On
CO2 796.1 ppm
RAT 20.3 °C
SPD FB 7.50 A
SPD 50.0%
ENAB On
MAD 72.0 %
2.0 AMPS
On
SWT 41.0 °C
FRZ ON
SAT 15.5 °C
HCV 57.3%
RWT 19.5 °C
Regular Schedule
ON
Special Schedule
OFF
PREVIOUS
MENU
FLOOR PLAN

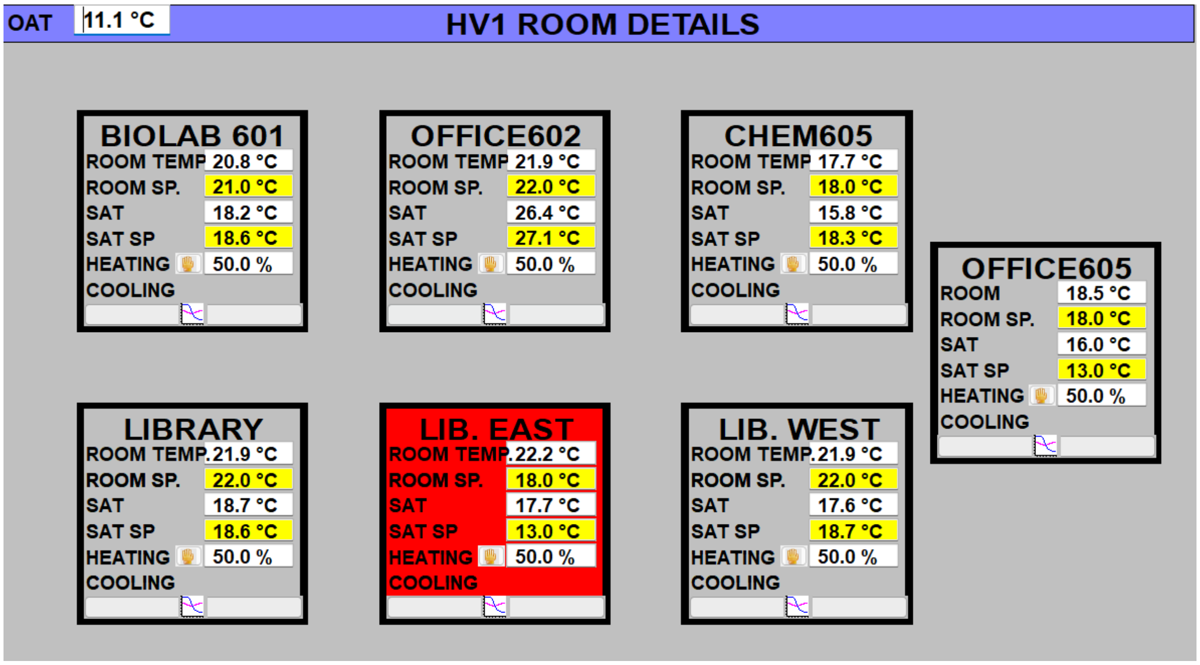
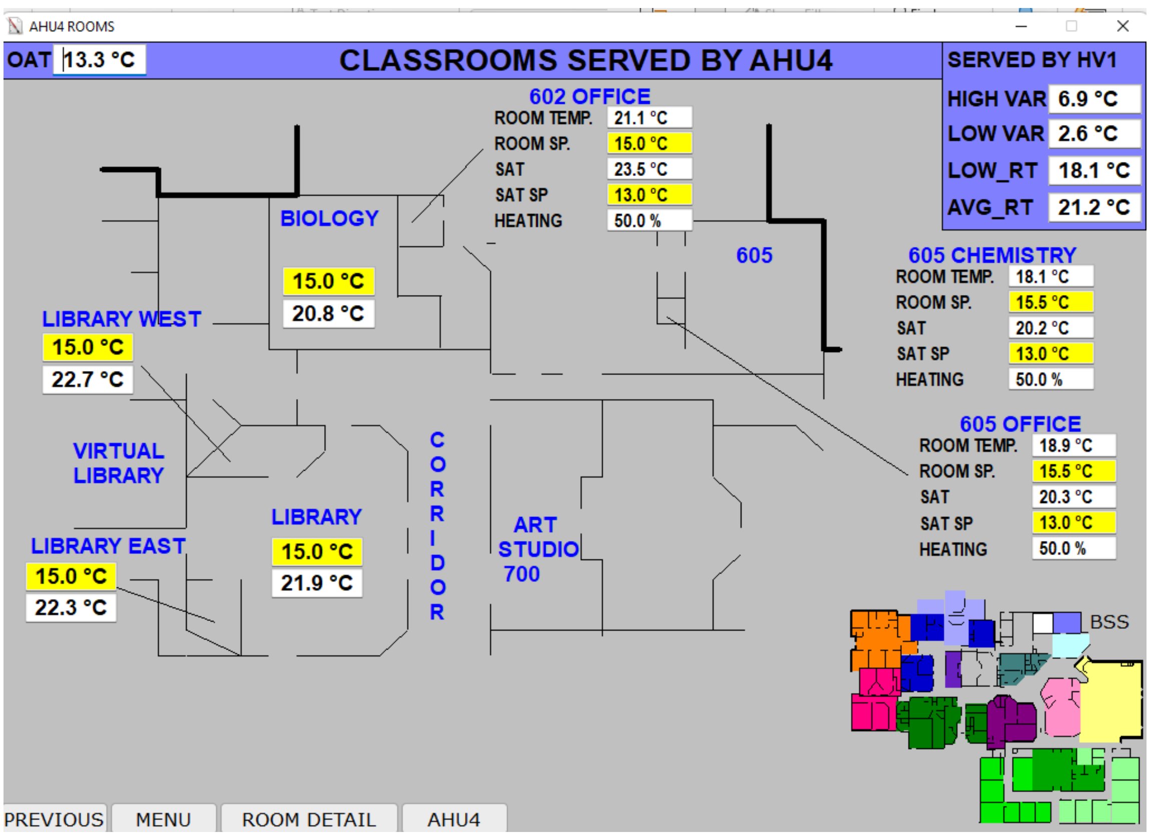
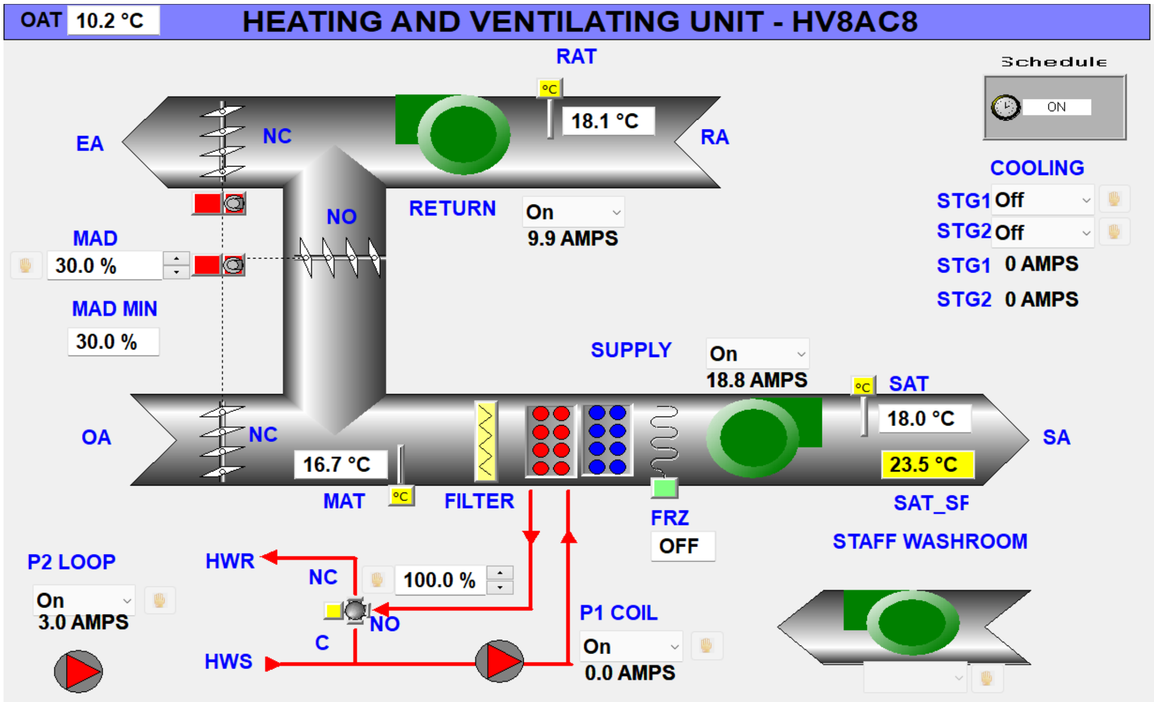
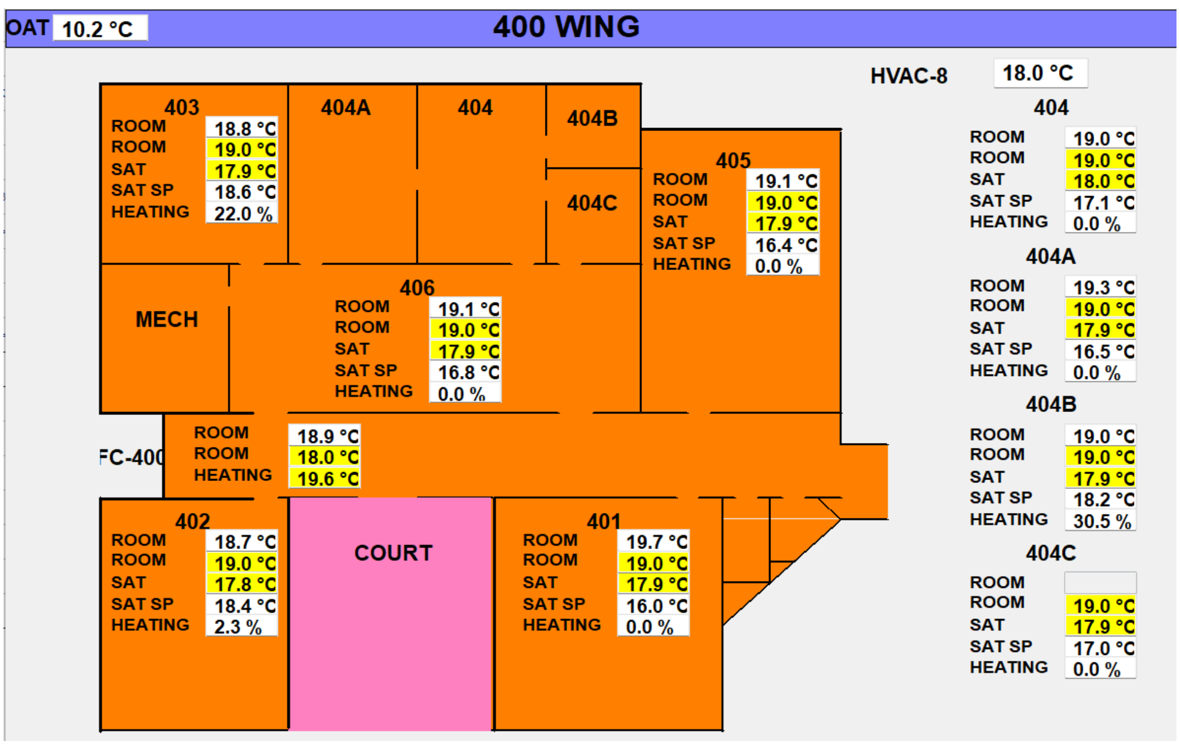


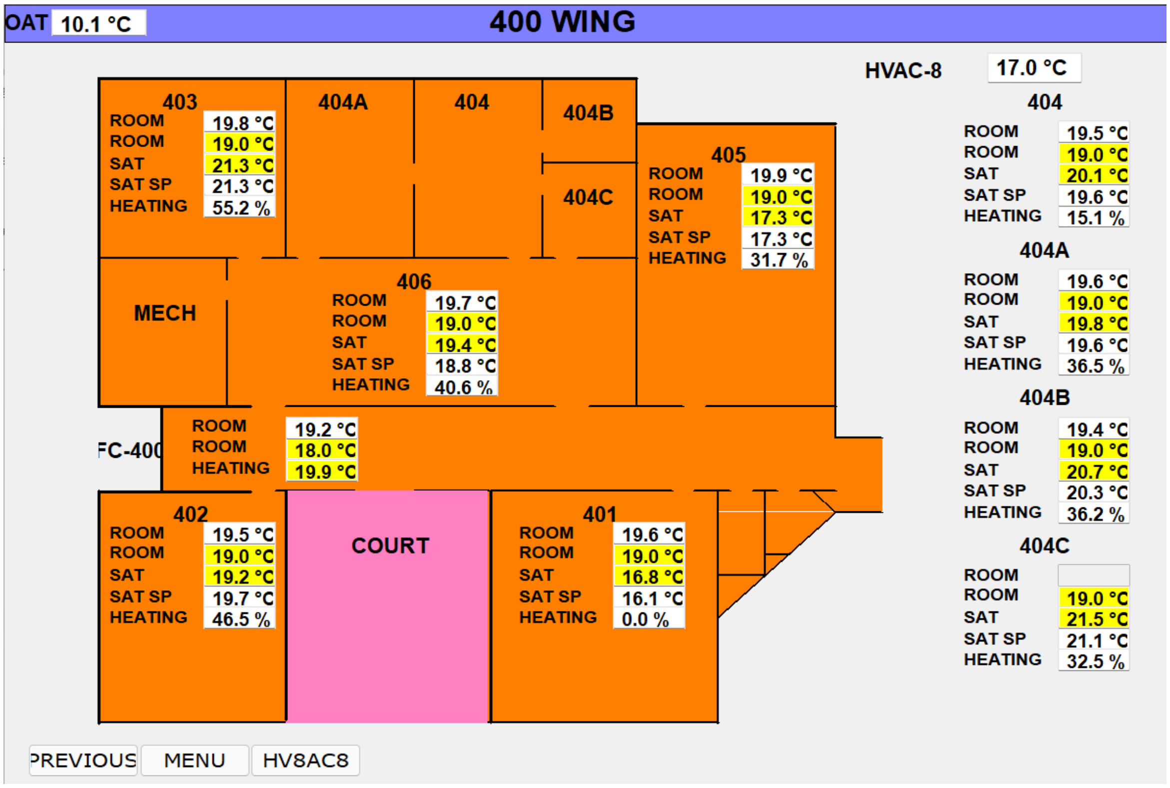
Figure 32: AHU4 room details (note the title is wrong)



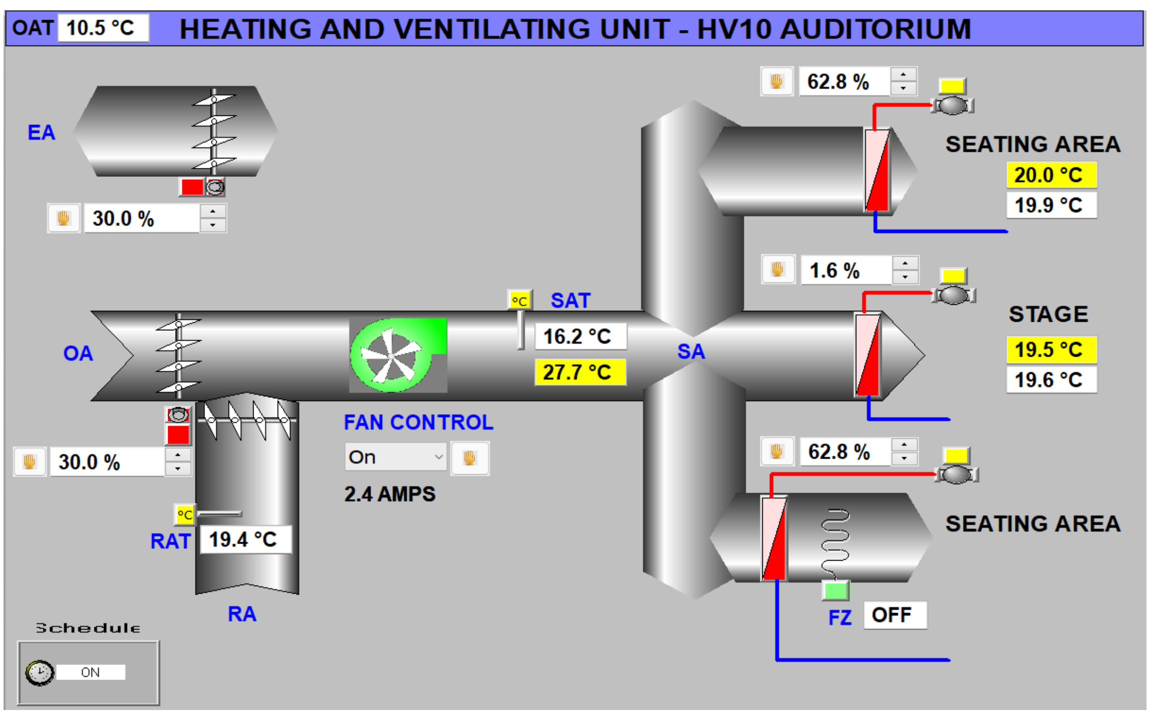
HV8AC8


OAT 10.2 °C
HEATING AND VENTILATING UNIT - HV8AC8
RAT
18.1 °C
RA
EA
NC
NO
RETURN
On
9.9 AMPS
Schedule
ON
COOLING
STG1 Off
STG2 Off
STG1 0 AMPS
STG2 0 AMPS
MAD
30.0 %
MAD MIN
30.0 %
SUPPLY
On
18.8 AMPS
SAT
18.0 °C
23.5 °C
SA
OA
NC
16.7 °C
MAT
FILTER
FRZ
OFF
SAT_SF
STAFF WASHROOM
P2 LOOP
On
3.0 AMPS
HWR
NC
100.0 %
NO
C
HWS
P1 COIL
On
0.0 AMPS

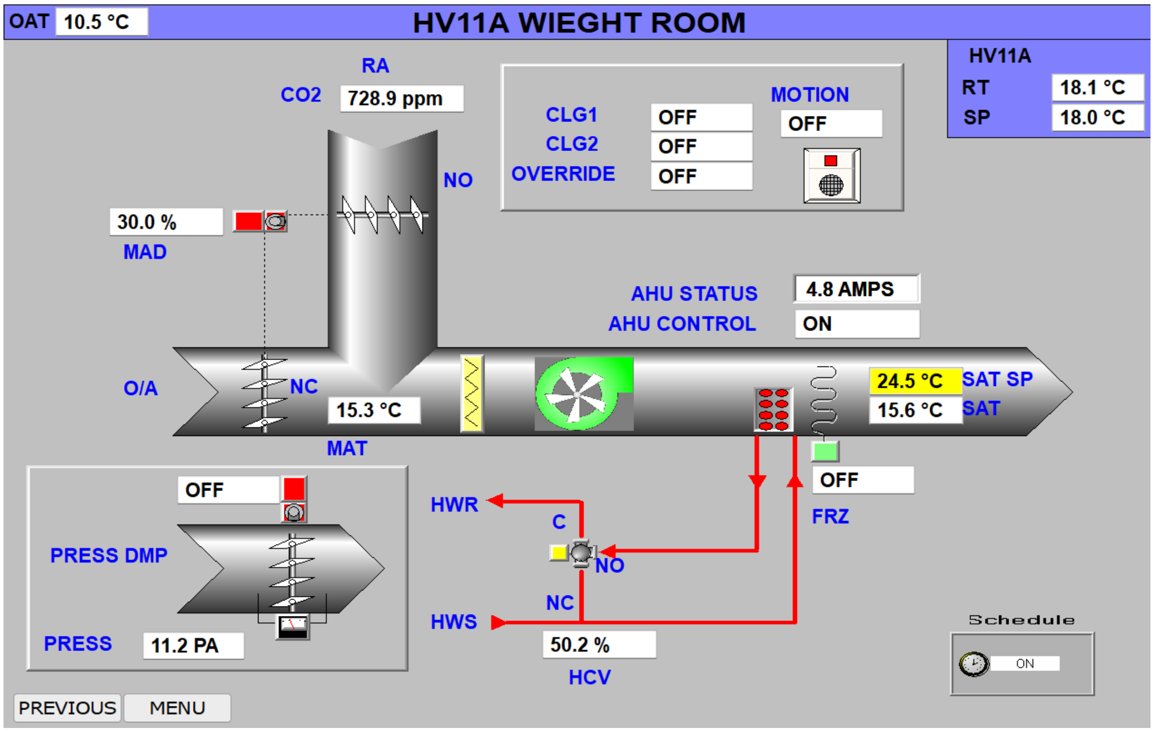

OAT 10.2 °C
400 WING
HVAC-8 18.0 °C
403
ROOM 18.8 °C
ROOM 19.0 °C
SAT 17.9 °C
SAT SP 18.6 °C
HEATING 22.0 %
404A
404
404B
404C
405
ROOM 19.1 °C
ROOM 19.0 °C
SAT 17.9 °C
SAT SP 16.4 °C
HEATING 0.0 %
MECH
406
ROOM 19.1 °C
ROOM 19.0 °C
SAT 17.9 °C
SAT SP 16.8 °C
HEATING 0.0 %
FC-400
ROOM 18.9 °C
ROOM 18.0 °C
HEATING 19.6 °C
402
ROOM 18.7 °C
ROOM 19.0 °C
SAT 17.8 °C
SAT SP 18.4 °C
HEATING 2.3 %
COURT
401
ROOM 19.7 °C
ROOM 19.0 °C
SAT 17.9 °C
SAT SP 16.0 °C
HEATING 0.0 %
404
ROOM 19.0 °C
ROOM 19.0 °C
SAT 18.0 °C
SAT SP 17.1 °C
HEATING 0.0 %
404A
ROOM 19.3 °C
ROOM 19.0 °C
SAT 17.9 °C
SAT SP 16.5 °C
HEATING 0.0 %
404B
ROOM 19.0 °C
ROOM 19.0 °C
SAT 17.9 °C
SAT SP 18.2 °C
HEATING 30.5 %
404C
ROOM
ROOM 19.0 °C
SAT 17.9 °C
SAT SP 17.0 °C
HEATING 0.0 %


OAT 10.1 °C
400 WING
HVAC-8 17.0 °C
403
ROOM 19.8 °C
ROOM 19.0 °C
SAT 21.3 °C
SAT SP 21.3 °C
HEATING 55.2 %
404A
404
404B
404C
405
ROOM 19.9 °C
ROOM 19.0 °C
SAT 17.3 °C
SAT SP 17.3 °C
HEATING 31.7 %
MECH
406
ROOM 19.7 °C
ROOM 19.0 °C
SAT 19.4 °C
SAT SP 18.8 °C
HEATING 40.6 %
FC-400
ROOM 19.2 °C
ROOM 18.0 °C
HEATING 19.9 °C
402
ROOM 19.5 °C
ROOM 19.0 °C
SAT 19.2 °C
SAT SP 19.7 °C
HEATING 46.5 %
COURT
401
ROOM 19.6 °C
ROOM 19.0 °C
SAT 16.8 °C
SAT SP 16.1 °C
HEATING 0.0 %
404
ROOM 19.5 °C
ROOM 19.0 °C
SAT 20.1 °C
SAT SP 19.6 °C
HEATING 15.1 %
404A
ROOM 19.6 °C
ROOM 19.0 °C
SAT 19.8 °C
SAT SP 19.6 °C
HEATING 36.5 %
404B
ROOM 19.4 °C
ROOM 19.0 °C
SAT 20.7 °C
SAT SP 20.3 °C
HEATING 36.2 %
404C
ROOM
ROOM 19.0 °C
SAT 21.5 °C
SAT SP 21.1 °C
HEATING 32.5 %
PREVIOUS
MENU
HV8AC8

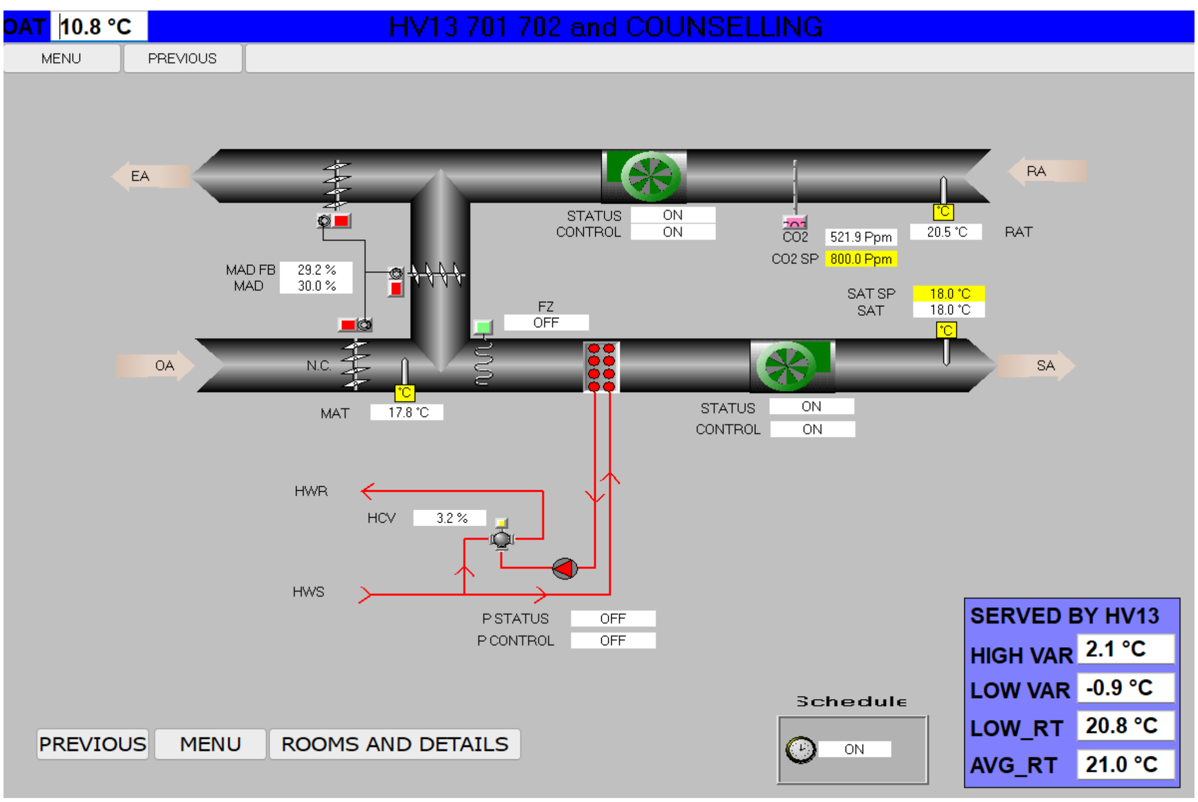
HV10

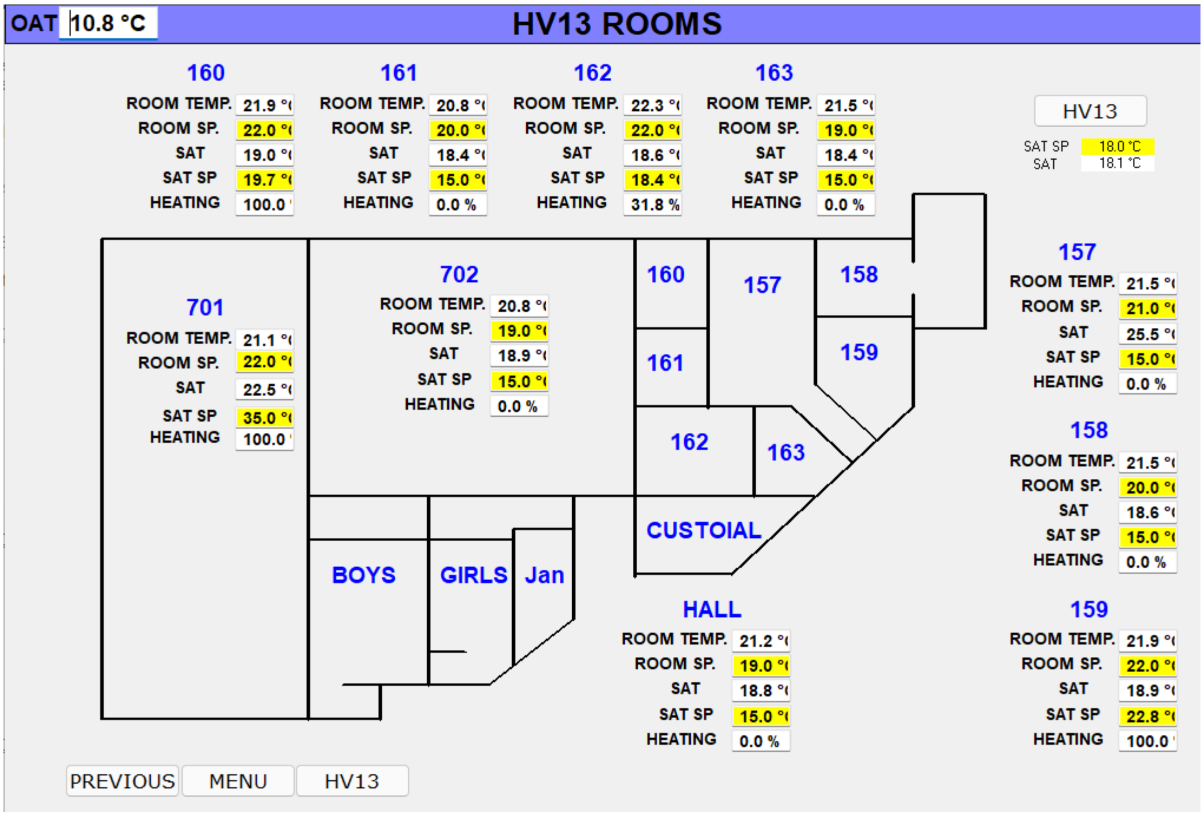

OAT 10.5 °C
HEATING AND VENTILATING UNIT - HV10 AUDITORIUM
EA
30.0 %
OA
30.0 %
RAT 19.4 °C
RA
SAT
16.2 °C
27.7 °C
FAN CONTROL
On
2.4 AMPS
SA
62.8 %
SEATING AREA
20.0 °C
19.9 °C
1.6 %
STAGE
19.5 °C
19.6 °C
62.8 %
SEATING AREA
FZ OFF
Schedule
ON

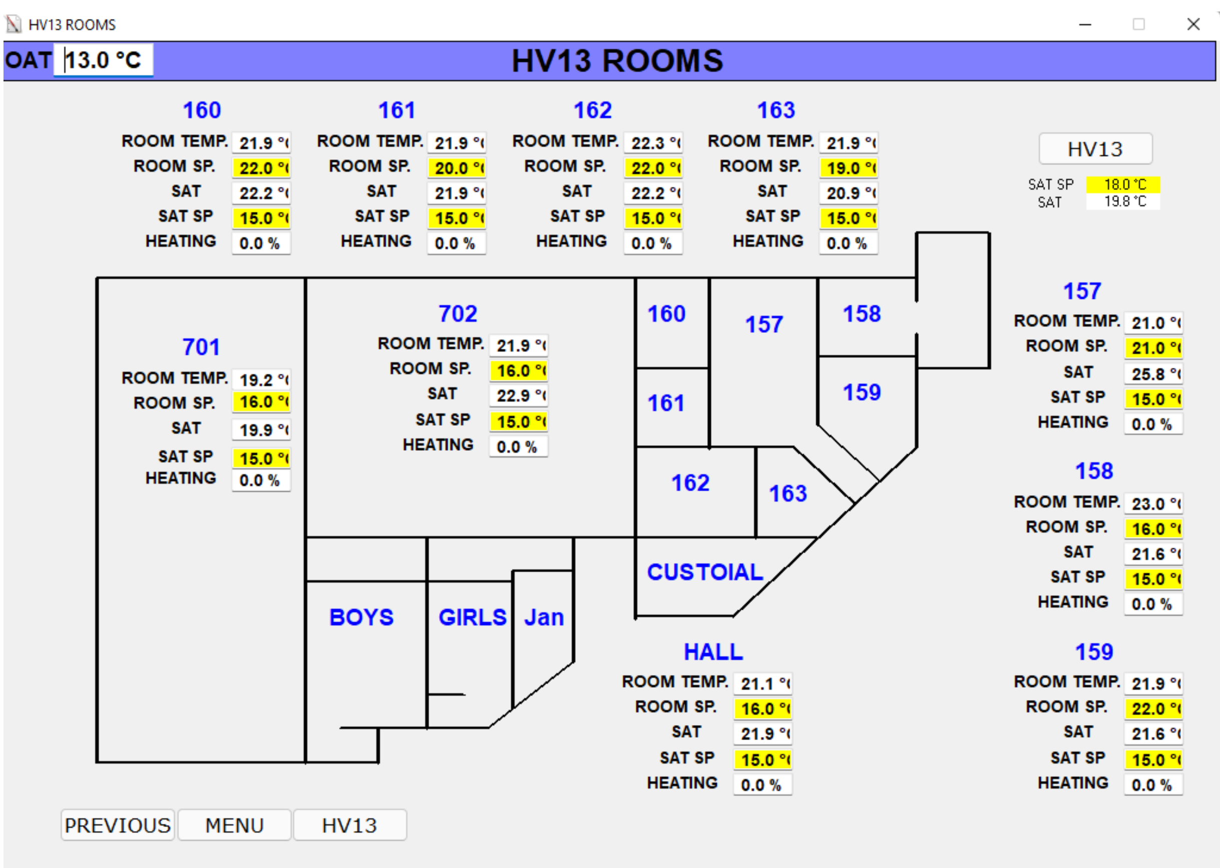
HV11A


OAT 10.5 °C
HV11A WIEGHT ROOM
HV11A
RT 18.1 °C
SP 18.0 °C
RA
CO2 728.9 ppm
CLG1 OFF
CLG2 OFF
OVERRIDE OFF
MOTION OFF
NO
30.0 %
MAD
AHU STATUS 4.8 AMPS
AHU CONTROL ON
O/A
NC
15.3 °C
MAT
24.5 °C SAT SP
15.6 °C SAT
OFF
FRZ
OFF
PRESS DMP
PRESS 11.2 PA
HWR
C
NO
NC
HWS
50.2 %
HCV
Schedule
ON
PREVIOUS
MENU

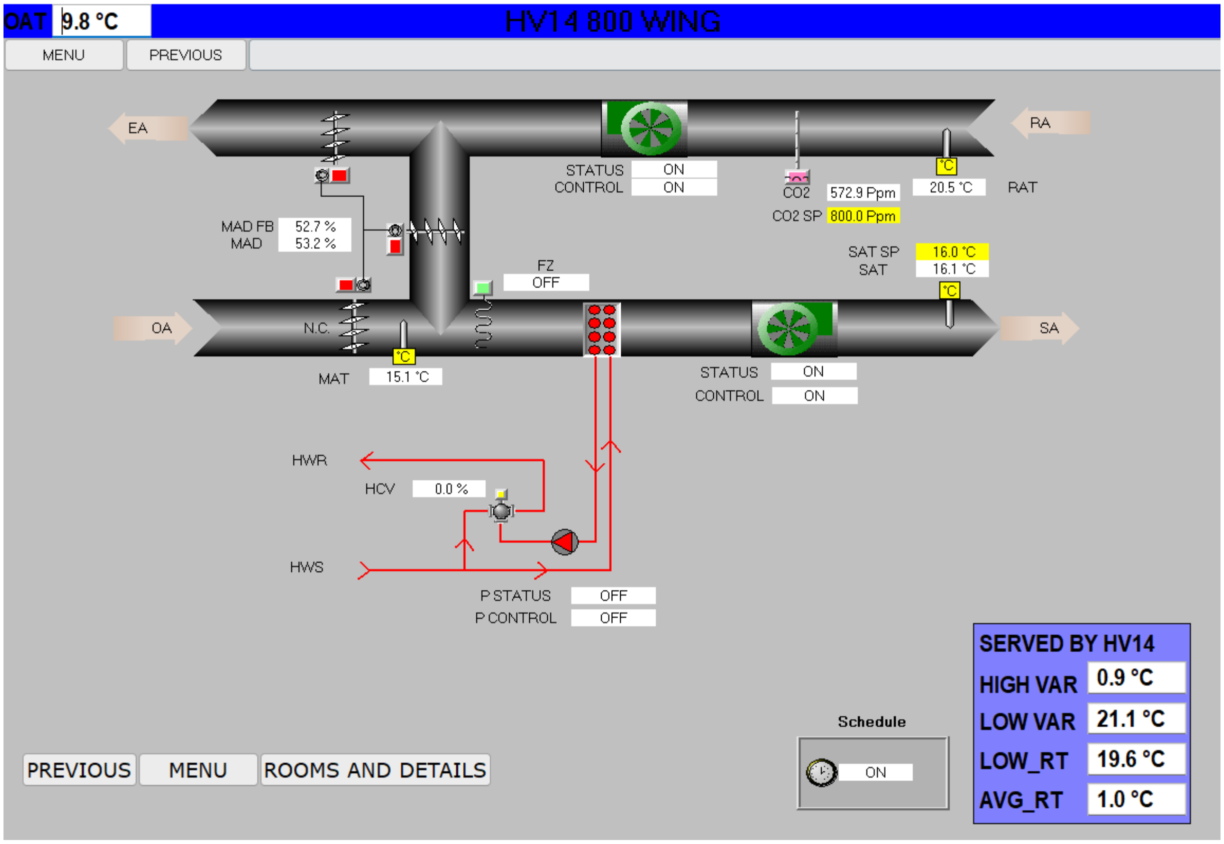
HV13

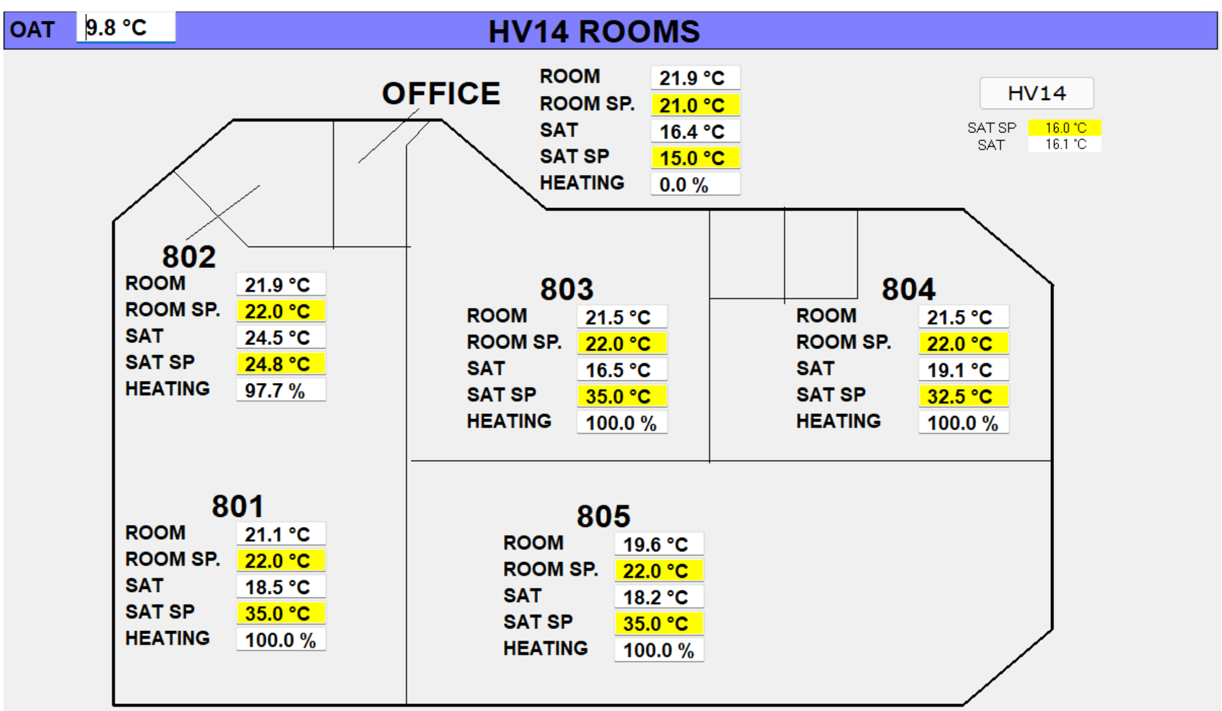

OAT 10.8 °C
HV13 701 702 and COUNSELLING
MENU
PREVIOUS
EA
RA
STATUS ON
CONTROL ON
CO2 521.9 Ppm
CO2 SP 800.0 Ppm
20.5 °C
RAT
MAD FB 29.2 %
MAD 30.0 %
FZ
OFF
SAT SP 18.0 °C
SAT 18.0 °C
OA
N.C.
SA
MAT 17.8 °C
STATUS ON
CONTROL ON
HWR
HCV 3.2 %
HWS
P STATUS OFF
P CONTROL OFF
SERVED BY HV13
HIGH VAR 2.1 °C
LOW VAR -0.9 °C
LOW_RT 20.8 °C
AVG_RT 21.0 °C
Schedule
ON
PREVIOUS
MENU
ROOMS AND DETAILS


OAT 10.8 °C
HV13 ROOMS
160
ROOM TEMP. 21.9
ROOM SP. 22.0
SAT 19.0
SAT SP 19.7
HEATING 100.0
161
ROOM TEMP. 20.8
ROOM SP. 20.0
SAT 18.4
SAT SP 15.0
HEATING 0.0 %
162
ROOM TEMP. 22.3
ROOM SP. 22.0
SAT 18.6
SAT SP 18.4
HEATING 31.8 %
163
ROOM TEMP. 21.5
ROOM SP. 19.0
SAT 18.4
SAT SP 15.0
HEATING 0.0 %
HV13
SAT SP 18.0 °C
SAT 18.1 °C
701
ROOM TEMP. 21.1
ROOM SP. 22.0
SAT 22.5
SAT SP 35.0
HEATING 100.0
702
ROOM TEMP. 20.8
ROOM SP. 19.0
SAT 18.9
SAT SP 15.0
HEATING 0.0 %
160
157
158
161
159
162
163
CUSTOIAL
BOYS
GIRLS
Jan
HALL
ROOM TEMP. 21.2
ROOM SP. 19.0
SAT 18.8
SAT SP 15.0
HEATING 0.0 %
157
ROOM TEMP. 21.5
ROOM SP. 21.0
SAT 25.5
SAT SP 15.0
HEATING 0.0 %
158
ROOM TEMP. 21.5
ROOM SP. 20.0
SAT 18.6
SAT SP 15.0
HEATING 0.0 %
159
ROOM TEMP. 21.9
ROOM SP. 22.0
SAT 18.9
SAT SP 22.8
HEATING 100.0
PREVIOUS
MENU
HV13


HV13 ROOMS
OAT 13.0 °C
HV13 ROOMS
160
ROOM TEMP. 21.9
ROOM SP. 22.0
SAT 22.2
SAT SP 15.0
HEATING 0.0 %
161
ROOM TEMP. 21.9
ROOM SP. 20.0
SAT 21.9
SAT SP 15.0
HEATING 0.0 %
162
ROOM TEMP. 22.3
ROOM SP. 22.0
SAT 22.2
SAT SP 15.0
HEATING 0.0 %
163
ROOM TEMP. 21.9
ROOM SP. 19.0
SAT 20.9
SAT SP 15.0
HEATING 0.0 %
HV13
SAT SP 18.0 °C
SAT 19.8 °C
701
ROOM TEMP. 19.2
ROOM SP. 16.0
SAT 19.9
SAT SP 15.0
HEATING 0.0 %
702
ROOM TEMP. 21.9
ROOM SP. 16.0
SAT 22.9
SAT SP 15.0
HEATING 0.0 %
160
157
158
161
159
162
163
CUSTOIAL
BOYS
GIRLS
Jan
HALL
ROOM TEMP. 21.1
ROOM SP. 16.0
SAT 21.9
SAT SP 15.0
HEATING 0.0 %
157
ROOM TEMP. 21.0
ROOM SP. 21.0
SAT 25.8
SAT SP 15.0
HEATING 0.0 %
158
ROOM TEMP. 23.0
ROOM SP. 16.0
SAT 21.6
SAT SP 15.0
HEATING 0.0 %
159
ROOM TEMP. 21.9
ROOM SP. 22.0
SAT 21.6
SAT SP 15.0
HEATING 0.0 %
PREVIOUS
MENU
HV13

HV14


OAT 9.8 °C
HV14 800 WING
MENU
PREVIOUS
EA
RA
STATUS ON
CONTROL ON
CO2 572.9 Ppm
20.5 °C
RAT
CO2 SP 800.0 Ppm
MAD FB 52.7 %
MAD 53.2 %
FZ OFF
SAT SP 16.0 °C
SAT 16.1 °C
OA
N.C.
SA
MAT 15.1 °C
STATUS ON
CONTROL ON
HWR
HCV 0.0 %
HWS
P STATUS OFF
P CONTROL OFF
SERVED BY HV14
HIGH VAR 0.9 °C
LOW VAR 21.1 °C
LOW_RT 19.6 °C
AVG_RT 1.0 °C
Schedule
ON
PREVIOUS
MENU
ROOMS AND DETAILS


OAT 9.8 °C
HV14 ROOMS
OFFICE
ROOM 21.9 °C
ROOM SP. 21.0 °C
SAT 16.4 °C
SAT SP 15.0 °C
HEATING 0.0 %
HV14
SAT SP 16.0 °C
SAT 16.1 °C
802
ROOM 21.9 °C
ROOM SP. 22.0 °C
SAT 24.5 °C
SAT SP 24.8 °C
HEATING 97.7 %
803
ROOM 21.5 °C
ROOM SP. 22.0 °C
SAT 16.5 °C
SAT SP 35.0 °C
HEATING 100.0 %
804
ROOM 21.5 °C
ROOM SP. 22.0 °C
SAT 19.1 °C
SAT SP 32.5 °C
HEATING 100.0 %
801
ROOM 21.1 °C
ROOM SP. 22.0 °C
SAT 18.5 °C
SAT SP 35.0 °C
HEATING 100.0 %
805
ROOM 19.6 °C
ROOM SP. 22.0 °C
SAT 18.2 °C
SAT SP 35.0 °C
HEATING 100.0 %

Boilers (unoccupied)

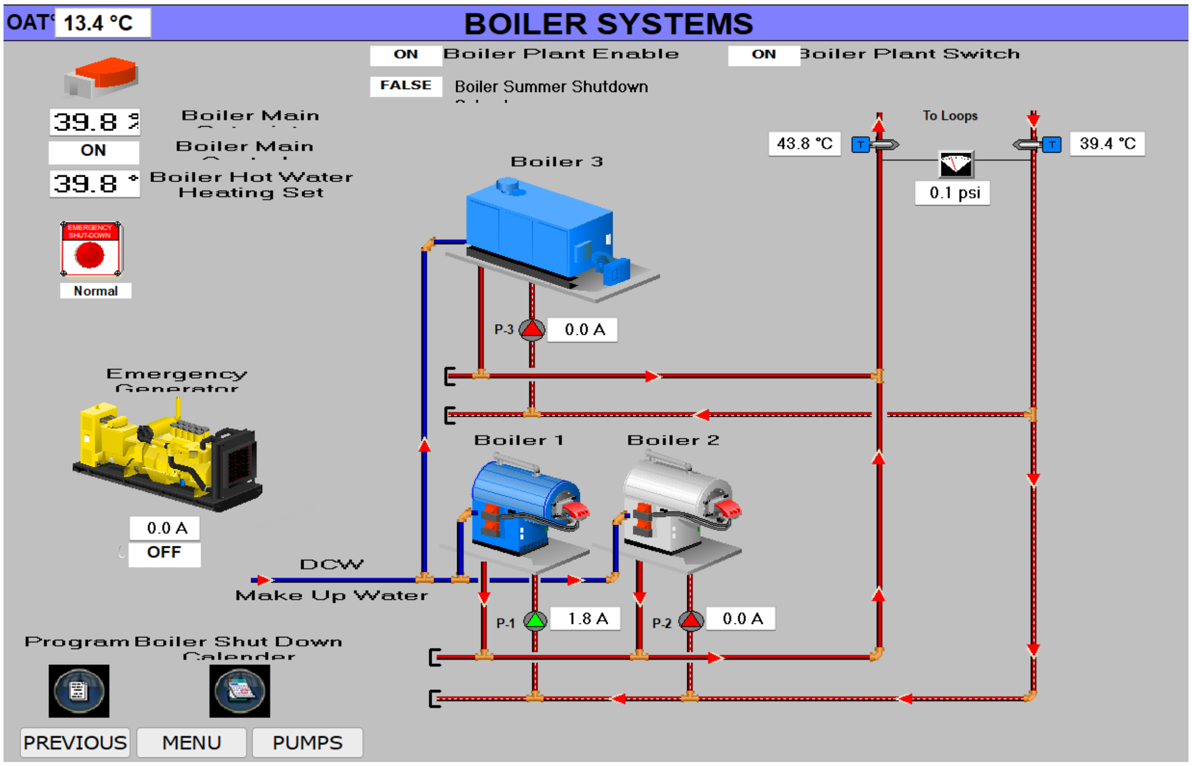


Figure 33: Boiler loop losing over 4°C even with all AHUs off

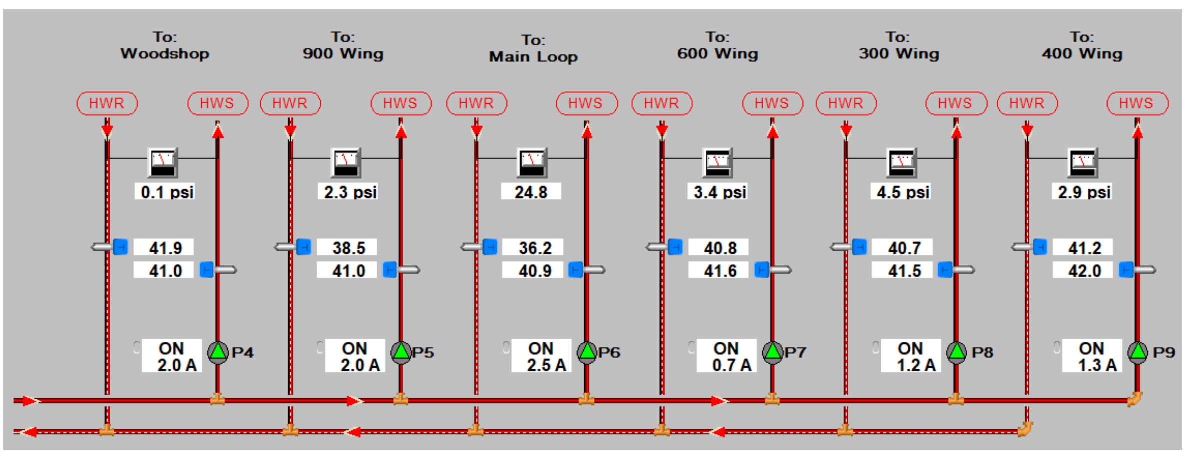


Figure 34: Biggest temperature drop is in the main loop