Continuous Optimization for Commercial Buildings Program

Retrocommissioning Investigation Report

August 3, 2015

Prepared for:

Thompson Rivers University

Old Main Building

Kamloops, BC

Project No. COP10-352

Prepared by:

SES Consulting Inc.

Suite 410 – 55 Water St.

Vancouver, BC

604-568-1800

TABLE OF CONTENTS

Introduction

Christopher Naismith of SES Consulting 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 Thompson Rivers University Old Main building. 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.

The measures selected for implementation are presented in the *Investigation Summary Table* (see Appendix A). To ensure each measure is implemented according to the C.Op Provider's specifications, the *Retrocommissioning Investigation Report* details the Measure Description and the recommended verification method to show that each measure is implemented correctly. This information can be used by the owner to specify the corrective actions and what needs to be presented to show that the correction or improvement has been successfully implemented by those responsible (e.g. controls contractor) for the implementation.

While the investigation focuses on low-cost improvements with short paybacks, major capital improvement opportunities may also be identified. Major retrofit measures are beyond the scope of the Program but other BC Hydro programs provide a variety of incentives to complete the retrofits.

BC hydro powersmart

1.0 Project Key Information

Project Information	
Project / Building Name	Old Main
Building Owner	Thompson Rivers University
Building Location	Vancouver, BC
Project Start Date	2014-07-08
COP File #	COP10-352

Contact List	
C.Op Provider	Christopher Naismith
C.Op Firm	SES Consulting Inc.
email	christopher@sesconsulting.com
phone	(604)568-1804
Building Owner Representative	Jim Gudjonson
email	jgudjonson@tru.ca
phone	(250) 852-7253
Building Engineer	Tom O'Byrne
email	tobyrne@tru.ca
phone	(250) 371-5866
BC Hydro Program Representative	Tommy Yim
email	tommy.yim@bchydro.com
phone	(604) 453-9284

Building Energy Usage Summary	
Building Size (gross sq. meters)	19,815
Building Size (conditioned sq. meters)	19,815
Annual Electric Consumption (kWh/yr)	2,966,264
Annual Electric Cost (with applicable taxes)	$258,069
Bulk cost per kWh (with demand charges)	$0.087
Utility Rate Tariff	1600
Fuel Type	Natural Gas
Annual Fuel Consumption (GJ)	9,499
Annual Fuel Cost (with applicable taxes)	$122,249
Fuel Cost per gigajoule	$12.87
Total Energy Cost (with applicable taxes)	$380,319
Electric Energy Use Intensity (EUI) (kWh/sq. meters)	150
Building Energy Use Intensity (EUI) (ekWh/sq. meters)	283

RCx Costs & Savings	
Implementation Cap	$80,000
Implementation Cost	$74,900
Annual Electric Usage Savings (kWh)	162,900
Annual Electric Usage Savings - Avg. of Year 1&2 ($)	$15,781
Savings as % of Total Electric Usage	5.5%
Annual Electric Demand Savings ($)	$4,198
Annual Fuel Savings (GJ)	1,220
Annual Fuel Savings ($)	$15,701
Savings as % of Total Fuel Usage	12.8%
Total Energy Cost Savings - Avg. of Year 1&2 ($)	$35,681
RCx Project Simple Payback	2.2
Savings as % of Total Energy Cost	9.4%

2.0 Brief Description of Existing Systems

2.1 Heating System

A Block: Three gas fired condensing boilers provide hot water to heating coils in Air Handling Units (AHUs), terminal variable air volume boxes (VAVs) and perimeter radiation.

B Block: Two gas fired boilers provide heating water to AHU-3 and 4, VAVs and radiation system. Other Air conditioning unit (ACU), RTU and AHU heating is provided by internally equipped gas burners.

C Block: Heating is provided by gas burner in RTUs.

2.2 Cooling System

A Block: Two water cooled chillers provide cooling to coils in AHUs. Four heat pumps provide both heating and cooling to 1st and 2nd floor east perimeter zones.

B Block: Cooling for AHU-3 and 4 is provided by the chillers at A Block, other AHU RTU and ACU cooling is provided by internally equipped direct expansion (DX) units.

C Block: Cooling is provided by DX cooling.

2.3 Ventilation System

A Block 1st floor is served by AHU-1 through terminal VAVs. RTU-13 and RTU-14 serve East Perimeter and Interior respectively.

A Block 2nd floor is served by AHU-2 through terminal VAVs. RTU-11 and RTU-12 serve East Perimeter and Interior respectively.

AHU-1 and AHU-2 share the same return fan. Supply Fans (SF) 2 and 3 provide preheat air to AHU-1 and AHU-2 respectively.

A Block 3rd and 4th floor are served by AHU-3,4 5 through terminal VAVs and an HRV.

B Block is served by AHU-2, 3, 4, RTU-15 and ACU-1 to 8. VAVs exist on both 1st floor and 2nd floor.

C Block is served by RTU-1, 2, 3.

2.4 Domestic Hot Water System

A Block: Two gas fired domestic hot water tanks (DHWT) provide domestic hot water (DHW) to the building.

B Block: One gas fired DHWT provides DHW to B Block.

C Block: DHWT at B Block provide DHW to C Block.

2.5 Control System

A Block is all controlled by Johnson Controls Building Automation System (BAS). A Block 2nd floor VAVs are pneumatically controlled. Part of B Block 1st floor VAVs are controlled by an Automated Logic BAS. The remaining systems of B Block and C Block are controlled by a Siemens Insight BAS.

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

This section provides an overview of each measure, Measure Description, and the most suitable method for providing evidence of implementation. For each measure, costs, payback calculations and incentive amounts can be referenced in the *Investigation Summary Table* (see **Appendix A).**

3.1 Measure 2: Scheduling and Optimal Start

Description of Finding

AHUs in A Block and B Block are operating from 6am to 11pm. Some of the AHUs operate almost 24 hours per day instead of running according to the schedule, including A Block AHU-1, AHU-3, AHU-4 and AHU-5

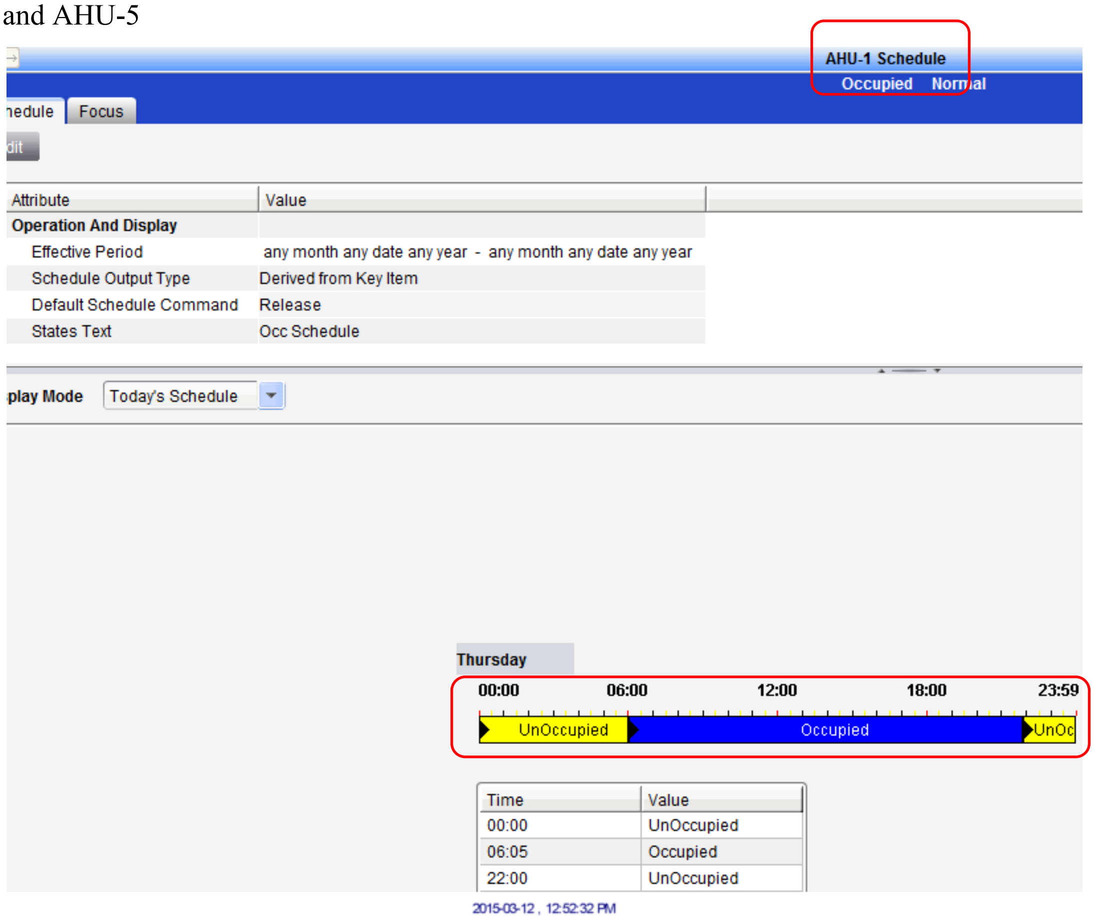


Figure 1: AHU 1 Schedule

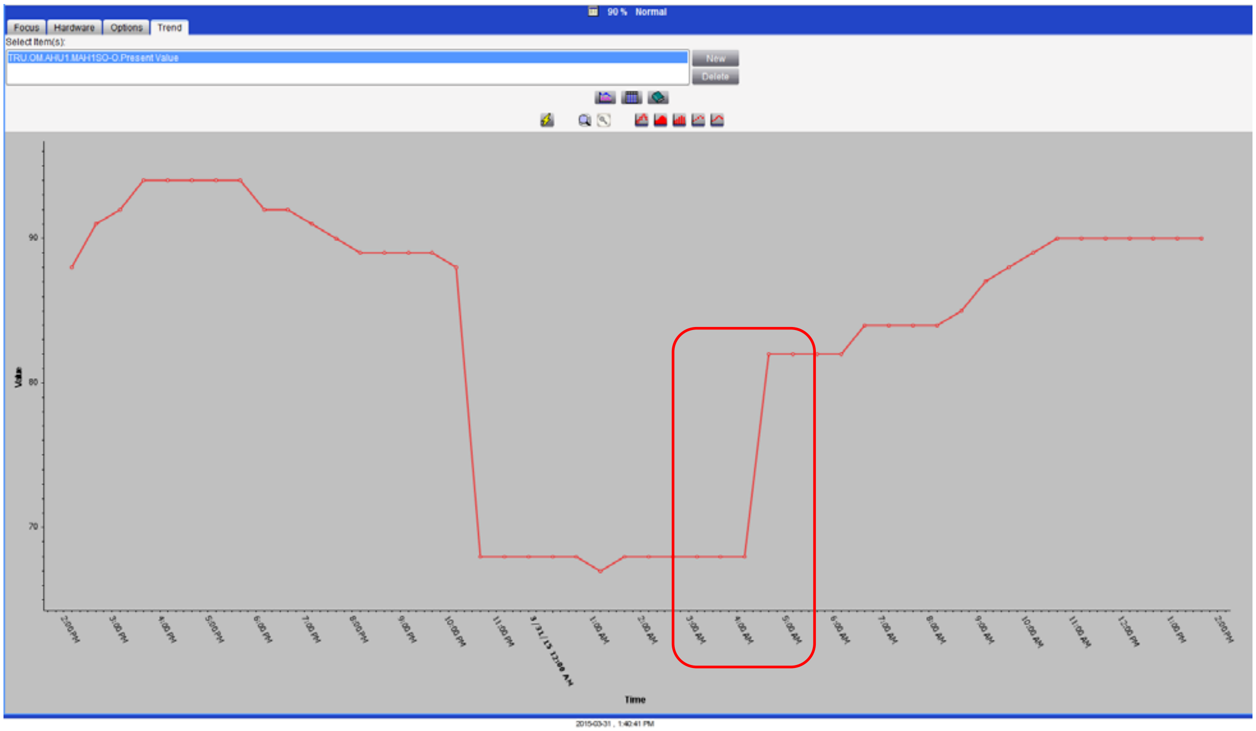


Figure 2: AHU 1 Supply Fan Trend

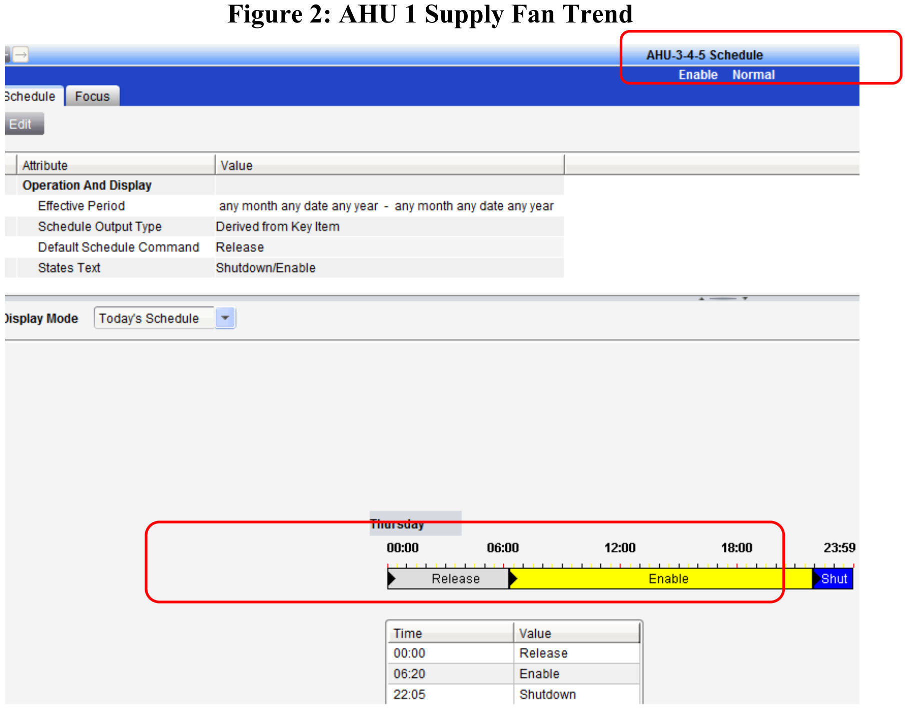


Figure 3: AHU 3, 4, & 5 Schedule

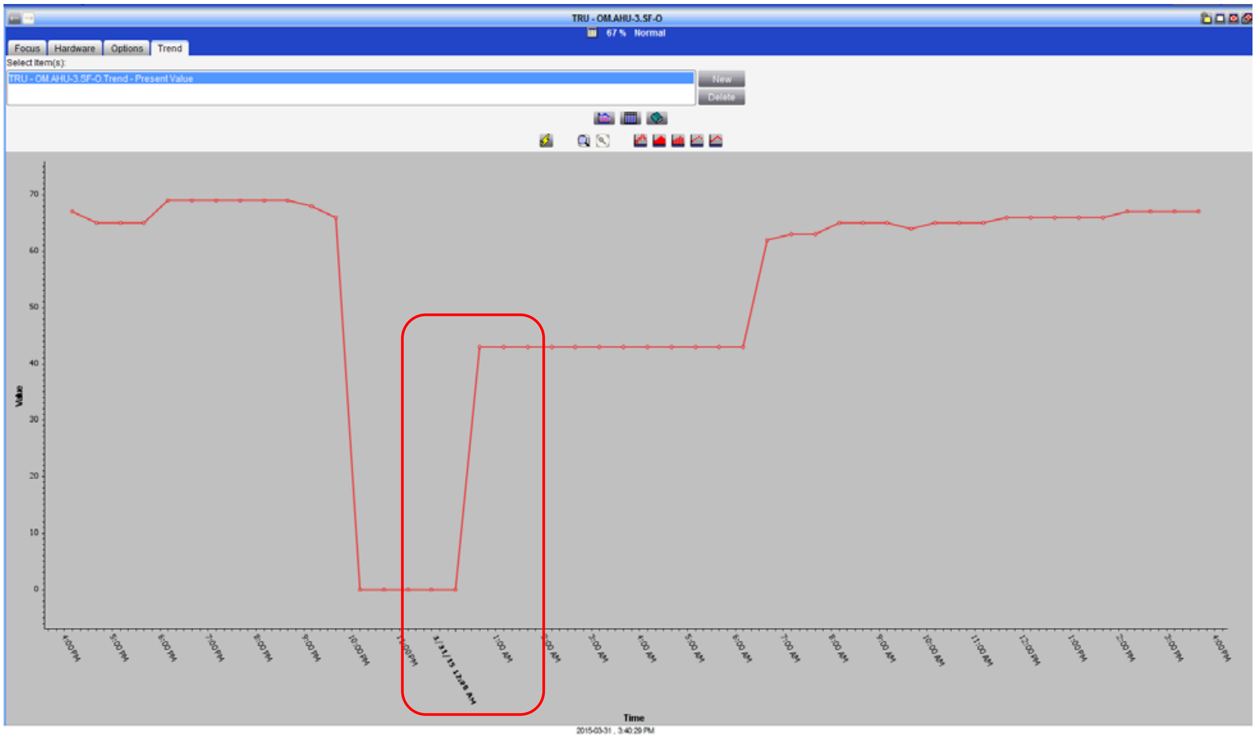


Figure 4: AHU 3 Supply Fan Trend

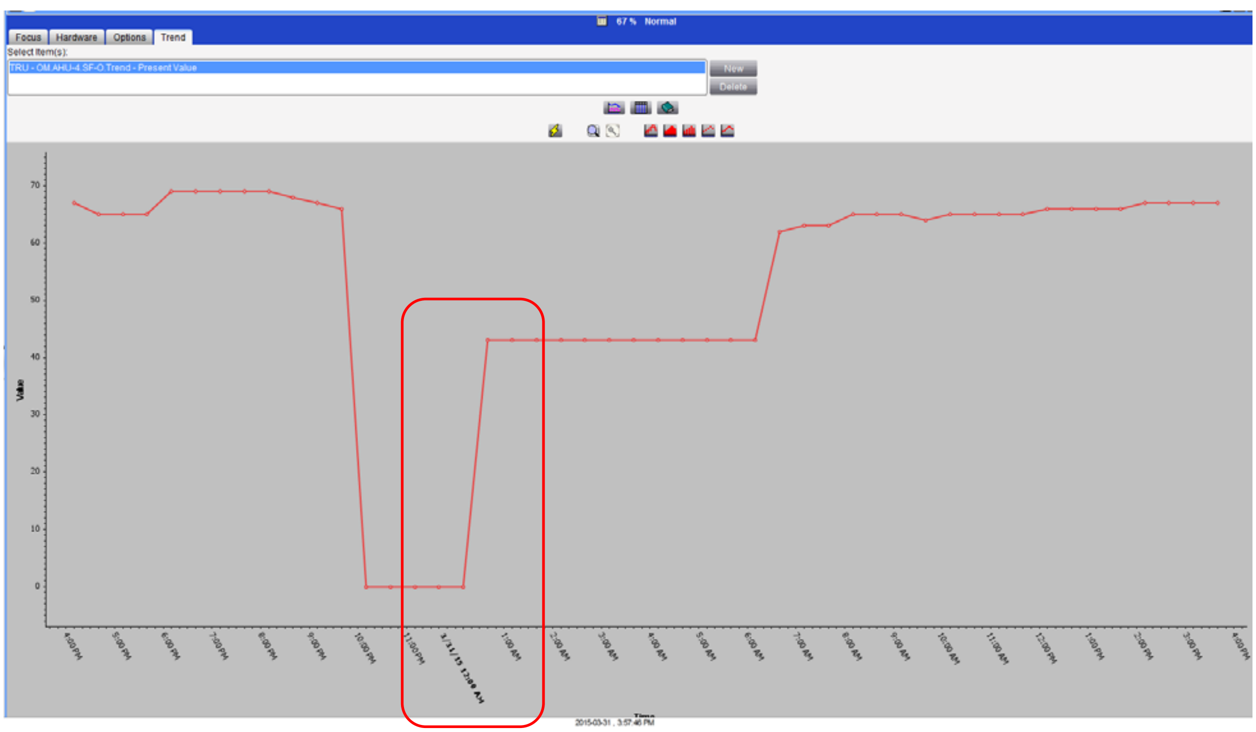


Figure 5 AHU 4 Supply Fan Trend

Measure Description

Apply scheduling that turns off ventilation when spaces are typically unoccupied and there is no call for heating. Use an optimal start routine to determine when to start up ventilation systems to meet setpoints at the start of occupancy.

Where afterhours use is of critical importance, install push button overrides to provide heating and ventilation

Evidence of Proper Implementation

The recommended method for verifying that this measure is implemented properly is by reviewing BAS trends and BAS programming.

3.2 Measure 3: Heating Water Supply Temperature Reset

Description of Finding

HWST varies between max and min supply water temperature based on OAT. This strategy limits the ability of the system to respond to demands from the spaces, and may promote non-condensing conditions at the boilers.

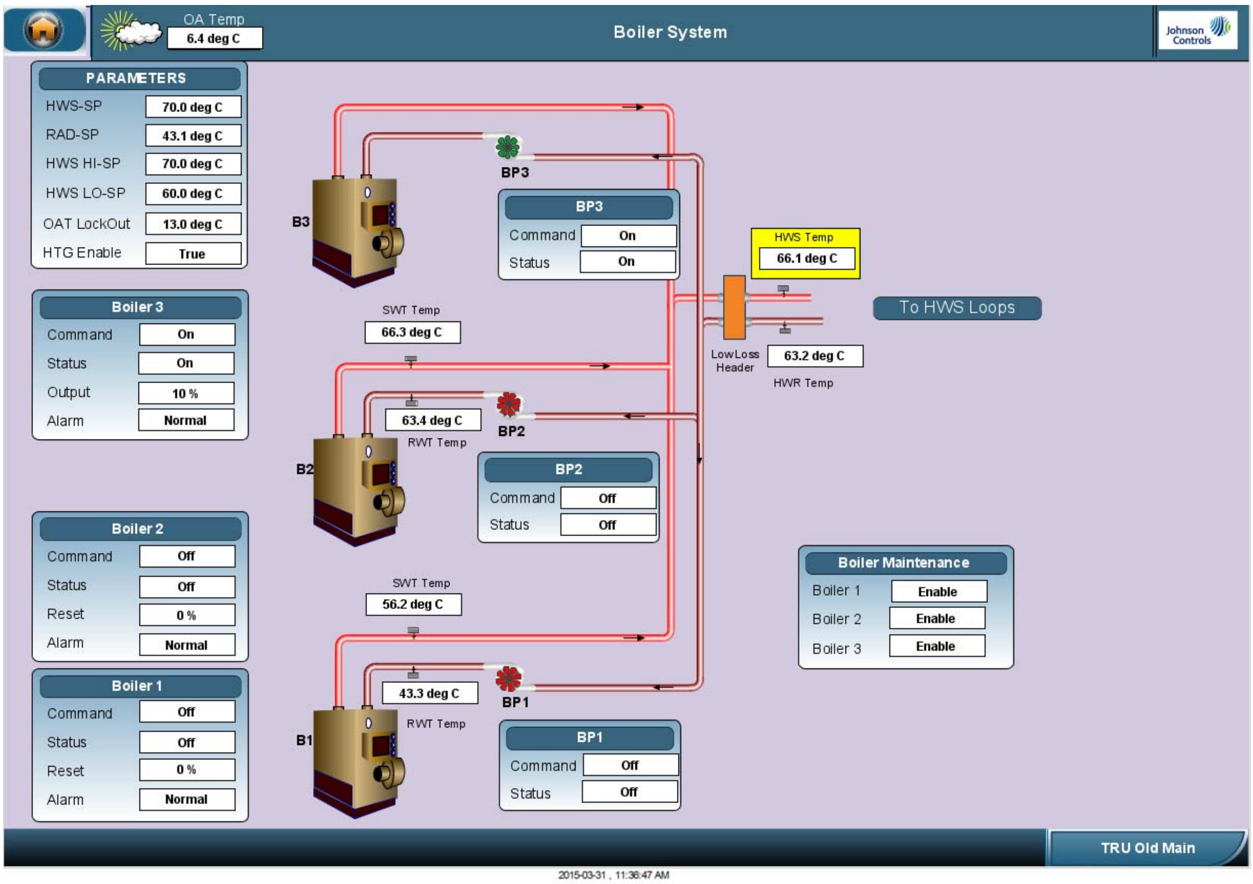


Figure 6: Boiler Supply Water Conditions at 6°C Outdoor Air (OA)

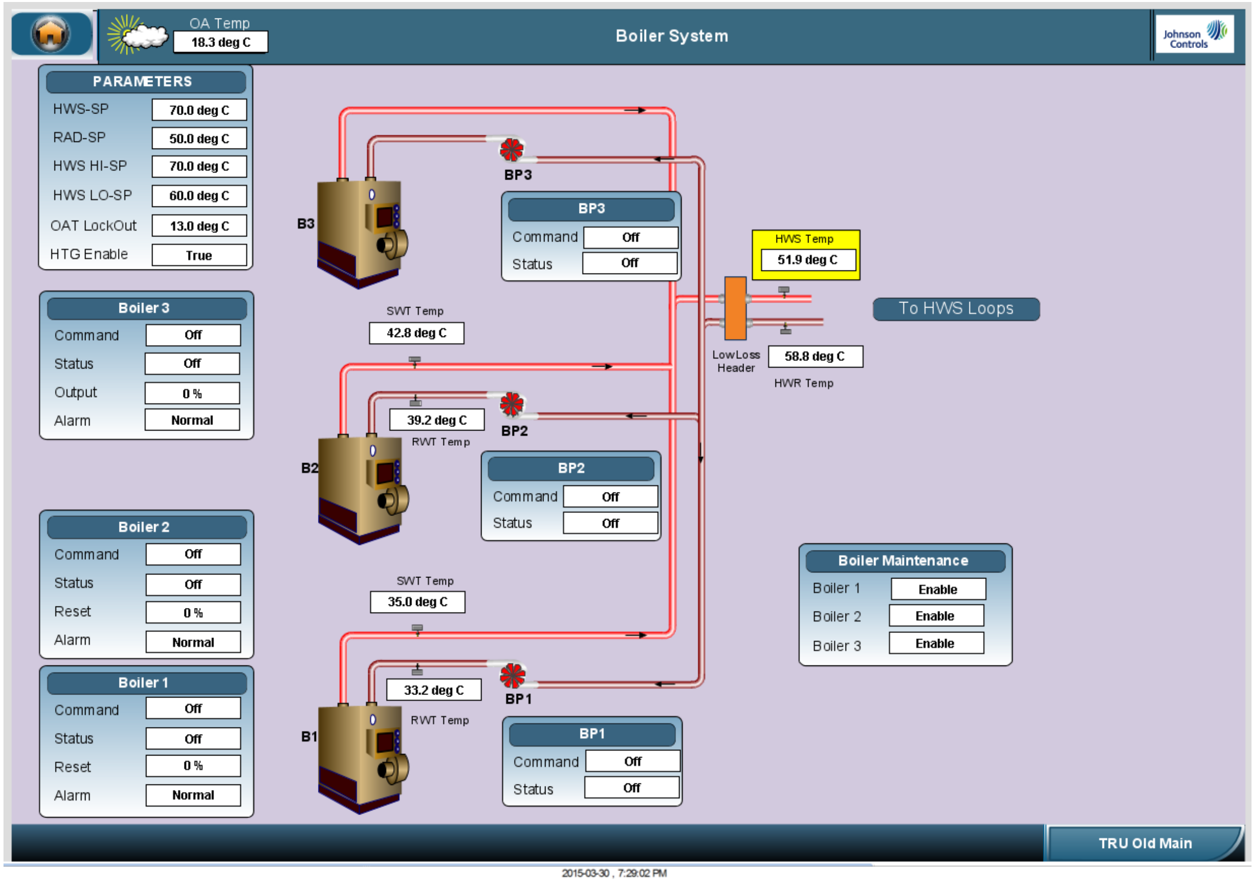


Figure 7: Boiler Supply Water Conditions at 18°C OA

Measure Description

Reset boiler heating water supply temperature based on demand feedback from the zones. This feedback may include supply and return temperatures and zone controller readings.

Evidence of Proper Implementation

The recommended method for verifying that this measure is implemented properly is by reviewing BAS trends and BAS programming.

3.3 Measure 4: Supply Air Temperature Reset

Description of Finding

Supply air temperature (SAT) is currently based on outdoor air temperature (OAT), rather than zone demand.

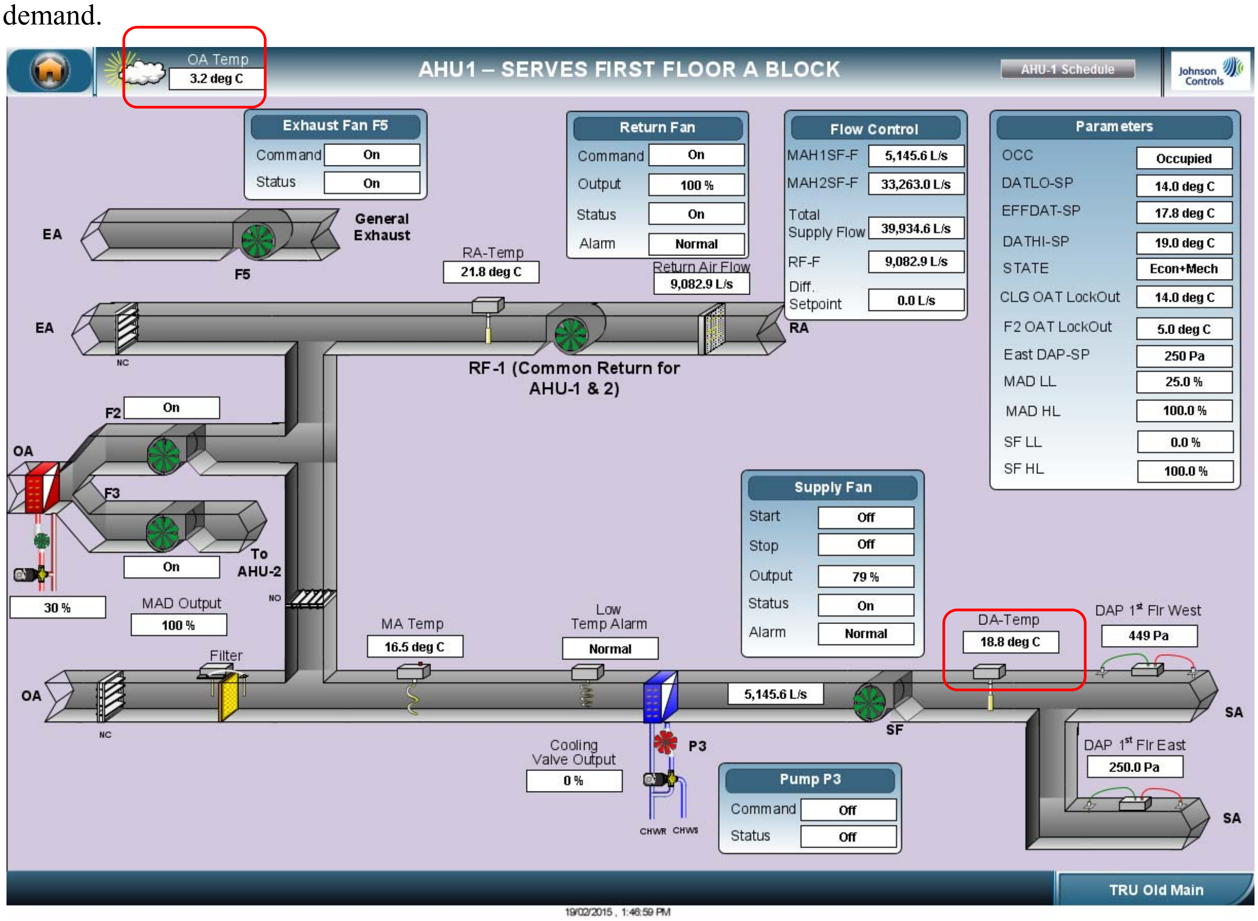


Figure 8: AHU 1 OA and SA Temperature

Measure Description

Reset SAT based on the feedback from the VAV boxes to minimize simultaneous heating and free cooling.

Evidence of Proper Implementation

The recommended method for verifying that this measure is implemented properly is by reviewing BAS trends and BAS programming.

BC hydro powersmart

3.4 Measure 5: Supply Air Pressure Reset

Description of Finding

AHUs serve VAV boxes with reheat in A Block and B Block. AHU supply fans are equipped with variable speed drive and operate to a static pressure setpoint.

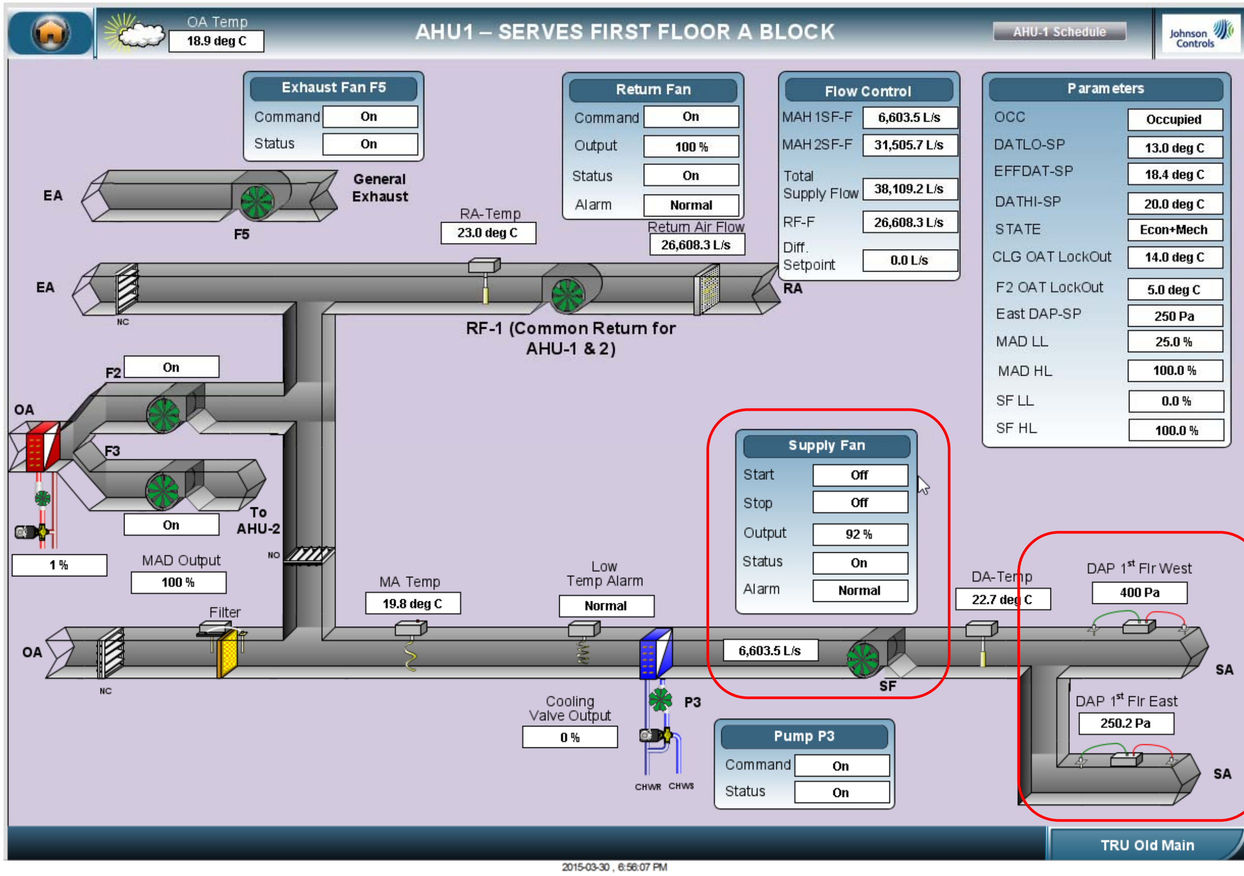


Figure 9: AHU 1 Supply Pressure Sensor

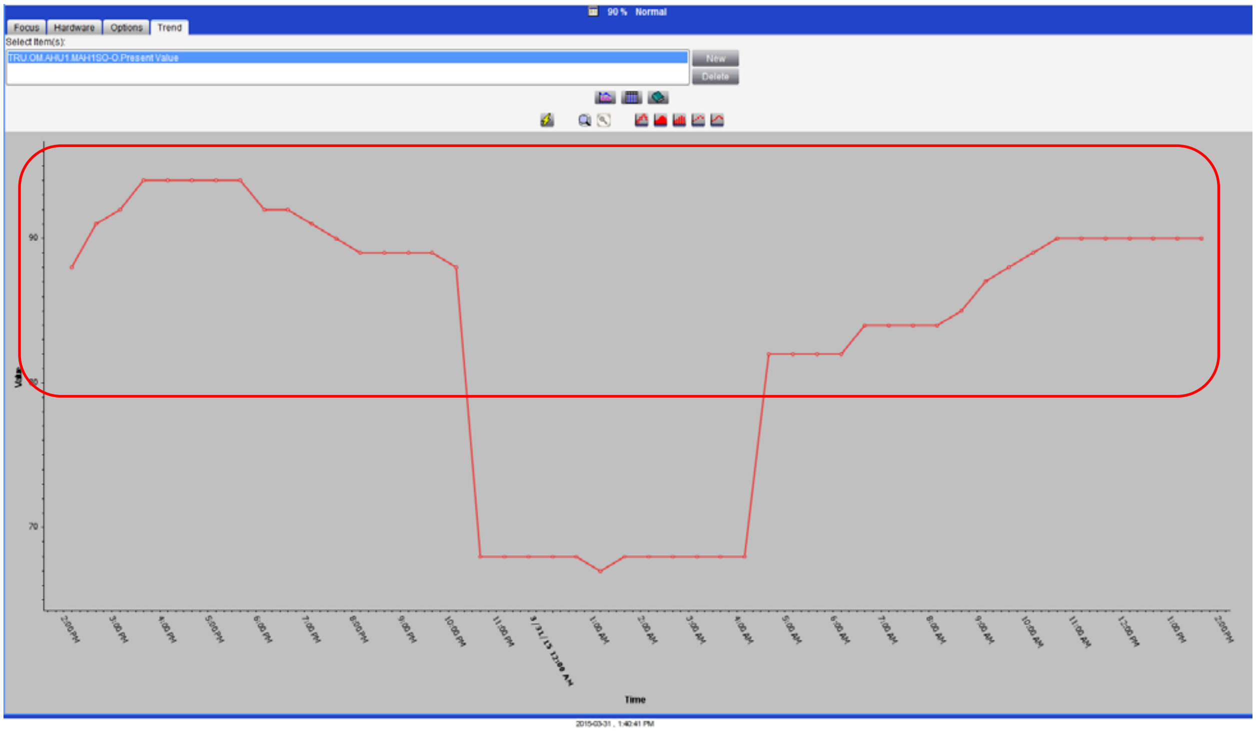


Figure 10: AHU 1 Supply Fan Trend

Measure Description

We recommend implementing a dynamic supply air pressure reset program to reduce fans speeds during non-peak cooling periods. SAP setpoints are typically set to deliver enough air flow for the worst-case cooling scenario. During heating conditions the SAP setpoint may be reduced while still maintaining desirable space conditions with reduced air delivery.

Evidence of Proper Implementation

The recommended method for verifying that this measure is implemented properly is by reviewing BAS trends and BAS programming.

3.5 Measure 6: Dual maximum VAV control

Description of Finding

Variable air volume terminal units are controlled to minimum and maximum flow setpoints based on heating or cooling demand. Perimeter radiation is controlled to operate at the same time as VAV reheat.

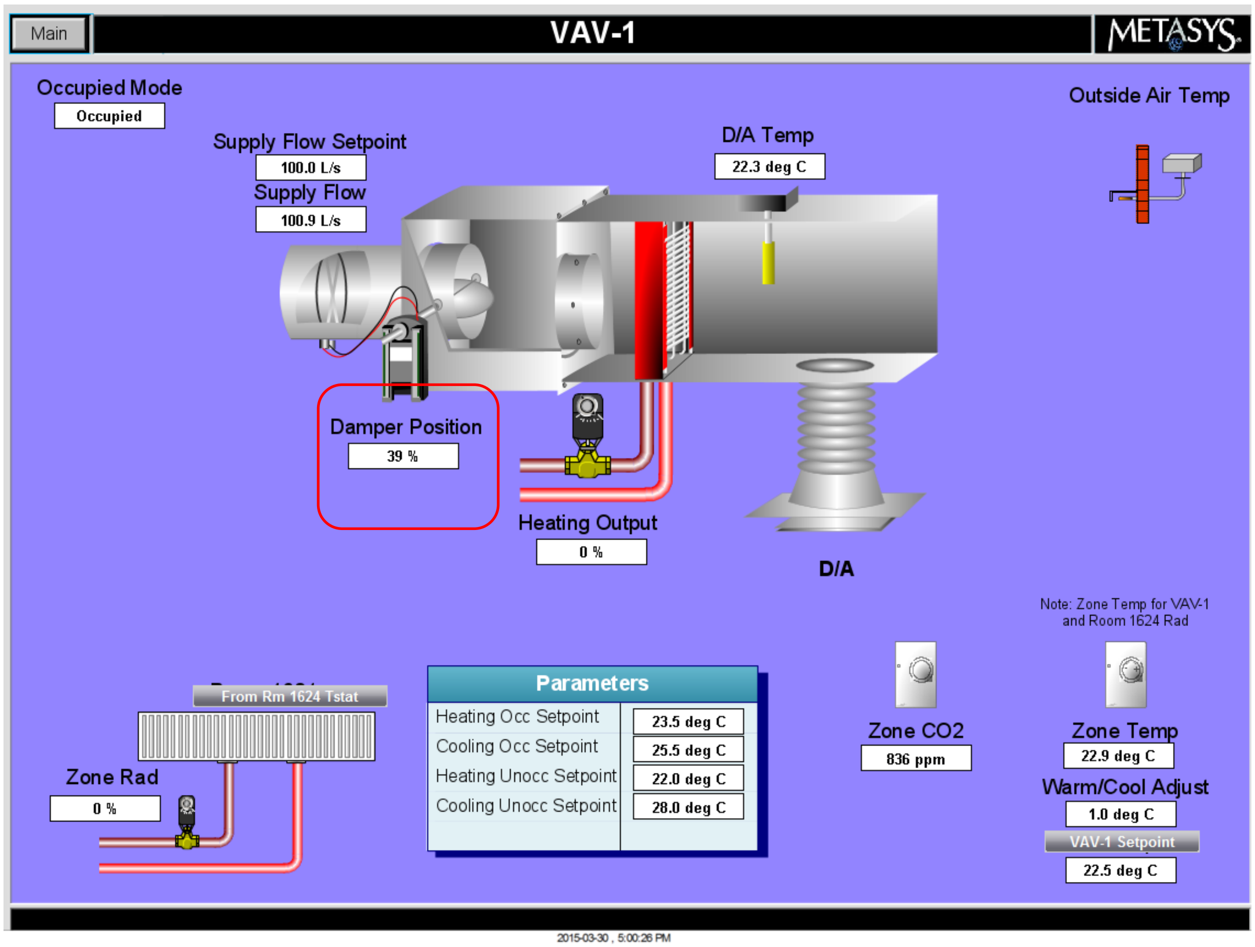


Figure 11: AHU 1 VAV-1

Measure Description

Program dual-maximum VAV control for all terminal units. This strategy will maintain a lower flow rate when the space is in dead-band, and stage zone heating to minimize airflow while meeting space demand.

Evidence of Proper Implementation

The recommended method for verifying that this measure is implemented properly is by reviewing BAS trends and BAS programming.

3.6 Measure 7: Demand Controlled Ventilation

Description of Finding

Minimum outdoor air damper positions do not modulate based on air quality. Most zones served by rooftop units (RTU) do not have air quality sensors.

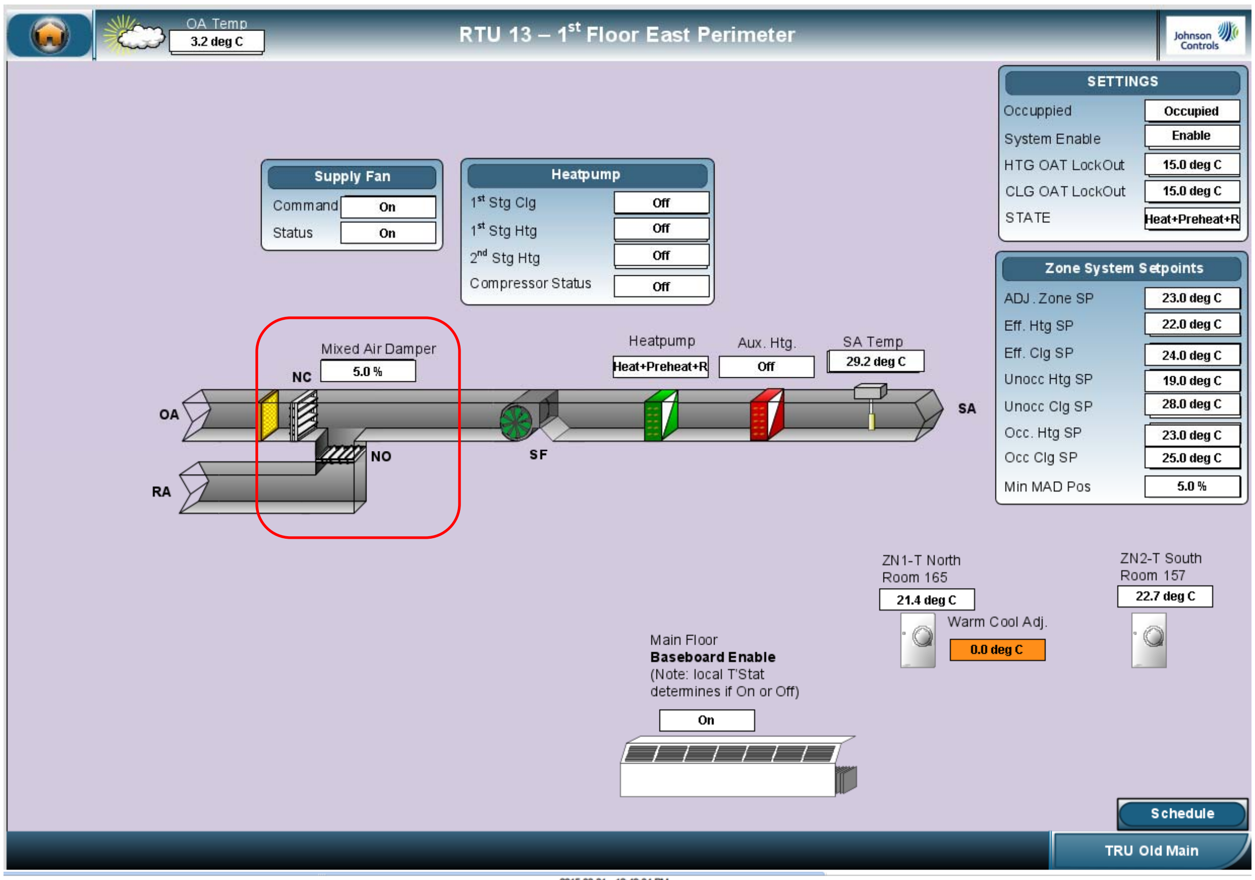


Figure 12: RTU-13A Damper

Measure Description

Install CO2 sensors in all AHUs and RTUs not currently controlled by air quality feedback. Reset minimum damper position based on air quality readings.

Evidence of Proper Implementation

The recommended method for verifying that this measure is implemented properly is by reviewing BAS trends and BAS programming.

3.7 Measure 8: Occupancy Counter

Description of Finding

There are a number of large spaces where occupancy is intermittent, including the theatre, art spaces, and law school lecture theatres.

Measure Description

Install occupancy sensors in large spaces. Apply counter algorithms to monitor occupant density and set back temperature and flow setpoints when occupant density is low.

Evidence of Proper Implementation

The recommended method for verifying that this measure is implemented properly is by reviewing BAS trends and BAS programming.

3.8 Measure 9: Connect domestic hot water to BAS

Description of Finding

Currently the domestic hot water (DHW) tanks are not on BAS and the DHW circulation pumps are running 24/7

Measure Description

Connect DHW tanks to the BAS and schedule the DHW pumps based on actual occupancy.

Evidence of Proper Implementation

The recommended method for verifying that this measure is implemented properly is by reviewing BAS trends and BAS programming.

3.9 Measure 10: Computer lab scheduling

Description of Finding

Many computer labs are conditioned prior to class start up. All labs are open to public use prior to classes and are conditioned accordingly.

Figure 13: Computer Lab Scheduling

Measure Description

Open one or two labs for public use prior to the start of classes, maintain the others in setback mode until occupancy is detected.

Integrate lighting occupancy sensors to BAS for use in HVAC control.

Evidence of Proper Implementation

The recommended method for verifying that this measure is implemented properly is by reviewing BAS trends and BAS programming.

3.10 Measure 11: Curtain for leaky garage doors

Description of Finding

There is a leaky garage door in the sculpture studio which causes unnecessary heating loss .

Measure Description

Install curtain for leaky garage doors to prevent heating or cooling losses.

Evidence of Proper Implementation

The recommended method for verifying that this measure is implemented properly is by reviewing BAS trends and BAS programming.

3.11 Measure 14: Weather Predictor

Description of Finding

There are OAT lockouts in place in this facility, but no weather predictor program. This results in the building heating in the morning and cooling in the afternoon.

Measure Description

Integrate a real-time weather feed from environment canada and use it to lock out heating when daytime temperatures will be high.

Evidence of Proper Implementation

The recommended method for verifying that this measure is implemented properly is by reviewing BAS trends and BAS programming.

3.12 Measure 15: Load Shedding

Description of Finding

There are a number of variable loads in the building which cause high peak demands.

Measure Description

Implement a load shedding strategy to reduce variable loads during peak demand periods.

Evidence of Proper Implementation

The recommended method for verifying that this measure is implemented properly is by reviewing BAS trends and BAS programming.

4.0 Measures Selected for Implementation (Under Other Power Smart programs)

This section provides an overview of each measure, Measure Description, and the most suitable method for providing evidence of implementation.

4.1 Measure 12: Integrate lighting control to BAS

Description of Finding

Many zones have lighting occupancy sensors.

Measure Description

As part of the BAS upgrade, lighting occupancy sensors may be integrated to BAS and used for control of HVAC systems.

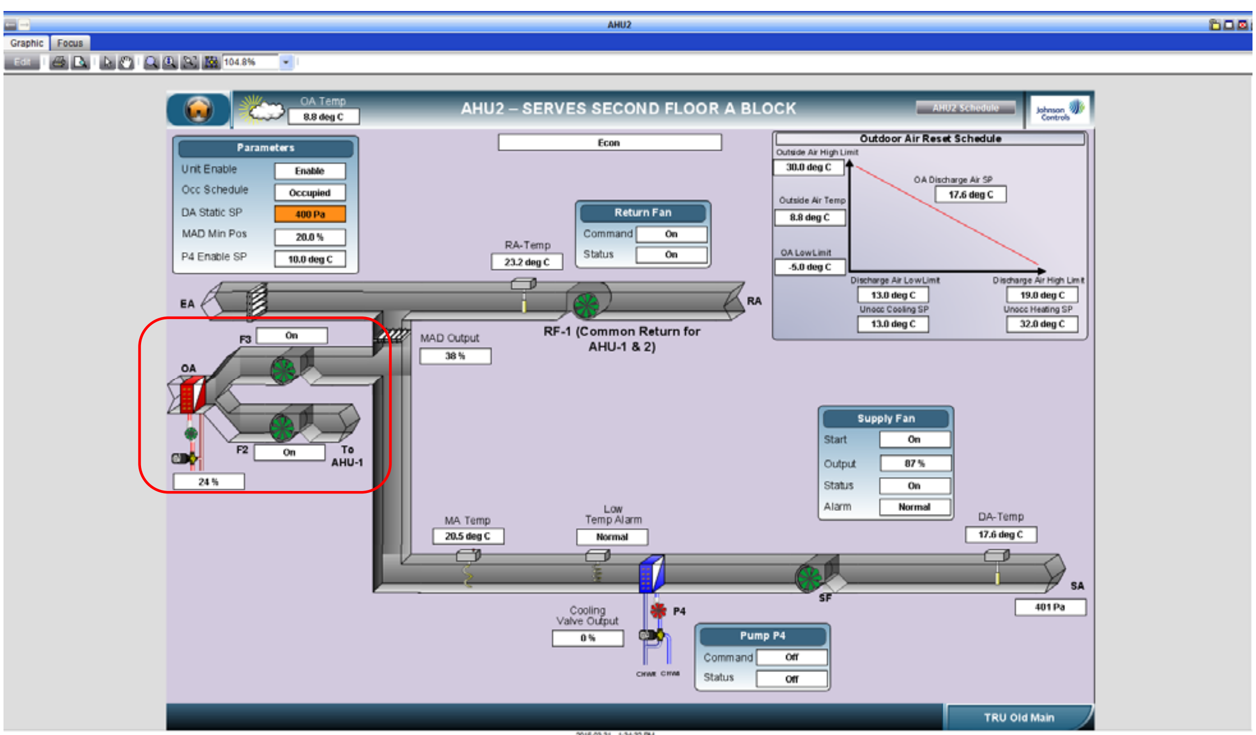
Evidence of Proper Implementation

The recommended method for verifying that this measure is implemented properly is by reviewing BAS trends and BAS programming.

4.2 Measure 17: F2 and F3 VFD Upgrade

Description of Finding

F2 and F3 provide supplemental heating and 100% OA to return air for AHU-1 and AHU-2. The units are 40 horsepower and constant volume.



BC hydro powersmart

Measure Description

Install VFDs on Fans 2 and 3 and operate to maintain duct pressure setpoint.

Evidence of Proper Implementation

The recommended method for verifying that this measure is implemented properly is by reviewing BAS trends and BAS programming.

4.3 Measure 18: T8 Relamping to LED

Description of Finding

The majority of lighting fixtures in this building contain 32 watt F32T8 fluorescent lamps.

Measure Description

Fixtures may be re-lamped with LED replacements

Evidence of Proper Implementation

The recommended method for verifying that this measure is implemented properly is by reviewing BAS trends and BAS programming.

4.4 Measure 19: Washroom occupancy sensors

Description of Finding

Washrooms lights are controlled by line voltage wall switches.

Measure Description

Switch-integrated occupancy sensors occupancy sensors may be installed in spaces with a minimum of 4 fluorescent fixtures per switch.

Evidence of Proper Implementation

The recommended method for verifying that this measure is implemented properly is by reviewing BAS trends and BAS programming.

5.0 Measures to be considered for Future Implementation

This section provides an Description of Finding of each measure, Measure Description, and the most suitable method for providing evidence of implementation.

5.1 Measure 1: BAS and pneumatics Upgrade

Description of Finding

HVAC systems in A Block are controlled by Johnson Controls BAS though terminal units on 2nd floor are pneumatically controlled.

B Block 1st floor VAVs are controlled by Automated Logic BAS with the remaining systems of B Block and C Block being controlled by a Siemens Insight BAS system.

The systems communicate in different protocols and use different control sequences, making a unified strategy for control very difficult to deploy.

Operators have a varying degree of training on programming each system.

Figure 14: Johnson Controls BAS Graphic

Figure 15: Care System Trend Log

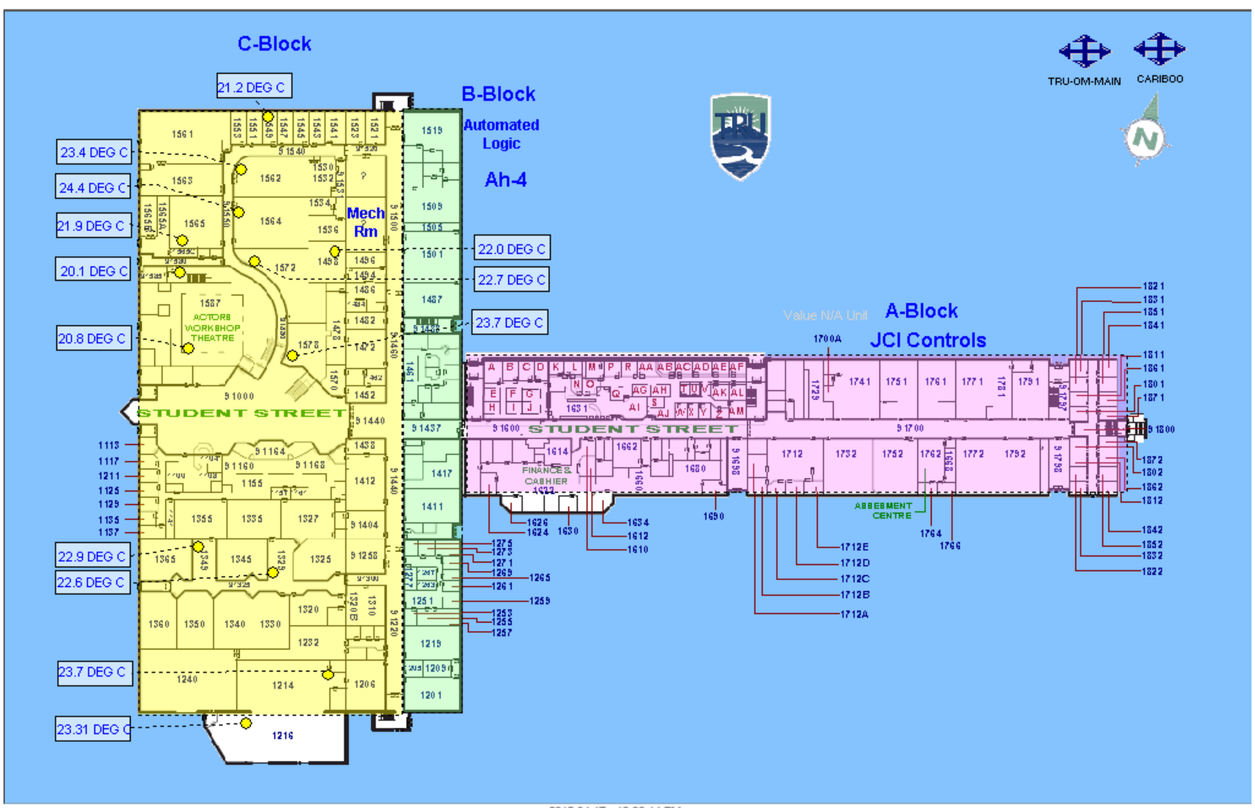


Figure 16: Siemens BAS Graphic

Measure Description

Install a contractor-agnostic control platform to integrate the three BAS systems.

Upgrade all pneumatic controls to electronic, and integrate stand-alone controllers in C block to BAS.

Evidence of Proper Implementation

The recommended method for verifying that this measure is implemented properly is by reviewing BAS trends and BAS programming.

5.2 Measure 13: Fault Detection and Analytics

Description of Finding

Maintenance spend the majority of their time on responding to service calls and have little time for preventative maintenance.

Measure Description

A fault detection system may be integrated with the BAS system in order to capture and prioritize equipment faults automatically and present it to maintenance staff in an easy to use interface.

The fault detection system will also ensure that any control recommissioning measures are maintained in the long-term.

Evidence of Proper Implementation

The recommended method for verifying that this measure is implemented properly is by reviewing BAS trends and BAS programming.

5.3 Measure 16: 2nd Floor VAV Upgrade

Description of Finding

AHU-2 is a large unit equipped with VSD serving A block 2nd floor.

Terminal units are constant volume, leading to little opportunity for demand based flow control.

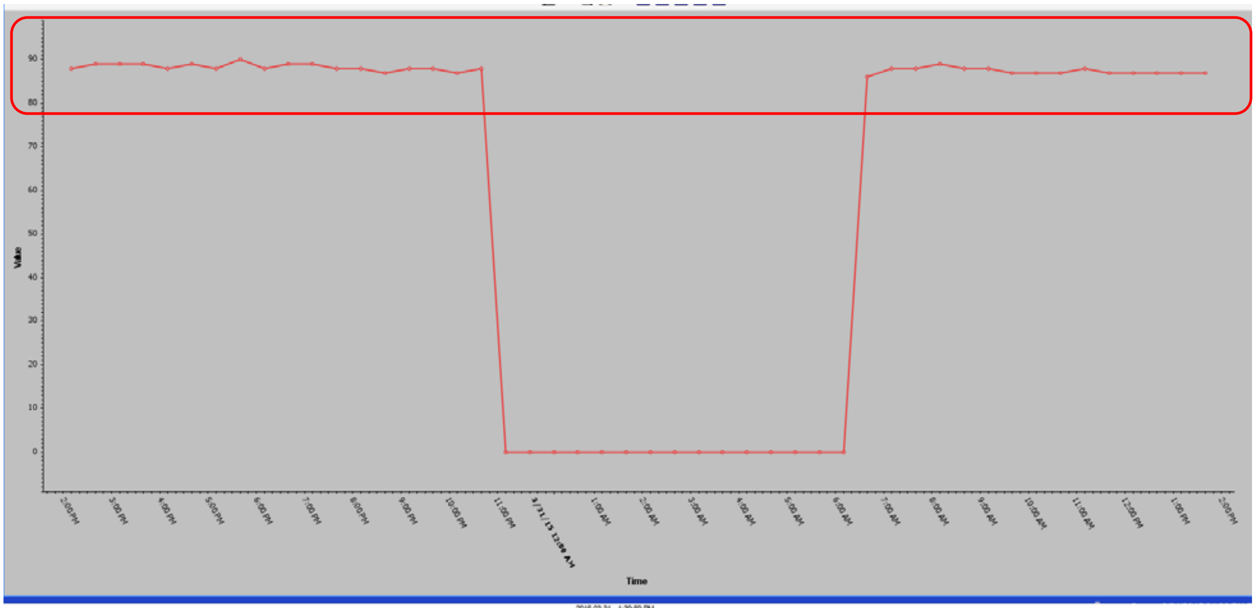


Figure 17: AHU 2 Fan Speed

Measure Description

Install VAVs in the second floor of A block and control AHU-2 fan speed to feedback from the VAVs.

Evidence of Proper Implementation

The recommended method for verifying that this measure is implemented properly is by reviewing BAS trends and BAS programming.

6.0 Next Steps – Implementation Phase and Hand-off Phase

6.1 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. According to the program agreement, the time period allowed for the Implementation Phase is the "rest of fiscal year + additional year" as measured from completion of the Investigation Phase (could range from 13 to 23 months), with the proviso that the Energy Management Information System (EMIS) must have sufficient time to collect the required baseline data. Therefore for this project, the Implementation phase must be completed by Mar 31, 2017

Once implementation is complete, the *Implementation Summary Table* will be submitted to the owner and the program (for approval) as part of the *Retrocommissioning Final Report*.

6.2 Hand-off Phase

The Program provides an incentive payment to SES Consulting to follow up after implementation of the selected measures to create the *Retrocommissioning Final Report (Final Report)*. The *Final Report* for the implemented measures includes, but is not limited to: a description of the new or improved sequences of operation, energy savings impact of the measures, requirements for ongoing maintenance and monitoring of the measures, the *Training Outline*, *Training Completion Form* and contact information for SES Consulting, in-house staff and contractors responsible for implementation.

Appendix A: Investigation Summary Table

#	Measure	Estimated Annual Electric Usage Savings (kWh)	Estimated Annual Electric Usage Savings ($)	Estimated Annual Electric Demand Savings ($)	Estimated Annual Gas Savings (GJ)	Estimated Annual Gas Savings ($)	Estimated Annual Total Savings ($)	Estimated Implementation Cost ($)	Simple Payback (years)	Measure life (years)	NPV ($)	IRR (%)	Description of Finding	Implementer	Recommendations for Implementation	Recommended Evidence of Implementation Method	Implement without incentives as part of <2 year simple payback bundle? (Y or N)
2	Apply scheduling that turns off ventilation when spaces are typically unoccupied and there is no call for heating. Use an optimal start routine to determine when to start up ventilation systems to meet setpoints at the start of occupancy. Where afterhours use is of critical importance, install push button overrides to provide heating and ventilation	42,900	$4,156	$0	310	$3,990	$8,146	$8,000	1.0	5.0	$ 29,305	102%	AHUs in A Block and B Block are operating from 6am to 11pm. Some of the AHUs operate almost 24 hours per day instead of running according to the schedule, including A Block AHU-1, AHU-3, AHU-4 and AHU-5	Controls Contractor	Apply scheduling that turns off ventilation when spaces are typically unoccupied and there is no call for heating. Use an optimal start routine to determine when to start up ventilation systems to meet setpoints at the start of occupancy. Where afterhours use is of critical importance, install push button overrides to provide heating and ventilation This measure will be applied to: 1. A Block: AHU-1, 2, 3, 4, 5 (Existing schedule 6am to 10:30pm) 2. B Block: AHU-2, 3, 4 (can not get schedule from DDC) Johnson controls thermostats on the third and fourth floors have override buttons integrated.	Pulse or energy consuption data and DDC review.	Y
3	Reset boiler heating water supply temperature based on feedback from the zones.	0	$0	$0	80	$1,030	$1,030	$4,900	4.8	5.0	$ (185)	21%	HWST varies between max and min supply water temperature based on OAT. This strategy limits the ability of the system to respond to demands from the spaces, and may promote non condensing conditions at the boilers.	Controls Contractor	Use Trim and Respond control logic	Pulse or energy consuption data and DDC review.	Y
4	Reset SAT based on the feedback from the VAV boxes to minimize simultaneous heating and cooling.	0	$0	$0	110	$1,416	$1,416	$4,300	3.0	5.0	$ 2,183	33%	Supply air temperature (SAT) is currently based on outdoor air temperature (OAT), rather than zone demand.	Controls Contractor	Use Trim and Respond control logic	Pulse or energy consuption data and DDC review.	Y
5	We recommend implementing a dynamic supply air pressure reset program to reduce fans speeds during non-peak cooling periods. SAP setpoints are typically set to deliver enough air flow for the worst-case cooling scenario. During heating conditions the SAP setpoint may be reduced while still maintaining desirable space conditions with reduced air delivery.	86,500	$8,380	$0	0	$0	$8,380	$4,300	0.5	5.0	$ 34,077	195%	AHUs serve VAV boxes with reheat in A Block and B Block. AHU supply fans are equipped with variable speed drive and operate at static speed most of the time.	Controls Contractor	Use trim and respond control logic This measure will be applied to: 1. A block: AHU1, 2, 3, 4 2. B Block: AHU2, 3, 4	Pulse or energy consuption data and DDC review.	Y

6	Program dual-maximum VAV control for all terminal units. This strategy will maintain a lower flow rate when the space is in dead-band, and stage zone heating to minimize airflow while meeting space demand.	31,700	$3,071	$0	160	$2,059	$5,130	$5,800	1.1	5.0	$ 17,695	88%	Variable air volume terminal units are controlled to minimum and maximum flow setpoints based on heating or cooling demand. Perimeter radiation is controlled to operate at the same time as VAV reheat.	Controls Contractor	Reference: http://www.taylor-engineering.com/downloads/articles/ASHRAE%20Journal%20-%20Dual%20Maximum%20VAV%20Box%20Control%20Logic.pdf General Notes 1. VAV boxes are scheduled for operation based on the associated System. 2. Reheat valve to remain fully closed associated System is off. 3. Minimum Airflow = 20% of Maximum Cooling Flow 4. Maximum Heating Flow = 50% of Maximum Cooling Flow Normal Mode 1. VAV damper and reheat valve modulate to maintain supply air temperature setpoint 2. Airflow and reheat control is split into the following	Pulse or energy consuption data and DDC review.	Y
7	Install thermostats with integrated CO2 and occupancy sensors in zones served by rooftop units. Control RTU damper position to maintain adequate air quality and space temperature.	0	$0	$0	250	$3,217	$3,217	$22,000	6.8	5.0	$ (7,265)	15%	Minimum outdoor air damper positions do not modulate based on air quality. Most zones served by rooftop units (RTU) do not have air quality sensors.	Controls Contractor	Review strategies to determine whether it is most appropriate to put sensor in supply or return duct for this space. Several RTUs do not have minimum damper position set by DDC. Determine whether it is more cost effective to take control of economizers or to leave as-is and reduce minimum economizer position. This measure will be applied to: A block: AHU1, 2; RTU-11, 12, 13, 14 B Block: AHU2, 3, 4 C Block: RTU1, 2, 3 No damper control on DDC: B Block: RTU-15 B Block: ACU-1 to ACU-8 In A block AHU3, 4, 5, there is CO2 censor in return air duct, but it seems that min OAD position is not controlled by CO2 level.	Pulse or energy consuption data and DDC review.	Y
8	Install occupancy sensors in large spaces. Apply counter algorithms to monitor occupant density and set back temperature and flow setpoints when occupant density is low.	0	$0	$0	140	$1,802	$1,802	$5,000	2.8	5.0	$ 3,252	36%	There are a number of large spaces where occupancy is intermittent, including the theatre, art spaces, and law school lecture theatres.	Controls Contractor	Maintain daytime unoccupied deadband of ±1.5°C. This will allow RTU to quickly bring room to setpoint when dense occupancy is detected. This measure will be applied to: • Theatre • Art wing • Lecture theatres in law school	Pulse or energy consuption data and DDC review.	Y
9	Connect DHW tanks to the DDC and schedule the DHW pumps based on actual occupancy.	1,800	$174	$0	50	$643	$818	$5,100	6.2	10.0	$ 1,877	16%	Currently the domestic hot water (DHW) tanks are not on DDC and the DHW circulation pumps are running 24/7	Controls Contractor	Run on same schedules as AHUs	Pulse or energy consuption data and DDC review.	Y
10	Open one or two labs for public use prior to the start of classes, maintain the others in setback mode until occupancy is detected. Integrate lighting occupancy sensors to DDC for use in HVAC control.	0	$0	$0	30	$386	$386	$3,500	9.1	5.0	$ (1,732)	11%	Many computer labs are conditioned prior to class start up. All labs are open to public use prior to classes and are conditioned accordingly.	Controls Contractor	Add overrides to allow staff and students to bring systems outside of operating hours	Pulse or energy consuption data and DDC review.	Y
11	Install curtain for leaky garage doors to prevent heating or cooling losses.	0	$0	$0	30	$386	$386	$1,700	4.4	5.0	$ 68	23%	There is a leaky garage door in the sculpture studio which causes unnecessary heating loss .	Controls Contractor	Could also change garage door for one with higher U-value	Pulse or energy consuption data and DDC review.	Y
14	Integrate a real-time weather feed from environment canada and use it to lock out heating when daytime temperatures will be high.	0	$0	$0	60	$772	$772	$5,300	6.9	5.0	$ (1,764)	15%	There are OAT lockouts in place in this facility, but no weather predictor program. This results in the building heating in the morning and cooling in the afternoon.	Controls Contractor		Pulse or energy consuption data and DDC review.	Y
15	Implement a load shedding strategy to reduce variable loads during peak demand periods.	0	$0	$4,198	0	$0	$4,198	$5,000	1.2	5.0	$ 14,227	84%	There are a number of variable loads in the building which cause high peak demands.	Controls Contractor	JCI is currently integrating the campus demand meter to the metasys DDC system in house of learning. The new chipkin device can be used for this project also.	Pulse or energy consuption data and DDC review.	Y
		162,900	$ 15,781	$ 4,198	1,220	$ 15,701	$ 35,681	$ 74,900	2.1								