Continuous Optimization for Commercial Buildings Program

Retrocommissioning Investigation Report

May 2, 2013

Prepared for:

Thompson Rivers University

Science Building

BC Hydro #:COP10-351

Prism Project #: 2012100

Prepared by:

saving you energy

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Introduction

Prism Engineering Ltd is pleased to present the results of the Investigation Phase that was conducted as part BC Hydro's Continuous Optimization for Commercial Buildings Program for the Science building at the Thompson Rivers University Kamloops Campus. 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 implementations 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 recommendations for implementation 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.

Seven retrofits were identified as a part of this investigation. The proposed measures were reviewed in a meeting with Thompson Rivers University, BC Hydro and Prism Engineering representatives to determine which measures will be implemented.

Retrofits approved for implementation include:

- Install Occupancy Sensors in Classrooms;
- Shutdown Heating Pumps at Night;
- Implement Heat Pump Loop Pumps Night Shutdown;
- Lower Heat Pumps Night Setpoints;
- Lower SF-3 Supply Air Temperature;
- Recommission Demand Controlled Ventilation System;
- Add DDC control to Vestibule Forced Flow Heaters.

The following retrofits were not considered for implementation under the C Op program but are recommended for further analysis and implementation for addressing comfort or operational issues:

- Install VSD on SF-3

The following retrofits were not considered for implementation due to the long payback periods:

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1.0 Project Overview

Project Information	
Project/Building Name	Science Building
Building Owner	Thompson Rivers University
Building Location	Kamloops, BC
Project Start Date	3/12/2012
Project Completion Date	3/15/2013

Contact List	
C.Op Provider	Ken Holdren/Juan Mani
C.Op Firm	Prism Engineering
email	ken@prismengineering.com
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Building Owner Representative	Jim Gudjonson
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Building Engineer	Tom O'Byrne
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BC Hydro Program Representative	Graham Henderson
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phone	(604) 453-6471
phone	(604) 453-6471

Task	Date Completed
RCx investigation kickoff meeting	20/Jun/2012
EMIS installation date (Electricity)	11/Apr/2013
EMIS installation date (Fuel)	11/Apr/2013
Master List of Findings submitted	15/Mar/2013
Master List of Findings approved	
Master List of Findings meeting with owner	
Measures selected for implementation	
RCx Investigation Report submitted	

Estimated Project Implementation Start Date	August 1, 2013

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Building Energy Usage Summary	
Building Size (gross sq. meters)	10,800
Building Size (conditioned sq. meters)	10,800
Annual Electric Consumption (kWh/yr)	1,266,767
Annual Electric Cost (with applicable taxes)	$84,397
Bulk cost per kWh (with demand charges)	$0.067
Utility Rate Tariff	1611
Fuel Type	Natural Gas
Annual Fuel Consumption (GJ)	3,816
Annual Fuel Cost (with applicable taxes)	$36,330
Fuel Cost per gigajoule	$8.50
Total Energy Cost (with applicable taxes)	$120,727
Electric Energy Use Intensity (EUI) (kWh/sq. meters)	117
Building Energy Use Intensity (EUI) (ekWh/sq. meters)	215

RCx Costs & Savings	
Implementation Cap	$29,100
Implementation Cost	$26,400
Annual Electric Usage Savings (kWh)	40,848
Annual Electric Usage Savings - Avg. of Year 1&2 ($)	$3,583
Savings as % of Total Electric Usage	3.2%
Annual Electric Demand Savings ($)	$0
Annual Fuel Savings (GJ)	254
Annual Fuel Savings ($)	$2,161
Savings as % of Total Fuel Usage	6.7%
Total Energy Cost Savings - Avg. of Year 1&2 ($)	$5,744
RCx Project Simple Payback	5.5
Savings as % of Total Energy Cost	4.8%

Implementation cost includes engineering and project management. It is our intent to provide accurate pricing; however, the measure implementation costs provided should be used as budgets only and not fixed prices. Pricing assumes that all measures will be implemented. Implementation costs for individual measures will likely increase if measures are excluded from the scope of contracted services.

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1.1 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.

Boilers

The West heating loop is served by two Smith Cooper 1,200 mBH atmospheric Boilers. The boilers are connected in parallel; water is circulated through the boilers by a ¾ hp boiler pump. The East heating loop has a Bryan model CL-180-W-FDG forced draft boiler (B-1) rated at 1,800 mBH input. Water is circulated through B-1 by a ¾ hp boiler pump. Both heating plants are connected for backup.

Hot Water Distribution

The heating plant serves the heat pump loops through a heat exchanger controlled by a two-way valve. Perimeter radiation is achieved by hot water convectors, all without zone control valves. Make-up air units SF101 and SF102 heating coils are supplied from the secondary loop. A summary of the heating distribution pumps is included in Table 1.

Table 1: Summary of Heating Water Distribution Pumps

Tag	Description	Hp
P-102	Boiler loop circulator	1
P-103	East hot water heating loop	3/4
P-104	West hot water heating loop	3/4
P-105	SF-101 heating coil	1/3
P-106	SF-102 heating coil	1/3

Heat Pump Loop

The main source of heating and cooling for the Building is via a series of water source heat pump units connected by two independent water loops, one serving the East wing and one for the West, through which water is continuously circulated.

Heat is rejected into the water loops when units are in cooling mode and is taken out of the loops when units are heating the space they serve. To keep the water loop temperature within a specified range, the loops are equipped with evaporative fluid coolers (one per loop) for heat rejection and the gas-fired boilers for heat addition.

Heat Pump Loop Water Distribution

Two pumps, P-1 and P-101, serving the East and West water loops respectively, circulate water in the heat pump loops. The 7 ½ hp pumps operate continuously.

Fluid Coolers

Two fluid coolers, one per loop, located on the roof provide heat rejection for the heat pump loops. The fluid coolers, B.A.C. model F1743-L, are equipped with two fan motors rated at 15 and 5 hp in a main/pony fashion and a 1 hp spray pump.

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Heat Pump Units

There are 32 McQuay water source heat pumps (WSHP) installed in the building's mechanical closets that provide heating, cooling and air circulation. The units are controlled by DDC. A summary of the units is presented in Table 2.

Table 2: Summary of WSHP

Size	Quantity	Cooling Capacity (TON)
12	2	1
19	2	1 3/4
24	4	2
30	4	2 1/2
36	6	3
42	4	3 1/2
48	3	4
60	7	5

Make-Up Air Units

Three make-up air units, AH-1, SF101 & SF-102, provide ventilation for the areas served by the heat pumps. Additional make up air is provided to areas with fume hoods by units SF-103 and MAU-1. SF-103 consists of a a constant volume supply fan and a recirculation damper controlled to maintain a constant static pressure to allow for variable flow. Unit MAU-1(also called SF-104) is equipped with a VFD. The VAV boxes supplying the space are controlled in accordance with the number of fume hoods in operation. All units are under DDC, a summary is presented in Table 3.

Table 3: Summary of Makeup Air Units

Tag	Service	HP	CFM	Flow Control	Heating Coil	Cooling
AH-1	Base building	N/A	N/A	None	Yes	No
SF-101	East wing addition	5	3,700	None	Yes	No
SF-102	West wing addition	5	6,600	VSD	Yes	No
SF-103	VAV	10	8,900	VSD	Yes	No
MAU-1	Second floor VAV	7 ½	7,100	VSD	Gas fired Burner	DX

Exhaust

General and washroom exhaust is provided by two DDC controlled exhaust fans.

Twenty two roof exhaust fans serve the fume hoods installed on the laboratories. All fume hoods are locally controlled by manual switches and the status is DDC monitored.

Compressed air systems

Two Ingersoll Rand air compressors located in the basement mechanical room provide compressed air for the labs.

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Building Management/Automation System (BAS)

The mechanical systems in the building are controlled from a BAS controlled with Direct Digital Control (DDC). The system is a SIEMENS Insight, version 3.11.

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

This section provides an overview of each measure, recommendations for implementation, 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).**

2.1 Measure 1: Install Occupancy Sensors in Classrooms

Overview

Heat pumps serving classrooms operate under a weekly schedule from 7:00 AM to 6:00 PM, seven days a week. The classrooms and other areas are not continuously occupied during weekly scheduled hours. In addition, during some periods such as professional days or reading week, the building is open for the staff but the classrooms are unoccupied.

Energy savings can be achieved by installing occupancy sensors in areas with intermittent occupancy

Table 4: Areas Recommended for Occupancy Control

Floor	Room Number	Area	Heat Pump
2nd	275	Computer lab	SH065
2nd	203	Lecture	SH051
2nd	201	Classroom	SH050
2nd	233	Classroom	SH015
2nd	266	Computer lab	SH005
3rd	375	Classroom	SH072
3rd	373	Lecture	SH071
3rd	337	Lecture	SH032

Recommendations for Implementation

Install occupancy sensors in the rooms included in Table 4. The heat pumps serving these rooms would operate in “standby mode” when the spaces are not in use. The standby heating and cooling setpoints would be allowed to drift by up to 1.5°C from the occupied setpoint. The supply fan will be off and cycle with the compressor as required to maintain standby setpoint. A brief (15 minute) flush would be provided if a heat pump does not operate for 2 hours.

Evidence of Proper Implementation

The recommended method for verifying that this measure is implemented properly is by setting trends showing the room temperatures, supply fan and compressor status.

2.2 Measure 2: Shutdown Heating Pumps at Night

Overview

There are two hot water radiation loops in the building. The East Wing is served by pump P-103 and the West Wing is served by pump P-104. Both loops comprise a three-way valve for temperature control and serve wall fin convectors, forced flow heaters and radiant panels.

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The pumps are enabled when the outdoor temperature is below 15 °C and disabled above 17 °C.

With the existing outdoor temperature control, the heating pumps are continuously enabled from November to March, according to Kamloops hourly weather data, regardless of occupancy.

Recommendations for Implementation

We recommend shutting down the radiation pumps at the end of the building's occupancy periods. The heating pumps would be enabled if the at least three sensors read below 15°C and disabled when all sensors are above 17 °C. Pumps will run continuously if the outdoor temperature is 5°C or lower.

Evidence of Proper Implementation

The recommended method for verifying that this measure is implemented properly is by setting trends showing the heating pump status and the building's minimum room temperature.

2.3 Measure 3: Implement Heat Pump Loop Pumps Night Shutdown

Overview

The building is equipped with two independent heat pump loops to provide heating and cooling. Each heat pump loop uses a 7 ½ HP circulating pump operating continuously. An energy retrofit in 2011 was implemented to shut down the loop pumps at the end of the occupied periods. The pumps were programmed in the DDC code to start if any heat pump in the loop they serve was required to start, once the pump was started, the pump would run until the end of the following occupied period.

The heat pump shutdown was abandoned due to some heat pumps tripping on high head pressure.

Recommendations for Implementation

We recommend investigating the reason of the heat pumps tripping. Provided that the loop flow is established prior to enabling of heat pump compressors and loop flow is maintained for a few minutes after all compressors have shutdown, shutting off the loop pumps will not result in tripping of the units. Once the problem is resolved, restore the heat pump loop pump night shutdown.

Evidence of Proper Implementation

The recommended method for verifying that this measure is implemented properly is by trend logs for pump status

2.4 Measure 4: Lower Heat Pumps Night Setpoints

Overview

The heat pumps serving the building are controlled by Siemens configurable Terminal Equipment Controllers (TEC). The DDC system switches the operation mode from day to night via a weekly schedule; when in night mode, the controllers switch to night heating and cooling setpoints.

The night mode heating setpoints on the controllers are between 18°C to 21°C. The cooling setpoint is between 24°C and 28°C

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Recommendations for Implementation

We recommend setting the night setpoints to 15 °C for heating and 28° for cooling.

Evidence of Proper Implementation

The recommended method for verifying that this measure is implemented properly is by reviewing a report of TEC controller settings for the building and reviewing trends showing the space temperatures.

2.5 Measure 5: Lower SF-3 Supply Air Temperature

Overview

SF-3 provides makeup air for fume hoods in the West Wing. The unit comprises a 10 hp supply motor, a gas fired heating and a run around bypass damper section to supply 10 VAV boxes. A graphic representation from the DDC system is shown in Figure 1.

The gas burner is not controlled by DDC. The supply air temperature is monitored by DDC. Observations during the winter time showed that the supply air temperature is around 23°C.

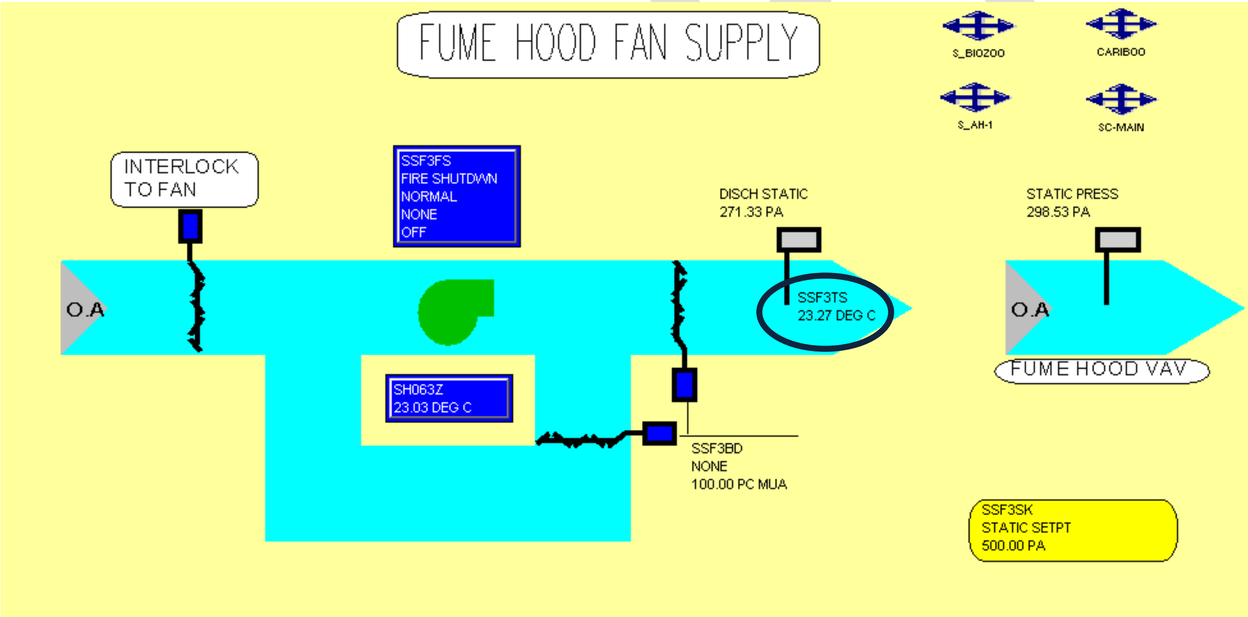

Figure 1: SF-3 DDC Graphic

Air supplied from SF-3 is not intended to condition the space since is used as makeup for the fume hoods. A neutral supply air temperature would reduce the ventilation load without compromising comfort.

Recommendations for Implementation

We recommend lowering the supply air temperature setpoint at the unit to 20°C.

Evidence of Proper Implementation

The recommended method for verifying that this measure is implemented properly is by reviewing trends of the supply air temperature.

2.6 Measure 6: Recommission Demand Controlled Ventilation System

Overview

A Demand Controlled Ventilation (DCV) was implemented in 2011. A modulating damper on the outdoor air duct and a CO2 transmitter was installed in each heat pump closet. The dampers are controlled, subject to a 25% minimum position, to maintain a maximum CO2 concentration of 750 ppm. The makeup air units serving the closets (AH1, SF-1 and SF-2) are equipped with VSDs which modulate the fan speed to maintain static pressure setpoint.

During most of the course of the investigation SF-2 was observed operating constantly at 100% even when all the dampers were at minimum position, as can be observed in Figure 2.

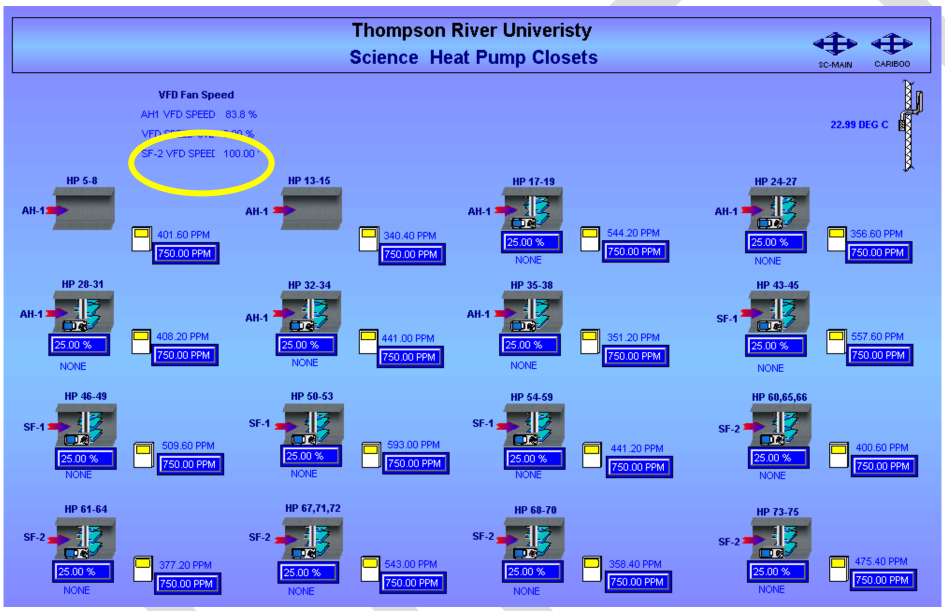

Figure 2: Heat Pump Closet Screen Taken on 7/20/2012

Since the beginning of March, SF-2 fan speed is modulating. However, SF-1 is now operating close to 100% speed with erratic control.

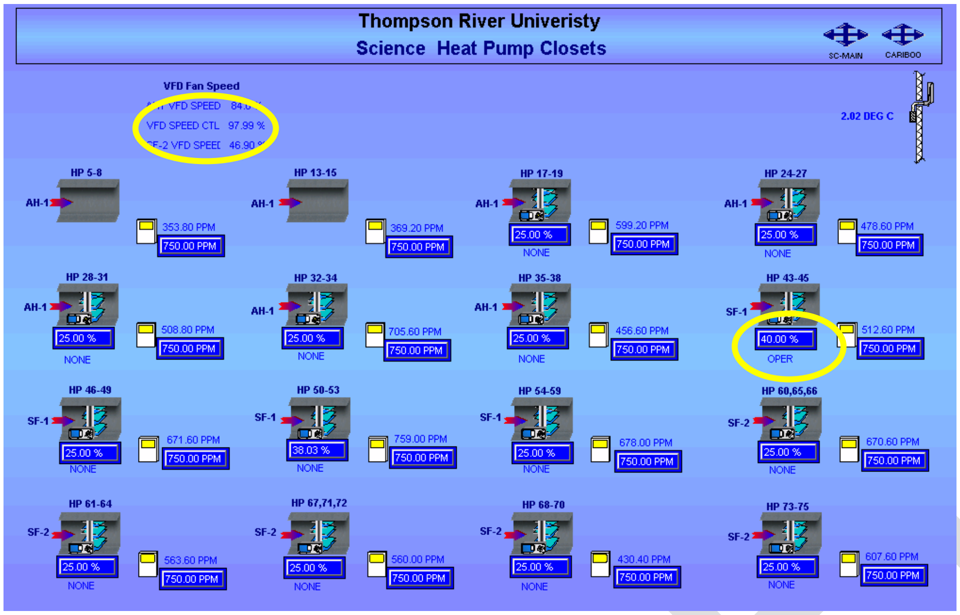

Figure 3: Heat Pump Closet Screen Taken on 3/06/13

The damper serving Heat pump closet HP 43-45 has been overridden to 40%. This override is not only restraining the energy savings but also limiting the amount outdoor air provided to this closet, hence jeopardizing the supply of sufficient ventilation to the spaces the heat pump serves.

Recommendations for Implementation

We recommend having the DDC contractor recommission the DCV system to perform as per original design intent.

Evidence of Proper Implementation

The recommended method for verifying that this measure is reviewing trends including fans speeds, closet damper position, CO_2 concentrations.

2.7 Measure 7: Add DDC control to Vestibule Forced Flow Heaters

Overview

Vestibules in the building are heated by forced flow heaters controlled by local thermostats. The vestibules are heated to a constant setpoint of 18°C, as recorded on a site visit at night.

Recommendations for Implementation

Add DDC control to the three forced flow heaters located in the vestibules. During occupied periods the heaters would be controlled to maintain a temperature of 15°C and a night setback temperature of 5°C.

Evidence of Proper Implementation

The recommended method for verifying this measure is by reviewing trend logs including vestibule temperature and forced flow heater status.

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3.0 Measures to be considered for Future Implementation

The following measures include findings that were investigated but not selected for implementation under the BC Hydro Continuous Optimization program. These measures have longer than the 2 years payback considered in the BC Hydro C. Op program or are capital measures.

3.1 Install VSD on SF-3

Overview

SF-3 Serves the West Wing as makeup air unit for fume hoods. The unit comprises a 10 hp supply motor, gas fired heating and a run around bypass damper section to supply 10 VAV boxes. The bypass dampers are controlled by DDC to maintain a static pressure setpoint of 500 Pa.

Recommendations for Implementation

Energy savings can be achieved by installing a VSD on the supply fan to modulate the air flow going to the VAV's instead of using the bypass.

Further investigation is required since the makeup air unit may need to be re-certified to operate with a VSD. In addition, there is no evidence there is enough potential savings to justify the expense. The bypass dampers are operating continuously at 100% position (full flow to the VAVs). This may be caused by the static pressure being too high since the E.S.P. on the shop drawings is 250 Pa (current setpoint 500 Pa) but the static pressure at the discharge was observed fairly stable around 275 Pa.

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4.0 Next Steps – Implementation and Hand-off Phases

4.1 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 *Retrocommissioning Investigation 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. The *Retrocommissioning Investigation Report* and *Investigation Summary Table* should provide sufficient detail to specify accurate implementation of the measures if handled by in-house staff, contractors or a combination of both.

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 March 2014.

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*.

4.2 Hand-off Phase

The Program provides an incentive payment to Prism Engineering Ltd. 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 Prism Engineering Ltd., in-house staff and contractors responsible for implementation.

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Appendix A: Investigation Summary Table

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BC Hydro Continuous Optimization for Commercial Buildings Program
Science Building

#	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 (%)
1	Install Occupancy Sensors in Classrooms	4,824	$423	$0	0	$0	$423	$10,200	24.1	5.0	$ (8,263)	4%
2	Shutdown Heating Pumps at Night	2,258	$198	$0	0	$0	$198	$4,100	20.7	5.0	$ (3,193)	5%
3	Implement Heat Pump Loop Pumps Night Shutdown	22,080	$1,936	$0	0	$0	$1,936	$4,400	2.3	5.0	$ 4,468	44%
4	Lower Heat Pumps Night Setpoints	11,130	$976	$0	0	$0	$976	$700	0.7	5.0	$ 3,770	139%
5	Lower SF-3 Supply Air Temperature	0	$0	$0	221	$1,874	$1,874	$400	0.2	5.0	$ 8,184	469%
6	Recommission Demand Controlled Ventilation System	323	$28	$0	24	$203	$231	$2,800	12.1	5.0	$ (1,742)	8%

BC Hydro Continuous Optimization for Commercial Buildings Program
Science Building

#	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 (%)
7	Add DDC control to Vestibule Forced Flow Heaters	234	$20	$0	10	$84	$105	$3,800	36.3	5.0	$ (3,321)	3%
		40,848	$ 3,583	$ -	254	$ 2,161	$ 5,744	$ 26,400	4.6			

BC Hydro Continuous Optimization for Commercial Buildings Program
Science Building

#	Measure	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)
1	Install Occupancy Sensors in Classrooms	Heat pumps serving classrooms operate under a weekly schedule from 7:00 AM to 6:00 PM, seven days a week. The classrooms and other areas are not continuously occupied during weekly scheduled hours. In addition, during some periods such as professional days or reading week, the building is open for the staff but the classrooms are unoccupied. Energy savings can be achieved by installing occupancy sensors in areas with intermittent occupancy	DDC contractor	Install occupancy sensors in the rooms served by heat pumps SH005, 015, 032, 50, 51, 65, 71 & 72. The heat pumps serving these rooms would operate in "standby mode" when the spaces are not in use. The standby heating and cooling setpoints would be allowed to drift by up to 1.5°C from the occupied setpoint. The supply fan will be off and cycle with the compressor as required to maintain standby setpoint. A brief (15 minute) flush would be provided if a heat pump does not operate for 2 hours.	Set trends showing the room temperatures, supply fan and compressor status.	Y
2	Shutdown Heating Pumps at Night	There are two hot water radiation loops in the building. The East Wing is served by pump P-103 and the West Wing is served by pump P-104. Both loops comprise a three-way valve for temperature control and serve wall fin convectors, forced flow heaters and radiant panels. The pumps are enabled when the outdoor temperature is below 15 °C and disabled above 17 °C. With the existing outdoor temperature control, the heating pumps are continuously enabled from November to March, according to Kamloops hourly weather data, regardless of occupancy.	DDC contractor	Shut down the radiation pumps at the end of the building's occupancy periods. The heating pumps would be enabled if the at least three sensors read below 15°C and disabled when all sensors are above 17 °C. Pumps will run continuously if the outdoor temperature is 5°C or lower.	Set trends showing the heating pump status and the building's minimum room temperature.	Y
3	Implement Heat Pump Loop Pumps Night Shutdown	The building is equipped with two independent heat pump loops to provide heating and cooling. Each heat pump loop uses a 7 ½ HP circulating pump operating continuously. An energy retrofit in 2011 was implemented to shut down the loop pumps at the end of the occupied periods. The pumps were programmed in the DDC code to start if any heat pump in the loop they serve was required to start, once the pump was started, the pump would run until the end of the following occupied period. The heat pump shutdown was abandoned due to some heat pumps tripping on high head pressure.	DDC contractor	Investigate the reason of the heat pumps tripping. Provided that the loop flow is established prior to enabling of heat pump compressors and loop flow is maintained for a few minutes after all compressors have shutdown, shutting off the loop pumps will not result in tripping of the units. Once the problem is resolved, restore the heat pump loop pump night shutdown.	Trend logs for pump status	Y
4	Lower Heat Pumps Night Setpoints	The heat pumps serving the building are controlled by Siemens configurable Terminal Equipment Controllers (TEC). The DDC system switches the operation mode from day to night via a weekly schedule; when in night mode, the controllers switch to night heating and cooling setpoints. The night mode heating setpoints on the controllers are between 18°C to 21°C. The cooling setpoint is between 24°C and 28°C	DDC contractor	Set the night setpoints to 15 °C for heating and 28° for cooling.	Review a report of TEC controller settings for the building and reviewing trends showing the space temperatures.	Y
5	Lower SF-3 Supply Air Temperature	SF-3 provides makeup air for fume hoods in the West Wing. The unit comprises a 10 hp supply motor, a gas fired heating and a run around bypass damper section to supply 10 VAV boxes. The gas burner is not controlled by DDC. The supply air temperature is monitored by DDC. Observations during the winter time showed that the supply air temperature is around 23°C. Air supplied from SF-3 is not intended to condition the space since is used as makeup for the fume hoods. A neutral supply air temperature would reduce the ventilation load without compromising comfort.	DDC contractor	Lower the supply air temperature setpoint at the unit to 20°C.	Review trends of the supply air temperature.	Y
6	Recommission Demand Controlled Ventilation System	A Demand Controlled Ventilation (DCV) was implemented in 2011. A modulating damper on the outdoor air duct and a CO_2 transmitter was installed in each heat pump closet. The dampers are controlled, subject to a 25% minimum position, to maintain a maximum CO_2 concentration of 750 ppm. The makeup air units serving the closets (AH1, SF-1 and SF-2) are equipped with VSDs which modulate the fan speed to maintain static pressure setpoint. During most of the course of the investigation SF-2 was observed operating constantly at 100% even when all the dampers were at minimum position. Since the beginning of March, SF-2 fan speed is modulating. However, SF-1 is now operating close to 100% speed with erratic control. The damper serving Heat pump closet HP 43-45 has been overridden to 40%. This override is not only restraining the energy savings but also limiting the amount outdoor air provided to this closet, hence jeopardizing the supply of sufficient ventilation to the spaces the heat pump serves.	DDC contractor	Have the DDC contractor recommission the DCV system to perform as per original design intent.	Review trends including fans speeds, closet damper position, CO_2 concentrations.	0

BC Hydro Continuous Optimization for Commercial Buildings Program
Science Building

#	Measure	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)
7	Add DDC control to Vestibule Forced Flow Heaters	Vestibules in the building are heated by forced flow heaters controlled by local thermostats. The vestibules are heated to a constant setpoint of 18°C, as recorded on a site visit at night.	DDC contractor	Add DDC control to the three forced flow heaters located in the vestibules. During occupied periods the heaters would be controlled to maintain a temperature of 15°C and a night setback temperature of 5°C.	Review trend logs including vestibule temperature and forced flow heater status.	0