

## 8.2 OPM-02: Building Automation System (BAS) Upgrades<sup>8</sup>

### 8.2.1 Measure Baseline

The current Building Automation System (BAS) comprises a Johnson Controls Metasys Direct Digital Control (DDC) System. Over the years, this system has undergone numerous partial upgrades, encompassing hardware, programming, and graphical interfaces. Consequently, this has led to a disparity in the ages of hardware throughout the facility, alongside an accumulation of redundant programming and graphics. In some instances, the graphics do not accurately represent the present configuration of the mechanical systems. Moreover, the recent upgrade of the refrigeration plant, which integrates a separate DDC system for its control, has highlighted certain shortcomings in the control of the existing HVAC chilled glycol loop.

### 8.2.2 Measure Description and Scope of Work

The purpose of this measure is to provide hardware throughout the facility of the same generation, provide consistent and updated programming throughout the systems, and upgrade BAS graphics to the latest graphics packaged offered by Johnson Controls with updates to accurately reflect the current HVAC configuration.

This scope of work includes the following:

- Upgrade and replacement of existing network engines and equipment controllers throughout PSLC (Arena and Pool)
- Reprogramming of existing control logic throughout facility and removal of redundant programs. New programming will follow best practices and ASHRAE Guide 36 "High-Performance Sequences of Operation for HVAC Systems" wherever practical. Reprogramming will include a thorough review of existing schedules and setpoints.
- Updating system graphics and removal of redundant graphics.
- Setting up of short-term and long-term trend logs for system performance monitoring.

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<sup>8</sup> This measure is potentially eligible for a FortisBC incentive.

## 8.5 OPM-05: Snow Melt Pit Heat Exchanger Retrofit

### 8.5.1 Source Notes

This measure was originally included in the FortisBC Study completed by Polar & FirstLight Energy in July 2022. The calculations have been reviewed and updated based on the current understanding of the system operation.

### 8.5.2 Measure Baseline

Three snow melt pits, one for each rink, facilitate snow melt for the arena complex. Each pit utilizes a shell and tube heat exchanger, integrating with the facility's condenser loop as a source of heat for snow melting. Warm condenser water is circulated through the shell-side of the heat exchanger. Cold water from the snow melt pit is circulated through the tube-side of the heat exchanger by a sump pump equipped with an inlet filter and is heated and returned to the snow melt pit to melt snow accumulated from ice surface cleaning.

The current ice melt configuration causes maintenance and performance issues with melting ice. Debris included in ice from snow removal clogs the pump filters regularly, drastically reducing ice melt efficiency. The system can typically keep up with snow melting needs during the off season, when each ice surface is cleaned up to a maximum of 8 times daily. However, according to the operations staff, during peak seasons, each ice sheet undergoes approximately 12 cleanings per day and the current configuration cannot adequately process ice melting in a timely manner.

During peak seasons, staff have resorted to using domestic hot water (DHW) from the Zamboni DHW system to spray onto the pits to augment ice melting. However, this approach has led to a number of issues:

1. This process utilizing domestic water for ice melting which has drastically increased domestic water consumption.
2. The DHW is heated using natural gas which has led to an increase in natural gas consumption by approximately 370 GJ per year.
3. Evaporation from spraying DHW on the ice pits, and the elevated pit temperatures (up to 18°C) has a negative impact on the arena relative humidity levels at the east end of the rinks.

<sup>10</sup> Figure adapted from Polar Engineering & First Light Energy Solutions PSLC Fortis BC Study, July 2022



Figure 42 - Existing Snow Melt Pit Configuration<sup>10</sup>

### 8.5.3 Measure Description

This measure involves replacing the existing shell-and-tube heat exchangers with stainless-steel immersion style heat exchangers. Each heat exchanger will be submerged in its associated snow melt pit. The source side of the heat exchanger will be connected to the existing condenser loop to circulate warm water through the heat exchanger tube bundles. Condenser flow through the heat exchanger will be controlled by a two-way control valve to maintain the pit water temperature at 10°C. This lower pit temperature will reduce snow melt evaporation and the corresponding humidity issues associated with the existing higher pit water temperatures. This configuration of snow melt heat exchanger is very common; and example is illustrated in Figure 43.



Figure 43 - Example of Proposed Heat Exchanger Retrofit<sup>11</sup>

#### 8.5.4 Measure Scope of Work

The scope of work for each ice melt pit is described below:

- Removal of the existing circulation pump, filter, and associated piping.
- Removal of the existing heat exchanger.
- Installation of new stainless-steel immersion heat exchanger.
- Modification to existing condensate piping to connect the new heat exchanger complete with a two-way control valve and pit temperature sensor.

<sup>11</sup> Figure from Polar Engineering & FirstLight Energy Solutions PSLC Fortis BC Study, July 2022

## 11.1 ERM-01: Hydronic System Modifications & Heat Pump Replacement<sup>21</sup>

### 11.1.1 Measure Baseline

PSLC has a complex, multi-stage heat recovery system that is an early version of the Thermenex system. While it does help recover heat that would otherwise be wasted, staff and users have complained about experiencing operational challenges with the complexity of the piping arrangement and unpredictability in the system's operating temperatures. The current header experiences instabilities in temperatures which cause significant temperature fluctuations throughout the day which impact connected systems. The system is currently unable to reliably provide temperatures suitable for cooling. The staff also complain about the noise level of the existing heat recovery chiller and a desire to reduce noise in the mechanical room.

When the Thermenex system was installed, it was designed to recover waste heat from the ice plant's condenser at around 100 °F. This design temperature necessitated elevating the compressors' discharge temperatures from 80°F to 100°F, corresponding to a pressure increase from 154 PSI to 212 PSI. Subsequently, this adjustment, caused a heightened discharge pressure, contributing to more rapid compressors wear and diminishing their reliability. To mitigate these effects, the refrigeration system has since been adjusted to operate at lower condensing pressures, delivering supply water at 80°F to the Thermenex system. This reduction in condenser temperature has led to a significant portion of the refrigeration plant's waste heat being rejected to the atmosphere at the cooling towers rather than being reused within the facility and through the heat recovery loop.

Moreover, the evaporator and condenser pumps on the existing heat recovery chiller are undersized and prevent the heat recovery chiller from operating at full load, before hitting the upper and lower operating limits of the chiller.

<sup>21</sup> This measure is potentially eligible for a FortisBC incentive.

### 11.1.2 Measure Description

*Please note, ERM-01 is a cornerstone for ERM-02 to ERM-04, without which the savings of those ERMs are very limited.*

A simplified heat recovery approach is desired which balances energy efficiency with operational reliability.

This measure is an extensive overhaul of the existing heat recovery loop, or the Thermenex system. At its heart, it has three distinct parts that include upgrading the heat recovery chiller, modification of the headers, and piping modification of each subsystem.

In simple language, the current heat recovery system at PSLC, the Thermenex, faces operational challenges and unreliability. These include temperature fluctuations, noise complaints, and compressor wear. To address these, a simplified and more efficient heat recovery approach is proposed. It involves upgrading the heat recovery chiller, modifying headers and piping, and subsystems. The scope includes installing a new heat recovery chiller and modifying headers and piping. The goal is to achieve energy savings and improved reliability. With this overhaul, maintenance requirements are expected to decrease due to a more stable system.

As part of this measure, the existing Thermenex header configuration will be simplified and the chilled water and cold water headers will be converted into a bi-directional condenser loop. The warm water and hot water headers will be converted to a heating water system. The existing HRC and associated pumps will be replaced with a larger heat pump using a low GWP refrigerant and larger capacity pumps to allow the HRC to operate at full load at lower temperature differentials, typical with the current system operation. The sub-systems' connections will be modified to provide a standard integration approach with the distribution system. The lobby radiant slab systems will be re-piped to provide more useful heating and cooling, and the BAS will be reprogrammed to facilitate a cohesive control strategy.

### 11.1.3 Measure Scope of Work

The scope of work for this measure is outlined below:

- System A.1 - Heat Recovery Chiller
  - Install a RTWD-180 screw heat recovery chiller
  - Install a new condenser water pump, 10 hp with VFD
  - Install a new evaporator water pump, 7.5 hp with VFD
  - Provide piping, fittings, couplings, etc.
  - Provide seismic restraint of chiller and pumps
  - Add piping insulation and cladding
  - Connect the new heat pump to the electric circuit
  - Integrate pumps and chillers into BAS
- Header Modifications
  - Cap 10" piping connections in refrigeration room
  - Cap 10" piping connections in pool mechanical room
  - Add insertion electromagnetic flow meter on condenser loop
  - Add 6 temperature sensors
  - Add insertion electromagnetic flow meter on hot water loop
  - Add 6" bypass on heating water piping

- Thermenex subsystems
  - Piping modification of system A.1, B.1, B.2, C, E, H, I, J, K, L, M, N as per Appendix C
- Add proper controls for piping changes and integrate into BAS

## 11.5 ERM-05: High Temperature Heat Pump Retrofit

### 11.5.1 Measure Baseline

The high-grade heat in the facility is generated using gas-fired burners. Last stage DHW is currently being provided by the existing pool gas-fired boilers, the desiccant dehumidifiers are heated using natural gas burners, and the hot tub also requires boiler back-up on a regular basis due to the required operating temperatures. These subsystems are not connected to the Thermenex loop since the existing heat recovery chiller is limited to 46 °C supply water temperature which limits the loads it can serve in the building.

The baseline for this measure is to continue using the gas boilers and burners.

This measure was also included in the FortisBC Study completed by Polar & FirstLight Energy in July 2022 and was previously qualified for FortisBC incentive.

### 11.5.2 Measure Description

After ERM-01 is implemented, some end uses will require a higher-grade heat than what the Thermenex's heat recovery chiller can provide. For example, the final stage of domestic hot water requires heat up to 55-60°C. This higher temperature can be met by a high temperature heat recovery chiller, capable of producing condenser water at around 70°C, instead of the existing gas boilers.

This measure includes installing a nominal 50-ton water-to-water heat pump capable of generating up to 70°C supply water temperature. This heat pump will upgrade the heat reclaimed from the refrigerant plant to a useful temperature for heating DHW, hot tub water, and provide heat for dehumidification desiccant regeneration if implemented along with ERM-06.

The heat pump will be a modular heat pump installed near the existing pool heat exchangers. The evaporator side of heat pump will be integrated to the condenser side of the system to reclaim heat from the refrigerant plant and its condenser side will supply hot water to the existing boiler loop to meet high temperature heating loads.

### 11.5.3 Measure Scope of Work

The scope of work for this measure is outlined below:

- Install a 50-ton high temperature modular heat pump
- Provide Housekeeping Pad
- Provide additional piping
- Provide piping insulation
- Provide electrical service to heat pump and circulators
- Integrate the heat pump with the Thermenex system
- Integrate the heat pump and circulators with BAS

## 11.7 ERM-07: Pool Heat Exchanger Upgrades

### 11.7.1 Measure Baseline

The base case for this measure is to continue using the existing pool heat exchangers until their end of life and then replacing them with like-for-like units, without upgrading them.

### 11.7.2 Measure Description

There are three heat exchangers that serve each pool separately. HX-101 (125 MBH) serves the Lap Pool, HX-102 (250 MBH) serves the Leisure Pool, and HX-103 (150 MBH) serves the Hot Tub. They are all connected to the Thermenex system for the first stage heating. Each pool has another heat exchanger downstream of the abovementioned heat exchangers to top up the remaining heat load. These three preheat pool side heat exchangers could be upgraded to recover more heat from the Thermenex headers, consequently, reducing the load on gas-fired pool boilers. This measure involves replacing the current heat exchangers with new titanium heat exchangers, sized for low-temperature heating, with higher plate count and heat transfer capacity, to enable them better to utilize lower-grade heat.

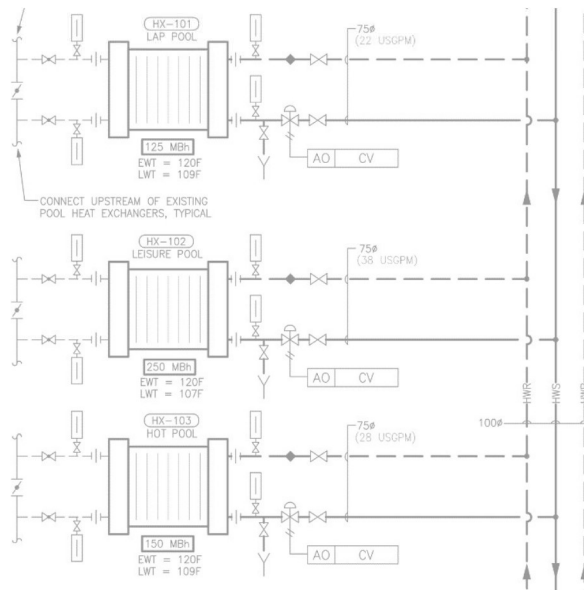


Figure 64 - Existing Pool Heat Exchangers and Their Capacities (top), HX-103 (bottom)

### 11.7.3 Measure Scope of Work

This measure involves replacing the existing pool heat exchangers with new, upgraded, higher capacity heat exchangers.