Recommissioning Alexander MacDonald Lodge

A case study

Sustainable Infrastructure Branch

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PROJECT SUMMARY

Project Name: Recommissioning Alexander MacDonald Lodge

Building Name/Type: Alexander MacDonald Lodge

Location: Dawson City, Yukon

Commissioning Scope: The Government of Yukon retained services to recommission Alexander MacDonald Lodge located in Dawson, Yukon. The consultants, Johnson Controls, conducted a thorough investigation of the building's control system to identify deficiencies and recommend actions for resolution or optimization.

Size of Commissioned Area: 1,260 sq. m.

Total Commissioning Investment: $48,505 (investigation) + $45,650 (implementation)

Energy Cost Savings: $13,234

Simple Payback: 7.11 years

Quantified annual non-energy benefits: Improved occupant comfort, increased recovered exhaust air energy, reduced operational issues and equipment downtime for the remote facility located in Dawson City.

Project overview and background

In 2018 the Government of Yukon (GY), with support from Natural Resources Canada, conducted a recommissioning project for Alexander MacDonald Lodge in Dawson City, Yukon. Alexander MacDonald Lodge (AML) is a 1,260 square metre, 24-hour long-term care facility that was constructed in 2016. This building was constructed as an attachment to the Dawson Hospital – AML's electrical and heating utilities are provided by the larger hospital.

Since occupancy, the building's operational issues require substantial efforts from building maintenance staff to ensure that the building remains comfortable for building occupants. The building maintenance team completed a prior investigation as part of their service contract to identify deficiencies; the report concluded that the building was inadequately commissioned during construction. This helped inform the objective of this recommissioning project: to perform a more complete investigation to thoroughly identify and resolve deficiencies, thereby increasing the performance of the building's mechanical and control systems.

PROJECT MANAGEMENT

PROJECT TEAM

Building owner: the Government of Yukon
YG project manager: Phil Christensen, Senior Building Program Manager
YG building maintenance lead: Louis Gerberding, Northern Superintendent
YG energy team: Tony Lam, Manager Energy Management Unit
Recommissioning agent: Johnson Controls Performance Infrastructure team

GY procured the services of Johnson Controls (JC) services to investigate and resolve deficiencies in the buildings HVAC and controls systems. The scope of work was collaboratively developed by the energy and building maintenance teams as a replicable framework. Since the Government of Yukon pursued recommissioning work for AML and Yukon University simultaneously, a shared scope of work would improve the efficiency of the tendering process, better communicate our expectations to the

consultants and provide a valuable framework for project management. The challenge was to standardize a scope of work that was adaptable to the unique circumstances of each building.

The work was led by JC's Performance Infrastructure team, based in Alberta. They were supported by consulting engineering partner Prism Engineering. The commissioning agent is both the manufacturer and existing maintenance service provider for AML's building control system, which made them a great fit for the job. The team interviewed the building maintenance staff, the building's occupants and the contracted service agent for the site. This gave the project team a lot of information relevant to their investigation and deliver the project's four phases.

Project scope of work

Phase 1: Document review

The GY's project team gathered relevant documents for the recommissioning agent's review. The goal of this review was for the consultant to develop an initial understanding of the building's current condition. Since the building was still new, the collection of documents were readily available. Additionally, JC was also the existing service provider for the building's control systems so the company was able to draw from its own records as well. Some examples of documents that they reviewed include:

- operations and maintenance manuals;
- documented sequence of operations;
- utility use data;
- building automated system logs;
- maintenance records;
- list of past operational issues and corrective actions performed;
- list of known operational deficiencies;
- feedback from the GY building maintenance staff; and
- feedback from the contracted service technician for the site.

In particular, the previous inspection of AML's building control system, an effort led by the building maintenance team, concluded that "some of the mechanical systems may have been only partially commissioned or the original parameters have been lost or altered for some original equipment manufacturer (OEM) systems (*Johnson Controls, Alexander MacDonald Lodge – Post Inspection Report and Recommendations report*)". The report also suggested a number of outstanding deficiencies that needed to be further investigated and addressed to improve building operability and occupant comfort. This report provided an invaluable first step for further recommissioning work.

Phase 2: Mechanical and control system review

After the initial review of readily available information, the recommissioning agent developed an assessment plan to outline how their on-site visit would impact the tenants of the building. With AML being a long term care facility for the community, it was important that privacy, comfort, and other needs of the occupants be respected.

When the consultant team arrived on site in November 2019, they inspected the building to determine problem areas within the mechanical system. This included a thorough review of the graphical interface and end-to-end check on all control devices (inputs and outputs). This investigation, combined with the information gleaned from the document review, allowed the technician to build an informed understanding of the building automation's current conditions and challenges.

Phase 3: Corrective actions work plan

The consultant team provided a work plan to the GY in May 2020, outlining the identified deficiencies and recommended corrective actions for each.

The report summarized the results of the recommissioning investigation for Alexander MacDonald Lodge with the goals of resolving operational issues and reducing energy use. The report highlighted three main deficiencies:

1. The regular freezing of energy recovery ventilator "AHU-101".
2. Preheat coils and controller issues of energy recovery ventilator "AHU-102" lead to loss of heat recovery functionality.

3. Complaints and comfort issues.

The report recommended 9 measures to resolve these issues and reduce energy use. See Table 1 below for the full list of recommendations.

Table 1: List of Recommendations

#	ECM Recommendation	Est. Energy Savings ($)	Budgets ($)	Priority	Notes
1	Install VFDs on circulation pumps	$ 5,176.00	$ 52,000.00	1	Includes on site time and separate travel
2	AHU-101 scheduling	$ 6,098.00	$ 1,500.00	2	Estimated as 100% remote.
3	Heating plant optimization	$ 1,960.00	$ 1,100.00	2	Estimated as 100% remote.
4	Trend BTU meters	-	$ 1,100.00	2	Estimated as 100% remote.
5	Clean, replace or remove humidifiers	-	Remove $ 4000.00 Clean $ 6000.00 Replace $15,000.00	2	Estimated as 100% remote.
6	Integrate AHUs with DDC	-	$ 35,000.00	2	
7	Fix heating near resident room 4	-	$ 2,000.00	2	
8	Revise heating staging	-	$ 2,000.00	2	
9	Prevent preheat coils from freezing	-	$ 12,000.00	1	Estimated as 100% remote.
TOTAL		$ 13,234.00			

Notes:
- ECM 1, 6, 9 is estimated to be in the +/-5% accuracy level
- Remaining ECMs to be in the +/- 15% accuracy level
- Operational benefits are excluded from savings noted above
- Engineering fees required to finalize scope of work for recommendations.

Alexander MacDonald Lodge pays a monthly electrical utility bill and a flat rate to Dawson Hospital for heat. The energy savings outlined above reflect the current cost for electricity and an estimated rate for heat. The heat was calculated based on an assumption of the building's current heating load divided by the flat rate.

The electrical bills show savings of over $5,000 since implementation in fall 2021! Only a few months have passed at the time of this report; this suggests we are on track to realizing the anticipated savings the implemented measures.

Phase 4: Implementation of recommendations

The implementation of recommendations occurred during COVID-19, and as such, the project team had to be vigilant to abiding by pandemic etiquette and travel restrictions. The GY project manager and building maintenance team worked with JC and the AML's staff to minimize the project's risk to occupants. This was particularly important during COVID-19 as the contracted technicians were arriving from out of the territory and the building's occupants, due to their age group, were more susceptible to the disease. JC implemented remote corrective actions through the building automation system's web access to minimize their on-site presence where possible.

The freezing of preheat coils and poorly designed BACnet control functionality inherent to AHU-101 and AHU-102 was particularly problematic.

The implemented recommendations include the replacement/reconfiguration of the piping arrangement for control valves and full integration 2 of energy recovery units (AHU-101, AHU-102) to the direct digital control (DDC). When fully integrated, enhanced operating sequences were developed to ensure reliable operation.

Since the air handling units were located outside, the preheat coils in these units routinely froze every year. This forcefully reduced building ventilation rates and the loss of heat recovery from exhaust streams, which are particularly concerning due to the building's use for health care services. These buildings typically have increased ventilation requirements compared to most institutional buildings to prevent airborne infections from disbursing. Well ventilated spaces promote healthy indoor air quality for the building occupants.

Alexander MacDonald Lodge suffered from poor ventilation during these periods. Building operators increased ventilation rates by overriding the system's default controls in order to keep the building occupants safe. However, make-up air from the energy recovery ventilators could not keep up and caused the loss of building envelope static pressure and subsequent drafts in common areas. This negatively impacted building occupant comfort.

The cost to repair the frozen coils was high due to the remote community, exterior work in the cold and limited local trade skills available. Typically, repairs could not be affected until late spring due to very low ambient temperatures.

The use of unit-mounted (factory) controls required maintenance staff to attend to the units on the roof. The harsh conditions caused multiple control failures and without control cabinet heaters restarting the units after shutdown trips was difficult. Wiring work during the winter was particularly challenging as technicians sacrificed warmth for dexterity to complete the necessary work.

Relocation of the control equipment to within the building eliminates the need to work on the roof and provides a reasonable ambient temperature for the control equipment. The additional control features included:

- Enhanced coil circulation pump control logic, including monitoring the coil pump status.
- Proper piping arrangement for the coil 3-way control valves and coil circulation pumps.
- The logic for sequences to allow full coil flow when required to eliminate coil freezing.
- Coil heating fluid leaving temperature monitoring and logic for a minimum leaving fluid temperature.
- Heating coil piping configuration to allow for full flow through the coil during bypass mode and full flow through the coil in case of unit shutdown from power failure.

The results of the implementation of these measures allowed for continued use of the energy recovery ventilators, reduced repair costs, reduced operator labour, increased occupant comfort, increased indoor air quality (IAQ) and increased rates of energy recovery.

Changes in energy consumption and its related costs savings were not available since the GY pays a monthly flat rate for heat provided by the adjacent hospital building.

Lessons learned

The recommissioning project at Alexander MacDonald Lodge successfully identified and resolved the deficiencies that the building was experiencing. One of main reasons of success stemmed from the proactive planning our project team did to fully develop

the scope of the project and our expectations from the consultants. We integrated historical knowledge from building maintenance staff, JC's service technician and building occupants during the early investigation phases of the building. Additionally, the coordination of the investigative work and implementation of recommendations required involvement of the building's stakeholders to ensure the healthcare services were not impacted by concurrent work in the space.

This recommissioning project was an invaluable opportunity to conduct thorough investigation for a root cause analysis. Through this work, we were able to resolve fundamental deficiencies, increase building performance, improve occupant comfort and reduce energy use.

This report was written by Tony Lam, Manager, Energy Management Unit, for the Sustainable Infrastructure Branch.