Fire Rescue Services Fire Station #5

Submitted: May 3, 2011

ENGINEERING HEMISPHERE

2-Page Project Highlights

Fire Station #5

Edmonton, Alberta is a rapidly growing city with an increasing number of residents in a challenging economic climate. City leaders are constantly looking to develop new public facilities that not only support the growing population but meet LEED requirements that support the City's green initiatives. Fire Station #5, located in the heart of downtown Edmonton in the Norwood district, is a perfect example of the sustainable initiative and is currently pending LEED Silver Status.

Building a sustainable Fire hall has its challenges. These facilities are in use 24 hours a day 7 days a week. They use large amounts of hot air for drying equipment and clothes, large amounts of water including truck fill, showering facilities and washing stations for trucks and other equipment. It also serves as a residence for employees with eating, sleeping, relaxation and workout areas.

With all the demands on the facility, the energy usage for these types of facilities are quite large. Balancing the critical need for performance, with the desire for efficiency in energy and water use is not a simple undertaking.

Working alongside Rockliff Pierzchajlo Architects & Planners, our team was able to develop innovative solutions and new applications of existing techniques to meet the design challenges of this type of facility. From and engineering standpoint, challenges faced included:

1. Running truck and other gas and diesel engine's within the apparatus bay
2. Large quantities of washroom exhaust
3. High humidity in equipment drying areas
4. High water use.

Running Engine's within the Facility

When fire fighters get an emergency call, a signal is sent that changes the traffic stop lights, starts the trucks, and opens the apparatus bay doors. The problem is the fire trucks are parked inside the bay and the diesel exhaust degrades the indoor air quality within the facility. This is not only a nuisance, but affects the health and well being of the station fire fighters.

To alleviate this problem, Hemisphere provided a flexible air exhaust system. A sliding track with an exhaust hose was attached to the inside of the bay. This hose is then attached to the exhaust pipe of the truck, and when the engine starts the exhaust fumes are drawn up the hose to an exhaust fan. The hose connection is fastened to the tailpipe exhaust by a magnetic clip so when the fire fighters get a call, they can simply drive away. This solution not only saves precious seconds in an emergency call, but ensures a safe work environment with proper air quality.

Large Amount of Washroom Exhaust

Another challenge for this facility is the large amount of washroom exhaust generated by a facility like this. Large washrooms and showering areas are provided as the facility serves as a 24 hour facility and residence. Consequently large amounts of energy is constantly being used to condition or heat outside air only to blow it back outside. To conserve energy Hemisphere provided an enthalpy recovery ventilator (ERV) with a heat wheel. Exhaust air from the washrooms inside the building passes through the heat wheel transferring its heat and moisture to the makeup air. This makeup air is then delivered to the return air intakes of the various roof top units (RTUs) where it is mixed, and further conditioned before being delivered to the facility. This is an effective way to save on natural gas costs, however additional electrical energy must be invested to run additional fans to run this system. Hemisphere had to find the right balance between the use of electricity and natural gas to find out the optimum return on the building. This was done by our in house experts through the use of energy modeling /simulation tools.

This strategy, combined with other energy initiatives, have allowed for a reduction of 48.5% of natural gas and 6.0% of electricity consumption.

High Humidity in the Equipment Drying Areas

When a fire fighter returns from the call of duty, their equipment and uniforms are soiled and damp. Fire Station # 5 was designed with a special drying room where clothes and equipment are placed on racks, and at the push of a button, moisture is removed the whole room dries out. We had to develop a strategy to remove the humidity from the space preventing the growth

of mold or other damage to the building envelope. We also wanted to ensure that the methods used required the least amount of energy possible to keep the room dry.
A Roof Top Unit (RTU) with a dehumidification coil was selected to keep the room dry while meeting our reduced energy requirements. To reduce the load on this unit, moist air is exhausted through a cross flow heat exchanger, pre-conditioning the makeup air without transferring moisture.

A set of motorized dampers also re-directs supply air from the equipment storage room to the drying room during the drying cycle. This provides high air volume at high velocity, decreasing the time required to dry the equipment, which ensures the drying system is only being utilized to full capacity when needed which in turn reducing energy use.

High Water Use

A fire station typically uses a large quantity of water during operation. Water is not only used to fill the trucks, but also for washing, landscaping, showering, and washrooms. In an effort to reduce the demand for city water by this facility, a rain-water recovery system was designed and installed. This system harvests snow melt and rain water from the station roof, and stores it in an underground tank. This tank then draws water as needed, filters and chlorinates its, and distributes it throughout the facility.
The primary use for this non-potable water is for the flushing of toilets and urinals, but it can also be used for watering the landscaping, or for filling and washing of the trucks. Combined with the low volume plumbing fixtures, we were able to eliminate the need for domestic water for the conveyance of sewage from the facility.

These strategies have reduced the annual water consumption for the facility (excluding truck wash and fill) from 326,000 L to 144,500 L. This represents a water use reduction of 55.6%.

Full Project Description

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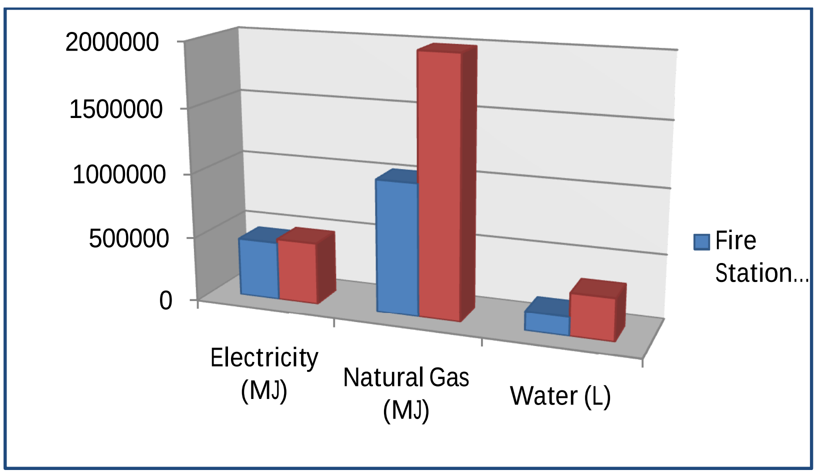
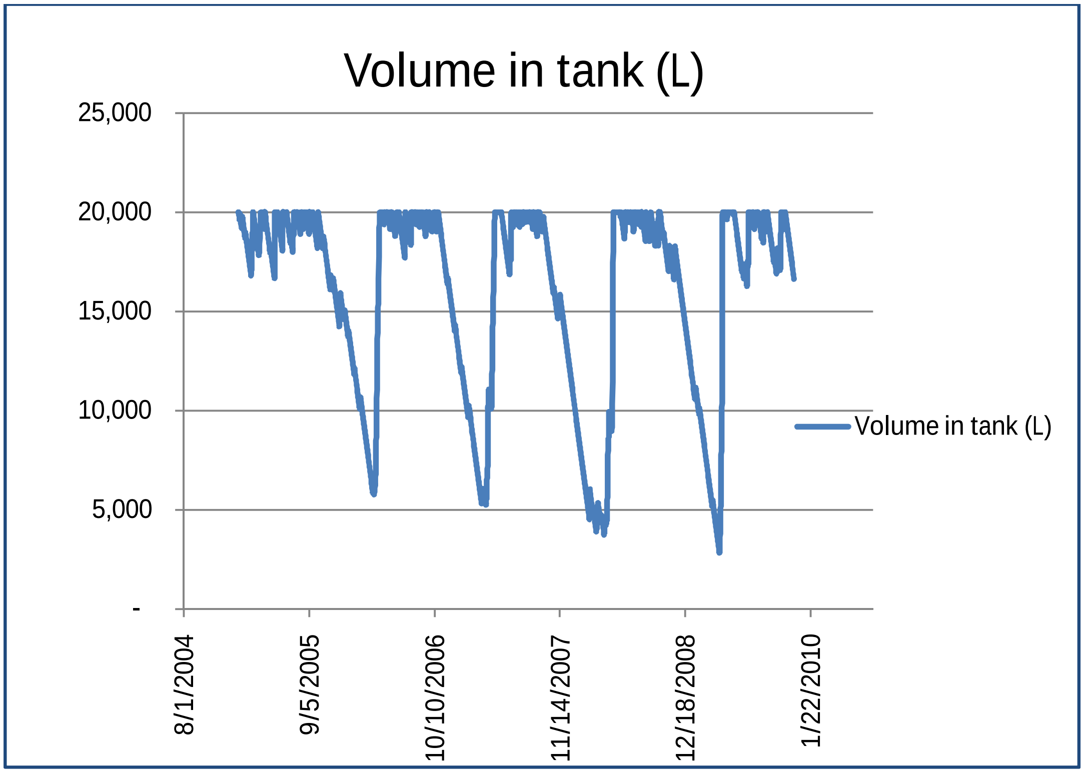


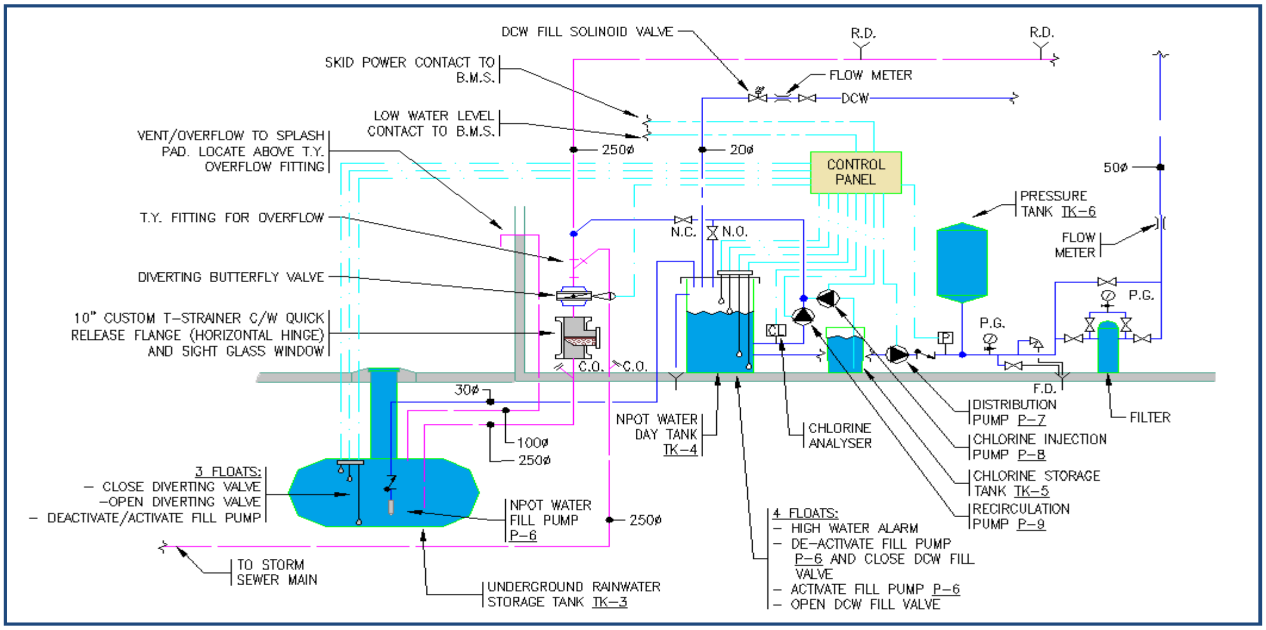
The Fire Station #5 project was compared to a reference building from the Model National Energy Code as part of our energy modeling and analysis. Water usage was modeled using methods outlined in the LEED Letter Templates. With the energy and water saving technologies utilized on this project, electricity usage was reduced by 6%, Natural Gas Usage was reduced by 49%, and domestic water usage was reduced by 56%.

Annual Utility Usage	Electricity (MJ)	Natural Gas (MJ)	Water (L)
Fire Station #5	451,998	1,023,688	144,686
MNECB / LEED base line:	480,941	1,989,856	325,982
Savings:	-28,943	-966,168	-181,296
% Savings:	6.02%	48.55%	55.62%



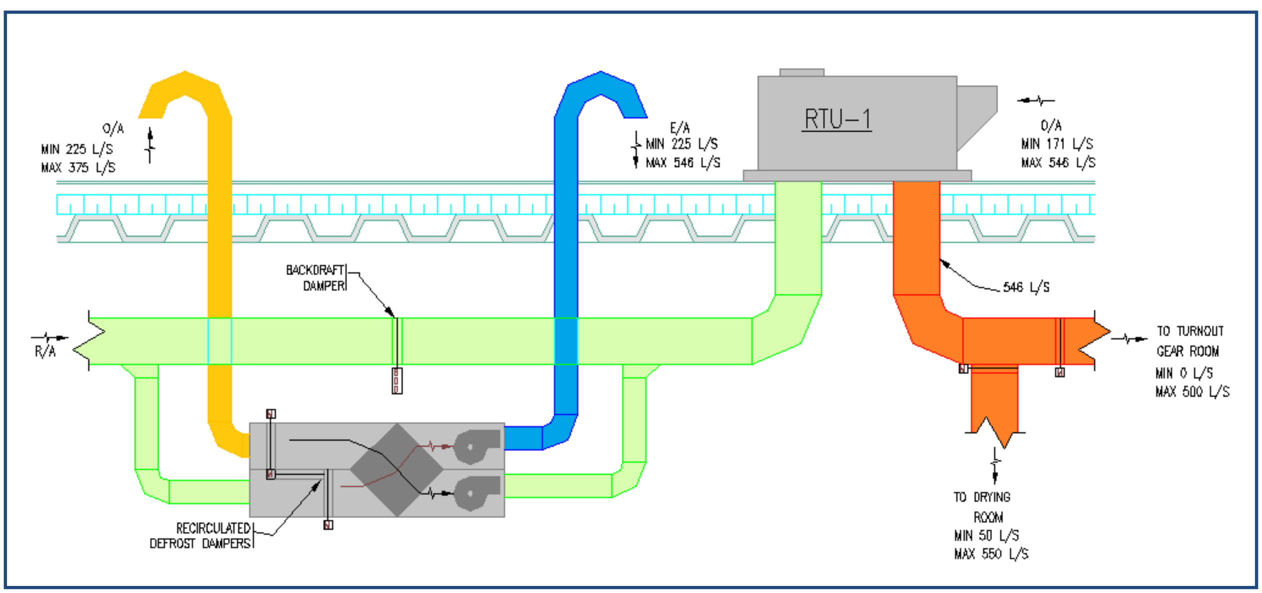
Using weather data from Natural Resources Canada, and projected daily water usage for the facility, we were able to simulate the tank levels over four seasons. The holding tank was selected to be large enough to bridge the long winter months when very little moisture would be available to refill the tank. During times warmer months, we showed that the precipitation levels would be enough to refill the tank back to its 20,000 L capacity. Any additional rainwater from the roof after the tank was filled, would be diverted to the storm sewer.

This simulation allowed us to ensure that tank was “right sized” for the application, and ensure that the owners money was not wasted on more tank then was requ



The rain water recovery system collects both storm water and snow melt from the flat roofed area of the fire station, and directs it to the building mechanical room. If the holding tank is full, then storm water is diverted to the storm sewer. If not, the water then passes through a course strainer to remove any leaves, or other debris.

When required, water is pumped from the large cistern to a smaller day tank inside the mechanical room. This water is then analyzed, chlorinated, and pumped into the non-potable water system. In the event that holding cistern has been emptied, the day tank can be re-filled using domestic city water. This re-fill provides the air gap required by the city of Edmonton and local plumbing codes. Non-potable water cannot be interconnected.



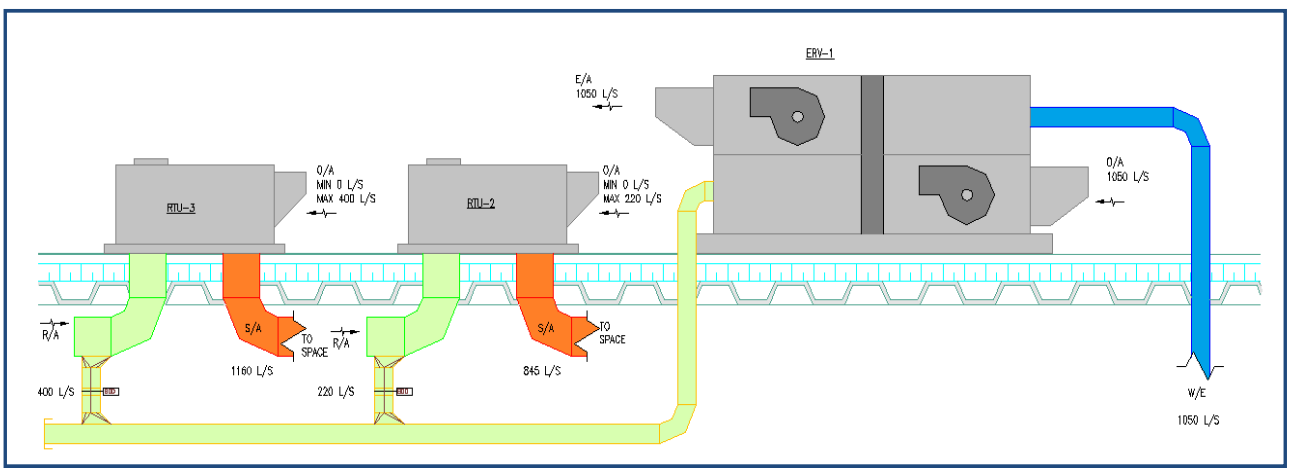
The rooftop air unit system in the drying room consists of an RTU with, gas heat and DX cooling, a heat recovery ventilator (HRV), and isolation dampers. The system operates on a continuous basis as required for 24/7 operation.

The Building Management Control Service (BMCS) controls the heat/cool dampers on the RTU and the hydronic during heating mode. The RTU modulates the gas valve to maintain 15º minimum discharge temperature on the supply air. The ERV unit runs on low speed to provide the minimum required outside air. RTU dampers are set to 15% minimum position, but BMCS will disable the power to the damper motors (thus closing the damper) while the ERV is in low speed mode. At outside temperatures between 15ºC to 24ºC, the HRV supply fan is shut down and the damper for free cooling is enabled. The ERV exhaust fan continues to run. Above 24ºC (in air conditioning mode), the RTU outside air damper is disabled and the HRV is activated for cooling recovery.

A space humidity sensor will monitor space humidity and dehumidifies the air if required. On a call for dehumidification, the BMCS system first enables high speed on the ERV unit. A continued rise of space humidity will bring on the dehumidification coils of the RTU.

A pushbutton mounted beside thermostat will enable the quick dry cycle. When enabled, this cycle modulates the dampers to direct all of the RTU air into the drying room and switchs the ERV to high speed. The cycle expires when space humidity reaches setpoint or by a elapsed time.

These sequences optimize the requirements for heating, cooling, and space dehumidification to use the most energy efficient devices to satisfy the space requirements.



The typical rooftop unit system for the rest of the facility consists of Rooftop units with gas heat and DX cooling, a common Energy recovery ventilator (ERV) unit and a humidifier. The system operates continuously as required for 24/7 operation.

The BMCS controls the heating, cooling, dampers and fan functions of the RTUs using a local space thermostat and a discharge sensor. During heating mode, the gas valve maintains a 15° minimum discharge temperature. The ERV unit runs continuously. Internal factory controls cycle the heat wheel as required. RTU dampers are set up for 15% minimum position. The BMCS will disable the power to the damper motors (closing the damper) while the ERV is in normal mode. When the ERV goes into frost prevention cycle, the unit dampers are enabled and go to minimum position. At outside air temperatures between 15°C and 24°C, the ERV supply fan is shutdown and the RTU outdoor air dampers are enabled for free cooling. Above 24°C, in air conditioning mode, the dampers are again closed for cooling recovery by the ERV.

Hemisphere Engineering worked in conjunction with Rockliff Pierzchajlo Architects & Planners to design the systems outline, producing a fully functional, highly efficient facility which has been a significant addition to the City of Edmonton's Emergency Response Division.