BERG
CHILLING SYSTEMS

How the Canlan Ice Sports York facility achieved annual energy savings of more than $300,000

Expert thermal process energy management

With 57 ice sheets in operation year-round, Canlan Ice Sports was spending too much money on the electrical energy needed to keep rinks cool at the company's six-rink York location in Toronto. Management realized their 20-year-old refrigeration system needed an energy efficiency upgrade. They tackled the challenge in cooperation with process cooling and thermal energy management expert Berg Chilling Systems Inc. Together, along with vital contributions from several highly regarded engineering and technology organizations, they produced a cooling system that reduced peak demand by 45% and saves more than $300,000 annually.

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Canlan Ice Sports is the largest private recreational ice operator in North America. The company's 57 ice surfaces include a world-class international-sized sheet as one of six rinks at their flagship facility at the York University campus in Toronto, Ontario.

It takes a constant flow of large amounts of energy to keep all that ice cooled year-round to optimal rink temperatures. As with many businesses and industries, Canlan's energy costs are second only to labour costs. Though the facility is successful in its marketplace, increasing electricity costs were consuming an ever-greater portion of revenue.

Required: experience, expertise, imagination

In early 2017, as Canlan's power costs kept rising, management decided their 20- year-old refrigeration system was the first place to look for a remedy. They wanted a local company to tackle the unacceptable energy costs, eventually choosing Berg.

Having acquired seasoned refrigeration specialist Industrial Refrigerated Systems Ltd. (IRSL), Berg made use of their long-standing rink experience, assigning an all- star team from both companies to manage all aspects of the project.

The facility's existing system was a low capital cost design when it was installed in the 1990s. However, optimal energy efficiency was a trade-off that became more apparent as electricity became more expensive and more sophisticated control technology became available. From a heat transfer capability perspective, flow in the system's secondary refrigeration loop proved too tightly specified, resulting in the need for extra compressor capacity in the primary loop to compensate. The refrigeration system maintained ice but at an unacceptably higher operating cost.

Canlan management and their power distribution company, Toronto Hydro, found they could realize substantial energy savings by making major equipment changes to debottleneck the secondary loop. This decreased the required cooling capacity – and the energy consumption – of the primary one. It would be a complex project requiring a refrigeration supplier that could deliver a solution without disrupting arena operations. This was a particularly important requirement because rinks don't lose just a week or a month if they shut down for service or capital upgrades. They lose entire seasons because sports leagues schedule full seasons of play. Extended shutdowns can result in the loss of entire seasons' revenue. In addition, there is a greater business risk because a drop in customer satisfaction can mean teams may choose to play elsewhere.

Canlan and their consulting engineer, Bradley Refrigeration Consultants, conceptualized the project, produced a specification, and put the job out to tender. Berg Sales Engineer Evis Buli and Concept Group Manager Chris West got involved with Canlan directly, developing a proposal that would meet Canlan's. In keeping with Berg's commitment to collaborating with client experts, they opened an active dialog with Canlan and their consultant. Both companies made important recommendations for changes based on their extensive experience. Most importantly, the team from Berg and IRSL committed to deliver the project while maintaining York's ice availability.

"Canlan and Eric Bradley produced a remarkably complete and accurate specification that played a big role in Berg's successful time-sensitive implementation. It also paved the way for the kind of innovation that both companies are known for." ***says Morrow.***

A thorough examination of rink operation, equipment, piping, and temperature requirements confirmed that the undersized secondary refrigeration loop couldn't provide enough coolant flow to the ice sheets. The project team determined that increasing the flow would allow Canlan to replace the three 250 horsepower screw compressors with three 125 horsepower reciprocating compressors. They would perform as well or better than the existing setup while consuming half the energy required by the old system.

Mycom Reciprocating Compressors doing the whole job while consuming half the power.

Focusing on maximum efficiency in the secondary heat exchange loop yielded major performance and financial benefits. Increasing the size of the plate and frame chillers increased the system's ability to remove heat from the rinks. The original glycol pumps worked well but operated only in a strict on/off mode and could not be fine tuned. Variable frequency drives were added to the pumps and they now work at levels exactly matching demand while using only the precise amount of needed energy. Overall, each upgraded component contributes to better system performance, increasing Canlan's total cost savings.

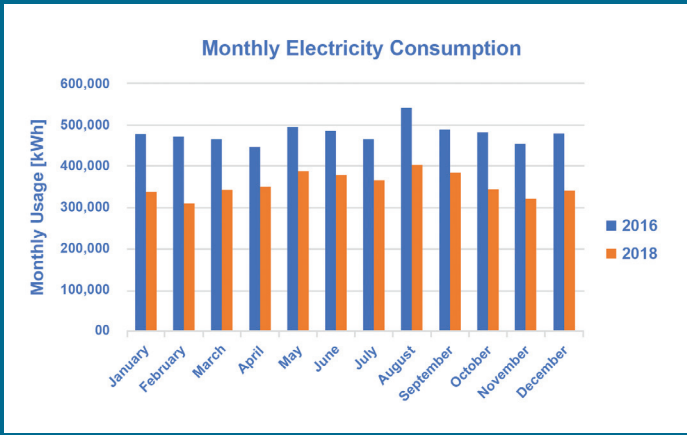
"We are pleased to be working with Canlan in Ontario. Their leadership in refrigeration innovation stems from their commitment to energy efficiency. Constantly challenging the standard techniques puts them on the cutting edge – a very refreshing attitude that has brought them to the highest level of efficiency in ice rink technology. Other companies will strive to achieve Canlan's level of energy-efficiency in their own future designs,"
says Don Bayley, General Manager of IRSL.

Other specialists were invited into Canlan's mechanical room to ensure all aspects of the project benefited from top-level expertise. For instance, compressor manufacturer Mayekawa's contribution of knowledge and top-performing equipment played an important role in the project's success. As well, building automation specialist Guest Automation of Calgary, Alberta provided the central control technology that integrates operation of all components of the upgraded system.

Brodie Guest, President of Guest Automation, says, *"We were involved from the beginning. Our 10-year relationship with Canlan meant they trusted our long-term experience with control automation in ice rinks. Using our open source software and vendor neutral hardware, we were able to monitor and control every piece of major mechanical equipment in the facility, including the refrigeration plant".*

Recognizing the potential reduction in peak loads on the grid, Toronto Hydro agreed to provide $135,000 of incentive funding through Ontario's Save on Energy program. The facility is undergoing a rigorous validation process to confirm the energy savings and correlate them back to the project to determine final eligibility for funding. Canlan management is confident of satisfying Toronto Hydro's targets.

Significant improvement in Canlan York's energy usage



While every rink has its own set of specific needs, an effective custom-designed cooling solution always focuses on:

- Providing high quality product – perfect ice – all the time
- Optimizing total cost of ownership, including capital, operating, and maintenance costs
- Lowering energy costs
- Meeting current and future cooling needs
- Achieving the highest efficiency
- Using readily available, proven components
- Ensuring serviceability with built-in redundancy

Max efficiency and control - glycol pumps with variable frequency drives each feed a specific rink

Don Berggren, Berg's President explains, *"With our custom design approach, every specification and requirement is handled individually. That means ideal sizing and packaging. All equipment is precisely rated and growth capability within a particular application is built-in."*

More savings resulted from a full redesign of the system's architecture. The original mechanical room had a single chilled glycol header that split into three lines, each feeding a pair of rinks. Warm glycol returned through another common header leading to the chillers. This meant any issue with leaks or poor performance in any single rink affected all six rink circuits. The system included some isolation valves but not enough to separate each rink for inspection and service. With no way to quickly identify which rink required attention each one needed to be inspected. That is a time-consuming process that could impact operations throughout the facility.

The Berg/IRSL team worked closely with Canlan to ensure a smooth implementation with no major disruption to their operation.

A major upgrade completed in minimal time, with no downtime or loss to business

- **Most investigation and design activity was completed before the contract signing in late April 2017.**
- **Switchover of individual rinks was done in stages beginning with re-piping**
- **Removal and installation of compressors, plate and frame chillers, and pumps followed.**
- **Full system was up and running in early January 2018.**
- **Further testing and calibration continued to reduce unnecessary energy costs.**
- **Fine-tuning yielded better flow and consistent temperature control.**
- **Implementation of an innovative liquid leg equalization header brought the work to an end in early May 2018.**

A Berg innovation saved cost and disruption

A portion of the system known as the “liquid drop legs” uses three pipes feeding liquid ammonia to each of the three chillers, and here the engineers found a challenge. The chillers in the existing system were designed to be completely flooded with ammonia and controlled together by maintaining a constant level in a vessel high above them. In the upgrade, they were replaced with three more efficient Alfa Laval chillers. Designed to run most efficiently at 25% to 30% capacity, these allow for the exact flow needed to attain the desired heat transfer.

Instead of controlling levels in the three chillers with three sets of monitoring and adjusting equipment, engineers realized that precise level control could be attained more simply with just one new equalization header to control and balance all three. The level of liquid in the header is maintained by a control valve tied into the central automation system, responding to the varying needs of all rinks.

Berg energy-efficiency expertise at work at Canlan:

- **Replaced three 250 horsepower screw compressors with three 125 horsepower MYCOM reciprocating compressors.**
- **Changed to variable frequency drives (VFD) for each of the six pumps that feed glycol coolant to the rinks.**
- **Reduced overall ammonia charge.**
- **Isolated each individual rink from problems occurring in other rinks.**
- **Balanced capacity of primary and secondary systems, and increased maximum flow rate.**
- **Designed a new equalizing header to help maintain optimal ammonia level in the three ice rink chillers.**
- **Undertook energy study of current cooling equipment and predicted electrical energy consumption post-completion.**
- **Optimized equipment performance through integration of existing automation system.**
- **Demonstrated effective project management by planning and coordinating an installation schedule made more difficult by Canlan’s need to accomplish the upgrade without affecting ice availability.**

David Stewart**, Canlan's Director of Energy Management, Facilities, Assets, and Equipment; North America points out strategic advantages accruing to the company by refitting the facility with a highly advanced refrigeration system, **"We've reduced our peak demand from a high of 1,000 kW down to an average of 550 kW, or a very significant 45% reduction. If every large commercial or industrial user did that, there would be no need to build additional electricity generation capacity. The province would have ample capacity to deal with the really hot peak days. This is also an added advantage for Canlan because all commercial and industrial clients pay each month based on peak demand. It is definitely an additional monetary savings. We've proven that making our ice rinks more affordable to operate keeps us competitive in a highly competitive industry. This allows us to keep hockey affordable and within reach for our customers. Energy conservation is definitely a key component to our business strategy."

Since 1972, Berg Chilling Systems has served the cooling needs of diverse industries such as recreational ice, manufacturing, food & beverage, oil & gas, and marine. Berg's collaborative approach brings Berg professionals and client professionals together to produce custom engineered solutions specific for each application.

The company's field and in-house engineers apply unmatched expertise to fully understand and satisfy customers' cooling challenges. Berg's custom-designed cooling solutions yield maximum efficiency and cost savings immediately and over the long term. Clients trust Berg expertise to make the difference between adequate and excellent.

The mechanical room is now a more comfortable, quieter, cooler environment.

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Expert thermal process energy management

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