Project profile
Refrigeration
Technological Innovation

RAPB
REFRIGERATION ACTION PROGRAM For BUILDINGS

Colisée des Bois-Francs Victoriaville (Québec)

MAJOR RETROFIT

Summary

Potential for substantial heat recovery from refrigeration system

Extensive integration of refrigeration system with heating, ventilation and dehumidification system

Short-term heat storage

Variable condensing temperature and pressure *(Floating head pressure)*

Characteristics of Arena

Owner	Municipality
Built in	1978
Rebuilt in	2001
Rink and bleachers	
Surface area (footprint)	4,140 m² (44,700 ft²)
Volume	51,000 m³ (1,814,000 ft³)
Building (including multipurpose hall)	
Surface area (footprint)	13,000 m² (140,000 ft²)
Volume	59,000 m³ (2,084,000 ft³)
Number of rinks	1
Seating capacity	2,100
Months operated / year	9
Hours open / week	80
Number of ice resurfacings / week	50
Heated bleachers	Yes, to 15°C (60°F)
Annual energy consumption (98 % electricity, 2% natural gas)	1,560,000 kWh-eq. (in 2003-2004) 130 kWh-eq / m² (12 kWh-eq. / ft²)
Contract power	400 kW
Annual energy cost	$90,000 (in 2003-2004)

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Canada

Refrigeration System Installed

Equipment type	Factory-built commercial packages (2)
Compressors	4 semi-hermetic screw compressors
Condensers	4 tube and shell condensers
Evaporators	2 direct expansion tube and shell evaporators
Heat rejection system	Indirect evaporative fluid cooler
Refrigerant	HCFC-22 (174 kg combined total for all equipment)
Total cooling capacity	120 tons
Operation of condenser	Floating head pressure
Heat transfer fluid in cold secondary loop	Mixture of water and methanol
Heat transfer fluid in warm secondary loop	Mixture of water and ethylene glycol

Energy Efficiency Measures

Design

Heat recovery

Bleachers heating	Using condensation heat rejected in the warm secondary loop (water/ethylene glycol) and transfered through a coil in the ventilation duct
Players' rooms heating	Same system as for bleachers heating
Service rooms heating	No measures
Domestic water heating	Domestic water is heated to 55 °C by the means of a heat pump using the warm secondary loop as an energy source
Heating resurfacing water	Domestic hot water, heated from 55°C to 80°C with a natural gas boiler
Preheating outdoor air	No measures
Preheating domestic water	Using heat from warm secondary loop by the means of a plate type heat exchanger
Heating under ice rink slab	System in place but not used
Heat recovery from waste water	No
Use of surplus heat exceeding arena heating requirements	No measures

Thermal storage

Heat storage	
Short term	Reserve of 4,500 litres (1,000 gallons) for domestic hot water at 55°C
Seasonal	No
Cold storage	
Short term	No
Seasonal	No

Other measures

Dehumidifying of ice rink	Air is dehumidified by a cold loop bypass to a coil in the ventilation duct
Melting rink scrapings	No mesures
Modulation of circulating pumps	Yes, variable speed 25 HP pump
Reduction of maximum flow in cold secondary loop	No, 2 passes in secondary fluid circuit in the slab
Low-emissivity ceiling	No
Building Automation System (BAS)	Yes
Efficient lighting	
High-intensity discharge (HID) lamps	Metal hallide, power 31 kW
Lighting intensity varied to suit different activities	2 light intensity levels
Lighting switched off when arena not in use	Yes

Operation

Modulation of condensing temperature to suit refrigeration and heating needs, and according to outside temperature	Yes, controlled by BAS
Electrical demand control through peak-load shifting	Yes, by BAS
Resurfacing water temperature lowered	Ajusted manually
Modulation of ice temperature set point	Yes, controlled by BAS
Indoor temperature lowered during unoccupied periods	Yes, controlled by BAS
Refrigeration system shut down during unoccupied periods	Yes, controlled by BAS
Circulating pumps shut down during unoccupied periods	Yes, controlled by BAS
Ventilation shut down during unoccupied periods	Yes, controlled by BAS
Ice thickness management	Ice thickness ajusted manually
Lighting reduced for certain activities	Yes, ajusted manually
Ice temperature monitored by infrared sensor	Yes, by BAS

Project Cost

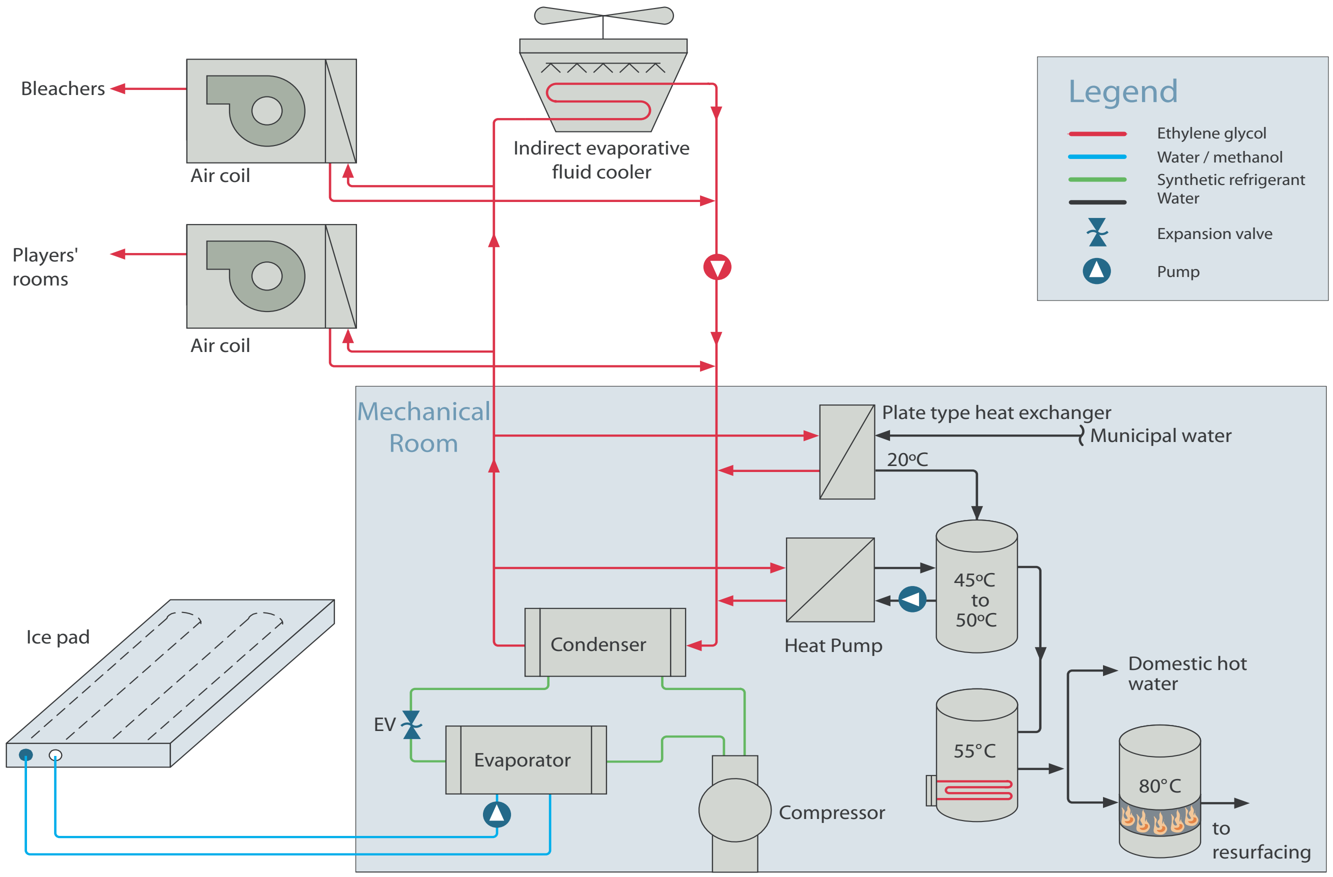
Overall cost of work, including engineering (before financial assistance):	**$693,300**

Financial assistance for energy efficiency

Agence de l'efficacité énergétique du Québec (AEE)

CETC-Varennes (through RAPB)

Simplified System Schematic



Benefits

Building energy consumption

14% electrical energy savings for 50% greater cooling capacity compared with previous system. Savings are all the more impressive because some energy saving measures were already in place before the refrigeration system was retrofited.

Contract power

Comparable to the contract power prior to the retrofit, despite a 50% increase in installed cooling capacity

Note : Savings were calculated based on the energy invoices analysed before and after the retrofit only. No adjustments were made to reflect the increase in cooling capacity, the total ice time used, or weather conditions.

Environmental benefits

Greenhouse gas (GHG) emissions

The use of modular package refrigeration units enabled to-confine the refrigerant in the mechanical room and to reduce by 70% the required amount of refrigerant per ton of cooling capacity. Potential refrigerant leaks were also reduced by the same amount. Since the new refrigeration system was started up, no refrigerant losses were registered, whereas with the old system the leaks accounted for 120 t eq. CO_2 per year.

Effect of refrigerant on ozone layer

Significant reduction in the impact on the ozone layer for the above reasons

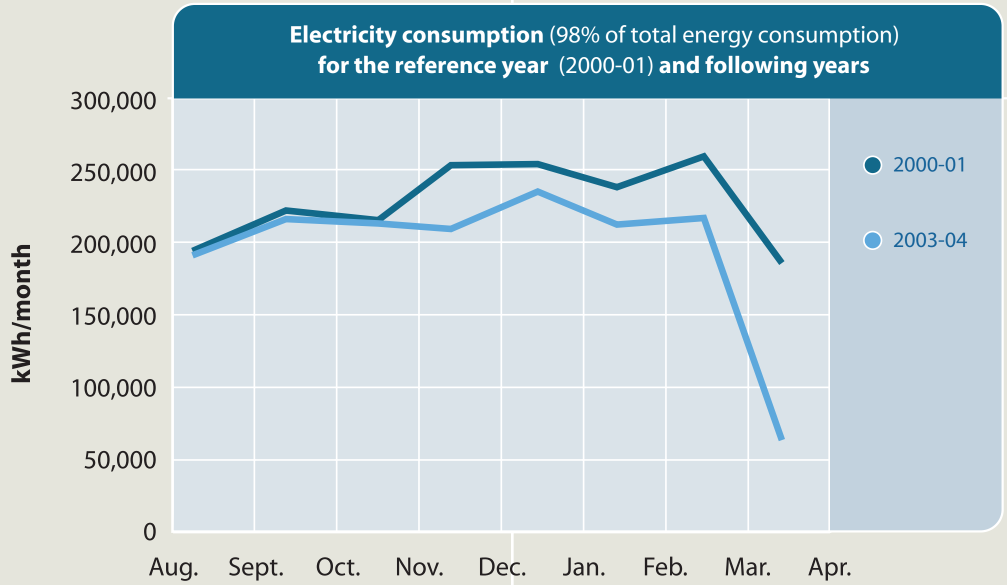
Other benefits

Reduction of maintenance costs

Insufficient data at this time

Qualitiative benefits

Good quality ice
System more reliable
Greater comfort for spectators



Rationale

Refrigeration system was obsolete

Original capacity was inadequate for growing needs

Sought improved spectator comfort

Solution considered the most cost effective
based on life cycle cost analysis over a period of 20 years

Suppliers and Contractors

General contractor	LS Réfrigération
Refrigeration contractor	LS Réfrigération
Manufacturer of refrigeration equipment	Trane
Control system	Johnson Controls
Mechanical, electrical and structural engineers	Dessau-Soprin Inc.

RAPB

The Refrigeration Action Program for Buildings (RAPB) fosters the use of innovative refrigeration practices in order to reduce the greenhouse gas emissions that result from the efficient use of energy and the reduction of refrigerant leaks in supermarkets, ice and curling rinks.

A French version is also available

FOR MORE INFORMATION
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