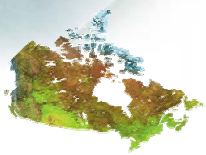

INTEGRATED REFRIGERATION AND HEATING SYSTEMS IN AN ICE RINK

VAL-DES MONTS (QUÉBEC)

New building

GENERAL INFORMATION

Owner	Association récréative de Val-des-Monts
Year of construction	2001
Rink	
➢ Area	1,452 m^2 (15,600 sq.ft.)
➢ Volume	14,230 m^3 (502,190 cu.ft.)
Building	
➢ Area	2,973 m^2 (32,000 sq.ft.)
➢ Volume	17,950 m^3 (633,470 cu.ft.)
Number of ice pads	1
Number of seats	350
Months of operation per year	10 months
Hours of operation per week	70-80
Number of resurfacings per week	65
Normal temperature in stands	set point 15C (60ºF), heated with radiant floor
Total annual energy consumption (electricity) and cost	760,000 kWh $50,000

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INSTALLED REFRIGERATION AND HEATING SYSTEM

Refrigeration system	Commercial type, factory built package unit
➢ Compressor	Hermetic
➢ Condenser	Plate exchanger
➢ Evaporator	Flooded
➢ Heat rejection system	Underground heat sink + fluid cooler
➢ Refrigerant	R-404a (35.4 kg)
➢ Refrigeration capacity	72 tons
➢ Condenser operating pressure	Variable (*floating head pressure*)
➢ Fluid in secondary loop in ice pad	Methanol
➢ Fluid in secondary loop for heating applications (heat recuperated in refrigerant condenser)	Methanol

Heating system

➢ Space heating	With recovered heat (mostly floor radiant heating)
➢ Service water heating	With recovered heat coupled with cascade heat pump
➢ Resurfacing water heating	With recovered heat coupled with cascade heat pump, and occasional supplemental electric heat
➢ Under pad frost prevention	With recovered heat
➢ Snow pit heating	Yes, with recovered heat

ENERGY EFFICIENCY MEASURES

Integrated at design phase

Heat recovery

➢ Stand area heating	Radiant floor in stands with secondary loop piping
➢ Heating of players rooms and other service areas	Radiant floor with secondary loop piping
➢ Service water heating	With recovered heat coupled with cascade heat pump
➢ Resurfacing water heating	With recovered heat coupled with cascade heat pump, and occasional supplemental electric heat
➢ Outdoor air preheating	Yes, with heat recovery on air exhaust
➢ Service water preheating	With heat on secondary loop.
➢ Under pad frost prevention	Yes, with recovered heat
➢ Heat recovery on air exhaust	Yes
➢ Heat recovery on sewage water	No
➢ Use of excess recovered heat	Provisions have been made to supply the excess heat to a nearby Community Centre

ENERGY EFFICIENCY MEASURES (CONT.)

Thermal Storage

Heat storage	
➢ Short term	Yes, in 500 gallon water tank
➢ Seasonal	Yes, underground with horizontal loop
Cold storage	
➢ Short term	Yes, under ice pad
➢ Seasonal	No
Air dehumidification in rink area	Yes, cooling with heat pump and reheating with recovered heat
Heated snow pit	Yes, with sub-cooling features
Circulating pumps	Six X 3 HP pumps operating in steps
Multi-pass circuits in ice pad	Yes, equivalent to five passes
Low emissivity ceiling	Yes

High efficiency lighting

➢ High efficiency lamps (HID)	Yes, metal hallide, 10.5 kW connected load
➢ Multi-level lighting capability	Yes, four levels controlled by building automation system (BAS); in process of implementation
➢ Lights turned off after occupancy	Yes, controlled by BAS and integrated with schedule of activities; in process of implementation

Operating measures

Floating head pressure in condenser	Yes
Electrical load shedding	No
Resurfacing water temperature setback	Manual reset
Evaporator temperature set-up	Yes, by step controller
Heating temperature setback during unoccupied periods	In process of implementation
Compressors shut-off during unoccupied periods	Yes, by step controller
Circulating pumps shut-off during unoccupied periods	Yes, by step controller
Ventilation systems shut-off during unoccupied periods	Yes, in process of implementation
Ice thickness optimization	Yes, manually
Reduced lighting levels whenever feasible	Yes, in process of implementation
Infrared sensor for ice temperature control	Yes, in process of implementation

PROJECT COST

Total construction cost including professional fees (before grants and incentives):	$ 3,2 Million
Grants and incentives	
➢ Agence de l'efficacité énergétique du Québec(AEE)	$ 110 000
➢ Commercial Buildings Incentive Program (CBIP) Office of Energy Efficiency	$ 60 000
➢ Hydro-Québec	$ 20 000
➢ CETC-Varennes	Technical support

BENEFITS

Energy

➢ Energy consumption	58% less than the reference CBIP ice rink
➢ Power demand	Less than half of a typical power demand

Environment

➢ Effect on ozone layer	Refrigerant with no impact on ozone depletion
➢ Green house gas emissions	More than 80% reduction compared to a conventional ice rink in Québec. Reduction results mainly from lower refrigerant losses

Other benefits

➢ Savings in maintenance costs	Not available

Figure 1. Power Demand in Typical Ice Rinks Compared to Val-des-Monts Ice Rink

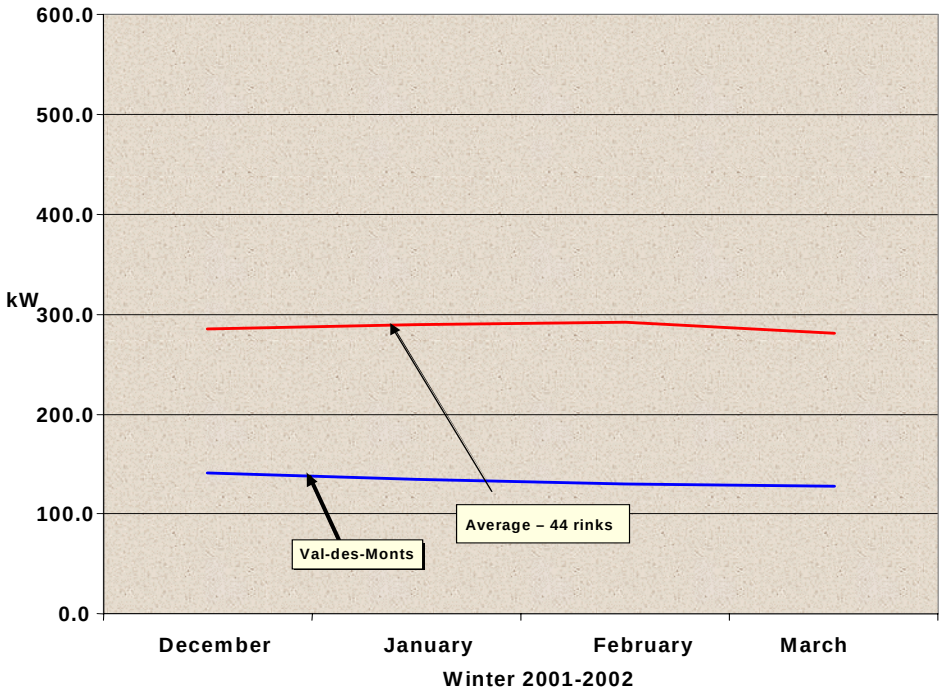
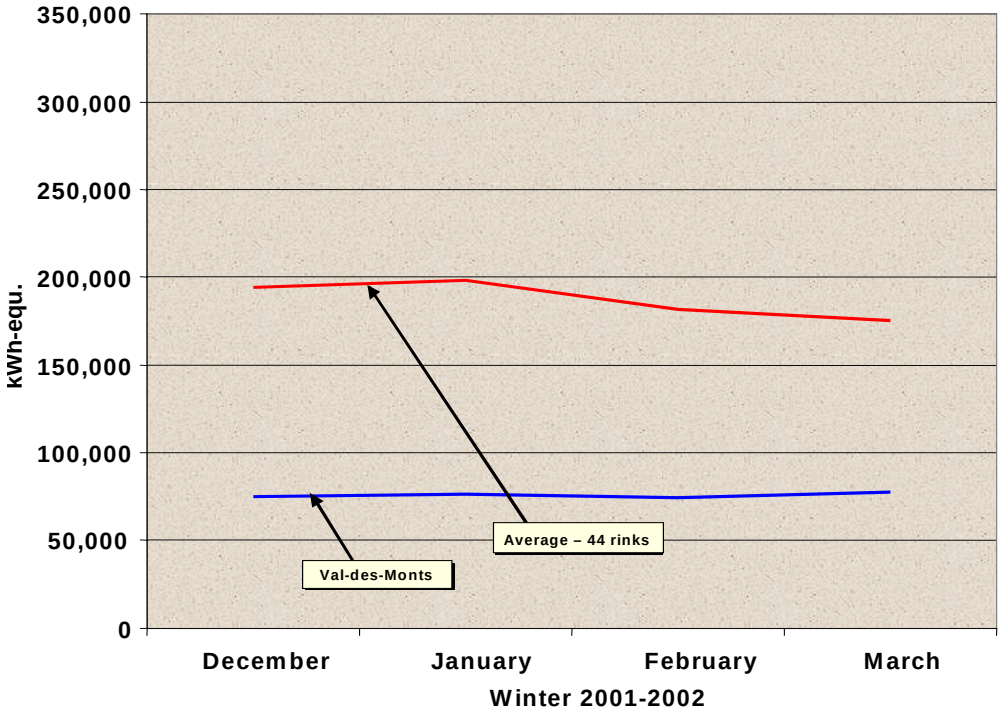


Figure 2. Energy Consumption in Typical Ice Rinks Compared to Val-des-Monts Ice Rink



SERVICE PROVIDERS

Vendors and contractors

➢ General contractor	Project Management assumed by the owner
➢ Refrigeration contractor	Ice Kube Systems
➢ Refrigeration equipment manufacturer	Frontier Refrigeration
➢ Controls	NTI, installed by Combustion RB

Professional services

➢ Architect	Leon Mercier, architect, M.O.A.Q.
➢ Mechanical and electrical consulting engineers	Stantec Consulting