Festive OUTFITTERS, inc.

April 4, 2006

Mr. Steve Buchal
Minneapolis Park & Recreation Board
2117 West River Road
Minneapolis, MN 55411-2227

RE: Edison Youth Hockey Civic Arena

Dear Mr. Buchal:

It was a pleasure meeting and speaking with you concerning the inspection of the Edison Youth Hockey Civic Arena. We have completed the inspection, and have the following evaluation report for your review:

Facility: Edison Youth Hockey Civic Arena
Address: 1306 Central Avenue North East
Minneapolis, MN 55418
Phone: 612-782-2123

**Facility Refrigeration System Summary**
The Edison Youth Hockey Civic Arena completed construction, and began operation sometime in 1997. The rink refrigeration system consists of the mechanical room equipment with heat exchangers to cool a secondary coolant, which is circulated through piping in the rink floor to make and maintain ice. The system is consider being an indirect system utilizing R22 as the primary refrigerant, and inhibited ethylene glycol as the secondary coolant. The heat absorbed in the rink floor is transferred to the glycol, and then to the R22 in the mechanical room, and eventually to the evaporative condenser located directly outside the mechanical room. Some of the heat is use in the subfloor heating, and snow melting system, or called the heat reclaim system. The equipment in the mechanical room is considered to be a commercial grade, and not industrial. The rink floor is installed with steel supply and return lines, a steel distribution manifold and polyethylene piping spaced evenly throughout the rink floor. The polyethylene piping runs the 200' direction, is connected to the manifold at hose barb adapters, utilizing hose clamps, and has return bends at each end.

**System Information**
Year Built: 1996, first ice 1997 (information provided)
Ice Sheet: Single ice sheet, concrete encased 201' x 87' (approximately)
System Type: Indirect, R22 primary refrigerant, inhibited ethylene glycol
Refrigeration: Packaged indirect commercial unit, manufactured by Hussman
Installer: Premier Ice Rinks

2118 Midlothian Road • Roseville, MN 55113
phone 651/636-9240 fax 651/631-9483 email AndersonIce1@aol.com

**Package Information**
Package Serial Number 6DH3-3500 TSK, CCJ9615125
4 Copeland brand, Discus type, semi-hermetic compressors
Compressors manufactured in 1996
Compressor Run Hours
Compressor #1: 58029
Compressor #2: 9020, new compressor at 6970
Compressor #3: 45363
Compressor #4: 18902
Chiller is direct expansion type, dual circuit (2 compressors per circuit)
Manufacturer: Chil-Con, year built 1996
Model: RF12084-800
Glycol Circulation Pumps – 2 Each
Pump #1 Baldor Brand
10 HP – no pump flow rate information available
Flow estimate: 350 to 400 gpm
Pump #2 Baldor Brand
3 HP – no pump flow rate information available
Flow estimate: 200 to 250 gpm

**Subfloor Heating & Snow Melting**
The subfloor heating and snow melting system consists of a desuperheater heat exchanger which absorbs heat from the discharge gas prior leaving the mechanical room and going to the evaporative condenser. In the desuperheater the gas is cooled, as the heat is absorbed by the glycol circulating to the snow melt coil, and the subfloor heating system. The glycol is stored in a central polyethylene tank, and circulated with pumps to the snow melt coil, and subfloor heating system. This system is dependent upon the compressors to run to heat the glycol, and melt the snow. The subfloor heating system requires less heat as it is primarily a frost, or freeze, prevention system, which can be operated at approximately 40 degrees. We are unaware of any problems with this system in melting snow, however the amount of snow the system can melt is directly related to the amount the system is run.

**Evaporative Condenser**
Manufacturer: Evapco
Year Built: 1996
Model: AIC-80, Draw through
Serial: 961953

**Rink Floor Design and Construction**
The rink floor portion of the system consists of a supply and return distribution manifold with tee connections. The manifolds run the 85' direction, and it is unclear if a reverse return was installed. (The reverse return guarantees a balance flow down each pipe in the floor) The manifolds are located at the blue line on the rink floor. The tee connection on top of the manifold has two hose barb adapters welded, and each adapter is a connection

to the 1" polyethylene piping running the 200' direction. Each connection was reported to have a single hose clamp holding the polyethylene piping to the hose barb. On each end of the rink a return bend was installed with the hose barb adapters, and a hose clamp also.

**Current and Historical Information**

**Rink Floor**

The information provided is that the rink floor distribution manifold connections at the hose barbs have been leaking since the initial season, and even during the placement of the rink floor concrete. Recently the operator used ice and water shield over the manifolds on top of the concrete to stop the leaking glycol from getting into the ice. This seems to be working at this time, as a short term solution. The other solution was for the operator to reduce the operating pressure in the system, decreasing the leaking potential.

The causes of the leakage could be two fold. The first being the initial design of the hose barb not machined to specific tolerances. Adapters purchased from normal manufacturers has an outside diameter of approximately 26 thousands smaller than the inside diameter of the polyethylene tubing used in the rink floor. This provides for a very loose fitting joint, which is difficult to seal. The other potential problem is using a single clamp, and a clamp that is not considered a high torque. Two clamps are required, facing opposite directions, and the clamp should be a 150 psi rated clamp, to ensure a good connection. A light film of silicone sealant can also be placed on the hose barb to assist in sealing this connection.

The system utilizes smaller pumps than most other rinks. This low flow system of 350 to 400 gpm is approximately half the flow of other systems. This maybe due to the refrigeration heat exchanger selection not allowing higher flow in the system. The floor piping system can allow flow as high as 950 gpm, under high load conditions, and typical flow rates under low load average around 650 gpm. A low flow system results in higher temperature differences from the glycol going to the rink, and returning from the rink, under higher loads. This reduces the system efficiency.

**Mechanical**

The refrigeration package has not had any major problems except for the failure of one of the compressors. The evaporative condenser has had major water leakage, and ice formation outside of the unit. A sledge hammer remains near by for the operator to break up the ice when it becomes too large. The draw through style of evaporative condensers were not recommended due to the ice problems.

**Short Term Recommendations**

The most immediate problem is the leaking in the rink floor. It is recommended that the installed ice and water shield be removed, and the floor pressure raised to 40 or 50 psi static, and check for leaking locations. All discovered leaks should be located and repaired. A procedure for testing and repair can be provided.

The system pressure should be always maintained to have a 2 to 10 psi on the return side of the system to prevent pump cavitations. Most of the pressure gauges have failed and should be replaced.

The current exhaust system in the mechanical room does not meet code. The code requires the exhaust to be drawn off of the floor (12" from the floor), as the R22 in the system is heavier than air. Suffocation is the potential danger. A leak detector should also be installed with warning lights, and tied into the exhaust for proper operation. The current fresh air intake into the room is from the ice rink, and this also does not meet code. This should be changed with the change in the exhaust. A full system design can be provided.

As funds become available, the leaking evaporative condenser should be replaced with an air cooled condenser, to eliminate the ice formation problem.

**Long Term Recommendations**
In the long term, it is likely that if the leaking floor cannot be fixed adequately, then the floor should be replaced.

The refrigeration package has an expected life of approximately 15 years, however it can last longer. The compressors selected on this package were not designed to run at ice making pressures and temperatures. They were designed to run at higher pressures and temperatures, so failures are expected.

The size of the mechanical room does not allow for the installation of other, more industrial type, equipment. If equipment replacement is considered than the building will require an addition.

If you have any questions concerning this report please feel free to contact me.

Sincerely,

Joel Anderson