Michigan Technological University

Department of Manufacturing and Mechanical Engineering Technologies

Student Development Complex (SDC) Ice Plant

MET4360L01 Fall 2021
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The MTU Student Development Center (SDC) houses our campus ice area and pool. The school utilizes a system to recover the heat produced by the ice production and uses it to heat the pool and some domestic water heaters for the sinks and showers in the SDC. This system was installed in 2012, to start, the previous floor to the ice area was completely taken out down to dirt but the previous vapor barrier under the building was kept intact.

Below the vapor barrier first was a layer of dirt followed by floor insulation. The floor insulation consists of two (2) layers of 2” thick, 2’ x 8’ sheets connected via stagger joints. The vapor barrier is laid on top of this and all holes and joints are taped over to ensure sealing, followed by pipe and rebar support chairs and reinforcement that go the length of the rink. The rink piping, made of 1” polyurethane pipe is laid on top of the reinforcement and is connected via flush weld connections. This is followed by the wire mesh, which is connected to the rebar at 24” increments. Lastly a 6” thick slab of 3-5% air entrainment concrete is poured over top, rated at 5000 PSI. Lastly, the layer of 2 inch thick ice is allowed to form on top of the slab.

Figure 1: Layers of Ice Arena Floor

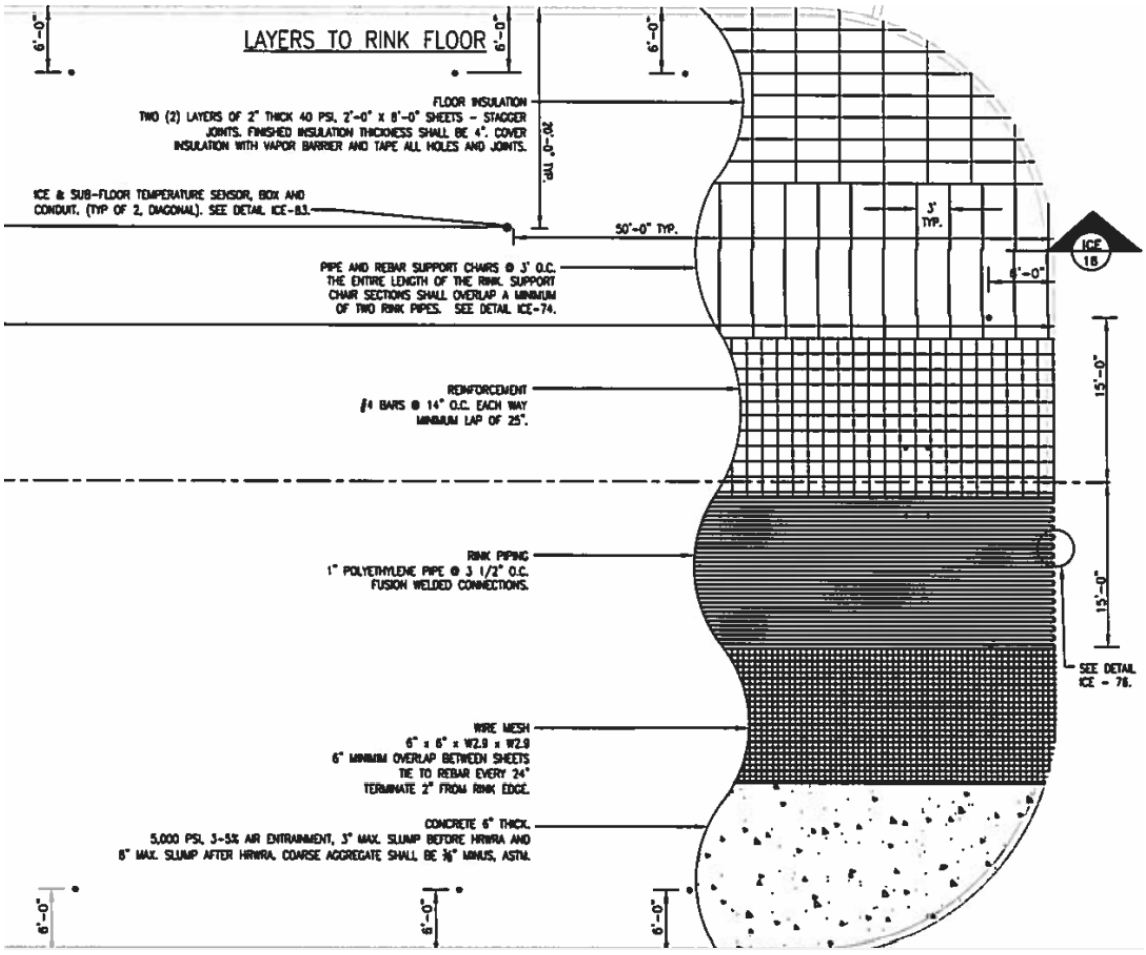

Figure 2:Refrigeration Piping and Valve Schematic

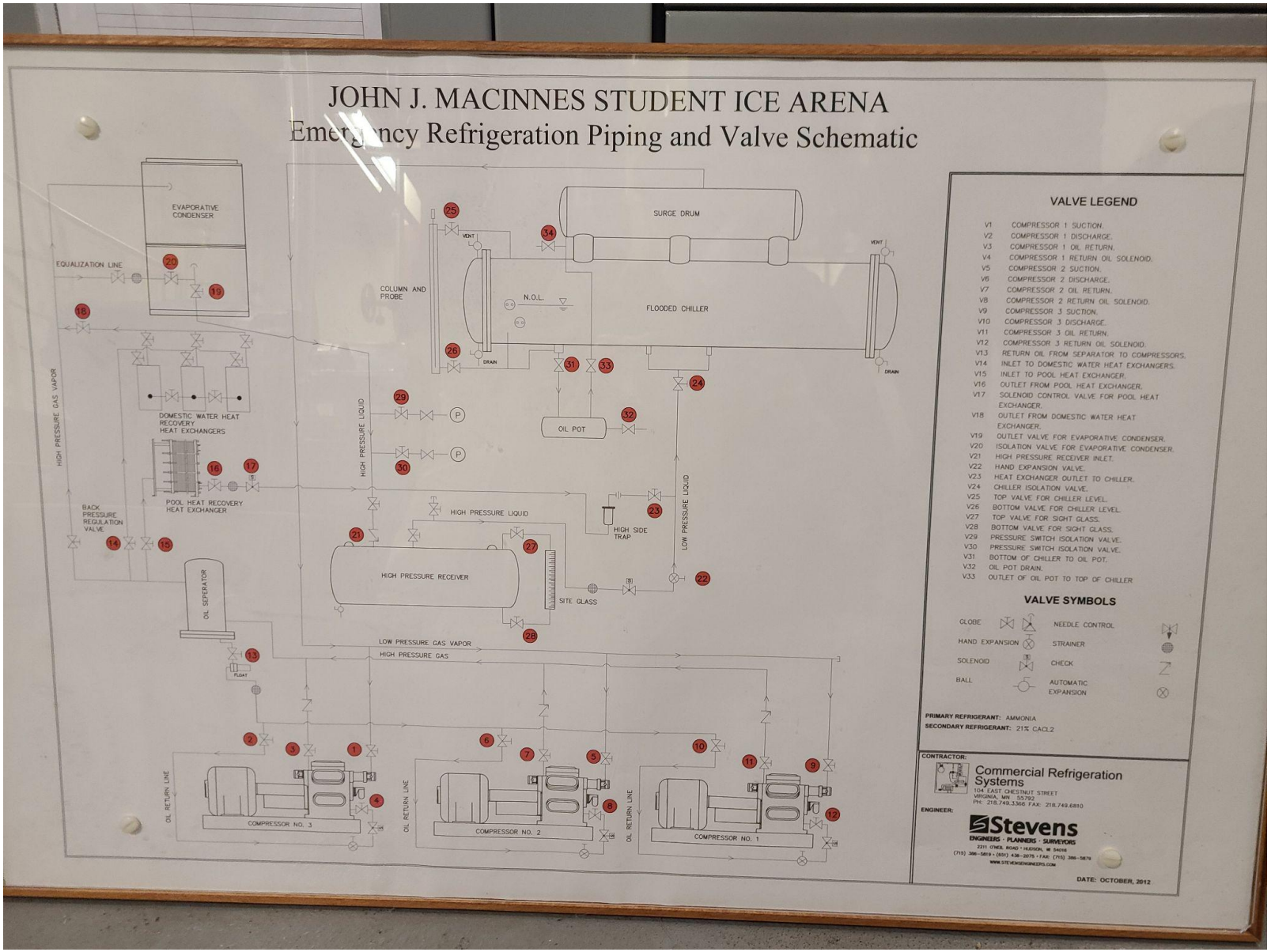

Figure 2 shows the schematic for the entire system. The ice is kept cold with a R-717 refrigerant system, this cools a brine that is pumped through the floor of the ice arena. It has 3 compressors but is designed to only need two even on a 90 degree fahrenheit day, the third is a backup.

The maintenance staff at any given time has one compressor running lead, one running lag and third either in backup mode or off. They cycle through which compressors are running the hardest based on oil pressure due to the crankcases not pressurizing equally. The compressor with the lowest crankcase oil level will be switched into the third position and allow the oil level to stabilize until more heat is demanded on another compressor's level oil drops.

The R-717 system is a closed loop system because of the hazardous nature of the refrigerant. The compressors produce a lot of heat and this heat goes to three different places. First, a slip stream of this heat is taken to a first heat exchanger that transfers the heat from the hazardous refrigerant to a more stable glycerine solution. This new closed loop goes to a second parallel plate heat exchanger that heats the pool water directly, eliminating the chance of contaminating the pool with ammonia. After the pool water heat exchanger, some of the heat is used to heat the domestic water heaters within the Student Development Center. Last, the remainder of the heat is pushed out to the roof of the building.

Maintenance on this system is quite minimal, with the only real maintenance required is the greasing of the compressors on a semi-annual basis. The compressors have each been rebuilt once so far around 20,000 hours of run time. With the life time of the electric motors used to drive the compressors being around 20-30 years, the system can run all of the time, and with the redundancy of having an extra compressor, does not pose an immediate issue when more demanding days come along. An external company is contracted to do maintenance on any components that comes in contact with the refrigerant.