LEDDY PARK – GORDON H. PAQUETTE SKATING RINK SPECIFICATIONS

SECTION 13000

R-717 AMMONIA ICE RINK REFRIGERATION

PART 1 - GENERAL

1.0-Design Consideration

The system is designed for the following conditions:

Operating Season	Year Round
Ice Surfaces	Concrete
Number of Ice Surfaces	Two
Concrete Thickness	5"
Primary Refrigerant	R-717 Ammonia
Refrigerant Capacity	120 tons
Cold Floor Refrigerant	21% Calcium Chloride Brine
Cold Floor Refrigerant Supply	14°F
Cold Floor Refrigerant Return	17.2°F
Cold Floor Maximum Flow Rate	Two @ 1125 USGPM 90' head each
Cold Floor Maintaining Cycle Flow Rate	One @ 1125 USGPM 90' head each
Condensing Temperature	90°F
Chiller Evaporative Temperature	8°F
Compressor Suction Temperature	17°F
Rink Indoor Temperature	60°F
Rink Relative Humidity	50%
Outdoor Dry Bulb Temperature	88ºF
Outdoor Wet Bulb Temperature	74ºF
Potable Water Temperature	N/R
Potable Water Flow	N/R
Condenser Spray Tower Flow Rate	220 USGPM @ 37' head (220 USGPM per Pump)

1.01-Prime Contractor

It is the intent of the awarding authority to have the refrigeration contractor act as the prime contractor. This Prime Contractor must present qualifications that his company, as the prime contractor, has completed 3 concrete refrigerated ice floors in the past 5 years. This Refrigeration Prime must present qualifications that acting as a mechanical contractor they have 10 complete ice rink refrigeration plant installations in the last 10 years with at least three where they acted as the Prime Contractor. This is not inclusive of repairs but complete installations. It is the intent of the awarding authority to have only companies with recent proven expertise in specialty Ice Rink work to bid this project. The contractor must provide proof with their bid that if decided by the awarding authority they can in fact provide a payment and performance bond for the full amount of the project. The contractor will provide emergency service within 2 hours of an emergency service call with a local vendor and 6 hours with their own forces for non-emergency service calls. All personnel will be certified as American Citizens or provide documentation of approved immigration status.

The Provided specifications and plans are for use by the Prime contractor and his subcontractors. They are inclusive of the entire scope required for a fully operational system but are the minimum acceptable. It is the responsibility of the Prime Refrigeration Contractor to provide specific drawings with his chosen equipment selections shown. It is our understanding that the manufacturers differ in their approach and for all intents and purposes are custom when providing a design. The prime contractor must provide an installation to for a fully operational system in accordance with the chosen manufacturer, local, state and federal code. Energy efficiency and reduced maintenance costs are paramount within all design manufacturers.

The Prime Contractor shall work with Efficiency Vermont to provide the customer with a custom rebate for the new energy efficient refrigeration system. It is preferable that the Prime Contractor has worked with Efficiency Vermont on a custom ice rink rebate in the past.

1.02-Submittals

The ice rink contractor shall submit complete shop drawings for approval with specific details for the following:

A. Equipment Room Piping
    1. Refrigerant piping
    2. Condenser piping
    3. Glycol piping

B. Refrigeration Unit
    1. Component layout (general configuration)
    2. Ladder type-wiring diagrams inclusive of controls
    3. Piping and Flow diagrams
    4. Total System Charge and Verification of Room Exhaust Rate

C. Written Sequence of Operation for the control system specific to the chiller manufacturer

D. Electrical
    1. Electrical Distribution for Both Compressors and Controls
    2. Plant Shunt Trip, Exhaust fan with Override switch, Ammonia Leak detection and Strobes

1.03-Work By Others

A. Fire Watch and building permit direct costs provided by the Owner if required by the City

B. Temporary lighting, power and heating.

C. Non-potable 1-1/2” cold water service to Mechanical Room for system filling.

D. Heat for equipment room to maintain minimum 50°F (if necessary).

E. Protected 600 AMP 460/480V, 3-phase, 60HZ electrical source.

F. 110V control power to equipment.

G. Making and painting ice surface.

H. Condenser water treatment system and piping as well as provision of water treatment chemicals.

I. Warranties for evaporative condenser coil section, existing concrete rink floors, existing piping reused and cold / warm floor connections.

J. Provision of access to the rink when required.

END OF SECTION

SECTION 13001

DEMOLITION

1.0 Reclaim the ammonia refrigerant charge in entirety from the existing plant. Remove all oil from the compressors. Ammonia refrigerant and compressor oil shall be removed from site and disposed of in accordance with all local and federal regulations. Demolish and remove from site the existing refrigeration plant, pumps, refrigeration room piping / exterior condenser piping, conduits, pipe hangers, any and all unused devices concerning the plant not to be reused. All existing material in containers and discarded equipment in the mechanical room will be included in the demolition portion of this project. The integrity of the room envelope must be returned to a tight condition after demolition so all ceiling and wall openings for piping and conduits must be sealed upon completion of project.

2.0 Prior to any work commencing the customer shall send samples of the brine to Tradebe Newington, NH (888-276-0887) the brine shall be tested for PH, Chromates and traces of Ammonia. The results of this test shall confirm that the brine is safe for disposal and how it should be treated for reuse.

3.0 The existing B.A.C. VC1-185 evaporative condenser coil section shall be retained for reuse. It will be the responsibility of the refrigeration contractor to rig the condenser from support stand to perform the following.

- 3.1 Remove and dispose of desuperheater section.
- 3.2 Provide and replace the condenser fan and sump section.
- 3.3 Clean coil and provide an (annual startup) preventive maintenance.
- 3.4 Replace wide flanged support beams in kind w/ new galvanized.
- 3.5 Rig Condenser back on support stand.

4.0 All demolished material must be removed from site and Prime contractor shall maintain his own dumpsters for use by all subcontractors under his contract.

5.0 It is the responsibility of the Prime Contractor to take a digital picture record of the facility prior to demolition so as to assure the owner that the facility is returned to like condition when the project is complete. The prime contractor is responsible for protection of finishes as well as cleaning of all areas affected by the work performed. Any existing damage must be noted to the Ice Rink Consultant at the start of work.

END OF SECTION

SECTION 13160
REFRIGERATION

1.01-Water / Brine Piping

A. Above Ground Piping:

1. Material shall be carbon steel A53 B Schedule 40 for cold piping. Schedule 80 PVC piping may be used on condenser water piping.

2. All joints shall be welded steel, PVC socket glued or Victaulic. All fittings to be manufactured not field fabricated.

B. Testing: All piping to be tested at 100 psig for 24 hours, verified by consultant.

C. Supports: All above ground piping shall be supported in such a way to meet applicable codes covering mechanical piping, and to eliminate swaying.

D. Labeling: All piping will be labeled at every connection with content description and flow arrows. Labels will be manufactured by Seton or equal.

E. Water valves: Shall be rated at 125 psi minimum. 2-1/2" and above shall be cast iron lug type butterfly valves with EPDM seal and liner. Valves shall have lever handle operator. Water service butterfly valves shall have an aluminum bronze disc. 2" and below shall be Brass two piece ball valves with chrome plated brass ball. Connections can either be sweat or threaded. Valves shall be installed per Piping and Instrumentation Diagram (P&ID) drawing and also be provided to facilitate isolation and removal of each pump or heat exchanger. Suitable manufactures are Milwaukee, Nibco and Apollo.

F. Brine valves: Shall be rated at 125 psi minimum. 2-1/2" and above shall be cast iron lug type butterfly valves with EPDM seal and liner. Valves shall have lever handle operator. Brine service butterfly valves shall have be nickel plated ductile iron disc. 2" and below shall be carbon steel two piece ball valves with stainless steel ball. Connections can be either sweat or threaded. Valves shall be installed per Piping and Instrumentation Diagram (P&ID) drawing and also be provided to facilitate isolation and removal of each pump or heat exchanger. Suitable manufactures are Milwaukee, Nibco and Apollo.

G. All valves will contain a tag and description to align to the Piping and Instrumentation Diagram (P&ID) designation. A valve chart will be posted within the Refrigeration room to identify these valves.

1.02- Ammonia Piping

Ammonia piping should conform to ASME Standard B31.5, Refrigerant Piping and IIAR Standard 2.

A. Ammonia Pipe and Fittings

1. Liquid lines 1.5 inches and smaller shall be not less than Schedule 80 carbon steel pipe.

2. Liquid lines 2 through 6 inches shall be not less than Schedule 40 carbon steel pipe.

3. Vapor lines 6 inches and smaller shall be not less than Schedule 40 carbon steel pipe.

4. All threaded pipe shall be Schedule 80.

5. Carbon steel pipe shall be ASTM Standard A 53 Grade A or B, Type E (electric resistance welded) or Type S (seamless); or ASTM Standard A 106 (seamless).

6. Couplings, elbows, and tees for threaded pipe shall be rated for a minimum of 3000 psi design pressure and constructed of forged steel.

7. Tongue and groove or ANSI flanges shall be used. Welded flanges for low-side piping shall have a minimum 200 psig design pressure rating. The high side shall have a minimum of 300 psig design rating.

8. Joints between lengths of pipe or between pipe and fittings can be threaded if the pipe size is 1.25 in. or smaller. Pipe 1.5 inches or larger shall be welded.

9. Do not use excessive amounts of thread sealants and compounds or apply on female threads because any excess can contaminate the system.

10. Pipe shall be cut and beveled before welding. Use pipe alignment guides to align the pipe and provide a proper gap between pipe ends so that a full penetration weld is obtained. The weld should be made by a qualified welder, using proper procedures set forth by the National Certified Pipe Welding Bureau (NCPWB).

11. An Ammonia compatible fiber gasket shall be used with flanges. Before tightening flange bolts to valves, controls, or flange unions, properly align the pipe and bolt holes. To prevent leaks, flange bolts shall be drawn up evenly when connecting the flanges. Flanges at compressors and other system components must not move or indicate stress when all bolts are loosened.

12. Unions shall be steel ground joint unions rated for 3000 psig.

B. Ammonia Valves and Strainers:

1. Valves shall be globe or angle type.

2. Only qualified personnel should be allowed to operate stop valves.

3. Consideration should be taken for Installing globe-type stop valves with the valve stems horizontal. This lessens the chance for dirt or scale to lodge on the valve seat or disk and cause it to leak.

4. Globe and angle valves shall have the following features:
    a. Soft seating surfaces for positive shutoff (no copper or copper alloy).
    b. Back seating to permit repacking the valve stem while in service.
    c. Arrangement that allows packing to be tightened easily.
    d. All-steel construction (preferable).
    e. Bolted bonnets above 1 in., threaded bonnets for 1 in. and smaller.
    f. Solenoid valves and check valves shall be flanged for easy assembly and removal.
    g. All 2” and smaller valves shall be socket weld or have welded companion flanges. Threaded valves can alternately be used on 1-1/4” and below.
    h. All 2-1/2” and larger valves shall be butt welded or have welded companion flanges.

5. Strainers: Shall be used in front of solenoid valves to protect them from pipe construction material and dirt.

6. Solenoid Valves: Solenoid Valve stems shall be upright with their coils protected from moisture. They shall have flexible conduit connections and an electric pilot light wired in parallel to indicate when the coil is energized.

7. Relief Valves: Safety Valves shall be provided and installed per Piping and Instrumentation Diagram (P&ID) designation as well as conform to ASHRAE Standard 15 and Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code and IIAR Bulletin 109.

1.03-Insulation

A. Above ground refrigerated glycol and refrigerant suction piping shall be insulated with 1-1/2" Polyisocyanurate (urethane) including vapor retarder film (Saran 540-CX) and PVC jacket or two layers of 1" closed cell fiber free elastomeric insulation (Armaflex) with PVC jacket. Suitable Manufacturers are ITW, Armacell, K-Flex or equal.

B. Cold Floor pump bodies shall be insulated with 1" closed cell fiber free elastomeric insulation (Armaflex).

1.04-Refrigeration Equipment

Manufacturers and equipment specified are for the purpose of setting the minimum standard of capacity and quality of equipment for performance of the ice rink system. If equipment substitution is required the equipment will either match or exceed the quality of the original intended equipment. The plant will be constructed to meet a light industrial use. Refrigeration systems classified as commercial in nature will not be considered an or equal. Acceptable manufacturers of the chiller skids are Ultimate Fabrication Inc., M&M Refrigeration or Preferred Iceberg R717.

Compressors: Two Screw Compressors 60 TR at 8°F SST and 90°F SCT

Compressor Motors: - (2) 100 horsepower Premium Efficiency.

Evaporative Condenser: Reuse of existing with replacement of fan section and sump.

Condenser Water Pumps: Two 3 horsepower 220 USGPM at 37'of head.

Cold Floor Chiller: One plate and frame flooded ammonia chiller with U-Turn Liquid Separator.

Cold Floor Pumps: Two 1125 USGPM at 90 foot of head 40 HP.

Evaporative Condenser Remote Sump Tank: One reinforced Polyethylene (HDPE) at 327 gallons.

Cold Floor Expansion Tank: One at 120 gallons.

Liquid Line Economizer: One providing sub cooling of liquid refrigerant to 36.6°F.

Shell and Tube Heat Exchanger: – One providing ammonia heat reclamation for warm floor

A. COMPRESSORS

1. Performance: (2) 60 TR 100HP Ammonia (R-717) screw compressors:

   Compressors shall come from the factory skid mounted as a package. Accepted Manufacturers shall be M&M Refrigeration, containing their on board controller utilizing R-717 Sabroe Compressors or Bitzer Ammonia Screw Compressor Pack utilizing their R-717 OSKA-8551 Compressors. Compressors shall be open drive with 100 horsepower premium efficiency motors, direct drive couplings with self-aligning housings and OSHA guards (as required). Compressors will contain all accessories as required by the manufacturer such as (insulated for noise) discharge coalescing oil separators with automatic secondary oil return system, oil separator heaters, Thermosiphon oil cooler, High pressure ,Low pressure and oil pressure switches are required on each compressor. The suction, economizer and discharge piping of each compressor will contain an inline vibration isolator. A minimum of one crankcase heater will be installed per compressor. High oil temp thermostat / sensor and head temperature thermostat are required. The Liquid Line from receiver will be sub cooled by a plate and shell heat exchanger as manufactured by Alfa Laval, Bitzer, and or Tranter heat exchanger with a thermosiphon circuit. Entering liquid to the Chiller will be sub cooled to no more than 36.6°F. The heat exchangers will be piped to the medium pressure connection of each screw compressors. Each liquid feed will contain a solenoid valve for off cycle isolation.

2. Compressor Soft Start Panel:
   Compressor Package shall be furnished with one UL rated Soft Starter Panel Consisting of the following:

   A. Two 460 Volt, 3 Phase, 60Hz Power Supplies
   B. One NEMA-1 modular style enclosure
   C. Electrical interlock
   D. Two main circuit breakers with operating handle mounted on the door
   E. Power distribution blocks
   F. Branch#1 & 2; each branch will consist of:
      - One Soft starter Branch circuit breaker without through the door handle.
      - One soft starter with built in end of the ramp AC1 rated bypass contactor (100HP).
      - RS-485 (Modbus RTU) communication module for Soft Starter
      - Soft starter lug kits/Motor power terminal blocks.
      - Auxiliary control terminal blocks for customer's remote commands.
   G. One 3KVA control power transformer (480/120V AC) with primary & secondary protection.
   H. One 20amp @ 24V DC rated power supply.
   I. Following items will be installed on the enclosure door:
      - 2 x Soft starter keypads.
      - 2 x "RUN" & 2 x "FAULT" Pilot lights. (22mm).
      - One "E-Stop" PB.
      - Cooling fan & exhaust filter assemblies.

2a. **ALTERNATE #1** Compressor VFD Panel:
Compressor Package shall be furnished with two UL rated Enclosed Variable Speed drives panel (one per compressor) consisting of the following:

A. Two 460 Volt, 3 Phase, 60Hz Power Supplies
B. Two Circuit breakers with through door handle
C. Fused 480V/120V control power transformer
D. Internal fan and heat sink
E. Run/fault lights, start/stop push buttons.
F. Nema 12 enclosure.
G. One NEMA-1 modular style enclosure.
H. input reactor offering no less than 4.5% effective impedance at rated motor amps

3. Compressor Control Panel:
Compressor Package shall be furnished with one UL rated Control Panel Consisting of the following:

A. 120 Volt, 1 Phase, 60Hz Primary Power Supply.

B. 24V DC Secondary Power Supply.

C. One NEMA-1 modular style enclosure.

D. Programmable Logic:
- Compressor and capacity control.
- Dual target set points based on pressure or process temperature
- Data Logging.
- Pre-alarms warning of operation out of application limits.
- Alarms and shutdown parameters for suction, discharge, and oil (pressure and temperature).
- Motor thermistors.
- Motor current.
- Economizing control.

E. Human Machine Interface (HMI)
- 12" Color Touchscreen Display
- Replicate Display w/any web browser or direct to PC

F. Communication
- Open Communication Protocols for system integration (TCP/IP Modbus communication)
- Communicates with Soft starters via Modbus

4. Coalescing Oil Separator:
Compressor Package shall be furnished with one Oil Separator built to the following specifications:

A. Shell Side:
- Max. Allowable Work Pressure: 300psi @ 250F
- Min. Design Metal Temp.: -20F @ 300psi
- Capacity: 24.05 ft3

- Type of Fluid (Non-lethal): ANHYDROUS NH3 /OIL
- Physical State of Fluid: LIQUID / VAPOR
- Vessel Stamp: U

B. Manufacture vessel in accordance with ASME Sec VIII Div. 1 (Latest Version)
C. Pressure boundary parts are carbon steel.
D. Vessel will be painted black.
E. Vessel will be shipped with 4 heater wells including (4) 200 watt heaters

5. Oil Cooler:
Compressor Package shall be furnished with one thermosiphon oil cooler built to the following specifications:

A. Shell Side:
- Construction: Carbon Steel
- Max. Allowable Work Pressure: 300psi @ 300F
- Min. Design Metal Temp.: -20F @ 300psi
- Type of Fluid (Non-lethal): ANHYDROUS NH3
- Physical State of Fluid: LIQUID / VAPOR
- Vessel Stamp: U

Performance:
- Capacity: 243,000 Btuh
- Flow: 499.4 lb./h
- Temp in: 91°F
- Temp out: 91°F
- Evap Temp: 91°F

B. Plate Side:
- Construction: AISI 316L 0.7mm
- Max. Allowable Work Pressure: 300psi @ 300F
- Min. Design Metal Temp.: -20F @ 300psi
- Type of Fluid (Non-lethal): OIL VG68
- Physical State of Fluid: LIQUID

Performance:
- Flow: 9,019 lb./h
- Temp in: 175°F
- Temp out: 120°F

C. Manufacture vessel in accordance with ASME Sec VIII Div. 1 (Latest Version)
D. Setup for Horizontal Position.
E. Vessel will be coated with high quality paint.

6. Economizer:
Compressor Package shall be furnished with one thermosiphon oil cooler built to the following Specifications:

A. Shell Side:
- Construction: Carbon Steel
- Max. Allowable Work Pressure: 300psi @ 300F

- Min. Design Metal Temp.: -20F @ 300psi
- Type of Fluid (Non-lethal): ANHYDROUS NH3
- Physical State of Fluid: LIQUID / VAPOR
- Vessel Stamp: U

Performance:

- Capacity: 180,000 Btuh
- Flow: 329.6 lb/h
- Temp in: 27.6°F
- Temp out: 27.6°F
- Evap Temp: 27.6°F

B. Plate Side:

- Construction: AISI 316L 0.7mm
- Max. Allowable Work Pressure: 300psi @ 300F
- Min. Design Metal Temp.: -20F @ 300psi
- Type of Fluid (Non-lethal): OIL VG68
- Physical State of Fluid: LIQUID / VAPOR

Performance:

- Flow: 2,923 lb/h
- Temp in: 91°F
- Temp out: 36.6°F

C. Manufacture vessel in accordance with ASME Sec VIII Div. 1 (Latest Version)
D. Setup for Horizontal Position.
E. Vessel will be coated with high quality paint.

B. CONDENSER (INDUCED DRAFT EVAPORATIVE CONDENSER WITH REMOTE SUMP AND WATER TREATMENT)

1. The coil section of this B.A.C. VC1-185 condenser was replaced recently however the lower fan section and basin were not replaced. It is the intent to remove any older sections of the condenser and replace with new. The existing condenser coil and coil casing shall be reused. The condenser shall be completely serviced. All nozzles and fill devices shall be cleaned. The desuperheater section is not recommended with screw compressors and will be removed. New gaskets shall be furnished and installed between all sections and resealed. New drift eliminators shall be furnished and installed. A new VFD shall be furnished and installed on the fan motor to modulate the fan from a reset compressor discharge pressure and shall include a mechanical contactor bypass.

2. The existing support wide flange beams on the structure will be replaced with an all hot-dip galvanized structural steel capacity and size equal to existing support structure.

3. The existing water piping will be replaced with Schedule 80 PVC and all ammonia piping as well as ammonia relief piping will be replaced with schedule 40 carbon steel with welded connections.

4. The remote sump tank will be replaced with a new 1” Thick High-Density Polyethylene (HDPE) Water Tank with overhanging Bottom, 1” Thick x 3” Top Flange, 50/50 SS Bolted Top Cover. Tank inside dimensions shall be 30”W x 42”L x 60”H. Tank will have (3) steel tube painted girth bands. Tank volume shall be 327 Gallons Full. The indoor sump tank shall be furnished with a new makeup water float assembly for connection of the non-potable water source.

Float valve shall be McDonnell Miler 25A or equal. Each pump will have an independent wye strainer with blow down valve.

Tank Fittings List:
(2) 4" Diameter Polyethylene Welded-Gusseted Flange
(1) 1-1/2" Diameter PE Half Coupling
(2) 2" Diameter PE Half Coupling
(1) 2" Diameter PE Full Coupling
(2) 1" Diameter PE Half Couplings
(1) 3/4" Diameter PE Half Coupling

5. The existing Pep Cartridge style filtration system shall be retained for reuse. It is the responsibility of the prime contractor to repair the discharge piping, replace the filter cartridges & bring the pep filter back to operational use. One spare set of cartridges shall be handed to the owner after project completion.

6. Water Treatment:

   a) A new cooling tower water treatment controller shall be provided and installed per the P&ID drawing. The controller shall be based on a Walchem WECT400-1N1U. Solids Blow down shall be through a slow closing pilot operated solenoid valve such as a ¾" ASCO RedHat cat. no. 8221G005, 120 volt coil.

   b) The Prime contractor must employ the services of Chem-Aqua Services for Chemical Water Treatment of the Evaporative Condenser, Sump Tank and Treatment of the Brine Systems. Please contact Tom Cowles at 860-604-7456 pricing.

C. COLD FLOOR PLATE AND FRAME CHILLER

The chiller will be constructed of a titanium plates, Steel heads and arranged for single circuit thermosiphon with electronic float valve operation based on Alfa Laval model MK15-BWFD furnished with the "U Turn Liquid Separator" Acceptable manufacturers are Alfa Laval, Tranter, and or Thermal Products Inc.

1. The design flow and quantities will be as listed in paragraph 1.02.

3. The chiller will be constructed to ASME standards and designed for 300 psi working pressure.

4. The chiller will be insulated with 1-1/2 inch thick Urethane insulation or two layers of ¾ inch closed cell elastomeric (Armaflex) and 20mil PVC cover.

5. The Chiller will have one Ethylene Glycol Circuit.

6. The Chiller will have one Flooded Refrigeration circuit and will be fed from a Hansen Technologies HS4A solenoid valve (120V coil). The Solenoid Valve shall be controlled via a Hansen Technologies VariLevel 3 Relay Level Control with Hansen 40"L level probe. The controller shall be furnished with a 4-20mA output module to provide feedback to plant DDC Controls. Refer to Piping and Instrumentation Diagram (P&ID) drawing for the Chiller Ammonia Feed Diagram.

7. The Chiller shall include pre-piped connections to and from the U-Turn Separator assembly. U-Turn separator shall be supported entirely by the plate heat exchanger. An integrated oil drain assembly (oil pot) shall be included.

8. Provide complete housekeeping pad to extend beyond chiller base by 6” in all directions.

D. EVAPORATIVE CONDENSER SPRAY WATER PUMPS

1. Furnish and install (2) pumps supplying evaporative condenser spray with performance of 220 GPM at 37’HD (Water).

2. Pumps shall be close coupled, foot mounted, single stage, end suction design, capable of being serviced without disturbing pump piping connections. Pump volute shall be class 30 cast iron with integrally cast pedestal support feet. The impeller shall be cast stainless steel enclosed type. Impeller shall be hydraulically and dynamically balanced to ANSI/HI 9.6.4-2009, ISO 1940 balance grade G6.3, keyed to the shaft and secured by a stainless steel locking cap screw.

3. The liquid cavity shall be sealed off at the motor shaft by an internally flushed mechanical seal with ceramic seal seat and carbon seal ring, suitable for continuous operation at 225°F (107°C). A replaceable shaft sleeve of stainless steel shall completely cover the wetted area under the seal.

4. Pumps shall be rated for 175 psi (12 bar) working pressure. Volute shall have gauge tappings at the suction and discharge nozzles and vent and drain tappings at the top and bottom.

5. Motor shall meet NEMA specifications and shall be of the size, voltage and enclosure called for on the plans. It shall have heavy duty grease lubricated ball bearings, completely adequate for the maximum load for which the motor is designed.

6. The pump selected shall conform to ANSI/HI 9.6.3.1-2012 standard for preferred operating region (POR) unless otherwise approved by the engineer. The pump NPSH shall conform to the ANSI/HI 9.6.1-2012 standards for Centrifugal and Vertical Pumps for NPSH Margin.

7. Each pump shall be factory hydrostatically tested per Hydraulic Institute standards. It shall then be thoroughly cleaned and painted with at least one coat of high-grade paint prior to shipment.

8. The pump shall be manufactured, assembled and tested in an ISO 9001 approved facility.

9. Pumps shall be Series e-1532 as manufactured by Xylem Bell and Gossett, Taco, Armstrong or approved equal.

10. Two pumps supplying the condenser spray water include primary pump and 100% stand by pump.

11. Both pumps will have a single wye strainer mounted prior to the suction inlet with manual blow down valve.

12. Provide complete housekeeping pad to extend beyond pump motor but not inhibit volute and strainer.

E. COLD FLOOR PUMPS

13. Furnish and install (2) pumps Refrigerated Cold Floor with performance of 1125 GPM at 90'HD (21% Calcium Chloride Brine at minimum 10°F).

14. Pumps shall be close coupled, foot mounted, single stage, end suction design, capable of being serviced without disturbing pump piping connections. Pump volute shall be class 30 cast iron with integrally cast pedestal support feet. The impeller shall be cast stainless steel enclosed type. Impeller shall be hydraulically and dynamically balanced to ANSI/HI 9.6.4-2009, ISO 1940 balance grade G6.3, keyed to the shaft and secured by a stainless steel locking cap screw.

15. The liquid cavity shall be sealed off at the motor shaft by an internally flushed mechanical seal with ceramic seal seat and carbon seal ring, suitable for continuous operation at 225°F (107°C). A replaceable shaft sleeve of stainless steel shall completely cover the wetted area under the seal.

16. Pumps shall be rated for 175 psi (12 bar) working pressure. Volute shall have gauge tappings at the suction and discharge nozzles and vent and drain tappings at the top and bottom.

17. Motor shall meet NEMA specifications and shall be of the size, voltage and enclosure called for on the plans. It shall have an internal shaft grounding ring provided from factory by motor manufacturer. It shall have heavy duty grease lubricated ball bearings, completely adequate for the maximum load for which the motor is designed.

18. The pump selected shall conform to ANSI/HI 9.6.3.1-2012 standard for preferred operating region (POR) unless otherwise approved by the engineer. The pump NPSH shall conform to the ANSI/HI 9.6.1-2012 standards for Centrifugal and Vertical Pumps for NPSH Margin.

19. Each pump shall be factory hydrostatically tested per Hydraulic Institute standards. It shall then be thoroughly cleaned and painted with at least one coat of high-grade paint prior to shipment.

20. The pump shall be manufactured, assembled and tested in an ISO 9001 approved facility.

21. Pumps shall be Series e-1532 as manufactured by Xylem Bell and Gossett, Taco, Armstrong or approved equal.

22. Two pumps supplying the cold floor include primary pump and 100% stand by pump.

23. Each pump shall have a Variable Speed Drive with predetermined flow rates set forth in the sequence of operation. Balancing Contractor shall be responsible to set the VFD speeds corresponding to flow rates required.

24. Provide complete housekeeping pad to extend beyond pump motor but not inhibit volute and strainer.

F. WARM FLOOR PUMP

1. Furnish and install (1) pump supplying Warm Floor with performance of 125 GPM at 45'HD (21% Calcium Chloride Brine at minimum 40°F).

2. Pumps shall be close coupled, foot mounted, single stage, end suction design, capable of being serviced without disturbing pump piping connections. Pump volute shall be class

30 cast iron with integrally cast pedestal support feet. The impeller shall be cast stainless steel enclosed type. Impeller shall be hydraulically and dynamically balanced to ANSI/HI 9.6.4-2009, ISO 1940 balance grade G6.3, keyed to the shaft and secured by a stainless steel locking cap screw.

3. The liquid cavity shall be sealed off at the motor shaft by an internally flushed mechanical seal with ceramic seal seat and carbon seal ring, suitable for continuous operation at 225°F (107°C). A replaceable shaft sleeve of stainless steel shall completely cover the wetted area under the seal.

4. Pumps shall be rated for 175 psi (12 bar) working pressure. Volute shall have gauge tappings at the suction and discharge nozzles and vent and drain tappings at the top and bottom.

5. Motor shall meet NEMA specifications and shall be of the size, voltage and enclosure called for on the plans. It shall have heavy duty grease lubricated ball bearings, completely adequate for the maximum load for which the motor is designed.

6. The pump selected shall conform to ANSI/HI 9.6.3.1-2012 standard for preferred operating region (POR) unless otherwise approved by the engineer. The pump NPSH shall conform to the ANSI/HI 9.6.1-2012 standards for Centrifugal and Vertical Pumps for NPSH Margin.

7. Each pump shall be factory hydrostatically tested per Hydraulic Institute standards. It shall then be thoroughly cleaned and painted with at least one coat of high-grade paint prior to shipment.

8. The pump shall be manufactured, assembled and tested in an ISO 9001 approved facility.

9. Pumps shall be Series e-1532 as manufactured by Xylem Bell and Gossett, Taco, Armstrong or approved equal.

10. Pump will have a wye strainer mounted prior to the suction inlet with manual blow down valve.

11. Provide complete housekeeping pad to extend beyond pump motor but not inhibit volute and strainer.

G. SHELL AND TUBE HEAT EXCHANGER (AMMONIA HEAT RECLAMATION)

1. The heat exchanger shall be of an ASME carbon steel pipe shell construction with an ASME carbon steel tube sheet bundle.

2. Heat Exchanger Performance shall be as shown on the plans.

3. Shells shall be sand blasted and cleaned prior to assembly. Tube sheets shall be epoxy coated to prevent pitting caused by galvanic action.

4. Heat Exchanger shall have ASME precision machined carbon steel heads. The inside of the heads shall be epoxy coated to prevent pitting caused by galvanic action.

5. All water side connections shall be flanged. All refrigerant side connections shall be NOM. Safety connections shall be FNPT.

6. The heat exchanger shall be designed with a working pressure of 350 psi shell side (Refrigerant) and 225 psi tube side (Brine).

7. The heat exchanger shall be equipped with the necessary connections as shown on the plans as well as the operation of the heat exchanger.

8. Exterior surfaces shall be cleaned and painted with a high quality paint and primer.

9. Approved Manufacturers are Alfa Laval, Henry Technologies, M&M and or Cimco.

H. COMBINED THERMOSIPHON / MAIN REFRIGERANT RECEIVER

1. The receiver shall be of an ASME carbon steel construction with an ASME stamp and National Board Registered.

2. Pressure Rating Shall be 300 psi.

3. Connections shall be as indicated on plans.

4. Exterior surfaces shall be cleaned and painted with a high quality paint and primer.

1.05-REFRIGERATION CHILLER CONTROLS

Chiller and refrigeration plant will be controlled by a fully digital PLC style system as manufactured by Distech, Carel, Johnson Controls, or approved equal. The control package shall include but not be limited to all PLC's, relays, enclosures, wiring, transformers, overcurrent protection, valves, VFD's, sensors, and devices required for a fully functioning automated control system. The digital system installed must be capable of the following:

1. Offer a fully distributed architecture for all analog and digital I/O devices.

2. Provide communication capability to all device controllers over BACnet MS/TP protocol. All communication cards or licenses required for BACnet operation shall be installed during this project so any new integration only requires communication bus tie in. The new BACnet controller(s) will integrate to the existing building Automated Logic control system. The Prime contractor must employ the services of the existing BMS Company to integrate new DDC Chiller plant using BACnet. Upon project completion a complete BACnet points list must be included in project closeout documentation.

3. Provide a panel mounted user interface to be located within the refrigeration room that uses plain English text to explain plant operation and/or alarms and failures.

4. System updates or program flashes must be able to be made via standard media access (disk, USB flash drive, or EEPROM replacement).

5. Have no recurring licensing fees.

7. Have the capability to generate alarms and provide notification of system failures per the Sequence of Operation contained herein.

8. Employ the use of 10KΩ@77° F Type III immersion sensors in stainless steel wells installed per ASHRAE standards with thermal conductive compound.

9. Provide redundant embedded temperature sensors in the cold floor via the existing header trench.

10. Provide a modulating 0-10V signal to control Variable Frequency Drives (VFD)

11. Have adequate I/O for 10% future expansion.

12. Perform 3-phase monitoring that will shut down all Refrigeration 3-phase equipment in the event of phase loss.

13. A refrigeration plant amber trouble strobe shall be located at the main refrigeration room entry to alert personnel of a system fault. Strobe shall have a placard that reads "REFRIGERATION SYSTEM FAILURE ALARM".

14. Provide ammonia leak detection system, refer to specification 1.07 below.

15. Provide a break glass style emergency shunt trip (E-Stop) at main refrigeration room entry door. Shunt trip must shutdown all refrigeration equipment except condenser fans. Condenser fans shall be allowed to operate in the event of an emergency. Shunt trip shall have a placard that reads "REFRIGERATION MACINERY ROOM SHUTDOWN EMERCENCY USE ONLY BREAK GLASS TO PUSH BUTTON".

1.06-Chiller Control and Motor Control Center

A. OVERVIEW: Control panel and Motor Control Center shall be pre-assembled and wired. One compartment shall contain control devices and one compartment shall contain the motor control center. All wiring shall be in accordance with current NEC.

1. Starters for condenser pumps and warm floor pump to be NEMA sized for the pump being controlled complete with manual reset overload protection as manufactured by Eaton Cutler-Hammer, Square-D, or approved equal.
   Sprecher and Shuh will not be considered for this project.

2. Pump and Condenser Fan Motor Control Center shall be complete, requiring single point power to load center for all equipment (except for Screw Compressors).

3. Each independent motor control device shall have appropriate overcurrent protection by means of fuses or manual reset circuit breakers.

4. The evaporative condenser fan will be controlled via VFD with mechanical bypass and shall be similar to Danfoss, ABB and or Honeywell VFD's. Substitutions will need to be approved by ice rink consultant prior to installation.

5. All motor controllers contained within the MCC shall have face mounted Hand-Off-Auto selector switches with proper clear lamacoid labeling.

B. VARIABLE SPEED DRIVES

1. General: Variable torque AC drive consisting of a solid state adjustable frequency controller (AFC) and a performance matched energy efficient motor. The manufacturer shall provide, coordinate and start-up the drive package to ensure both proper application of the motor to the controller and to the system. The variable speed drive shall be fully digital pulse with modulation (PWM) utilizing very large scale integration (VLSI) techniques, as well as surface mount technology for increased reliability. The entire VSD Package including all options shall be in one common cabinet with the entire assembly UL approved and listed.

2. Adjustable frequency Controller: Shall convert service voltage, three phase, 60 hertz utility power to adjustable voltage/frequency, three phase, AC power for stepless motor control 10 percent to 110 percent of base speed. All drives to have input line reactors offering no less than 4.5% effective impedance at rated motor amps to meet acceptable requirements of applicable electrical utility for efficiency programs.

3. Designed and constructed to operate within the following service conditions:

    a. Elevation: to 3,300 feet without derating.

    b. Ambient Temperature Range: 0 degrees C to 40 degrees C.

    c. Atmosphere: Non-condensing relative humidity to 95 percent.

    d. AC Line Voltage Variation: -10 percent to +10 percent and +/-2 percent frequency.

    e. Ride-through power sags up to 500 mSec without a controller trip.

4. AFC shall be selected to be compatible with motor maximum FLA nameplate rating. All components shall be horsepower rated.

5. Circuits shall provide time derivative variable voltage and variable current protection for semiconductors. AFC shall be capable of starting into a rotating load without delay. Protective circuits shall cause instantaneous trip (IET) should any of the following faults occur:
    a. 110 percent of controller maximum sine wave current rating is exceeded for longer than one (1) minute.

    b. Output phase to phase short circuit condition.

    c. Total ground fault protection under any operating condition.

    d. High input line voltage.

    e. Low input line voltage.

    f. Loss of input phase.

    g. External fault (this protective circuit shall permit by means of terminal strip, wiring of remote N.C. safety contacts such as high pump static pressure, fire or
    smoke safety, etc., to shut down the drive).

6. The following adjustments shall be available in the controller:

    a. Maximum frequency (15 to 120 Hz) factory set at 60 Hz.

b. Minimum frequency (5 to 60 Hz) factory set at 6 Hz.

c. Adjustable Acceleration (0.1 to 360 seconds) factory set at 20 seconds.

d. Adjustable Deceleration (0.1 to 360 seconds) factory set at 20 seconds.

e. Volts/Hertz ratio factory set for service voltage at 60 Hz.

f. Voltage offset or boost factory set at 100 percent torque.

g. Current limit (50 percent to 100 percent sine wave current rating) factory set at 100 percent current.

7. Door mounted operator control of AFC shall be furnished with a micro-processor based command center with a membrane keypad which allows auto/manual, start/stop, manual speed control, programming, and visual display of the units operating parameters. The microprocessor system shall be password protected and provide full monitoring, control and diagnostics.

   a. In automatic mode, controller shall follow an external signal and respond to remote start/stop contact wired to terminal strip and all safety interlocks.

   b. Digital display shall be door mounted to indicate power on, drive faults, motor running and external faults.

8. Voltage, current and frequency display: Shall be provided to digitally indicate the output voltage, output frequency and output current.

C. COMPRESSOR MOTOR SOFT STARTERS (Supplied by Compressor Manufacturer)
The soft starter shall contain the following features, functions and adjustments as a minimum.

1. Acceleration Control.
   As a minimum, the soft starter shall come complete with the following settings:

   a) Initial Voltage: Initial voltage output shall be adjustable between 30-70% of the nominal voltage.
   b) Maximum Current Limit: Current Limit shall be adjustable between 200% and 500% of the soft starter's rated full load current.
   c) Ramp Time: The time between initial torque and full output torque shall be adjustable between 1 and 120 seconds in increments of one second.
   d) Kick Start: In order to accommodate high inertia loads, the soft starter shall include settings for a kick start. The kick start initial voltage setting shall be adjustable between 50-100% of nominal voltage. The kick start time shall be adjustable between 0.1 and 1.5 seconds in increments of 0.1 seconds.
   e) Jog: In order to allow rotation checks during start-up or in order to perform test procedures, the soft starter shall include a jog function that matches the programmed acceleration profile. The jog function shall be initialized either directly from the keypad or through a programmable input.

2. Preset Application Macros

   The soft starter shall be provided with preset application macros. The macros shall be fully adjustable in order to allow optimization of starting and stopping parameters. The soft starter must contain macros for the most common applications as follows:

   - Hydraulic Pump
   - Centrifugal Pump
   - Compressor
   - Fan

3. Sequence Start

   The soft starter shall have the ability to sequentially start up to three motors. Each sequential start shall include independently programmable start ramp profiles. Each start ramp profile shall include programmable settings for initial voltage, ramp time, and maximum current limit.

4. Deceleration Control (soft stop)

   Deceleration control (soft stop) shall be a standard feature. All deceleration setting shall be independent of any acceleration setting. As a minimum, the soft starter shall come complete with the following settings:

   a) Step Down Voltage: In order to eliminate hunting effects for pump applications, a step down voltage shall be available and adjustable from 30 to 100% of the line voltage
   b) Ramp Time: The deceleration time should be adjustable from 0-120 seconds in increments of one second to allow controlled deceleration (soft stop) of motors.
   c) End Voltage Level: The end voltage level shall be adjustable from 30-70% of line voltage.

5. Motor and Load Protection

   Motor and Load Protection shall be integrated with the soft starter. All protection functions shall under no circumstances be disconnected or disabled when a by-pass contactor is used. In order to protect both the motor and load, the soft starter shall be provided with the following functions as a minimum:

   a) Motor Overload Protection: Motor overload protection shall be programmable from Class 10A, 10, 20 and 30. The overload protection shall be based on a Dynamic Thermal Register retained in memory even upon loss of power.
   b) Dual Overload Protection: The soft starter must include two separate overload curves – one for starting and one for continuous run. Dual overload protection will allow a higher trip class to avoid nuisance tripping during acceleration while providing maximum motor protection during continuous run conditions. For maximum flexibility, each trip curve shall be independently programmable within the four different trip curve classes described above.
   c) Manual or Automatic Reset: For maximum flexibility, the soft starter shall be programmable to allow automatic reset for unattended remote applications. The factory default shall be manual reset.
   d) Thermal Memory: The over load protection shall not lose track of the motor temperature after loss of power. Upon reapplication of power, the microprocessor shall update the motor temperature and adjust for real time cooling while the power was off.

e) PTC Protection: Input terminals for PTC signals directly from the motor to the soft starter shall be available as a standard design feature.
f) Thermal Capacity Reset Level: The soft starter shall not allow a restart of the motor after an over load trip if sufficient thermal capacity is not available for a successful re-start.
g) Phase Imbalance Protection: The soft starter shall be provided with programmable phase imbalance protection. The sensitivity shall be adjustable for imbalances between any two phases between 10% and 80% of the rated current.
h) Phase Reversal Protection: Protection for phase reversal shall be available to prevent the soft starter from starting if the phases are connected in a different order than ABC. This will ensure that the motor will not turn in an inappropriate direction.
i) High Current Protection: The soft starter shall be equipped with high current protection and shall trip if the current exceeds eight times the set rated current.
j) Locked Rotor Protection (electronic shear pin protection): Locked rotor protection shall be available. The trip current shall be programmable from 300% to 800% of set rated current. The time delay before tripping shall be adjustable from 0.2 to 10 seconds.
k) Under Load Protection: The soft starter shall be equipped with under load protection and shall trip if the current falls below a preset level during a certain time period. The trip level shall be programmable from 40% to 100% of the programmed full load motor current. The time delay before tripping shall be adjustable from 1 to 30 seconds.

6. Mechanical Construction
The soft starters shall be constructed to the following mechanical specifications:

a) Housing and Termination: The soft starter shall be housed in plastic or metal material and termination points provided to accommodate the required incoming cables for the line and load connections.
b) Ventilation: The soft starter shall be ventilated with fan cooling when necessary. The fans shall be temperature regulated and automatically switch on only when cooling is necessary in order to reduce energy consumption and noise level.
c) Integrated Bypass Contactors: Soft starters with a rating over 300A shall be equipped with an integrated by-pass contactor as standard. The integrated by-pass contactor shall reduce the power losses during continuous run to less than 200W per soft starter, independent of the size. A means to allow external energizing of the integrated bypass contactor shall be provided to
allow emergency bypass operation in the unlikely event that the soft starter should fail. Consult factory for proper soft starter selection when emergency bypass operation is required.
d) Inline and Inside Delta Connection: Each soft starter shall be possible to connect inside the delta of delta wound motors or in-line with standard 3-lead motors. The inside-delta connection makes it possible to reduce the soft starter size by 42%. The soft starter shall automatically detect if it is wired in-line or inside delta. The use of dipswitches or other settings for the selection of the two alternate connections is not acceptable.
e) Bypass Connection Terminals: For soft starters not equipped with an integrated bypass contactor, the soft starter shall be equipped with double connections on the incoming side. The extra terminals shall be used for the by-pass connections allowing the protection functionality

integrated in the soft starter to be utilized when the soft starter is in bypass mode.

D. REFRIGERATION SYSTEM SEQUENCE OF OPERATION

1.) The refrigeration plant will have three modes of operation:

a) **Unoccupied** - 2° interstage between compressor stages with 800 USGPM flow from lead pump *cycled* on/off by imbedded slab sensor default setpoint of 19° (adjustable)
b) **Practice** - 1° interstage between compressor stages with 1000 USGPM flow from lead pump *cycled* to maintain return glycol sensor default setpoint of 18° (adjustable)
c) **Game Mode** - 0.5° interstage between compressor stages with 1125 USGPM flow from lead pump *in constant run* to maintain return glycol sensor default setpoint of 17° (adjustable)

2.) Lead cold floor pump will be initiated by user selectable sensor (embedded slab, or return glycol temperature). *If return glycol temperature is selected as active sensor, lead pump must remain in constant run.* There are two cold floor pumps which must alternate in a lead/lag fashion. Upon a rise in cold floor/glycol temperature above setpoint +1° (adj.) as detected by the active sensor, the lead pump shall be commanded to start. If the lead pump fails to start within 15 seconds, a cold floor pump alarm shall be generated and the lag pump shall be started and continue to run until the lead pump is restored to service. Lead/lag shall rotate the lead device once per week during the middle of a normal business day.

3.) There are two screw compressors (C-1 and C-2) which run in a lead/lag configuration. Lead/lag shall rotate the lead device once per week during the middle of a normal business day. Upon a rise in glycol return temperature above Stage 1 setpoint + bias, the oil return solenoid valves shall open, the compressor soft starter shall enable and ramp it up and run unloaded for 60 seconds. The compressor will then run loaded and the economizer solenoid valves shall open. Once demand is satisfied the economizer solenoid valves and will close and the compressor will unload before stopping. After stopping the oil return solenoids shall close. Upon a further rise in glycol return temperature above the Stage 2 setpoint + bias, the lag compressor shall be started following the aforementioned sequence. If the lead compressor fails to start within 15 seconds, a compressor alarm shall be generated and the lag compressor shall be started and continue to run until the lead compressor is restored to service.

4.) The lead condenser spray water pump will be staged on whenever a compressor is staged on. Lead/lag shall rotate the lead device once per week during the middle of a normal business day. If the lead pump fails to start within 15 seconds, a condenser spray pump alarm shall be generated and the lag pump shall be started and continue to run until the lead pump is restored to service.

5.) The condenser shall be staged as follows:
- Condenser water pump is first stage (see #4 above).

- Second stage shall be condenser fan (modulating via VFD) starting at 20 HZ and increasing to 60 Hz to maintain compressor discharge pressure of 180 PSI in summer and 140 PSI in winter (adjustable).
- If the fan fails to prove run status within 15 seconds a tower fan alarm shall be generated.

E. Alarming

There shall be two levels of alarming, local and remote.

1.) Local alarming will close a set of contacts that will initiate a "local alarm relay" to power on a line voltage amber strobe light within the refrigeration room. Strobe light shall be placarded with a sign that reads "Refrigerant System Failure Alarm".
Local alarms shall be as follows:
   a. *Either* compressor failure
   b. Lead cold floor pump failure
   c. Evaporative condenser fan failure
   d. Lead condenser spray pump failure
   e. Warm floor pump failure

2.) Remote alarming will close contacts on a "remote alarm relay" which will allow for integration into the buildings existing DDC Automated Logic control system
Remote alarms shall be as follows:
   a. Cold Floor imbedded slab sensor temperature in excess of 27° for 15 minutes (adjustable).
   b. Failure of *both* compressors.
   c. Failure of either *both* cold floor or *both* condenser spray pumps
   d. Compressor discharge pressure exceeds 195 PSI.

1.07-Refrigerant Leak Detection and Refrigeration Room Exhaust

A. An ammonia gas leak monitor shall be supplied and designed to have a low alarm detection set point of 50 ppm which will enable exhaust ventilation control and a high alarm set point of 75 ppm for refrigeration room evacuation. The monitor shall have a LCD readout for PPM (0 to 10,000) within the room. The monitor shall have a sensitivity of 25 PPM. The monitor shall be mounted at the main entrance to the refrigeration room (location shown on plans). Remote sampling inlet tubing with filter shall be supplied and installed low on the chiller skid (location shown on plans). A remote horn / red strobe combination must be mounted at the main entry to the refrigeration room as well as within the refrigeration room (see locations on plans).

B. Provide and install at each horn / strobe combination a placard that reads the following:
WARNING WHEN ALARMS ARE ACTIVATED AMMONIA HAS BEEN DETECTED.
   1. LEAVE ROOM IMMEDIATELY.
   2. DO NOT ENTER EXCEPT BY TRAINED AND AUTHORIZED PERSONNEL.
   3. DO NOT ENTER THE ROOM WITHOUT PERSONAL PROTECTION EQUIPMENT.

C. Ammonia gas leak monitor shall be based on Bacharach AGM-SZ supplied with sampling tubing and inlet filter.

1.08- Refrigeration Room Door Placards

Provide and install on the main refrigeration room entry door placards that read the following.

- REFRIGERATION MACHINERY ROOM AUTHORIZED PERSONNEL ONLY
- CAUTION AMMONIA R-717
- CAUTION EYE AND EAR PROTECTION REQUIRED IN THIS AREA.

1.09-Brine

A. The existing brine must be tested by a laboratory and retained within cold and warm floors. It is the intent to use the existing brine by bringing the PH and iron levels into acceptable standards (if required). Lab results shall be provided to the ice rink consultant. Result may indicate that the brine needs to be filtered while dormant. Please provide an add alternate quote to filter the existing brine by utilizing a pump filtration cart with bag style filter. The above floor Brine within the mechanical room will be replaced with a new mixture of 21% Calcium Chloride. A corrosion inhibiting solution shall be added to the brine before plant startup, Inhibitor shall be based on Barclay Industries BR-234.

1.10-Expansion Tanks

A. Provide two suspended carbon steel hot dip galvanized compression style tanks. Tank sizes are indicated on plans. Tanks shall be ASME rated and have a maximum design pressure of at least 125 psig. Suitable manufacturers are Bell and Gossett, Wessels, John Wood or approved equal.

B. Tanks shall be supplied with a level gauge glass and tank drainer fitting.

END OF SECTION

PART 2-Startup

2.01 – Electrical Energy Management Digital Controls

A. Provide the services of a manufacturer factory trained technician to completely check control operation.
B. Verify calibration of all new sensors and transducers to accuracy within +/-5% of actual as measured with an independently calibrated measuring device.
C. Verify control operation per published Sequence of Operation.
D. Provide owners operating personnel with hands on instruction for a period of up to 8 hours.
E. Turn over operation and maintenance manuals to owner at time of instruction, to run concurrently with checkout and startup.
F. Revisit site after 6 months to review operations and maintenance with owner's personnel.
G. A one year guarantee period will be extended on all provided devices and workmanship from date of acceptance of owner.

2.02-System Startup

A. Provide the services of factory trained technician for 40 hours to completely check unit operation.
B. Start units and pull down floor to operating temperature over a 48-hour period. When temperature is achieved an entire working charge of at least half the cold expansion tank will be left for the operator as well as one 55 gallon drum of 21%% premix for future charging. A 120 Volt charging pump and all hoses will be left for the operator. A complete ammonia Charge with clear sight glasses will be turned over to the owner. An oil charging hand pump with hoses and quick connection to each compressor along with 30 gallons of fresh oil as well as an empty 55 gallon oil drum for waste oil will be turned over to the owner for the first year of use.
C. Provide owners operating personnel with 24 hours or hands on instruction.
D. Turn over 2 complete copies in hard cover binder containing operation and maintenance manuals to owner at time of instruction, to run concurrently with checkout and startup.
E. Revisit site after 6 months to review operations and maintenance with owner's personnel.
F. A one year guarantee period will be extended to the owner from ice making.

END OF SECTION

SECTION 22 00 00

PLUMBING

PART 1 - GENERAL

1.0 Design Consideration

Supply and install make up water for sump tank and hose connection.

1.01 Prime Contractor

The prime contractor shall employ the services of a licensed plumber within the state of VT.

1.02 Submittals

The prime contractor shall submit submittals on all material and devices used.

1.03 Products

A. Furnish and install a Watts model 919 1-¼" Reduced pressure Backflow assembly for the cold water feed to the proposed condenser indoor tank and provide one frost proof hose bib outside for wash down of the condenser. Replace the existing line with the new 1 ¼" line.

B. Piping of all domestic water and non-potable piping will be of Type L copper as well as copper or wrought brass fittings. All piping and products will conform to the local and state plumbing code. All domestic and non-potable water piping will contain ½ inch fiberglass insulation with a service jacket with preformed PVC fittings.

END OF SECTION
SECTION 23 00 00

HVAC

PART 1 - GENERAL

1.0 Design Consideration

Supply and install Refrigeration room ventilation system.

1.01 Prime Contractor

The prime contractor shall be responsible for the provision and installation of refrigeration room ventilation system. This will include provision of any wall openings required.

1.02 Submittals

The prime contractor shall submit submittals on all material and devices used.

1.03 Products

A. The mechanical room ventilation will need to meet ASHRAE 15 code. A new ¾ HP inline exhaust fan capable of 2,500 CFM at 0.5" ESP shall be provided with ductwork to the exterior 15' above grade (see plans). The main refrigeration room entry door shall have a break glass style push button switch to override the fan on. The switch shall have a placard that reads "REFRIGERATION MACHINERY ROOM VENTILATION OVERRIDE EMERGENCY USE ONLY".

B. A direct drive propeller sidewall exhaust fan capable of 450 CFM at 0.375" ESP will be installed within the refrigeration room (see plans) and operated whenever the lights are on to satisfy occupancy ventilation requirements.

END OF SECTION