SECTION 13 18 00

ICE RINKS - AMMONIA STANDARD SYSTEM

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\*\* NOTE TO SPECIFIER \*\* CIMCO Refrigeration, Inc.; recreational ice rinks  
.  
This section is based on the products of CIMCO Refrigeration, Inc., which is located at:  
1551 Corporate Dr.  
Burlington, ON L7L 6M3  
Toll Free: 800-267-1418  
Phone: 416-465-7581  
Fax: 416-465-8815  
Email: \_\_\_\_\_\_\_\_.  
Web: <https://www.cimcorefrigeration.com/industries/recreational-ice-rinks/ice-rink-solutions> .  
[ [Click Here](http://www.arcat.com/company/53279) ] for additional information.  
Whether you are 10 years old or a 10-year pro hockey player, there is nothing like the feeling of skating on perfect ice. At CIMCO, we believe that everyone deserves the opportunity to enjoy that amazing experience - and that is why we work hard to make your perfect ice as affordable, efficient, and reliable as possible.  
From ultra-economical ice systems to environmentally-friendly alternatives to fully-integrated thermal solutions, CIMCO offers a wide range of Recreational Ice Solutions designed to meet and exceed the requirements of any arena facility. CIMCO solutions feature distinct cooling layouts, control simplicity, floor design and effective engineering - all brought together to ensure a reliable, low maintenance system.

1. GENERAL
   1. SECTION INCLUDES

\*\* NOTE TO SPECIFIER \*\* Delete items below not required for project.

* + 1. Ice Rink systems and related requirements:
  1. RELATED SECTIONS

\*\* NOTE TO SPECIFIER \*\* Delete any sections below not relevant to this project; add others as required.

* + 1. Division 22 PLUMBING, for plumbing requirements not specified in this section.
    2. DIVISION 23 HEATING, VENTILATING AND AIR CONDITIONING, for HVAC requirements not specified in this section.
    3. DIVISION 26 ELECTRICAL, for electrical requirements not specified in this section.
  1. REFERENCES

\*\* NOTE TO SPECIFIER \*\* Delete references from the list below that are not actually required by the text of the edited section.

* + 1. American National Standards Institute (ANSI):
       1. ANSI/IIAR Standard 2-1992.
       2. ANSI/ASME B31.1 - Power Piping.
       3. ANSI/ASME B31.5 - Refrigeration Piping and Heat Transfer Components.
       4. ANSI/ASME - Boiler and Pressure Vessel Code.
    2. American Society of Heating Refrigeration and Air Conditioning Engineers.
       1. ASHRAE/ANSI - 15 Safety Code for Mechanical Refrigeration.
    3. International Building Code.
    4. International Fire Code.
    5. International Mechanical Code.
    6. International Institute of Ammonia Refrigeration:
       1. IIAR-2 Standard for Safe Design of Closed-Circuit Ammonia Refrigeration Systems.
  1. DEFINITIONS
     1. Engineer: Ice Rink Systems Designer's Representative.
     2. Installer: The Contractor performing the work specified of this Specification and on the R-Drawing sheets.
     3. Ice Rink System: Equipment, piping, physical construction, and materials required to install a fully functional, code compliant ice rink, including refrigeration system, ice rink floor, ice rink piping, valves, controls, electrical, waste heat recovery, dasher boards, and accessories.
  2. UNIT PRICES
     1. Submit unit prices stating increase or decrease to Contract Price for additional or deleted work listed. This allows accurate comparison between base system bid prices. Unit prices to include labor, materials, products, equipment, services and respective overhead, profit, taxes, disbursements, and related charges, and represent the actual addition or credit to the Contract Price.
  3. SUBMITTALS
     1. Submit under provisions of Section 01 30 00 - Administrative Requirements.
        1. Submittals: On company letterhead, signed by authorized representative of company. Include project description, portion of project completed by the company, location, construction cost, completion date, Owner's name, Owner's Representative, phone number and completion date of work.
     2. Product Data:
        1. Manufacturer's data sheets on each product to be used.
        2. Preparation instructions and recommendations.
        3. Storage and handling requirements and recommendations.
        4. Typical installation methods.
        5. Spare Parts lists the different systems.
     3. Shop Drawings: Material details, construction, and finish. Relationship with adjacent construction.
     4. Motor Control Panel: Prior to ordering submit one copy of engineered panel drawings to Municipality for review.
        1. Drawings must indicate:
           1. All refrigeration equipment excluding electrical connections,
           2. Control panel electrical schematic.
           3. Control panel enclosure dimensions including location of all gauges, switches, lights, controls, and labels.
     5. Dasher Board Systems: To be of appropriate scale, dimensions, and details.
        1. Shop Drawings: Submitted by Manufacturer to Contractor for Engineer, Architect or Owner approval prior to fabrication. Include but not limited to the arena board system, glazing assemblies and detail, and joining methods.
           1. Joining Methods: Fastening, joint locations, methods of anchoring, sizes of anchorage's, and hardware.
           2. Details of other pertinent components of the Work, and adjacent constructions to which work of this Section will be attached.
        2. Dimensioned layout and placement drawings for installation of floor anchors.
        3. Verification Samples. Materials, finishes and colors for review.
        4. Operation and Maintenance Data On completion of installation, supply three copies of instructions covering removal and replacement of panel system, reglazing, adjustments and other relevant operating and maintenance data.
        5. Provide "As Built" drawings showing overall layout of the boards and glass.
     6. Ice Rink Control System:
        1. Network Diagrams: Supervisory devices, field level controllers, and point-to-point wiring diagrams. Detail diagrams down to a level acceptable for troubleshooting and problem analysis. Modify device templates to show how device is wired.
        2. System and Process Flow Schematics: For control device and identification of points.
        3. Point Schedule: Minimum data for system points: Name, Type, Expanded Description, Display units, Controller Identification and Controller Address.
        4. Samples of graphics and screen menus.
        5. Point Schedule: Minimum data for system points: Name, Type, Expanded Description, Display units, Controller Identification and Controller Address.
        6. Samples of graphics and screen menus.
        7. Product Data Sheets: With identifying marks depicting the exact device or component used.
        8. Interconnections: Detailed wiring diagrams depicting connections and modifications made to motor control center, compressors, VFD's etc.
     7. Ice Rink Smart Transfer Module: Ammonia.
        1. Network Diagrams: Supervisory devices, field level controllers, and point-to-point wiring diagrams. Detail diagrams down to a level acceptable for troubleshooting and problem analysis. Modify device templates to show how device is wired.
        2. System and Process Flow Schematics: For control device and identification of points.
        3. Point schedule for every point in the system with a minimum of the following: Point Name, Point Type, Expanded Description, Display units, Controller Identification and Controller Address.
        4. Samples of graphics and screen menus.
        5. Product Data Sheets: With identifying marks depicting the exact device or component used.
        6. Interconnections: Detailed wiring diagrams depicting connections and modifications made to motor control center, compressors, VFD's etc.
     8. Progress Schedule. Before project begins.
     9. Test Reports and Certifications. Electronic copies to Engineer when specified.
     10. Operation and Maintenance Manuals (O/M Manuals). Electronic soft copies for review. Final electronic copies to be available for owner to download.
         1. Include the following in addition to Division 1 requirements.
            1. Electronic Copy: Self-contained. Include software to access product data.
            2. System Description: Description of controls. Step by step written instructions on operating control system.
            3. Table of Contents: Dynamic links to view and print product data.
            4. Viewer Software: Ability to display, zoom, and search documents.
            5. As-Built System Record Drawings: Record Drawings representing as-built conditions. Incorporate information supplied with approved submittal.
            6. Manufacturer's Product Data Sheets: All products including software.
            7. System and Software Operator's manuals.
            8. Archive copy of site-specific databases and sequences.
            9. IRCS and BMS network diagrams.
            10. Interfaces to third-party products and work by other trades.
            11. Operating license for software.
            12. Start-Up and Shut-Down Procedures: Detailed instructions, system checks, safety device checks, valves number references, typical levels in vessels, etc.
            13. Equipment and Valve Data:

Approved shop Drawings.

Parts list.

Detailed Wiring Diagrams: Electrical and control systems and other electrical and control information.

Maintenance and operation.

Trouble shooting.

Address and contact information of manufacturers and service representatives for each piece of equipment.

Warranties: Including project, equipment, and material warranties.

Valve List: Valve number, description, manufacturer, and operation.

Schematics: Locations of valves, equipment, and controls.

* + - * 1. Test Records:

Material and fluid tests for concrete, sand, glycol, CaCl2, etc.

Pipe pressure tests for refrigeration system piping, rink floor piping, and transmission mains.

* + - * 1. Certifications of inspections by regulatory agencies.
        2. Record plan information of pipe routing, joint locations on underground transmission mains, wiring diagrams, equipment layout, valve locations, etc.
        3. Daily checklist form for recording operation of refrigeration system.
    1. Closeout Documents: Required by General Conditions and these specifications.
       1. Final Payment Request: Include the following.
          1. Insurance certificates for products and equipment where required.
          2. Proof that taxes, fees, and similar obligations are paid.
          3. Contractors Affidavit of Payment of Debts and Claims, AIA Document G706.
          4. Contractors Affidavit of Release of Liens, AIA Document G706A.
          5. Consent of Surety to Final Payment, AIA Document G707.
          6. Final pay request document accurately reflecting to the contract amount.
          7. All outstanding shop Drawings.
          8. Final liquidated damages settlement statement.
  1. QUALITY ASSURANCE
     1. Any deviations from this specification, unless approved in writing by the owner, will be charged back to the supplier at the Owner's discretion.
     2. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with five years documented experience.
     3. Installer Qualifications: Company specializing in performing Work of this section with five years documented experience with projects of similar scope and complexity.
        1. Installer of Refrigeration Systems: Successfully installed similar systems for five construction projects completed in the past five years.
        2. Placing and Finishing Concrete: Placement and finishing of concrete on 8 concrete ice rink floor construction projects in the past 5 years.
        3. Controls Systems: Completed programming and installation of 2 ice rink projects in the past 5 years.
        4. Expansion Joint Systems: Completed twenty projects using same type of joint.
        5. Motor Control Panel: Completed Five (5) - Refrigeration MCP installations within the last year. Provide references.
        6. Ice Rink Control Systems and Ice Rink Smart Transfer Control:
           1. As evidence and assurance of the Contractor's controls subcontractor's ability to construct the project, the control subcontractor must have successfully completed the design, programming, and installation of ten (10) ice rink control systems similar to this project within the past three (3) years.
           2. Experience in implementing Ice Rink Controller Systems framework, projects size and scope, specifically related to ice rink system.
     4. Source Limitations: Provide each type of product from a single manufacturing source to ensure uniformity.
  2. PRE-INSTALLATION CONFERENCE
     1. Convene a conference 2 weeks before scheduled commencement of Work. Attendees include Architect, Contractor and trades involved. Agenda shall include schedule, responsibilities, critical path items and approvals.
  3. DELIVERY, STORAGE, AND HANDLING
     1. Transport, store, and handle in strict compliance with manufacturer's written instructions and recommendations.
     2. Protect from damage due to weather, excessive temperature, and construction operations.
        1. Store products with seals and labels intact and legible.
  4. PROJECT CONDITIONS
     1. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.
  5. WARRANTY
     1. In addition to the standard manufacturer's warranty on all equipment and materials, the contractor shall provide a standard one-year materials and labor warranty on all work performed for this project.
     2. Signage: Legible permanent signs on outside of ice rink equipment mechanical room doors as detailed on Drawings and as follows:
        1. Informative Signs, Emergency Signs, Charts, and Labels: Per NFPA 704, ANSI/IIAR, ANSI Z535.2 and International Mechanical Code.
           1. For Ammonia Refrigerant: NFPA 704 or Fire Diamond numbering to be 3-3-0-blank (blue- red-yellow-white) or per current code requirements.
           2. Provide other signs required by code even if not shown on Drawings.
           3. Next to strobe lights and audible alarms.
           4. Next to emergency stop buttons and ventilation, enable switches.
        2. Schematic Drawing or Panel: Operation directions per ASHRAE-15 paragraph 11.7.
        3. If Owner requires format (font, size, colors, etc.) of signage to match signage in the facility, provide format required by Owner unless it does not meet code requirements.
     3. Motor Control Panel: One year parts and labor warranty from start-up date. Including 2 hour emergency response time in the event of failure of the system.
     4. Ice Rink Control System and Ice Rink Smart Transfer:
        1. One-year parts and labor warranty from start-up date.
        2. The refrigeration contractor shall carry the warranty for the control system as part of the total refrigeration installation. The owner shall have a single source of responsibility for both the refrigeration system and the control system.
        3. The refrigeration contractor shall provide 24/7 customer support services for the control system for the duration of the warranty period.

1. PRODUCTS
   1. MANUFACTURERS
      1. Acceptable Manufacturer: CIMCO Refrigeration, Inc., which is located at: 1551 Corporate Drive, Burlington, ON L7L 6M3; Toll Free: 800-267-1418; Phone: 416-465-7581; Fax: 416-465-8815; Email: \_\_\_ ; Web: https://www.cimcorefrigeration.com/industries/recreational-ice-rinks/ice-rink-solutions

\*\* NOTE TO SPECIFIER \*\* Delete one of the following two paragraphs; coordinate with requirements of Division 1 section on product options and substitutions.

* + 1. Substitutions: Not permitted.
    2. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.
  1. PROJECT SCOPE DEFINITION
     1. Ice Rinks:

\*\* NOTE TO SPECIFIER \*\* Delete either "New Construction" or "Retrofit existing systems" option, whichever is not required. Delete the "Number of Skating Rinks" options that do not apply to the project scope

* + - 1. New construction.
      2. Retrofit existing systems.
      3. Number or Skating Rinks: One.
      4. Number or Skating Rinks: Two.
      5. Number or Skating Rinks: Three.
      6. Number or Skating Rinks: Four.
      7. Refrigeration Systems:

\*\* NOTE TO SPECIFIER \*\* New construction only uses a Glycol secondary refrigeration system. Retrofit systems may be Glycol or Brine. New and retrofit systems may have an ammonia evaporative or adiabatic condenser. If sustainability is an issue the adiabatic condenser is the recommended choice for new and retrofit systems. Delete the condenser options not required.

* + - * 1. Secondary Refrigeration Systems: Glycol.
        2. Secondary Refrigeration Systems: Brine.
        3. Condenser: Ammonia Evaporative.
        4. Condenser: Adiabatic.
      1. Piping, Valves, and Accessories:

\*\* NOTE TO SPECIFIER \*\* Delete the piping material option not required.

* + - * 1. Piping Material: Carbon Steel Sch 40.
        2. Piping Material: High-density polyethylene.
      1. Equipment Redundancy:

\*\* NOTE TO SPECIFIER \*\* Delete the "Backup Cold Pumps"option not required.

* + - * 1. Backup Cold Pumps: Required.
        2. Backup Cold Pumps: Not required.
      1. Green Options:

\*\* NOTE TO SPECIFIER \*\* Delete the �Desuperheater� option not required.

* + - * 1. Desuperheater: Yes. Does not replace anything.
        2. Desuperheater: No.

\*\* NOTE TO SPECIFIER \*\* Delete any of the next six items that are not part of the project scope.

* + - 1. Motor control panels.
      2. Ammonia desuperheater heat exchanger.
      3. Dasher board systems.
      4. Control systems.
      5. Smart Transfer Module: Ammonia refrigerant.
      6. Heat Recovery System: Underfloor and snow melt
  1. PERFORMANCE AND DESIGN REQUIREMENTS
     1. Standards Compliance:
        1. Selected Contractor must comply with all codes and standards (latest versions) applicable to this type of work, including:
           1. International Code.
           2. IIAR-2.
           3. ASHRAE 15 Safety Code for Mechanical Refrigeration.
           4. ASME B31.5 Refrigeration Pressure Piping Code.
           5. WCB Regulations.
     2. Design Requirements for Refrigeration Capacity:
        1. Operating Season: 12 month.
        2. Rink Duty: Hockey Facility.
        3. Primary Refrigerant: Ammonia (R717).

\*\* NOTE TO SPECIFIER \*\* Delete smart transfer module paragraph below if it was deleted in the prior article.

* + - * 1. Safety: Smart transfer module.

\*\* NOTE TO SPECIFIER \*\* Delete system type options not required.

* + - 1. Secondary Refrigerant System Type: New glycol system.
      2. Secondary Refrigerant System Type: Retrofit glycol system.
      3. Secondary Refrigerant System Type: Retrofit brine system.

\*\* NOTE TO SPECIFIER \*\* Delete number of rinks options not required.

* + - 1. Plant Capacity for 1 Rink: Tons of Refrigeration (TR): 100
         1. Refrigerated Surface Arena: 1 sheet, a minimum of 85 x 200 ft; 17,000 to 20,000 sq ft.
      2. Plant Capacity for 2 Rinks: Tons of Refrigeration (TR): 200
         1. Refrigerated Surface Arena: 2 sheets, a minimum of 85 x 200 ft each; 34,000 to 40,000 sq ft.
      3. Plant Capacity for 3 Rinks: Tons of Refrigeration (TR): 250
         1. Refrigerated Surface Arena: 3 sheets, a minimum of 85 x 200 ft each; 51,000 to 60.000 sq ft.
      4. Plant Capacity for 4 Rinks: Tons of Refrigeration (TR): 350
         1. Refrigerated Surface Arena: 4 sheets, a minimum of 85 x 200 ft each; 68, 000 to 80000 sq ft.

\*\* NOTE TO SPECIFIER \*\* Delete if new rink floor is not required.

* + 1. Design Requirements: New rink floor system.
       1. Rink Cold Piping: High-density polyethylene (HDPE).
       2. Rink Cold Piping: Carbon Steel Schedule 40.
       3. Rink Floor Cold Pipe Spacing: 3 inches.
       4. Rink Floor Cold Pipe Spacing: 3.5 inches.
       5. Rink Floor Cold Pipe Spacing: 4 inches.
       6. Rink Floor Warm Pipe Spacing: N/A (outdoor)
       7. Rink Floor Warm Pipe Spacing: 18 inches.
       8. Rink Floor Warm Pipe Spacing: 20 inches.
       9. Rink Floor Warm Pipe Spacing: 24 inches.
       10. Concrete Floor Thickness / psi: 5 inches 4000 psi.
       11. Concrete Floor Thickness / psi: 5 inches 5000 psi.
       12. Concrete Floor Thickness / psi: 6 inches 4000 psi.
       13. Concrete Floor Thickness / psi: 6 inches 5000 psi.
       14. Rink Floor Insulation: 3 inches 25 psi.
       15. Rink Floor Insulation: 3 inches 40 psi.
       16. Rink Floor Insulation: 3 inches 60 psi.
       17. Rink Floor Insulation: 4 inches 25 psi.
       18. Rink Floor Insulation: 4 inches 40 psi.
       19. Rink Floor Insulation: 4 inches 60 psi.
       20. Cold Headers Type: HDPE DR11.
       21. Cold Headers Type: Steel Sch 40.
       22. Warm Header Type: HDPE DR11 Buried.
       23. Warm Header Type: Steel Sch 40 Buried.
       24. Warm Header Type: Steel Sch 40 Exposed.

\*\* NOTE TO SPECIFIER \*\* For new and existing systems, Delete the following paragraph is specifying Calcium Chloride or Brine.

* + 1. Additional Design Criteria: Ethylene Glycol
       1. Cold Floor Secondary Refrigerant: 40 percent by wt. Ethylene Glycol.
       2. Warm Floor Secondary Refrigerant: 40 percent by wt. Ethylene Glycol.
       3. Condenser Secondary Refrigerant: 40 percent by wt. Ethylene Glycol.
       4. Heat Reclaim Secondary Refrigerant: 40 percent by wt. Ethylene Glycol.
       5. Evaporative Temperature: 11 degrees F.
       6. Condensing Temperature: 100 degrees F.
       7. Cold Floor Glycol Supply Temperature: 15.0 degrees F.
       8. Cold Floor Glycol Return Temperature: 18.0 degrees F.
       9. Power: 3/60/460 Volt.
       10. Control: 1/60/120 Volt.

\*\* NOTE TO SPECIFIER \*\* For new and existing systems, Delete the following paragraph is specifying Ethylene Glycol.

* + 1. Additional Design Criteria: Calcium Chloride or Brine
       1. Cold Floor Secondary Refrigerant: 21 percent Calcium Chloride or Brine.
       2. Warm Floor Secondary Refrigerant: 21 percent Calcium Chloride or Brine.
       3. Condenser Secondary Refrigerant: 21 percent Calcium Chloride or Brine.
       4. Heat Reclaim Secondary Refrigerant: 21 percent Calcium Chloride or Brine.
       5. Evaporative Temperature: 11 degrees F.
       6. Condensing Temperature: 100 degrees F.
       7. Cold Floor Calcium Chloride or Brine Supply Temperature: 15.0 degrees F.
       8. Cold Floor Calcium Chloride or Brine Temperature: 18.0 degrees F.
       9. Power: 3/60/460 Volt.
       10. Control: 1/60/120 Volt.

\*\* NOTE TO SPECIFIER \*\* Delete article if not required.

* 1. REFRIGERATION SYSTEM
     1. Scope of Work:
        1. Ice Rink Equipment work called for, or implied, together with necessary incidentals, whether referred to or not, as will be required to complete the Work to the full intent and meaning of the specifications.
        2. The Work includes, but is not limited to the following:
           1. A central ice rink refrigeration package to serve the arena ice sheet. The package will consist of compressors, chiller, condenser, cold glycol pumps, heat reclaim system, starter, and control panel.
           2. Cooling tower, along with power wiring between tower and refrigeration control panel. Include field mounted disconnect switch.
           3. Evaporative Condenser sump tank.
           4. Evaporative Condenser water pump.
           5. Ammonia Diffusion Tank.
           6. Ammonia leak detector.
           7. Initial charge of Ammonia, Oil and Ethylene Glycol for rinks and Refrigeration Package.
           8. Necessary power and control wiring between starter panel and refrigeration equipment.
           9. Necessary Glycol and Water piping between refrigeration package, cooling tower and rink floor.
           10. Necessary ammonia and glycol insulation.
           11. One year warranty.
           12. Start up and commissioning.
           13. Training.
     2. Related Work by Other Divisions:
        1. Cutting, patching, sleeving, sealing, and fireproofing of floor, wall and ceiling openings for all refrigeration system piping and related electrical conduits.
        2. Direct outside wall opening and interior passageways for rigging of the refrigeration package into the ice plant room.
        3. Temporary lighting, heating, 120 V power and water. Should refrigeration contractor require additional light, heat, or power, he shall provide it to complete his work.
        4. Refrigeration Room to be constructed in accordance with current edition of the International Mechanical Refrigeration Code.
        5. Refrigeration Room exhaust and fresh air make-up to meet the current international Mechanical Refrigeration Code.
        6. Heat for Refrigeration Room to maintain minimum 65 degrees F room temperature. Open flame heater is not acceptable.
        7. Forming, steel re-enforcing and pouring of level concrete housekeeping pads for refrigeration package.
        8. 1-1/2 inch cold water service with valved back flow preventer inside the ice pant room for initial system filling.
        9. Floor drain in ice plant room.
        10. One 800 amp, 460 V/3 Ph/60 Hz electrical power supply and conductors terminated at refrigeration package starter panel disconnect switch lugs.
        11. 120 V power to the refrigeration package DDC control panel.
        12. 120 V power to the Ammonia leak detector and run control wiring from the Ammonia leak detector to exhaust fans and dampers.
        13. Necessary partitions around construction areas for dust control.
        14. Supply structural concrete isolation/inertia pads for refrigeration equipment.
        15. Supply pads and counterflashing for roof supported pipe supports, etc.
        16. Supply and install necessary level support or platforms for the cooling tower.
        17. Specialty valves such as a back flow preventer required by the local Public Utilities.
        18. Subgrade prepared per recommendations of soils engineer and structural engineer.
        19. Excavation and back filling for placement of four (4) access vent boxes, concrete slab box- outs and pouring of box-outs. Box-outs shall be poured after valve boxes installed mains and rink headers tied into buried.
        20. Cleaning of concrete surface prior to commissioning of ice rink system.
        21. A permanent water supply shall be available for the rink floor piping system pressure test, concrete rink floor pour, and flushing.
        22. Excavation and forming of trenches, including backfilling and compaction for any buried portions of refrigeration system piping.
     3. Refrigeration Package: Field built systems are not allowed.
        1. Approved Manufacturer: CIMCO MAP or approved equal.
           1. Services ice rink floor cooling with heat reclaim capabilities.
        2. Equipment: Factory packaged, prewired and pre-piped including valves, controls, insulation, and wiring on a structural steel skid. Package Mounted Motors: Factory aligned. Package Piping Systems: Factory pressure tested. Factory painted with manufacturer's standard color.
        3. Includes but not limited to the following equipment.
           1. Reciprocating Compressors: Mycom MII series or approved equal. C/w unloading steps/ Open drive compressors c/w XXX HP,ODP, 1800 rpm, 460/3/60 soft starter motors, 40 percent glycol to oil heat exchanger, manual oil return system, relief valves, safety cut outs, service shut off valves, and thermometers.

Compressor Motor Manufacturer: WEG, Toshiba or approved equal.

One Rink: Two Compressors. 100 TR c/w One (1) N4M at 100 HP and one N2M at 75 HP.

Two Rinks: Two Compressors. 200 TR c/w Two N6M at 150 HP.

Three Rinks: Three Compressors. 250 TR c/w Three N6M at 150 HP.

Four Rinks: Three Compressors. 350 TR c/w Three N6M at 200 HP.

* + - 1. Oil Separators: ASME pressure vessel. c/w service valves, relief valves and oil return valve.
         1. One Rink: c/w Two, DOT 10, 10 inch diameter x 18 inches long.
         2. Two Rink: c/w Two, DOT 14, 14 inch diameter x 20 inches long.
         3. Three Rink: c/w Three, DOT 14, 14 inch diameter x 20 inches long.
         4. Four Rink: c/w Three DOT 14, 14 inch diameter x 20 inches long.
      2. Compressor Oil Cooling Pump:
         1. S.A. Armstrong model 4380, BF construction. Vertical in line centrifugal pump
         2. c/w VFD controlled NEMA Premium motor, 1.5 HP, ODP, 1800 rpm, 460/3/60 V
         3. ANSI 125 flanged connections.
         4. Braided stainless steel flush line pressure gauge on pump inlet and outlet.
      3. Chiller / Surge Drum Assembly: A semi-welded plate heat exchanger arranged for flooded ammonia operation.
         1. Approved Manufacturer: Alfa Laval or approved equal.
         2. Design Capacity: See Equipment Schedule on Drawings.
         3. Constructed to ASME code requirements.
         4. Registered by National Board:
         5. Design Working Pressures: Ammonia Side: 250 psig. Glycol Side: 150 psig.
         6. Chiller Plates: Ammonia Side: Welded. Glycol Side: Gasketed.
         7. Chiller Plates: Titanium when Brine (CaCl) is selected.
         8. Dual refrigerant pressure relief valves. Two reflex type level sight glasses with frost shields to establish the refrigerant operating level.
         9. Oil collection drop leg and spring return valve for periodic oil draining.
         10. Surge Drums: Sized for system pull down load, and effectively protect the compressors from liquid carryover.

Factory Insulated: 2 inch thick foamed-in-place urethane insulation covered with a protective fiberglass jacket.

* + - * 1. Chillers: Mounted on a drip pan with a float switch and isolating valves to protect the compressors against high liquid levels.

High Side Float Valves: Controls supplying high pressure liquid to the chiller assemblies.

Hand Stop Valves: Use to Isolate high side float valves.

Include hand expansion valve bypasses.

Glycol vent and drain valves.

Thermometers: Glycol inlet and outlet.

* + - 1. Heat Reclaim System for Underfloor and Snow Melt Pit
         1. Heat Exchanger

One pass Horizontal Shell and Tube Ammonia / 40 percent Ethylene Glycol Condenser

Dimensions: 6 inch OD x 48 inch L (For 1 Rink), 8 inch OD x 72 inch L (for 2 Rinks), 10 inch OD x 108 inch L (for 3 and 4 Rinks)

Capacity: 300 MBH (for 1 rink), 500 MBH (for 2 Rink), 800 MBH (for 3 and 4 rinks)

40 percent Glycol Temperatures: 65 degrees F in / 68 degrees F out

* + - * 1. Pump

Bronze fitted construction with mechanical shaft seal, stainless steel shaft sleeve, non-overloading impeller, flex coupling, coupling guard and steel base.

Approved Manufacturer: S.A. Armstrong 4300 or approved equal.

Design Capacity: Flow rate, pump head, horsepower, and starter method; see Equipment Schedule on Drawings

Glycol System Flow Rate: 150 GPM. 45 ft (for 1 Rink), 250 GPM for 2 Rinks, 400 GPM for 3 and 4 Rinks

Pump Motor: WEG, or approved equal, 3/60/460V, 1800 RPM, Class B insulation, open drip proof with 1.15 SF, meeting Federal Efficiency requirements.

Suction and discharge butterfly valves, discharge check valves and pressure gauges

Side Stream Glycol Filter: Replaceable 25 micron bags to allow system filtration. A pressure gauge is connected across filter to indicate differential pressure

\*\* NOTE TO SPECIFIER \*\* Delete one of the two following condenser paragraphs

* + 1. Ammonia Evaporative Condenser:
       1. One (1) Evaporative Condenser. The condenser shall be force draft type. Induce draft type shall be considered as alternate option.
       2. Approved Manufacturer: EVAPCO, BAC or approved equal.
       3. Design Capacity 1 Rink: 1607 MBH
       4. Design Capacity 2 Rinks: 3150 MBHC
       5. Design Capacity 3 Rinks: 3950 MBH
       6. Design Capacity 4 Rinks: 5450 MBH
       7. Primary Refrigerant: R717 (Ammonia).
       8. Constructed to ASME code requirements. Registered by National Board for 300 psig ammonia side and 150 psig glycol side design working pressure.
       9. Dual refrigerant pressure relief valves, and ammonia equalizing line.
       10. Inlet and outlet isolation valves
       11. Additional 40 percent E. Glycol coil for compressor oil cooling.
       12. Condenser Glycol Coil Capacity 1 Rink: 42 MBH.
       13. Condenser Glycol Coil Capacity 2 Rinks: 77 MBH.
       14. Condenser Glycol Coil Capacity 3 Rinks: 100 MBH.
       15. Condenser Glycol Coil Capacity 4 Rinks: 150 MBH.
       16. Glycol vent and drain valves.
       17. Glycol inlet and outlet thermometers.
       18. Fan Motors: HP as recommended by manufacturer, premium efficiency and inverter duty. Power 460V3/60.
           1. Contractor: Provide new contactors, fuse box, starters and wiring.
           2. Sound Level: Low noise option.
       19. Passivation to Coil: Provided prior to start-up of the new unit, as per manufacturer recommendations and guidelines.
       20. Unit Structure: Designed, analyzed, and constructed in accordance with the latest edition of International Building Code (IBC) for: IP = \_\_\_, SDS = \_\_\_, P = \_\_\_ psf.
       21. Components: Factory assembled and tested. Induced draft counter flow cooling tower complete with fan, fill, louvers, accessories and rigging supports.
       22. Cold Water Basin Components: Vertical supports, air inlet louver frames, and panels up to rigging seam to be heavy gauge mill G-235 hot-dip galvanized steel.
       23. Upper Casing, Channels and Angle Supports: Heavy gauge mill G-235 hot-dip galvanized steel.
       24. Fan Coil and Guard: G-235 Galvanized steel.
       25. Galvanized Steel Panel Edges: Coated with a 95 percent pure zinc-rich compound.
       26. Fans: High efficiency axial propeller type statically balanced and installed in a closely fitted cowl with venturi air inlet for maximum fan efficiency. High strength die cast aluminum hub. Fiberglass reinforced polypropylene (PPG) wide chord blades.
       27. Drift Eliminators: Polyvinyl Chloride in easily handled sections. Incorporates three air direction changes. Limits water carryover to 0.001 percent of recirculating water rate.
       28. Spray Nozzles: Precision molded ABS, large orifice utilizing fluidic technology for superior water distribution over the fill media. Designed to minimize water distribution system maintenance. Spray Header and Branches: Schedule 40 Polyvinyl Chloride for corrosion resistance with a steel connection to attach external piping.
       29. Fill Media: Polyvinyl Chloride. Cross-fluted design suitable for inlet water temperature up to 130 degrees F. The bonded block fill to be bottom supported and suitable as an internal working platform. Fill to be self-extinguishing, with flame spread of 5 under ASTM designation E84-81a, and be resistant to rot, decay and biological attack.
       30. Air Inlet Louver Screens: UV inhibited polyvinyl chloride. Framed interlocking design for removal of louver screens to access entire basin area for maintenance. Screens to have a minimum of two air direction changes and a non-planar design to prevent splash-out and block direct sunlight and debris from entering the basin.
       31. Fan Electric Motors: Totally enclosed, ball bearing type suitable for moist air service. Premium efficient, Class F insulated. Service Factor: 1.15. Inverter rated per NEMA MG1 Part 31.4.4.2. Suitable for variable torque applications and constant torque speed range with properly sized and adjusted variable frequency drives.
       32. Fan Drive: Multigroove, solid back V-belt type with QD tapered bushings designed for 150 percent of the motor nameplate power. Belt Material: Neoprene reinforced with polyester cord specifically designed for evaporative equipment service. Fan Sheave: Aluminum alloy. Belt Adjustment: Accomplished from exterior of the unit.
       33. Fan Shaft: Solid, ground, and polished steel. Exposed Surface: Coated with rust preventative.
       34. Fan Shaft Bearings: Heavy-duty, self-aligning ball type bearings. Extended lubrication lines to grease fittings located on access door frame. Bearings to be designed for a minimum L-10 life of 100,000 hours.
    2. Adiabatic Condenser: NH3 Condenser manufactured by EVAPCO Model EAVCA, BAC, Guntner or approved equal. Factory assembled and tested, induced draft, adiabatic condenser complete with casing, coil, fan, motor, accessories, rigging supports and adiabatic pre-cooling system.
       1. Thermal Performance:
          1. Reject 2,500 MBH of NH3 in full adiabatic mode at 95 degrees F condensing with an entering air dry bulb of 80 degrees F, entering air wet bulb of 78 degrees F, and relative humidity of 91.58 percent.
          2. Reject 2,500 MBH of NH3 in dry mode at 95 degrees F condensing with an entering air dry bulb of 78.25 degrees F.

\*\* NOTE TO SPECIFIER \*\* Delete rink sizes not required.

* + - 1. Total Heat Rejection Requirements for One Rink: 1,607 MBH.
      2. Total Heat Rejection Requirements for Two Rinks: 3,150 MBH.
      3. Total Heat Rejection Requirements for Three Rinks: 3,950 MBH.
      4. Total Heat Rejection Requirements for Four Rinks: 5,450 MBH.
      5. IBC Compliance: Structure to be designed, analyzed, and constructed in accordance with the wind and seismic load requirements of the following:
         1. IBC 2018, ASCE/SEI 7-16, NFPA 5000.

Importance Factor (IP): 1.0. SDS: 1.6 (at z/h = 0). P: 59.5 psf

* + - 1. Components:
         1. Fans: Direct drive high efficiency axial propeller type. Dynamically balanced. Installed in a closely fitted cowl with venturi air inlet for maximum fan efficiency.
         2. Heat Transfer Coil: Constructed with 5/8 inch diameter 304L Stainless Steel tubes in a staggered arrangement.

Tubing: Roll formed, continuously welded, and annealed.

Tubes to be expanded into continuous, enhanced 0.01 inch thick high grade aluminum fins.

Fins: Fully drawn collars completely covering tubes for maximum heat transfer efficiency.

Header Connections: Schedule 40 304L Stainless Steel.

Tube sheet design eliminates sharp edges and minimizes tube fatigue.

Coil Design Pressure: 350 psi and be in compliance with ASME/ANSI B31.5, Refrigeration Piping and Heat Transfer Components.

Coil Assembly: Strength tested in accordance with ASME/ANSI B31.5 and leak tested using air under water.

Evacuated and charged with low pressure nitrogen prior to shipment.

* + - * 1. Adiabatic Pre-Cooling System: Adiabatic pads, water distribution piping, solenoid valve with wye strainers and drip tray. System to have no measurable drift and tested in accordance with CTI ATC 140
        2. Adiabatic Pad: Impregnated with cellulose to prevent shrinking and deterioration by UV rays, fungus, bacteria and algae. Pad to be made with 100 percent recyclable material and have high evaporation efficiency with low air pressure drop. A separate distribution pad to be located above the cooling pad to ensure even coverage during operation
        3. Water Distribution System: Schedule 40 PVC designed to evenly distribute water over the adiabatic pad at low flow for maximum water savings. Fully accessible. End plugs for easy clean out. Flow: Factory set for maximum efficiency and minimal water use. Self-draining when solenoid valve closes.
        4. Drip Tray: Excess water from adiabatic pads drain to an accessible covered drip tray designed to minimize sunlight exposure. Drip tray cover to be easily removable for cleaning.
        5. 2-Stage Adiabatic System: Two slow closing solenoid valves for optimizing water usage.

When unit can no longer maintain desired set-point while operating completely dry, the designated, primary solenoid valve will open allowing water to trickle over the adiabatic media on one side of the unit.

Fan speed is modulated to maintain desired set-point.

Single-stage operation will alternate between the two sides of the unit as the Adiabatic system cycles on and off.

When ambient temperature increases such that the system can no longer maintain set-point while operating only a single stage of the Adiabatic system, the 2nd solenoid valve will open to allow water to trickle over the adiabatic media on the other side of the unit.

The adiabatic media on both sides of unit will be wetted to provide peak dry-bulb depression.

* + - * 1. Pipe Connection Type: Any connections provided with a Groove (GVD) or Beveled for Welding/Grooved (BFW/GVD) shall conform to standard groove specification (SGS)
      1. Motors and Drives:
         1. Fan Motors: Zero maintenance, totally enclosed fan cooled, ball bearing type electric motors with permanently sealed bearings.

Premium Efficient, Class F insulated, severe duty, 1.0 service factor design; Inverter rated per NEMA MG1 Part 31.4.4.2 and suitable for variable torque applications and constant torque speed range with properly sized and adjusted variable frequency drives.

Continuous duty within temperature range of Minus 20 to 147 degrees F.

* + - 1. Maintenance Access:
         1. Inspection Panel: Removable to inspect internal surface of coils.
      2. Controls: Motors to be factory wired to a common terminal box by Condenser Manufacturer. Refer to wiring systems specification section for more specific details.
    1. Pumps: Either end suction base mounted or vertical inline. Capable of continuous operation without fault and rated at 175 psi.
       1. Bronze fitted construction with mechanical shaft seal, stainless steel shaft sleeve, non-overloading impeller, flex coupling, coupling guard and steel base.
       2. Approved Manufacturer: S.A. Armstrong 4030/4300 or approved equal.
       3. Design Capacity: Flow rate, pump head, horsepower, and starter method; see Equipment Schedule on Drawings.
          1. Brine System Flow Rate: 900 gpm. 55 ft
          2. Glycol System Flow Rate: 1000 gpm. 65 ft
       4. Pump Motor: WEG, or approved equal, 3/60/460V, 1800 RPM, Class B insulation, open drip proof with 1.15 SF, meeting Federal Efficiency requirements.
       5. Suction and discharge butterfly valves, discharge check valves and pressure gauges.
       6. Side Stream Glycol Filter: Replaceable 25 micron bags to allow system filtration. A pressure gauge is connected across filter to indicate differential pressure.
    2. Starter Panel: Includes main disconnect, phase failure protection, starters, fuses, overload relays with reset buttons in panel door and control transformer, housed in NEMA 12 enclosure.
       1. Mounted on refrigeration package. Power and control wiring for equipment within refrigeration package to be pre-wired at the factory.
       2. Refer to Article, "Dasher Board Systems" in this specification.
    3. Refrigeration Control System:
       1. DDC Control Panel: Includes necessary hardware, software and interface device for a complete microprocessor based DDC control system.
       2. Mounted on refrigeration package. Sensor and control wiring for transducer within refrigeration package to be pre-wired at factory.
    4. Remote Sump Tanks:
       1. High grade polyethylene. A seamless one-piece vertical tank.
       2. Manufacturers: ACO CONTRAINER or approved equal.
       3. Dimensions: See Equipment Schedule on Drawings.
       4. Sump Tank shall be constructed of high grade polyethylene.
    5. Evaporative Condenser Water Pumps:
       1. Either end suction base mounted or vertical inline. Capable of continuous operation without fault. Rated at 175 psi.
       2. Bronze fitted construction with mechanical shaft seal, stainless steel shaft sleeve, non-overloading impeller, flex coupling, coupling guard and steel base.
       3. Approved Manufacturer: S.A. Armstrong 4030/4300 or approved equal.
       4. Design Capacity; Flow Rate, Pump Head, Horsepower and Starter Method: See Equipment Schedule on Drawings.
       5. Pump Motor: WEG, or approved equal, 3/60/460V, 1800 RPM, Class B insulation, open drip proof with 1.15 SF, meeting Federal Efficiency requirements.
       6. Suction and discharge butterfly valves, discharge check valves, and pressure gauges.

\*\* NOTE TO SPECIFIER \*\* Delete if Adiabatic Condenser is being specified.

* + 1. Chemical Water Treatment Systems:
       1. For condenser system to control scale, corrosion, and biological growth. Provide piping, valves, controls, wiring, meters, strainers, equipment, and chemicals required for a complete operating system. Interlock with water pump as necessary for automatic operation.
       2. Chemical Feed Piping: Internal sump of unit that is located outside the building to be stainless steel.
       3. Chemicals: For one year for prevention of scale, corrosion, and biological growth.
          1. Must be compatible with equipment materials used in system and meet or exceed environmental requirements.
          2. Annual chemical cost information and supplier names must be submitted with proposed chemical treatment system shop drawings.
       4. Accessories: pH cube kit as manufactured by HACH Cat. No. 12519 Phenol red.
       5. Chemical Treatment Supplier: To provide a passivation plan for cooling towers.
       6. Containment Tray: For chemical drums. Approved manufactures: PIG www.newpig.com or approved equal. System to be durable plastic, one-piece utility tray with 5 inch minimum side walls.
    2. Snow Melt Pit Coil: All stainless steel tube bundle, encased in stainless steel framework with pipe connections above the water line. Factory tested to 400 psig air pressure under water. Sized to melt ice resurfacer based on one flood per hour per ice sheet.
    3. Expansion and Overflow Tanks:
       1. Separate expansion tanks for cold and warm systems to allow for expansion and contraction of system charges. Tanks to be closed to minimize air contact with heat transfer fluid. Tanks will require level indication if tanks are not translucent. Glycol Tanks: Have overflow lines piped to overflow tank.
       2. One overflow tank.
    4. Pipe and Fittings:
       1. Refrigerant Piping to Conform to the Following:
          1. Latest edition of ASME B31.5 Refrigeration Pressure Piping Code and ASHRAE 15.
          2. 2 inch and Larger: ASTM A53, Grade B, ERW, Schedule 40 carbon steel.
          3. 1-1/2 inch and Smaller: ASTM A106, Grade B, Seamless, Schedule 80 carbon steel.
       2. Refrigerant Pipe Fittings to Conform to the Following:
          1. 2-1/2 inch and Larger: ASTM A234-B, Schedule 40, Butt weld, carbon steel.
          2. 2 inch and Smaller: ASTM 105-N, 3000 lbs, socket weld, forged steel.
       3. Secondary Refrigerant Pipe and Fittings: Supply and install secondary refrigerant piping as indicated on Drawings.
          1. Secondary Refrigerant Piping, Above Ground: Conform to ASTM A53, Grade B, ERW, Schedule 40, carbon steel.
          2. Secondary Refrigerant Piping Below Ground: Confirm to PE4710, DR17, High Density Polyethylene.
          3. Secondary Refrigerant Fittings Above Ground: Conform to the following:

2-1/2 inch and Larger: ASTM 105-N, 3000 lbs, socket weld, forged steel.

2 inch and Smaller: ASTM 197, 150 lbs, threaded, Malleable Iron.

* + - * 1. Secondary Refrigerant Fittings Below Ground: Conform to PE4710, DR17, Butt weld, High Density Polyethylene.
      1. Valves:
         1. Ammonia Valves and Controls: As indicated on Drawings. Valves Manufacturer: Danfoss Henry, Hansen, Phillips, R/S, or approved equal.
         2. Ammonia Relief Valves: Sized and piped to suitable location as defined in ASHRAE 15 Safety Code/IIAR-2 for Mechanical Refrigeration. Valves to be manufactured by Cyrus Shank , Hansen, Danfoss, or approved equal.
         3. Secondary Refrigerant and Water Valves and Controls: For safe, convenient operation and maintenance.
         4. Butterfly Valves: Full lug type with trim selection compatible with fluid being handled. Valves 10 inches and larger to be gear operated.

Manufacturer: Challenger, Bray, or approved equal.

* + - * 1. Lines 2 inch and Smaller: May use ball valves manufactured by Flow+ or approved equal.
      1. Gauges and Thermometers:
         1. Main Refrigerant Gauges: Minimum 4 inch diameter.
         2. Component Gauges: May be 2-1/2 inch diameter.
         3. Gauge Manufacturer: Weiss or approved equal.
         4. Gauges: Constructed of material compatible with fluid being measured.

Liquid filled and with gauge valves.

* + - * 1. Heat Exchanger Thermometers: Solar powered digital display. Adjustable stem angle and separable wells. Manufacturer: Weiss or approved equal.
        2. Compressor Thermometers: Supplied by compressor manufacturer.
      1. Insulation: Install per manufacturer's recommendations.
         1. Low Temperature Line Insulation: Thick enough to prevent surface condensation.
         2. Package Insulation: Foam-in-place urethane with fiberglass jacket installed at factory.
         3. Field Insulation Above Ground: Polyisocyanurate rigid insulation with tongue and groove horizontal joints and ship lap end joints. Insulation to be complete with vapor barrier and white PVC jacket.
         4. Field Insulation Below Ground: Polyurethane foam pre-insulated insulation with high density polyethylene jacket or approved equal.
      2. Refrigerant Charge:
         1. Refrigerant System: To be thoroughly evacuated prior to charging.
         2. Supply and install a complete operating charge of ammonia refrigerant. The system is considered fully charged when the system is operating, and the chiller lower sight glass is half full.
      3. Oil Charge: Initial charge of oil for compressors and one 50 gallon drum. System is fully charged when oil return system is fully operational and replenishing compressor crankcases as required.
      4. Glycol Charge: Initial charge of 40 percent by weight inhibited ethylene glycol. Dilute glycol only with de-ionized water. System is fully charged when all air is purged from piping.

\*\* NOTE TO SPECIFIER \*\* Delete article if not required.

* 1. FLOORS, PIPING, VALVES, AND ACCESSORIES
     1. Scope: Ice Rink Contractor will be responsible for proper supervision and installation of the rink structural slab including underfloor sand, insulation, vapor barrier, rink pipe, rink chairs, reinforcing, concrete, and floor inserts for hockey and the circus; as required.
     2. Warranties: Flooring contractor will guarantee floor for a two year period after the successful completion and approval by the Owner's representative. The guarantee is to cover dusting, disintegration or any other defects of surface coming within control of the Contractor.
     3. Performance and Design Requirements for Rink Floor System
        1. Add decision questionnaire for Rink Floor System
     4. Rink Floor Headers:

\*\* NOTE TO SPECIFIER \*\* Delete one of the two piping options.

* + - 1. Piping: Carbon Steel Sch 40.
         1. Cold Header Pipe: 8 inch carbon steel sch 40
         2. Warm Header Pipe: 3 inch carbon steel sch 40
      2. Piping: High-density polyethylene complying with requirements of ASTM D3350 cell classification and have a Plastic Pipe Institute (PPI) designation of PE4710.
         1. Minimum Density: 58 lbs per cu ft (0.957 gm per cu cm).
         2. Cold Header Pipe: 8 inch SDR11. Pressure Rating: 200 psi.
         3. Warm Header Pipe: 3 inch SDR11. Pressure Rating: 200 psi.
         4. Joints and Connections: Fusion welded by personnel fully trained in the fusion welding process.
      3. Location: Inside the rink, across full width of rink, at end nearest refrigeration room.
      4. Fittings: High-density polyethylene complying with requirements of ASTM D3350 cell classification and have a Plastic Pipe Institute (PPI) designation of PE4710.
         1. Minimum Density: 58 lbs per cu ft (0.957 gm per cu cm).
         2. Fittings 2-1/2 inch and Above: Molded butt weld conforming to ASTM F714.
         3. Fittings 2 inch and Under: Socket type conforming to ASTM 2683.
      5. Approved manufacturers: ISCO, Integrity, GFPS or approved equal.
    1. Rink Floor Piping:
       1. Carbon Steel Sch 40: 1 inch.
       2. Polyethylene or Poly Pipe: 1 inch SDR11 high-density complying with ASTM D3350 cell classification and have a Plastic Pipe Institute (PPI) designation of PE4710.
          1. Minimum Density: 58 lbs/cf (0.957 gm/cc) or CSA B137.1 approved pipe manufactured for rink use.
       3. Floor Cooling Piping: The only permitted connections or joints in cold floor piping, except as noted in the Paragraph "Rink Cooling Floor Chairs" in this specification Article, are to be at the headers and at the180 degree return bends. Fusion weld pipes to headers. Install on 3, 3-1/2, or 4 inch centers.
       4. Underfloor Heating Piping: The only permitted connections or joints in the underfloor piping, except as noted in the Paragraph "Rink Cooling Floor Chairs" in this specification Article, to be at the headers. Pipes to be fusion welded. Installed on 18, 20, or 24 inch centers.
       5. Rink Cooling Floor and Header System: Test with air pressure at 50 psig for 48 hours, prior to pouring concrete. Maintain pressure on system during the rink pour.
       6. Rink Underfloor and Header System: Test with air pressure at 50 psig for 48 hours, prior to placement of top lift of sand. Maintain pressure on system during sand placement and compaction.
       7. Rink Return Bend: High-density polyethylene fabricated as one piece molded socket weld U-Bend. U-Bends fabricated from 90 degree elbows is not allowed.
          1. Manufacturers: ISCO, GES or approved equal.
       8. To Repair a Polyethylene Pipe Leak; Damaged after Welded Wire Mesh is Placed in the Cold Floor or after the Sand is Placed in the Underfloor:
          1. Cut pipe at the leak. Install a 1 inch plastic insert coupling and re-test.
          2. Brine piping leaks found prior to pouring of the floor slab, while the pipe circuit is accessible will be repaired by replacing the entire brine pipe circuit.
       9. Return Bend Wire Ties: To be cut two days after the concrete floor pour, through the perimeter side of the expansion joint before the compression seal is installed, to permit the floor slab to contract during operation.
    2. Rink Cooling Floor Chairs: Top loaded pipe supporting chairs made of steel rod fabricated with 3 inch wide, 24 gauge steel plate on the bottom. Pipe lift to allow 1-3/4 inch concrete over top of rink piping. Top loaded feature will allow ease of reinforcing bar installation.
       1. Pipe chairs space cooling rink floor piping on 3, 3-1/2, or 4 inch centers and placed in rows on 2 ft centers down length of rink. Overlap chairs by one pipe at end of each chair.
    3. Rink Floor Valve Boxes: Two high density polymer concrete valve boxes, flush mounted with removable cover in perimeter slab edge. One adjacent to each end of rink headers. One vent valve per header in each valve box.
       1. Valve boxes to be provided by the general contractor. The same division providing the openings shall backfill and compact clean sand to underside of valve boxes and place and finish concrete in the box-outs after boxes are installed and rink floor is poured.
    4. Rink Underfloor Sand: Clean and free of clay and organic material. 90 percent of sand must pass US sieve size No. 12; 0.0681 inch opening size.
       1. Place a bed of under floor sand to thickness specified in the schedule of values, in one 2 inch and one 5 inch lift compacted to 95 percent standard density and level to plus or minus 3/16 inches.
       2. When completing second lift of sand, do not damage the subfloor heating pipes.
    5. Rink Floor Insulation: Insulation: DOW HI4, DOW HI25, or DOW HI60 Styrofoam extruded polystyrene. Insulation Sheets: 4 x 8 ft.
       1. Layers: Two, 2 or 1-1/2 inch layers. Place with a minimum of 24 inch staggered and overlapped joints.
       2. Polyethylene 6 mil Sheeting: 20 x 100 ft rolls. Cover top and bottom of insulation with one layer. Seams to overlap a minimum of 12 inches.
    6. Rink Floor Concrete Re-enforcement:
       1. No rebar below the pipes with 12 inch centers parallel to pipe chairs and at the spacing listed in the schedule of values for rebar parallel to rink pipe.
          1. Bars to be intermediate grade deformed steel, rust and scale free without sharp offsets or bends.
          2. Longitudinal bars for bottom reinforcing to be 20 ft lengths minimum.
          3. Bars to be placed beginning 4 inches clear of the bulkhead on each side and ends of the rink.
       2. Welded wire mesh above the pipes: 6x6 - W2.9xW2.9.
    7. Rink Floor Concrete:
       1. Mix Design: Submitted to Contractor one month prior to the rink pour and must be approved by the Owner's representative
          1. Designed with admixtures to produce the specified compressive strength in 28 days. Any concrete admixtures must be compatible with the specified ice rink floor piping. Aggregate: Clean and properly graded with a maximum size of 3/4 inches. Slump: Maintained at 3-1/2 to 4-1/2 inches at end of pump hose to allow for complete flow around the piping system.
       2. Concrete Floor Thickness and Strength: 5 inches and 4000 psi
       3. Concrete Floor Thickness and Strength: 5 inches and 5000 psi
       4. Concrete Floor Thickness and Strength: 6 inches and 4000 psi
       5. Concrete Floor Thickness and Strength: 6 inches and 5000 psi.

\*\* NOTE TO SPECIFIER \*\* Delete article if not required.

* 1. MOTOR CONTROL PANELS
     1. Refrigeration Control Panel: Provides for operation of refrigeration equipment.
        1. One Rink:
           1. Two compressors. One Cold pump. One condenser water pump and fan. One water jacket head cooling. One Warm pump.
        2. Two Rinks:
           1. Two compressors. One condenser water pump and fan. One water jacket head cooling. One Warm pump. Two Cold Pumps.
        3. Three Rinks:
           1. Two compressors. One condenser water pump and fan. One water jacket head cooling. Two Warm pumps. Three Cold Pumps.
        4. Four Rinks:
           1. Three compressors. One condenser water pump and fan. One water jacket head cooling. Two Warm pumps. Four Cold Pumps.
     2. Standards Compliance: Refer to most recent editions in all instances.
        1. IIAR 2 latest edition and/or Local Mechanical Code.
        2. National Electrical Code and/or Local Code.
        3. ANSI/ASME Boiler and Pressure Vessel Code.
     3. Materials: All new factory wired refrigeration control panel to ESA code compliance. Panel includes:
        1. NEMA 12 enclosure panel.
        2. IEC rated starters, contactors, relays, selector switches and push buttons.
        3. Adjustable overloads with external manual reset buttons.
        4. Soft Starters for compressors and brine pump (WEG).
        5. GREEN Indicator Lights: For brine pump1, compressor 1, compressor 2, condenser pump, condenser fan, and compressor jacket cooling pump.
        6. RED Indicator Lights: For High ammonia liquid level, Compressor 1 failure and Compressor 2 failure, Compressor 1 high ammonia pressure, Compressor 2 high ammonia pressure, Compressor 1 low ammonia pressure, Compressor 2 low ammonia pressure.
        7. BLUE Indicator Light: For alarm silenced.
        8. YELLOW Indicator: For compressor anti short cycle.
        9. Disconnect Switch: 200 Amp non-fused.
        10. Transformer: 2 KVA.
        11. Lead/Lag selector switch for two compressors.
        12. Hour meters for compressors.
        13. Alarm horn, silence push button, and high liquid level reset.
        14. One 4-1/2 inch panel mounted high pressure gauge c/w top mounted gauge board.
        15. One 4-1/2 inch panel mounted low pressure gauge c/w top mounted gauge board.
        16. One reverse acting high pressure control for the condenser fan.
        17. One reverse acting high pressure control for the condenser pump.
        18. ON/OFF/AUTO switches for all motors.
        19. Honeywell T775 digital readout electronic thermostat c/w new sensor
        20. Lamacoid name plates for switches, buttons, controls, and indicator lights. Black with white letters.
        21. Selector switch for back up and future DDC (Direct Digital Control) rink control system
     4. Equipment:
        1. Compressor 1.
        2. Compressor 2.

\*\* NOTE TO SPECIFIER \*\* Delete Brine or Glycol pumps as required.

* + - 1. Brine Pump.
      2. Glycol Pump
      3. Water Jacket Pump.
      4. Condenser Water Pump.
      5. Condenser Fans.
      6. Brine Pump for heat recovery.
      7. Glycol Pump for heat recovery.

\*\* NOTE TO SPECIFIER \*\* Delete article if not required.

* 1. AMMONIA DESUPERHEATER HEAT EXCHANGER
     1. A heat recovery heat exchanger installed in the compressor discharge line between the compressors and the condensers. The unit recovers waste heat from discharge gas to preheat potable water. Refrigeration Contractor to provide.
        1. Unit to have properly sized refrigerant circuits to match the number and capacity of the refrigeration system. Refrigerant circuits must be independent of each other to prevent migration of refrigerant and oil between circuits.
        2. Minimum Heat Transfer Effect: 1000 Btuh per ton of total system capacity at 60 degrees F entering water temperature, R-717 refrigerant vapor entering at 95 degrees F saturated condensing temperature, and 220 degrees F actual discharge temperature.
           1. See schedule for specific project performance requirements.
           2. Full load refrigerant pressure drop is not to exceed 4.0 psi to have minimal effect on the refrigeration system.
     2. Design:
        1. Vented double-wall, straight tube-in-tube.
        2. Unit to be gravity drained.
        3. Mechanically cleanable from one end. Non-cleanable construction is not acceptable.
        4. An external refrigerant containing carbon steel tubes and internal, double-wall, 304L/316L, stainless steel tubes with integral vent path suitable for potable water service.
        5. Enclosed in an insulated cabinet consisting of 20 gauge minimum painted galvanized steel with 1 inch of fiberboard insulation to minimize heat loss.
        6. UL and USDA listed and rated for 450 psig shell and 300 psig tube side.
     3. Unit to be installed such that the heat recovery gas outlet is located above the condenser inlet so oil and condensed refrigerant do not accumulate in the unit.
        1. Otherwise, a "P" trap with float drainer is required to clear the discharge line and heat recovery heat exchanger of oil and condensed refrigerant.
     4. Potable Water Pump: Provided by others and be interlocked with refrigerant compressors.
     5. Thermostat: Set at 180 degrees F to be installed in return water line to the heat recovery unit. Wired to optional hot gas bypass solenoid around heat recovery unit to limit water temperature rise and sound an alarm.

\*\* NOTE TO SPECIFIER \*\* Delete article if not required.

* 1. DASHER BOARD SYSTEMS
     1. Complete factory prefabricated, arena board system with spectator shielding, including team, penalty and officials' boxes as indicated on Drawings and specified herein.
     2. Acceptable Manufacturers:
        1. Athletica Sport Systems: 554 Parkside Drive, Waterloo, Ontario, Canada N2L 5Z4; Phone: 519.747.1856; Toll-Free: 1.877.778.5911; Fax: 519.747.3659. Web: www.Athletica.com
        2. Athletica Sport Systems: 17200 Medina Rd., Suite 600, Minneapolis, Minnesota, USA 55447; Phone: 763.249.7465; Toll-free 1.800.809.7465; Fax: 763.249.7475; Web: [www.Athletica.com](http://www.Athletica.com)
     3. Dasher Board Systems:
        1. Manufacturer to provide materials and labor for a dasher board system and installation. Shop fabricated as much as possible prior to delivering to job site.
        2. Frames: Aluminum or steel. Not a combination of the two.
           1. Aluminum: Alloy 6005A-T6. Meet STM B221 and Federal Specifications QQA200-9.
           2. Steel: Hot dip galvanized after fabrication.
        3. Dasher Panels: Straight, curved or gated, similar design and all welded construction.
           1. Sizes of Panel Sections: Heights may be modified if ice retainers are used.

Straight (HxLxW): 41 x 96 x 6 inches.

Curved (HxLxW): 41 x 88 x 6 inches.

Back of Players Boxes (LxW): 96 x 6 inches. Height: See plan.

* + - * 1. Components: See Drawings.
        2. Panel Connections: With end plates at 3 or more locations. Bolts: 1/2 inch diameter.
        3. Additional Supports: Quick release backer panels, gap closures, taller panels, etc.
        4. Framing System Holes: Pre-punched and slotted for expansion and contraction in polyethylene materials.
        5. External Support Posts on Back Side of Dasher Panels: Not acceptable unless noted on Drawings.
      1. Shielding: As specified herein and shown on Drawings.
         1. Clear Float Tempered Glass. CAN2-12.1- M79, Type 2. Edges ground or beveled.

Height of Shielding: See Drawings. From top of top sill to top of shielding.

Thickness of Shielding: Dimensions: Inches. Nominal Dimensions: ():

Acrylic: Sides: 0.545 to 0.620. Ends: 0.545 to 0.620. Radius: 0.545 to 0.620.

Glass: Sides: 0.472 (1/2). Ends: 0.591 (5/8). Radius: 0.591 (5/8).

Interchangeable equal panel widths wherever possible.

Top Two Corners of Shielding: Rounded to 1/2 inch radius.

Speaker Holes: 2.5 inch diameter in shielding in front of scorer's box. Hole Edges: Routed smooth.

Transitions: Angled top edge matching height of adjacent shielding pieces of shielding. Where two different height shielding meet as shown on the Drawings.

Extra Pieces of Shielding: Match specified area thickness. Height: 72 inches.

Seamless System. Material: Tempered Glass. Qty: \_\_\_.

Supported System. Material: Tempered Glass. Qty: \_\_\_.

4 ft Access gate. Material: Tempered Glass. Qty: \_\_\_.

3 ft Access gate. Material: Tempered Glass. Qty: \_\_\_.

2.5 ft Access gate. Material: Tempered Glass. Qty: \_\_\_.

Equipment gate. Material: Tempered Glass. Qty: \_\_\_.

Emergency Repair. Material: Tempered Glass. Qty: \_\_\_.

* + - 1. Shielding Supports: Structural alloy 6005A-T6 conforming to ASTM B221 and Federal Specifications QQA200-9 or architectural alloy 6061-T6. Finish: Mill finish.
         1. Supports Between Shielding: Two-piece design. Ice Side Piece: Flat faced. Screwed assembly. Not Acceptable: Round construction on ice side.

Ends and Terminations: One-piece channel design for glazing terminations, gates, and 90 degree corners.

Fit snug through top sill. Secure at bottom of middle stringer. See Drawings.

* + - * 1. Gaskets: Continuous polyethylene holding shielding in place. Gasket Thickness: Dependent on shielding thickness. Provide snug fit between shielding and support.
        2. Hardware: Aluminum 6005A or 6351-T-6. Fasteners: Recessed flush with support surface. Removable for shielding replacement, disassembling, and reinstallation.
        3. Height: 1 inch below top of shielding if not indicated on Drawings.
        4. Spacing: 4 ft on center.
        5. Eye Bolts: On each support on ends and radius for connection of netting.
        6. Polycarbonate H sleeves for each different height of shielding: Quantity: 3 each.
      1. Supportless Shielding Support Aluminum Channel: ASTM B221, Federal Specification QQA200-9. Alloy: 6005A or 6351-T-6. Continuous aluminum channels supporting glass welded into frame. Bottom 3-1/2 inch of tempered glass to be covered with U-shaped gaskets inserted in channels.
         1. Polyethylene Channel: See "Polyethylene" Paragraph in this article.

Continuous block of polyethylene supporting glass welded into frame. Bottom 3-1/2 inch of tempered glass to be covered with U-shaped gaskets inserted in polyethylene channels.

* + - * 1. Gaskets: Continuous polyethylene or approved equal gasket to hold shield in place. Mounted to glass with adhesive tape.
        2. Hardware: Aluminum alloy 6005A or 6351-T-6. Fasteners: Recessed flush with support surface. Removable for replacement, disassembling, and reinstallation.
        3. System to support netting below top of shielding.
        4. Gap between Glass Shields: Where there are no gates; 1/4 to 3/8 inches.
        5. Spring-Loaded Lexan Clip Assemblies: Connect shielding sections together at tops of shielding.

Protection Covers: For each bolt on back of each assembly.

Provide 8 extra clips and 20 extra covers for Owner's use.

* + - * 1. Plastic Spacers between shielding panels for proper spacing.
      1. Polyethylene: High impact, high density, stress relieved, virgin polyethylene.
         1. Dimensions: See Drawings.
         2. Colors: See material schedules on Drawings. Like colors to match.

Standard Colors: White, black, royal blue, red, gold, and yellow.

White: Bright white in color. Natural white is not acceptable.

Premium Colors: Light blue, green, navy blue, shades of grey, custom colors.

* + - * 1. Fasteners: For fastening polyethylene components to aluminum and steel.

Aluminum Framing: 1/4 Type F Zinc, self-tapping. Color: Match poly material.

Steel Framing: 1/4-20 Phillips flat head machine screw, flat washers, nylon insert lock nuts.

* + - * 1. Top Sill: Dimensions: See Drawings.

Supported Acrylic Shielding System: 3/8 inch deep continuous channel routed in top sill to support shielding.

* + - * 1. Kick Plate: Fastened to facing of dasher board system.
        2. Facing Panels: One piece, cut to match dimension of frame.

Line Markings: Locations shown on Drawings. Flush with dasher board facing.

Facing: Routed 1/4 inch deep so colored line marking material can be inserted into facing panel.

* + - 1. Backer Panels: One piece, cut to match frame dimensions.
         1. In Player's Boxes: Backer panels cover exposed framing.
         2. Trim: Polyethylene pieces between back panel sections.
      2. Thresholds for Equipment Gates: Metal frame and polyethylene top piece.
         1. Frame Height: As required providing overall height shown in table on Drawings. See Drawings also for thickness of polyethylene.
         2. Frame: As specified in this Article.
         3. Polyethylene: As specified in this Article.
         4. Equipment Gate Thresholds: Removable for dry floor event access and replacement.
      3. Fasteners for Polyethylene Material: Secure facing, backing, top sill and kick plate materials.
         1. Aluminum Framing: 1/4 Type F Zinc, self-tapping, color to match poly material.
         2. Steel Framing: 1/4-20 Phillips flat head machine screw, flat washers, nylon insert lock nuts.
         3. Construction:

Outdoor Rinks: Fasteners to be stainless steel.

Screw Heads: Painted to match facing color.

Fasteners for Bottom Row of Kick Plate: Stainless steel.

Spacing: 10 inches maximum on center.

Screw Holes in Poly Material: Large enough to allow expansion and contraction.

Thresholds: Counter-sunk 1/2 inch.

* + - 1. Players, Penalty, Scorer, and Camera Boxes: Dimensions: As shown on Drawings.
         1. Framing Systems: Same material as dasher frame.

Components: See Drawings.

Benches: Easily removeable including supports built into flooring.

* + - * 1. Flooring. 3/4 inch fire treated plywood screwed to framing.

Coaches Walk: As shown on Drawings. Full length of player's benches.

Exposed Surfaces: Cover with 1/2 inch black resilient flooring material.

* + - * 1. Scorers Box Tables and Benches: Dimensions as shown on Drawings.

Framing: As specified in this Article.

Bench Material: \_\_\_\_\_\_\_\_. Thickness as specified on the Drawings.

* + - * 1. Fasteners: Plain finish.
        2. Fasteners In Contact with Pressure or Fire Retardant Treated Wood as required by the International Building Code Section 2303.1.8.5:

Hot-dipped galvanized steel. Minimum rating of G-185 (1.85 oz. of zinc/sq ft of metal) meeting ASTM A153, stainless steel, or silicon bronze.

* + - * 1. Electroplated Galvanized Fasteners: Not acceptable for exterior use.
        2. Bench Fasteners: 3/8 inch carriage bolts.
        3. Backing: Specified in Article 2.07 of these specifications.
        4. Other: Water bottle shelf in player's boxes as shown on Drawings. Full length of player's box. Material Thickness: As shown on Drawings. Color: White or match backer color.
      1. Players and Access Gates with Openings: As shown on Drawings.
         1. Gates: Integrate into 8 ft panel sections. Gate Swing Direction: As directed by Owner.
         2. Gate Panel Framing: Similar to dasher framing.
         3. Gate Gravity Latches: Welded, 2 x 3/8 inch steel flat bar. Opens with gloved hand.

Fastened with 3/8 x 1-1/4 hex head bold and 3/8 inch nylon locking nut.

Latch automatically via gravity when closed.

* + - * 1. Gate Hinges: Two lift off type hinges. Grease fittings or nylon bushings.

Piano Type Hinges: 10 GA, non-greaseable, adjustable, and bolted to frame, is acceptable where shielding is not used.

* + - * 1. Doorstop: Welded to frame. 3/8 x 3-1/2 x 4-1/2 inches long.
        2. Ice Side Release Devices for Player and Access Gates with Shielding: Push button releases located in top sill, on ice side, to open from ice side.
        3. Finger Hold: 3/8 x 3/4 inch wide groove in top sill for access gates with glass shielding to close doors from ice side of board system.
        4. Construct gate so top of threshold is located as follows:

Players Gate Distance Above Finished Floor: 9 inches.

Access Gates Distance Above Finished Floor: 3 inches.

Equipment Gates Distance Above Finished Floor: 2 inches.

* + - * 1. Casters For Gates 42 inches wide or larger: On each leaf; 5 inch diameter polyurethane tires, spring loaded, and adjustable with zinc plated framing.
      1. Equipment Gates: Double leaf. Opening sizes as shown on Drawings.
         1. Framing Materials: Meet dasher board framing requirements as specified.
         2. Latch: Zinc plated components. Two latches per gate.

Sliding steel tube with minimum dimensions of 2-1/4 x 2-1/4 inch x 12 gauge.

Solid Steel Rod: 2 inch diameter with large push down handle.

* + - * 1. Lock For Each Gate Leaf: Cane Bolts 3/4 inch diameter by 12 inch long steel, zinc plated. Lock into concrete perimeter slab.
        2. Hinges: Two per door. Lift off adjustable type. Welded to frame. Grease fittings. Zinc plated, 3/8 inch thick steel, 3/4 inch diameter hinge pins.
        3. On each leaf, 5 inch diameter polyurethane tires, spring loaded, and adjustable with zinc plated framing.
        4. Fasteners: Zinc plated and color to match where necessary.
      1. Gap Closures: Material to fill gap between back of dasher board panel bleachers, stairs, ramps, and other raised structures.
         1. Aluminum Angle: 1/4 inch thick. Piece Lengths: 8 ft or longer, as needed. Other dimensions as shown on Drawings.
         2. Fasteners: 1/4 Type F Zinc, self-tapping, color to match poly material.
         3. Construction: Mount gap closures to dasher boards and not adjacent structure.
      2. Floor Anchors and Inserts:
         1. Anchor Components: Bolts, inserts, washers, threaded rod, and hold down plate as follows and as detailed on Drawings.

Dasher Board System Located on Perimeter Concrete:

Drill holes for anchors.

Anchors: 5/8 x 3 inch zinc plated inserts by Hilti-HFA 200, Hilti HY 150, or approved equal. Expansion anchors are not acceptable.

Dasher Board System Located on Ice Rink Slab:

Anchor Assembly: As detailed on Drawings or approved equal and cast in place in concrete ice rink floor. If not designated on Drawings:

Permanent Panels: Materials to be zinc plated.

Removable Panels: Anchor Inserts and Washers: 303 stainless steel. Base Plate: 303 stainless steel or carbon steel. Bolts: Zinc plated material.

Dasher Board System Replacing Existing System: Replace existing anchor assembly. Secure dasher board system as specified.

Dasher Board System Located Outside for Outdoor Rink: Anchor inserts: 303 stainless steel. Base Plate and Washers: 303 stainless steel. Bolts: Zinc plated material.

Where ice retainer is used, provide 5 inch anchors.

* + - * 1. Hold Down Plates: Size as shown on Drawings.
        2. Anchoring Adhesive: For drilled in anchors.

Approved Manufacturers: Hilti HIT Doweling Adhesive HIT HY-150 MAX, Red Head A7 Adhesive, Simpson Strong-Tie AT-High Strength or approved equal.

Properties: ASTM C881 Type IV, Grade 3, Class A, B, C.

Bond Strength: ASTM C882: 2900 psi minimum at 2 days.

Compressive Strength: ASTM D695: 9200 psi at 7 days.

Water Absorption: ASTM D570: 0.23 percent (24 hours).

* + - * 1. Plug Materials: Threaded for each insert. Stainless steel for circus inserts. Brass for dasher board inserts.
      1. Ramps: Same materials as Player's, Penalty and Scorer's boxes. Cover with rubber flooring as specified for Player's Penalty and Scorer's boxes.
      2. Advertisement Panels: On entire face and perimeter of dasher board system.
         1. Material: Lexan: 1/8 inch thick sheets. Pre-drilled and countersunk. Bevel edges with 1/2 inch radius corners.
         2. Straight Panels 96 inch: 33 x 94 inches. Radius Panels: 33 x 86 inches.
         3. Panel Attachment: Special 1/4 inch Hi-Lo screws with undercut heads.
         4. Printed Messages: Adhered to backside of Lexan.
         5. Refrigeration must be turned on for ad panel installation per manufacturers recommendations.
      3. Protective Spectator Netting System: Size and Location as shown on Drawings.
         1. Netting: Extends 6 inches below top of shielding supports to height specified on Drawings. Custom made to fit length and height required.
         2. Material: Nylon. No. 420 knotless High Tenacity Polypropylene (HTPP) Pylon, 1-1/2 inch square mesh x 1.8 mm twine. UV and weather resistant. Fire retardant coating.

Break Strength: 125 lbs.

Perimeter Edging: Reinforced vinyl, double sewn with No. 2 brass grommets. Grommet Locations: 24 inches on center. Color: Black or white as selected by Owner.

* + - * 1. Support System:

Top of Netting: Support with continuous rigid conduit or rigid bar system. Section Lengths: 10 ft minimum formed to radius of rink.

Rigid Supports: Installed at bottom of netting at equipment and access gates and across bench areas without shielding.

Conduit Supports: Galvanized steel.

Support Cables: 3/16 inch galvanized steel cable to roof structure.

Fasteners: Attach netting to top of shielding with cable system and metal clips or nylon ties every 4 ft on center, centered on each shielding sheet.

Cable: Attached to shielding with suction cups if supportless shielding. Fasteners to be attached to poly clips at top of shielding.

Nylon Ties: 1/8 inch wide. UL recognized. Tensile Strength: 100 lbs.

Cables, clamps, turnbuckles, eyebolts, suction cups, plastic ties, as required.

* + - 1. Accessories:
         1. Glass Handler Suction Cups: One pair of suction cup devices for glass handling for removal of tempered glass or acrylic shielding.

Diameter: 8 inches with Lexan handle. Capacity: 125 lbs.

Wood's Power Grip or approved equal.

* + - * 1. Glass and Acrylic Cleaning Kits as manufactured by Novus or approved equal:

Cleaning Kit:

One 8 oz. Bottle of Polish 1: Clean and Shine.

One 8 oz. Bottle of Polish 2: Fine Scratch Remover.

One 8 oz. Bottle of Polish 3: Heavy Scratch Remover.

Two NOVUS Polish Mates

One Package of Ten Polish Mates: Microfilament, highly absorbent, extra durable, soft, and abrasion resistant. Re-usable and washable.

Size: 13 x 13 inch each.

Buffing Kit:

One wool applicator pad.

One wool buffing pad.

One back plate adapter.

One 1/4 inch spindle adapter.

One Instruction sheet.

* + - * 1. Shielding Pads: At exposed ends of shielding or supports, corners, and terminations.

Full length of shielding or supports.

Heavy duty 18 oz. reinforced fabric sleeve with impact-absorbing foam core.

Secure in place with 2 inch wide Velcro fastening system.

Color: Owners to select color from Manufacturer's standard colors of red, navy, orange, gray, tan, green, burgundy, yellow or black.

* + - 1. Ice Marking Set for Rink. Includes but not limited to:
         1. Paint: Approved Manufacturers: Lumin' Ice Pro, Crystal-Ice, Jet Ice, or approved equal.

Entire Ice Surface: White in color

Ice Markings: Circles, lines, dots, and goal crease per USA hockey requirements.

Ice Logos: By Owner.

* + - 1. Poly Electrical Enclosures: Cover electrical outlets, wiring and other devices located beneath scorer's table. Size: Full height of space beneath table and as narrow as possible maximizing leg room.
         1. Latched Hinged Door: Size so electrical outlets are unobstructed when open.

\*\* NOTE TO SPECIFIER \*\* Delete article if not required.

* 1. CONTROL SYSTEMS
     1. Summary: Specification Article includes Ice Rink Equipment work called for, or implied, together with necessary incidentals, whether referred to or not, required to complete the Work to the full intent and meaning of the specifications.
        1. Work Includes, but is not Limited to the Following:
           1. Work under this Contract covers the upgrade and/or replacement of the Refrigeration Plant Control System. This includes but is not limited to the reinstatement of all connections to the panel in accordance with the specifications. Also additional new equipment may be provided as noted in the specification. It is the responsibility of the refrigeration Contractor to coordinate all components of the project as defined herein.
           2. The specification is not intended as a detailed description of installation methods but serves to indicate the quality and requirements of the completed Work Result.
           3. Any items omitted which are clearly necessary for completion of the Work or its appurtenances is to be considered as part of the work result.
           4. Refrigeration Contractor: Responsible to review existing system and equipment within refrigeration plant and include for all necessary devices to complete the installation. Coordinate requirements with electrical Contractor.

Provide a fully functional control system to safely operate the refrigeration plant condenser system based on a floating head pressure design.

Any ministry Inspections.

Start-up and testing.

Training.

Manuals and as-built drawings (2 electronic copies).

* + 1. Basis of Design: SMART Hub IRC Ice Rink Controller using distech platform by CIMCO Refrigeration Inc.
    2. Standards Compliance: Selected Contractor must comply with all codes and standards; latest editions, as applicable to the work, including:
       - 1. CAN/CSA-B52-99 Mechanical Refrigeration Code, latest revision.
         2. ANSI B31.5
         3. ASHRAE 15 Safety Code for Mechanical Refrigeration.
         4. ASME B31.5 Refrigeration Pressure Piping Code.
         5. Boiler and Pressure Vessels Act.
         6. WCB Regulations.
         7. Register the Design with TSSA.
    3. Minimum System Requirements: Design, provide and commission the necessary accessories, software, human machine interfaces, relays, transmitters, control panels, etc. for the complete operation of a DDC based centralized control system following refrigeration equipment where applicable:
       - 1. Cold glycol / brine pump.
         2. Warm glycol / brine pump.
         3. Refrigeration compressors.
         4. Evaporative Condenser/Cooling tower pumps.
         5. Underfloor heating.
         6. Evaporative Condenser/Cooling tower fans.
         7. Condenser is floating head pressure ready.
         8. Machine room ventilation system.
    4. Infrared Temperature Control of Refrigeration System:
       1. Refrigeration Contractor: Supply a complete microprocessor based automatic control system to achieve the performance specified in the following clauses.
       2. Refrigeration Management System: To be Cimco Hub. To be part of the refrigeration control system forming a single physical network so data can be directly shared.
       3. Controllers: Distech Controls; Eclypse hardware version 1.10.18199.491 or newer.
       4. All Control Products: To be comprised of a BACnet internetwork. Communication involving control components; i.e., all types of controllers and Operator Workstations, must conform to ANSI/ASHRAE Standard 135-2001, BACnet.
       5. Each Building Controller: Support BACnet over IP. Building Controller to be connected to BACnet network using the BACnet IP.
       6. Building Controller secondary communication network, if applicable, must support BACnet MS/TP.
    5. Control System Equipment:
       1. Controls will be assembled in appropriate enclosure.
       2. Control Elements: Identified by P-TOUCH type ribbon inside enclosure.
          1. Elements in Front of Enclosure: Will be indicated by means of engraved plate.
       3. Wiring Inside the Panel: Routed inside appropriate wire duct. Each wire will carry a number at each end. These numbers are to correspond to electric Drawings.
       4. Control Panels: Manufactured in a factory. Certified CSA. Panels will have clear indication they conform with CSA standards.
       5. Control Panel Characteristics: Hinged doors. Electrostatic factory paint of gray color. Interior components such as transformer, fuses relays, programmable controllers, will be assembled on a dismountable back plate. Installation of components directly on panel is not acceptable.
       6. Panel Power Supply: 120 VAC, 15 amps maximum, protected by an integrated circuit breaker and having a double service socket to power 115 volt laptop and router.
       7. Wiring Connection of Cables Coming from Outside the Enclosure: Will have connections to a terminal block with the exception of the wires connecting to the Input side of the programmable controllers.
    6. Sensors:
       1. Transmitters: Electronic type with 4 to 20 mA control signal.
       2. Control System: Controls refrigeration equipment based on information received from the following field sensors.
          1. Infrared camera mounted above the ice surface.
          2. Cold glycol / brine supply temperature.
          3. Cold glycol / brine return temperature.
          4. Compressors discharge pressure.
          5. Compressors suction pressure.
          6. Sub-slab temperature.
          7. Outdoor air temperature and relative humidity.
          8. Condenser condensate temperature.
          9. Rink space temperature and relative humidity.
          10. Status inputs from all, pumps, compressors, and fans.
          11. Individual safety status from each compressor.
    7. Operator Workstation:

\*\* NOTE TO SPECIFIER \*\* A system can have both or either of the following two workstations. Delete a workstation if one of them is not required.

* + - 1. Provide the following minimum configuration for a panel mounted touchscreen operator station:
         1. Intel Core i5 Processor or higher.
         2. 4GB RAM Memory or more.
         3. 250GB hard drive or larger.
         4. 19 inch Panel mount touchscreen display.
         5. USB ports: Two.
         6. Network Interface Cards: Two.
         7. Windows 10 Professional operating system.
         8. HTML5 compatible web browser.
      2. Provide the following minimum configuration for a desktop operator workstation:
         1. Intel Core i5 Processor or higher.
         2. 4GB RAM Memory or more.
         3. 250GB hard drive or larger.
         4. 27 inch LCD Flat screen Monitor.
         5. USB ports: Two.
         6. Network Interface Cards: Two.
         7. USB Optical mouse.
         8. Windows 10 Professional operating system.
         9. HTML5 compatible web browser.
    1. DDC Controller:
       1. DDC System: Must utilize high-speed networks using Ethernet between the major controllers and the HMI. Between major and secondary controllers, the DDC system must use BACnet/MSTP.
          1. Must be able to communicate with other peripheral controllers using Modbus.
       2. BACnet DDC Controllers: To be mounted in CSA certified control panel installed locally in building as close as possible of controlled equipment.
       3. The DDC HMI: Must be capable of communicating with other HVAC manufacturer's equipment using industry standard BACnet protocol.
       4. DDC Controllers: Peer-to-peer data communication between BACnet/IP, and BACnet MS/TP networks.
          1. BACnet system with inputs, outputs, and variables available as standard BACnet AI, BI, AO, BO, AV, and BV objects.
          2. Controllers when connected can have their firmware upgraded without disconnecting them from an active network.
          3. Each controller must have a specific network address.
       5. DDC Controller Functions:
          1. Control refrigeration equipment and associated components directly.

Must not depend on any other CPU or computer to perform this function.

* + - * 1. Loss or failure of an operator workstation must in no way affect the refrigeration equipment operation.
        2. Provide scheduling for temperature setpoints.

Schedules to include, day mode, night mode and game mode settings. Capable of scheduling at four different on/off periods per day for each 7 day schedule.

* + - * 1. Each Ice Surface: Must have its own unique set of schedules.

A trend log. As a minimum, the DDC system HMI must store to hard drive, all input readings and control outputs from control system.

* + - * 1. Compressors, Pumps and Fans: Will have their own individual trend logs.

Trends will show readings of equipment status, i.e. on/off or fail, and associate control variable relevant to that equipment, i.e. temperature, pressure etc.

* + - * 1. Log run hours and number of starts for each pump, compressor, and fan.
        2. Monitor temperatures, pressures, and equipment status for alarm conditions.

Alarm Setpoints: Adjustable by operator with appropriate password.

* + - * 1. Upon an Alarm Condition: Message appears on operator interface indicating what alarm condition is and time it occurred. Alarms to be documented in the trend logs.
        2. Acknowledgment of alarm will clear the alarm.
        3. Ability to send an alarm message via email to an email recipient or to a cell phone equipped with text-messaging capability. It will generate a specific alarm message for each alarm incident including date and time stamp.
        4. Capable of being monitored remotely from any location via Internet. Remote diagnostics, software maintenance, graphics updates and setpoint adjustments to be possible with remote communications.
        5. Password protected: Minimum of four password levels: Programmer/engineer, service technician, supervisor/operator, and view only.
    1. Graphic Interface Software:
       1. Graphical operator interface software viewable via an HTML5 supported web browser.
       2. Operator Software: Allow navigation through screens by using a mouse. Other than entering numerical values, key entries are to be kept to a minimum.
          1. Allow for restricted access to setpoints and selected information depending on operator password level.
          2. Allow for editing of setpoints, alarms, and schedules.
          3. Allow the display of trends, equipment screens, run-hours, flow screens, sensor values etc.
          4. A screen specific help icon is to be available on each screen providing user with relevant information.
       3. Minimum Graphic Requirements:
          1. Logon graphic.
          2. Main project graphic.
          3. Flow graphic.
          4. One schedule graphic per ice surface.
          5. One graphic for each trend log.
          6. Setpoint graphics.
          7. Alarm graphics.
          8. Runtime data graphics.
    2. Remote Communications Software: Achieve by installing remote viewing software on the local workstation. Refrigeration contractor is to install remote access software to remotely support and monitor the system if required.
    3. Variable Frequency Drives:
       1. Manufacturer: ABB Inc., Model No. ACH550-VDR or approved equivalent.
       2. Line Reactor and Enclosure: Manufacturer: ABB Inc. or approved equivalent.
       3. Engineered Wiring Drawings: Must be complete by the selected contractor.
       4. Programming of VFDs: Must be completed by the selected contractor.
    4. Condenser Fan Motor:
       1. Manufacturer: WEG or approved equivalent.
       2. Condenser Fan Motor: Open Drip Proof NEMA Premium Motor.

\*\* NOTE TO SPECIFIER \*\* Delete article if not required.

* 1. SMART - AMMONIA REFRIGERANT TRANSFER MODULE
     1. Refrigeration Contractor: To install safety components on Artificial Ice plant. Each artificial ice system will undergo a mechanical safety enhancement with the installation of a pre-assembled Ammonia Refrigerant Transfer Module, to transfer liquid and vapor out of the main system in the event of a major Ammonia release.
     2. Standards Compliance: Selected Contractor must comply with codes and standards (latest editions) applicable to this type of work, including:
        1. CAN/CSA-B52-99 Mechanical Refrigeration Code, latest revision.
        2. Ontario Electrical Safety Code, latest revision.
        3. ANSI B31.5
        4. ASHRAE 15 Safety Code for Mechanical Refrigeration.
        5. ASME B31.5 Refrigeration Pressure Piping Code.
        6. Boiler and Pressure Vessels Act.
        7. WCB Regulations.
     3. Features;
        1. Permanent connection to main refrigeration circuit.
        2. Continually monitor and detect Ammonia vapor, independently from main system.
        3. Computer Control System and HMI display requirements:
           1. Vessel level transducer.
           2. Fail alarm for all sensors if their reading is out of normal range.
           3. Monitoring of all Smart Transfer motor run feedback.
           4. Fail to start alarms for Smart Transfer compressor.
           5. Event logging of all Transfer starts and stops.
           6. Event logging of all Refrigeration Plant Shutdown starts and stops.
           7. System flow page showing sensor readings, valve positions, and motor run statuses.
           8. HMI and/or physical push buttons: Transfer Initiate and Transfer Abort.
           9. HMI selection between metric and imperial temperature and pressure reading display.
           10. Runtime hours tracking of all motors, with daily, weekly, monthly, and yearly displays and 3 runtime service flag intervals and indicators.
           11. Access to setup parameters restricted to authorized users.
           12. Hand Off Auto Switches for all outputs, which can be either physical or in HMI.
        4. Clear indicators for:
           1. Refrigeration Plant Shutdown status.
           2. Transfer in Progress.
           3. Transfer Complete.
           4. Transfer Aborted.
        5. Trending of all inputs and outputs values every 1 minute.
        6. Graphic display of any trended values, selected by user, in configurable time periods
        7. Ability to send alarm and event emails using customer supplied SMTP server.
        8. Ability to automatically trigger a weekly or monthly test alarm, including email.
        9. When system detects a leak exceeding a predetermined PPM threshold, it shuts down the ice plant and transfers refrigerant out of main refrigeration system and isolates it.
        10. Ammonia Refrigerant Transfer System:
            1. Must quickly pump down system by transferring liquid and vapor from the low and high side of the main refrigeration circuit. Once leak is resolved, refrigerant can manually be returned to the main refrigeration circuit.
            2. Can be activated manually to pump out and return refrigerant during maintenance.
            3. Capable of aborting pump out if required.
     4. Equipment:
        1. One (1) Bitzer reciprocating ammonia compressor.
        2. One (1) Refrigerant to water, plate, and frame condenser.
        3. One (1) Ammonia storage vessel.
        4. One (1) NEMA 12 electrical motor control panel.
        5. One (1) NEMA 12 computer control panel with touch screen display.
           1. Bacnet native DDC controller with web server based display interface.
           2. Separate relays for all DDC outputs.
        6. Two (2) - dedicated supply zones c/w solenoid / strainer and isolation valves.
        7. Two (2) - dedicated return zones c/w solenoid / strainer and isolation valves.
        8. All required flow regulators, solenoids, water regulating valve, oil separators etc. for a complete operating system.
        9. Gauge Panel: Complete with high pressure, low pressure, oil failure and high temperature cut out safety controls along with LP, HP, OP, gauges.
        10. All material mounted on a structural steel base (WxLxH): 4 x 8.5 x 6 ft.
        11. Module will be totally enclosed with perforated side panels.
        12. NH3 sensor for dedicated use with smart transfer.
        13. Temperature and pressure sensors.

1. EXECUTION
   1. EXAMINATION
      1. Do not begin installation until substrates have been properly constructed and prepared.
      2. If substrate preparation is the responsibility of another installer, notify Architect in writing of unsatisfactory preparation before proceeding.
   2. PREPARATION
      1. Clean surfaces thoroughly prior to installation.
      2. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
   3. INSTALLATION
      1. Install in accordance with manufacturer's instructions, approved submittals, and in proper relationship with adjacent construction.
      2. Ice Rink Refrigeration System:
         1. Field-Fabricated Steel: Painted with primer, ready to receive final coat as indicated by owner/consultant.
         2. Identification: Primary and secondary refrigerant lines and water lines pertaining to ice rink refrigeration system will be identified after painting and insulation as to substance in the pipe, and direction of flow. Lines penetrating wall sections must be immediately identified on either side of wall. Markers to be Brady as per ASHRAE.
         3. Testing and Instruction:
            1. Refrigeration Contractor: Provide a licensed refrigeration mechanic to operate refrigeration plant during commissioning and training period.
            2. After concrete is cured and rink slab pull down procedure is completed, the owner's personnel will install the first sheet of ice on each new rink floor per Manufacturer's instruction and under Manufacturer's supervision.
            3. Refrigeration Contractor: Provide three (3) days of training minimum, on refrigeration system, for owner's representatives. One day constitutes 8 hours.
      3. Ice Rink Floor Systems:
         1. Ice Rink Contractor: Responsible for supervision and installation of rink floor:
            1. Underfloor sand with heating piping system.
            2. Insulation, slip sheet and vapour barrier.
            3. Reinforced concrete rink slab with refrigeration piping system.
            4. Floor inserts.
            5. Rink perimeter expansion joint.
         2. Rink will be handed over to the Ice Rink Contractor when the following is complete:

Drained subgrade, level to plus or minus 1 inch at elevation 15 inch below finished floor including depressed section at rink headers.

Rink perimeter slab is installed providing an 86 ft 2 inch wide x 201 ft 2 inch long x 28 ft 7 inch opening, level to plus or minus 1 inch within 15 inches of rink edge.

* + - 1. Rink Underfloor Sand: 6 inch thick underfloor stone dust sand in two (2) lifts compacted to 95 percent Proctor standard density and level to plus or minus 3/16 inches. Sand: Clean and free of clay and organic material. Screenings can be provided in lieu of clean sand at the rink contractor's discretion.
      2. Rink Insulation, Slip Sheet, and Vapor Barrier:
         1. Rink Insulation: DOW SE Styrofoam extruded polystyrene insulation.

Supplied in 4 x 8 ft sheets. Compression Strength: 25 psi

* + - * 1. Place In multiple layers, with minimum 24 inch staggered and overlapped joints.
        2. Slip Sheet on Top of Insulation: 6 mil polyethylene vapor barrier.

Supplied in 20 x 100 ft sheets and placed with seams overlapped a minimum of 12 inches.

* + - * 1. Vapor Barrier on Top of Sand: 6 mil polyethylene vapor barrier.

Supplied in 20 x 100 ft sheets and placed with seams overlapped a minimum of 12 inches.

* + - 1. Rink Reinforced Concrete Floor:
         1. Thickness: 5 or 6 inches minimum. Total thickness of concrete over freezing pipes to be a nominal 1-3/4 inch.
         2. Reinforcing: No. 4 bars at 12 inch centers perpendicular to rink pipes, and at 14 inch centers parallel to rink pipes, below the pipes and with 6 x 6 W2.9 x W2.9 welded wire mesh above the pipes. Bars to be intermediate grade deformed steel rust and scale free without sharp offsets or bends. Longitudinal bars for bottom reinforcing to be 20 ft lengths minimum and the minimum overlap to be 24 inches. Place bars beginning 4 inch clear of bulkhead on each side and ends of rink.
         3. Rebar Placement: First layer of No. 4 reinforcing to be laid parallel to rink pipe supports at 12 inch centers and installed before the rink piping. Second layer of No. 4 reinforcing to be laid parallel to rink pipe at 14 inch centers and installed into top loaded pipe chairs after rink piping. The two layers of reinforcing are to be tied together with loop type wire ties at every intersection along diagonal, starting at every third rebar intersection along the rink length.
         4. Mesh Placement: One layer of 6 x 6 W2.9 x W2.9 wire mesh laid on top of rink pipe with 6 inch overlap at seams. Tie mesh with loop type wire ties to pipe chairs every 12 inches and around perimeter of each mesh sheet as required to hold mesh securely in place.
         5. Concrete Mix: Compressive strength of 4000 psi in 28 days. Use any concrete admixtures compatible with specified ice rink floor piping. Submit mix design to be reviewed and approved by structural engineer and Owner's representative. Aggregate: Clean and graded with a maximum size of 3/4 inch. Slump must be maintained at 3-1/2 to 4-1/2 inch at end of pump hose allowing for complete flow around piping system.
         6. Concrete Pump: Concrete slab to be poured in place using a concrete pump with minimum output of 50 cubic yards per hour. No trucks are allowed in floor area and the use of power operated buggies will not be permitted. A standby concrete pump is to be provided.
         7. Runways: 4 x 8 ft, 3/4 inch thick plywood in good structural condition laid on pipe chair supports.
         8. Concrete Placement: In 10 to 12 ft lanes running across width of rink starting in one corner. Vibrators are not permitted in placing concrete. Care must be exercised to prevent damage to piping systems.
         9. Concrete Pour: After concrete placing commences, it must be carried on continuously until completion. Changing of shifts must be done so there is no delay in pouring and meal hours for the crew must be staggered to avoid any stoppage of pouring. Concrete is to be struck off at the exact 6 inch thickness and finished with rotary steel floats until latency has disappeared.
         10. Testing: Testing of concrete mix and test cylinders to be performed by Owner's testing services consultant. Six test cylinders will be taken throughout the pour and tested for a compressive strength at 7 days and 28 days. Cylinders are to be stored at the Project site, under the same conditions of temperature and moisture as the floor, until tested.
         11. Surface Tolerance: Lace concrete to achieve Floor Flatness of FF 45, and Floor Levelness of FL35 (ASTM E1115). Minimum local values for FF/FL to be at least 60 percent of specified overall values.
         12. Finishing: Slab surface to be finished with power driven rotary trowels following immediately behind the pouring crew.
         13. Floor Hardener: BASF Masterkure HD 300WB 55 gallon drum. Disposal of drum after use is by Owner.
         14. Curing and Protection: Continuous moist cure to be maintained for a period of 7 days after the finishing process. The entire slab area is to be covered with polyethylene sheets with care being taken to overlap joints. Polyethylene is to remain in place free of traffic during the wet cure.
      2. Rink Floor Inserts:
         1. Hockey goal post inserts with plugs. To accept Marsh flexible pegs. Qty: 8.
         2. Insert shafts and plugs to be stainless steel. Refer to tender drawings for general details, installation notes and locations.
         3. Supply and placement of Dasher Board inserts are not part of the rink floor insert scope. See Paragraph "Dasher Board System" in this Article. Coordinate installation of rink floor materials and dash board inserts with the dasher board Contractor.
      3. Rink Perimeter Expansion Joint:
         1. A 1 inch expansion joint around the rink perimeter as detailed on the tender Drawings. Expansion joint is to incorporate a Watson Bowman Acme WE-225, or approved equal, black Santoprene compression seal acceptable for use in pedestrian and vehicular traffic areas with ADA requirements.
         2. Install compression seal per manufacturer's recommendations.
    1. Ice Rink Motor Control Panel:
       1. Disconnect and remove Existing Control Panel and related ammonia tubing and dispose in environmentally sound manner.
       2. Supply and Install New NEMA Enclosure Factory built Panel c/w 6 inch panel fan.
       3. Supply and install new cold floor slab temperature sensor and connect to new Honeywell T775 Panel mount controller.
       4. Supply and install new power feeds to all motors.
       5. All control is to be 120 V.
       6. Supply and install new emergency stop button inside vestibule or outside refrigeration room main entrance.
       7. Supply and install 2 x RAHP switches and ammonia tubing to new panel location.
       8. Configure RAHP cut outs with new panel to ensure efficient operation of condenser water pump and fan for condenser.
       9. Test and Tag all plant safeties after panel is installation.
       10. Calibrate ammonia leak detection system.
       11. Check all motor/compressor/pump/fan rotation.
       12. ESA inspections.
    2. Dasher Board System:
       1. Prior to Beginning Installation: Verify rink floor has been released for lift access and expansion joint is installed, inspected, and approved.
       2. Complete installation under direct supervision of experienced Manufacturer Representative.
       3. Install per manufacturers recommended requirements and instructions. Anchor system in place. Provide trim, shims, and accessories for a complete, level, and plumb, installation.
       4. Replace any material scratched, marked up, chipped, dented, or damaged in any way.
       5. Test all parts of system and adjust, as necessary. Walk through system with Owner and make adjustments necessary for Owner's satisfaction.
       6. Nylon ties used to attach netting at top of shielding and elsewhere to be cut off or trimmed in such a manner, and with appropriate tools, to eliminate sharp edges.
       7. Supportless Shielding Systems: Install with 3/8 inch gap between pieces of shielding.
       8. Anchors and Inserts: When dasher board system is installed on the rink floor.
       9. Dasher Board Manufacturer: To be on-site prior to and during concrete rink floor pour to install, protect, and adjust anchors and inserts.
       10. Field verify goal insert locations in concrete floor. Assure alignment with goal line markings on dasher board system.
       11. Resilient Flooring in Boxes: Loose laid over plywood substrate on main box level. Securely fastened on coaches raised platform and raised floor levels within box areas. Cut flooring to fit neat and tight around fixed objects and perimeter. Flush surfaces at sills and gates.
       12. Other exposed aluminum or steel horizontal surfaces: Cover with rubber flooring.
       13. Other exposed aluminum or steel vertical surfaces: Cover with poly.
       14. Advertisement Panels: Install per manufacturer's recommendations. Typically, cool rink floor to operating temperature prior to installing advertisement panels.
       15. Ice Markings: Dasher board manufacturer to supply and install paint and ice markings as shown on Drawings and/or as specified.
       16. Coordinate with Installer and/or Owner when making the ice sheet.
       17. Apply paint as recommended by paint manufacturer and supplier; 3 coats minimum for white paint and to achieve uniform coverage of ice surface, marking areas, etc.
       18. Painting shall be performed by a company or crew that has painted a complete set of ice markings for a minimum of ten (10) ice rinks.
       19. Logos: Furnished and installed by Owner.
    3. Ice Rink Control System:
       1. Commissioning: Refrigeration contractor is to provide a competent experienced technician for control system commissioning. Refrigeration contractor employees will accomplish commissioning.
       2. Drawings and Post Install Inspection:
          1. A complete as-built drawing of the new installation is to accompany the final installation inspection report, including piping changes and form part of the tender and construction documents.
          2. Relevant documentation from the Technical Standards and Safety Authority, verifying pressure tests of new piping has been undertaken and inspected by the local Safety Authority representative.
          3. Documentation pertaining to acquisition of a new Provincial Registration number is to accompany the final installation.
          4. Equipment drawings and details to be reviewed and stamped by a professional engineer accredited in the State where the ice rink is located.
       3. Manuals: Three copies of operating and maintenance manuals for equipment covered under this contract, including as-built Drawings. Equipment, drawings, and details to be reviewed and stamped by a professional engineer accredited in the State where the ice rink is located.
       4. Coordination: Ice rink control system contractor is to closely coordinate interactions with other contractors and trades. Specifically mark and identify exact locations for thermowells, transducers and other devices installed by others. Provide specific installation directions and conduct jobsite meetings to make sure devices others are installing are installed properly.
       5. Installation: Work to be in a quality workmanship fashion.
          1. Conduit and Raceways: Routed in a perpendicular fashion with 90 degree and 45 degree bends.
          2. Fire Rated Assemblies Penetrations: Fire stopped or fireproofed conforming to local and national codes.
          3. Weather Station: In open equipment well in a location providing the most accurate outdoor ambient weather information.
       6. Points List: Provide the following system points necessary for a complete properly functioning control system. Provide 10 percent excess hardware points on each controller for future expansion.
       7. Inputs:
          1. Type AI:

Rink 1 Infrared Temperature: IRC.

Return Temperature: TT4WellLo.

Supply Temperature: TT4WellLo.

Suction Pressure: PT100.

Discharge Pressure: PT300.

Outside Air Temperature: ATRHCombo.

Outside Air Humidity: ATRHCombo.

Rink 1 Underfloor Temperature: TTSubSlab.

Rink 1 Slab Temperature: TTSlab.

Snow Pit Temperature: TT4WellLo.

CF1 Actual Speed: (from VFD).

CF2 Actual Speed: (from VFD).

* + - * 1. Type DI:

E-Stop Alarm.

DDC Mode.

Rink 1 Pump Run.

Rink Backup Pump run.

Compressor 1 Run.

Compressor 2 Run.

Compressor 3 Run.

Condenser Pump Run.

Condenser Fan 1 Run.

Condenser Fan 2 Run.

Underfloor Rink No. 1 Pump Run.

Snow Melt Pit Pump Run.

High Level.

Refrigerant Detection.

* + - 1. Outputs:
         1. Type DO:

General Alarm.

Remote Alarm Contact.

Rink 1 Main Pump.

Rink backup Pump Start.

Compressor 1 Start.

Compressor 2 Start.

Compressor 3 Start.

Compressor 4 Start.

Condenser Pump Start.

Condenser Fan 1.

Condenser Fan 2.

Underfloor Rink No.1 Pump Start.

Snow Melt Pit Pump Start.

* + - * 1. Type AO:

Condenser Fan CF1 VFD Reference.

Condenser Fan CF2 VFD Reference.

* + 1. SMART Transfer:
       1. Place Ammonia Refrigerant SMART Transfer Module according to drawings
       2. Remove Ammonia refrigerant from artificial ice plant and contain in certified ammonia cylinders. Weigh cylinders to ensure cylinders contain no more than 70 percent internal volume.
       3. Two (2) Ammonia discharge lines from SMART Transfer module to points identified on drawings. Provide isolation globe valves, strainers, and solenoid valves.
       4. Two (2) Ammonia Liquid Return lines from SMART Transfer Module to points identified on drawings. Provide isolation globe valves, strainers, and solenoid valves.
       5. Install compressor / condenser cooling water piping from main water supply line and to drain.
       6. Install Ammonia Relief lines from Ammonia Refrigerant Transfer Module receiver vessel to main plant relief header.
       7. Install electrical system to the motor control panel on ART module.
       8. Remove all material and obstacles from the Ice Plant room to allow a clear unobstructed workspace.
       9. Internet connection to Smart transfer system.
       10. Electrical Scope:
           1. Breaker: 30 amp on main panel.
           2. Wiring from 30 amp breaker from electrical panel to Ammonia Refrigerant Transfer Module Motor Control Panel.
           3. Install new GG-NH3 Ammonia Room sensors dedicated to the Ammonia Refrigerant transfer system.
           4. Install new GG-VL2-NH3 Ammonia Dispersion Tank sensor (YK Arena)
           5. Install new GG-6 CIT Control panels.
           6. Low voltage wiring from room NH3 Sensor and vent stack sensor to GG-6 Ammonia Alarm Panel.
           7. Electrical interlock from Alarm panel to Artificial Ice Plant control panel.
       11. Commissioning and Startup:
           1. Evacuate system utilizing an ammonia vacuum pump.
           2. Inspect electrical wiring and connections.
           3. Add Ammonia Charge.
           4. Start each Artificial ice system and go through start up procedure.
           5. Testing of Smart Transfer System will include completing Six (6) transfer cycles over a period of 24 hours.
           6. Record operating data and pump out times.
       12. Drawings and Post Install Inspection:
           1. Drawings: Stamped drawings by Engineer registered to practice in the state ice rink is located. Supply Drawings for electrical and mechanical components.
           2. Site Inspection: Contractor is responsible for the following.

Having necessary inspections completed by appropriate professional and authorities and providing Owner proof of inspections.

Arranging on-site inspection with Owner prior to "turn over of ice plant.

* + - * 1. Document and System Control: Contractor is responsible for the following.

Supply city with 2 electronic copies of equipment documentation and drawings for purpose of updating existing O and M Manuals.

Control modifications and programming and updated graphics to match and control the new modification.

* + - * 1. Training: Minimum of 8 hours of training on operating system to facility staff.
  1. FIELD QUALITY CONTROL
     1. Notify Engineer 7 Business Days Prior to the Following Work Phases:
        1. Completion of subgrade preparation.
        2. Start of sub-floor heating system piping.
        3. Completion of transmission main installation.
        4. Start of floor insulation.
        5. Completion of floor insulation.
        6. Start of rink piping and header piping.
        7. Completion of rink piping and header piping.
        8. Final flushing of all piping systems.
        9. Start of concrete placement.
        10. Start of refrigeration piping insulation installation.
        11. Start and completion of all pressure tests.
        12. Start up and Training.
     2. Field Inspection: Coordinate with appropriate sections in Division 01.
        1. Engineer will be on-site at end of project to generate the final Punch List.
        2. Punch list of uncompleted, or unsatisfactorily completed items, (i.e., punch list) after the project is reported complete by the Contractor and prior to the project's required completion date. If the items are not satisfactorily completed and should additional site visits be required to follow up on uncompleted items, the Engineer shall be compensated at the typically hourly rate for each person involved in the re-inspection. The Contractor will be back charged the amount of the additional inspections.
     3. Testing of Piping Systems: To be witnessed by Engineer. Notify Engineer 10 business days prior to testing.
        1. Test piping prior to backfilling. Isolate equipment and other devices that may be damaged by pressure test. Testing procedures must meet all code requirements.
        2. Testing Requirements:
           1. Polyethylene Pipe: Tested as specified in the "Ice Rink Floor System" Article.
           2. Stainless Steel and Carbon Steel Refrigerant Pipe: Tested as specified in the "Ice Rink Floor System" Article.
           3. Gauges for pressure tests must be for pressures greater than test pressure.

\*\* NOTE TO SPECIFIER \*\* Include if manufacturer provides field quality control with onsite personnel for instruction or supervision of product installation, application, erection, or construction. Delete if not required.

* + 1. Manufacturer's Services: Coordinate manufacturer's services in accordance with appropriate sections in Division 01.
  1. SYSTEM STARTUP

\*\* NOTE TO SPECIFIER \*\* Delete the two following paragraphs if CO2 refrigeration is not required.

* + 1. Notify NH3 refrigeration package manufacturer three weeks in advance of refrigeration system startup. Prior to NH3 refrigeration arrival to site:
       1. An NH3 must be approved.
       2. Complete and test ice rink bowl, emergency ventilation, egress lighting, gas monitoring and FA systems.
       3. Facility must be safe for construction personnel and staff occupancy for making ice.
       4. Data cables are run to refrigeration package control panel.
    2. Do not start refrigeration system until local and state Authorities Having Jurisdiction have inspected and provided written approval for systems including refrigeration, piping, controls, ventilation, NH3 gas detection, ice equipment room and related systems; and alarms and controls are tested for all conditions and modes of operations.
    3. Prior to final inspections of Owner, demonstrate control and alarm systems are working as required by code and specified. Make necessary adjustments, additions, and electrical modifications to provide systems. Document procedures were witnessed by Owner. Document piping pressures tests and vacuum tests on systems.
    4. After testing piping systems according to specifications and current codes, clean and fill piping systems with a complete charge of specified refrigerant.
    5. Provide refrigerant as necessary to maintain fully charged systems during project warranty period. Test refrigerants at 3, 12, and 16 months after startup, provide final test reports of each refrigerant; including moisture content, etc.
    6. Concrete Ice Rink Floors: Cure 28 days prior to lowering temperature of ice rink floor. After curing, lower temperature of ice rink floor at a maximum rate of 1 degree F per hour until slab temperature reaches 34 degrees F. Then 1 degree F every 2 hours until slab temperature reaches 16 to 18 degrees F before applying water. Provide documentation procedure was witnessed by Owner or Owner representative.
    7. Demonstrate control and alarm systems are working as required by code and as specified. Make adjustments, additions, and electrical modifications to provide these systems. Provide documentation procedure was witnessed by Owner or Owner representative.
    8. The Installer will provide these follow-up services, at no additional cost to Owner:
       1. Forty-Eight hours after operating system, shut down the system, remove construction bags from compressor, and clean strainers and screens on compressor that has been operating. Clean strainers and screens on other valves and equipment. Start operation of other compressors that were not operating previously.
       2. Forty-Eight hours after operating next group of compressors, shut down system, remove construction bags from compressor, and clean strainers and screens on operating compressor. Repeat this step for additional equipment. Provide documentation of work performed and observations.
       3. Thirty days after startup, change filter dryer cores. Provide documentation of work performed and observations.
       4. One complete oil change of compressors at runtime recommended by manufacturer. Provide documentation of work.
    9. Variable Frequency Drives: Provide startup services by certified manufacturer's representative to provide an additional 1 year warranty. Provide field report and documentation of all work performed and observations.
  1. STARTUP TRAINING AND SITE SUPPORT
     1. Up to eight days on-site by direct employee of Manufacturer and/or Controls Manufacturer for programming and startup of system.
     2. Five days minimum on-site by a direct employee of Manufacturer for receiving refrigeration package on-site and reviewing installation by Installer.
     3. Fifteen days minimum on-site by a direct employee of the Manufacturer for system startup.

\*\* NOTE TO SPECIFIER \*\* Delete if CO2 refrigeration system is not required.

* + 1. Four days minimum on-site by a direct employee of Manufacturer for hands-on instructions of Owner's operating staff for a total of thirty two hours of training on startup procedures of the NH3 refrigeration system during initial startup of refrigeration system.
    2. Two days minimum on-site for commissioning system. Verify design and operational parameters of refrigeration system. Provide a full, detailed report of findings.
    3. Refrigeration System: Is not to be started until local and state governing authorities have inspected and provided written approval for systems related to, and including refrigeration, piping, controls, ventilation, ice equipment room, building and other related systems. Alarms and controls must have been tested for all conditions and modes of operations.
    4. Documentation of piping pressures and vacuum tests on systems. Owner or Owner's representatives must witness test.
    5. After testing and cleaning piping systems per specifications and codes, fill piping systems with a complete charge of primary and secondary refrigerants. Remove free air from the systems. Contractor is responsible for removing air from system throughout project warranty period. Fill piping system in a manner that avoids trapping air in the system. If air becomes trapped, Contractor must remove fluid and refill system as required until air is removed. Provide field report for each site visit where air is removed, or systems checked clearly detailing processes and observations.
    6. Provide primary and secondary refrigerants needed to maintain fully charged systems throughout project warranty period. Test refrigerants 3 and 11 months after start up. Provide test reports of each refrigerant, including moisture content, inhibitor concentration, solids, refrigerant content, etc.
    7. Provide a factory trained technician for 30 hours to check operation of refrigeration system and equipment and associated systems and equipment during start up. Provide documentation and certification from technician with completed, detailed, check list.
    8. Concrete Ice Rink Floors: Cure for 28 days prior to lowering floor temperature. After curing, lower temperature of ice rink floor at a maximum rate of 1 degree F per hour until slab is 34 degrees F. Then 1 degree F every 2 hours until slab temperature is 16 to 18 degrees F. Apply water after desired operating temperature is reached. Provide documentation procedure was witnessed by Owner or Owner representative.
    9. Provide Owner's operating staff with 14 hours of hands-on instructions on safe operation of entire ice system. A minimum of two separate days. Include detailed instructions on how to build first ice sheets. Operation and Maintenance Manuals must be completed and approved at by this time so they can be reviewed during training sessions. Provide 14 days notice for training sessions. Coordinate with Owner's schedule.
    10. Demonstrate control and alarm systems are working as required by code and specified in contract documents and necessary adjustments, additions, and electrical modifications have been made. Document that Owner or Owner representative witnessed procedure.
    11. Provide these follow-up services, at minimum. Cost of services to be incidental.
        1. After forty-eight hours of operation, shutdown system and remove construction bags from the compressor. Clean strainers and screens on compressor, rink pump and on other valves and equipment. Start operation of second compressor and rink pump.
        2. Forty-eight hours after second compressor and rink pump start up, shutdown system and remove construction bags from compressor, clean screens on compressor and rink pump and on other valves and equipment operating during this period. Provide field report and documentation of work performed and observations.
        3. Thirty days after start-up change filter dryer cores. Provide field report and documentation of work performed and observations.
        4. Provide one complete oil change of compressors at runtime recommended by manufacturer. Provide documentation of work.
        5. Site Visits During Warranty Period: A required to adjust to control settings, equipment functions, and other parts of system as required to optimize operation.
    12. Variable Frequency Drives: Provide start up services by a certified manufacturer's representative to provide additional 1-year warranty. Provide field report and documentation of work performed and observations.
    13. Build first ice sheet on ice rink floors. Build in thin layers of water in accordance with industry standard practices.
        1. Build black ice layer of ice. Ice layer prior to painting.
        2. Furnish and install white paint on entire ice rink floors and ice markings as shown on Drawings and/or specified. Apply paint at rates recommended by paint manufacturer; 3 coats minimum for the white paint, and to achieve full uniform coverage of the ice surface, marking areas, etc. Logos: Furnished and installed by Owner.
        3. Build ice over the ice markings to thickness desired by Owner.
        4. Train Owner's staff in building the ice sheet.
    14. Assist Owner in preparing an Emergency Preparedness Plan, Process Hazard Assessment, or related documents by providing Owner's planning consultant with required information on the ice system as requested. Take part in planning session with Owner, Owner's planning consultant and others to assist Owner's planning consultant in developing this plan.
  1. SHUTDOWN TRAINING
     1. Eight hours of hands-on instructions for Owner's operating staff, on shutdown procedures of ice and related systems after the first ice season has expired.
  2. CLEANING AND PROTECTION
     1. Ice Rink Refrigeration System: On completion of the work, all protection erected under this section shall be removed, all damage to this work and to the work of other trades resulting from the execution of the work of this section shall be made good, and all surplus materials, debris, tools, plant, and equipment shall be removed from the premises, and the buildings and site left in a condition satisfactory to the owner/consultant.
     2. Installer must keep premises clean and free of unnecessary materials and debris. On direction at any time from the Owner, clear any designated areas or area of materials and debris. On completion of any portion of the work, remove from premises tools and machinery and debris occasioned by the work, leaving premises free of obstructions and hindrances.
     3. Installer: Responsible for cleaning immediate construction area including rink floor, perimeter concrete, and mechanical rooms where work is performed. Specific requirements:
        1. Patch and paint holes caused or left by construction and demolition work. Match adjacent textures and colors.
        2. Clean equipment and piping to original condition after project has been completed.
        3. Touch up equipment paint, using paint provided by manufacturer, after installation.
        4. Clean out ice re-surfacer snow melt pits.

END OF SECTION