SECTION 21 00 00 - 25 00 00 – MECHANICAL

PART 1 - GENERAL

1.1 PROJECT DESCRIPTION

A. The project is a remodeled professional arena in Seattle, Washington. The arena will seat approximately 18,000± spectators and will be designed to host basketball, hockey, concerts and shows including both ice and non-ice events.

B. Refer to the architectural plans for a detailed description of the facility.

1.2 INTENT

A. This narrative provides information, consistent with the level of detail available at Schematic Design, to help confirm the cost and configuration of the Mechanical systems.

B. Work shall be based on all drawings and narratives including architectural, structural, mechanical, plumbing, electrical, civil, and landscape. All systems shall be priced as complete, working systems. The Contractor shall review this narrative and the drawings for “scope” not “take-offs.” The Contractor shall price all components necessary to extend the narrative to full and complete working systems. In the case of discrepancy between this narrative and the architectural drawings, request clarification from the Engineer.

C. All systems shall be constructed in accordance with all appropriate building codes and be installed complete for a fully-functional facility.

D. The design intent is that the mechanical systems enhance the facility’s flexibility of use, provide a safe and comfortable environment, optimize energy consumption, and minimize maintenance costs, all for the lowest possible construction cost.

1.3 DESIGN CRITERIA

A. Compliance with applicable codes should be considered a minimum requirement.

B. The entire building HVAC and plumbing systems shall be designed in accordance with the following:
1. Plans prepared by Populous and narratives prepared by M-E Engineers, Inc.
2. ASHRAE 111-2008 Standard entitled "Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems."
3. ASHRAE 62-2010 Standard entitled "Ventilation of Acceptable Indoor Air Quality."
4. ASHRAE 55-2010 Standard entitled "Thermal Environmental Conditions for Human Occupancy."
5. ASHRAE 15-2001 Standard entitled “Safety Standard for Refrigeration Systems.”
6. ASHRAE 90.1-2010 Standard entitled "Energy Efficient Design of New Buildings Except New Low-Rise Residential Buildings."
7. Other ASHRAE Standards as are reasonably applicable to the project.
8. National Fire Protection Association criteria.
9. SMACNA Sheet Metal Contractors Association Standards for Duct Construction.
10. ASME - American Society of Mechanical Engineers.
11. ASTM - American Society of Testing and Materials.

12. AWWA - American Water Works Association.
13. UL - Underwriters Laboratories.
14. 2015 International Building Code
15. 2014 National Electrical Code
16. 2015 International Mechanical Code
17. Washington Administrative Code, including Uniform Plumbing Code and Washington State Energy Code requirements.
18. 2015 International Fire Code
19. 2015 International Fuel Gas Code
20. Local amendments to all identified Codes.
21. Underwriters Laboratories (U.L.).
22. National Electrical Manufacturer's Assoc. (NEMA).
23. American National Standards Institute (ANSI).
24. Americans with Disabilities Act (ADA).

1.4 SYSTEMS SCOPE

A. The following lists the systems included in this Scope of Work.

- Cooling
- Heating
- Ventilation
- Exhaust including environmental, grease, laundry, smoke
- Sanitary Drainage
- Storm Drainage
- Domestic Hot Water
- Domestic Cold Water
- Natural Gas
- Insulation
- Acoustic and Vibration Control for Mechanical Systems
- Energy Management and Temperature Control Systems
- Fire Sprinkler and Standpipe Systems
- Other Mechanical Systems in support of known conditions and consistent with the Intent Statement

PART 2 – DESCRIPTION OF MECHANICAL WORK

2.1 APPLICABLE CRITERIA

A. Design Conditions

The following criteria will be used to calculate the heating and cooling loads in accordance with ASHRAE and for the design of the HVAC systems:

1. ASHRAE 0.4% category design conditions will be used for the project location. They are shown below. These conditions represent the base point for the load simulation model and do not necessarily reflect conditions at time of space or coil "peak".
2. Summer -

Outdoor DB Design Temperature:	86°F Dry Bulb 66°F Mean Coincident Wet Bulb
Outdoor wet-bulb design includes a 1°F local effect increase above the ASHRAE 0.4% value.	68°F Wet Bulb 83°F Mean Coincident Dry Bulb

Outdoor air dew point design for a "Hockey Event" includes a 1°F local effect increase above the ASHRAE 0.4% value.	62°F Dew Point 70°F Mean Coincident Dry Bulb
Indoor DB Design Temperature:	60° - 65°F (arena bowl) 72° - 75°F (other areas)

3. Winter -

Outdoor Design Temperature:	25°F Dry Bulb
Indoor Design Temperature:	60° - 65°F (arena bowl) 68° - 72°F (other areas)

4. Inside Relative Humidity Control:

a.	Arena Bowl During NHL Ice Events:	35-44ºF dew point float
b.	Arena Bowl During non-NHL Ice Events:	44-50ºF dew point float
c.	Arena Bowl During Non-Ice Events:	30% - 60% RH
d.	Concourses, Suites, Office Areas:	30% - 60% RH
e.	Meeting Rooms, Club Area:	30% - 60% RH
f.	Team Locker Space:	40% - 70% RH

5. Elevation: Sea Level

B. Cooling shall be provided to all areas except:
- Interior Toilet Rooms
- Mechanical Rooms
- Storage Rooms (non-perishables)
- Service Corridors, Stairs & Exits
- Vestibules

C. Heating shall be provided in all areas.

D. Ventilation requirements will be per applicable Code and LEED requirements. For early estimating assume the following:
- Meeting rooms, club areas: 15 cfm per person.
- Kitchen: based on the exhaust airflow requirements of the cooking and equipment hoods.
- Toilets: 75 cfm per water closet and urinal or 2 cfm/sf, whichever is larger
- Arena Bowl: minimum 9 cfm/person.
  Note, the bowl air handlers will be capable of providing up to 100% outside air for events requiring more air changes.
- Administration Offices: 20 cfm/person.
- All other areas: per Code.

The volume of outside air delivered to the bowl will be controlled via carbon dioxide sensors. Outside air dampers at the bowl air handlers will modulate in response to the carbon dioxide level in order to maintain the level within the parts-per-million-level required by ASHRAE. Additionally, the HVAC system is designed to provide approximately 10% positive pressure with respect to the outside. This helps control infiltration and thermal stack effect.

E. Acoustics: The background noise criteria (NC) design goals shall be as follows:

• Conference Rooms, Interview Rooms	NC 30-35
• Press Boxes, Video, Audio Visual,	NC 35-40
• Media Workrooms, Suites, Retail Areas	NC 40-45
• Conference Rooms and Executive Offices	NC 30
• Enclosed Offices	NC 35
• Open Plan Offices	NC 40

- Bowl Area - to the least favorable seat NC 40
- Lobbies, Reception, Ticket Booth, Lounges, Training NC 40
- Concourses, Corridors, Vestibules, Dressing Rooms NC 40-45
- Club/VIP Lounge NC 30-35
- Concessions, Workshops, Washrooms NC 45
- Loading, Dock Area, Laundry NC 50

F. Occupancy Schedules
- Certain areas (control room, security room, etc.) are designed for 24 hour, seven days per week operation, and they will have separate HVAC units.
- Office areas will be occupied 8:00 a.m. to 5:00 p.m. Monday through Friday, plus occupancy during events scheduled in the Arena.
- The bowl will be scheduled to coincide with actual events.

G. Zoning: All air handlers with VAV operation or constant volume with reheat shall follow the criteria noted below.
- Perimeter areas shall be separate from interior areas.
- Perimeter areas vary by orientation.
- Corner rooms are handled with a separate zone.
- Special use rooms (i.e. conference, meeting rooms and divisions of meeting rooms) are separate zones.
- High profile areas, such as private suites and clubs, get separate control.
- Provide an average of 750SF per zone for office and locker areas.

H. Controls; discharge air and heating water re-set; will be utilized to comply with the requirements of ASHRAE 90.1, minimize operating costs, and maximizing human comfort.

Design Conditions:	Chilled Water	Heating Water
Building Supply	45	180
Building Return	55	150

PART 3 – DESCRIPTION OF HVAC SYSTEMS

3.1 SYSTEMS - GENERAL

A. Direct connection to the existing campus chilled water system will be provided to distribute chilled water throughout the building for cooling via air handlers and fan coils.

B. Connection to the existing campus steam system via steam to heating water heat exchangers will be provided to distribute heating water throughout the building for heating via air handlers, fan coils, finned tube and terminal units.

C. Each heating water, condenser water, and chilled water system will be thoroughly chemically cleaned (internally) and flushed. Systems then will be circulated through cartridge type filtering devices until clean.

D. Each water system will be hydrostatically tested and proved leak tight prior to insulation.

E. All HVAC pumps shall be mounted on spring isolated inertia bases. Pumps shall be factory capacity tested and shall have dynamically balanced impellers, flexible drive couplings, mechanical seals and shall be free of flashing and cavitation at all flow rates.

F. All water systems will be balanced to design flow rates and documented.

G. All air distribution will be balanced and documented.

H. Acoustic treatment will be applied as needed to meet sound levels in noted spaces as defined by the sound level criteria. Major air handlers will have supply duct silencers.

I. Air handling units will include the following features:
1. Constant volume or variable air volume operation. Units with variable flow operation will include variable frequency drives for fan modulation.
2. Return fan section (units with minimal return ducting will not have return fans).
3. Filter bank/mixing section.
4. 100% Economizer Section.
5. Hydronic heating coil with two-way valve.
6. Chilled water cooling coil with two-way valve.
7. Reheat coil, where appropriate, with two-way control valve.
8. Appropriate access sections.
9. Return air and low leakage outdoor air dampers.
10. Double-wall construction.
11. Internal spring isolation.

J. Outside air and exhaust ducting will be coordinated and architecturally integrated into the perimeter wall layout with louvers.

K. The Chilled Water System will also serve as the heat rejection medium for the water-cooled food service equipment. Provide chilled water supply and return lines and dedicated inline circulation pump at each concession stand, pantry, and food service equipment area.

L. All existing mechanical and plumbing services to be demolished unless specifically noted otherwise. Existing utilities shall be capped and prepared for new connection. Specifically:

1. Campus steam and chilled water service entry to remain at northwest corner. Cap at exterior manhole and prepare for new connection. Existing chilled water and steam supply to buildings in north courtyard to remain.
2. Existing ice cooling tower and boiler in north courtyard to be demolished. Existing pump adjacent to cooling tower and boiler to remain in operation.
3. Existing club HVAC/glycol system adjacent to loading dock to be demolished.
4. Existing domestic and sewer utilities to arena to be capped and prepared for new connection.
5. All existing utilities serving existing buildings to be demolished shall be capped.

3.2 CENTRAL PLANTS

A. Provide connection to upgraded campus chilled water plant consisting of additional chiller in space at campus plant, associated primary and secondary pumping within plant, variable tertiary pumping within arena, complimentary components, and chemical treatment. Provide chilled water without glycol- ref. Part 11.
1. 2,000 – tons estimated capacity.
   a. 800 tons capacity via existing campus plant.
   b. 1200 tons capacity via new additional chiller located on existing vacant pad within campus plant, along with new associated primary and secondary pumps.
   c. Provide compressor VFD on new chiller.
2. Provide a variable tertiary pumping system within arena.
   a. Base-mounted split-case pumps.
   b. Variable speed drives.
   c. Bypass line and valve.

3. Expansion tanks.
4. All valves, piping, control taps, etc. required for a fully integrated system.
5. Distribution piping will be routed throughout the building.

B. Condenser Water Plant:
1. Provide new 1200 ton cooling tower at existing campus plant to match new 1200 ton chiller.
2. The cooling tower shall be all stainless steel construction with bolted or welded stainless steel basins, stainless steel frame, and stainless steel casing. The cooling tower shall be induced draft, cross-flow or counter flow design. Fans shall be selected for quiet operation. Each motor shall be premium efficiency inverter duty rated and equipped with a variable speed drive. Each cell shall be equipped with a solid state liquid level controller. Cooling tower capacity shall be certified by the manufacturer to provide the scheduled capacity in the cooling tower enclosure shown on the architectural drawings.
3. Provide cooling tower basin sweeping system with blow down tank and sand filter.
4. Waterside economizer
   a. Plate and frame heat exchanger, assume 600 tons
   b. Associated controls and sequences

C. Provide connection to campus steam plant consisting of steam to heating water heat exchangers and variable flow pumping. Provide heating water without glycol- ref. Part 11.
1. (3) heat exchangers sized at 6,000 MBH each
2. (3) primary pumps
   a. Parallel operation with boiler isolation valves
   b. Base-mounted end suction
3. 2-way temperature control valves with some 3-way to avoid dead heading.
4. All associated valves, expansion tanks, etc.
5. Distribution piping will be routed throughout the building.

3.3 AIR HANDLING SYSTEMS

A. General: All internal air handlers including the arena bowl units will be custom or packaged modular units similar to Trane or CES. Air handlers will use MERV 8 pre-filters with MERV 13 final filters. Fan coils will use 2" MERV 8 filters. All air handling units will be supplied with full outside air economizer capability unless noted otherwise. Units shall be double wall with internal spring isolation. All air handling units shall be provided with safety controls to prevent freezing with clear water operation.

B. Air Handlers
1. Arena Bowl/Concourse System: The arena bowl/concourse air distribution system will include four (4), 4-pipe, variable volume air handling units. Each unit will be sized for 100,000 cfm supply for a total of 400,000 cfm supplied to the arena bowl.
   a. The units will be located in mechanical rooms on the upper mechanical mezzanine and supply air to the bowl will be distributed through ductwork within the roof trusses.
   b. Return air grilles will be located at the Event Level, Main Concourse, Suite Level, and Upper Concourse. Return air will be routed through structurally designed shafts capable of operation at 21 lbs/sf negative pressure.
   c. The air handlers will consist of double acoustical wall construction with outside air/return air mixing section, air blender, MERV 8 pre-filters, MERV 13 final filters, heating coil, cooling coil, reheat coil, supply fan array, and appropriate access sections. The units will be capable of sub cooling the air to provide dehumidification.
   d. The units will have sound attenuators on both supply and return mains. The system will be capable of using 100% outside air for economizer operation.
   e. Relief/exhaust/smoke fans will be located as high as possible in the arena and be controlled using variable frequency drives to maintain building pressure. These fans

will also be used during pyrotechnic events and will include silencers. The building will be maintained at 10% positive pressure.

f. The bowl air-handling units will be capable of heating and cooling the required outside air for the design event crowd at design ventilation loads. A carbon dioxide monitor in the return air path will modulate the outside air dampers to maintain the required maximum parts per million level of CO_2 in the space.

g. Bowl relief air will be controlled by operating the smoke exhaust/relief fans based on pressure differential between the inside and outside.

h. Large, de-stratification fans will be located high in the bowl and will include VFDs for speed control. Assume (4) fans, Big Ass Fans maximum available size or equivalent.

i. A desiccant dehumidification system will be required to meet NHL Standards.

- Four units, 40,000 –cfm each, with one unit coupled to each bowl air handler.
- Pre-cool coil
- Desiccant wheel
- Gas-fired reactivation
- Appropriate filtration.

2. Concourses: The Main Concourse and Upper Concourse will be conditioned using air transferred from the arena bowl units through the open concourses. High cooling load areas such as lobbies, entries, food courts, large glazed areas, and retail spaces will be cooled using air handling units or fan coil units dedicated to these areas. “Spot” cooling will be provided by fan coil units or air handling units cooling re-circulated air.
3. Offices: The various office and administrative areas will be served by VAV air handling systems. The units will have variable frequency drives on the supply fans and 100% air-side economizers.
4. Locker Rooms (NHL, NBA, Officials, Auxiliary, Staff, Visitors): The multiple locker rooms will be supplied by VAV air handlers. In Unoccupied Mode the air handlers will be capable of complete recirculation. In Occupied Mode the air handlers will provide 100% outside air (once-through system) with VAV reheat boxes for temperature control and VAV exhaust air boxes for exhaust air control. Both the supply and exhaust VAV boxes will be two-position control (constant volume) to allow shut down of individual spaces. The air handlers will also include the exhaust fans necessary to exhaust the once-through air in Occupied Mode. Additionally, the air handlers will house an energy-recovery enthalpy wheel, which will recovery energy from the exhaust stream during Occupied Mode. The air handlers will be located at the Event or Mezzanine Level.
   a. The Home and Visitor Hockey Locker Rooms will have an additional heating-only fan coil unit (“super heat unit”) capable of heating the space to 120ºF to dry out clothing and equipment.
5. Commissary/Kitchen: Provide a variable volume 4-pipe air handler with 100% economizer capability to serve this area. This air handling unit will be capable of providing make-up air for the cooking hoods.
6. Main Lobby: The Main Lobby will be served by a constant volume air handler with VFD for speed control and economizer controls for energy savings.
7. Suites: Each suite will be served by a 4-pipe fan coil unit.
8. Press Level: Provide individual wall mounted split systems for each booth/room.
9. Club Lounges: Each Club Lounge will be served by a dedicated, 4-pipe, single zone variable volume air handler.
10. Training and Hydrotherapy: Provide dedicated cooling/dehumidification units for each Hydrotherapy Room. Training Rooms will be served by the air handling systems serving the associated Locker Rooms.
11. Miscellaneous Areas: Some areas such as first aid, VIP Entries, pantries and trash rooms will receive small 4-pipe fan coils in the ceiling with outside air capability to provide comfort or cooling for these spaces. Isolated areas such as perishable storage rooms and basketball floor storage room shall be provided with cooling.

12. Electrical Rooms with Internal Heat Gain:
    a. Where main transformers are located in interior vaults they will be mechanically cooled with fan coils.
    b. Provide air handlers or fan coils with cooling coils to cool the main switchgear room(s).
    c. Refer to critical use areas below for quad electrical room requirements.

3.4 MISCELLANEOUS AIR HANDLING SYSTEMS FOR CRITICAL USE AREAS

A. Provide DX cooling only fan coils on emergency power for the following areas:
1. Emergency Electrical Room
2. Telecom Demarc Rooms
3. Elevator Machine Rooms
4. Food Service Server Room
5. Ticketing Server Room
6. Fire Pump Room
7. Press areas that include critical A/V equipment

B. Provide DX cooling fan coils with electric heat on emergency power for the following areas:
1. Security Command Center
2. Fire Command Center

C. Prove dedicated VRF systems on emergency power for all electrical and telecomm rooms. Each bank of electrical and telecomm rooms will be combined vertically with indoor units at each room and a common condensing unit on the roof.

D. Provide (2) 15 ton dedicated computer room type units for underfloor air distribution with chilled water cooling and humidification for the Data Center. In addition, provide (2) 15 ton dedicated computer room type unit for underfloor air distribution with DX cooling (remote condenser) and humidification for system redundancy in this room. The DX systems are on emergency power.

E. Provide (2) 15 ton dedicated computer room type units with chilled water cooling and electric heating for the Main Telecom Room. In addition, provide (2) 15 ton dedicated computer room type units with DX cooling (remote condenser) and electric heating for system redundancy in this room. The DX systems are on emergency power.

F. Provide (1) 10 ton dedicated computer room type unit with chilled water cooling and electric heating for the Head End Room. In addition, provide (1) 10 ton dedicated computer room type unit with DX cooling (remote condenser) and electric heating for system redundancy in this room.

G. Wireless Equipment Room. Provide (2) 25 ton dedicated computer room type units with chilled water cooling and electric heating for the Wireless Equipment Room. In addition, provide (2) 25 ton dedicated computer room type units with DX cooling (remote condenser) and electric heating for system redundancy in this room.

H. Provide a dedicated computer room air conditioning unit for the Scoreboard Control Room, 15-ton, and the Rack Room 10-ton, both on emergency power.

3.5 ALL NON-COOLED AREAS

A. Provide hot water unit heaters or cabinet heaters in all spaces that are on the perimeter wall and do not require cooling. These include storage areas and mechanical rooms.

B. Areas with air-cooled condensers will be ventilated via transfer air fans. This includes ceiling cavities above concession spaces.

C. Stairwells will be heated with cabinet heaters located at the lowest entry point.

D. Provide cabinet unit heaters in entry vestibules.

E. Loading Dock: Provide high capacity unit heaters and air curtains at the loading dock

F. Storage Rooms: Storage rooms will be ventilated with transfer fans and transfer openings.

3.6 BASEBOARD HEATING

A. Provide hydronic, finned tube baseboard heat at targeted locations along perimeter wall with large expanses of glass. These areas include drink rails and party deck locations adjacent to the glass. Assume completely enclosed finned tube with decorative extruded-aluminum enclosure. The enclosure will be specified as part of the curtain wall system where finned tube is integrated.

3.7 EXHAUST SYSTEMS

A. Provide exhaust systems for all public toilet groups and toilets in locker areas at the rate of 2.0 cfm per square foot.

B. Exhaust Locker Rooms at 1 cfm per square foot.

C. Provide miscellaneous exhaust for kitchen uses, laundry, janitor storage, carpentry and other areas which need air movement (but not necessarily heating), at a rate of 2.0 cfm per square foot.

D. Storage areas will be ventilated at 0.2 CFM/sf.

E. Provide carbon monoxide sensor controls for the exhaust fans serving the staging/marshalling areas on the Event Level.

F. General exhaust ductwork and fans are to be provided for each non-cooking concession stand. All non-cooking concessions will be exhausted at 2.0 cfm per square foot for cooling effect. Each exhaust system will serve the ceiling plenum space as well for heat rejection of equipment.

G. In cooking stands, provide supplemental transfer fans to ventilate the ceiling plenum for heat rejection from food service equipment.

H. Provide a full commercial exhaust and lint filter system for the laundry.

I. Provide general and emergency exhaust for the ice chiller plant room, per ASHRAE Standard 15.

3.8 EMERGENCY GENERATOR

A. A generator supplied by Division 16 will be an exterior generator unit with underslung fuel tanks.

3.9 LIFE SAFETY SYSTEMS

A. Provide a complete life safety system as required including, but not limited to, stairwell pressurization and building exhaust including all associated interlocks to the fire alarm system and Fire-Command Center.

B. All Life Safety Systems will be controlled by the Listed Fire Alarm System.

C. The stairwell pressurization system will include a pressurization fan for each stairwell, four total at 15,000 cfm each.

D. In general, the smoke exhaust system will include four zones; two concourse zones, a south lobby zone and a bowl zone.

E. The concourse exhaust systems serve the main and upper concourses and consist of the following:
   1. Four 50,000 cfm exhaust fans; one fan is located in each quadrant.
   2. The quadrant exhaust fans will be connected to the concourse return-air risers with smoke control dampers at all levels to control airflow movement.
   3. These fans will be used for relief air control and will have variable speed controllers and sound attenuators.

F. The south lobby smoke exhaust system consists of the following:
   1. Eight 50,000 cfm exhaust fans with variable speed controllers.
   2. Operable doors at the event level for makeup air supply.

G. The bowl smoke exhaust system consists of the following:
   1. Sixteen 50,000 cfm exhaust fans.
   2. Eight 50,000 cfm supply fans.
   3. Operable loading dock doors for makeup air supply (4 total.)
   4. These exhaust fans may also be used for pyrotechnic events and relief air control. Each fan will have a variable speed controller and sound attenuator.
   5. Locate the exhaust fans high within the trusses or on the roof.
   6. Locate the supply fans in mechanical rooms on the upper mezzanine level.

H. All Smoke Control System devices have override control at the Fire Fighters Control Panel (FFCP).

I. Stairwell pressurization systems will include fans with VFDs to use as balancing tools for locking in the pressurization set point. These VFDs will be specified without manual bypass switches to prevent over-pressurization.

3.10 KITCHEN GREASE EXHAUST SYSTEMS

A. NFPA 96 kitchen hood exhaust systems will be provided for connection to cooking hoods.

B. Fans will be inline, upblast or utility sets based on locations of the units. Fans shall be UL listed for kitchen exhaust application.

C. The systems shall be individual with no common or gathering ductwork systems, except for hoods in the same kitchen.

D. Ductwork will be wrapped with zero-clearance, 2-hour, UL rated, duct wrap.

E. Assume one 20,000 CFM grease exhaust system for the Central Commissary Kitchen.

F. Provide approximately eight 8,000-cfm and four 5,000-cfm grease exhaust fans and grease duct systems for exhaust hoods in cooking concession stands located around the arena.

G. Include an allowance for two connections at each cooking hood (stands and Kitchen).

3.11 MISCELLANEOUS REQUIREMENTS

A. Provide Vibration Isolators on all reciprocating or rotating equipment. Packaged fans, which are internally isolated with springs, do not require additional isolation. Provide spring and rubber-in – shear vibration isolation hangers for all suspended equipment of ½ HP or greater.

B. Provide identification of all equipment, control cabinets, ductwork, etc.

3.12 START-UP

A. Division 23 shall include services of factory-trained representatives for a period of at least ten (10) working days to supervise initial start-up and assist in necessary adjustments to place the equipment in operation.

B. In addition to start-up time, include additional five (5) days to train designated operation personnel to safely and properly operate and maintain the equipment.

C. Provide appropriate staff to support the full commissioning process required per the USGBC LEED program.

PART 4 - CONTROLS

4.1 GENERAL

A. A complete DDC, Building Management System (BMS) will be provided using electric dampers, motors, etc., for control.

B. The BMS will be provided under Division 23.

C. The BMS will be a direct digital electronic control (DDC) system. The BMS will be connected to the existing campus system for complete monitoring, scheduling, and control from both the building and the central campus control. All hardware and software used shall be compatible, and the system shall include a web based front end. The system shall consist of programmable control modules at the equipment, building control modules as needed, and a PC computer front end with the ability to communicate over a local area network and via the Internet.

D. All control valves, damper operators, and VAV box actuators will be Belimo (or equivalent) electronic actuators operated by a DDC control interface. All heating water and chilled water valves at the air handlers will have 2-way control valves.

E. The BMS system shall connect to major energy using HVAC and plumbing systems and components for control, scheduling, optimizing, recording, trending, maintenance management, trend logging, etc. The BMS will be easily programmable and provide flexibility to handle the intermittent use of the facility. Programmed sequences and schedules will maximize energy-efficiency within the facility.

F. The control systems shall meet the following overview intent:
   1. "The architecture of the system shall be fully open and seam-less. It shall be built around industry standards to meet today's needs of the proposed facility yet be able to accommodate the future. The system shall be modular and distributed in nature. The architecture shall be fault-tolerant so that no single point failure can bring down the whole system. Control strategies shall be contained in stand-alone controllers, independent from each other and the rest of the system. Despite independence, controllers shall share information or be directed by a supervising controller to handle exceptions. The system shall be easy to use and understand. The operator workstation shall include a full graphic user interface. The operator shall be able to command points from a "mouse" but also be able to extract management reports, live dynamic trend data, and historic information in the same way."

G. Coordinate the smoke control panel, which will be provided as part of the Listed Fire Alarm System. Coordinate appropriate graphics matched to the smoke control and stairwell pressurization systems described herein. This system shall provide the Fire Department with the capability to determine what portion of the system is automatic mode and allow them to control the system manually.

H. The control system shall re-boot after a power failure and resume normal activities.

I. The BMS shall have the ability to page an engineer on duty when there are certain alarm troubles, as designated by the operating staff.

J. The BMS shall include the main “front end” in the engineering offices as well as interface connections points at each level and at each equipment room.

K. The controls contractor will make available to the operating staff, training sessions designed to leave the operating staff with "hands-on" capability.

PART 5 - DESCRIPTION OF THE PLUMBING SYSTEM

5.1 GENERAL

A. Systems will be designed and installed in accordance with Local Building and Plumbing Codes, applicable standards, and County ordinances. Only approved materials and installation methods will be allowed. The Plumbing System includes:
   1. Domestic Cold Water System
   2. Domestic Hot Water System
   3. Sanitary Drainage System
      a. Includes condensate drainage
   4. Storm Drainage System
   5. Interface to sub-soil drainage system per Geotech requirements.
   6. Natural Gas System
   7. Carbon Dioxide Distribution Piping

B. No plumbing piping shall be installed above or in any electrical rooms, vaults or electrical spaces.

C. Provide adequate clearance for piping and equipment in all areas.

D. Domestic cold water, hot water, and hot water recirculation piping will be run to serve all equipment and fixtures as shown on the architectural drawings and program. The Plumbing Drawings further detail typical fixture configurations and piping, but the architectural drawings and program shall be utilized to determine actual fixture counts.

E. Where piping penetrates fire separations, an approved fire stopping installation shall be provided.

F. Domestic water piping shall be Type "L" hard copper tube third party certified. Joints shall be made with lead free solder. Piping over 2" shall be brazed or joined using Victaulic style roll groove couplings.
   1. As an alternative material, stainless steel will be allowed on pipe 3” or larger.

5.2 DOMESTIC COLD WATER

A. Provide a dedicated water service.
   1. The arena will have one 8" water service.
   2. Provide appropriate reduced pressure backflow prevention, meter and bypass arrangement assembly consistent with local water department requirements.
   3. The meter will be inside the building to prevent tampering.
   4. The piping will be sized for the peak usage expected in this facility; this peak will greatly exceed minimum code requirements.
      a. Assume 600-1000 GPM as the domestic water demand peak.

B. Provide a triplex booster pumping system to boost water pressure for 55-psi at most remote concession stand. A PRV station will be provided where pressures exceed 80-psi. One of the pump motors shall be on emergency power. The horsepower of the pumps will be evaluated once flow/pressure data is confirmed.
   1. Provide one low-pressure (80-psi) loop around the Mezzanine Level. This loop will serve the Event Level and Main Concourse.
   2. Provide one high-pressure (120-psi) loop around the Mezzanine Level. This loop will serve the levels above Main Concourse.

C. Interior cold water hose bibs with backflow preventers will be provided for mechanical rooms, staging/loading, etc. Provide recessed, cold water wall hydrants in all general public toilet rooms.

D. The system will be designed to prevent water hammer conditions by providing shock arrestors for quick closing valves.

E. Isolation valves will be provided for each group of fixtures.

F. All cold water piping will be insulated and covered with a fire retardant jacket.

G. Assume a reduced pressure backflow preventer is required for irrigation and will be provided by the Irrigation Contractor.

H. Drinking water will be provided by individual drinking fountains for all public areas. These fountains will be located throughout the building and will not be provided with chillers. Electric water coolers will only be provided at the Club Lounges, Suite Level, Locker Rooms, and Administrative Areas.

I. Provide a 2” water service to the Jet Ice System, which is provided by another Division.

J. Provide a water softener system to serve the 8” water service sized for a flow of 500 GPM

5.3 DOMESTIC HOT WATER

A. The central hot water system will include dedicated, gas-fired water heaters with associated storage tanks. The Event Level, Mezz Level and Main Concourse will be served from (2) 2,000 MBH input domestic water heaters coupled with (2) 1500 gallon vertical storage tanks.

B. Electric water heaters will be provided for all concessions above the Main Concourse. The public toilet rooms above the Main Concourse will also be served by electric water heaters.

C. Remote fixtures will be served by instantaneous water heaters.

D. Provide a 140°F main loop, with associated recirculation line, around the Mezzanine Level to serve all spaces up to and including the Main Concourse, including concessions. Tempering valves will be required where serving plumbing fixtures.

E. All hot water piping will be insulated and covered with a fire retardant jacket.

F. Hot water temperature will be maintained on long runs of distribution piping by use of hot water return circulation systems including a main recirculation loop at the Event Level.

G. The Zamboni Room will be provided with separate water heaters capable of producing 170ºF water for the Zamboni. Pre-heat for this hot water may come from an auxiliary condenser included on the ice-chiller skid. The heaters, as well as an R.O./Jet Ice System, will be provided as part of the Ice Plant/Ice Sheet Package. Refer to, “Part 9 – Ice Plant” herein.

H. Hot water shower heads will be provided in the ice melt pit.

5.4 SANITARY DRAINAGE SYSTEM

A. The sanitary sewer system will be a standard commercial grade system with schedule 40 cast iron waste and vent piping, heavy duty couplings.

B. Plumbing fixtures will be drained by gravity to five feet outside building where the Civil Division will connect the mains to service lines on the site. Adequate gradients will be maintained to ensure a self-cleansing velocity. Cleanouts will be provided per code.

C. Floor drains will be provided where required adjacent to equipment, in toilet rooms and in wet mechanical rooms. All floor drains and floor sinks except shower drains shall be equipped with trap primers. Insulate exposed sanitary lines feeding floor drains at ice dump locations.

D. Provide oil interceptors at escalator drains.

E. Provide sand/oil interceptor at the Dock.

F. Provide one 10,000-gallon below-grade grease interceptor. Route all grease waste from the Kitchens and Commissary through the grease interceptor.

G. Provide point of use grease traps at the three compartment sinks in concessions and pantries in lieu of routing through the central interceptor. To be confirmed with local jurisdiction.

H. A sump pump will be used to drain the Zamboni pit. Another will be located at the ice melt pit. Provide “Oil Minder” pumps at cast elevator sumps.

I. Provide drainage at the Zamboni parking area.

5.5 STORM DRAINAGE SYSTEM

A. The storm sewer system will be a standard commercial storm system with cast iron piping sized for the code-mandated per-hour (2") rainfall.

B. Roofs will be drained by gravity via roof drains through inside leaders and risers to site storm lines five feet outside the building. From this point, the Civil Division will route the mains to connection points on the site.

C. Overflow drainage will be through separate, overflow drains, leaders, and risers. Overflow risers will be routed to daylight through "lamb's tongue" outlets at grade.

D. All horizontal storm lines and other piping subject to "sweating" will be insulated for the entire length.

E. Piping will be cast iron or Schedule 10 galvanized steel. Heavy duty couplings.

F. Storm piping installation - Utilize heavy duty, 8 psi, no-hub couplings for cast iron. No-hub may only be used on piping within 20' below the roof. This limitation is to prevent a failure of the 8 psi rated couplings in the event of a downstream system blockage. Threaded or mechanical couplings with Schedule 10 galvanized piping are acceptable for all locations.

5.6 SUBSOIL DRAINAGE

A. Provide an allowance for a sump with a duplex pumping system piped to storm sewer.

5.7 NATURAL GAS SYSTEM

A. The gas meter and main pressure regulator will be located at the Dock. From the meter location, medium-pressure gas lines will be routed above grade to inside the building.

B. Inside the building, the natural gas system shall consist of a gas main distributed around the Event Level with risers and laterals routed to locations requiring natural gas. The distribution pressure will be 5-psig. Gas-fired equipment and service includes:
1. Domestic water heaters
2. Zamboni water heaters
3. Laundry
4. Cooking equipment at the Kitchen and Concessions
5. Desiccant reactivation

C. Above ground piping shall be Schedule 40 Black steel pipe with 150 pound malleable screwed fittings. Provide welded fittings on concealed pipe located in return air plenums.

D. Any required pressure regulating valves (PRVs) shall be vented to the outdoors as required by local code. Vents from PRVs shall be increased one pipe size for each 50 feet of run.

E. Vent limiting devices on PRVs shall not be allowed on indoor locations unless specifically approved by the local AHJ.

5.8 CARBON DIOXIDE DISTRIBUTION SYSTEM

A. Furnish and install a complete, fully-operational carbon dioxide (CO_2) distribution system to serve all CO_2 usage points in the arena.

B. The system shall serve all Food Service areas including but not limited to concessions, bars, pantries, kitchens, and beer storage rooms.

C. Include all piping, fittings, and associated components to form a complete, low-pressure distribution system. Liquid CO2 storage tanks, heaters, and liquid CO2 filling ports will be furnished and installed by the CO2 supplier and are not part of this specification.

D. All piping shall be type K copper. Provide a 1" horizontal distribution loop around the Event Level, 3/4" risers in each quad, 3/4" horizontal distribution at each level in each quad, and 1/2" branches. All joints shall be brazed; use a nitrogen purge during brazing. All drops shall include an isolation valve at the start of the drop, a hi-flow regulator with gauge, a check valve, and a shut off valve at the terminus of the drop. Additional isolation valve shall be provided at every tee and at the start of each riser.

E. The completed piping systems shall be cleaned and tested for impurities prior to use. All piping shall be labeled per the requirements and standards for this project.

F. Refer to the Food Service narrative for additional requirements.

5.9 PLUMBING FIXTURES

A. Assume the plumbing fixtures will be per code requirements for the various spaces and per the occupant load outlined in the architectural package.

B. Provide standard commercial quality materials and methods for the public areas. Higher quality fixtures shall be provided in the Suites and Clubs.

C. Assume the following:
1. Wall-supported, wall outlet water closets with battery powered 1.28 GPF low-flow flush valves in public spaces.
2. Individual urinals with battery powered .125 GPF low-flow flush valves in public spaces.
3. Wall-mounted lavatories in public toilets battery powered .5 GPM faucets.
4. Higher end space lavatories will have counter mounted bowls and battery powered .5 GPM faucets
5. Locker room area lavatories will have counter mounted bowls with manual .5 GPM faucets
6. Bar sinks in suites.
7. Stainless steel kitchen and bar sinks.
8. Non-refrigerated stainless steel drinking fountains in all public spaces and stainless steel refrigerated water coolers in all team and private patron spaces. Water coolers and drinking fountains to be stainless steel.
9. Showers will include balanced pressure mixing valves with 1.5 GPM flow restrictors in the heads.
10. Hose bibs connected to the buildings potable water system will be provided throughout the building utility areas including recessed wall hydrants around the exterior perimeter and at the truck dock adjacent to the dumpster area.
11. Emergency showers and eye wash stations will be provided for hazardous areas in machine rooms.

D. Fixtures will be provided with chromium plated brass trim and individual stop valves.

E. Appropriate "Barrier Free" fixtures will be provided in accordance with ADA requirements.

F. All accessible hand wash faucets will be provided with an ASSE 1070 approved tempering valve.

G. All fixtures and valves in contact with the domestic water system shall comply with NSF 71

5.10 CONCESSION SERVICES

A. The following utilities are identified for planning and early costing exercises.

B. The following utility services should be planned for concession stands.
1. Assume a 4” sanitary sewer service at each stand.
2. All fixtures/drains receiving grease waste will route through a central grease interceptor.
3. If allowed by local jurisdiction, utilize point of use grease traps at the three compartment sinks in lieu of routing stand to the central interceptor
4. 1-1/2” water service.
5. 1-1/2” hot water service from the central domestic hot water system.
6. 500 MBH gas service at cooking stands.

C. The following utility services should be planned for Commissary Kitchen.
1. Assume a 6” sanitary sewer service.
2. Assume 4” grease waste service.
3. 2” water service.
4. 2” hot water service from the central domestic hot water system.
5. 2,500 MBH gas service.

5.11 START-UP SERVICES

A. Division 22 shall include services of factory-trained representatives for a period of at least seven (7) working days to supervise initial start-up and assist in necessary adjustments to place the equipment in operation.

B. In addition to start-up time, include additional two (2) days to train operation designated personnel to safely and properly operate and maintain the equipment.

C. Plumbing start-up services shall be included for each of the following:
1. Domestic water booster pumps
2. Water Heaters

D. Provide appropriate staff to support the full commissioning process required per the USGBC LEED program.

PART 6 - FIRE PROTECTION

6.1 FIRE PROTECTION SUMMARY

A. The Fire Protection systems will be designed to conform, as a minimum, with the following codes and standards:
1. Drawings and documents produced by Populous.
2. The International Building Code (IBC), 2012 Edition.
3. The National Fire Protection Association (NFPA), Latest Edition.
4. The National Electrical Manufacturers Association (NEMA).
5. American Society for Testing Materials (ASTM).
6. American National Standards Institutes (ANSI).

7. American Water Works Association (AWWA).
8. Underwriters Laboratories (UL).

B. Sprinkler Systems Design Criteria:
1. The building sprinkler systems will be hydraulically calculated to meet the coverage classifications as described herein.
2. The installing contractor will provide the sprinkler system design layout and hydraulic calculations in accordance with design specifications. The installing contractor will become the Engineer of Record for the fire protection system. All routing of sprinkler piping will be pre-approved by Populous and M-E Engineers, Inc., during the shop drawings phase.
3. Sprinkler systems will be zoned per quadrant and per floor with additional zones to match the smoke control system zones.

6.2 FIRE PROTECTION SYSTEM DESCRIPTION

A. Building Fire Sprinkler and Standpipe System:
1. Provide a fire protection system consisting of a fully sprinkled building and combination Class I standpipes installed per Fire Department requirements.
2. Design the sprinkler system for Hazard Classifications in conformance with NFPA. Refer to the project specifications for sprinkler densities, which may exceed NFPA occupancy requirements.
3. Provide a 1,250-gpm electric fire pump, and an associated jockey pump, conforming to the requirements of the AHJ. Provide a test header.
4. Provide on-site fire water tank(s) as required by local Codes.
5. Standpipes shall conform to NFPA 14 requirements including but not limited to:
    a. Drain line.
    b. Outlets (2-1/2") located at (to be confirmed with AHJ):
        1) Inside the stairwell at each intermediate floor landing.
        2) Each side of a horizontal exit.
        3) The roof.
        4) Top of most remote standpipe for testing.
        5) One at each "corner" of the Event Level for use on the floor.
        6) Other locations required by the AHJ.
        7) Pressure reducing valves where required.
        8) Provide system to maintain flow and pressure requirements per NFPA.
6. Provide wet sprinkler system throughout the building. Sprinkler heads shall be concealed type in all finished areas and upright type in open ceiling areas. Where located in ceiling tile systems, center sprinkler heads in the ceiling tile. All heads shall be quick-response.
7. Assume a fully sprinklered bowl until such time as the AHJ approves elimination of heads.
8. Provide a complete dry-pipe system in interior dock area to prevent accidental discharge from freeze-up conditions.
9. Provide Pre-Action and dry chemical (i.e. FM-200) systems at the following locations:
    a. Main Telecom Room
    b. Scoreboard Control Room and Amp Room
    c. TV Truck Head End Room
    d. Data Center
    e. Wireless Equipment Room
10. Branches to individual sprinkler zones will be provided with monitored control valves and water flow switches as well as a system drain/test connection. All control valves and water flow switches will be annunciated at the life safety control panel.
11. All isolating and sectionalizing valves on the fire protection system will be provided with tamper switches that will be annunciated at the life safety control panel.
12. Fire extinguishers will be provided by others and located throughout the building. Make provisions for hose valve cabinets to hold an extinguisher. Coordinate with the Architect.

13. Pedestal-type or surface-mounted Fire Department Connection(s) will be provided at the building's exterior in accessible areas to enable the Fire Department to pump water directly into the system. Assume multiple locations on opposite sides of the arena.
14. Meet all the requirements of the local water department.

6.3 PIPE AND FITTINGS

A. Pipe
1. All wet sprinkler piping above grade will be s10 or s40. The use of threadable lightwall pipe with a corrosion resistance rating (CR) less than 1.0 will not be permitted.
2. All dry sprinkler piping will be schedule 40, galvanized.
3. All sprinkler piping exposed to the public will be painted as directed by the Architect. Dry pipe piping will be painted with an epoxy-based paint.
4. All underground piping will be cement lined, ductile iron pipe, wrapped in a full polyethylene sleeve. Additional precautions as may be required for cathodic protection will be applied.

B. Fittings
1. Fittings for above-ground pipe less than 1-½" will be threaded. Fittings for above-ground pipe 1-½" and larger will be threaded or grooved.
2. The use of grooved end fittings will be limited to one manufacturer. Due to recent history of failures, it is recommended that all grooved end fittings be proprietary to United States manufacturers only.
3. The use of press-fit or compression type fittings will not be permitted. The use of mechanical tees will not be permitted.

C. Underground pipe fittings will be in accordance with NFPA 24.

PART 7 - TESTING AND BALANCING

7.1 GENERAL

A. Fully tested and balanced systems will be provided that include the following:
1. Water balancing (domestic, chilled, heating). Include balancing of all PRVs on the domestic water system.
2. Air balancing including bowl diffusers, which requires careful sequencing and planning during construction.
3. Control system functional testing including testing of all VAV boxes, thermostats, chilled water and heating water systems, generator, fire pumps, alarms, etc.
4. Domestic water pump start up.
5. Water treatment results testing.
6. Monitoring of pipe and duct pressure testing.
7. Life Safety Systems testing.
8. Code required testing.
9. Other tests as are considered industry standard.

B. Testing and balancing will be performed by an independent firm specializing in this work with a Registered Professional Engineer in charge of the work. T&B firm shall provide a certified test and balance report sealed by a professional engineer registered in the State of Washington.

C. Test certificates, forms, charts, logs, etc., will be provided for record.

D. Balancing reports will be provided for record and reference.

E. Periodic call backs for re-testing during 1st year are to be included. Include two specific calls back, at the Owner's discretion, to adjust bowl diffusers after several events.

F. Test and balance contract to be held with General Contractor.

G. The installing contractor will perform other tests, including:
   1. Pipe pressure testing.
   2. Duct pressure testing.
   3. Code required testing.

PART 8 – MECHANICAL SPECIFICATIONS

8.1 DUCTWORK

A. Ductwork will be constructed, installed, and tested in accordance with SMACNA standards. Ductwork shall be galvanized sheet metal. Round ductwork shall be with a spiral seam. Longitudinal seams, knock down, fiberglass ductboard or flexible duct over 8 feet will not be allowed. Rectangular duct shall be constructed with standing seam, braced per SMACNA. Ductmate fittings (or approved equal) are allowed. Install all ductwork upstream of VAV boxes to +4" wc (medium pressure). Ductwork downstream of VAV boxes will be constructed to +2" wc. Construct return and exhaust duct to -2" wc.

B. Grease Exhaust Ductwork; welded black steel.

C. Aluminum duct for exhaust at Locker Rooms. Welded stainless steel duct for dishwasher exhaust.

D. Bowl Ductwork; Double wall with 2" insulation and perforated inner wall.

8.2 INSULATION

A. Piping and ductwork insulation, materials, and thickness will comply with the requirements of ASHRAE 90.1 - 2010.
   1. Insulation will be finished with all-purpose jacket where it is within mechanical rooms, service rooms, shafts and ceiling spaces (i.e., where concealed from public view). Insulation shall be installed to prevent condensation forming on all piping and ductwork.
   2. Where exposed to public view, insulation shall have an additional UL approved fabric jacket over the all-purpose jacket with pre-molded PVC covers over fittings. Piping located outside shall have an aluminum jacket.
   3. All rectangular supply and return ductwork and the bowl ductwork will be internally lined for acoustic attenuation.
   4. Other round duct shall be wrapped unless it is exposed to view. If exposed to view, provide internal liner.
   5. All outside air duct to be wrapped.

B. Cold Plumbing Locations:
   1. All domestic cold water piping will be insulated.
   2. All cooling coil condensate pans and drains will be insulated and include a continuous vapor barrier.
   3. Roof hoppers, and vertical and horizontal storm drains will be insulated.
   4. Sump pump discharge lines that pass through ceiling spaces will be insulated.

C. Hot Plumbing Locations:
   1. All domestic hot water, tempered water, and hot water re-circulation piping will be insulated.
   2. Run outs from mixing valves to shower heads will be insulated.

D. HVAC piping and equipment will be insulated. Provide extra layer of insulation and aluminum jacket on any piping located outside.

E. Wrap grease duct with 2-hour, zero clearance fire-rated wrap.

F. Plumbing Equipment Insulation:
   1. Domestic hot water storage tanks will be insulated with 2" thick J-M thermo-12 blocks or 2" thick fiber glass AF-570. Finish with ½" thick insulating cement and canvas with flintguard #120 white fire retardant lagging adhesive.

8.3 PIPING

A. Storm, sanitary, and vent piping – cast iron.

B. Water piping – copper or stainless steel.

C. Chilled water and hot water – steel or copper, welded. (Victaulic not permitted.)

D. Natural Gas – Schedule 40 black steel.

PART 9 – ICE PLANT

9.1 ICE PLANT AND ICE SHEET SYSTEM DESCRIPTION

A. The ice plant will provide temperature control for the ice sheet. The ice plant shall be designed for ice surface temperatures of approximately 18ºF.

B. Provide both overhead infrared and in-slab ice sheet temperature sensors. The ice plant is designed for a non-low-e ceiling.

C. A refrigeration skid or commercial chiller system will be provided. This system will include three compressors or chillers in accordance with NHL standards. 300-ton output capacity at 5F evaporator temperature and 100F condensing temperature. Chiller shall consist of two, flooded, shell and tube heat exchangers; 200 tons each.
   1. Option 1 is for a custom refrigeration skid.
   2. Option 2 is for commercial screw chillers, Trane.

D. Provide two cold glycol pumps (one pump 100% standby) to serve the ice sheet. Pumps arranged in lead/lag configuration with automatic changeover upon lead pump failure.

E. Provide two condensers sized at 200 tons each. The condensers shall be piped to a stand-alone evaporative condenser for heat rejection.

F. Provide two (one is 100% backup) condenser water pumps each sized for one 200 ton condenser.

G. Provide a glycol-to-heating water heat exchanger, for quick ice removal, at 7,000 MBH.

H. Provide a reverse osmosis (RO) water conditioning system for the resurfacing equipment. Provide two, gas-fired water heaters to heat treated water. Provide a hot water and cold water mixing valve to serve the RO system. Heat exchangers for heating of treated water are not acceptable.
   1. Alternate: Two electric water heaters.

I. NHL ice sheet piping:
   1. 1-1/4 inch schedule 40 steel pipe, meeting STM S53, will used for the NHL ice sheet.
   2. Headers and main piping to be steel.
   3. Ice sheet piping to be 4 inches on center. Pipe chairs at 6-feet on center.
   4. Ice sheet headers to be 10 inch.

J. The glycol solution will be composed of 40% ethylene glycol. Provide a cold glycol and a warm glycol expansion tank.

K. Heat recovery will be used for under-slab heating, the Zamboni snowmelt pits and domestic water preheating. Provide a preheat tank with a heat recovery exchanger in the ice chiller plant.

L. Domestic hot water will be provided, via shower heads, in the ice melt pit for quicker melting.

M. A submerged heat exchanger will be provided in the Zamboni pit (snowmelt pit) for snow melting, served via the hvac heating water system.

N. The electrical service to the ice sheet refrigeration system shall include both a normal power and an emergency power feed. All equipment provided as part of ice system to be served from this electrical service.

O. The following equipment shall be served by emergency power:
   1. One cold glycol primary pump.
   2. One condenser water pump.
   3. One ice chiller.
   4. Two cold glycol pumps.
   5. One heat recovery pump.
   6. Control system.

P. Provide concrete floor, floor insulation and under-floor sand for the rink slab.
   1. 8” concrete floor, with a minimum of 1-3/4 inch of concrete above the rink piping.
   2. 5,000-psi concrete leveled to a tolerance not exceed +/-3/16 inch.
   3. Reinforced with #5 bars at 12 inch centers in both directions.
   4. Two layers of 2” (4” total) high-load rigid insulation with a 6 mil vapor barrier.
   5. 12 inch sand fill.
   6. Refer to ice system sheets for additional details and information.

PART 10 – ESTIMATED PRELIMINARY UTILITY LOADS

10.1 GENERAL

A. The following is an estimate of preliminary utility requirements to serve this building. It is based on M-E Engineer's understanding of the current (conceptual) program and preliminary drawings. Any pricing exercise or cost estimate should be based on complete distribution of these utilities to the various areas of the building depicted on the drawings, in accordance with the scope of work outlined above.
   1. Domestic Water: Peak Demand: 1,000 gpm.
   2. Sanitary Sewer: Peak flow: 1.8 cfs.
   3. Storm Water: 16.25 cfs during a 100-year storm.

4. Fire Protection: 1,250-gpm.
5. Natural Gas: 51,000 MBH.
6. Two 10,000 – gallon grease interceptors
7. Chilled Water:
   a. 2,000-tons
   b. 4,800-gpm
8. Heating Water:
   a. 18,000 MBH
   b. 1,200-gpm

PART 11 – SPECIFIC HVAC SYSTEM NOTES

11.1 GENERAL

A. HVAC options listed as *under consideration* are not included for "base" pricing and are intended as items for discussion.

11.2 SPECIFIC SYSTEM DETAILS

A. HVAC System Options under consideration:
   1. The use of a 30% propylene glycol solution in chilled and heating water in lieu of integral coil circulation pumps and associated controls sequences for freeze protection.
   2. The installation of a standalone chilled water plant within the arena or adjacent parking garage. Total capacity estimated at 2,000 tons. (Heating to remain as supplied by campus system.)

PART 12 – ENERGY CONSERVATION MEASURES

12.1 GENERAL

A. All systems will be designed to reduce the consumption of energy and operate as efficiently as possible.

B. Energy conservation measures listed as *under consideration* are not included for "base" pricing and are intended as items for discussion and review.

12.2 SPECIFIC SYSTEMS

A. Energy conservation features include the following:
   1. Air handling systems with full air-side economizer operation permitting "free cooling" when outside air temperatures are suitable.
   2. Variable air volume supply systems for areas with diverse utilization.
   3. Computer based BMS with sequencing to optimize the operation of mechanical systems. Programs will include, but are not limited to:
      a. Economizer optimization
      b. Demand limiting
      c. Optimized start-stop of all equipment
      d. Occupancy setpoints based on actual planned programs
      e. VAV controls
      f. Pump and fan speed controls

g. Supply air temperature reset
h. Energy recovery controls

4. Demand controlled ventilation.
5. Fan powered VAV boxes designed to recapture plenum heat to minimize “reheat.”
6. ECM motors on fan powered boxes.
7. Variable speed pumping.
8. Metered faucets.
9. Heat reclaim from ice sheet chillers.
10. Energy recovery wheels on the Locker Room air handlers.

END OF MECHANICAL NARRATIVE