Feasibility Report

Schmitz-Maki Ice Arena – Ice System Replacement

City of Farmington

January 27, 2010

Project Number 000141-09316-0

Bonestroo

2335 Highway 36 W
St. Paul, MN 55113

Tel 651-636-4600
Fax 651-636-1311

www.bonestroo.com

January 27, 2010

Bonestroo

Honorable Mayor and City Council
City of Farmington
430 Third Street
Farmington, MN 55024

Re: Schmitz-Maki Ice Arena – Ice System Replacement
City of Farmington
Bonestroo File No.: 000141-09316-0

Dear Mayor and Council:

Enclosed for your review and consideration is the Project Feasibility Report for the Ice System Replacement at Schmitz-Maki Ice Arena. The proposed project consists of replacement and renovation of the ice rink floor, refrigeration system, dasherboards, and dehumidification system.

This report includes our analysis and recommendations for system types, as well as estimated costs of the systems.

We would be pleased to meet with City Council and Staff to discuss the improvements identified in this Feasibility Report at your convenience.

Sincerely,

BONESTROO

Gary D. Kristofitz, P.E.
Project Manager

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Gary D. Kristofitz, P.E.

Date: January 27, 2010 Reg. No.: 22090

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Introduction

The City of Farmington authorized the preparation of this report on December 23, 2009 to determine the feasibility of options for replacement of the ice systems at Schmitz-Maki Ice Arena.

The Arena was constructed by the City of Farmington in 1975, and the majority of the ice and mechanical systems constructed at that time are still in use. Although the existing systems were constructed using high quality components, the normal lifespan of 25 to 30 years for this type of equipment has been exceeded, and the replacement or renovation of many components is required at this time.

The City would like to demolish all or portions of the existing ice and mechanical systems, and replace them with new modern, reliable systems and components that will operate efficiently, with minimal need for maintenance. The City is also currently considering the construction of one or two new indoor ice rinks to be located at another site. The decided course of action on that project could influence the scope of work that is performed at Schmitz-Maki Arena.

The specific ice and mechanical systems that are within the scope of this feasibility study include:

- The NHL regulation size (85 ft x 200 ft) ice rink floor
- The mechanical refrigeration system that cools the ice rink floor
- The ice rink dasherboards
- The arena dehumidification system

The purpose of this report is to detail the proposed improvement options and to provide estimates of cost to assist the City in determining the feasibility of the proposed project.

Discussion

BACKGROUND

The existing ice rink system (rink floor and refrigeration plant) is a Holmsten Direct Liquid Refrigeration (DLR) system, which circulates cold Freon R-22 refrigerant directly through steel pipes in the concrete surface rink floor. Holmsten Ice Rinks was a St. Paul company that installed hundreds of similar DLR rink systems around the world between 1966 and the early 1990's. The DLR systems are noted for their excellent ice quality and high energy efficiency. Holmsten Ice Rinks also supplied and installed the ice rink dasherboards and the dehumidification system that currently exist in the arena.

ICE RINK FLOOR IMPROVEMENTS

EXISTING RINK FLOOR

The existing ice rink floor consists of a 5" thickness reinforced concrete slab with 5/8" O.D. steel tubing at 4" on center spacing. 4" and 2" steel headers are located at the ends of the rink, and are used to evenly distribute the R-22 refrigerant into the nearly 10 miles of floor tubing.

The floor section below the concrete rink slab includes two layers of foam insulation, a vapor barrier, and a sub-floor heating piping system surrounded by sand fill. The sub-floor heating system consists of ¾" diameter poly tubing at 18" on center spacing, fed by 2-1/2" diameter PVC headers. The sub-floor heating system is not operating at this time due to a piping leak beneath the rink that occurred many years ago. Repairs to the sub-floor heating system would have required expensive removal and replacement of portions of the ice rink floor.

The refrigerated rink floor is currently performing acceptably, and there is no visible heaving caused by frozen sub-soils, which can occur when there is not an operational sub-floor heating system. The steel rink floor piping has, however, begun to develop leaks, including recent leaks that resulted in the loss of 3,900 pounds of R-22 refrigerant. Ongoing corrosion of the thin-wall steel piping will likely result in more frequent and more significant leakage in the future.

RINK FLOOR REPLACEMENT OPTIONS

Six options are identified for improvements to the ice rink floor. All options are NHL regulation size 85'-0" width by 200'-0" length, with 28'-0" radiused corners. All options also provide for mounting of the dasherboards on the rink perimeter slab rather than directly onto the refrigerated rink surface. Mounting of the dasherboards on the rink floor would provide better ice quality on the edges of the rink, but would require major demolition and reconstruction of the concrete floors and bleachers outside the rink. All options also include a subsoil heating system consisting of 1" polyethylene piping at 18" spacing, located within a 6" depth sand layer below the rink floor insulation layer. The six options identified for replacement of the ice rink floor are as described below. The costs estimated for all options include removal and disposal of the existing rink floor, all installation costs, and a 5% contingency factor:

A. Concrete rink floor with indirect style 1" polyethylene piping.

Rink section to consist of the following:

- 5-1/2" thickness concrete, reinforced with No. 4 rebar and wire mesh, with a smooth-troweled surface.
- Refrigeration piping within the concrete floor to be 1" polyethylene piping at 4" spacing, fed by 8" polyethylene header pipes located at the center of the rink. All piping connections to be fusion welded to reduce leakage potential.
- 3" of rigid foam insulation with a 6 mil poly vapor barrier.

Comments:

- Concrete surfaced rink floor allows multi-use of the arena space when ice is not in place, and reduces maintenance and ice-building labor expenses each year.
- Polyethylene piping provides acceptable heat transfer for community rink applications at reasonable cost. Polyethylene is highly resistant to corrosion, and fusion welded joints are leak free.

Estimated construction cost of Rink Floor Replacement Option A is $450,000.

B. Sand rink floor with indirect style 1" polyethylene piping.

Rink section to consist of the following:

- 2-1/2" thickness sand surfacing.
- Refrigeration piping within the concrete floor to be 1" polyethylene piping at 4" spacing, fed by 8" polyethylene header pipes located at the center of the rink. All piping connections to be fusion welded to reduce leakage potential.
- 3" of rigid foam insulation with a 6 mil poly vapor barrier.

Comments:

- Sand surface rink floor provides ice quality equal to concrete floor, at lower initial cost.
- Polyethylene piping provides acceptable heat transfer for community rink applications at reasonable cost. Polyethylene is highly resistant to corrosion, and fusion welded joints are leak free.

Estimated construction cost of Rink Floor Replacement Option B is $410,000.

C. Concrete rink floor with indirect style 1" steel piping.

Rink section to consist of the following:

- 5-1/2" thickness concrete, reinforced with No. 4 rebar and wire mesh, with a smooth-troweled surface.
- Refrigeration piping within the concrete floor to be 1" diameter schedule 40 steel piping at 4" spacing, fed by 8" steel pipes located at the center of the rink. All piping connections to be welded.
- 3" of rigid foam insulation with a 6 mil poly vapor barrier.

Comments:

- Concrete surfaced rink floor allows multi-use of the arena space when ice is not in place, and reduces maintenance and ice-building labor expenses each year.
- Steel piping provides exceptional heat transfer and improved ice quality, but at substantially increased installation cost. Steel is subject to corrosion if improperly installed or operated.

Estimated construction cost of Rink Floor Replacement Option C is $619,000.

D. Sand rink floor with indirect style 1” steel piping.

Rink section to consist of the following:

- 2-1/2” thickness sand surfacing.
- Refrigeration piping within the concrete floor to be 1” diameter schedule 40 steel piping at 4” spacing, fed by 8” steel pipes located at the center of the rink. All piping connections to be welded.
- 3” of rigid foam insulation with a 6 mil poly vapor barrier.

Comments:

- Sand surface rink floor provides ice quality equal to concrete floor, at lower initial cost.
- Steel piping provides exceptional heat transfer and improved ice quality, but at substantially increased installation cost. Steel is subject to corrosion if improperly installed or operated.

Estimated construction cost of Rink Floor Replacement Option D is $577,000.

E. Concrete rink floor with direct style 5/8” stainless steel piping.

Rink section to consist of the following:

- 5-1/2” thickness concrete, reinforced with No. 4 rebar and wire mesh, with a smooth-troweled surface.
- Refrigeration piping within the concrete floor to be 5/8” diameter stainless steel piping at 4” spacing, fed by 4” and 2” steel pipes located at the ends of the rink. All piping connections to be mechanical joints.
- 3” of rigid foam insulation with a 6 mil poly vapor barrier.

Comments:

- Concrete surfaced rink floor allows multi-use of the arena space when ice is not in place, and reduces maintenance and ice-building labor expenses each year.
- The combination of the direct refrigeration process and the use of stainless steel piping provides exceptional heat transfer and improved ice quality, but at increased installation cost. Although the stainless steel piping is not subject to corrosion, the long term leak potential of the mechanical joints is unknown.
- Direct piping system requires large quantities (approximately 5,000 pounds) of R-22 refrigerant to operate. The manufacture of R-22 has ceased due to environmental concerns, and the price of R-22 will continue to increase as stockpiled supplies are reduced.
- There is currently only one contractor in the United States who is experienced with the use of stainless steel piping for a direct style rink floor. Multiple competitive bids would be difficult to obtain.

Estimated construction cost of Rink Floor Replacement Option E is $525,000.

F. Sand rink floor with direct style 5/8" stainless steel piping.

Rink section to consist of the following:

- 2-1/2" thickness sand surfacing.
- Refrigeration piping within the concrete floor to be 5/8" diameter stainless steel piping at 4" spacing, fed by 4" and 2" steel pipes located at the ends of the rink. All piping connections to be mechanical joints.
- 3" of rigid foam insulation with a 6 mil poly vapor barrier.

Comments:

- Sand surface rink floor provides ice quality equal to concrete floor, at lower initial cost.
- The combination of the direct refrigeration process and the use of stainless steel piping provides exceptional heat transfer and improved ice quality, but at increased installation cost. Although the stainless is not subject to corrosion, the long term leak potential of the mechanical joints is unknown.
- Direct piping system requires large quantities (approximately 5,000 pounds) of R-22 refrigerant to operate. The manufacture of R-22 has ceased due to environmental concerns, and the price of R-22 will continue to increase as stockpiled supplies are reduced.
- There is currently only one contractor in the United States who is experienced with the use of stainless steel piping for a direct style rink floor. Multiple competitive bids would be difficult to obtain.

Estimated construction cost of Rink Floor Replacement Option F is $485,000.

ICE RINK REFRIGERATION SYSTEM IMPROVEMENTS

EXISTING REFRIGERATION SYSTEM

The existing direct Holmsten DLR refrigeration system consists of the following major components:

- Two 6-cylinder York RS64A compressors with 75 HP high efficiency electric motors. The motors are not original equipment.
- Low pressure receiver vessel.
- Two pumping vessels.
- Electrical power/control panel.
- Structural steel skid, mounted on a concrete isolation pad.
- Subsoil heating equipment, including a heat exchanger, circulation pump, and expansion tank. The subsoil heating equipment is currently inoperative.
- The original evaporative condenser was replaced in 2008 with a Baltimore Aircoil Model VC1-110 evaporative condenser. The condenser water pump and chemical treatment system were also replaced at that time.
- All refrigeration piping is welded steel.
- Although a snowmelting pit was provided inside the adjacent ice resurfacer room, the snow melting system to melt resurfacer shavings using waste compressor heat was inadequately sized, and was removed several years ago. Resurfacer shavings now therefore must be dumped in stockpiles outside the building, to melt naturally.

The existing refrigeration system is in acceptable operating condition, but has experienced several R-22 leaks in the past. The condition of many components cannot be determined accurately without disassembly of components and removal of insulation covering. The refrigeration plants' electrical usage varies, but averages $2,500 per month during the 7 month season, for a total yearly usage of approximately $17,500.

REFRIGERATION SYSTEM REPLACEMENT OPTIONS

Based on conversations with City administrative and maintenance staff, six styles of refrigeration equipment packages were selected for analysis, as further described below. The costs estimated for all options include removal and disposal of the existing refrigeration system components, all installation costs, and a 5% contingency factor:

A. Ammonia Indirect Refrigeration, Industrial Quality Components.

Major equipment components include:

- All components to be sized to provide 100 tons refrigeration capacity, using ammonia as the primary refrigerant and calcium chloride brine as the secondary refrigerant
- Two industrial quality open reciprocating compressors, each equipped with a high efficiency electric motor, oil separator, and microprocessor controller.
- Flooded chiller vessel with surge drum, receiver vessel, and electronic level controller.
- Utilize existing evaporative style condenser, indoor remote sump tank, and pump.
- Two centrifugal pumps used to circulate chilled brine through the ice rink floor. One pump is run at a time, with the second pump serving as backup.
- A supplemental heat system will use waste heat generated by the compressors for heating of the rink sub-soil and the snowmelt pit. Separate shell and tube heat exchangers and pumps will be provided.
- A 1,000 gallon polyethylene water tank will be provided for termination of pressure relief valves, as required by Code.

Comments:

- Although lower in efficiency than a direct refrigeration system, ammonia provides the best possible efficiency for an indirect system.
- Industrial quality equipment has a long lifespan – typically 30 years or more.
- Ammonia is completely environmentally friendly. In the event of a leak, the ammonia soon breaks down to inert substances.
- Due to its' toxic nature, alarm and safety systems must be installed, operators must be well trained, and equipment must receive regular maintenance.
- The material cost of ammonia is very low, and its price will never increase substantially.
- A 1,000 gallon poly disbursement tank is required for an ammonia refrigeration system. Since the existing equipment room is not adequately sized to contain the tank, it will be necessary to install the tank in the adjacent First Aid Room.
- The walls, ceiling, and doors of the equipment room must be upgraded to a 1-hour fire rating for ammonia use.

  Estimated construction cost of Refrigeration System Option A is $460,000.

  Total estimated electrical usage for the refrigeration plant is $20,000 for a 7 month season.

B. R-22 Indirect Refrigeration, Industrial Quality Components

Major equipment components include:

- All components to be sized to provide 100 tons refrigeration capacity, using R-22 (Freon) as the primary refrigerant and ethylene glycol as the secondary refrigerant
- Two industrial quality open reciprocating compressors, each equipped with a high efficiency electric motor, oil separator, and microprocessor controller.
- Flooded chiller vessel with surge drum, receiver vessel, and electronic level controller.
- Utilize existing evaporative style condenser, indoor remote sump tank, and pump.
- Two centrifugal pumps used to circulate chilled glycol through the ice rink floor. One pump is run at a time, with the second pump serving as backup.
- A supplemental heat system will use waste heat generated by the compressors for heating of the rink sub-soil and the snowmelt pit. Separate shell and tube heat exchangers and pumps will be provided.

Comments:

- Although lower in efficiency than a direct refrigeration system or ammonia, R-22 provides very good efficiency (approximately 5% less than ammonia) and has a good track record for use in low-temperature refrigeration.
- Industrial quality equipment has a long lifespan – typically 30 years or more.
- R-22 is generally not considered to be environmentally friendly, particularly in regards to its potential to increase global warming. The EPA has R-22 on its phase out list, and regulations are in place to severely limit its use.
- The price of R-22 has doubled over the last few years, and future larger price increases are guaranteed.
- The existing refrigeration system contains over 5,000 pounds of R-22. That material may be used in a new or renovated system, and sufficient quantity of R-22 may be stored in tanks for future use.
- R-22 is non-toxic, however a large leak can cause the displacement of oxygen in the equipment room. Leakage detection and alarm systems are required.

Estimated construction cost of Refrigeration System Option B is $428,000.

Total estimated electrical usage for the refrigeration plant is $21,000 for a 7 month season.

C. R-507 Indirect Refrigeration, Commercial Quality Components

Major equipment components include:

- All components to be sized to provide 100 tons refrigeration capacity, using R-507 as the primary refrigerant and ethylene glycol as the secondary refrigerant
- Four commercial quality semi-hermetic compressors, each equipped with a high efficiency electric motor, oil separator, and microprocessor controller.
- Direct-expansion chiller vessel.
- Utilize existing evaporative style condenser, indoor remote sump tank, and pump.
- Two centrifugal pumps used to circulate chilled glycol through the ice rink floor. One full-flow pump is provided, with the second pump sized for 60% of full flow.
- A supplemental heat system will use waste heat generated by the compressors for heating of the rink sub-soil and the snowmelt pit. Separate desuperheater heat exchangers and pumps will be provided.

Comments:

- Commercial quality equipment has a shorter useful life than industrial equipment. Typical lifespan is 20 to 25 years.

- System utilizes copper piping for primary system, and PVC piping for secondary system, rather than welded steel used in all other options.
- R-507 is lower in efficiency than either a direct refrigeration system, ammonia, or R-22 (approximately 10% less than R-22) but is the most common substitute for R-22 for low temperature refrigeration.
- R-507 is considered to be environmentally friendly, and the EPA has no intention to limit its use.
- The price of R-507 is much higher than R-22, and higher price lubricants must be used in compressors.
- R-507 is non-toxic, however a large leak can cause the displacement of oxygen in the equipment room. Leakage detection and alarm systems are required.

Estimated construction cost of Refrigeration System Option C is $272,000.

Total estimated electrical usage for the refrigeration plant is $23,000 for a 7 month season.

D. Geothermal Refrigeration, Commercial Quality Components

Major equipment components include:

- Four cold-temperature heat pump packages, each with a 25 HP commercial quality scroll compressors. The heat pump compressors utilize environmentally safe R-404A refrigerant.
- Eight hot and cold liquid pumps, each with motors between 1.0 HP and 1.5 HP.
- Centrifugal glycol pumps for the rink floor, buffer grid, and subfloor heat, sized at 7.5 HP, 3 HP, and 1 HP respectively. All pump motors are operated using variable speed drives to regulate horsepower use based on refrigeration need.
- A geothermal well field is used to store excess system heat. A fluid cooler with fan is used to dissipate excess heat to the atmosphere that cannot be accommodated in the well field. The existing evaporative condenser would not be utilized.
- A supplemental heat system will use waste heat generated by the compressors for heating of the rink sub-soil and the snowmelt pit. Separate desuperheater heat exchangers and pumps will be provided.

Comments:

- Geothermal refrigeration provides substantially better efficiency than any other refrigeration option, including direct style.
- The refrigeration components are sized smaller than conventional systems, so the system is slower to respond to temperature fluctuations, and ice quality can be marginal in difficult conditions.
- The requirement for a geothermal field requires available space on the site outside the building. Vertical style well field requires less space, but is more costly than a horizontal field.
- Commercial quality equipment has a shorter useful life than industrial equipment. Typical lifespan is 20 to 25 years.
- R-404A is considered to be environmentally friendly, and the EPA has no intention to limit its use.
- R-404A is non-toxic, however a large leak can cause the displacement of oxygen in the equipment room. Leakage detection and alarm systems are required.

Estimated construction cost of Refrigeration System Option D is $595,000.

Total estimated electrical usage for the refrigeration plant is $12,600 for a 7 month season.

E. R-22 Indirect Refrigeration, Used Industrial Quality Components

Major equipment components include:

- The compressors, flooded chiller, and receiver would be the 14 year old industrial quality units recently removed from either Bielenberg Arena in Woodbury or Brooklyn Park Arena. The components are in excellent operation condition, and were removed only so new geothermal refrigeration systems could be installed at the facilities.
- All components to be sized to provide 100 tons refrigeration capacity, using R-22 (Freon) as the primary refrigerant and ethylene glycol as the secondary refrigerant
- Utilize existing evaporative style condenser, indoor remote sump tank, and pump.
- Two new centrifugal pumps used to circulate chilled glycol through the ice rink floor. One pump is run at a time, with the second pump serving as backup.
- A supplemental heat system will use waste heat generated by the compressors for heating of the rink sub-soil and the snowmelt pit. Separate shell and tube heat exchangers and pumps will be provided.

Comments:

- Although lower in efficiency than a direct refrigeration system or ammonia, R-22 provides very good efficiency (approximately 5% less than ammonia) and has a good track record for use in low-temperature refrigeration.
- Industrial quality equipment has a long lifespan – typically 30 years or more. The remaining lifespan of the used equipment is approximately 16 years.
- R-22 is generally not considered to be environmentally friendly, particularly in regards to its potential to increase global warming. The EPA has R-22 on its phase out list, and regulations are in place to severely limit its use.
- The price of R-22 has doubled over the last few years, and future larger price increases are guaranteed.
- The existing refrigeration system contains over 5,000 pounds of R-22. That material may be used in a new or renovated system, and sufficient quantity of R-22 may be stored in tanks for future use.
- R-22 is non-toxic, however a large leak can cause the displacement of oxygen in the equipment room. Leakage detection and alarm systems are required.

Estimated construction cost of Refrigeration System Option E is $366,000.

Total estimated electrical usage for the refrigeration plant is $21,000 for a 7 month season.

F. Convert Existing Direct Refrigeration System to R-22 Indirect

Major equipment components include:

- The existing industrial quality compressors would completely rebuilt, including new high efficiency electric motors.
- R-22 pumping vessels would be eliminated, and new plate-and frame chillers added.
- New MCC panel and controls added.
- All components to be sized to provide 100 tons refrigeration capacity, using R-22 (Freon) as the primary refrigerant and ethylene glycol as the secondary refrigerant.
- Utilize existing evaporative style condenser, indoor remote sump tank, and pump.
- Two new centrifugal pumps used to circulate chilled glycol through the ice rink floor. One pump is run at a time, with the second pump serving as backup.

- A new supplemental heat system will use waste heat generated by the compressors for heating of the rink sub-soil and the snowmelt pit. Separate plate and frame heat exchangers and pumps will be provided.

Comments:

- Although lower in efficiency than the existing direct refrigeration system, R-22 provides very good efficiency (approximately 5% less than ammonia) and has a good track record for use in low-temperature refrigeration.
- Reuse of existing components provides lowest possible initial system cost.
- Industrial quality compressors have a long lifespan when fully rebuilt – typically 25 years or more.
- R-22 is generally not considered to be environmentally friendly, particularly in regards to its potential to increase global warming. The EPA has R-22 on its phase out list, and regulations are in place to severely limit its use.
- The price of R-22 has doubled over the last few years, and future larger price increases are guaranteed.
- The existing refrigeration system contains over 5,000 pounds of R-22. That material may be used in a new or renovated system, and sufficient quantity of R-22 may be stored in tanks for future use.
- R-22 is non-toxic, however a large leak can cause the displacement of oxygen in the equipment room. Leakage detection systems are required.

Estimated construction cost of Refrigeration System Option E is $278,000.

Total estimated electrical usage for the refrigeration plant is $21,000 for a 7 month season.

DASHERBOARD IMPROVEMENTS

The existing dasherboards are of wood framing with ¼" thickness white polyethylene facing over plywood, ¾" thickness polyethylene cap rail, plywood backer panel, and 5'-0" height tempered glass shielding. Although well maintained, these original components are in substandard condition due to their advanced age.

Rink access gates, penalty boxes, the scorer box, and a portion of the south end of the rink dasher panels were replaced in a renovation project that extended over several years, ending in 2003. All framing used for the renovation work is heavy galvanized steel, and all facing is solid polyethylene. All renovated components are in very good condition, and could be utilized as part of the current proposed renovation work if desired. If these items are reused, staff has requested that shielding be added to the front of the penalty boxes (to conform to current safety standards), and that passage openings be cut between the scorer box and the penalty boxes.

The four options identified for improvements to the ice rink dasherboards are as described below. The costs estimated for all options include removal and disposal of existing dasherboards, all installation costs, and a 5% contingency factor:

A. Replace all dasherboards, boxes, shielding, and netting with new galvanized steel framed components.

   Estimated construction cost of Option A is $150,000.

B. Replace all dasherboards, boxes, shielding, and netting with new aluminum framed components.

Estimated construction cost of Option B is $152,000.

C. Replace dasherboards, shielding, and netting with new galvanized steel framed components. Reuse all gates, boxes, and dasher panels from the 2003 renovation. Add shielding in front of penalty boxes and cut openings between penalty boxes and the scorer box.

Estimated construction cost of Option C is $133,000.

D. Replace all dasherboards, boxes, shielding, and netting with new aluminum framed components. Reuse all gates, boxes, and dasher panels from the 2003 renovation. Add shielding in front of penalty boxes and cut openings between penalty boxes and the scorer box.

Estimated construction cost of Option D is $135,000.

DEHUMIDIFICATION SYSTEM IMPROVEMENTS

EXISTING DEHUMIDIFICATION SYSTEM

The existing dehumidification system consists of a single Holmsten Rink-Drier unit that is installed on the south end of the arena near the ceiling. The Rink-Drier system uses a mechanical refrigeration process to reduce the relative humidity inside the building. Although mechanical refrigeration style dehumidifiers were common in ice arenas constructed prior to the 1990's, the technology was never capable of providing sufficiently dry air in a cold (below 60°F) arena space, and distribution of dried air was poor because the airflow was not ducted from the unit to the far corners of the arena.

Maintenance of proper humidity level is critical in an ice arena environment to:

- Eliminate fogging conditions, which disrupts play of ice sports
- Eliminate condensation of moisture onto building surfaces, which reduces building corrosion and improves safety by eliminating mold growth and wet seats, floors, and stairs.
- Improve ice surface quality, and reduce operation costs for refrigeration equipment, since the rink will remove humidity from the air (by freezing it) in the absence of a dehumidifier.

DEHUMIDIFICATION SYSTEM IMPROVEMENTS

With the introduction of desiccant dehumidification technology over the past 10 to 20 years, the use of mechanical refrigeration style dehumidifiers in ice arenas has greatly decreased. Instead of condensing moisture out of the air with refrigeration, a desiccant dehumidifier uses a desiccant chemical to attract moisture to a rotating wheel. Heat is then used to dry the desiccant wheel, and the moisture is expelled outside the building. Since the desiccant process is not affected by building temperature, it is possible to lower the arena humidity to any level desired, at any temperature. For many years, a natural gas burner was the most common heat source to dry the desiccant wheel. As natural gas prices have risen over the past several years, systems have been developed that allow the excess waste heat from the ice rink refrigeration system to be used to dry the desiccant wheel. This excess waste heat is a byproduct of the refrigeration process, and is available for minimal cost. The original dehumidifiers that utilized waste heat for desiccant regeneration were problematic, but newer models have proven to be reliable and very effective.

The two options identified for improvements to the dehumidification system are as described below. The costs estimated for both options include removal and disposal of the existing dehumidifier, all installation costs, distribution ductwork, and a 5% contingency factor:

A. Desiccant Dehumidification with Gas Fired Reactivation

System Description:

- Major system components include an 8,000 CFM supply fan, reactivation fan, desiccant wheel, natural gas fired heater for desiccant reactivation, and a post cooling coil. All components are housed in a weatherproof enclosure suitable for outdoor installation.
- Normal Operation - 100% return air mode, Dehumidification Operation - provides appropriate combination of outside air, cooling, and return air for indoor air quality and comfort (post-cool stage would be utilized during need for high quantities of outside air)

Comments:

- Provides needed dehumidification at lowest possible up-front cost.
- The temperature of the dry air leaving the unit and entering the arena is between 100°F and 125°F. Warm air increases loading to the ice rink refrigeration compressors, and increases their electrical usage.
- Uses expensive natural gas for desiccant reactivation. Estimated typical annual gas usage for an ice arena operating 7 months per year is $20,000.
- Requires installation of natural gas piping as well as electrical service

Estimated construction cost of Dehumidification Option A is $155,000.

B. Desiccant Dehumidification with Waste Heat Reactivation

- Major system components include a 8,000 CFM supply fan, reactivation fan, single compressor heat pump, desiccant wheel, DX pre-cooling (brine cooling), evaporator side reclaims waste heat from ice sheet refrigeration compressors, condenser side heats outdoor air to regenerate the desiccant rotor without additional cooling energy from ice sheet refrigeration plant, also uses waste heat from refrigeration compressors for winter heating
- Normal Operation - 100% return air mode, Dehumidification Operation - provides appropriate combination of outside air, cooling and return air for indoor air quality and comfortable (pre-cool stage would be utilized during need for high quantities of outside air)

Comments:

- Higher installation cost than Option A, but elimination of natural gas use, and lower annual maintenance cost provides payback in 5 to 8 year period.
- The temperature of the dry air leaving the unit and entering the arena is between 65°F and 75°F. Cool air decreases loading to the ice rink refrigeration compressors, and decreases their electrical usage.
- Utilizes waste heat from ice sheet refrigeration system
- All electric unit, no natural gas piping required
- Life of desiccant wheel is greatly extended due to lower reactivation temperature

Estimated construction cost of Dehumidification Option B is $290,000.

Estimated Construction Costs

Estimated construction costs for each proposed improvement option are included in the discussion sections of this report, and are summarized below. Estimated costs are based upon anticipated bid prices for the 2010 construction season and include 5% for construction contingencies. Estimates do not include an estimated 10% for engineering, legal and administration costs. If work is proposed to be performed later than the 2010 construction season, it is recommended that an inflation factor of 5% per year be added to all estimates.

ICE RINK FLOOR IMPROVEMENTS

Option A. Concrete rink floor with indirect style 1" polyethylene piping.	$450,000
Option B. Sand rink floor with indirect style 1" polyethylene piping.	$410,000
Option C. Concrete rink floor with indirect style 1" steel piping.	$619,000
Option D. Sand rink floor with indirect style 1" steel piping.	$577,000
Option E. Concrete rink floor with direct style 5/8" stainless steel piping.	$525,000
Option F. Sand rink floor with direct style 5/8" stainless steel piping.	$485,000

ICE RINK REFRIGERATION SYSTEM IMPROVEMENTS

Option A. Ammonia indirect refrigeration, industrial quality components.	$460,000
Option B. R-22 indirect refrigeration, industrial quality components.	$428,000
Option C. R-507 Indirect refrigeration, commercial quality components.	$272,000
Option D. Geothermal refrigeration, commercial quality components.	$595,000
Option E. R-22 indirect refrigeration, used industrial quality components.	$366,000
Option F. Convert existing direct refrigeration system to indirect	$288,000

DASHERBOARD IMPROVEMENTS

Option A. Replace all dasherboards, boxes, shielding, and netting with new galvanized steel framed components.	$150,000
Option B. Replace all dasherboards, boxes, shielding, and netting with new aluminum framed components.	$152,000
Option C. Replace dasherboards, shielding, and netting with new galvanized steel framed components. Reuse all gates, boxes, and dasher panels from the 2003 renovation. Add shielding in front of penalty boxes and cut openings between penalty boxes and the scorer box.	$133,000

Option D. Replace all dasherboards, boxes, shielding, and netting with new aluminum framed components. Reuse all gates, boxes, and dasher panels from the 2003 renovation. Add shielding in front of penalty boxes and cut openings between penalty boxes and the scorer box.
$135,000

DEHUMIDIFICATION SYSTEM IMPROVEMENTS

Option A. Desiccant Dehumidification with Gas Fired Reactivation $155,000

Option B. Desiccant Dehumidification with Waste Heat Reactivation $290,000

Proposed Project Schedule

The proposed project schedule is as follows:

City Council accepts Feasibility Report and authorizes the preparation of plans and specifications	February 1, 2010
City Council approves plans and specifications and authorizes Ad for Bid	February 15, 2010
Bid opening	March 10, 2010
City Council accepts Bids and awards contract	March 17, 2010
Contractor begins construction	April 5, 2010
Substantial construction completion date	August 17, 2010
Final construction completion date	August 31, 2010
New ice rink usable for skaters	September 15, 2010

Conclusions and Recommendations

The proposed improvements in this report are feasible and cost effective as they relate to general engineering principles and construction practices. The project feasibility as a whole is subject to the financial review by the City. The proposed improvements are necessary to improve public facilities to provide service to the affected residents at current City standards.

Our recommendations as to the scope of the ice system work to be designed and constructed at this time are dependent on the City's chosen course of action on the construction of a new single or twin sheet ice arena on another site in the City, as described below:

Option 1 – Operation of Schmitz-Maki Arena to continue indefinitely

- Construct concrete rink floor with indirect style 1" polyethylene piping, construction cost of $450,000. Concrete floor allows multi-use of the facility in the non-ice season, at a moderate $40,000 cost increase over sand surface floor. Polyethylene piping provides acceptable heat transfer at a cost of $169,000 less than a steel pipe floor.
- Construct ammonia indirect refrigeration, industrial quality components, construction cost of $460,000. Industrial quality system provides 10 year longer life than commercial quality system, and best efficiency of the non-geothermal systems. Ammonia is also the most environmentally friendly refrigerant available.
- Replace dasherboards, shielding, and netting with new galvanized steel framed components. Reuse all gates, boxes, and dasher panels from the 2003 renovation, construction cost of $133,000. Bid could be configured to also allow aluminum framing to be quoted, to increase number of bidders.
- Install desiccant dehumidification with waste heat reactivation, construction cost of $290,000. Reduction in use of natural gas results in straight payback of 6.75 years compared to a unit with gas fired reactivation.
- Total project construction cost of Option 1 is $1,333,000.

Option 2 – Schmitz-Maki Arena deactivated between 4 and 15 years in the future

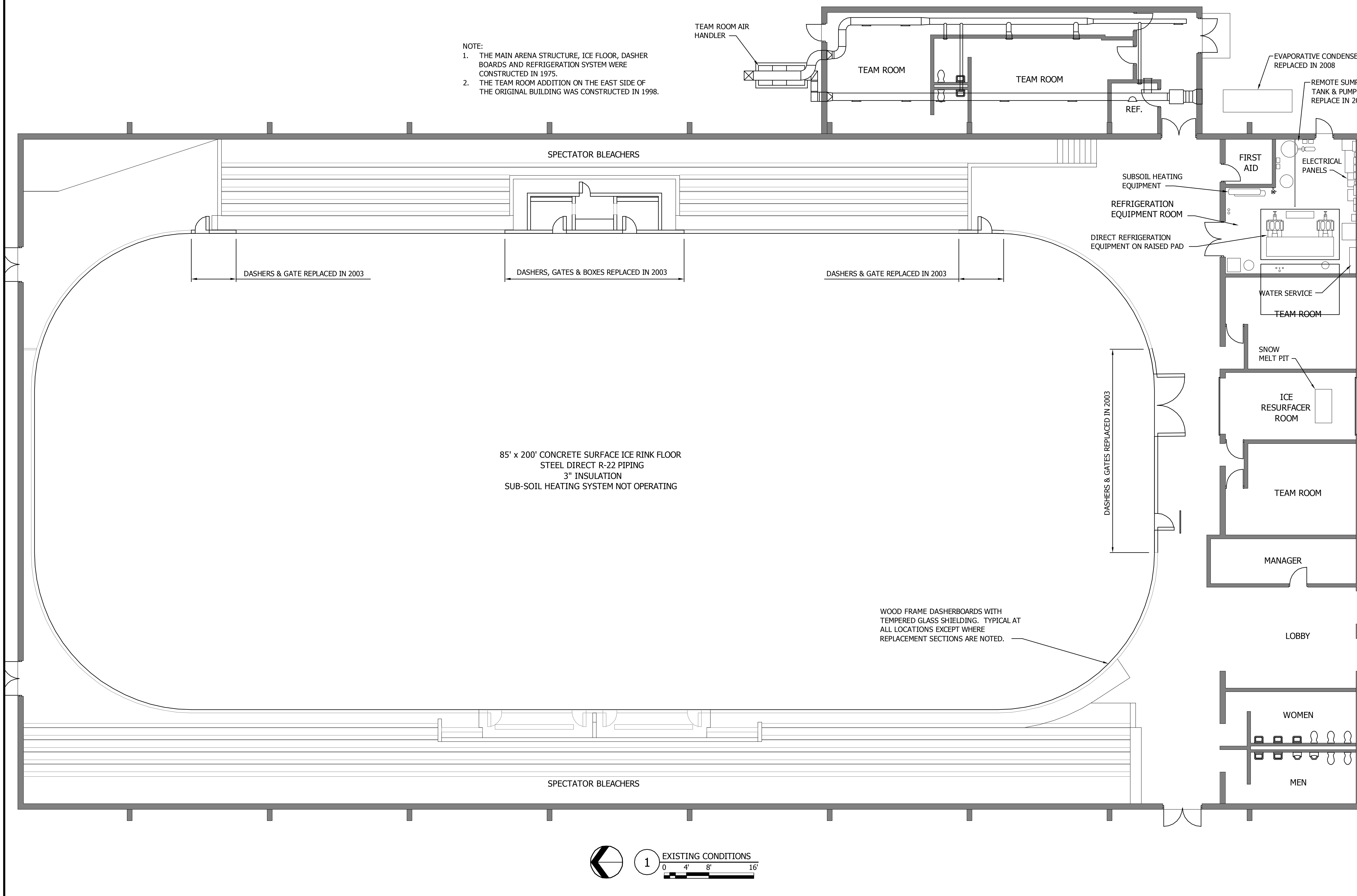
- Construct concrete rink floor with indirect style 1" polyethylene piping, construction cost of $450,000. Concrete floor allows multi-use of the facility in the non-ice season, at a moderate $40,000 cost increase over sand surface floor. Polyethylene piping provides acceptable heat transfer at a cost of $169,000 less than a steel pipe floor.
- Construct R-507 Indirect refrigeration, commercial quality components, construction cost of $272,000. Commercial grade components provide quality ice, with acceptable longevity for expected life of the facility.
- Replace dasherboards, shielding, and netting with new galvanized steel framed components. Reuse all gates, boxes, and dasher panels from the 2003 renovation, construction cost of $133,000. Bid could be configured to also allow aluminum framing to be quoted, to increase number of bidders.

- Install desiccant dehumidification with waste heat reactivation, construction cost of $290,000. Reduction in use of natural gas results in straight payback of 6.75 years. Dehumidification unit can be moved to the new arena facility if Schmitz-Maki is deactivated.
- Total project construction cost of Option 2 is $1,145,000.

Option 3 – Schmitz-Maki Arena deactivated in 2 to 3 years or less

- Pressure test existing floor piping, repair any leaks discovered, construction cost $15,000.
- Pressure test existing equipment and piping systems, repair any leaks discovered, construction cost of $5,000.
- The equipment and piping testing procedures described above will verify the current leakage status of the systems, but will not guarantee that further leaks will not develop during the ice season. Corrosion present in the systems in ongoing, and is expected to worsen with time.
- Dasherboards to remain as is.
- Dehumidification system to remain as is.
- Total project construction cost of Option 3 is $20,000.

Appendix A – Proposed Improvements Figures



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St. Paul, MN 55113
Ph: 651-636-4600
Fax: 651-636-1311
www.bonestroo.com

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PRINT NAME: GARY D. KRISTOFITZ
SIGNATURE:
DATE:
LIC. NO. 22090

FARMINGTON, MINNESOTA
SCHMITZ-MAKI- ARENA ICE SYSTEM REPLACEMENT
EXISTING CONDITIONS

NO.	REVISION	DATE

SURVEY	
DRAWN	LHK
DESIGNED	GDK
APPROVED	GDK
PROJ. NO.	141093160

SHEET NUMBER
FIG. 1

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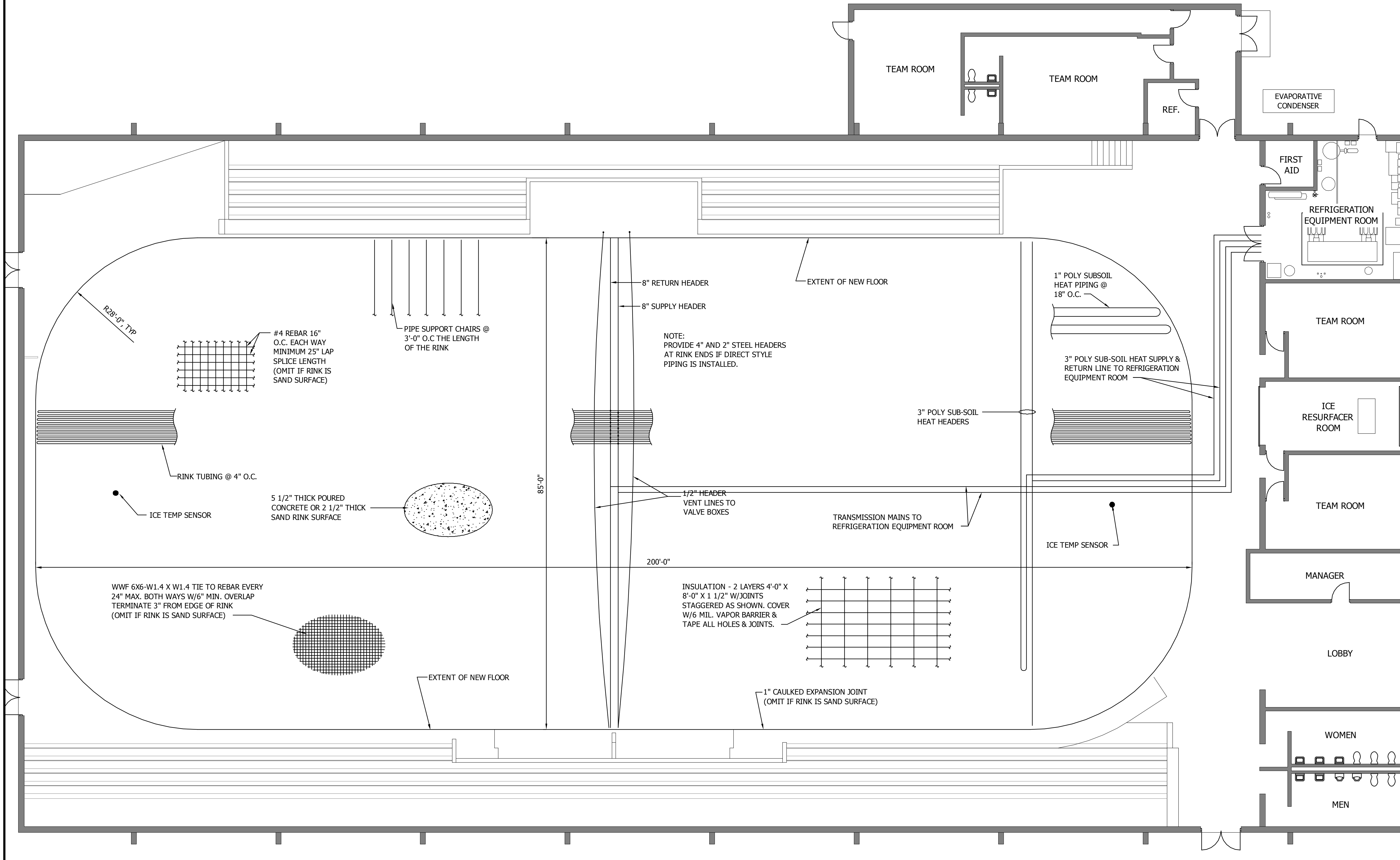

2 ICE RINK FLOOR IMPROVEMENT PLAN
0 4' 8' 16'

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FARMINGTON, MINNESOTA
SCHMITZ-MAKI- ARENA ICE SYSTEM REPLACEMENT
ICE RINK FLOOR IMPROVEMENT PLAN

NO.	REVISION	DATE

SURVEY	
DRAWN	LHK
DESIGNED	GDK
APPROVED	GDK
PROJ. NO.	141093160

SHEET NUMBER
FIG. 2

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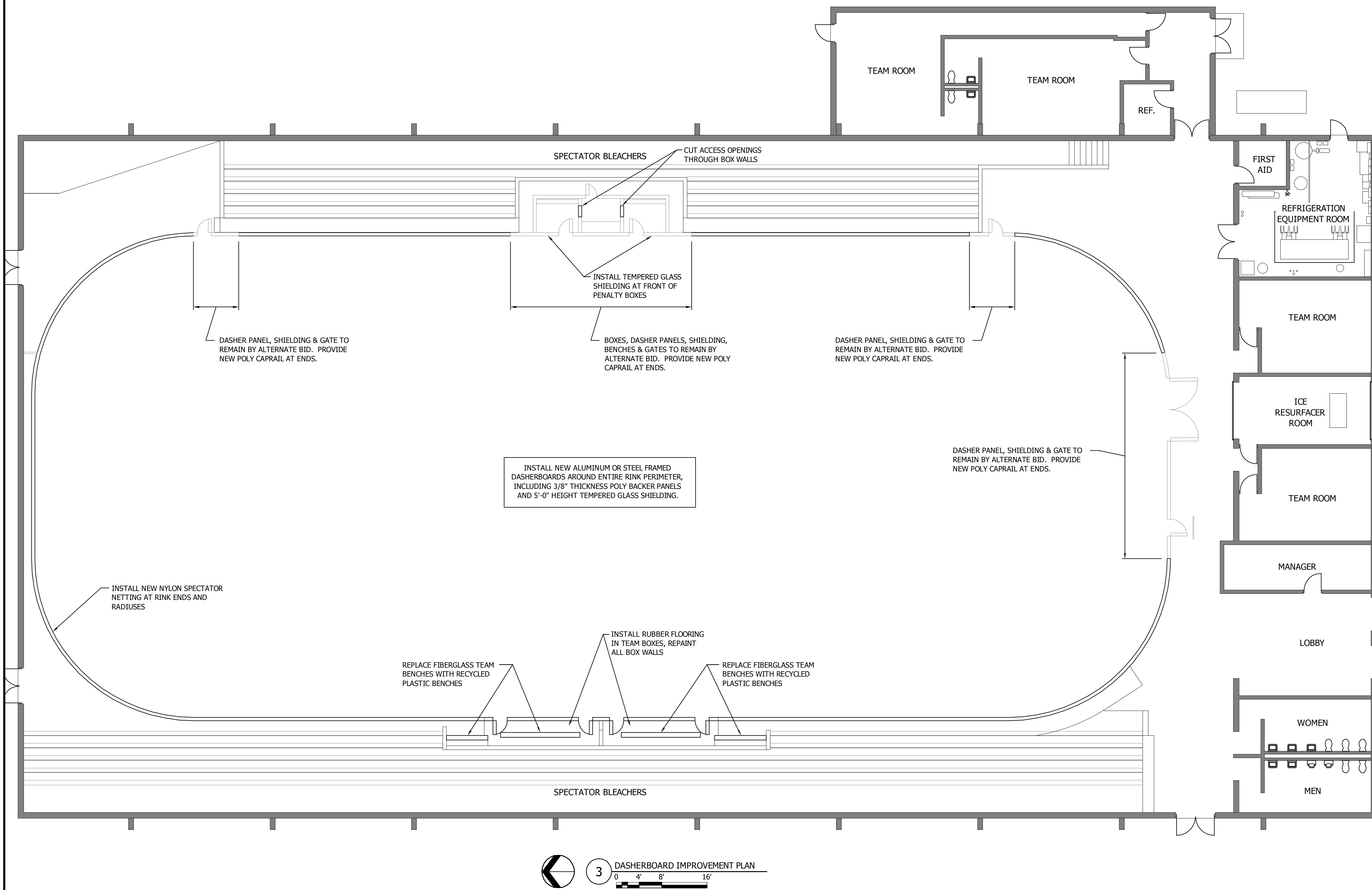

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Fax: 651-636-1311
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FARMINGTON, MINNESOTA

SCHMITZ-MAKI- ARENA ICE SYSTEM REPLACEMENT

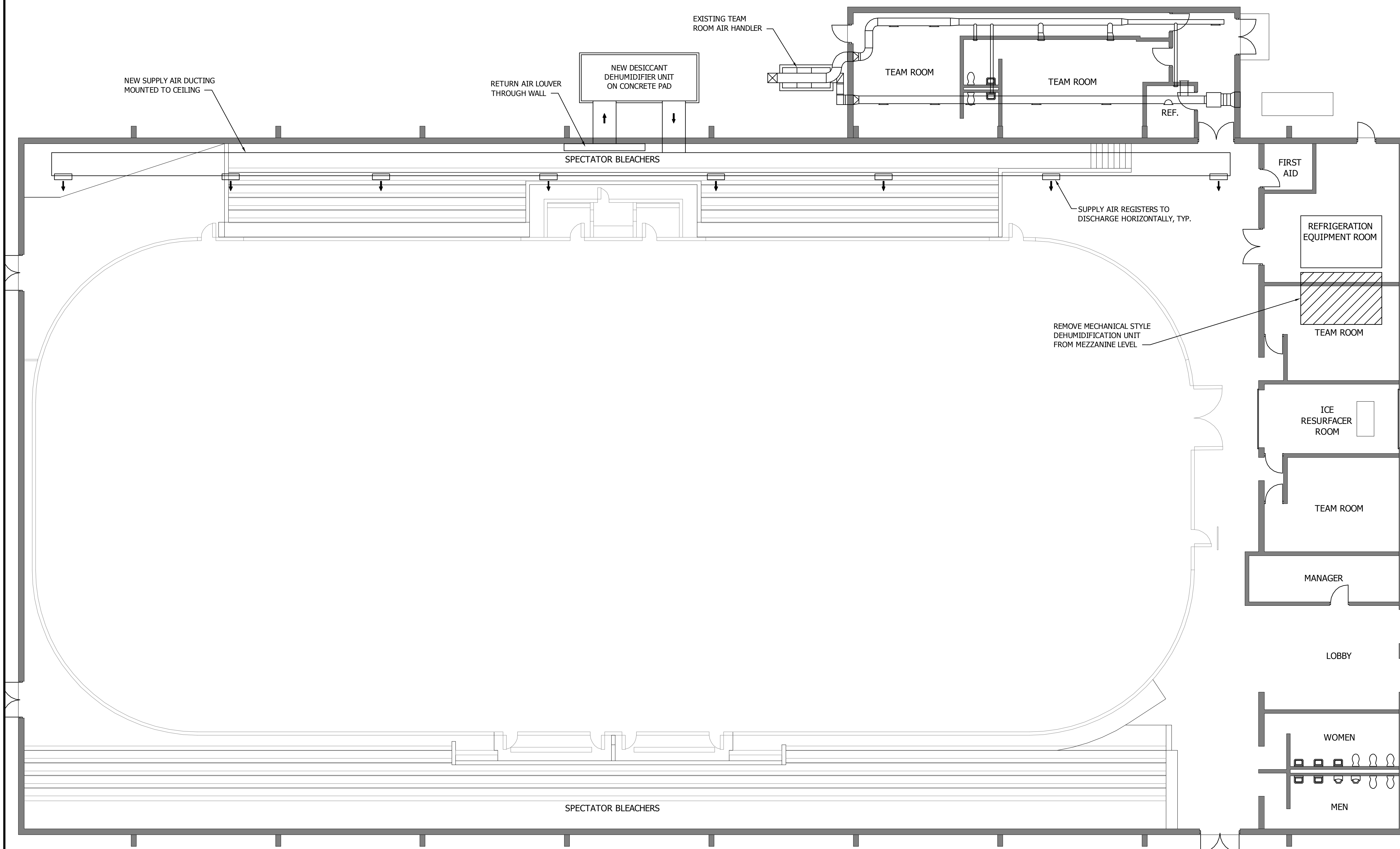
DASHERBOARD IMPROVEMENT PLAN

NO.	REVISION	DATE

SURVEY	
DRAWN	LHK
DESIGNED	GDK
APPROVED	GDK
PROJ. NO.	141093160

SHEET NUMBER

FIG. 3



4 DEHUMIDIFICATION IMPROVEMENT PLAN

0 4' 8' 16'

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FARMINGTON, MINNESOTA

SCHMITZ-MAKI- ARENA ICE SYSTEM REPLACEMENT

DEHUMIDIFICATION IMPROVEMENT PLAN

NO.	REVISION	DATE

SURVEY	
DRAWN	LHK
DESIGNED	GDK
APPROVED	GDK
PROJ. NO.	141093160

SHEET NUMBER

FIG. 4

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