**COLUMBUS PARKS AND**
**RECREATION DEPARTMENT**
**CITY OF COLUMBUS, INDIANA**

## Hamilton Community Center & Ice Arena Plant Conversion Project

# Exhibit M

Detailed Specifications

# PART 1 – ICE RINK GENERAL

## 1.1 Scope of Work

.1 The objectives of this project encompass the following:
- .1 Provide a refrigeration plant conversion at the Hamilton Community Center & Ice Arena located at 2501 Lincoln Park Drive, Columbus, Indiana 47202.
- .2 Provide a design-build electrical system.
- .3 Provide piping tie-in work on a time and material basis.
- .4 Execute work using the most effective use of time and resources.
- .5 Minimize disruption of arena operation, and co-ordinate any required service disruption with the Owner and the Consultant.
- .6 Work may commence, at the earliest, by 19-May-25.
- .7 All work is to be substantially completed by 25-Jul-25.
- .8 If the work is not substantially completed by the substantial completion date, the contractor shall be required to provide and connect a temporary refrigeration plant to the system, at no additional cost to the Owner.

## 1.2 Definitions

.1 Plant Conversion: This conversion consists of a life cycle upgrade of the refrigeration system for the ice rinks. It comprises all fully operational and functional elements, including equipment, software, and programming interfaced to the associated work of other related trades. This includes packaged refrigeration systems, pumps, sump tanks, refrigeration field piping, water field piping, automation equipment, automation programming, and instrumentation.

.2 Contractor: The single Contractor to provide the work of this Bid Document. This Contractor shall be the supplier, installer, and commissioner. This party shall be the contractor signatory to the contract, and shall take on all responsibilities therein. The Contractor shall supply all materials, labour, and equipment required to complete all work and provide all fully functional deliverables.

.3 The Owner: For the specifications herein Columbus Parks & Rec shall be referred to as The Owner.

.4 The Consultant: For the specifications herein I.B. Storey US Inc. shall be referred to as the Consultant.

1.3 Plant Conversion Description

.1 The removal and disposal of existing, supply, and installation of equipment, testing, start-up and warranty of an ice rink refrigeration system as outlined.

.2 The intent of the plant conversion is that minimal loss of ice time will occur. This contractor must be able to demonstrate to the Owner that a proper plan be implemented such that the allotted time for installation is satisfied.

.1 If the start-up date for the refrigeration plant does not occur by the substantial completion date, the Contractor will be responsible for supplying and installing a rental refrigeration system at no cost to the Owner. The Contractor is responsible for all equipment selection and functionality in this scenario.

.2 At the option of the Contractor, a rental refrigeration system may be provided in lieu of meeting the substantial completion date. This must be noted at the time of bidding and include all costs relating to switching-over the plant from the rental refrigeration system to the permanent system. This must be approved by the Owner. The Contractor is responsible for all equipment selection and functionality within this option.

.3 Supply and install refrigeration system components, including packaged refrigeration systems, pumps, valves, piping, back up control equipment, and labour.

.4 The work shall consist of the provision of all labour, materials, tools, equipment, testing, commissioning, training services, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, removal, installation, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in this documents which are required for the complete, fully functional and commissioned refrigeration system.

.5 Provide a complete, neat and workmanlike installation. Use only employees who are certified journeyman or registered apprentices (under the supervision of a journeyman). The labour used to carry out the work shall be skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project. Contractors must submit registration numbers for key personnel that are certified journeyman.

.6 Manage and coordinate the work in a timely manner in consideration of the Project schedule.

1.4 Drawings Package

.1 Drawings packages have been issued with this specifications document and are referred to as 24-021 PKG01 Hamilton CC & Ice Arena-Plant Conversion Package v2.0.

.2 In the event of discrepancy between the drawings package and this specifications document, the specifications document shall prevail unless otherwise noted. Any discrepancies should be brought to the Owner's attention prior to proceeding.

1.5 Quality Assurance

.1 General
- .1 The Contractor shall be regularly engaged in the installation and service of mechanical and refrigeration systems in Indiana.
- .2 The system components included in this project shall consist of the products from manufacturers regularly engaged in the production of refrigeration and mechanical equipment, and shall be the manufacturer's latest standard of design at the time of bid.

.2 Workplace Safety and Hazardous Materials
- .1 Provide a safety program in compliance with the Contract Documents.
- .2 Contractor shall have a corporately certified comprehensive Safety Manual and a designated Safety Supervisor for the Project.
- .3 The Contractor and its employees and subtrades comply with local, state, and federal safety regulations.
- .4 The Contractor shall ensure that all subcontractors and employees have written safety programs in place that covers their scope of work, and that their employees receive the training required by the Occupational Safety and Health Administration for the State of Indiana for at least each topic listed.
- .5 Hazards created by the Contractor or its subcontractors shall be eliminated before any further work proceeds.
- .6 Hazards observed but not created by the Contractor or its subcontractors shall be reported to the Consultant and the Owner within the same day. The Contractor shall be required to avoid the hazard area until the hazard has been eliminated.
- .7 The Contractor shall sign and date a safety certification form prior to any work being performed, stating that the Contractors' company is in full compliance with the Project safety requirements.

.8 The Contractor's safety program shall include written policy and arrangements for the handling, storage and management of all hazardous materials to be used in the work in compliance with the requirements of the Authorities Having Jurisdiction at the Project site.

.9 The Contractor's employees and subcontractor's staff shall have received training as applicable in the use of hazardous materials and shall govern their actions accordingly.

.3 Quality Management Program

.1 Designate a competent and experienced employee to provide Project Management. The designated Project Manager shall be empowered to make technical, scheduling and related decisions on behalf of the Contractor. At minimum, the Project Manager shall:

.1 Manage the scheduling of the work to ensure that adequate materials, labour and other resources are available as needed

.2 Manage the financial aspects of the Contract, with respect to the budget and payment applications.

.1 Be responsible for the work and actions of the workforce on site

1.6 References

.1 The Contractor shall fully comply with all codes and standards applicable to this type of work, including;

.1 State Occupational Safety and Health Administration (OSHA)
.2 The National Electrical Code
.3 National Fire Code
.4 ASME Boiler and Pressure Vessel Code (BPVC)
.5 Underwriters Laboratories (UL) listing and labels
.6 American National Standards Institute (ANSI)
.7 American Society for Testing and Materials (ASTM)
.8 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) Standards:

.1 ASHRAE Standard 15 - Safety Standard for Refrigeration System

.2 ASHRAE Standard 34 – Designation and Safety Classification of Refrigerants.

.2 In the case of conflicts or discrepancies, the more stringent regulation shall apply

.3 All work shall meet the approval of the Authorities Having Jurisdiction at the project site

1.7 Shop Drawings

.1 Manufacturer's data sheets must be used for each product included as part of the scope of work. The submittal package must include:
  .1 Install preparation instructions, methods, and recommendations.
  .2 Safety requirements and details.
  .3 Operating and design parameters such as temperatures, pressures, RPM, and physical size.
  .4 Performance and equipment specifications.
  .5 Storage and handling requirements and recommendations.

.2 All specifications for equivalents being offered must be received electronically by the Consultant for review no later than the question deadline during the bidding process.
  .1 For maintenance purposes, equivalents for equipment will only be approved if all equipment of a similar type meet the specifications (such as pumps).

.3 Shop drawings must also contain complete wiring and schematic diagrams, sequences of operation, control system bus layouts, and any other details required to demonstrate that the system has been coordinated and will properly function as a system.

1.8 Record Documentation

.1 Provide two (2) paper copies and one (1) USB digital copy of operating and maintenance manuals for all installed equipment pertaining to this contract, including as-built drawings

.2 After completion of all tests and adjustments, the contractor shall provide a copy of all as-built information and product data.

.3 On Site documents: Maintain at job site, one copy each of the following (but is not limited to):
  .1 Contract drawings.
  .2 Specifications.
  .3 Addenda.
  .4 Reviewed shop drawings.
  .5 List of outstanding shop drawings.
  .6 Change orders.
  .7 Other modifications to Contract.
  .8 Copy of approved Work schedule.
  .9 Health and Safety Plan and other Safety related documents.
  .10 Manufacturers' installation and application instructions.
  .11 Labour conditions and wage schedules.
  .12 Other documents as specified.

.4 Manual shall be bound in three (3) ring binders and contain, as a minimum, the following:
  .1 System operation and maintenance instructions, troubleshooting guidelines and operating log.
  .2 Safety bulletins and material safety data sheets.
  .3 Reviewed and approved (stamped) shop drawings
  .4 Completed and approved Application for water connection form (As Required). Contractor to comply with all local and state backflow prevention requirements, where applicable
  .5 Approvals by all Authorities having jurisdiction.
  .6 Equipment operation and maintenance instructions

.5 As-built drawings must contain, as a minimum, the following;
  .1 Refrigeration equipment layout and schedule
  .2 Mechanical System equipment layout and schedule
  .3 Control Sequences of Operation
  .4 Structural Drawings and Plans
  .5 Electrical Wiring Diagrams, Layouts and Schematics
  .6 All flow schematics

.6 Prepare an index of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and item description.
  .1 Electrical design, as required in this scope of work, will be provided by the contractor. I.B. Storey US Inc. will not review, comment, or approve any documentation related to this aspect of the project.

.7 The contractor shall correct any errors or omissions noted in the first review.

.8 Within two (2) weeks of contract award the contractor shall provide a schedule, in a Gantt Chart to the Owner and the Consultant, which summarizes all construction timelines and milestone dates. Including, but not limited to:
  .1 Shop drawing submittal and review time;
  .2 Equipment order dates;
  .3 Lead time;
  .4 Site construction milestones (demolition, package placement, etc.)
  .5 On-site completion;
  .6 System start-up;
  .7 Substantial completion;
  .8 Training and owner turnover.

1.9 Commissioning

.1 Upon completion of the work, the contractor shall start up and calibrate the system to ensure all installed components start, and are installed properly.

.2 The contractor shall provide the Consultant with a Start Up checklist four (4) weeks prior to project start-up for review and approval. The checklist shall include, but is not limited to, the following elements:
- .1 Equipment status
- .2 Time of day
- .3 Inlet temperatures
- .4 Outlet temperatures
- .5 Suction pressures
- .6 Discharge pressures
- .7 Liquid flow rates
- .8 Valve positions
- .9 Power reading including: power draw, voltage, current, power factor

.3 An initial equipment check shall occur three (3) days prior to start up to ensure functionality of all components. Prior to this check, all equipment shall be visually inspected.

.4 The Contractor shall provide the Consultant with an automation point-to-point report prior to start up to ensure functionality of all automation points.

.5 Once start-up has occurred, the Start-Up Checklist shall be completed. The checklist shall be completed when the system is under load and at steady state to ensure all equipment is running. The contractor shall be immediately available in the hours following start up to provide start up services and to rectify issues immediately as they arise.

.6 After substantial completion independent performance commissioning shall be completed by I.B. Storey and a deficiency list shall be provided to the contractor. Following receipt of the deficiency list the contractor shall provide weekly updates in writing of the completion status of the deficiencies, including proof of completion. After completion of all deficiencies the Consultant shall perform one final inspection, any requisite subsequent inspections shall be at the cost of the contractor ($1,200 per inspector per occurrence.)

1.10 Training

.1 The contractor shall provide the owner's staff with two (2) up to four (4) hour training sessions in coordination with the Owner's staff and the packaged refrigeration system manufacturer.

.1 First Session – to occur at plant start-up, with training specifically geared toward plant start-up
.2 Second Session – to occur at a later time for other arena staff in the event they are unable to attend, and to address any operational issues that arise during regular operation

.2 The date and time of the training sessions shall be at the option of the Owner, and shall be coordinated by the contractor.

1.11 Warranty

.1 Standard Material and Labour Warranty:
.1 Provide a one-year labour and material warranty on the refrigeration system and rink engineering components following substantial completion unless otherwise noted.
.2 If within twelve (12) months from the date of acceptance of a product, upon written notice from the Owner, it is found to be defective in operation, workmanship, or materials, it shall be replaced, repaired, or adjusted at the option of the Contractor at the cost of the Contractor.

# PART 2 – REFRIGERATION PLANT

## 2.1 Demolition Scope of Work

.1 The contractor is to remove and dispose the existing refrigeration plant equipment, refrigerant, and systems. The Owner will retain any noted refrigerant, equipment, piping and salvage, once removed, for use.
- .1 This includes all existing ice rink refrigeration and rink heating equipment being replaced in the refrigeration plant conversion including all heat exchangers, pipes, valves, and fittings.
- .2 All existing housekeeping pads for all removed equipment are to be removed and disposed except where noted.
- .3 All refrigerant in the system is to be removed by the Contractor. Existing facility equipment is not to be used to pump-out the refrigerant.
  - .1 This includes the refrigerant in the plant.
  - .2 All refrigerant from the plant is to be stored on site for the owner to retain.
- .4 The existing glycol in the cold and warm floors is to remain.

## 2.2 Refrigeration Plant Scope of Work

.1 Supply and install site three (3) magnetic bearing oil-less compressor packaged rink system (ITP-1, ITP-2, ITP-3). The following performance requirements are for each package.
- .1 Refrigerant: R513a
- .2 Evaporator Side:
  - .1 Total Capacity: 50 TR (per packaged system, 200 TR total)
  - .2 Fluid: 40% Ethylene Glycol
  - .3 Flow rate: 467 USGPM
  - .4 EFT: 13°F
  - .5 LFT: 10°F
  - .6 Pressure Drop: 33 ft.
- .3 Condenser Side:
  - .1 Fluid: 40% Ethylene Glycol
  - .2 Flow rate: 220 USGPM
  - .3 EFT: 85°F
  - .4 LFT: 93°F
  - .5 Pressure Drop: 25 ft.
- .4 Power: 52.8 kW
- .5 Electrical Requirements: 460/3/60
- .6 Must include Danfoss frictionless, magnetic bearing, oil-less compressors.

.7 Compressor must be of high lift design.
.8 Manufacturer must have fifteen (15) years experience in integrating Danfoss Turbocor compressor internal protection software for stall and surge situations at various operating conditions.
.9 Include a five (5) year warranty on the magnetic bearing compressors only (priced separately on the Bid Forms).
.10 Use only hybrid condenser/evaporator vessels set with hybrid film design.
.11 Pressure relief valves are to be included on both evaporator and condenser as provided by the manufacturer.
.12 Package must include a PLC controller with colour touchscreen.
.13 IIOT (Industrial Internet of Things) 4.0 control system capable of controlling multiple independent units.
.14 C-UL 508a standard control panel.
.15 Controller must be BACnet compatible.
.16 Condenser water regulating valve must be included on the package.
.17 Wholly independent, standalone packaged units
.18 Package manufacturer must be:
    .1 Nationally recognized supplier of OEM parts
    .2 Experienced in building units with Danfoss magnetic bearing compressors
.19 Package must be able to unload with constant entering water temperature.
.20 Packaged System Dimensions:
    .1 Length: 144.1” (inches)
    .2 Width: 33.3” (inches)
    .3 Height: 74.15” (inches)
.21 Any deviation from the Standard of Acceptance must maintain the walking path in the room and allow for serviceability of the unit. This must be demonstrated in a Clearances and Interfaces Drawing.
.22 Supplier must provide, and comply with the manufacturer’s instructions for, rigging, loading, transporting, and un-loading.
.23 Testing data demonstrating performance must be available upon request.
.24 Contractor is to ensure direct ethernet connection is provided to the packages with a Port 80 access as required by the Manufacturer for remote diagnosis.
.25 The unit must be protected from physical damage at all times.

.26 Standard of Acceptance: Thermal Care TCFW375 Limited, or approved equivalent

.2 Relocate the existing Cooling Tower (CT-1)
  .1 Cooling tower details provided for reference only:
    .1 Manufacturer: BAC
    .2 Model: VF1-144N-41P
    .3 Dimensions:
      .1 Length: 19.7 ft.
      .2 Width: 7.9 ft.
      .3 Height: 14.3 ft.
    .4 Operating Weight: 33,380 lbs
  .2 Cooling tower is to be relocated as indicated in the drawings package.
  .3 Contractor is to relocate the cooling tower following the manufacturers recommended rigging instructions.
  .4 Plumbing to drain will be done by the Owner.
  .5 Water connections will be done by the Owner.

.3 Supply and install one (1) Cold Floor Pump Deck (CP-1, CP-2, CP-3):
  .1 Pump package shall have a welded structural steel frame and a solid plate steel pump deck
  .2 Package shall include the following:
    .1 Three (3) Armstrong 4030 6x5x11.5 pumps
      .1 Motor: 30 HP, premium efficiency
      .2 Power: 460/3/60
      .3 Flow Rate: 934 GPM
      .4 Working Fluid: 40% Ethylene Glycol
      .5 Pumping Head: 86 ft. $H_2O$
    .2 Three (3) 8” grooved trim for process pumps
    .3 Three (3) Armstrong SG-86 suction guides
    .4 Three (3) Armstrong FTV-8FS Flo-Trex valves
    .5 10” grooved 3-pump process pump suction manifold
    .6 10” grooved 3-pump process pump discharge manifold
    .7 10” grooved second discharge manifold
    .8 Three (3) 30 HP ACH580-01-046A-4 VFDs mounted on pump deck and wired to pumps
    .9 Three (3) line reactors wired to input of VFDs (line side)
    .10 Eight (8) isolation valves
    .11 Hard pipe conduit for wiring to pumps
  .3 Standard of Acceptance: Thermal Care Cold Floor PD-30-30-30-C-SL-DR-460, or approved equivalent.

.4 Supply and install drip pans for the cold floor pump prepackaged pump skid.

.5 Supply and install one (1) side stream glycol filter (SF-1) across the connections of the cold floor pumps (discharge to suction). The filter shall be sized sufficiently in accordance with the floor charge to provide a minimum of 4 glycol charge filtrations per day.
    .1 Standard of Acceptance: PRM BFHBFH2DCSX, or approved equivalent.

.6 Supply and install one (1) Condenser Pump Deck (HP-1, HP-2):
    .1 Pump package shall have a welded structural steel frame and a solid plate steel pump deck
    .2 Package shall include the following:
        .1 Two (2) Armstrong 4030 5x4x10 pumps
            .1 Motor: 25 HP, premium efficiency
            .2 Power: 460/3/60
            .3 Flow Rate: 660 GPM
            .4 Working Fluid: 40% Ethylene Glycol
            .5 Pumping Head: 91.2 ft. $H_2O$
        .2 Two (2) 6" grooved trim for process pumps
        .3 Two (2) Armstrong SG-65 suction guides
        .4 Two (2) Armstrong FTV-6FS Flo-Trex valves
        .5 6" grooved 2-pump process pump suction manifold
        .6 6" grooved 2-pump process pump discharge manifold
        .7 Two (2) 25 HP ACH580-01-034A-4 VFDs mounted on pump deck and wired to pumps
        .8 Two (2) line reactors wired to input of VFDs (line side)
        .9 Four (4) isolation valves
        .10 Hard pipe conduit for wiring to pumps
    .3 Standard of Acceptance: Thermal Care Condenser PD-25-25-C-SL-DR-460, or approved equivalent.

.7 Supply and install one (1) side stream glycol filter (SF-2) across the connections of the condenser pumps (discharge to suction). The filter shall be sized sufficiently in accordance with the floor charge to provide a minimum of 4 glycol charge filtrations per day.
    .1 Standard of Acceptance: Axiom SFP-20, or approved equivalent.

.8 Supply and install one (1) Warm Floor Pump Deck (WFP-1, WFP-2, WFP-3):
    .1 Pump package shall have a welded structural steel frame and a solid plate steel pump deck
    .2 Package shall include the following:
        .1 Three (3) Armstrong 4030 1.5x1x6 pumps
            .1 Motor: 1 HP, premium efficiency

.2 Power: 460/3/60
.3 Flow Rate: 31 GPM
.4 Working Fluid: 40% Ethylene Glycol
.5 Pumping Head: 36.1 ft. $H_2O$
.2 Three (3) 2" grooved trim for process pumps
.3 Three (3) Armstrong SG-1515TF suction guides
.4 Three (3) Armstrong FTV-2GS Flo-Trex valves
.5 3" grooved 3-pump process pump suction manifold
.6 2" grooved 3-pump process pump discharge manifold
.7 2" grooved second discharge manifold
.8 Eight (8) isolation valves
.3 Standard of Acceptance: Thermal Care PD-1-1-1-C-SL-DR-460, or approved equivalent.

.9 Supply and install one (1) side stream glycol filter (SF-3) across the connections of the warm floor pumps (discharge to suction). The filter shall be sized sufficiently in accordance with the floor charge to provide a minimum of 4 glycol charge filtrations per day.
.1 Standard of Acceptance: Axiom SFP-20, or approved equivalent.

.10 Supply and install one (1) Automatic Cold Loop Feeder (GF-1)
.1 Size: 100 Gallons
.2 Tank Material: Plastic
.3 Include pump with automatic pressure controls
.4 Must include a diverting valve.
.5 Must include a fluid level switch to automatically shut the pump off at a low tank level.
.6 Standard of Acceptance: Axiom SF-100L, or approved equivalent.

.11 Supply and install one (1) Automatic Warm Loop Feeder (GF-2)
.1 Size: 100 Gallons
.2 Tank Material: Plastic
.3 Include pump with automatic pressure controls
.4 Must include a diverting valve.
.5 Must include a fluid level switch to automatically shut the pump off at a low tank level.
.6 Standard of Acceptance: Axiom SF-100L, or approved equivalent.

.12 Supply and install one (1) Cold Loop Air Separator (AS-1)
.1 Shell Material: Fabricated Steel
.2 Maximum Working Pressure: 165 PSI
.3 Connections to be 150# flanged ANSI raised face.

.4 Design and built with the latest ASME pressure vessel code, section VIII, Division 1.
.5 Must include a blowdown connection for cleaning.
.6 Standard of Acceptance: Armstrong VA-10-U, or approved equivalent.

.13 Supply and install one (1) Cold Loop High-Capacity Air Vent
.1 Install on the cold floor loop above the air separator.
.2 Air Elimination Range:
.1 150 psi at 250°F
.2 175 psi at 150°F
.3 Standard of Acceptance: Armstrong AAE-750, or approved equivalent.

.14 Supply and install one (1) Warm Loop Air Separator (AS-2)
.1 Shell Material: Fabricated Steel
.2 Maximum Working Pressure: 165 PSI
.3 Connections to be 150# flanged ANSI raised face.
.4 Design and built with the latest ASME pressure vessel code, section VIII, Division 1.
.5 Must include a blowdown connection for cleaning.
.6 Standard of Acceptance: Armstrong VA-8-U, or approved equivalent.

.15 Supply and install one (1) Warm Loop High-Capacity Air Vent
.1 Install on the warm floor loop above the air separator.
.2 Air Elimination Range:
.1 150 psi at 250°F
.2 175 psi at 150°F
.3 Standard of Acceptance: Armstrong AAE-750, or approved equivalent.

.16 Supply and install one (1) Cold Loop Expansion Tank (EX-1)
.1 Acceptance Volume: 113.5 gal.
.2 Total Volume: 140 USGAL
.3 Type: Pre-charged heavy-duty butyl diaphragm.
.4 Include tank saddles to install horizontally.
.5 Shell Material: Carbon Steel
.6 Head Material: Carbon Steel
.7 Working Temperature: 240°F
.8 Working Pressure: 125 PSI
.9 ASME Certified Construction
.10 Standard of Acceptance: Armstrong AX-240V, or approved equivalent

.17 Supply and install one (1) Warm Loop Expansion Tank (EX-2)

.1 Acceptance Volume: 36 gal.
.2 Total Volume: 45 USGAL
.3 Type: Pre-charged heavy-duty butyl diaphragm.
.4 Include tank saddles to install horizontally.
.5 Shell Material: Carbon Steel
.6 Head Material: Carbon Steel
.7 Working Temperature: 250°F
.8 Working Pressure: 125 PSI
.9 ASME Certified Construction
.10 Standard of Acceptance: Armstrong AX-80V, or approved equivalent

.18 Supply and install one (1) Glycol Relief High Capacity Air Vent
.1 Install on the warm loop.
.2 Provide manual isolation valves before the high capacity air vents.
.3 Pressure Range: 30-150 PSI
.4 Pressure Setting: 125 PSI
.5 Maximum Temperature: 250°F
.6 Standard of Acceptance: Watts 174A, or approved equivalent.

.19 Supply and install one (1) Hydraulic Separator (HS-1)
.1 Size: 3”
.2 Capacity: 124 GPM
.3 Fluid: 40% Ethylene Glycol
.4 Standard of Acceptance: Caleffi 548082A, or approved equivalent.

.20 Where noted in the specifications or the drawings, pressure gauges must meet the following requirements:
.1 Pressure Range: 0 – 100 PSI
.2 Standard of Acceptance: Kodiak Controls Inc. KC201 D25 100

.21 Where noted in the specifications or the drawings, analog thermometers must meet the following requirements:
.1 Type: Adjustable angle liquid-in-glass thermometer.
.2 Range: 0°F to 160°F
.3 Contractor to include all thermowells as required.
.4 Standard of Acceptance: Trerice, or approved equivalent.

.22 Supply and install one (1) plant room exhaust fan (EF-1)
.1 Drive Type: Direct
.2 CFM: 2,195
.3 Total External SP: 0.1
.4 Motor: 3/4 HP

.5 Power: 115/60/1
.6 Sones (inlet): 9
.7 Include a disconnect switch, factory mounted.
.8 Include a backdraft damper, gravity operated.
.9 Standard of Acceptance: Greenheck AER-30-03-0305-VG, or approved equivalent

.23 Supply and install one (1) Intake Louver for the plant room (IL-1)
.1 Width: 36”
.2 Height: 36”
.3 Depth: 4”
.4 Volume: 2,195 CFM
.5 Pressure Drop: 0.047 in. WG
.6 Free Area: 4.2 SQFT
.7 Free Area Velocity: 521 ft/min
.8 Include an extended sill, shipped loose.
.9 Flanged Frame, front.
.10 Bird screen, 1/2” x 0.063” aluminum mesh, internally mounted.
.11 Include a motorized VCD-23 damper, interlocked to fan.
.1 Actuator Standard of Acceptance: Belimo NFB24-MFT-S, or approved equivalent.
.12 Standard of Acceptance: Greenheck ESD-403, or approved equivalent.

.24 Supply and install one (1) Exhaust Louver for the plant room (EL-1)
.1 Width: 36”
.2 Height: 36”
.3 Depth: 2”
.4 Volume: 2,195 CFM
.5 Pressure Drop: 0.071 in. WG
.6 Free Area: 3.2 SQFT
.7 Free Area Velocity: 695 ft/min
.8 Include an extended sill, shipped loose.
.9 Flanged Frame, front.
.10 Bird screen, 1/2” x 0.063” aluminum mesh, internally mounted.
.11 Include a motorized VCD-23 damper, interlocked to fan.
.1 Actuator Standard of Acceptance: Belimo NFB24-MFT-S, or approved equivalent.
.12 Standard of Acceptance: Greenheck ESD-202, or approved equivalent.

2.3 Additional Refrigeration Plant Items

.1 Provide rental refrigeration system connections as detailed on the design drawings.

.2 The contractor is to test the existing ethylene glycol in the cold and warm floor systems and confirm a concentration of 40% as required.

.1 The contractor will be responsible for adjusting the concentration to the desired amount as needed. This will be considered a valid change order.

.3 Any electrical or fire alarm shutdowns required by the Contractor for the scope of work must be approved by the Owner two (2) weeks prior to being performed for coordination purposes.

.4 The contractor it to provide one (1) cold floor testing report for the glycol charge after the system has been installed and prior to start-up. This is to verify the fluid properties and concentration.

.5 Contractor to provide all required new electrical equipment and modifications to the existing MCC and distribution panels to install the new refrigeration equipment. Reconfiguration is required to provide adequate power to the new equipment.

.1 Refer to Part 6 – Electrical Design-Build.

.2 All MCC's, VFD's, and starters are to be clearly labelled detailing:

.1 Equipment name

.2 Source of electrical

.3 Voltage and amps

.6 All valves and controls should be located at ergonomic heights unless technically unfeasible.

.7 Contractor to supply and install a refrigeration room as-built refrigeration system schematic and valve chart detailing all new and existing equipment relevant to the upgrades.

.8 Contractor to supply and install a permanent sign with all relevant refrigeration plant information, but not limited to, plant size, prime-mover horsepower, contractor contact information, local emergency service information, and plant refrigerant charge.

.9 The contractor shall install thermometers on the inlets and outlets of all refrigeration packages, and pressure gauges on all pumps. Pressure gauges are to be dial type and thermometers are analog type as specified.

.10 Contractor to provide structural steel support members as required for hanging equipment and pipes.

.11 Cutting, patching, sleeving, sealing, and fireproofing of floor, wall and ceiling necessary for all delivery and installation of refrigeration system shall be provided by the contractor.

.12 The contractor shall install dust enclosures while performing work in occupied facility zones, which generates large amounts of particulates.

.13 The contractor shall carry the cost of all piping, valves, fittings, and adaptors required to make a fully functional system as outlined in the specification herein, even if not specifically mentioned.

.14 Site cleanup and removal of construction/demolition debris is the responsibility of the contractor.

.15 Equipment layout shall allow adequate clearances for cleaning and maintenance purposes. The proposed clearances must be documented on a Clearance and Interface drawing and submitted to the Owner and the Consultant for comment, prior to commencing work.

.16 All installed equipment shall be labelled with placards, and shall be labelled by equipment type in sequential order (Pumps, Expansion Tanks, etc.).

.17 Contractor shall seal all building penetrations created/modified under the scope of this contract with a watertight sealant; the penetration shall be painted to match the surrounding building finishes.

.18 The contractor shall furnish, supply and install all required refrigerant isolation and control valves in accordance with all applicable codes and standards.

.19 The contractor shall provide all required fluids required for a fully functional and operational system including:
.1 Glycol Charge

.20 All equipment installations must be constructed in conformance with all local, state, and national code. Any additional requirements from the latest codes and standards supersede any requirements as written in this document.

.21 All equipment shall be installed such that it meets or exceeds the manufacturer’s recommended installation practices and requirements.

.22 Prior to commencing work the contractor shall determine the location of any utility entrances (power, water, sewer), which may

interfere with carrying out this work. This shall be done in conjunction with the utility companies, and shall be at the cost of the contractor.

.23 The contractor shall provide a new log book ("Ice Rink Log Book") for the facility at turnover, for logging pressures and temperatures.

.1 Work with the Consultant for content.

.24 Contractor must pay for all local inspections, approvals, and permits as required for the refrigeration plant replacement project.

.25 Contractor to coordinate the installation of all equipment with the Automation Contractor. Any required testing and commissioning of the automation system (on top of the back-up or secondary control system) must also be coordinated by the Contractor in this scope.

PART 3 - AUTOMATION

3.1 Automation System Functional Intents

1. Automation system functional intents:
2. R513A Packages
    a. The R513A packages are intended to operate to provide refrigeration to the cold slabs. The three packages are to be staged to operate based on cooling demands from the loads with the lead package rotating between the three units.
    b. When an ice sheet is in operation the supply temperature commanded to the R513A packages are to be set to the rink temperature.
    c. The R513A packages are to have multiple modes of operation depending on ice conditions.
    d. A minimum condenser flow rate of 100 GPM per unit in operation is to be maintained by the condenser pumps.
    e. A minimum evaporator flow rate of 268 GPM per unit in operation is to be maintained by the cold floor pumps.
    f. Startup bypass valve (104) is intended to open for 5 minutes when the R513A packages are starting up.
3. Cooling Tower
    a. The cooling tower is to provide cooling to the heat rejection loop when the refrigeration plant is running and the building heat loads are satisfied. The fluid cooler is to fluctuate its setpoint based on outdoor weather when a fixed heating setpoint is not required.
    b. A floating head field commissioned minimum glycol leaving temperature must be maintained. Glycol leaving temperature is to be equal to the outdoor wet bulb temperature (°F) + 15°F, down to a minimum of 65°F.
    c. The cooling tower basin heater is to operate as per the onboard basin heater control package.
    d. The cooling tower sump pump is to operate when the cooling tower fans are in operation. The cooling tower sump pump is not to run when the outdoor temperature is 20°F or below.
    e. The cooling tower basin heater is to be de-energized when the cooling tower sump pump is in operation.

4. Cold Floor Pumps
    a. The cold floor pumps are intended to operate to distribute the cold glycol to the ice sheets from the R513A packages.
    b. The pumps are to stage in operation with the R513A packages and operate at the same speed to maintain the minimum flow required for the R513A packages. The pumps are to minimize energy use by maintaining a fixed temperature differential.
5. Condenser Pumps
    a. The condenser pumps are intended to operate to distribute the heating provided by the R513A packages to the warm floor and the adiabatic fluid cooler.
    b. The pumps are to stage in operation with the R513A packages and operate at the same speed to maintain the minimum flow required for the R513A packages. The pumps are to minimize energy use by matching the required warm glycol flow rates based on what loads are calling for heating.
6. Warm Floor Pumps
    a. The warm floor pumps are intended to provide heating to the warm rink floors to prevent frost below the ice rink floors. They are to keep the floor above 40°F and cycle off when the warm floor temperatures are at setpoint.
7. Exhaust Fan
    a. The exhaust fan for the plant room (EF-1) is intended to operate based on the required ventilation for Carbon Dioxide (CO2) and temperature required for the space. In addition, the fan will be operated by the refrigerant detector controller to ensure refrigerant levels are below the allowable PPM in the event of a leak.

3.2 Automation Scope of Work

.1 Plant Control System
    .1 The Contractor is to supply and install all equipment including controllers for a secondary or back-up control system for the ice rink refrigeration plant.

.2 Back-up Control System
    .1 The mechanical contractor is to supply and install all equipment including controllers for a secondary or back-up control system for the ice rink refrigeration plant.
    .2 The back-up controller is to operate the equipment in the event of a primary control system failure to ensure a fully functional system. This back-up control system will only activate when the manual selector switch is activated.

.3 Provide a labelled selector switch that will activate the back-up control system in the event the primary rink Building Management System (BMS) is offline. This switch can then be used to revert back to the BMS one it is functional. Equipment must not turn-off when the switch-over occurs.
.4 The control system must be installed and functioning prior to start-up.
.5 Standard of Acceptance: Honeywell T775, or approved equivalent.

.3 Supply and install Power Meters
.1 Real Power and Energy Accuracy: ± 0.2% from 1% to 100% of rated load.
.2 Must be BACnet compatible.
.3 Must be able to measure voltages from 120 to 600 Vac and currents from 5 to 6,000 amps in delta (phase to phase) and wye (phase to neutral) configurations.
.4 Standard of Acceptance: Honeywell E-mon Class 5000, or approved equivalent.

.4 Supply and install fluid flow meters
.1 Temperature Range: up to 150°F
.2 Accuracy: ±0.5% at calibrated velocity
.3 Meter shall be insertion type.
.4 Meter shall have a dual turbine.
.5 Standard of Acceptance: Onicon F-1200-10-C3-1221, or approved equivalent.

.5 Supply and install Weather Stations
.1 Temperature: -40°F to 240°F, 0.4°F at 77°F accuracy
.2 Must include a selectable output signal of 4-20 mA or 0-10 Vdc.
.3 Humidity: 0 to 95% R.H., 3% accuracy
.4 Standard of Acceptance: Honeywell H7635C2015, or approved equivalent.

.6 Supply and install Wall CO2 Sensors
.1 Capable of 4-20 mA or 0-10 VDC signals.
.2 Range of 0 – 2,000 PPM
.3 Operating Conditions: -4°F to 122°F, 15 to 90% RH
.4 Accuracy: ± 50 ppm + 3% of reading.
.5 Response Time: 90 seconds
.6 Transmitter Accuracy: ± 0.25% of span.
.7 Standard of Acceptance: Greystone CDD4A101, or approved equivalent.

.7 Supply and Install one (1) Wall Temperature Sensors
  .1 Operating Temperature: 45°F to 99°F
  .2 Operating Humidity: 5% to 95% RH non-condensing
  .3 Standard of Acceptance: Honeywell TR21, or approved equivalent.

.8 Supply and install immersion water/glycol temperature sensors.
  .1 Temperature sensor is to have a working range of -40°F to 250°F.
  .2 Contractor to include well.
  .3 Standard of Acceptance: Honeywell C7041D2001, or approved equivalent.

.9 Supply and install immersion water/glycol pressure sensors
  .1 Pressure Range: 150 psi
  .2 Operating Temperature: -40°F to 257°F
  .3 Response Time: <2 ms
  .4 Accuracy: +/- 0.50% FSS
  .5 Standard of Acceptance: Honeywell MLH150PSM01B, or approved equivalent.

.10 Supply and install one (1) Vent Line Gas Detector
  .1 Gas: R513a
  .2 Accuracy: +/-25% at full-scale
  .3 Temperature Range: -46°F to 140°F
  .4 Humidity Range: 5% to 100% condensing
  .5 Enclosure: NEMA 4X 316 stainless steel gasketed housing
  .6 Standard of Acceptance: CTI GG-VL2-R, or approved equivalent.

.11 Supply and install one (1) refrigerant alarm system in the refrigeration room.
  .1 Refrigerant Type: R-513A
  .2 Enclosure: NEMA 4x with clear window
  .3 Mounting Height: 4-5 ft above finished floor
  .4 Operating Temperature: -4°F to 122°F
  .5 Humidity: continuous 15 to 90% RH, non-condensing and intermittent 0 to 99% RH, non-condensing.
  .6 Relay Contacts: Four (4) SPDT 10A @ 250 VAC Res.
  .7 Indicators: RED LED (Alarm), Yellow LED (Warning), Green LED (Status)
  .8 Include Concentration Display
  .9 Include Modbus RTU connection.
  .10 Sensor:
    .1 Detectable Gas: R-513A
    .2 Sensor Type: Infra-Red Temperature Controlled
    .3 Enclosure: Polycarbonate/ABS blend

.4 Supply Voltage: 24 VDC, nominal range
.5 Operating Temperature: -49°F to 149°F
.6 Accuracy: ±3% of reading
.7 Repeatability: ±3% of full scale
.8 Response Time: less than 30 seconds for 90% of step change
.9 Standard of Acceptance: QEL QIRF-513X-0, or approved equivalent.

.11 System to be connected to the refrigeration room exhaust fan for automatic ventilation activation.

.12 Provide one (1) switch for the manual fan switch located outside the refrigeration room and connected to the controller and exhaust fan.
.1 Standard of Acceptance: QEL Q-Switch, or approved equivalent.

.13 Provide one (1) switch for the manual fan switch located inside the refrigeration room and connected to the controller and exhaust fan.
.1 Standard of Acceptance: QEL Q-Switch, or approved equivalent.

.14 Provide one (1) switch for the reset fan switch located inside the refrigeration room and connected to the controller and exhaust fan.
.1 Standard of Acceptance: QEL R-Switch, or approved equivalent.

.15 Alarm system must include a strobe light inside and outside the refrigeration room.
.1 Standard of Acceptance: QEL M-Strobe, or approved equivalent.

.16 Must be ready for integration into a Building Automation System (BMS).

.17 Standard of Acceptance: QEL Q-Controller, or approved equivalent.

.12 Supply and install current transformers
.1 Frequency Range: 50/60 HZ.
.2 UL/ULC, CE listed
.3 Multiple selectable range split-cores
.4 Insulation class: 600V RMS
.5 Standard of Acceptance: Honeywell Senva Inc Current Transducers, or approved equivalent.

.13 Supply and install current transducers
.1 Accuracy: 2% of F.S. above 80A

.2 Range 0A-800A
.3 Type: Current Transducer, AC
.4 Output: 4-20 mA
.5 Standard of Acceptance: Veris H321, or approved equivalent.

.14 Supply and install power relays
.1 Poles: single pole per relay
.2 Coil volts: 24 VAC/DC
.3 Both AC and DC rated
.4 Amps: 6 A
.5 UL Approved only
.6 Standard of Acceptance: Allen-Bradley ALB700HLT1U24, or approved equivalent.

.15 All control systems are to include an Uninterruptable Power Supply (UPS) to prevent the control system shutting down in the event of a building power outage or fluctuations.
.1 Use only an industrial-grade power supply sized to provide power to all control components.
.2 Capacity: 300 Watts (500 VA).
.3 Recharge time: 8 hours to 90% capacity after full discharge.
.4 Typical Back-up Time: 4 minutes.
.5 Suitable Temperature Range: 32 – 122°F
.6 Standard of Acceptance: Sola SDU 500, or approved equivalent.

.16 Automation contractor is to supply all power wiring and control valves per this contract. 24V wiring is required for automation components.

.17 All control wiring shall have a minimum FT-4 rating.

.18 The Contractor of this division is required to install all noted control valves.

.19 Contractor is to supply and install all necessary transformers and relays.

3.3 Automation System Scope of Work

.1 General
.1 Contractor to provide a new automation system for additional control points with the specifications mentioned herein.
.2 Control system to be standalone.
.3 The Building Management System (BMS) shall be comprised of a network of interoperable, stand-alone digital controllers, a network area controller, graphics and programming and other control devices for a complete system as specified herein.

.4 The installed system shall provide secure password access to all features, functions and data contained in the overall BMS.

.5 Controls contractor to provide a data connection from the BMS to the I.B. Storey secure Niagara supervisory system, as well as all accessories required to provide that data connection.

.1 This will be coordinated with Owner's IT and Consultant.

.6 Standard of acceptance for Controller Vendors:

.1 Tridium's "JACE-8000 Niagara 4 Platform"

.2 Honeywell International's "WEB-8000 Niagara 4 Platform"

.3 Johnson Controls' "FX80 Niagara 4 Platform"

.2 Open, Interoperable, Integrated Architecture

.1 The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system utilizing Open protocols in one open, interoperable system.

.2 The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. Physical connection of any BACnet control equipment, such as chillers, shall be via Ethernet or IP.

.3 All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data will not be acceptable.

.4 The supplied system shall incorporate the ability to access all data using HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on the Operating System Server located in the Facilities Office on the LAN. Systems requiring proprietary database and user interface programs shall not be acceptable.

.5 A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.

.1 Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.

.2 Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

.3 BAS SERVER HARDWARE

.1 Minimum Computer Configuration (Hardware Independent).

.2 Central Server. Contractor shall provide a dedicated BAS server with configuration that includes the following components as a minimum:

.1 Processor: Intel Xeon CPU E5-2640 x64 (or better), compatible with dual- and quad-core processors.

.2 Memory: 2 GB or more recommended for large systems, 8 GB or more recommended for the Windows 64-bit version.

.3 Hard Drive: 4 GB minimum, more recommended depending on archiving requirements.

.4 Display: Video card and monitor capable of displaying 1024 x 768 pixel resolution or greater.

.5 Network Support: Ethernet adapter (10/100 Mb with RJ-45 connector).

.6 Connectivity: Full-time high-speed ISP connection recommended for remote site access (i.e. T1, ADSL, cable modem).

.3 Standard Client: The thin-client Web Browser BAS GUI shall be Microsoft Internet Explorer (10.0 or later) running on Microsoft 7+. No special software shall be required to be installed on the PCs used to access the BAS via a web browser.

.4 BAS MOBILE ACCESS HMI

.1 Contractor is to supply and install one (1) BAS Mobile Access HMI embedded into the exterior of the control panel for full control access in the form of a commercially standard tablet with the following specifications:

.1 A 12” touch screen

.2 Run on the latest Android OS

.5 SYSTEM NETWORK CONTROLLER (SNC)

.1 These controllers are designed to manage communications between the programmable equipment controllers (PEC), application specific controllers (ASC) and advanced unitary controllers (AUC) which are connected to its communications trunks, manage communications between itself and other system network controllers (SNC) and with any operator workstations (OWS) that are part of the BAS, and perform control and operating strategies for the system based on information from any controller connected to the BAS.

.2 The controllers shall be fully programmable to meet the unique requirements of the facility it shall control.

.3 The controllers shall be capable of peer-to-peer communications with other SNC's and with any OWS connected to the BAS, whether the OWS is directly connected, connected via cellular modem or connected via the Internet.

.4 The communication protocols utilized for peer-to-peer communications between SNC's will be Niagara 4 Fox, BACnet TCP/IP and SNMP. Use of a proprietary communication protocol for peer-to-peer communications between SNC's is not allowed.

.5 The SNC shall employ a device count capacity license model that supports expansion capabilities.

.6 The SNC shall be enabled to support and shall be licensed with the following Open protocol drivers (client and server) by default:
- .1 BACnet
- .2 Lon
- .3 MODBUS
- .4 SNMP
- .5 KNX

.7 The SNC shall be capable of executing application control programs to provide:
- .1 Calendar functions.
- .2 Scheduling.
- .3 Trending.
- .4 Alarm monitoring and routing.
- .5 Time synchronization.
- .6 Integration of LonWorks, BACnet, and MODBUS controller data.
- .7 Network management functions for all SNC, PEC and ASC based devices.

.8 The SNC shall provide the following hardware features as a minimum:
- .1 Two 10/100 Mbps Ethernet ports.
- .2 Two Isolated RS-485 ports with biasing switches.
- .3 1 GB RAM
- .4 4 GB Flash Total Storage / 2 GB User Storage
- .5 Wi-Fi (Client or WAP)
- .6 USB Flash Drive
- .7 High Speed Field Bus Expansion
- .8 -4-140°F Ambient Operating Temperature
- .9 Integrated 24 VAC/DC Global Power Supply

.10 MicroSD Memory Card Employing Encrypted Safe Boot Technology

.9 The SNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.

.10 The SNC shall provide alarm recognition, storage, routing, management and analysis to supplement distributed capabilities of equipment or application specific controllers.

.11 The SNC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via cellular modem, or wide-area network.

.1 Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:

.1 Alarm.

.2 Return to normal.

.3 To default.

.2 Alarms shall be annunciated in any of the following manners as defined by the user:

.1 Screen message text.

.2 Email of complete alarm message to multiple recipients.

.3 Pagers via paging services that initiate a page on receipt of email message.

.4 Graphics with flashing alarm object(s).

.3 The following shall be recorded by the SNC for each alarm (at a minimum):

.1 Time and date.

.2 Equipment (air handler #, access way, etc.).

.3 Acknowledge time, date, and user who issued acknowledgement.

.12 Programming software and all controller "Setup Wizards" shall be embedded into the SNC.

.13 The SNC shall support the following security functions.

.1 Module code signing to verify the author of programming tool and confirm that the code has not been altered or corrupted.

.2 Role-Based Access Control (RBAC) for managing user roles and permissions.

.3 Require users to use strong credentials.

.4 Data in Motion and Sensitive Data at Rest be encrypted.

.14 LDAP and Kerberos integration of access management. The SNC shall support the following data modeling structures to utilize Search; Hierarchy; Template; and Permission functionality:

.1 Metadata: Descriptive tags to define the structure of properties.
.2 Tagging: Process to apply metadata to components
.3 Tag Dictionary

.15 The SNC shall employ template functionality. Templates are a containerized set of configured data tags, graphics, histories, alarms... that are set to be deployed as a unit based upon manufacturer's controller and relationships. All lower level communicating controllers (PEC, AUC, AVAV, VFD…) shall have an associated template file for reuse on future project additions.

.16 The SNC shall be provided with a 5 Year Software Maintenance license. Labour to implement not included.

.6 Programmable Equipment Controller (PEC)

.1 Equipment control shall be accomplished using LonMark or BACnet based devices where the application has a LonMark profile or BTL Listed PICS defined. Where LonMark devices are not available for a particular application, devices based on LonWorks shall be acceptable. For each LonWorks device that does not have LonMark certification, the device supplier shall provide an XIF file for the device. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara 4 Framework, that allow standard and customizable control solutions required in executing the "Sequence of Operation".

.2 All PECs shall be application programmable and shall at all times maintain their certification. All control sequences within or programmed into the PEC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.

.3 The PEC shall provide LED indication of communication and controller performance to the technician, without cover removal.

.4 The PEC shall not require any external configuration tool or programming tool. All configuration and programming tasks shall be accomplished and accessible from within the Niagara 4 environment.

.5 The following integral and remote Inputs/Outputs shall be supported per each PEC:

.1 Eight integral dry contact digital inputs.
.2 Any two digital inputs may be configured as pulse counters with a maximum pulse read rate of 15 Hz.

.3 Eight integral analog inputs (configurable as 0-10V, 0-10,000 Ohm or, 20K NTC).
.4 Six integral 4-20 mA analog outputs.
.5 Eight integral 24 Vac Triac digital outputs, configurable as maintained or floating motor control outputs.
.6 One integral 20 Vdc, 65-mA power supply for auxiliary devices.
.7 If a 20 Vdc 65-mA power supply terminal is not integral to the PEC, provide at each PEC a separate, fully isolated, enclosed, current limited and regulated UL listed auxiliary power supply for power to auxiliary devices.

.6 Each PEC shall have expansion ability to support additional I/O requirements through the use of remote input/output modules.
.7 PEC Controllers shall support at minimum the following control techniques:
.1 General-purpose control loops that can incorporate Demand Limit Control strategies, Set point reset, adaptive intelligent recovery, and time of day bypass.
.2 General-purpose, non-linear control loops.
.3 Start/stop Loops.
.4 If/Then/Else logic loops.
.5 Math Function loops (MIN, MAX, AVG, SUM, SUB, SQRT, MUL, DIV, ENTHALPY)

.7 BAS Server & Web Browser GUI - System Overview
.1 The BAS Contractor shall provide system software based on server/thin-client architecture, designed around the open standards of web technology. The BAS server shall communicate using Ethernet and TCP. Server shall be accessed using a web browser over Owner intranet and remotely over the Internet.
.2 The intent of the thin-client architecture is to provide the operator(s) complete access to the BAS system via a web browser. The thin-client web browser Graphical User Interface (GUI) shall be browser and operating system agnostic, meaning it will support HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. Microsoft, Firefox, and Chrome browsers (current released versions), and Windows as well as non-Window operating systems.
.3 The BAS server software shall support at least the following server platforms (Windows 7, 8.1, Server 12). The BAS server software shall be developed and tested by the manufacturer of

the system stand-alone controllers and network controllers/routers.

.4 The web browser GUI shall provide a completely interactive user interface and shall provide a HTML5 experience that supports the following features as a minimum:
  .1 Trending.
  .2 Scheduling.
  .3 Electrical demand limiting.
  .4 Duty Cycling.
  .5 Downloading Memory to field devices.
  .6 Real time 'live' Graphic Programs.
  .7 Tree Navigation.
  .8 Parameter change of properties.
  .9 Set point adjustments.
  .10 Alarm / event information.
  .11 Configuration of operators.
  .12 Execution of global commands.
  .13 Add, delete, and modify graphics and displayed data.

.5 Software Components: All software shall be the most current version. All software components of the BAS system software shall be provided and installed as part of this project. BAS software components shall include:
  .1 Server Software, Database and Web Browser Graphical User Interface.
  .2 5 Year Software Maintenance license. Labour to implement not included.
  .3 Embedded System Configuration Utilities for future modifications to the system and controllers.
  .4 Embedded Graphical Programming Tools.
  .5 Embedded Direct Digital Control software.
  .6 Embedded Application Software.

.6 BAS Server Database: The BAS server software shall utilize a Java Database Connectivity (JDBC) compatible database such as: MS SQL 8.0, Oracle 8i or IBM DB2. BAS systems written to Non -Standard and/or Proprietary databases are NOT acceptable.

.7 Thin Client - Web Browser Based: The GUI shall be thin client or browser based and shall meet the following criteria:
  .1 Web Browser's for PC's: Only the current released browser (Explorer/Firefox/Chrome) will be required as the GUI and a valid connection to the server network. No installation of any custom software shall be required on the operator's GUI

workstation/client. Connection shall be over an intranet or the Internet.

.2 Secure Socket Layers: Communication between the Web Browser GUI and BAS server shall offer encryption using 128-bit encryption technology within Secure Socket Layers (SSL). Communication protocol shall be Hyper-Text Transfer Protocol (HTTP).

.8 Web Browser Graphical User Interface

.1 Web Browser Navigation: The Thin Client web browser GUI shall provide a comprehensive user interface. Using a collection of web pages, it shall be constructed to "feel" like a single application, and provide a complete and intuitive mouse/menu driven operator interface. It shall be possible to navigate through the system using a web browser to accomplish requirements of this specification. The Web Browser GUI shall (as a minimum) provide for navigation, and for display of animated graphics, schedules, alarms/events, live graphic programs, active graphic set point controls, configuration menus for operator access, reports and reporting actions for events.

.2 Login: On launching the web browser and selecting the appropriate domain name or IP address, the operator shall be presented with a login page that will require a login name and strong password. Navigation in the system shall be dependent on the operator's role-based application control privileges.

.3 Navigation: Navigation through the GUI shall be accomplished by clicking on the appropriate level of a navigation tree (consisting of an expandable and collapsible tree control like Microsoft's Explorer program) and/or by selecting dynamic links to other system graphics. Both the navigation tree and action pane shall be displayed simultaneously, enabling the operator to select a specific system or equipment and view the corresponding graphic. The navigation tree shall as a minimum provide the following views: Geographic, Network, Groups and Configuration.

.1 Geographic View shall display a logical geographic hierarchy of the system including: cities, sites, buildings, building systems, floors, equipment and objects.

.2 Groups View shall display Scheduled Groups and custom reports.

.3 Configuration View shall display all the configuration categories (Operators, Schedule, Event, Reporting and Roles).

.4 Action Pane: The Action Pane shall provide several functional views for each subsystem specified. A functional view shall be accessed by clicking on the corresponding button:
  .1 Graphics: Using graphical format suitable for display in a web browser, graphics shall include aerial building/campus views, color building floor-plans, equipment drawings, active graphic set point controls, web content and other valid HTML elements. The data on each graphic page shall automatically refresh.
  .2 Dashboards: User customizable data using drag and drop HTML5 elements. Shall include Web Charts, Gauges, and other custom developed widgets for web browser. User shall have ability to save custom dashboards.
  .3 Search: User shall have multiple options for searching data based upon Tags. Associated equipment, real time data, Properties, and Trends shall be available in result.
  .4 Properties: Shall include graphic controls and text for the following: Locking or overriding objects, demand strategies, and any other valid data required for setup. Changes made to the properties pages shall require the operator to depress an 'accept/cancel' button.
  .5 Schedules: Shall be used to create, modify/edit and view schedules based on the systems hierarchy (using the navigation tree).
  .6 Alarms: Shall be used to view alarm information geographically (using the navigation tree), acknowledge alarms, sort alarms by category, actions and verify reporting actions.
  .7 Charting: Shall be used to display associated trend and historical data, modify colors, date range, axis and scaling. User shall have ability to create HTML charts through web browser without utilizing chart builder. User shall be able to drag and drop single or multiple data points, including schedules, and apply status colors for analysis.
  .8 Logic - Live Graphic Programs: Shall be used to display' live' graphic programs of the control algorithm, (micro block programming) for the mechanical/electrical system selected in the navigation tree.
  .9 Other actions such as Print, Help, Command, and Logout shall be available via a drop-down window.
.5 Color Graphics: The Web Browser GUI shall make extensive use of color in the graphic pane to communicate information related to set points and comfort. Animated .gifs or .jpg, vector

scalable, active set point graphic controls shall be used to enhance usability. Graphics tools used to create Web Browser graphics shall be non-proprietary and conform to the following basic criteria:

.1 Display Size: The GUI workstation software shall graphically display in a minimum of 1024 by 768 pixels 24 bit True Color.

.2 General Graphic: General area maps shall show locations of controlled buildings in relation to local landmarks.

.3 Color Floor Plans: Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors, as selected by Owner. Provide a visual display of temperature relative to their respective set points. The colors shall be updated dynamically as a zone's actual comfort condition changes.

.4 Mechanical Components: Mechanical system graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. Selected I/O points being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation shall be used for rotation or moving mechanical components to enhance usability.

.5 Minimum System Color Graphics: Color graphics shall be selected and displayed via a web browser for the following:

.1 Each piece of equipment monitored or controlled including each terminal unit.

.2 Each building.

.3 Each floor and zone controlled.

.6 Hierarchical Schedules: Utilizing the Navigation Tree displayed in the web browser GUI, an operator (with proper access credentials) shall be able to define a Normal, Holiday or Override schedule for an individual piece of equipment or room, or choose to apply a hierarchical schedule to the entire system, site or floor area. For example, Independence Day ' Holiday' for every level in the system would be created by clicking at the top of the geographic hierarchy defined in the Navigation Tree. No further operator intervention would be required and every control module in the system with would be automatically downloaded with the ' Independence Day' Holiday. All schedules that affect the system/area/equipment highlighted in the Navigation Tree shall be shown in a summary schedule table and graph.

.1 Schedules: Schedules shall comply with the LonWorks and BACnet standards, (Schedule Object, Calendar Object, Weekly Schedule property and Exception Schedule property) and shall allow events to be scheduled based on:
  .1 Types of schedule shall be Normal, Holiday or Override.
  .2 A specific date.
  .3 A range of dates.
  .4 Any combination of Month of Year (1-12, any), Week of Month (1-5, last, any), Day of Week (M-Sun, Any).
  .5 Wildcard (example, allow combinations like second Tuesday of every month).

.2 Schedule Categories: The system shall allow operators to define and edit scheduling categories (different types of "things" to be scheduled; for example, lighting, HVAC occupancy, etc.). The categories shall include: name, description, icon (to display in the hierarchy tree when icon option is selected) and type of value to be scheduled.

.3 Schedule Groups: In addition to hierarchical scheduling, operators shall be able to define functional Schedule Groups, comprised of an arbitrary group of areas/rooms/equipment scattered throughout the facility and site. For example, the operator shall be able to define an ' individual tenant' group - who may occupy different areas within a building or buildings. Schedules applied to the ' tenant group' shall automatically be downloaded to control modules affecting spaces occupied by the ' tenant group'.

.4 Intelligent Scheduling: The control system shall be intelligent enough to automatically turn on any supporting equipment needed to control the environment in an occupied space. If the operator schedules an individual room in a VAV system for occupancy, for example, the control logic shall automatically turn on the VAV air handling unit, chiller, boiler and/or any other equipment required to maintain the specified comfort and environmental conditions within the room.

.5 Partial Day Exceptions: Schedule events shall be able to accommodate a time range specified by the operator (ex: board meeting from 6 pm to 9 pm overrides Normal schedule for conference room).

.6 Schedule Summary Graph: The schedule summary graph shall clearly show Normal versus Holiday versus Override Schedules and the net operating schedule that results from

all contributing schedules. Note: In case of priority conflict between schedules at the different geographic hierarchy, the schedule for the more detailed geographic level shall apply.

.7 Alarms: Alarms associated with a specific system, area, or equipment selected in the Navigation Tree, shall be displayed in the Action Pane by selecting an ' Alarms' view. Alarms, and reporting actions shall have the following capabilities:

.8 Alarms View: Each Alarm shall display an Alarms Category (using a different icon for each alarm category), date/time of occurrence, current status, alarm report and a bold URL link to the associated graphic for the selected system, area or equipment. The URL link shall indicate the system location, address and other pertinent information. An operator shall easily be able to sort events, edit event templates and categories, acknowledge or force a return to normal in the Events View as specified in this section.

.9 Alarm Categories: The operator shall be able to create, edit or delete alarm categories such as HVAC, Maintenance, Fire, or Generator. An icon shall be associated with each alarm category, enabling the operator to easily sort through multiple events displayed.

.10 Alarm Templates: Alarm template shall define different types of alarms and their associated properties. As a minimum, properties shall include a reference name, verbose description, severity of alarm, acknowledgement requirements, and high/low limit and out of range information.

.11 Alarm Areas: Alarm Areas enable an operator to assign specific Alarm Categories to specific Alarm Reporting Actions. For example, it shall be possible for an operator to assign all HVAC Maintenance Alarm on the 1st floor of a building to email the technician responsible for maintenance. The Navigation Tree shall be used to setup Alarm Areas in the Graphic Pane.

.12 Alarm Time/Date Stamp: All events shall be generated at the DDC control module level and comprise the Time/Date Stamp using the standalone control module time and date.

.13 Alarm Configuration: Operators shall be able to define the type of Alarm generated per object. A ' network' view of the Navigation Tree shall expose all objects and their respective Alarm Configuration. Configuration shall include assignment

of Alarm, type of Acknowledgement and notification for return to normal or fault status.

.14 Alarm Summary Counter: The view of Alarm in the Graphic Pane shall provide a numeric counter, indicating how many Alarms are active (in alarm), require acknowledgement and total number of Alarms in the BAS Server database.

.15 Alarm Auto-Deletion: Alarms that are acknowledged and closed shall be auto-deleted from the database and archived to a text file after an operator defined period.

.16 Alarm Reporting Actions: Alarm Reporting Actions specified shall be automatically launched (under certain conditions) after an Alarm is received by the BAS server software. Operators shall be able to easily define these Reporting Actions using the Navigation Tree and Graphic Pane through the web browser GUI. Reporting Actions shall be as follows:

.1 Print: Alarm information shall be printed to the BAS server's PC or a networked printer.

.2 Email: Email shall be sent via any POP3-compatible e-mail server (most Internet Service Providers use POP3). Email messages may be copied to several email accounts. Note: Email reporting action shall also be used to support alphanumeric paging services, where email servers support pagers.

.3 File Write: The ASCII File write reporting action shall enable the operator to append operator defined alarm information to any alarm through a text file. The alarm information that is written to the file shall be completely definable by the operator. The operator may enter text or attach other data point information (such as AHU discharge temperature and fan condition upon a high room temperature alarm).

.4 Write Property: The write property reporting action updates a property value in a hardware module.

.5 SNMP: The Simple Network Management Protocol (SNMP) reporting action sends an SNMP trap to a network in response to receiving an alarm.

.6 Run External Program: The Run External Program reporting action launches specified program in response to an event.

.7 Trends: As system is engineered, all points shall be enabled to trend. Trends shall both be displayed and user configurable through the Web Browser GUI. Trends shall comprise analog,

digital or calculated points simultaneously. A trend log's properties shall be editable using the Navigation Tree and Graphic Pane.

.1 Viewing Trends: The operator shall have the ability to view trends by using the Navigation Tree and selecting a Trends button in the Graphic Pane. The system shall allow y- and x-axis maximum ranges to be specified and shall be able to simultaneously graphically display multiple trends per graph.

.2 Local Trends: Trend data shall be collected locally by Multi-Equipment/Single Equipment general-purpose controllers, and periodically uploaded to the BAS server if historical trending is enabled for the object. Trend data, including run time hours and start time date shall be retained in non-volatile module memory. Systems that rely on a gateway/router to run trends are NOT acceptable.

.3 Resolution. Sample intervals shall be as small as one second. Each trended point will have the ability to be trended at a different trend interval. When multiple points are selected for displays that have different trend intervals, the system will automatically scale the axis.

.4 Dynamic Update. Trends shall be able to dynamically update at operator-defined intervals.

.5 Zoom/Pan. It shall be possible to zoom-in on a particular section of a trend for more detailed examination and ' pan through' historical data by simply scrolling the mouse.

.6 Numeric Value Display. It shall be possible to pick any sample on a trend and have the numerical value displayed.

.7 Copy/Paste. The operator shall have the ability to pan through a historical trend and copy the data viewed to the clipboard using standard keystrokes (i.e. CTRL+C, CTRL+V).

.8 Security Access: Systems that Security access from the web browser GUI to BAS server shall require a Login Name and Strong Password. Access to different areas of the BAS system shall be defined in terms of Role-Based Access Control privileges as specified:

.1 Roles: Roles shall reflect the actual roles of different types of operators. Each role shall comprise a set of ' easily understood English language' privileges. Roles shall be defined in terms of View, Edit and Function Privileges.

.1 View Privileges shall comprise: Navigation, Network, and Configuration Trees, Operators, Roles and Privileges, Alarm/Event Template and Reporting Action.

.2 Edit Privileges shall comprise: Set point, Tuning and Logic, Manual Override, and Point Assignment Parameters.

.3 Function Privileges shall comprise: Alarm/Event Acknowledgement, Control Module Memory Download, Upload, Schedules, Schedule Groups, Manual Commands, Print and Alarm/Event Maintenance.

.2 Geographic Assignment of Roles: Roles shall be geographically assigned using a similar expandable/collapsible navigation tree. For example, it shall be possible to assign two HVAC Technicians with similar competencies (and the same operator defined HVAC Role) to different areas of the system.

.9 Graphical Programming

.1 The system software shall include a Graphic Programming Language (GPL) for all DDC control algorithms resident in all control modules. Any system that does not use a drag and drop method of graphical icon programming shall not be accepted. All systems shall use a GPL method used to create a sequence of operations by assembling graphic microblocks that represent each of the commands or functions necessary to complete a control sequence. Microblocks represent common logical control devices used in conventional control systems, such as relays, switches, high signal selectors etc., in addition to the more complex DDC and energy management strategies such as PID loops and optimum start. Each microblock shall be interactive and contain the programming necessary to execute the function of the device it represents.

.2 Graphic programming shall be performed while on screen and using a mouse; each microblock shall be selected from a microblock library and assembled with other microblocks necessary to complete the specified sequence. Microblocks are then interconnected on screen using graphic "wires," each forming a logical connection. Once assembled, each logical grouping of microblocks and their interconnecting wires then forms a graphic function block which may be used to control any piece of equipment with a similar point configuration and sequence of operation.

.3 Graphic Sequence: The clarity of the graphic sequence shall be such that the operator has the ability to verify that system programming meets the specifications, without having to learn or interpret a manufacturer's unique programming language. The graphic programming shall be self-documenting and

provide the operator with an understandable and exact representation of each sequence of operation.

.4 GPL Capabilities: The following is a minimum definition of the capabilities of the Graphic Programming software:

.1 Function Block (FB): Shall be a collection of points, microblocks and wires which have been connected together for the specific purpose of controlling a piece of HVAC equipment or a single mechanical system.

.2 Logical I/O: Input/Output points shall interface with the control modules in order to read various signals and/or values or to transmit signal or values to controlled devices.

.3 Microblocks: Shall be software devices that are represented graphically and may be connected together to perform a specified sequence. A library of microblocks shall be submitted with the control contractors bid.

.4 Wires: Shall be Graphical elements used to form logical connections between microblocks and between logical I/O.

.5 Reference Labels: Labels shall be similar to wires in that they are used to form logical connections between two points. Labels shall form a connection by reference instead of a visual connection, i.e. two points labeled 'A' on a drawing are logically connected even though there is no wire between them.

.6 Parameter: A parameter shall be a value that may be tied to the input of a microblock.

.7 Properties: Dialog boxes shall appear after a microblock has been inserted which has editable parameters associated with it. Default parameter dialog boxes shall contain various editable and non-editable fields, and shall contain 'push buttons' for the purpose of selecting default parameter settings.

.8 Icon: An icon shall be graphic representation of a software program. Each graphic microblock has an icon associated with it that graphically describes its function.

.9 Menu-bar Icon: Shall be an icon that is displayed on the menu bar on the GPL screen, which represents its associated graphic microblock.

.10 Live Graphical Programs: The Graphic Programming software shall support a ' live' mode, where all input/output data, calculated data and set points shall be displayed in a ' live' real-time mode.

.10 LONWORKS Network Management

.1 Systems requiring the use of third-party LonWorks network management tools shall not be accepted.

.2 Network management shall include the following services: device identification, device installation, device configuration, device diagnostics, device maintenance and network variable binding.

.3 The Network configuration tool shall also provide diagnostics to identify devices on the network, to reset devices and to view health and status counters within devices.

.4 These tools shall provide the ability to "learn" an existing LonWorks network, regardless of what network management tool(s) were used to install the existing network, so that existing LonWorks devices and newly added devices are part of a single network management database.

.5 The network management database shall be resident in the Network Area Controller (NAC), ensuring that anyone with proper authorization has access to the network management database at all times. Systems employing network management databases that are not resident, at all times and within the control system shall not be accepted

3.4 Additional Automation Items

.1 Any electrical or fire alarm shutdowns required by the Contractor for the scope of work must be approved by the Owner two (2) weeks prior to being performed for coordination purposes.

.2 All valves and controls should be located at ergonomic heights unless technically unfeasible.

.3 All equipment installations must be constructed in conformance with the all local, state, and national code. Any additional requirements from the latest codes and standards supersede any requirements as written in this document.

.4 All equipment shall be installed such that it meets or exceeds the manufacturer’s recommended installation practices and requirements.

.5 The automation contractor must have a service staff member with spare components available no more than a 4-hour transport distance from the facility for emergency repairs or adjustments.

.6 The automation contractor must provide the Consultant with remote user access to the automation system. The remote user access must include control functionality such that changes may be made to setpoints or schedules as needed.

.7 Power and control wiring as much as possible is to be run through the building in non-accessible locations to the buildings occupants in the most aesthetically pleasing method as reasonable.
  .1 Power and control wiring shall be run in conduit as much as possible.
  .2 Power and control wiring shall be firmly secured to surfaces, walls, cable trays, or other.
  .3 Power and control wiring is to be run parallel along walls at a minimum elevation of 7 ft in occupied corridors or along the ceiling of these zones to prevent interference with building occupants.

.8 The automation contractor is responsible for performing a full operational test of the automation and controls system in manual (backup) mode to ensure full functionality of the system.

.9 All automation valves equipped with actuators shall feature position feedback functionality.

PART 4 – WATER PIPING

4.1 Water Piping General Comments

.1 All work of this Division shall be coordinated and provided by the Mechanical Contractor.

.2 All materials shall be first class and new.

.3 The Mechanical Contractor shall work with the facility, and the Consultant to provide completed hydronic piping in a timely manner.

.4 The work of this Division shall be as required by the Specifications and Schematic.

.5 If the Contractor believes there are conflicts or missing information in the project documents, the Contractor shall promptly request clarification and instruction from the Consultant.

4.2 Water Piping Definitions

.1 Water Piping: Piping which contains water (or a glycol mixture) for the purpose of distribution to loads.

.2 Mechanical Contractor (or Contractor): The Contractor responsible for supply and installation of all water piping components and requirements as specified.

4.3 Water Piping Description

.1 The supply and installation of piping, labeling, identification and insulation as outlined.

.2 The work shall consist of the provision of all labour, materials, tools, equipment, testing, commissioning, training services, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in this documents which are required for the complete, fully functional and commissioned water piping system.

.3 Provide a complete, neat and workmanlike installation. Use only manufacturers and employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project.

.4 Manage and coordinate the work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.

4.4 Water Piping Quality Assurance

.1 General
- .1 The Contractor shall be a recognized national supplier, installer and service provider for water piping.
- .2 As part of Risk Management and evidence and assurance of the contractor's ability to support the Owner's system with service and parts, the Contractor must have been in the business for at least the last ten (10) years and have successfully completed a total of ten (10) piping systems in the preceding five (5) years.

.2 Workplace Safety and Hazardous Materials
- .1 Provide a safety program in compliance with the Contract Documents.
- .2 The Contractor shall have a corporately certified comprehensive Safety Certification Manual and a designated Safety Supervisor for the Project.
- .3 The Contractor and its employees and subtrades comply with federal, state and local safety regulations.
- .4 The Contractor shall ensure that all subcontractors and employees have written safety programs in place that covers their scope of work, and that their employees receive the training required by the Health and Safety Commission in the jurisdiction for at least each topic listed in the Safety Certification Manual.
- .5 Hazards created by the Contractor or its subcontractors shall be eliminated before any further work proceeds.
- .6 Hazards observed but not created by the Contractor or its subcontractors shall be reported to either the Consultant or the Owner within the same day. The Contractor shall be required to avoid the hazard area until the hazard has been eliminated.
- .7 The Contractor shall sign and date a safety certification form prior to any work being performed, stating that the Contractors' company is in full compliance with the Project safety requirements.
- .8 The Contractor's safety program shall include written policy and arrangements for the handling, storage and management of all hazardous materials to be used in the work in compliance with the requirements of the Authorities Having Jurisdiction at the Project site.
- .9 The Contractor's employees and subcontractor's staff shall have received training as applicable in the use of hazardous materials and shall govern their actions accordingly.

.3 Quality Management Program
  .1 Designate a competent and experienced employee to provide Project Management. The designated Project Manager shall be empowered to make technical, scheduling and related decisions on behalf of the Contractor. At minimum, the Project Manager shall:
    .1 Manage the scheduling of the work to ensure that adequate materials, labour and other resources are available as needed.
    .2 Manage the financial aspects of the Contract.
    .3 Coordinate as necessary with other trades.
    .4 Be responsible for the work and actions of the workforce on site.

4.5 Water Piping Codes and Standards

.1 Contractor to comply with all codes and standards applicable to this type of work, including;
  .1 ASME B31.9 Building Service Piping
  .2 ASME Boiler and Pressure Vessel Code
  .3 Local, State and National Building Codes
  .4 ASHRAE Standards
  .5 OSHA Regulations

.2 In the case of conflicts or discrepancies, the more stringent regulation shall apply.

.3 All work shall meet the approval of the Authorities Having Jurisdiction at the project site.

4.6 Water Piping Record Documentation

.1 Provide two (2) paper copies and one (1) electronic copy of as-built water piping schematics and layouts for all installed piping covered under this contract.

.2 Manual shall be bound in 3 ring binders and contain, as a minimum, the following:
  .1 System operation and maintenance instructions, troubleshooting guidelines and operating log.
  .2 Safety bulletins and material safety data sheets.
  .3 Equipment operation and maintenance instructions.
  .4 Signed Dept. of Labour (or equivalent) Pressure Tests Data Reports
  .5 Shop drawings of all supplied equipment

.3 As-built drawings shall contain, typical piping layout, material details, piping connection details, and any additional pertinent details regarding the piping.

4.7 Water Piping Warranty

.1 Standard Material and Labour Warranty:
  .1 The Contractor shall provide a one-year labour and material warranty from the date of substantial completion on the water piping system including all valves and fittings.
  .2 If within twelve (12) months from the date of acceptance of product, upon written notice from the owner, any portion of the Water Piping system is found to be defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted at the option of the Contractor and at the cost of the Contractor.

4.8 Water Piping Scope of Work

.1 Piping shall conform to ASME B31.9 Building Service Piping.

.2 Piping shall be as follows
  .1 All Glycol and Water Piping
    .1 Up to 1 1/2" IPS
      .1 Schedule 40 ERW OR
      .2 Schedule 40 Seamless Black Steel Pipe With 150 LB Threaded, OR
      .3 Schedule 40 3M Socket Weld
    .2 2" IPS and up
      .1 Schedule 40 ERW Black Steel Pipe with Standard Butt Weld Fittings,

.3 Pipe fittings shall be as follows
  .1 Steel Piping
    .1 Flanges ANSI & RF
      .1 ASTM A105
      .2 Pressure Rating to Match Design Working Pressure
    .2 Up to 1 1/2" IPS
      .1 Threaded – Forged Steel, ASTM A105, 3000 LBS
      .2 Socket Weld – Forged Steel, ASTM A105, 3000 LBS
      .3 Butt Weld – Carbon Steel, ASTM SA-234-WPB E.H.
    .3 2" and Up
      .1 Socket Weld – Forged Steel, ASTM A105, 3000 LBS
      .2 Butt Weld – Carbon Steel, ASTM SA-234-WPB STD
  .2 Copper Piping
    .1 Up to 4"
      .1 Join using lead free solder suitable for domestic water system in conformance with ASTM B52 Gr 50A.
      .2 ATSM B88.
      .3 Any connections to dissimilar metals to include dielectric union.

.4 Piping shall be identified as per Owner's Current Labeling Standards. In the event that no standard is currently in place, labeling shall be as follows.
  .1 Labeling body shall be Black on Safety Yellow
  .2 Labeling shall indicate flow of water
  .3 Label Size, text height and placement should conform to ASME A13.1
    .1 Labels shall be adjacent to all valves and flanges
    .2 Adjacent to all changes of direction
    .3 On both sides of a wall or floor penetration
    .4 At regular intervals on straight runs (maximum 50 feet spacing)
  .4 Label Size, and Letter Size

| Outside Pipe Diameter, including insulation (in.) | Minimum Label Length (in.) | Minimum Letter Height (in.) |
|---|---|---|
| < 1.25 | 8 | 0.5 |
| 1.5 – 2 | 8 | 0.75 |
| 2.5 – 6 | 12 | 1.25 |
| 8 – 10 | 24 | 2.5 |
| > 10 | 32 | 3.5 |

.5 All insulated field fabricated steel piping shall be painted with a rust resistant primer prior to painting and insulation.
  .1 Standard of Acceptance: Polyguard RG-2400 Primer, or approved equivalent.

.6 To further protect the piping system, the piping shall be painted.
  .1 Colors shall match existing color scheme currently utilized at the facility. If no color scheme is present, the following shall be used
    .1 Light Blue Cold Glycol
    .2 Dark Blue Warm Glycol
    .3 Green Domestic Hot and Cold Water

.7 Piping shall be supported as follows

| Nominal Diameter Pipe NPS (in.) | Recommended Spacing Between Hangers (ft.) | Minimum Rod Size (in.) |
|---|---|---|
| 1/2 | 7 | 3/8 |
| 3/4 | 7 | 3/8 |
| 1 | 7 | 3/8 |
| 1-1/2 | 9 | 3/8 |
| 2 | 10 | 3/8 |
| 2-1/2 | 11 | 1/2 |
| 3 | 12 | 1/2 |
| 4 | 14 | 5/8 |
| 6 | 17 | 3/4 |
| 8 | 19 | 3/4 |
| 10 | 22 | 7/8 |
| 12 | 23 | 7/8 |
| 14 | 25 | 1 |
| 16 | 27 | 1 |
| 18 | 28 | 1 |
| 20 | 30 | 1-1/4 |
| 24 | 32 | 1-1/4 |

.8 Pipe hangars must include rubber lining on the inside of the clamp to prevent pipe wear, unless the pipe is insulated.

.9 Mechanical system shut-off valves:

.1 All hand shutoff valves shall be ball valves or butterfly valves.

.2 Valve type used:

.1 ¼" to 2", threaded full port ball valves

.2 2 ½" to 8", full lug type butterfly valves

.3 Ball valves to be two (2) piece construction with bronze or steel body, stainless steel ball and manual lever actuator with stem extension. Ball valves to have a rated working pressure or 600 PSIG.

.4 Butterfly valves to be full lug style and constructed with ductile iron body, ductile iron nickel plated disc, stainless steel shaft, and BUNA-N seat. Butterfly valve to have rated working pressure of 225 PSIG.

.10 Valve flow coefficient shall be, at minimum, as per the following. Pressure drop across any fully open valve shall be at maximum 1.5 psi.

| Pipe Size (in.) | CV |
|---|---|
| 1-1/2 | 45 |
| 2 | 75 |
| 2-1/2 | 140 |
| 3 | 240 |
| 4 | 400 |
| 5 | 700 |
| 6 | 1000 |
| 8 | 2100 |
| 10 | 3100 |
| 12 | 4500 |

.11 Indoor Glycol Piping Insulation
- .1 To be installed on cold side glycol piping located indoors.
- .2 Temperature range: Any
- .3 Thickness: 1”
- .4 Insulation Type: Polyiso
- .5 Jacket Type: PVC
  - .1 Single piece, pre-curled for insulation thickness

.12 Outdoor Glycol Piping Insulation
- .1 Temperature range: Any
- .2 Thickness: 2”
  - .1 To be installed on all cold side glycol piping located outdoors.
- .3 Thickness: 1”
  - .1 To be installed on all warm side glycol piping located outdoors.
- .4 Insulation Type: Polyiso
- .5 Jacket Type: Aluminum
  - .1 Single piece, pre-curled for insulation thickness
  - .2 Jacket thickness shall be 0.024”
  - .3 Standard of Acceptance: Johns Mansville Aluminum Roll Jacketing, or approved equivalent.

.13 Water Piping Insulation
- .1 Temperature range: Any
- .2 Insulation Type: Polyiso
- .3 Thickness: 1”
- .4 Jacket Type: PVC
  - .1 Single piece, pre-curled for insulation thickness

.14 Unless otherwise indicated, all materials must be new, first quality and approved by at least one of the following organizations: ULC,

ARI, AMCA, ASME or any other body with jurisdiction in the area concerned.

.15 Piping system test pressures:
- .1 All new piping to be pressure tested. Provide all test results to Owner upon completion.
- .2 Type of test: Hydronic
- .3 Cold Glycol System: 80 PSI.
- .4 Warm Glycol System: 100 PSI.

4.9 Specific Requirements

.1 The proponent is responsible for:
- .1 All pipe, valves and fittings shall be installed as per Local, State, and National Code.
- .2 Construction is to be completed in conjunction with owner.

4.10 Installation Practices

.1 All piping shall be installed as per manufacturer's specifications in accordance with ASME B31.9 as required.

.2 All piping shall be installed straight and true, and parallel to all walls.

.3 All valves and controls should be located at ergonomic heights unless technically unfeasible.

.4 All valves shall be tagged with identification tags, and a reference key identifying each valve shall be provided with the as-built drawings.

.5 Piping shall be installed as per the drawings package.

.6 Piping installed in public spaces shall be located inside a metallic mesh cage to prevent damage and unauthorized access.

## PART 5 – REFRIGERANT PIPING

### 5.1 Refrigerant Piping General Comments

.1 All work of this Division shall be coordinated and provided by the Mechanical Contractor.

.2 All materials shall be first class and new.

.3 The Refrigeration Contractor shall work with the facility, and the Consultant to provide completed refrigeration piping in a timely manner.

.4 The work of this Division shall be as required by the Specifications and Schematic.

.5 If the Contractor believes there are conflicts or missing information in the project documents, the Contractor shall promptly request clarification and instruction from the design team.

.6 The following specification is for the refrigerant relief piping from the new refrigeration package(s).

### 5.2 Refrigerant Piping Definitions

.1 Refrigerant Piping: Piping which contains refrigerant as any stage within the refrigeration cycle.

.2 Refrigerant Relief Piping: Piping specifically used to vent refrigerant to atmosphere, in the event of an emergency or for testing purposes.

.3 Refrigeration Contractor (or Contractor): The Contractor responsible for supply and installation of all refrigerant piping components and requirements as specified.

### 5.3 Refrigerant Piping Description

.1 The supply and installation of refrigerant piping, labeling, identification and insulation as outlined.

.2 The work shall consist of the provision of all labour, materials, tools, equipment, testing, commissioning, training services, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in this documents which are required for the complete, fully functional and commissioned refrigerant piping system.

.3 Provide a complete, neat and workmanlike installation. Use only manufacturers and employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project.

.4 Manage and coordinate the work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.

5.4 Refrigerant Piping Quality Assurance

.1 General

.1 The Refrigeration Contractor shall be a recognized national supplier, installer and service provider for refrigerant piping.

.2 As part of Risk Management and evidence and assurance of the contractor's ability to support the Owner's system with service and parts, the Contractor must have been in the business for at least the last ten (10) years and have successfully completed a total of ten (10) refrigerant piping systems in the preceding five (5) years.

.2 Workplace Safety and Hazardous Materials

.1 Provide a safety program in compliance with the Contract Documents.

.2 The Contractor shall have a corporately certified comprehensive Safety Certification Manual and a designated Safety Supervisor for the Project.

.3 The Contractor and its employees and subtrades comply with federal, state and local safety regulations.

.4 The Contractor shall ensure that all subcontractors and employees have written safety programs in place that covers their scope of work, and that their employees receive the training required by the Health and Safety Commission in the jurisdiction for at least each topic listed in the Safety Certification Manual.

.5 Hazards created by the Contractor or its subcontractors shall be eliminated before any further work proceeds.

.6 Hazards observed but not created by the Contractor or its subcontractors shall be reported to either the Consultant or the Owner within the same day. The Contractor shall be required to avoid the hazard area until the hazard has been eliminated.

.7 The Contractor shall sign and date a safety certification form prior to any work being performed, stating that the Contractors'

company is in full compliance with the Project safety requirements.

.8 The Contractor's safety program shall include written policy and arrangements for the handling, storage and management of all hazardous materials to be used in the work in compliance with the requirements of the Authorities Having Jurisdiction at the Project site.

.9 The Contractor's employees and subcontractor's staff shall have received training as applicable in the use of hazardous materials and shall govern their actions accordingly.

.3 Quality Management Program

.1 Designate a competent and experienced employee to provide Project Management. The designated Project Manager shall be empowered to make technical, scheduling and related decisions on behalf of the Contractor. At minimum, the Project Manager shall:

.2 Manage the scheduling of the work to ensure that adequate materials, labour and other resources are available as needed.

.3 Manage the financial aspects of the Contract.

.4 Coordinate as necessary with other trades.

.5 Be responsible for the work and actions of the workforce on site.

5.5 Refrigerant Piping Codes and Standards

.1 Contractor to comply with all codes and standards applicable to this type of work, including;

.1 ASME B31.9 Building Service Piping

.2 ASME Boiler and Pressure Vessel Code

.3 Local, State and National Building Codes

.4 ASHRAE Standards

.5 OSHA Regulations

.2 In the case of conflicts or discrepancies, the more stringent regulation shall apply.

.3 All work shall meet the approval of the Authorities Having Jurisdiction at the project site.

5.6 Refrigerant Piping Record Documentation

.1 Provide two (2) paper copies and one (1) electronic copy of as-built refrigerant piping schematics and layouts for all installed piping covered under this contract.

.2 Manual shall be bound in 3 ring binders and contain, as a minimum, the following:

.1 System operation and maintenance instructions, troubleshooting guidelines and operating log.
.2 Safety bulletins and material safety data sheets.
.3 Equipment operation and maintenance instructions.
.4 Signed Dept. of Labour (or equivalent) Pressure Tests Data Reports
.5 Shop drawings of all supplied equipment

.3 As-built drawings shall contain, typical piping layout, material details, piping connection details, and any additional pertinent details regarding the piping.

5.7 Refrigerant Piping Warranty

.1 Standard Material and Labour Warranty:

.1 The Contractor shall provide a one-year labour and material warranty from the date of substantial completion on the refrigerant piping system including all valves and fittings.

.2 If within twelve (12) months from the date of acceptance of product, upon written notice from the Owner, any portion of the Refrigerant Piping system is found to be defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted at the option of the Contractor and at the cost of the Contractor.

5.8 Refrigerant Piping Scope of Work

.1 Refrigerant piping shall conform to ASME B31.5 Refrigeration piping code.

.2 Refrigerant piping shall be as follows
.2 Up to 1 1/2” IPS
.1 Schedule 80 ASTM A53 Grade A or B Seamless, OR
.2 Schedule 80 ASTM A106 Grade A or B Seamless, OR
.3 Schedule 80 ASTM A333 Grade 1 or 6 Seamless
.3 2” IPS and up
.1 Schedule 40 ASTM A53 Grade A or B ERW, OR
.2 Schedule 40 ASTM A106 Grade A or B Seamless, OR
.3 Schedule 40 ASTM A333 Grade 1 or 6 Seamless
.4 All piping shall bear the manufacturers identification and conform to the pervious specifications.

.3 Refrigerant pipe fittings shall be as follows
.2 Flanges ANSI & RF
.1 ASTM A105
.3 Pressure Rating to Match Design Working Pressure
.4 Up to 1 1/2” IPS
.1 Threaded – Forged Steel, ASTM A105, 3000 LBS
.2 Socket Weld – Forged Steel, ASTM A105, 3000 LBS

.3 Butt Weld – Carbon Steel, ASTM SA-234-WPB E.H.

.5 2" and Up

.1 Socket Weld – Forged Steel, ASTM A105, 3000 LBS

.2 Butt Weld – Carbon Steel, ASTM SA-234-WPB STD

.4 Piping shall be identified as per the Refrigeration Pipe Labeling Guide:

.1 Labeling body shall be Black on Safety Yellow

.2 Labeling shall indicate flow of refrigerant and arrows shall be present on both sides of the label, with arrows wrapping around the entire circumference of the pipe

.3 Labeling shall have an abbreviation legend

.4 Labeling shall identify the system component as per the table listed below

.5 Labeling shall identify refrigerant physical state (Liquid or Vapour)

.1 Liquid shall be abbreviated as LIQ and set upon an Orange background

.2 Vapour shall be abbreviated as VAP and set upon a Blue background

.6 Labeling shall identify the working fluid as refrigerant

.7 Labeling shall identify pressure level

.1 LOW shall be any pressure below 70 psig and set upon a green background

.2 HIGH shall be any pressure above 70 psig and set upon a red background

.8 Label Size, text height and placement should conform to ASME A13.1

.1 Labels shall be adjacent to all valves and flanges

.2 Adjacent to all changes of direction

.3 On both sides of a wall or floor penetration

.4 At regular intervals on straight runs (maximum 50 feet spacing)

| | | |
|---|---|---|
| .1 | BD | Booster Discharge |
| .2 | CD | Condenser |
| .3 | DS | Defrost Condensate |
| .4 | ES | Economizer Suction |
| .5 | HGD | Hot Gas Defrost |
| .6 | HPL | High Pressure Liquid |
| .7 | HSD | High Stage Discharge |
| .8 | HSS | High Stage Suction |
| .9 | HTRL | High Temperature Recirculated Liquid |
| .10 | HTRS | High Temperature Recirculated Suction |
| .11 | LTRL | Low Temperature Recirculated Liquid |

.12 LTRS Low Temperature Recirculated Suction
.13 LIC Liquid Injection Cooling
.14 LSS Low Stage Suction
.15 RV Relief Vent
.16 TSR Thermosiphon Return
.17 TSS Thermosiphon Supply

.5 Label Size, and Letter Size

| Outside Pipe Diameter, including insulation (in) | Minimum Label Length (in) | Minimum Letter Height (in) |
|---|---|---|
| < 1.25 | 8 | 0.5 |
| 1.5 – 2 | 8 | 0.75 |
| 2.5 – 6 | 12 | 1.25 |
| 8 – 10 | 24 | 2.5 |
| > 10 | 32 | 3.5 |

.5 All insulated field fabricated steel piping shall be painted with a rust resistant primer prior to painting and insulation.
.1 Standard of Acceptance: Polyguard RG-2400 Primer, or approved equivalent.

.6 To further protect the refrigerant piping, the piping shall be painted.
.1 Colors shall match existing color scheme currently utilized at the facility. If no color scheme is present, the following shall be used
.1 Red Compressor High Vapour
.2 Yellow Intermediate Pressure
.3 Orange High Pressure Liquid
.4 Blue Low Pressure Liquid or Vapour
.5 Green Water

.7 Refrigerant piping shall be supported as follows

| Nominal Diameter Pipe NPS (in) | Recommended Spacing Between Hangers (ft.) | Recommended Rod Size (in) |
|---|---|---|
| 1/2 | 7 | 3/8 |
| 3/4 | 7 | 3/8 |
| 1 | 7 | 3/8 |
| 1-1/2 | 9 | 3/8 |
| 2 | 10 | 3/8 |
| 2-1/2 | 11 | 1/2 |
| 3 | 12 | 1/2 |
| 4 | 14 | 5/8 |
| 6 | 17 | 3/4 |
| 8 | 19 | 3/4 |
| 10 | 22 | 7/8 |
| 12 | 23 | 7/8 |
| 14 | 25 | 1 |
| 16 | 27 | 1 |
| 18 | 28 | 1 |
| 20 | 30 | 1-1/4 |
| 24 | 32 | 1-1/4 |

.8 Refrigerant isolation valves to be Angle or Globe type only.

.1 Supply and Return refrigerant valves to compressors shall be Angle type

.2 Supply and Return refrigerant valves to Plate and Frames shall be Globe type

.3 Supply and Return refrigerant valves to Condenser shall be Globe type

.4 Inline refrigerant valves shall be Globe type

.9 All refrigerant valves to be equipped with seal caps; however, handwheels shall also be provided.

.10 Refrigerant Valve flow coefficient shall be, at minimum, as per the following

| Pipe Size (in) | CV | Equivalent Pipe Length (ft.) |
|---|---|---|
| 1-1/2 | 45 | 11 |
| 2 | 75 | 26 |
| 2-1/2 | 115 | 22 |
| 3 | 180 | 31 |
| 4 | 280 | 54 |
| 5 | 550 | 47 |
| 6 | 775 | 65 |
| 8 | 1300 | 85 |
| 10 | 2250 | 97 |
| 12 | 3000 | 116 |
| 14 | 4000 | 143 |
| 16 | 5500 | 155 |

.11 Refrigerant systems shall be equipped with Pressure Relief valves. The Relief Valves shall start to function at a pressure not exceeding the design pressure of the system being protected.

.1 Stop Valves shall not be located between pressure relief valve and the system, unless when pressure relief valves are installed in parallel.

.2 The discharge to atmosphere shall be not less than 15 ft. above the adjoining ground level, and not less than 20 ft. from any window, ventilation opening, pedestrian walkway, or exit.

.12 Unless otherwise indicated, all materials must be new, first quality and approved by at least one of the following organizations: ULC, ARI, AMCA, ASME or any other body with jurisdiction in the area concerned.

.13 All refrigerant piping and fittings shall conform to the latest edition of the ASME B31.5 Refrigeration Piping and Heat Transfer Components.

5.9 Refrigerant Piping Specific Requirements

.1 The contractor shall provide a new refrigerant relief stack, which extends a minimum of 15 ft above the adjoining ground level and is 20 ft from any window, ventilation opening, pedestrian walkway, or building exit.

.1 A diffusor and goose-neck must be included on the relief stack to prevent direct spray of refrigerant on personnel in the vicinity and prevent foreign material or debris from entering the discharge piping.

.2 The proponent is responsible for:
  .1 All pipe, valves and fittings shall be installed as per code. The pipe sizes and valve equipment list are provided in drawings package.
  .2 Construction is to be completed in conjunction with the Owner.

5.10 Refrigerant Piping Installation Practices

.1 All piping shall be installed as per manufacturer's specification.

.2 Where refrigerant piping must cross an open space that provides a passageway, piping shall be installed no less than 7.5 feet above floor, unless it is against the ceiling of such a space.

.3 All valves and controls should be located at ergonomic heights unless technically unfeasible.

.4 All piping shall be installed straight and true, and parallel to all walls.

.5 Refrigerant piping shall not be installed in an enclosed stairway, stair landing or exit. Piping shall not be installed in an elevator, dumb waiter, or shaft containing a moveable object.

.6 All refrigerant piping, valves, and fittings shall be free of copper, zinc and its specific alloys.

.7 All refrigerant valves shall be tagged with identification tags, and a reference key identifying each valve shall be located within the mechanical room.

.8 Piping and valves shall be installed as per the drawings package.

.9 Piping installed in public spaces shall be located inside a metallic mesh cage to prevent damage and unauthorized access.

# PART 6 - ELECTRICAL DESIGN-BUILD

## 6.1 Electrical Design-Build Description

.1 The design-build of an electrical system as outlined.

.2 The intent of the electrical design-build is that no loss of ice time will occur. This contractor must be able to demonstrate to the Owner that a proper plan be implemented such that the allotted time for installation is satisfied.

.1 If the start-up date for the electrical design-build does not occur by the substantial completion date, the Contractor will be responsible for supplying and installing temporary power at no cost to the Owner. The Contractor is responsible for all equipment selection and functionality in this scenario.

.2 At the option of the Contractor, temporary power may be provided in lieu of meeting the substantial completion date. This must be noted at the time of bidding and include all costs relating to switching-over the plant from the temporary to the permanent power. This must be approved by the Owner. The Contractor is responsible for all equipment selection and functionality within this option.

.3 Supply and install electrical design-build components, including wiring, panels, labour, and other electrical equipment.

.4 The work shall consist of the provision of all labour, materials, tools, equipment, testing, commissioning, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, removal, installation, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in these documents which are required for the complete, fully functional, and commissioned electrical system.

.5 Provide a complete, neat, and workmanlike installation. Use only employees who are certified journeyman or registered apprentices (under the supervision of a journeyman). The labour used to carry out the work shall be skilled, experienced, trained, and is to be familiar with the specific equipment, software, standards, and configurations to be provided for this Project. Contractors must

submit registration numbers for key personnel that are certified journeyman.

.6 Manage and coordinate the work in a timely manner in consideration of the Project schedule.

6.2 Electrical Design-Build Scope of Work

.1 The Contractor shall provide a design-build electrical scope to provide all required electrical feed for the new refrigeration plant under this project.

.2 The electrical requirements of the plant are provided in 24021 E-701 Single Line Diagram.

.3 The Contractor is to pull from the plant room electrical panel connections based on the preliminary single line diagram verified by the Contractor's team for the refrigeration plant equipment, instrumentation, and controllers.

.1 The Contractor must coordinate with the Owner and Owner's Electrical to determine the requirements for starters, contactors, and any other relevant components.

.4 All wiring and conduit from the plant room electrical panel directly to equipment and instrumentation, including controllers, is the responsibility of the Contractor of this division.

.5 The Contractor is to coordinate the installation of the Building Main Power and Refrigeration Power Meters with the Owner and Owner's Electrical.

.6 Power and control wiring as much as possible is to be run through the building in non-accessible locations to the building occupants in the most aesthetically pleasing method as reasonable.

.1 Power and control wiring shall be run in conduit as much as possible

.2 Power and control wiring shall be firmly secured to surfaces, walls, cable trays or other.

.3 Power and control wiring is to be run parallel along walls at a minimum elevation of 7 ft in occupied corridors or along the ceiling of these zones to prevent interference with building occupants.

.7 Any disagreements between these requirements and relevant Electrical Codes for the local municipality are trumped by the Electrical Codes.

.8 The contractor is responsible for all required new electrical equipment. Reconfiguration is required to provide adequate power to the new equipment.

PART 7 – Time & Material

7.1 Time & Material Description

.1 The intent of the time & material scope of work is that the existing rink floor header piping be connected to the new refrigeration plant piping.
  .1 The Contractor must coordinate with the Owner and the Consultant to determine the location which new piping will be tied into the existing header piping
.2 The location of the existing rink floor header piping is not known and must be determined by the Contractor.
  .1 Although the existing header piping location is not known, the expected main header piping location is indicated in the drawings package.
.3 The contractor is responsible for repairing all damage to the facility that occurs when executing the time & material scope of work.
.4 All work will be completed on a time and material basis.
.5 All time & material work must be completed during a building shutdown period which is scheduled to occur between the dates of 30-Jun-25 and 25-Jul-25.

7.2 Time & Material Scope of Work

.1 Locate and excavate the existing main cold floor header pipes which are serving the two ice sheets.
  .1 This includes the NHL ice sheet cold floor supply, the NHL ice sheet cold floor return, the studio ice sheet cold floor supply, and the studio ice sheet cold floor return.
.2 Locate and excavate the existing main warm floor header pipes which are serving the two ice sheets.
  .1 This includes the NHL ice sheet warm floor supply, the NHL ice sheet warm floor return, the studio ice sheet warm floor supply, and the studio ice sheet warm floor return.
.3 Supply and install piping components as indicated in the drawings package.
  .1 The Contractor must coordinate with the Owner and the Consultant to determine the location which new piping will be tied into the existing header piping.
  .2 Piping components shall conform with the specifications in Part 4 – Water Piping.

.4 Supply and install four (4) immersion water/glycol temperature sensors.
  .1 Temperature sensor is to have a working range of -40°F to 250°F.
  .2 Contractor to include well.
  .3 Standard of Acceptance: Honeywell C7041D2001, or approved equivalent.
  .4 Sensors are to be integrated to the automation system in conformity with the drawings package as well as the specifications in Part 3 – Automation.

.5 Supply and install valves as indicated in the drawings package.

.6 Following the installation of all components in the time & material scope of work, the Contractor will be responsible for repairing all damage that was done to the facility.
  .1 This includes repairing the floor that was excavated to determine the location of existing header piping.
  .2 This includes replacing any flooring that was removed.

**COLUMBUS PARKS AND**
**RECREATION DEPARTMENT**
**CITY OF COLUMBUS, INDIANA**

## Hamilton Community Center & Ice Arena Plant Conversion Project

# Exhibit N

Drawings Package

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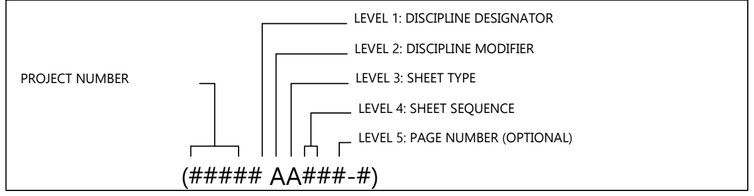
**IBS DRAWING SHEET DEFINITION**




| LEVEL 1 DISCIPLINE DESIGNATOR | |
|---|---|
| A | ARCHITECTURAL |
| B | GEOTECHNICAL |
| C | CIVIL |
| D | PROCESS |
| E | ELECTRICAL |
| F | FIRE PROTECTION |
| H | HAZARDOUS MATERIALS |
| I | INTERIORS |
| L | LANDSCAPE |
| M | MECHANICAL |
| O | OPERATIONS |
| P | PLUMBING |
| Q | EQUIPMENT |
| R | RESOURCE |
| S | STRUCTURAL |
| T | TELECOMMUNICATIONS |
| V | SURVEY/MAPPING |
| W | DISTRIBUTED ENERGY |
| X | OTHER DISCIPLINES |
| Z | CONTRACTOR/SHOP DRAWINGS |

| LEVEL 2 DISCIPLINE MODIFIER | | |
|---|---|---|
| | - | MODIFIER NOT USED |
| M | B | BOARDS & GLASS |
| | D | DEMOLITION |
| | H | HVAC |
| | I | INSTRUMENTATION |
| | P | PIPING |
| | R | RINK FLOOR |

| LEVEL 3 SHEET TYPE | |
|---|---|
| 0 | GENERAL |
| 1 | PLANS |
| 2 | ELEVATIONS |
| 3 | SECTIONS |
| 4 | LARGE-SCALE VIEWS |
| 5 | DETAILS |
| 6 | SCHEDULES & DIAGRAMS |
| 7 | COORDINATION |
| 8 | DESIGN STANDARD |
| 9 | 3D REPRESENTATIONS |

| LEVEL 4 SHEET SEQUENCE | |
|---|---|
| 01-99 | SEQUENTIAL VALUE |
| ODD | DISTINCT DRAWINGS |
| EVEN | MIRROR DRAWINGS |

**REVISION LOG**

| DRAWING # | DRAWING NAME | VER: | ISSUED FOR: | DATE |
|---|---|---|---|---|
| 24021 M-101 | SCOPE DIVISION LAYOUT | VER: 1.0 | ISSUED FOR TENDER | 06-NOV-24 |
| 24021 M-601 | SCHEMATICS & SCHEDULES | VER: 2.0 | ISSUED FOR TENDER | 06-NOV-24 |
| 24021 M-401 | EQUIPMENT LAYOUT | VER: 2.0 | ISSUED FOR TENDER | 06-NOV-24 |
| 24021 M-403 | PLANT ROOM VIEWS | VER: 2.0 | ISSUED FOR TENDER | 06-NOV-24 |
| 24021 M-901 | PLANT ROOM ISO VIEW | VER: 2.0 | ISSUED FOR TENDER | 06-NOV-24 |
| 24021 MP401 | PLANT ROOM COOLING PIPING LARGE-SCALE VIEW | VER: 1.0 | ISSUED FOR TENDER | 08-NOV-24 |
| 24021 MP403 | PLANT ROOM WARM PIPING LARGE-SCALE VIEW | VER: 1.0 | ISSUED FOR TENDER | 08-NOV-24 |
| 24021 MP405 | PLANT ROOM RELIEF PIPING LARGE-SCALE VIEW | VER: 1.0 | ISSUED FOR TENDER | 08-NOV-24 |
| 24021 MP901 | COOLING PIPING ISOMETRIC VIEW | VER: 1.0 | ISSUED FOR TENDER | 08-NOV-24 |
| 24021 MP903 | HEATING PIPING ISOMETRIC VIEW | VER: 1.0 | ISSUED FOR TENDER | 08-NOV-24 |
| 24021 MP905 | RELIEF PIPING ISOMETRIC VIEW | VER: 1.0 | ISSUED FOR TENDER | 08-NOV-24 |
| 24021 M-603 | BACKUP CONTROLLER SCHEMATIC | VER: 1.0 | ISSUED FOR TENDER | 08-NOV-24 |
| 24021 MI101 | AUTOMATION PLAN | VER: 1.0 | ISSUED FOR TENDER | 08-NOV-24 |
| 24021 MI601 | AUTOMATION SCHEMATICS | VER: 1.0 | ISSUED FOR TENDER | 08-NOV-24 |
| 24021 E-703 | SINGLE LINE DIAGRAM | VER: 1.0 | ISSUED FOR TENDER | 08-NOV-24 |
| 24021 S-703 | EQUIPMENT WEIGHTS & HOUSEKEEPING PADS | VER: 1.0 | ISSUED FOR TENDER | 08-NOV-24 |
| IBSDS M801 | GLYCOL RELIEF VALVES STANDARD | VER: 10.0 | ISSUED FOR TENDER | 30-AUG-24 |
| IBSDS M805 | AIR SEPARATOR STANDARD | VER: 12.0 | ISSUED FOR TENDER | 30-AUG-24 |
| IBSDS M809 | GLYCOL FEEDER STANDARD | VER: 10.0 | ISSUED FOR TENDER | 30-AUG-24 |
| IBSDS M811 | EXPANSION TANK STANDARD | VER: 11.0 | ISSUED FOR TENDER | 30-AUG-24 |
| IBSDS M815 | RENTAL CHILLER STANDARD | VER: 4.0 | ISSUED FOR TENDER | 27-MAR-24 |

REVISION LOG

**NOTES**

24021 PKG01

**REFERENCE DEFINITION**

SHEET COLUMN
SHEET NUMBER
SHEET ROW
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| 2.0 | ISSUED FOR TENDER | 08-NOV-24 | H.D. |
| 1.0 | ISSUED FOR CONCEPTUAL DESIGN | 21-OCT-24 | H.A. |

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24021 PKG01

**DRAWING NAME**
REVISION LOG

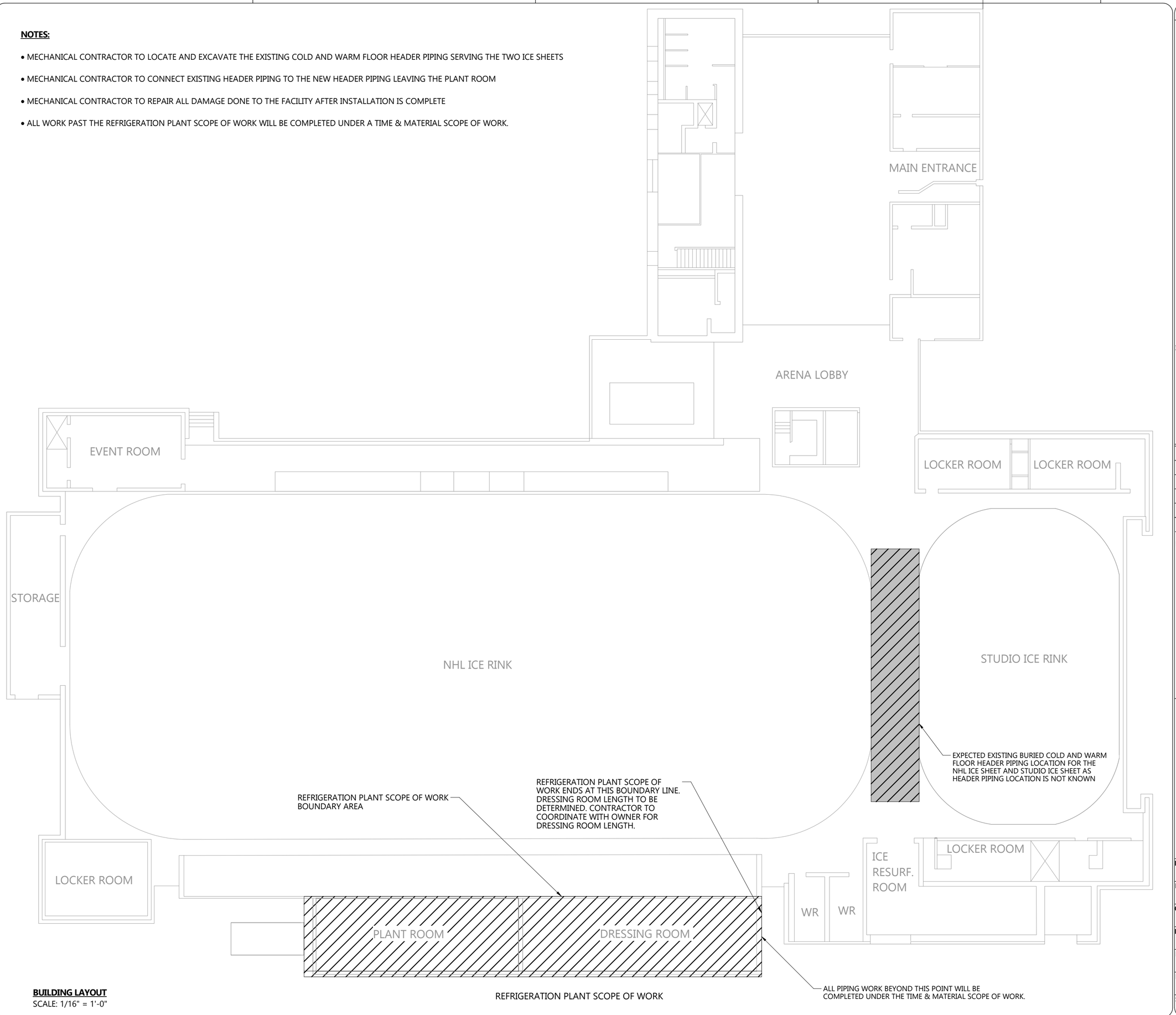
**CLIENT**
COLUMBUS PARKS & RECREATION

**PROJECT**
HAMILTON CC & ICE ARENA - PLANT CONVERSION

| DRAWN BY | CHECKED BY |
|---|---|
| H.DHAMELIYA | J.RITCHIE |
| **DATE** 08-NOV-24 | **REVISION** 2.0 |
| **SHEET SIZE** C | **SHEET NO.** 1 OF 1 |

**NOTES:**

- MECHANICAL CONTRACTOR TO LOCATE AND EXCAVATE THE EXISTING COLD AND WARM FLOOR HEADER PIPING SERVING THE TWO ICE SHEETS
- MECHANICAL CONTRACTOR TO CONNECT EXISTING HEADER PIPING TO THE NEW HEADER PIPING LEAVING THE PLANT ROOM
- MECHANICAL CONTRACTOR TO REPAIR ALL DAMAGE DONE TO THE FACILITY AFTER INSTALLATION IS COMPLETE
- ALL WORK PAST THE REFRIGERATION PLANT SCOPE OF WORK WILL BE COMPLETED UNDER A TIME & MATERIAL SCOPE OF WORK.




**BUILDING LAYOUT**
SCALE: 1/16" = 1'-0"

**NOTES**

| | |
|---|---|
| ——— | NEW |
| ——— | EXISTING |
| _ — — _ | TIME AND MATERIAL COLD PIPING |
| — _ _ — | TIME AND MATERIAL WARM PIPING |

24021 M-101

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| **DRAWING NUMBER** | 24021 M-101 |
| **DRAWING NAME** | SCOPE DIVISION LAYOUT |
| **CLIENT** | COLUMBUS PARKS & RECREATION |
| **PROJECT** | HAMILTON CC & ICE ARENA - PLANT CONVERSION |
| **DRAWN BY** | C.MACEWEN |
| **CHECKED BY** | J.RITCHIE |
| **DATE** | 08-NOV-24 |
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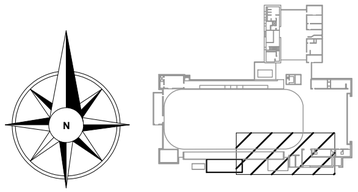
| **SHEET NO.** | 1 OF 2 |

SITE KEY



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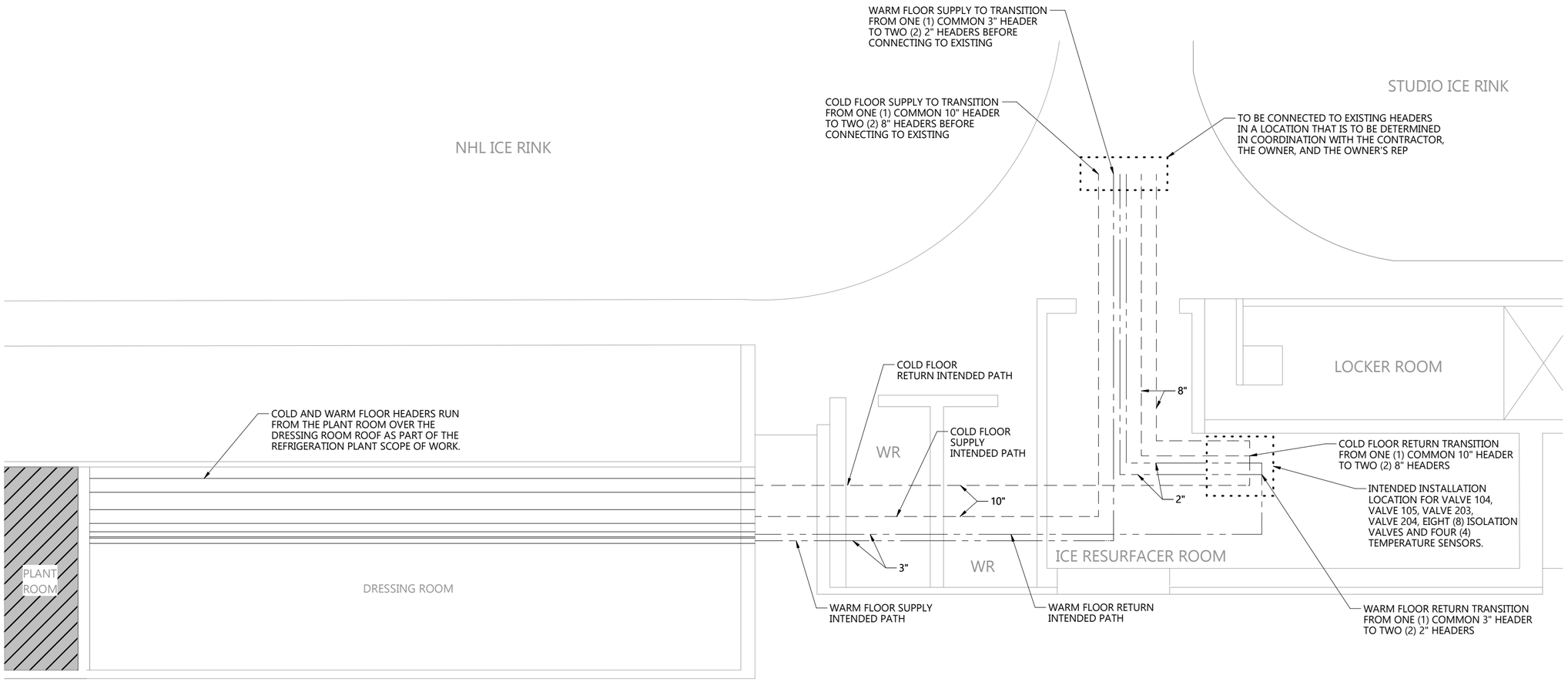
- MECHANICAL CONTRACTOR TO REPAIR ALL DAMAGE DONE TO THE FACILITY AFTER INSTALLATION IS COMPLETE
- INTENDED PIPING PATHS ARE SHOWN
- REFER TO DRAWING 24021 MI101 FOR AUTOMATION VALVE AND TEMPERATURE SENSOR AUTOMATION POINTS
- ALL WORK PAST THE REFRIGERATION PLANT SCOPE OF WORK WILL BE COMPLETED UNDER A TIME & MATERIAL SCOPE OF WORK.




**BUILDING LAYOUT**
SCALE: 1/8" = 1'-0"

PIPING TIE-IN SCOPE OF WORK

**NOTES**

| | |
|---|---|
| ——— | NEW |
| ——— | EXISTING |
| _ __ _ | TIME AND MATERIAL COLD PIPING |
| __ _ _ __ | TIME AND MATERIAL WARM PIPING |

24021 M-101

**REFERENCE DEFINITION**
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| **PROJECT** | HAMILTON CC & ICE ARENA - PLANT CONVERSION |
| **DRAWN BY** | C.MACEWEN |
| **CHECKED BY** | J.RITCHIE |
| **DATE** | 08-NOV-24 |
| **REVISION** | 1.0 |
| **SHEET SIZE** | C |
| **SHEET NO.** | 2 OF 2 |

CONTRACTOR TO LOCATE **EXISTING BURRIED COLD FLOOR MAIN HEADER**
**FOR STUDIO RINK** AND CONNECT NEW PIPING TO IT (TIME & MATERIAL SCOPE). SEE 24021 M-101 PAGE 2 FOR MORE INFORMATION.

COLD SLAB

8" SCH. 40 STEEL

8" SCH. 40 STEEL

TIME AND MATERIAL SCOPE

ICE RESURF. ROOM WALL

END OF REFRIGERATION PLANT SCOPE AT DRESSING ROOM ROOF

Ø 10"

10" SCH. 40 STEEL

10" SCH. 40 STEEL

Ø 2"

Ø 2"

**CP-1, CP-2, CP-3**
COLD FLOOR PUMPS

SF-1

Ø 10"

VFD

VFD

VFD

Ø 10"

Ø 10"

Ø 10"

**COLD PUMPS DECK**

FUTURE RINK SUPPLY CONNECTION

IBSDS: 1

10" SCH. 40 STEEL

N.C.

Ø 10"

8" SCH. 40 STEEL

8" SCH. 40 STEEL

CONTRACTOR TO LOCATE **EXSITING BURRIED COLD FLOOR MAIN HEADER**
**FOR NHL RINK** AND CONNECT NEW PIPING TO IT (TIME & MATERIAL SCOPE) . SEE 24021 M-101 PAGE 2 FOR MORE INFORMATION

COLD SLAB

AIR SEPARATOR 1 PIPING CONNECTION DIAGRAM

HIGH CAPACITY AIR VENT (ARMSTRONG AAE-750)

STRAINER

1" NPT FILL VALVE

SHUT OFF VALVE

RETURN FROM SYSTEM

AIR SEPARATOR

MANUAL BLOWDOWN VALVE

106

AS-1

FUTURE RINK RETURN CONNECTION

10" SCH. 40 STEEL

10" SCH. 40 STEEL

10" SCH. 40 STEEL

8" SCH. 40 STEEL

IBSDS: 3

6" SCH. 40 STEEL

6" SCH. 40 STEEL

10" SCH. 40 STEEL

COOLING SCHEMATIC

RELIEF HEADER

PPM

Ø3-1/2" SCH. 80 STEEL

Ø3/4" Ø3/4" Ø3/4" Ø3/4" Ø3/4" Ø3/4" Ø3/4" Ø3/4"

E-1, 2, 3, 4
EVAP. VESSEL

Ø3/4" Ø3/4" Ø3/4" Ø3/4" Ø3/4" Ø3/4" Ø3/4" Ø3/4"

C-1, 2, 3, 4
CONDENS. VESSEL

**NOTE:**
REFER TO THE TABLE ON THE DESIGN STANDARDS DRAWING

I. B. STOREY DESIGN STANDARDS: 1 (COLD SIDE)
IBSDS M809 GLYCOL FEEDER V10.0 -0.6
IBSDS M811 EXPANSION TANK V11.0 -11

I. B. STOREY DESIGN STANDARDS: 3
IBSDS M815 RENTAL CHILLER V4.0 -01

| | |
|---|---|
| 1 | STRUCTURAL SUPPORT AND PLUMBING TO DRAIN BY OWNER |
| 2 | PIPING TO BE INSULATED AS PER TENDER SPECIFICATIONS. |
| 3 | FACILITY DOMESTIC COLD WATER CONNECTIONS BY OWNER. |
| 4 | THE POINT OF VENT DISCHARGE SHALL BE LOCATED NOT LESS THAN 15 FT ABOVE THE ADJOINING GROUND LEVEL. THE POINT OF VENT DISCHARGE SHALL BE LOCATED NOT LESS THAN 20 FT FROM WINDOWS, BUILDING VENTILATION OPENINGS, PEDESTRIAN WALKWAYS, OR BUILDING EXITS. |
| 5 | MODULATING CONDENSER VALVE (FACTORY INSTALLED) |
| 6 | RELIEF VALVE FACTORY INSTALLED |

SEE (2, C5) FOR CONTINUATION

6" SCH. 40 STEEL
6" SCH. 40 STEEL
4" SCH. 40 STEEL
4" SCH. 40 STEEL
101
Ø 4"
Ø4"
EVAPORATOR
CONDENSER
**ITP-1**

6" SCH. 40 STEEL
6" SCH. 40 STEEL
4" SCH. 40 STEEL
4" SCH. 40 STEEL
102
Ø 4"
Ø4"
EVAPORATOR
CONDENSER
**ITP-2**

6" SCH. 40 STEEL
6" SCH. 40 STEEL
4" SCH. 40 STEEL
4" SCH. 40 STEEL
103
Ø 4"
Ø4"
EVAPORATOR
CONDENSER
**ITP-3**

6" SCH. 40 STEEL
6" SCH. 40 STEEL
4" SCH. 40 STEEL
4" SCH. 40 STEEL
**ITP-4 FOR FUTURE EXPANSION**

**NOTES**

| | |
|---|---|
| ——— | NEW |
| ——— | EXISTING |
| — — — | FOR FUTURE EXPANSION |

| | |
|---|---|
| | ISOLATING VALVE |
| | MODULATING VALVE |
| | SOLENOID VALVE |
| | EXPANSION VALVE |
| | RELIEF VALVE |
| | STRAINER |
| | CHECK VALVE |
| | BALANCING VALVE |
| | DRAIN |
| | FLO-TREX VALVE |
| | SUCTION GUIDE |
| P | PRESSURE SENSOR |
| T | TEMPERATURE SENSOR |
| F | FLOW METER |
| LS | LEVEL SWITCH |
| R | RELIEF LINE |
| | PRESSURE GAUGE |
| | THERMOMETER |
| PPM | REFRIGERANT DETECTOR |

**REFERENCE DEFINITION**
SHEET COLUMN / SHEET NUMBER — SHEET ROW
(#, X#)



**- NOT FOR CONSTRUCTION -**
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| VER # | REVISIONS | DATE | BY |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| 2.0 | ISSUED FOR TENDER | 08-NOV-24 | H.A. |
| 1.0 | ISSUED FOR CONCEPTUAL DESIGN | 21-OCT-24 | H.A. |

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Rink Engineering Experts

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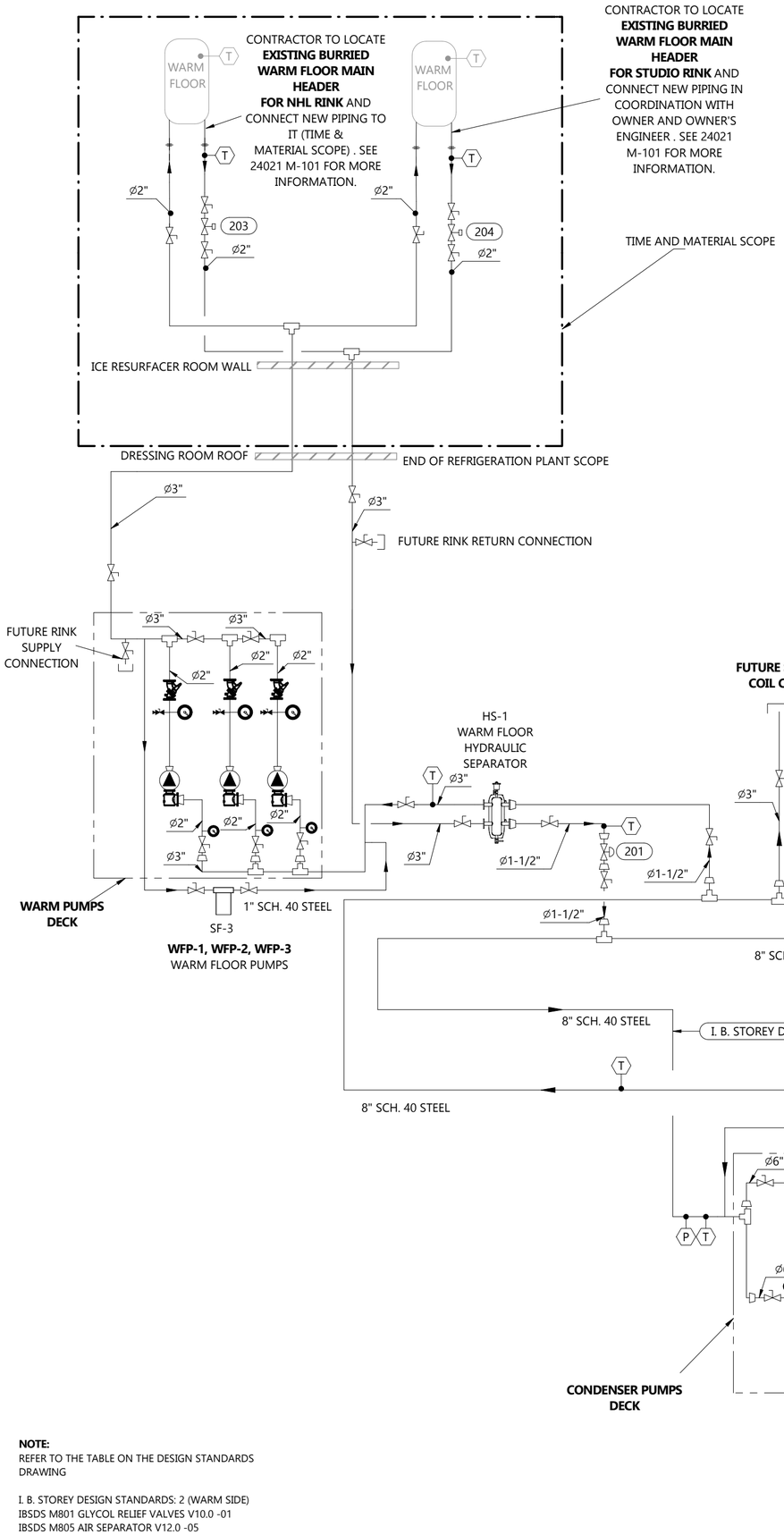
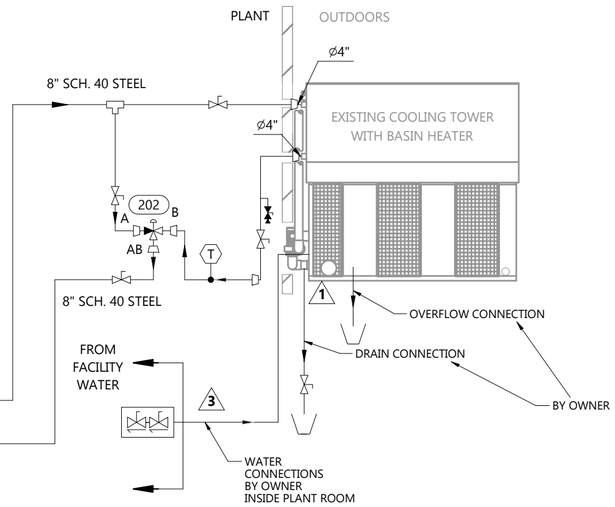
| | |
|---|---|
| **DRAWING NUMBER** | 24021 M-601 |
| **DRAWING NAME** | P&ID |
| **CLIENT** | COLUMBUS PARKS & RECREATION |
| **PROJECT** | HAMILTON CC & ICE ARENA - PLANT CONVERSION |
| **DRAWN BY** | H.AKAR |
| **CHECKED BY** | J.RITCHIE |
| **DATE** | 08-NOV-24 |
| **REVISION** | 2.0 |
| **SHEET SIZE** | C |
| **SHEET NO.** | 1 OF 3 |

24021 M-601

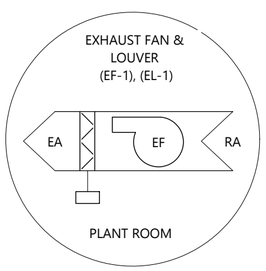


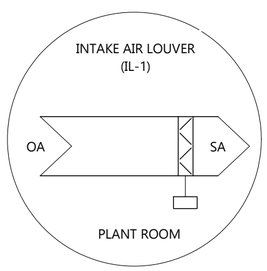

HEATING SCHEMATIC

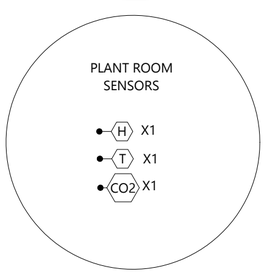
| | |
|---|---|
| 1 | STRUCTURAL SUPPORT AND PLUMBING TO DRAIN BY OWNER |
| 2 | PIPING TO BE INSULATED AS PER TENDER SPECIFICATIONS. |
| 3 | FACILITY DOMESTIC COLD WATER CONNECTIONS BY OWNER. |
| 4 | THE POINT OF VENT DISCHARGE SHALL BE LOCATED NOT LESS THAN 15 FT ABOVE THE ADJOINING GROUND LEVEL. THE POINT OF VENT DISCHARGE SHALL BE LOCATED NOT LESS THAN 20 FT FROM WINDOWS, BUILDING VENTILATION OPENINGS, PEDESTRIAN WALKWAYS, OR BUILDING EXITS. |
| 5 | MODULATING CONDENSER VALVE (FACTORY INSTALLED) |
| 6 | RELIEF VALVE FACTORY INSTALLED |

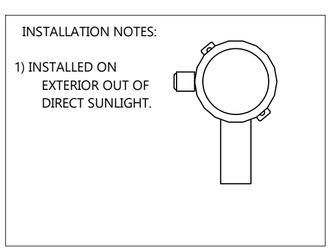



NOTE:
MAKE-UP WATER LINES TO BE HEAT TRACED AND INSULATED.




OUTDOOR SENSOR

**NOTE:**
REFER TO THE TABLE ON THE DESIGN STANDARDS DRAWING

I. B. STOREY DESIGN STANDARDS: 2 (WARM SIDE)
IBSDS M801 GLYCOL RELIEF VALVES V10.0 -01
IBSDS M805 AIR SEPARATOR V12.0 -05
IBSDS M809 GLYCOL FEEDER V10.0 -0.6
IBSDS M811 EXPANSION TANK V11.0 -05

**NOTES**

| | |
|---|---|
| ——— | NEW |
| ——— | EXISTING |
| – – – | FOR FUTURE EXPANSION |

| | |
|---|---|
| | ISOLATING VALVE |
| | MODULATING VALVE |
| | SOLENOID VALVE |
| | EXPANSION VALVE |
| | RELIEF VALVE |
| | STRAINER |
| | CHECK VALVE |
| | BALANCING VALVE |
| | DRAIN |
| | FLO-TREX VALVE |
| | SUCTION GUIDE |
| P | PRESSURE SENSOR |
| T | TEMPERATURE SENSOR |
| F | FLOW METER |
| LS | LEVEL SWITCH |
| R | RELIEF LINE |
| | PRESSURE GAUGE |
| | THERMOMETER |
| PPM | REFRIGERANT DETECTOR |

**REFERENCE DEFINITION**
SHEET COLUMN
SHEET NUMBER
(#, X#)
SHEET ROW



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| 2.0 | ISSUED FOR TENDER | 08-NOV-24 | H.A. |
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| | |
|---|---|
| **DRAWING NUMBER** | 24021 M-601 |
| **DRAWING NAME** | P&ID |
| **CLIENT** | COLUMBUS PARKS & RECREATION |
| **PROJECT** | HAMILTON CC & ICE ARENA - PLANT CONVERSION |
| **DRAWN BY** | H.AKAR |
| **CHECKED BY** | J.RITCHIE |
| **DATE** | 08-NOV-24 |
| **REVISION** | 2.0 |
| **SHEET SIZE** | C |
| **SHEET NO.** | 2 OF 3 |

24021 M-601

## ITP PACKAGE SCHEDULE (ICE BUILDING MODE)

| TAG | SERVICE | QTY | REFRIGERANT | COMPRESSOR DATA | | CAPACITY, TR | EVAPORATOR DATA | | | | | CONDENSER DATA | | | | | POWER (KW) | V/PH/HZ | MANUFACTURER AND MODEL NO. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | NO. COMPRESSORS | NO. CIRCUITS | | GPM | FLUID | EGT, F | LGT,F | FT. H2O | GPM | FLUID | EGT, F | LGT,F | FT. H2O | | | |
| ITP-1 | INTEGRATED THERMAL PKG | 1 | R513A | 1 | 1 | 50 | 467 | 40% E. GLYCOL | 13 | 10 | 33 | 220 | 40% E. GLYCOL | 85 | 93 | 25 | 52.8 | 460/3/60 | THERMAL CARE TCFW375 LIMITED |
| ITP-2 | INTEGRATED THERMAL PKG | 1 | R513A | 1 | 1 | 50 | 467 | 40% E. GLYCOL | 13 | 10 | 33 | 220 | 40% E. GLYCOL | 85 | 93 | 25 | 52.8 | 460/3/60 | THERMAL CARE TCFW375 LIMITED |
| ITP-3 | INTEGRATED THERMAL PKG | 1 | R513A | 1 | 1 | 50 | 467 | 40% E. GLYCOL | 13 | 10 | 33 | 220 | 40% E. GLYCOL | 85 | 93 | 25 | 52.8 | 460/3/60 | THERMAL CARE TCFW375 LIMITED |

## EXISTING COOLING TOWER (FOR REFERENCE)

| TAG | SERVICE | QTY. | MFR. | MODEL | FLOW, GPM | CAPACITY, MBH | AIR FLOW, CFM | DRY BULB TEMP, F | WET BULB TEMP, F | FLUID | EFT, F | LFT, F | PRESSURE DROP, PSIG | DIMENSIONS, LxWxH (FT) | OPERATING WEIGHT, LBS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CT-1 | EXISTING COOLING TOWER | 1 | BAC | VF1-144N-41P | 647 | 3743.74 | 65,960 | 87.26 | 77.72 | 40% EG | 105 | 92 | 12.93 | 19.7x7.9x14.3 | 33,380 |

**NOTE:** EXISTING COOLING TOWER TO BE RELOCATED AND REUSED.
EXISTING WATER TREATMENT TO BE REUSED.
SCHEDULE SHOWN FOR REFERENCE.

## PUMPS DECK SCHEDULE

| TAG | SERVICE | QTY. OF PUMPS | QTY. OF SKIDS | FLUID | FLOW PER PUMP, GPM | PD PER PUMP FT. H2O | MOTOR PER PUMP, HP | RPM | V/PH/HZ | VFD | SKID DIM. LxWxH, IN | PUMP MANUFACTURER AND MODEL NO. | SUCTION GUIDE | FLO TREX | SKID MANUFACTURER AND MODEL NO. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CP-1, CP-2, CP-3 | COLD FLOOR PUMPS DECK | 3 | 1 | 40% E. GLYCOL | 934 | 86.5 | 30 | 1761 | 480/3/60 | YES | 88x83-1/4x104-1/4 | ARMSTRONG 4030 6x5x11.5 | SG-86 | FTV-8FS | COLD FLOOR PD-30-30-30-C-SL-DR-460 |
| HP-1, HP-2 | CONDENSER PUMPS DECK | 2 | 1 | 40% E. GLYCOL | 660 | 91 | 25 | 1721 | 480/3/60 | YES | 83-1/2x52-1/4x95-1/8 | ARMSTRONG 4030 5x4x10 | SG-65 | FTV-6FS | CONDENSER PD-25-25-C-SL-DR-460 |
| WFP-1, WFP-2, WFP-3 | WARM FLOOR PUMPS DECK | 3 | 1 | 40% E. GLYCOL | 31 | 36.1 | 1 | 1735 | 480/3/60 | NO | 66x46-1/2x87-1/4 | ARMSTRONG 4030 - 1.5x1x6 | SG-1515TF | FTV-2GS | WARM FLOOR PD-1-1-C-SL-DR-460 |

## I.B.STOREY DESIGN STANDARDS SCHEDULE

| TAG | DESCRIPTION | QTY. | SERVICE/LOCATION ID | MAX.FLOW, USGPM | MANUFACTURER AND MODEL NO. | ACCEPTANCE VOLUME, USGAL | VOLUME, USGAL | SHIPPING WEIGHT, LB |
|---|---|---|---|---|---|---|---|---|
| EX-1 | EXP. TANK | 1 | COLD SIDE | - | ARMSTRONG AX-240V | 113.5 | 140 | 381 |
| EX-2 | EXP. TANK | 1 | WARM SIDE | - | ARMSTRONG AX-80V | 36 | 45 | 164 |
| AS-1 | AIR SEPARATOR | 1 | COLD SIDE | 1500 | ARMSTRONG VA-10-U | - | - | 390 |
| AS-2 | AIR SEPARATOR | 1 | WARM SIDE | 940 | ARMSTRONG VA-8-U | - | - | 228 |
| GF-1 | FEEDER | 1 | COLD SIDE | - | AXIOM SF100-L | - | 100 | 50 |
| GF-2 | FEEDER | 1 | WARM SIDE | - | AXIOM SF100-L | - | 100 | 50 |

## COLD GLYCOL VALVE SCHEDULE

| TAG | DESCRIPTION | QTY. | FLOW, GPM | PIPE SIZE, IN | VALVE SIZE, IN | VALVE PATTERN | VALVE CV | FAIL STATE | PART # | MANUFACTURER | ACTUATOR CONTROL SIGNAL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 101 | EVAP | 1 | 467 | 6 | 4 | 2-WAY | 600 | OPEN | F6100HD+DKRX24-MFT-T | BELIMO | ON/OFF |
| 102 | EVAP | 1 | 467 | 6 | 4 | 2-WAY | 600 | OPEN | F6100HD+DKRX24-MFT-T | BELIMO | ON/OFF |
| 103 | EVAP | 1 | 467 | 6 | 4 | 2-WAY | 600 | OPEN | F6100HD+DKRX24-MFT-T | BELIMO | ON/OFF |
| 104 | NHL COLD FLOOR | 1 | 750 | 8 | 5 | 2-WAY | 714 | OPEN | F6125-150SHP+PKRXUP-MFT-T | BELIMO | ON/OFF |
| 105 | STUDIO COLD FLOOR | 1 | 750 | 8 | 5 | 2-WAY | 714 | OPEN | F6125-150SHP+PKRXUP-MFT-T | BELIMO | ON/OFF |
| 106 | START UP BY-PASS | 1 | 467 | 6 | 4 | 2-WAY | 600 | OPEN | F6100HD+DKRX24-MFT-T | BELIMO | MODULATING |

**NOTE:** VALVES 104 AND 105 TO BE ADDED AS PART OF THE TIME & MATERIAL SCOPE

## WARM GLYCOL VALVE SCHEDULE

| TAG | DESCRIPTION | QTY. | FLOW, GPM | PIPE SIZE, IN | VALVE SIZE, IN | VALVE PATTERN | VALVE CV | FAIL STATE | PART # | MANUFACTURER | ACTUATOR CONTROL SIGNAL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 201 | UNDER FLOOR | 1 | 18 | 2 | 1 | 2-WAY | 10 | CLOSED | B223 + LF24-MFT US | BELIMO | MODULATING |
| 202 | FLUID COOLER BY-PASS | 1 | 880 | 8 | 5 | 3-WAY | 392 | OPEN | F7125-150SHP+SY4-24MFT | BELIMO | MODULATING |
| 203 | NHL WARM FLOOR | 1 | 31 | 2 | 3/4 | 2-WAY | 30 | CLOSED | B219VS-NFB24-X1 | BELIMO | ON/OFF |
| 204 | STUDIO WARM FLOOR | 1 | 31 | 2 | 3/4 | 2-WAY | 30 | CLOSED | B219VS-NFB24-X1 | BELIMO | ON/OFF |

**NOTE:** VALVES 203 AND 204 TO BE ADDED AS PART OF THE TIME & MATERIAL SCOPE

## EXHAUST FAN SCHEDULE

| TAG | AREA SERVED | MODEL | DRIVE TYPE | VOLUME (CFM) | TOTAL EXTERNAL SP | FAN SPEED (RPM) | OPERATING POWER (HP) | MOTOR SIZE (HP) | V/C/P | SONES (INLET) | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| EF-1 | MECHANICAL ROOM | GREENHECK AER-30-03-0305-VG | DIRECT | 2,195 | 0.100 | 671 | 0.07 | 1/4 | 115/60/1 | 9.0 | 1,2 |

1. SOLID STATE SPEED CONTROL, FACTORY MOUNTED
2. TWO SPEED FAN. 450 CFM LOW SPEED, 2195 CFM HIGH SPEED.

## HYDRAULIC SEPARATOR SCHEDULE

| TAG | FLUID | QTY. | SIZE IN | CAPACITY, GPM | MANUFACTURER AND MODEL NO. |
|---|---|---|---|---|---|
| HS-1 | 40% E. GLYCOL | 1 | 3 | 90 | CALEFFI 548082A |

## SIDE STREAM FILTER

| TAG | MODEL | SIZE | SIDE STREAM FLOW RATE | FILTER SIZE | VESSEL VOLUME |
|---|---|---|---|---|---|
| SF-1 | PRM BFHBFH2DCSX | 2" | 100 GPM | POLYESTER FELT BAG #2 7-1/16" DIA X 32"L | - |
| SF-2 | AXIOM SFP-20 | 1" | 10-20 GPM | 20" DOE COTTON WOUND | 0.8 GAL |
| SF-3 | AXIOM SFP-20 | 1" | 10-20 GPM | 20" DOE COTTON WOUND | 0.8 GAL |

## LOUVERS SCHEDULE

| TAG | AREA SERVED | MODEL | APPLICATION | WIDTH (IN) | HEIGHT (IN) | DEPTH (IN) | VOLUME (CFM) | PRESSURE DROP (IN. WG) | FREE AREA VELOCITY (FT/MIN) | FREE AREA (SQ FT) | NOTES | ACTUATOR | DAMPER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IL-1 | MECHANICAL ROOM | ESD-403 | INTAKE | 36 | 36 | 4 | 2,195 | 0.047 | 521 | 4.2 | BIRDSCREEN | NFB24-MFT-S | VCD-23 |
| EL-1 | MECHANICAL ROOM | ESD-202 | EXHAUST | 36 | 36 | 2 | 2,195 | 0.071 | 697 | 3.2 | BIRDSCREEN | NFB24-MFT-S | VCD-23 |

### NOTES

| | |
|---|---|
| ——— | NEW |
| ——— | EXISTING |
| – — – | FOR FUTURE EXPANSION |

| | |
|---|---|
| | ISOLATING VALVE |
| | MODULATING VALVE |
| | SOLENOID VALVE |
| | EXPANSION VALVE |
| | RELIEF VALVE |
| | STRAINER |
| | CHECK VALVE |
| | BALANCING VALVE |
| | DRAIN |
| | FLO-TREX VALVE |
| | SUCTION GUIDE |
| P | PRESSURE SENSOR |
| T | TEMPERATURE SENSOR |
| F | FLOW METER |
| LS | LEVEL SWITCH |
| R | RELIEF LINE |
| | PRESSURE GAUGE |
| | THERMOMETER |
| PPM | REFRIGERANT DETECTOR |

**REFERENCE DEFINITION**

SHEET COLUMN
SHEET NUMBER
(#, X#)
SHEET ROW



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| VER # | REVISIONS | DATE | BY |
|---|---|---|---|
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| | | | |
| | | | |
| 2.0 | ISSUED FOR TENDER | 08-NOV-24 | H.A. |
| 1.0 | ISSUED FOR CONCEPTUAL DESIGN | 21-OCT-24 | H.A. |

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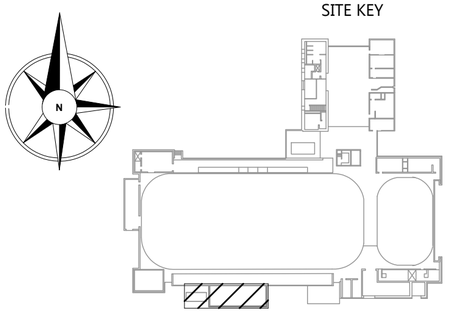
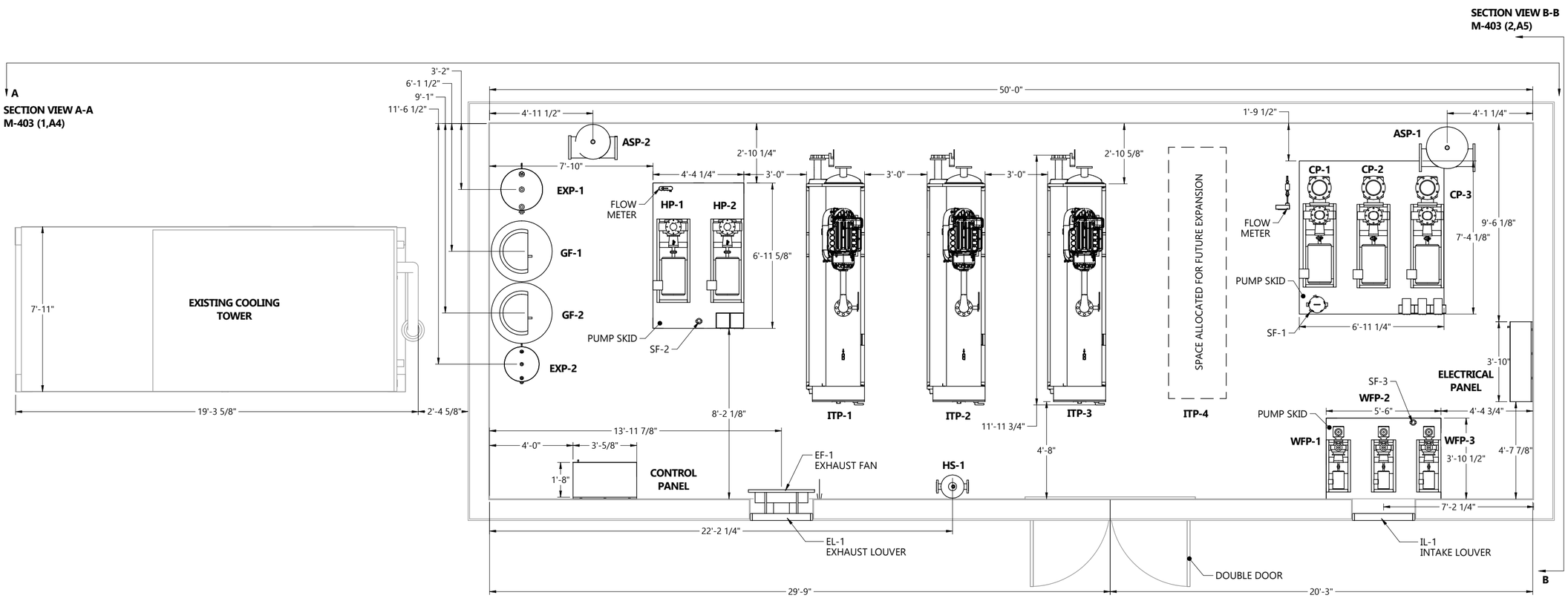
**DRAWING NUMBER** 24021 M-601
**DRAWING NAME** P&ID
**CLIENT** COLUMBUS PARKS & RECREATION
**PROJECT** HAMILTON CC & ICE ARENA - PLANT CONVERSION
**DRAWN BY** H.AKAR
**CHECKED BY** J.RITCHIE
**DATE** 08-NOV-24
**REVISION** 2.0
**SHEET SIZE** C
**SHEET NO.** 3 OF 3

24021 M-601

SITE KEY






## EQUIPMENT LAYOUT

SCALE 6/25" = 1'-0"

**NOTES**:

- ALL PUMP SKID SHOULD HAVE THICKNESS OF 4"
- ALL PIPING HIDDEN FOR CLARITY

EQUIPMENT LAYOUT

**NOTES**

**REFERENCE DEFINITION**

SHEET COLUMN
SHEET NUMBER
(#, X#)
SHEET ROW



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| VER # | REVISIONS | DATE | BY |
|---|---|---|---|
| 2.0 | ISSUED FOR TENDER | 08-NOV-24 | R.T. |
| 1.0 | ISSUED FOR CONCEPTUAL DESIGN | 21-OCT-24 | H.D. |


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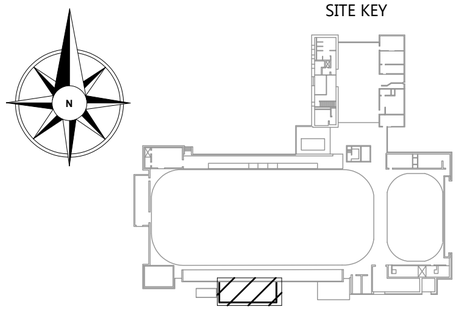
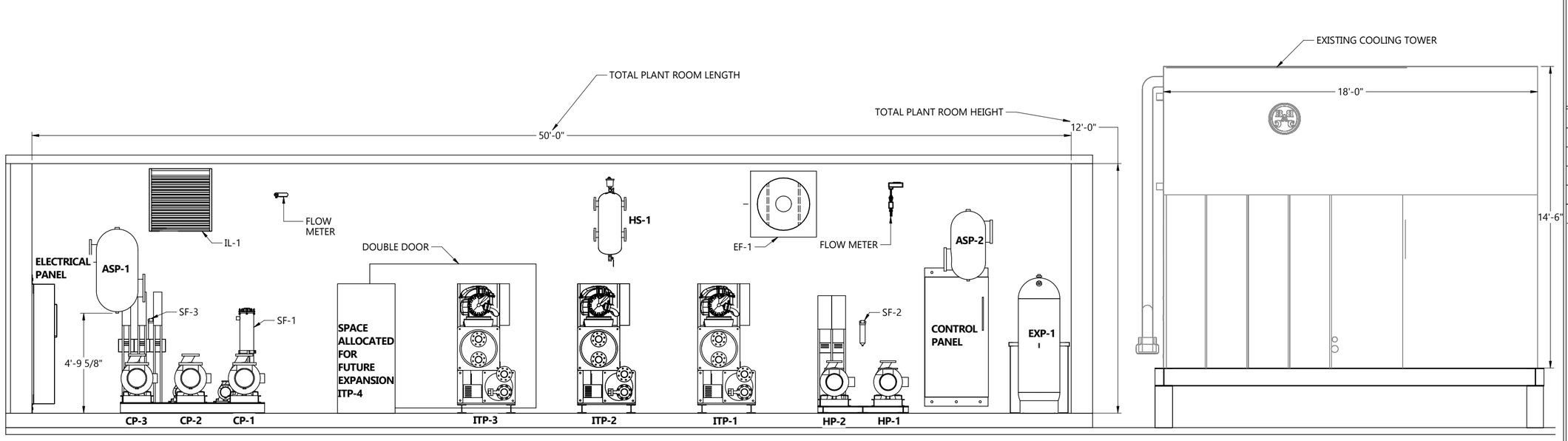
| | |
|---|---|
| **DRAWING NUMBER** | 24021 M-401 |
| **DRAWING NAME** | EQUIPMENT LAYOUT |
| **CLIENT** | COLUMBUS PARKS & RECREATION |
| **PROJECT** | HAMILTON CC & ICE ARENA PLANT CONVERSION |
| **DRAWN BY** | R.THOMAS |
| **CHECKED BY** | J.RITCHIE |
| **DATE** | 08-NOV-24 |
| **REVISION** | 2.0 |
| **SHEET SIZE** | C |
| **SHEET NO.** | 1 OF 1 |

SITE KEY






**SECTION VIEW A-A 180° (M-401-1, A3): PLANT ROOM FRONT VIEW**

SCALE 6/25"=1'-0"




FRONT VIEW

**NOTES**

| | |
|---|---|
| | NEW |
| | EXISTING |

24021 M-403

**REFERENCE DEFINITION**

SHEET COLUMN — SHEET ROW
SHEET NUMBER
(#, X#)



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**DRAWING NUMBER**
24021 M-403

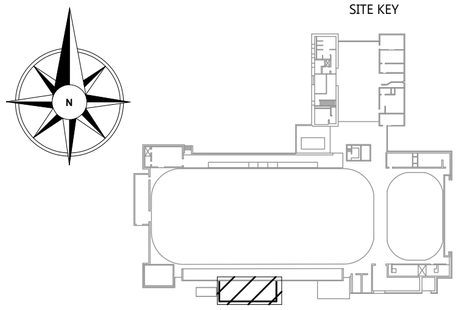
**DRAWING NAME**
PLANT ROOM VIEWS

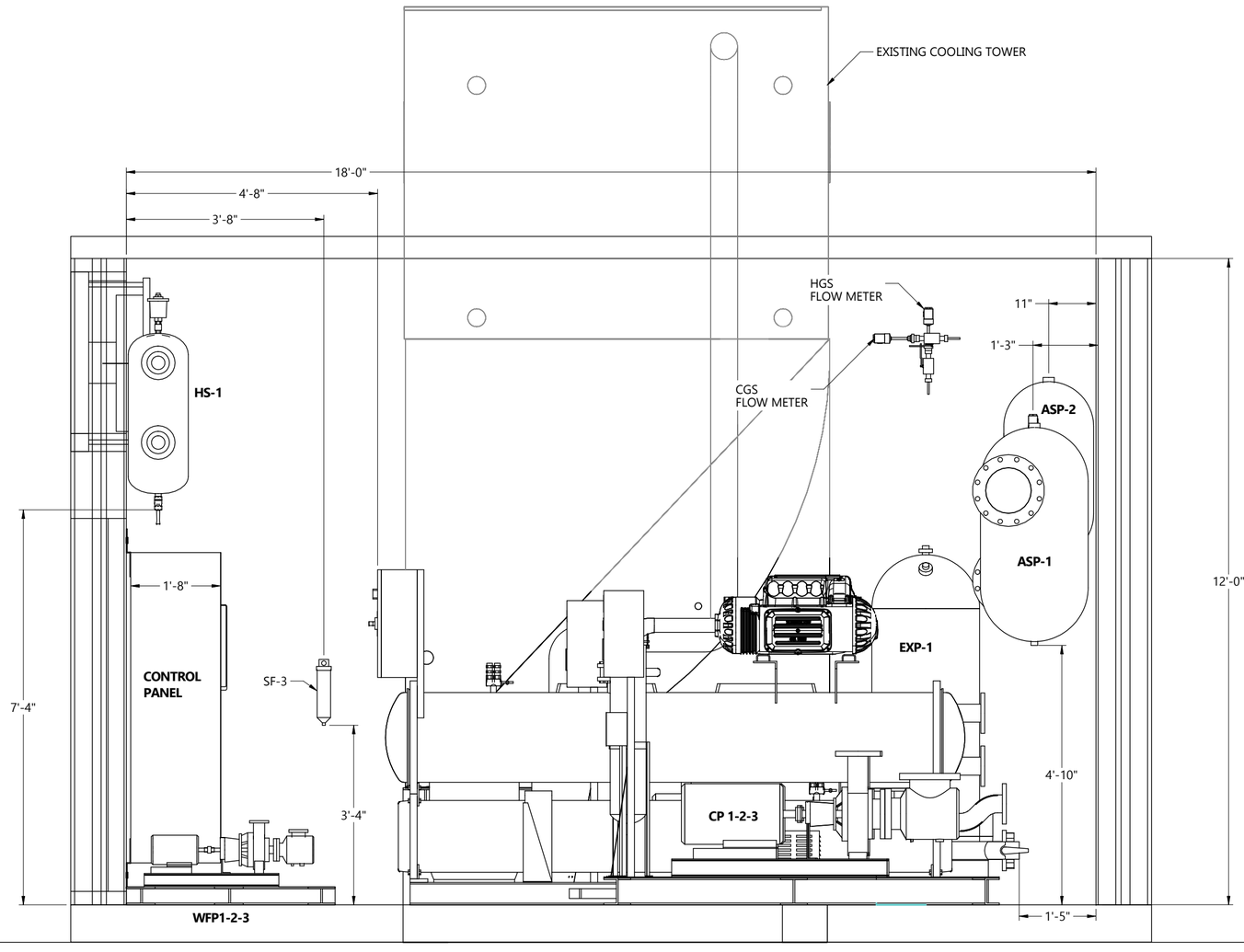
**CLIENT**
COLUMBUS PARKS & RECREATION

**PROJECT**
HAMILTON CC & ICE ARENA PLANT CONVERSION

| DRAWN BY | CHECKED BY |
|---|---|
| H.DHAMELIYA | J.RITCHIE |
| **DATE** | **REVISION** |
| 08-NOV-24 | 2.0 |
| **SHEET SIZE** | **SHEET NO.** |
| C | 1 OF 2 |

SITE KEY






**SECTION VIEW B-B 90°◠ (M-401-1, D2): PLANT ROOM SIDE VIEW**

SCALE 1/2"=1'-0"

SIDE VIEW

**NOTES**

| | |
|---|---|
| | NEW |
| | EXISTING |

24021 M-403

**REFERENCE DEFINITION**

SHEET COLUMN / SHEET ROW
SHEET NUMBER
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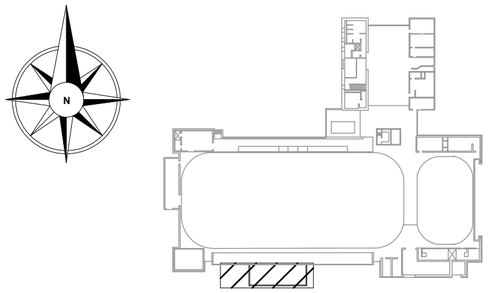
| **DRAWING NAME** | PLANT ROOM VIEWS |
| **CLIENT** | COLUMBUS PARKS & RECREATION |
| **PROJECT** | HAMILTON CC & ICE ARENA PLANT CONVERSION |
| **DRAWN BY** | H.DHAMELIYA |
| **CHECKED BY** | J.RITCHIE |
| **DATE** | 08-NOV-24 |
| **REVISION** | 2.0 |
| **SHEET SIZE** | C |
| **SHEET NO.** | 2 OF 2 |

SITE KEY





**PLANT ROOM ISOMETRIC VIEW**

SCALE 1/4" = 1'-0"

PLANT ROOM ISOMETRIC VIEW

**NOTES**:

- ALL PIPING HIDDEN FOR CLARITY.
- FOR EQUIPMENT TAGS REFER TO DWG 24021 M-401.

**NOTES**

24021 M-901

**REFERENCE DEFINITION**

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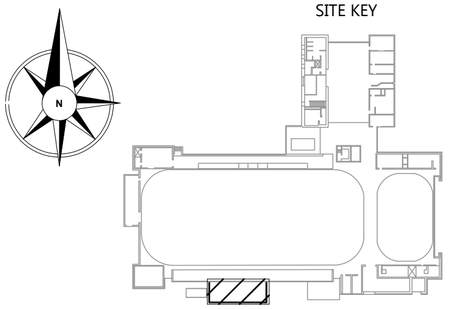
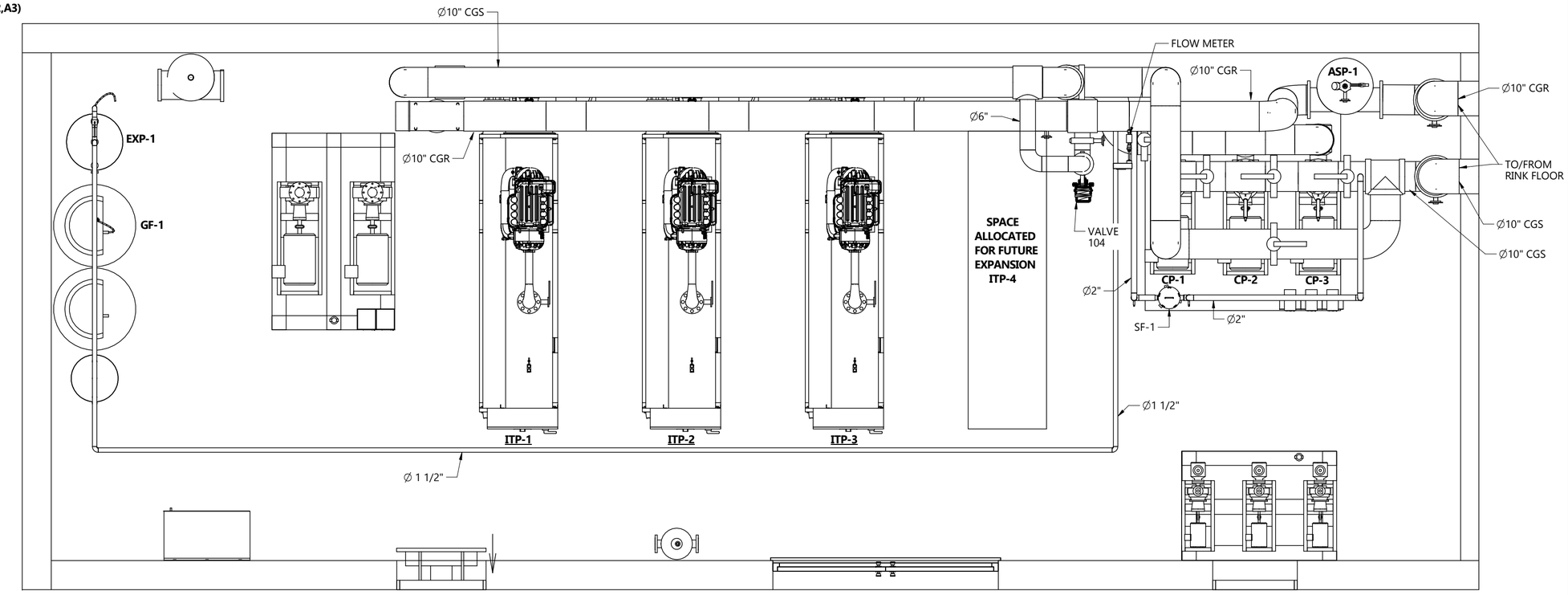
| **DRAWING NUMBER** | 24021 M-901 |
| **DRAWING NAME** | PLANT ROOM ISO VEIW |
| **CLIENT** | COLUMBUS PARKS & RECREATION |
| **PROJECT** | HAMILTON CC & ICE ARENA PLANT CONVERSION |
| **DRAWN BY** | R.THOMAS |
| **CHECKED BY** | J.RITCHIE |
| **DATE** | 08-NOV-24 |
| **REVISION** | 1.0 |
| **SHEET SIZE** | C |
| **SHEET NO.** | 1 OF 1 |

SITE KEY



C

**SECTION VIEW C-C**
**MP401 (2,A3)**




**COOLING PIPING PLAN**
SCALE 3/10"=1'-0"

D

**SECTION VIEW D-D**
**MP401 (2,A5)**

**NOTES**

| | |
|---|---|
| | NEW |
| | EXISTING |

24021 MP401

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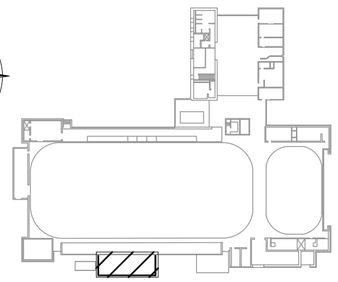
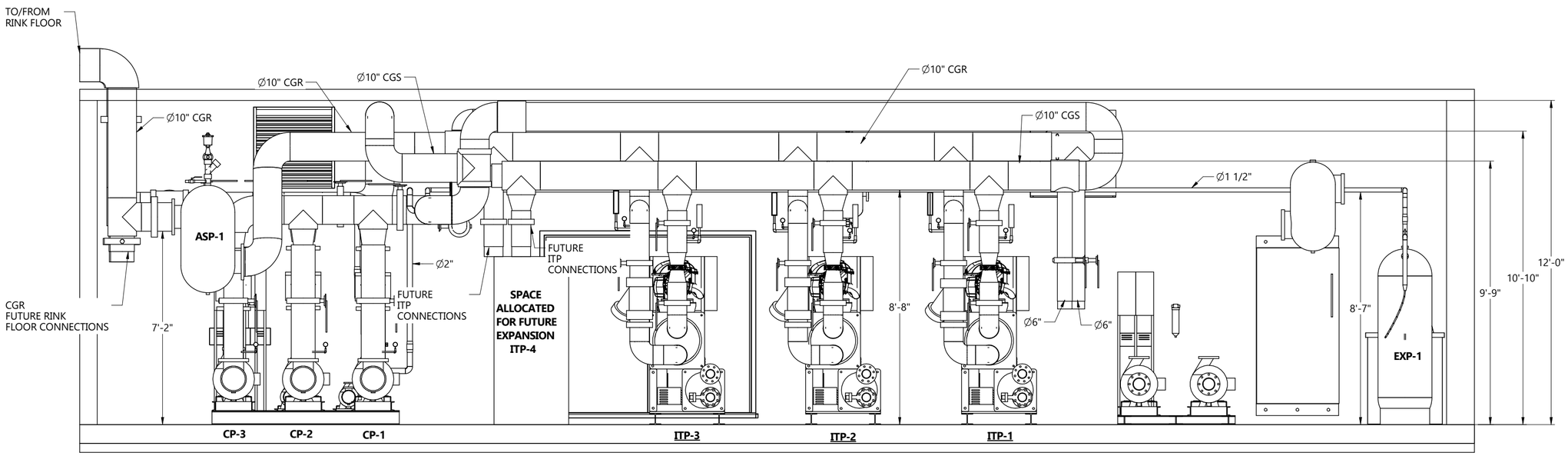
| **DRAWING NUMBER** | 24021 MP401 |
| **DRAWING NAME** | PLANT ROOM COOLING PIPING LARGE SCALE VIEWS |
| **CLIENT** | COLUMBUS PARKS & RECREATION |
| **PROJECT** | HAMILTON CC & ICE ARENA PLANT CONVERSION |

| **DRAWN BY** | **CHECKED BY** |
|---|---|
| H.DHAMELIYA | J.RITCHIE |
| **DATE** | **REVISION** |
| 08-NOV-24 | 1.0 |
| **SHEET SIZE** | **SHEET NO.** |
| C | 1 OF 2 |

COOLING PIPING PLAN

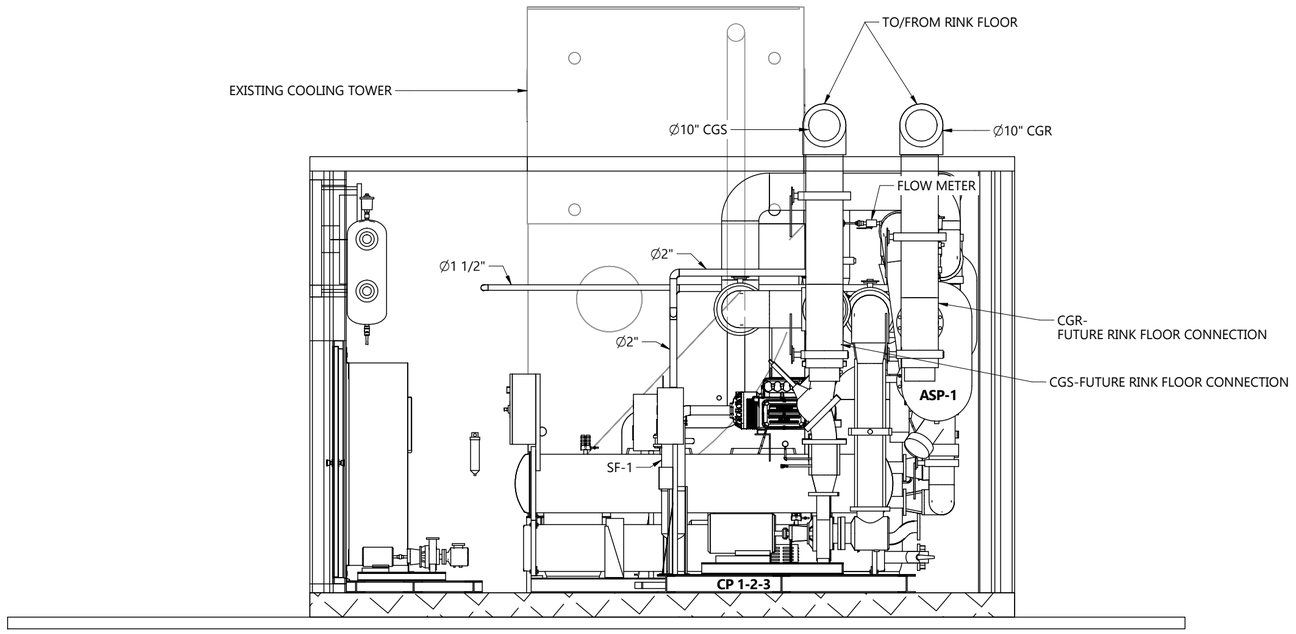
SITE KEY






SECTION VIEW C-C 180° (MP401,1,A2)

SCALE 3/10"=1'-0"




SECTION VIEW D-D 90° (MP401,1,D4)

SCALE 3/10"=1'-0"

COOLING PIPING SECTION VIEWS

**NOTES**

| | |
|---|---|
| | NEW |
| | EXISTING |

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**DRAWING NUMBER**
24021 MP401

**DRAWING NAME**
PLANT ROOM COOLING PIPING LARGE SCALE VIEWS

**CLIENT**
COLUMBUS PARKS & RECREATION

**PROJECT**
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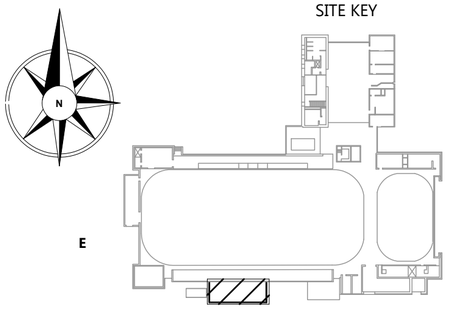
SITE KEY



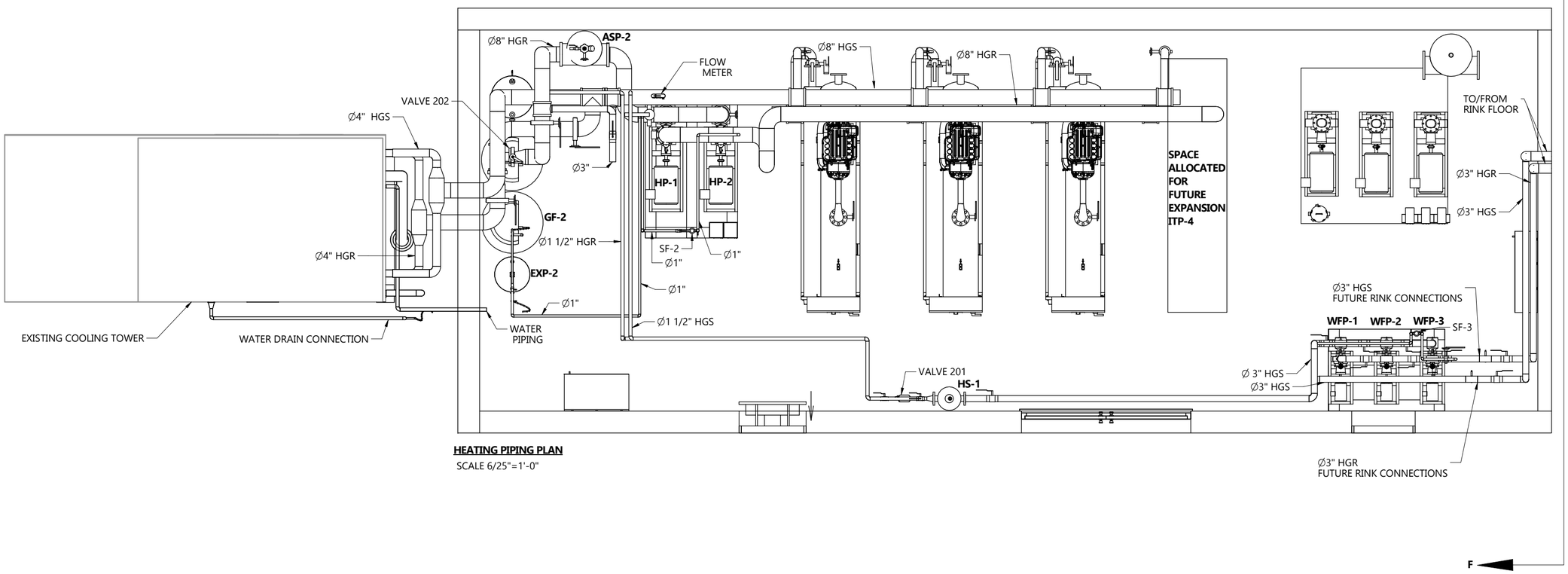

E

**SECTION VIEW E-E**
**MP403 (2,A3)**

E

F

**SECTION VIEW F-F**
**MP403 (2,B5)**




**HEATING PIPING PLAN**
SCALE 6/25"=1'-0"

**NOTES**

| | |
|---|---|
| | NEW |
| | EXISTING |

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| **CLIENT** | COLUMBUS PARKS & RECREATION |
| **PROJECT** | HAMILTON CC & ICE ARENA PLANT CONVERSION |
| **DRAWN BY** | H.DHAMELIYA |
| **CHECKED BY** | J.RITCHIE |
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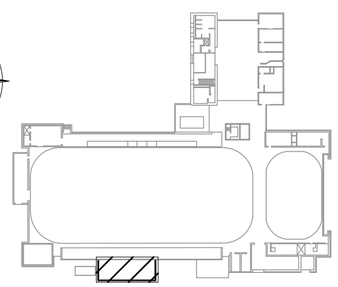
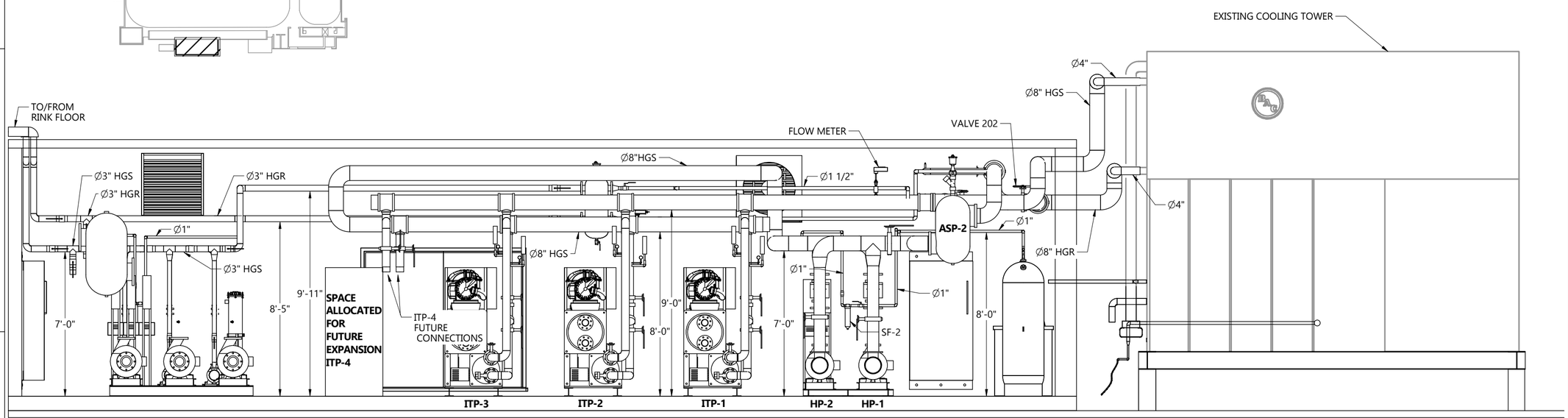
| **SHEET NO.** | 1 OF 2 |

HEATING PIPING PLAN

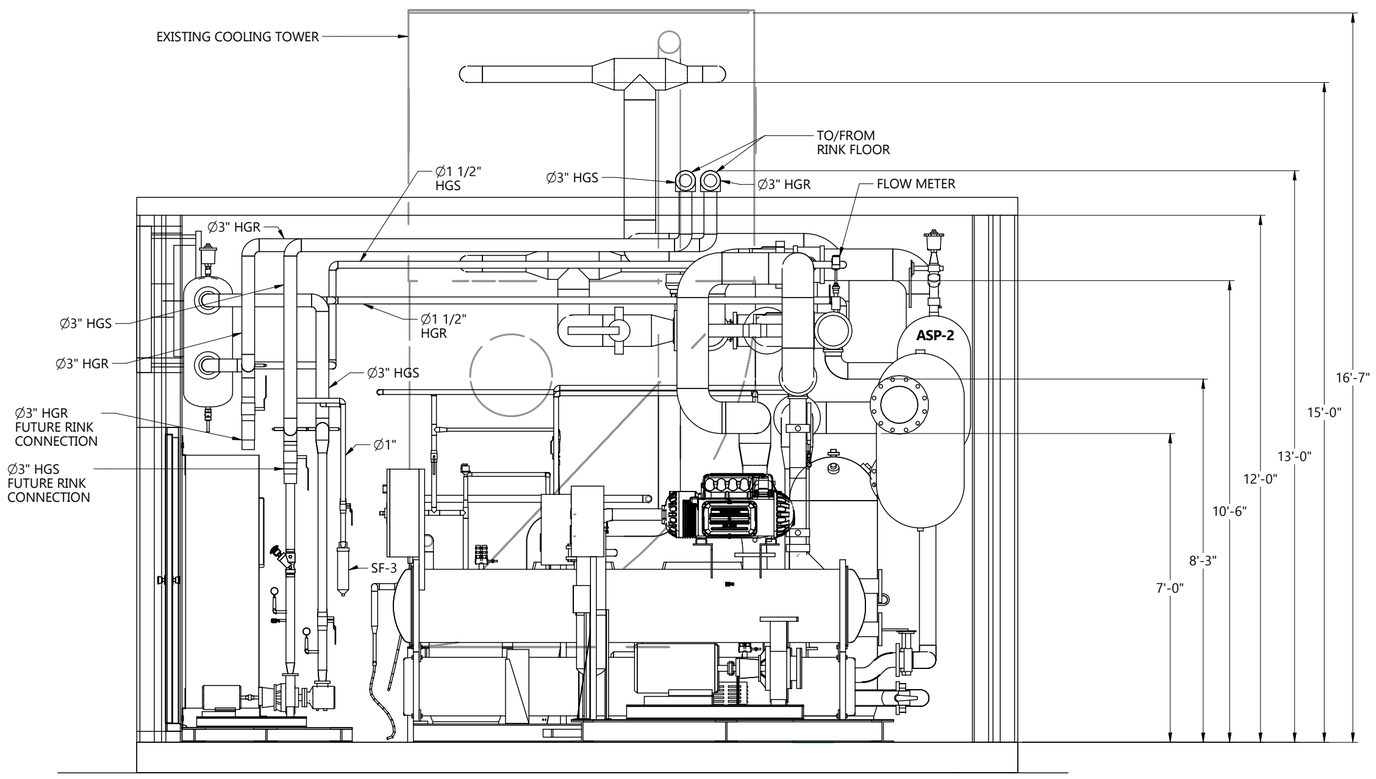
SITE KEY






**SECTION VIEW E-E ⌒ 180° (MP403.1.A2)**

SCALE 6/25"=1'-0"




**SECTION VIEW F-F ⌒ 90° (MP403.1.D2)**

SCALE 3/8"=1'-0"

HEATING PIPING SECTION VIEWS

**NOTES**

| | |
|---|---|
| | NEW |
| | EXISTING |

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| **CLIENT** | COLUMBUS PARKS & RECREATION |
| **PROJECT** | HAMILTON CC & ICE ARENA PLANT CONVERSION |
| **DRAWN BY** | H.DHAMELIYA |
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| **SHEET NO.** | 2 OF 2 |

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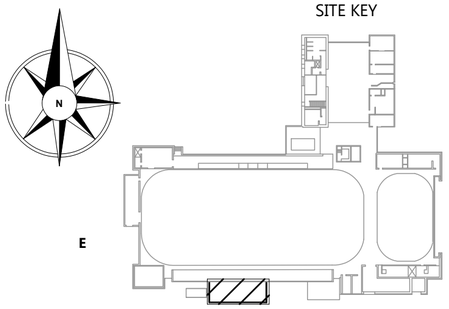
SITE KEY

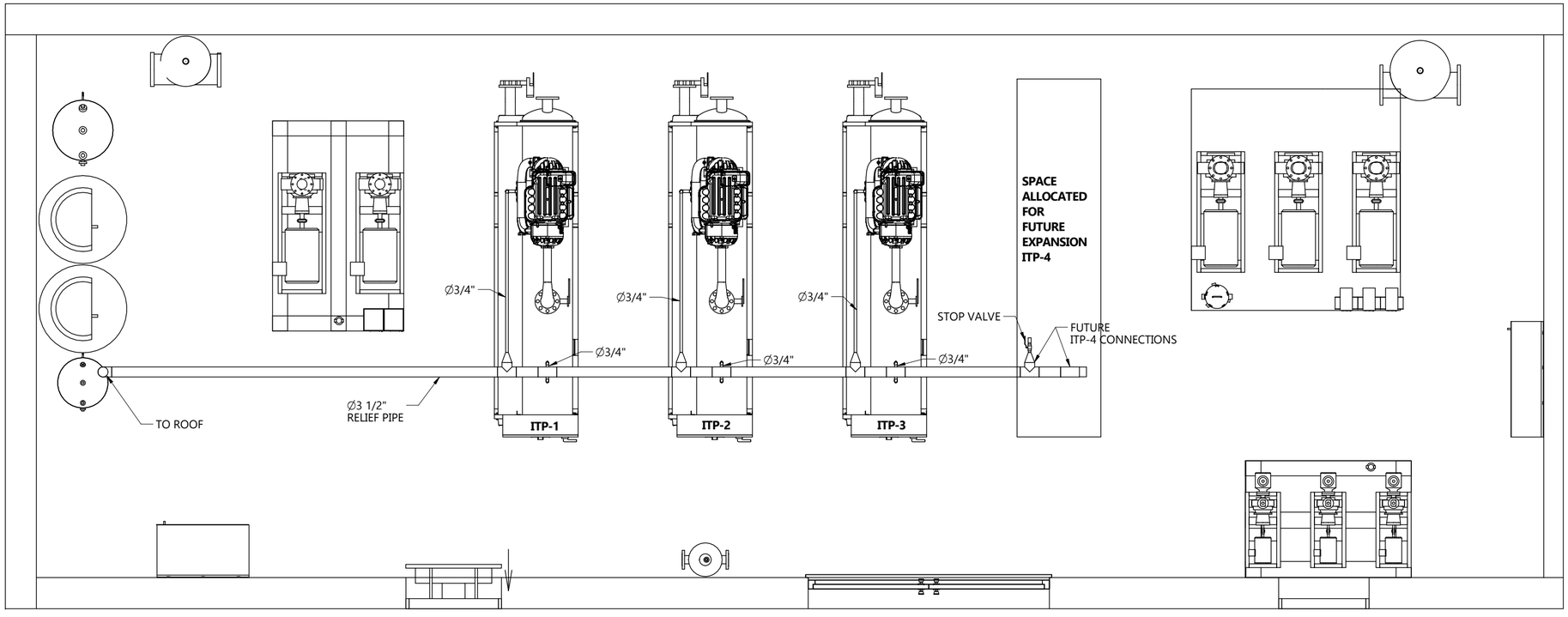



NOTE

- PIPE CAPS FOR RELIEF MUST BE RATED FOR MINIMUM 300 PSI
- A LOCKING DEVICE SHALL BE INSTALLED TO ENSURE THE STOP VALVES ARE LOCKED IN THE OPEN POSITION WHEN THE RELIEF PIPING IS CONNECTED TO FUTURE ITP-4
- STOP VALVES TO BE LOCKED IN CLOSED POSITION BEFORE ADDITION OF ITP-4

**G**
**SECTION VIEW G-G**
**MP405 (2,A4)**

**H**
**SECTION VIEW H-H**
**MP405 (3,B5)**




**RELIEF PIPING PLAN**
SCALE 3/10"=1'-0"

**G**

**H**

RELIEF PIPING PLAN

**NOTES**

| | |
|---|---|
| | NEW |
| | EXISTING |

24021 MP405

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24021 MP405

**DRAWING NAME**
PLANT ROOM RELIEF PIPING LARGE SCALE VIEWS

**CLIENT**
COLUMBUS PARKS & RECREATION

**PROJECT**
HAMILTON CC & ICE ARENA PLANT CONVERSION

| DRAWN BY | CHECKED BY |
|---|---|
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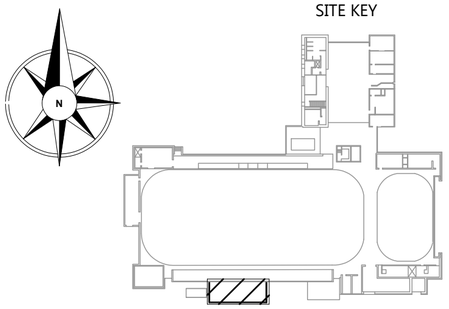
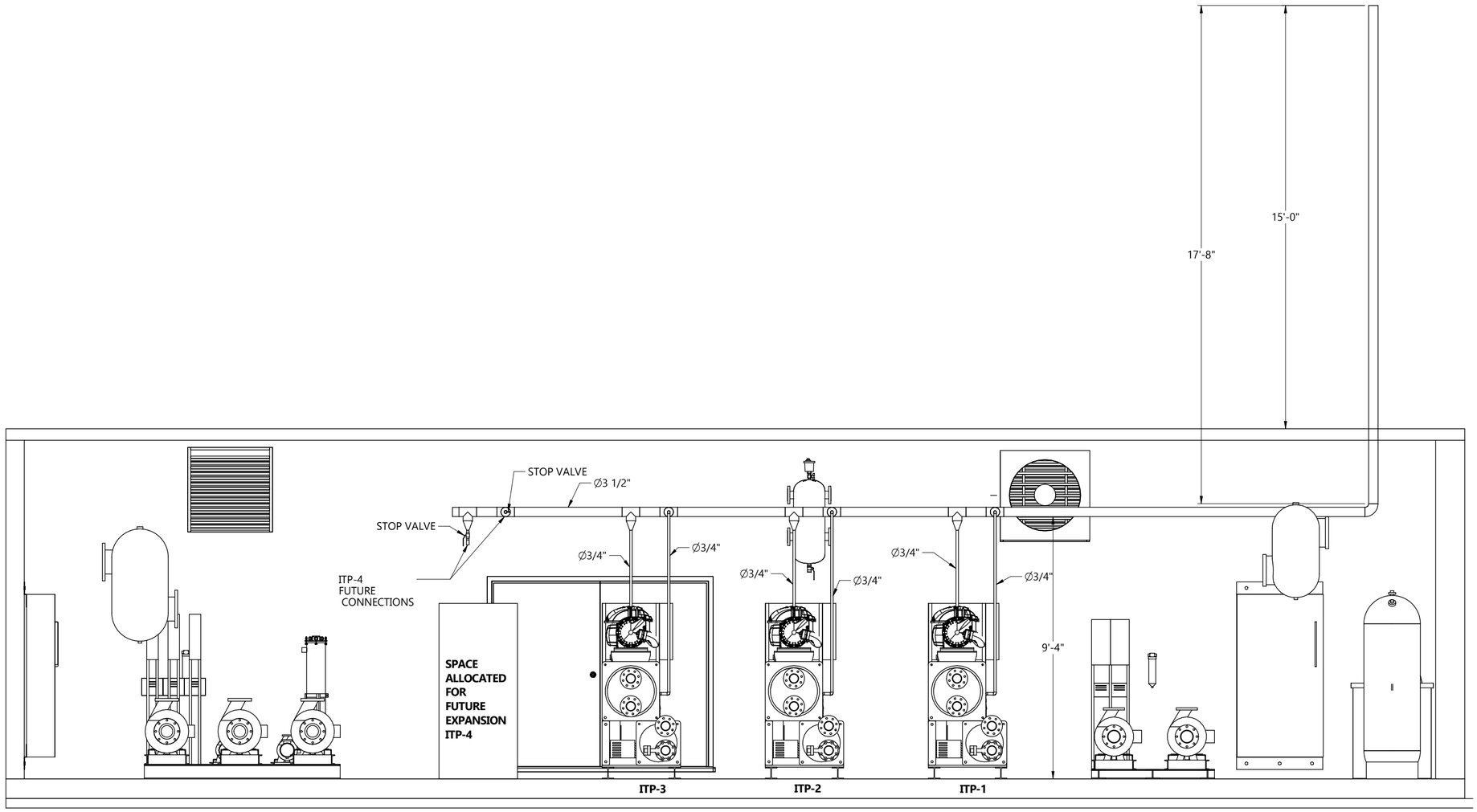
| **DATE** 08-NOV-24 | **REVISION** 1.0 |
| **SHEET SIZE** C | **SHEET NO.** 1 OF 3 |

SITE KEY




NOTE

- PIPE CAPS FOR RELIEF MUST BE RATED FOR MINIMUM 300 PSI
- A LOCKING DEVICE SHALL BE INSTALLED TO ENSURE THE STOP VALVES ARE LOCKED IN THE OPEN POSITION WHEN THE RELIEF PIPING IS CONNECTED TO FUTURE ITP-4
- STOP VALVES TO BE LOCKED IN CLOSED POSITION BEFORE ADDITION OF ITP-4




**SECTION VIEW G-G ⌒ 180· (MP405,1,A2)**

SCALE 3/10"=1'-0"

RELIEF PIPING SECTION VIEWS

**NOTES**

| | |
|---|---|
| ——— | NEW |
| ——— | EXISTING |

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**DRAWING NUMBER**
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**DRAWING NAME**
PLANT ROOM RELIEF PIPING LARGE SCALE VIEWS

**CLIENT**
COLUMBUS PARKS & RECREATION

**PROJECT**
HAMILTON CC & ICE ARENA PLANT CONVERSION

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|---|---|
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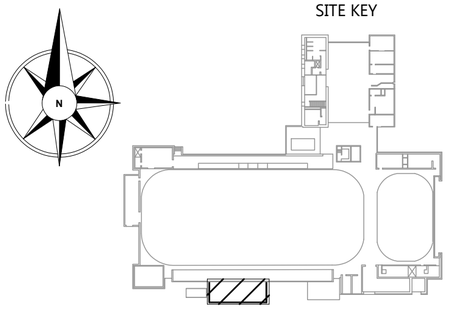
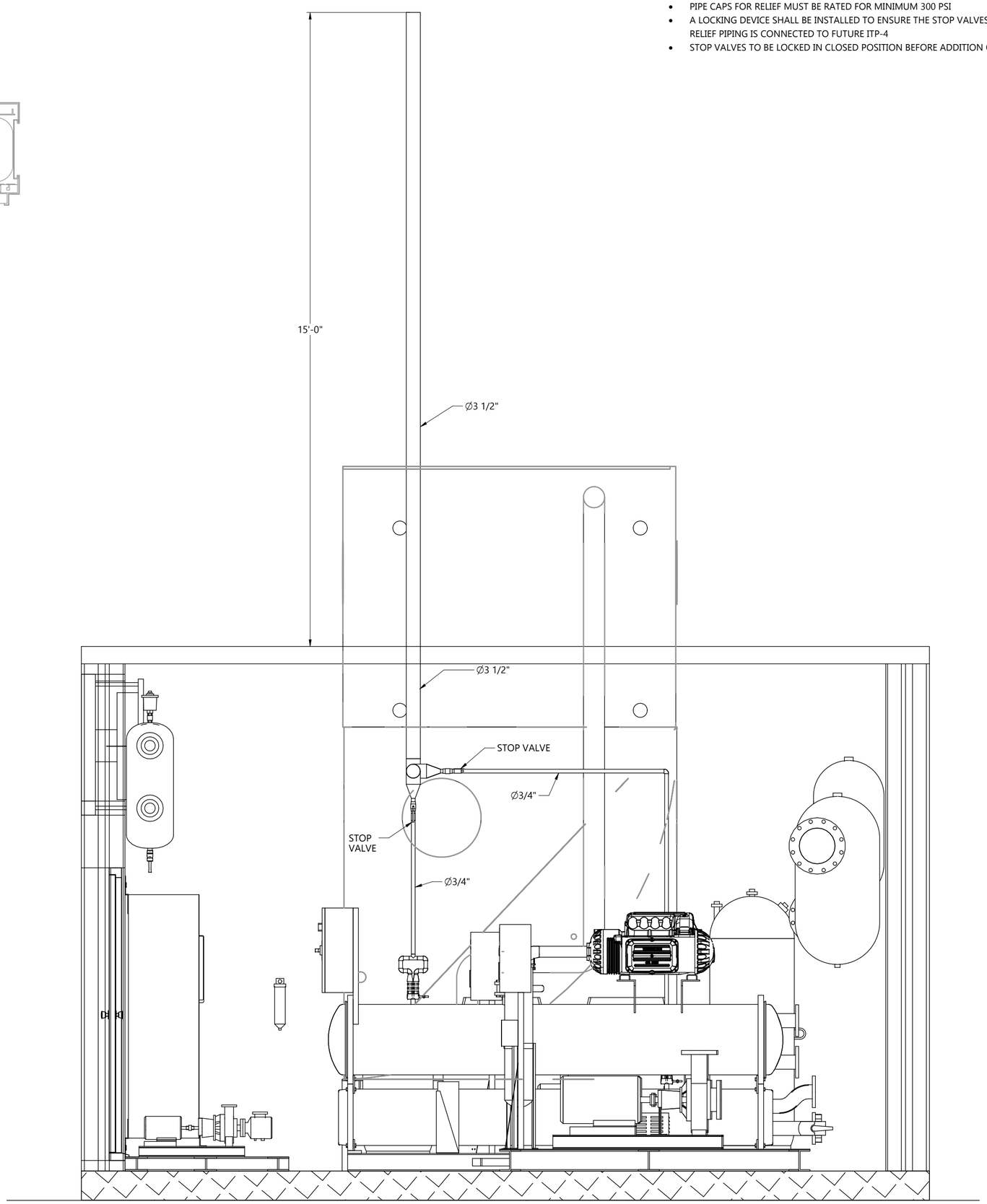
| **DATE** 08-NOV-24 | **REVISION** 1.0 |
| **SHEET SIZE** C | **SHEET NO.** 2 OF 3 |

SITE KEY




NOTE

- PIPE CAPS FOR RELIEF MUST BE RATED FOR MINIMUM 300 PSI
- A LOCKING DEVICE SHALL BE INSTALLED TO ENSURE THE STOP VALVES ARE LOCKED IN THE OPEN POSITION WHEN THE RELIEF PIPING IS CONNECTED TO FUTURE ITP-4
- STOP VALVES TO BE LOCKED IN CLOSED POSITION BEFORE ADDITION OF ITP-4




**SECTION VIEW H-H ⌒90· (MP405,1,D2)**

SCALE 1/2"=1'-0"

RELIEF PIPING SECTION VIEWS

**NOTES**

| | |
|---|---|
| | NEW |
| | EXISTING |

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**DRAWING NUMBER**
24021 MP405

**DRAWING NAME**
PLANT ROOM RELIEF PIPING LARGE SCALE VIEWS

**CLIENT**
COLUMBUS PARKS & RECREATION

**PROJECT**
HAMILTON CC & ICE ARENA PLANT CONVERSION

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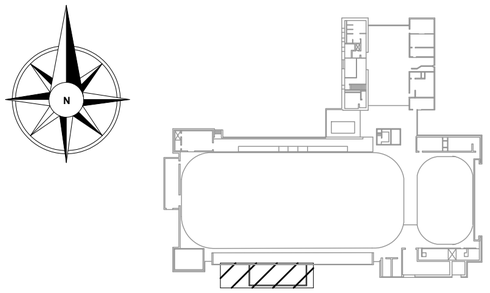
| **SHEET SIZE** C | **SHEET NO.** 3 OF 3 |

SITE KEY





**COOLING PIPING ISOMETRIC VIEW**

SCALE 1/4" = 1'-0"

COOLING PIPING ISOMETRIC VIEW

**NOTES**:

- HEATING & RELIEF PIPING HIDDEN FOR CLARITY.

**NOTES**

24021 MP901

**REFERENCE DEFINITION**

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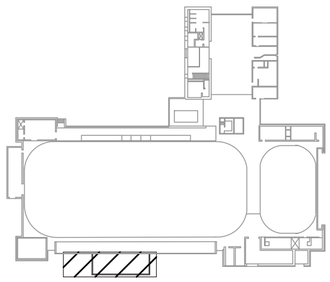
| **DRAWING NAME** | COOLING PIPING ISOMETRIC VEIW |
| **CLIENT** | COLUMBUS PARKS & RECREATION |
| **PROJECT** | HAMILTON CC & ICE ARENA PLANT CONVERSION |
| **DRAWN BY** R.THOMAS | **CHECKED BY** J.RITCHIE |
| **DATE** 08-NOV-24 | **REVISION** 1.0 |
| **SHEET SIZE** C | **SHEET NO.** 1 OF 1 |

SITE KEY





**HEATING PIPING ISOMETRIC VIEW**

SCALE 1/4" = 1'-0"

HEATING PIPING ISOMETRIC VIEW

**NOTES**:

- COOLING & RELIEF PIPING HIDDEN FOR CLARITY.

**NOTES**

24021 MP903

**REFERENCE DEFINITION**

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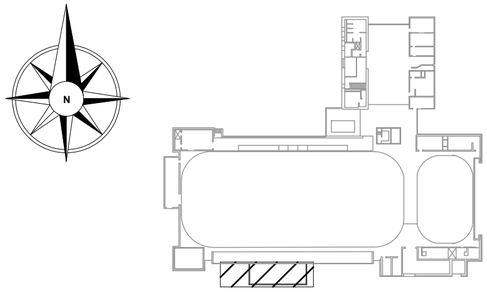
| **DRAWING NUMBER** | 24021 MP903 |
| **DRAWING NAME** | HEATING PIPING ISOMETRIC VEIW |
| **CLIENT** | COLUMBUS PARKS & RECREATION |
| **PROJECT** | HAMILTON CC & ICE ARENA PLANT CONVERSION |
| **DRAWN BY** R.THOMAS | **CHECKED BY** J.RITCHIE |
| **DATE** 08-NOV-24 | **REVISION** 1.0 |
| **SHEET SIZE** C | **SHEET NO.** 1 OF 1 |

SITE KEY





**RELIEF PIPING ISOMETRIC VIEW**

SCALE 1/4" = 1'-0"

RELIEF PIPING ISOMETRIC VIEW

**NOTES**:

- COOLING & HEATING PIPING HIDDEN FOR CLARITY.

24021 MP905

**NOTES**

**REFERENCE DEFINITION**

SHEET COLUMN — SHEET ROW
SHEET NUMBER
(#, X#)



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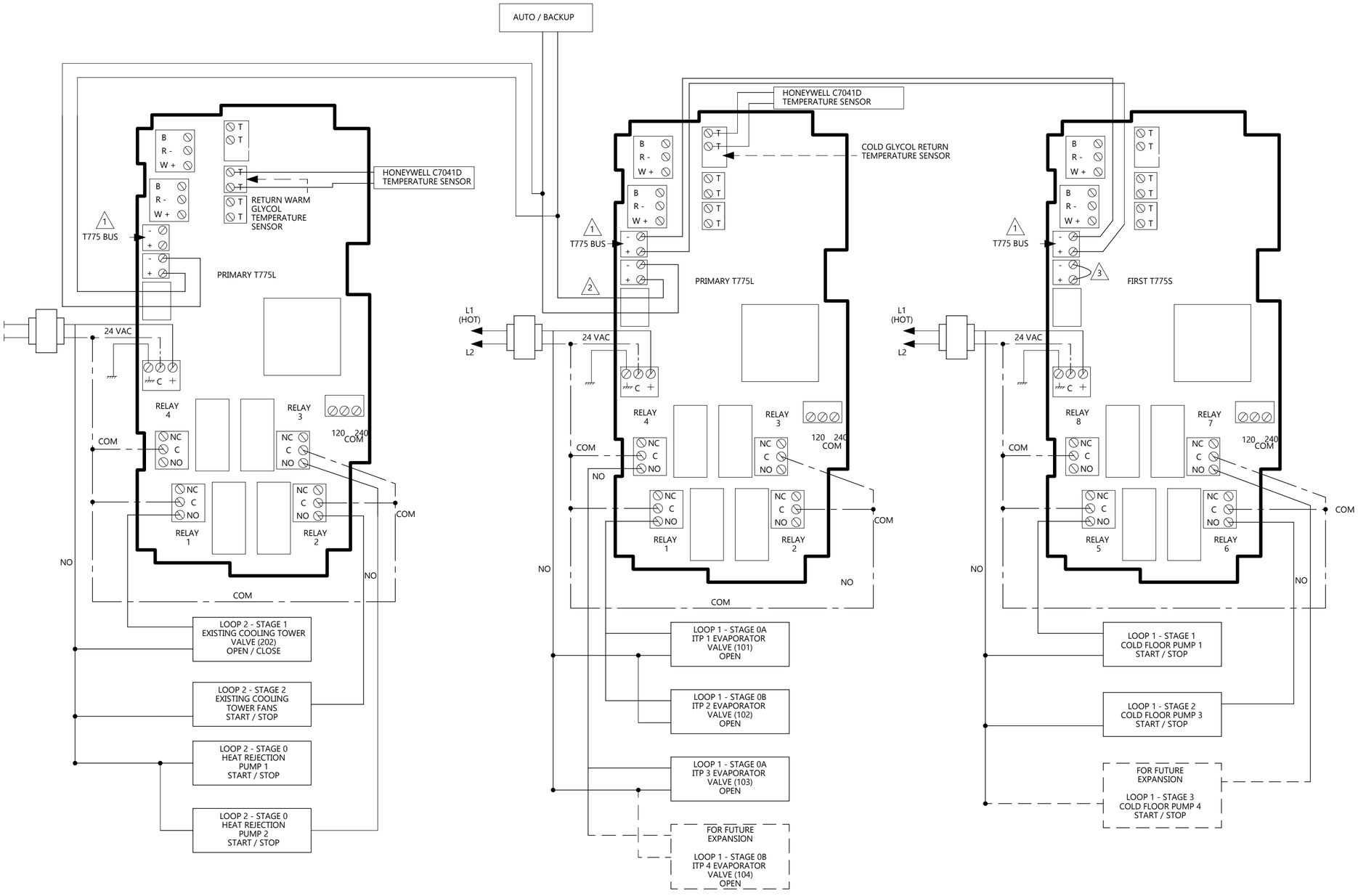
|---|---|
| **DRAWING NUMBER** | 24021 MP905 |
| **DRAWING NAME** | RELIEF PIPING ISOMETRIC VEIW |
| **CLIENT** | COLUMBUS PARKS & RECREATION |
| **PROJECT** | HAMILTON CC & ICE ARENA PLANT CONVERSION |
| **DRAWN BY** R.THOMAS | **CHECKED BY** J.RITCHIE |
| **DATE** 08-NOV-24 | **REVISION** 1.0 |
| **SHEET SIZE** C | **SHEET NO.** 1 OF 1 |




1. T775 BUS TERMINALS PROVIDE WIRING CONNECTIONS TO/FROM T775L AND T775S
2. DIGITAL INPUT FROM SELECTOR SWITCH (DRY CONTACT)
3. LAST T775S MUST HAVE A JUMPER INSTALLED AS SHOWN AT THE JUMPER TERMINAL

**NOTES:**

- COOLING TOWER MUST BE SENT TO LOCAL CONTROLS IF THE AUTOMATION SYSTEM IS OFFLINE.
- ALL INTEGRATED THERMAL PACKAGES MUST BE SENT TO LOCAL CONTROLS IF THE AUTOMATION SYSTEM IS OFFLINE.

BACK-UP CONTROLLER

**NOTES**

| | |
|---|---|
| ——— | NEW |
| ——— | EXISTING |

24021 M-603

**REFERENCE DEFINITION**

SHEET COLUMN / SHEET NUMBER — SHEET ROW

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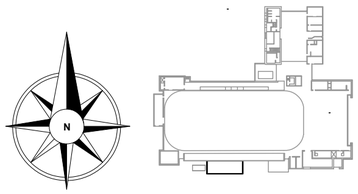
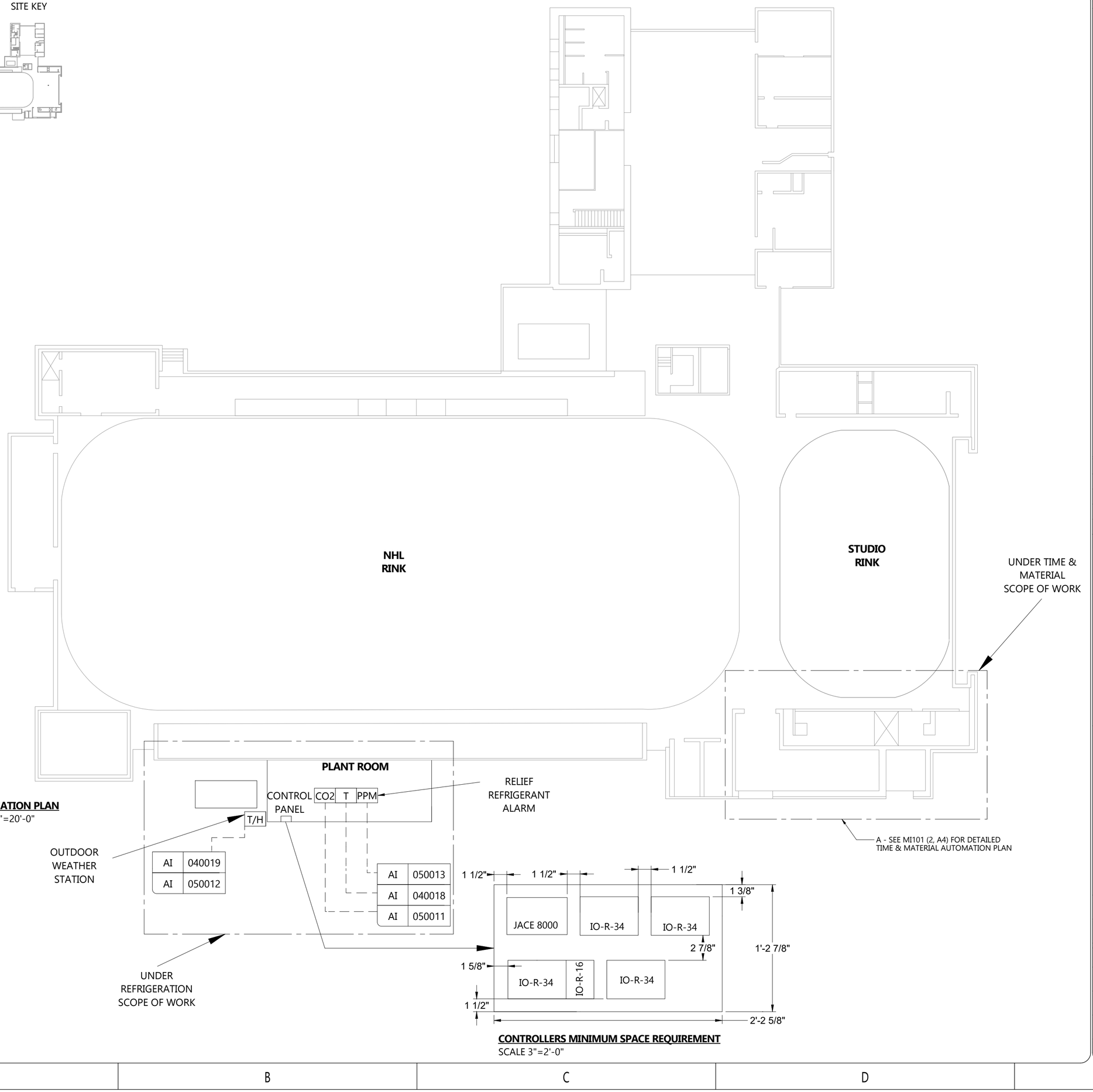
|---|---|
| **DRAWING NUMBER** | 24021 M-603 |
| **DRAWING NAME** | BACKUP CONTROLLER |
| **CLIENT** | COLUMBUS PARKS & RECREATION |
| **PROJECT** | HAMILTON CC & ICE ARENA - PLANT CONVERSION |
| **DRAWN BY** H.AKAR / **CHECKED BY** J.RITCHIE | |
| **DATE** 08-NOV-24 / **REVISION** 1.0 | |
| **SHEET SIZE** C / **SHEET NO.** 1 OF 1 | |

SITE KEY






**AUTOMATION PLAN**
SCALE 1"=20'-0"




**CONTROLLERS MINIMUM SPACE REQUIREMENT**
SCALE 3"=2'-0"

**NOTES**

24021 MI101

| SYMBOL LEGEND | |
|---|---|
| T | TEMPERATURE SENSOR |
| H | HUMIDITY SENSOR |
| CO2 | CARBON DIOXIDE SENSOR |
| PPM | RELIEF REFRIGERANT ALARM |

**REFERENCE DEFINITION**
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| **DRAWING NUMBER** | 24021 MI101 |
| **DRAWING NAME** | AUTOMATION PLAN |
| **CLIENT** | COLUMBUS PARKS & RECREATION |
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| **DRAWN BY** | H.AKAR |
| **CHECKED BY** | J.RITCHIE |
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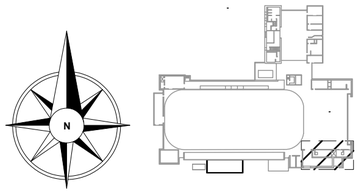
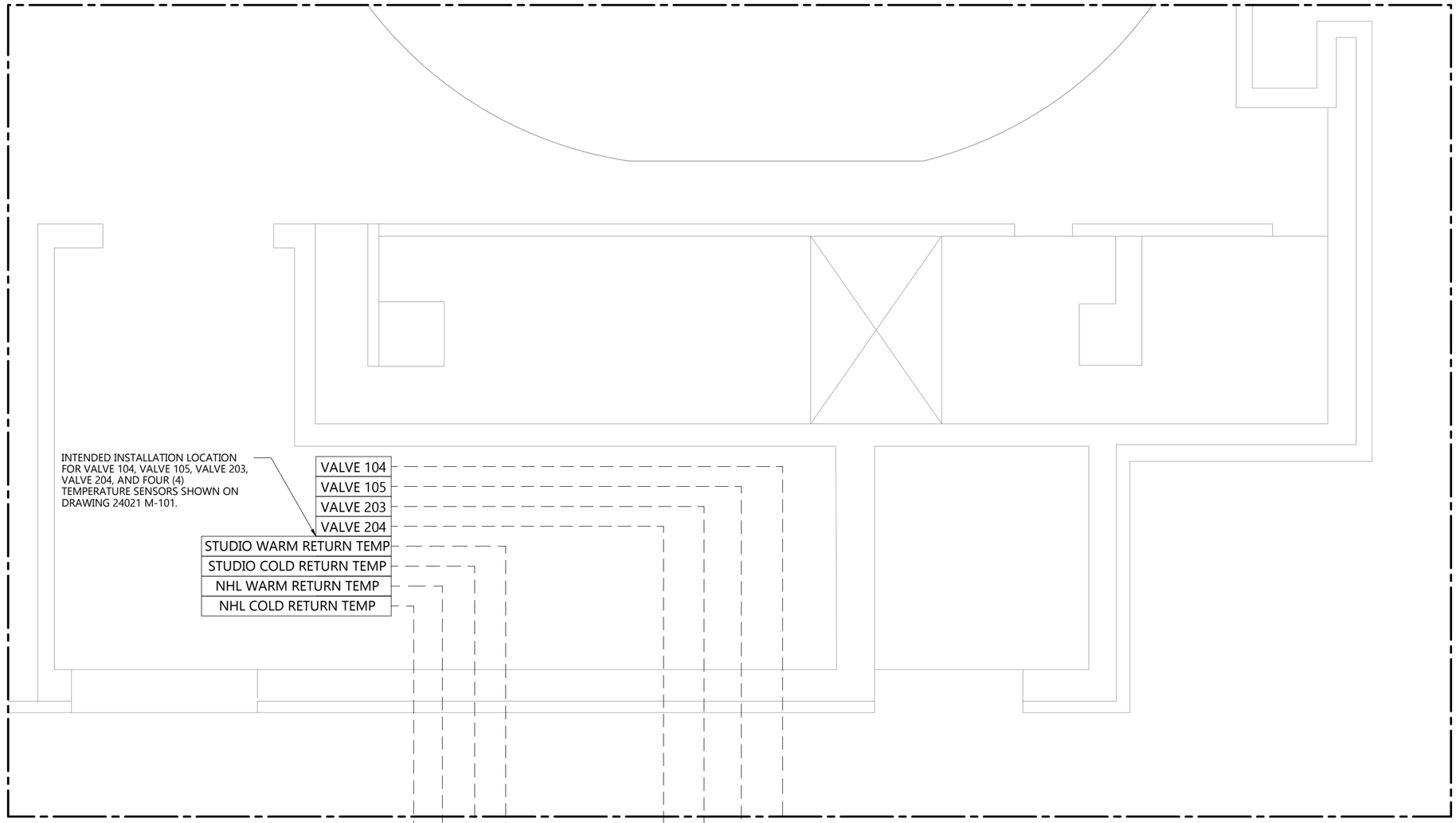
| **SHEET SIZE** | C |
| **SHEET NO.** | 1 OF 2 |

SITE KEY



**NOTE:**

- ALL WORK ON THIS SHEET WILL BE COMPLETED UNDER A TIME & MATERIAL SCOPE OF WORK.




**DETAIL A (MI101, 1, D4) TIME & MATERIAL AUTOMATION PLAN**
SCALE 1"=5'-0"

**NOTES**

24021 MI101

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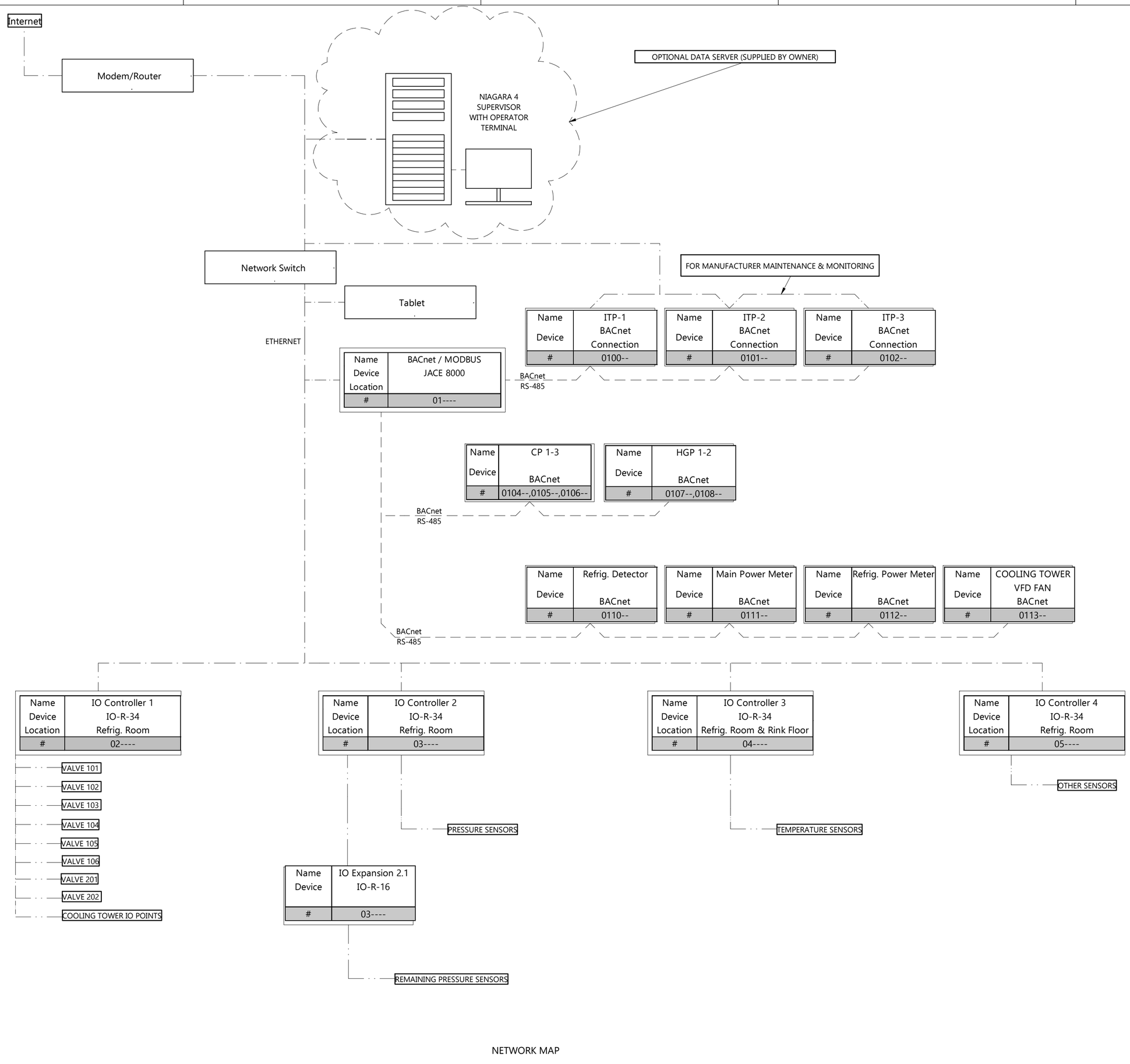
| **DRAWING NAME** | AUTOMATION PLAN |
| **CLIENT** | COLUMBUS PARKS & RECREATION |
| **PROJECT** | HAMILTON CC & ICE ARENA-PLANT CONVERSION |
| **DRAWN BY** H.AKAR | **CHECKED BY** J.RITCHIE |
| **DATE** 08-NOV-24 | **REVISION** 1.0 |
| **SHEET SIZE** C | **SHEET NO.** 2 OF 2 |




NETWORK MAP

**NOTES**

CAT 6/ETHERNET
RS-485
CONTROL WIRE

24021 MI601

**REFERENCE DEFINITION**

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**DRAWING NUMBER** 24010 MI601
**DRAWING NAME** AUTOMATION SCHEMATICS
**CLIENT** COLUMBUS PARKS & RECREATION
**PROJECT** HAMILTON CC & ICE ARENA - PLANT CONVERSION
**DRAWN BY** H.AKAR
**CHECKED BY** J.RITCHIE
**DATE** 08-NOV-24
**REVISION** 1.0
**SHEET SIZE** C
**SHEET NO.** 1 OF 7

**NOTE:**
- VFDs TO BE SUPPLIED BY AUTOMATION CONTRACTOR INSTALLED BY MECHANICAL CONTRACTOR
- WATER TREATMENT TO BE SUPPLIED AND INSTALLED BY OWNER
- INTERLOCK IMMERSION HEATERS WITH SPRAY WATER CIRCULATING PUMP TO DE-ENERGIZE HEATERS WHEN SPRAY PUMP IS RUNNING
- ALL AUTOMATION EQUIPMENT TO BE SUPPLIED BY AUTOMATION CONTRACTOR INSTALLED BY MECHNICAL CONTRACTOR

**NOTE:**
REFER TO THE TABLE ON THE DESIGN STANDARDS DRAWING

I. B. STOREY DESIGN STANDARDS: 1 (COLD SIDE)
IBSDS M809 GLYCOL FEEDER V10.0 -0.6
IBSDS M811 EXPANSION TANK V11.0 -11

I. B. STOREY DESIGN STANDARDS: 3
IBSDS M815 RENTAL CHILLER V4.0 -01

AI 030018
AI 050007
AO 020009
AI 020010
AI 040006
AI 040005
DO 020027
DI 020028
AI 030020
AI 040002
DO 020025
DI 020026
AI 040004
AI 030017
AI 040001
DO 020001
DI 020002
AI 030001
AI 030002
AI 030003
AI 030004
DO 020003
DI 020004
AI 030005
AI 030006
AI 030007
AI 030008
DO 020005
DI 020006
AI 030009
AI 030010
AI 030011
AI 030012

COLD SLAB
TIME AND MATERIAL SCOPE
ICE RESURF. ROOM WALL
END OF REFRIGERATION PLANT SCOPE AT DRESSING ROOM ROOF
FUTURE RINK SUPPLY CONNECTION
HIGH CAPACITY AIR VENT (ARMSTRONG AAE-750)
STRAINER
1" NPT FILL VALVE
SHUT OFF VALVE
RETURN FROM SYSTEM
AIR SEPARATOR
MANUAL BLOWDOWN VALVE
AIR SEPARATOR 1 PIPING CONNECTION DIAGRAM
FUTURE RINK RETURN CONNECTION
RELIEF HEADER
Φ3-1/2" SCH. 80 STEEL
E-1, 2, 3, 4 EVAP. VESSEL
C-1, 2, 3, 4 CONDENS. VESSEL
SEE (2, C5) FOR CONTINUATION
CP-1, CP-2, CP-3 COLD FLOOR PUMPS
SF-1
COLD PUMPS SKID
VFD
BACnet RS-485
SEE MI601 SHEET 5 VFD PUMPS
IBSDS: 1
IBSDS: 3
N.C.
EVAPORATOR
CONDENSER
ITP-1
ITP-2
ITP-3
ITP-4 FOR FUTURE EXPANSION
SEE MI601 SHEET 5 R-513A PACKAGE (1)
SEE MI601 SHEET 5 R-513A PACKAGE (2)
SEE MI601 SHEET 5 R-513A PACKAGE (3)
BACnet RS-485

**NOTES**

| | |
|---|---|
| | NEW |
| | EXISTING |

| | |
|---|---|
| | ISOLATING VALVE |
| | MODULATING VALVE |
| | SOLENOID VALVE |
| | EXPANSION VALVE |
| | RELIEF VALVE |
| | STRAINER |
| | CHECK VALVE |
| | BALANCING VALVE |
| | DRAIN |
| | FLO-TREX VALVE |
| | SUCTION GUIDE |
| P | PRESSURE SENSOR |
| T | TEMPERATURE SENSOR |
| F | FLOW METER |
| LS | LEVEL SWITCH |
| R | RELIEF LINE |
| | PRESSURE GAUGE |
| | THERMOMETER |
| PPM | REFRIGERANT DETECTOR |

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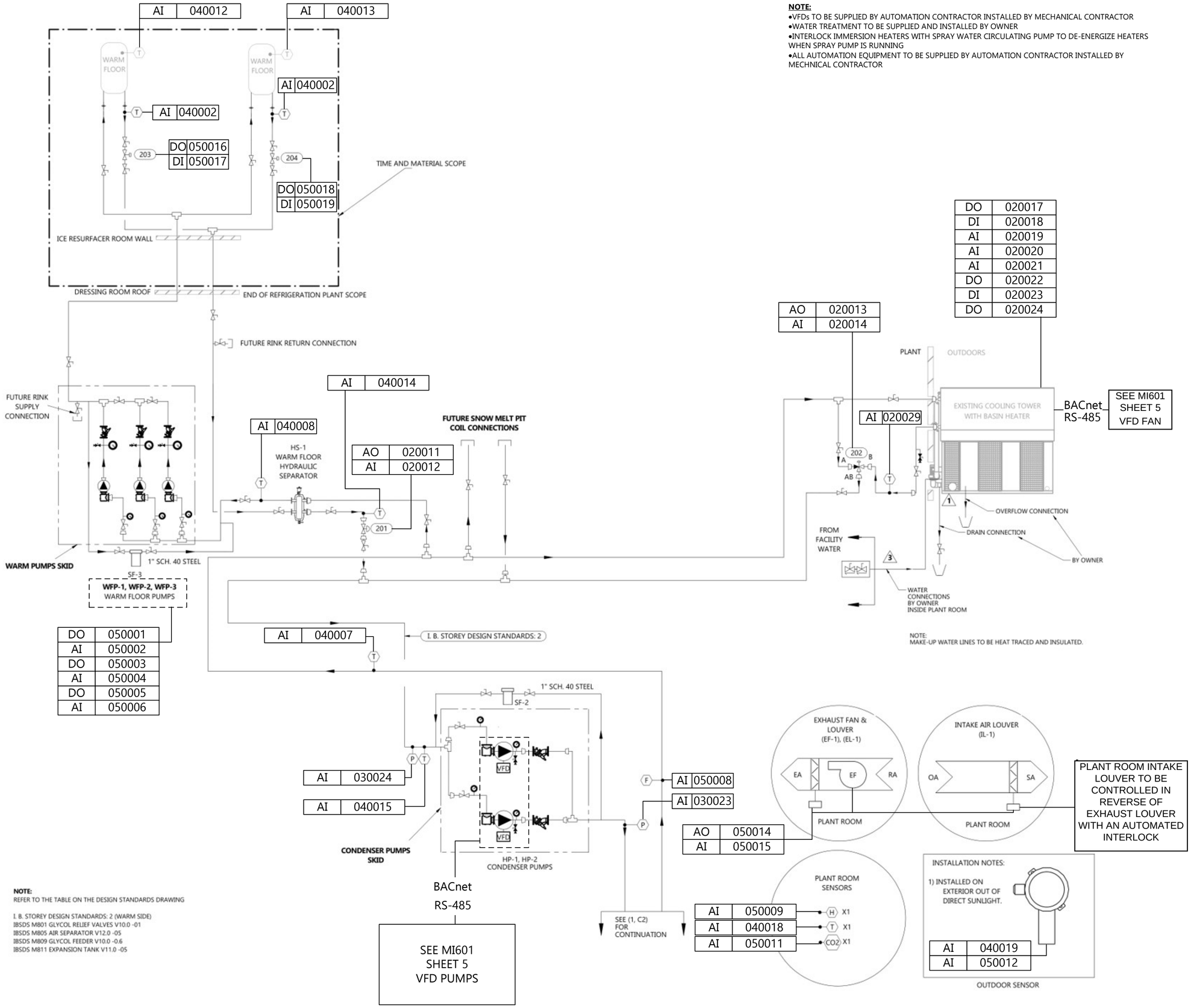
| **DRAWING NAME** | AUTOMATION SCHEMATICS |
| **CLIENT** | COLUMBUS PARKS & RECREATION |
| **PROJECT** | HAMILTON CC & ICE ARENA – PLANT CONVERSION |
| **DRAWN BY** | H.AKAR |
| **CHECKED BY** | J.RITCHIE |
| **DATE** | 08-NOV-24 |
| **REVISION** | 1.0 |
| **SHEET SIZE** | C |
| **SHEET NO.** | 2 OF 7 |

24-021 MI601




**NOTE:**
- VFDs TO BE SUPPLIED BY AUTOMATION CONTRACTOR INSTALLED BY MECHANICAL CONTRACTOR
- WATER TREATMENT TO BE SUPPLIED AND INSTALLED BY OWNER
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- ALL AUTOMATION EQUIPMENT TO BE SUPPLIED BY AUTOMATION CONTRACTOR INSTALLED BY MECHNICAL CONTRACTOR

**NOTE:**
REFER TO THE TABLE ON THE DESIGN STANDARDS DRAWING

I. B. STOREY DESIGN STANDARDS: 2 (WARM SIDE)
IBSDS M801 GLYCOL RELIEF VALVES V10.0 -01
IBSDS M805 AIR SEPARATOR V12.0 -05
IBSDS M809 GLYCOL FEEDER V10.0 -0.6
IBSDS M811 EXPANSION TANK V11.0 -05

**NOTES**

| | |
|---|---|
| | NEW |
| | EXISTING |

| | |
|---|---|
| | ISOLATING VALVE |
| | MODULATING VALVE |
| | SOLENOID VALVE |
| | EXPANSION VALVE |
| | RELIEF VALVE |
| | STRAINER |
| | CHECK VALVE |
| | BALANCING VALVE |
| | DRAIN |
| | FLO-TREX VALVE |
| | SUCTION GUIDE |
| P | PRESSURE SENSOR |
| T | TEMPERATURE SENSOR |
| F | FLOW METER |
| LS | LEVEL SWITCH |
| R | RELIEF LINE |
| | PRESSURE GAUGE |
| | THERMOMETER |
| PPM | REFRIGERANT DETECTOR |

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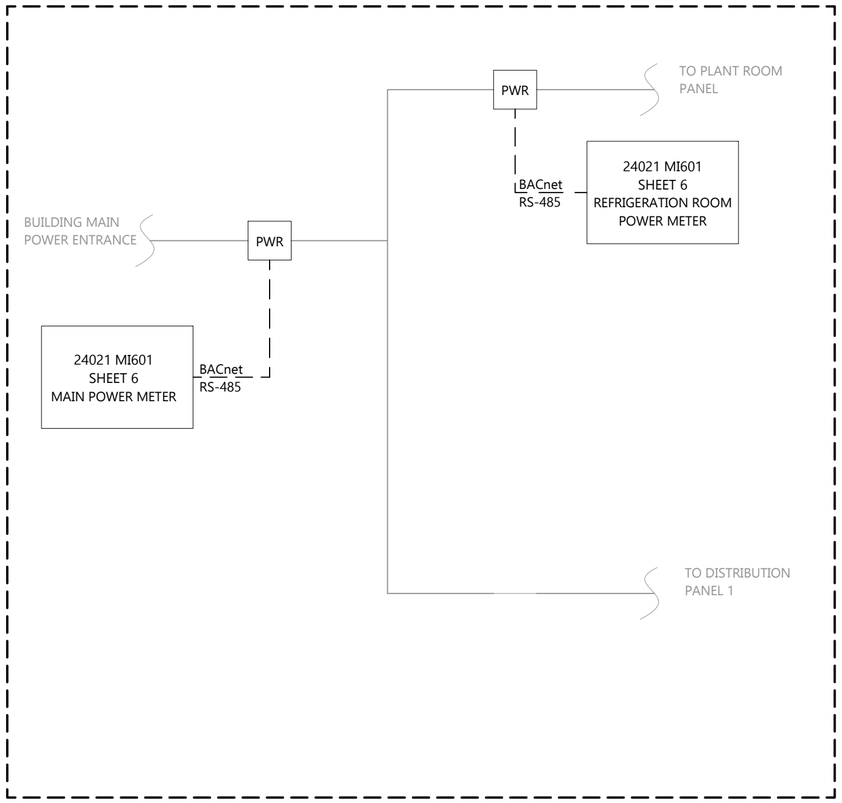
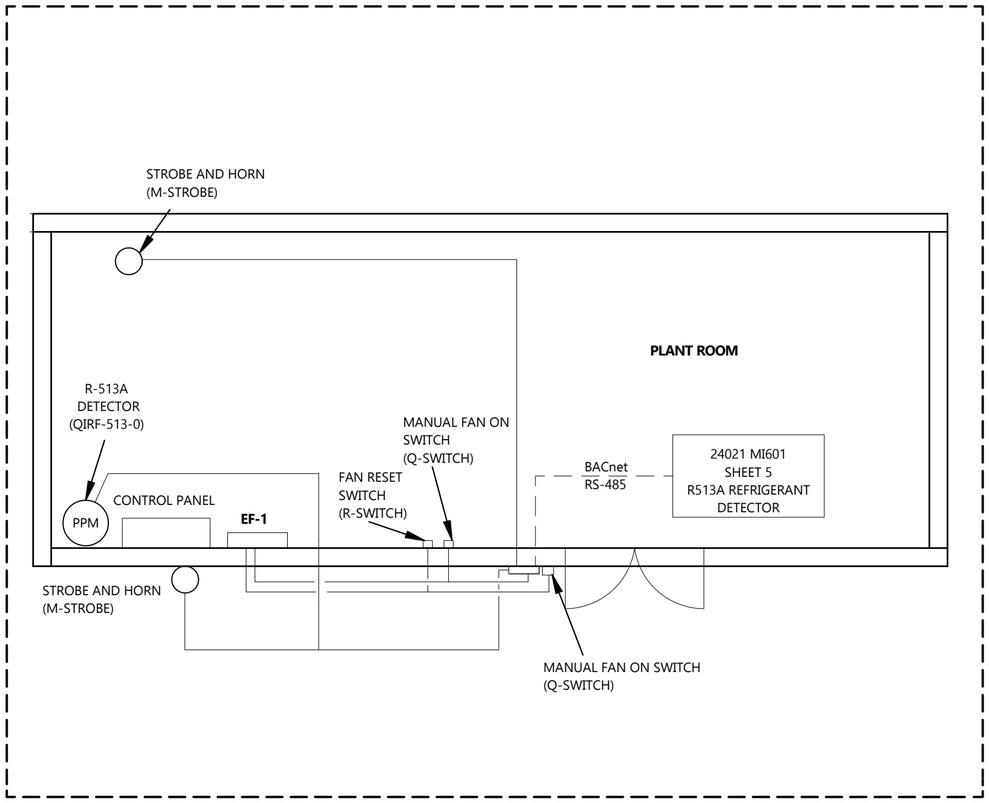
| **PROJECT** | HAMILTON CC & ICE ARENA – PLANT CONVERSION |
| **DRAWN BY** | H.AKAR |
| **CHECKED BY** | J.RITCHIE |
| **DATE** | 08-NOV-24 |
| **REVISION** | 1.0 |
| **SHEET SIZE** | C |
| **SHEET NO.** | 3 OF 7 |

24-021 MI601




**BUILDING POWER**




**REFRIGERANT DETECTOR**

MISC. EQUIPMENT

**NOTES**

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| **DRAWING NAME** | AUTOMATION SCHEMATICS |
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| **PROJECT** | HAMILTON CC & ICE ARENA - PLANT CONVERSION |
| **DRAWN BY** | H.AKAR |
| **CHECKED BY** | J.RITCHIE |
| **DATE** | 08-NOV-24 |
| **REVISION** | 1.0 |
| **SHEET SIZE** | C |
| **SHEET NO.** | 4 OF 7 |

| BACNET CONNECTION TO ICE REFRIGERATION PACKAGE 1 | | | | | |
|---|---|---|---|---|---|
| POINT NUMBER | POINT DESCRIPTION | INTEGRATED HARDWARE | | | |
| | | POINT TYPE | | | |
| | | ANALOG INPUT | ANALOG OUTPUT | DIGITAL INPUT | DIGITAL OUTPUT |
| 010001 | ITP-1 START/STOP | | | | X |
| 010002 | ITP-1 STATUS | | | X | |
| 010003 | COLD WATER SETPOINT | | X | | |
| 010004 | HOT WATER SETPOINT | | X | | |
| 010005 | ITP-1 POWER CONSUMP. | X | | | |
| 010006 | ITP-1 CAPACITY (%) | X | | | |
| 010007 | COND. IN TEMP | X | | | |
| 010008 | COND. OUT TEMP | X | | | |
| 010009 | EVAP IN TEMP | X | | | |
| 010010 | EVAP OUT TEMP | X | | | |
| 010011 | RUNTIME | X | | | |
| 010012 | STARTS | X | | | |
| 010013 | AMPS | X | | | |
| 010014 | POWER FACTOR | X | | | |
| 010015 | VOLTAGE | X | | | |
| 010016 | POWER (KW) | X | | | |
| 010017 | ITP-1 ALARM STATE | | | X | |
| 010018 | ITP-1 CONDENSER VALVE COMMAND | | X | | |
| 010019 | ITP-1 CONDENSER VALVE FEEDBACK | X | | | |

| BACNET CONNECTION TO RINK REFRIGERATION PACKAGE 2 | | | | | |
|---|---|---|---|---|---|
| POINT NUMBER | POINT DESCRIPTION | INTEGRATED HARDWARE | | | |
| | | POINT TYPE | | | |
| | | ANALOG INPUT | ANALOG OUTPUT | DIGITAL INPUT | DIGITAL OUTPUT |
| 010101 | ITP-2 START/STOP | | | | X |
| 010102 | ITP-2 STATUS | | | X | |
| 010103 | COLD WATER SETPOINT | | X | | |
| 010104 | HOT WATER SETPOINT | | X | | |
| 010105 | ITP-2 POWER CONSUMP. | X | | | |
| 010106 | ITP-2 CAPACITY (%) | X | | | |
| 010107 | COND. IN TEMP | X | | | |
| 010108 | COND. OUT TEMP | X | | | |
| 010109 | EVAP IN TEMP | X | | | |
| 010110 | EVAP OUT TEMP | X | | | |
| 010111 | RUNTIME | X | | | |
| 010112 | STARTS | X | | | |
| 010113 | AMPS | X | | | |
| 010114 | POWER FACTOR | X | | | |
| 010115 | VOLTAGE | X | | | |
| 010116 | POWER (KW) | X | | | |
| 010117 | ITP-2 ALARM STATE | | | X | |
| 010118 | ITP-2 CONDENSER VALVE COMMAND | | X | | |
| 010119 | ITP-2 CONDENSER VALVE FEEDBACK | X | | | |

| BACNET CONNECTION TO RINK REFRIGERATION PACKAGE 3 | | | | | |
|---|---|---|---|---|---|
| POINT NUMBER | POINT DESCRIPTION | INTEGRATED HARDWARE | | | |
| | | POINT TYPE | | | |
| | | ANALOG INPUT | ANALOG OUTPUT | DIGITAL INPUT | DIGITAL OUTPUT |
| 010201 | ITP-3 START/STOP | | | | X |
| 010202 | ITP-3 STATUS | | | X | |
| 010203 | COLD WATER SETPOINT | | X | | |
| 010204 | HOT WATER SETPOINT | | X | | |
| 010205 | ITP-3 POWER CONSUMP. | X | | | |
| 010206 | ITP-3 CAPACITY (%) | X | | | |
| 010207 | COND. IN TEMP | X | | | |
| 010208 | COND. OUT TEMP | X | | | |
| 010209 | EVAP IN TEMP | X | | | |
| 010210 | EVAP OUT TEMP | X | | | |
| 010211 | RUNTIME | X | | | |
| 010212 | STARTS | X | | | |
| 010213 | AMPS | X | | | |
| 010214 | POWER FACTOR | X | | | |
| 010215 | VOLTAGE | X | | | |
| 010216 | POWER (KW) | X | | | |
| 010217 | ITP-3 ALARM STATE | | | X | |
| 010218 | ITP-3 CONDENSER VALVE COMMAND | | X | | |
| 010219 | ITP-3 CONDENSER VALVE FEEDBACK | X | | | |

| BACNET CONNECTION TO VFD PUMPS | | | | | |
|---|---|---|---|---|---|
| POINT NUMBER | POINT DESCRIPTION | INTEGRATED HARDWARE | | | |
| | | POINT TYPE | | | |
| | | ANALOG INPUT | ANALOG OUTPUT | DIGITAL INPUT | DIGITAL OUTPUT |
| 010401 | CP-1 START/STOP | | | | X |
| 010402 | CP-1 STATUS | | | X | |
| 010403 | CP-1 VFD SPEED COMMAND | | X | | |
| 010404 | CP-1 VFD SPEED FEEDBACK | X | | | |
| 010405 | CP-1 VFD AMPS | X | | | |
| 010406 | CP-1 VFD VOLTAGE | X | | | |
| 010407 | CP-1 VFD POWER FACTOR | X | | | |
| 010408 | CP-1 VFD POWER (KW) | X | | | |
| 010501 | CP-2 START/STOP | | | | X |
| 010502 | CP-2 STATUS | | | X | |
| 010503 | CP-2 VFD SPEED COMMAND | | X | | |
| 010504 | CP-2 VFD SPEED FEEDBACK | X | | | |
| 010505 | CP-2 VFD AMPS | X | | | |
| 010506 | CP-2 VFD VOLTAGE | X | | | |
| 010507 | CP-2 VFD POWER FACTOR | X | | | |
| 010508 | CP-2 VFD POWER (KW) | X | | | |
| 010601 | CP-3 START/STOP | | | | X |
| 010602 | CP-3 STATUS | | | X | |
| 010603 | CP-3 VFD SPEED COMMAND | | X | | |
| 010604 | CP-3 VFD SPEED FEEDBACK | X | | | |
| 010605 | CP-3 VFD AMPS | X | | | |
| 010606 | CP-3 VFD VOLTAGE | X | | | |
| 010607 | CP-3 VFD POWER FACTOR | X | | | |
| 010608 | CP-3 VFD POWER (KW) | X | | | |
| 010701 | HP-1 START/STOP | | | | X |
| 010702 | HP-1 STATUS | | | X | |
| 010703 | HP-1 VFD SPEED COMMAND | | X | | |
| 010704 | HP-1 VFD SPEED FEEDBACK | X | | | |
| 010705 | HP-1 VFD AMPS | X | | | |
| 010706 | HP-1 VFD VOLTAGE | X | | | |
| 010707 | HP-1 VFD POWER FACTOR | X | | | |
| 010708 | HP-1 VFD POWER (KW) | X | | | |
| 010801 | HP-2 START/STOP | | | | X |
| 010802 | HP-2 STATUS | | | X | |
| 010803 | HP-2 VFD SPEED COMMAND | | X | | |
| 010804 | HP-2 VFD SPEED FEEDBACK | X | | | |
| 010805 | HP-2 VFD AMPS | X | | | |
| 010806 | HP-2 VFD VOLTAGE | X | | | |
| 010807 | HP-2 VFD POWER FACTOR | X | | | |
| 010808 | HP-2 VFD POWER (KW) | X | | | |

| BACNET CONNECTION TO R513A REFRIGERANT DETECTOR | | | | | |
|---|---|---|---|---|---|
| POINT NUMBER | POINT DESCRIPTION | INTEGRATED HARDWARE | | | |
| | | POINT TYPE | | | |
| | | ANALOG INPUT | ANALOG OUTPUT | DIGITAL INPUT | DIGITAL OUTPUT |
| 011001 | REFRIGERANT PPM | X | | | |
| 011002 | REFRIGERANT ALARM | X | | | |

| BACNET CONNECTION TO MAIN POWER METER | | | | | |
|---|---|---|---|---|---|
| POINT NUMBER | POINT DESCRIPTION | INTEGRATED HARDWARE | | | |
| | | POINT TYPE | | | |
| | | ANALOG INPUT | ANALOG OUTPUT | DIGITAL INPUT | DIGITAL OUTPUT |
| 011101 | ENERGY SUM - KWH | X | | | |
| 011102 | POWER SUM W | X | | | |
| 011103 | POWER A W | X | | | |
| 011104 | POWER B W | X | | | |
| 011105 | POWER C W | X | | | |
| 011106 | VOLT AVG LN V | X | | | |
| 011107 | VOLT A V | X | | | |
| 011108 | VOLT B V | X | | | |
| 011109 | VOLT C V | X | | | |
| 011110 | VOLT AVG LL V | X | | | |
| 011111 | FREQ HZ | X | | | |
| 011112 | CURRENT A AMP | X | | | |
| 011113 | CURRENT B AMP | X | | | |
| 011114 | CURRENT C AMP | X | | | |
| 011115 | POWER FACTOR AVG | X | | | |
| 011116 | POWER FACTOR A | X | | | |
| 011117 | POWER FACTOR B | X | | | |
| 011118 | POWER FACTOR C | X | | | |
| 011119 | DEMAND SUM W | X | | | |
| 011120 | DEMAND A | X | | | |
| 011121 | DEMAND B | X | | | |
| 011122 | DEMAND C | X | | | |

| BACNET CONNECTION TO REFRIGERATION ROOM POWER METER | | | | | |
|---|---|---|---|---|---|
| POINT NUMBER | POINT DESCRIPTION | INTEGRATED HARDWARE | | | |
| | | POINT TYPE | | | |
| | | ANALOG INPUT | ANALOG OUTPUT | DIGITAL INPUT | DIGITAL OUTPUT |
| 011201 | ENERGY SUM - KWH | X | | | |
| 011202 | POWER SUM W | X | | | |
| 011203 | POWER A W | X | | | |
| 011204 | POWER B W | X | | | |
| 011205 | POWER C W | X | | | |
| 011206 | VOLT AVG LN V | X | | | |
| 011207 | VOLT A V | X | | | |
| 011208 | VOLT B V | X | | | |
| 011209 | VOLT C V | X | | | |
| 011210 | VOLT AVG LL V | X | | | |
| 011211 | FREQ HZ | X | | | |
| 011212 | CURRENT A AMP | X | | | |
| 011213 | CURRENT B AMP | X | | | |
| 011214 | CURRENT C AMP | X | | | |
| 011215 | POWER FACTOR AVG | X | | | |
| 011216 | POWER FACTOR A | X | | | |
| 011217 | POWER FACTOR B | X | | | |
| 011218 | POWER FACTOR C | X | | | |
| 011219 | DEMAND SUM W | X | | | |
| 011220 | DEMAND A | X | | | |
| 011221 | DEMAND B | X | | | |
| 011222 | DEMAND C | X | | | |

| BACNET CONNECTION TO VFD FAN | | | | | |
|---|---|---|---|---|---|
| POINT NUMBER | POINT DESCRIPTION | INTEGRATED HARDWARE | | | |
| | | POINT TYPE | | | |
| | | ANALOG INPUT | ANALOG OUTPUT | DIGITAL INPUT | DIGITAL OUTPUT |
| 011301 | FAN START/STOP | | | | X |
| 011302 | FAN STATUS | | | X | |
| 011303 | FAN SPEED COMMAND | | X | | |
| 011304 | FAN SPEED FEEDBACK | X | | | |
| 011305 | FAN STATUS | X | | | |
| 011306 | FAN SPEED COMMAND | X | | | |
| 011307 | FAN SPEED COMMAND | X | | | |
| 011308 | FAN SPEED COMMAND | X | | | |

AUTOMATION POINTS (1/2)

**NOTES**

24021 MI601

**REFERENCE DEFINITION**

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**DRAWING NUMBER** 24010 MI601

**DRAWING NAME** AUTOMATION SCHEMATICS

**CLIENT** COLUMBUS PARKS & RECREATION

**PROJECT** HAMILTON CC & ICE ARENA - PLANT CONVERSION

| DRAWN BY | CHECKED BY |
|---|---|
| H.AKAR | J.RITCHIE |
| **DATE** 08-NOV-24 | **REVISION** 1.0 |
| **SHEET SIZE** C | **SHEET NO.** 5 OF 7 |

| IO-CONTROLLER 1 | | | | | |
|---|---|---|---|---|---|
| POINT NUMBER | POINT DESCRIPTION | INTEGRATED HARDWARE | | | |
| | | POINT TYPE | | | |
| | | ANALOG INPUT | ANALOG OUTPUT | DIGITAL INPUT | DIGITAL OUTPUT |
| 020001 | ITP-1 EVAP. VALVE 101 OPEN/CLOSE | | | | X |
| 020002 | ITP-1 EVAP. VALVE 101 FEEDBACK | | | X | |
| 020003 | ITP-2 EVAP. VALVE 102 OPEN/CLOSE | | | | X |
| 020004 | ITP-2 EVAP. VALVE 102 FEEDBACK | | | X | |
| 020005 | ITP-3 EVAP. VALVE 103 OPEN/CLOSE | | | | X |
| 020006 | ITP-3 EVAP. VALVE 103 FEEDBACK | | | X | |
| 020007 | <RESERVED FOR ITP-4> | | | | |
| 020008 | <RESERVED FOR ITP-4> | | | | |
| 020009 | STARTUP BYPASS VALVE 106 OPEN/CLOSE | | X | | |
| 020010 | STARTUP BYPASS VALVE 106 FEEDBACK | X | | | |
| 020011 | WARM FLOOR VALVE 201 OPEN/CLOSE | | X | | |
| 020012 | WARM FLOOR VALVE 201 FEEDBACK | X | | | |
| 020013 | CT-1 BY-PASS VALVE 202 OPEN/CLOSE | | X | | |
| 020014 | CT-1 BY-PASS VALVE 202 FEEDBACK | X | | | |
| 020015 | <RESERVED FOR FUTURE SNOW MELT PIT> | | | | |
| 020016 | <RESERVED FOR FUTURE SNOW MELT PIT> | | | | |
| 020017 | PONY FAN START/STOP | | | | X |
| 020018 | PONY FAN STATUS | | | X | |
| 020019 | WATER TANK TEMPERATURE SENSOR | X | | | |
| 020020 | WATER TANK LEVEL SENSOR | X | | | |
| 020021 | BASIN HEATER STATUS | X | | | |
| 020022 | BASIN HEATER START/STOP | | | | X |
| 020023 | SUMP PUMP STATUS | | | X | |
| 020024 | SUMP PUMP START/STOP | | | | X |
| 020025 | NHL RINK RETURN VALVE 104 OPEN/CLOSE | | | | X |
| 020026 | NHL RINK RETURN VALVE 104 FEEDBACK | | | X | |
| 020027 | STUDIO RINK RETURN VALVE 105 OPEN/CLOSE | | | | X |
| 020028 | STUDIO RINK RETURN VALVE 105 FEEDBACK | | | X | |
| 020029 | COOLING TOWER RETURN TEMPERATURE SENSOR | X | | | |

| IO-CONTROLLER 2 + (1) EXPANSION | | | | | |
|---|---|---|---|---|---|
| POINT NUMBER | POINT DESCRIPTION | INTEGRATED HARDWARE | | | |
| | | POINT TYPE | | | |
| | | ANALOG INPUT | ANALOG OUTPUT | DIGITAL INPUT | DIGITAL OUTPUT |
| 030001 | ITP-1 EVAP. OUTLET PRESSURE | X | | | |
| 030002 | ITP-1 EVAP. INLET PRESSURE | X | | | |
| 030003 | ITP-1 COND. OUTLET PRESSURE | X | | | |
| 030004 | ITP-1 COND. INLET PRESSURE | X | | | |
| 030005 | ITP-2 EVAP. OUTLET PRESSURE | X | | | |
| 030006 | ITP-2 EVAP. INLET PRESSURE | X | | | |
| 030007 | ITP-2 COND. OUTLET PRESSURE | X | | | |
| 030008 | ITP-2 COND. INLET PRESSURE | X | | | |
| 030009 | ITP-3 EVAP. OUTLET PRESSURE | X | | | |
| 030010 | ITP-3 EVAP. INLET PRESSURE | X | | | |
| 030011 | ITP-3 COND. OUTLET PRESSURE | X | | | |
| 030012 | ITP-3 COND. INLET PRESSURE | X | | | |
| 030013 | <RESERVED FOR FUTURE ITP-4> | | | | |
| 030014 | <RESERVED FOR FUTURE ITP-4> | | | | |
| 030015 | <RESERVED FOR FUTURE ITP-4> | | | | |
| 030016 | <RESERVED FOR FUTURE ITP-4> | | | | |
| 030017 | COLD GLYCOL HEADER SUPPLY PRESSURE | X | | | |
| 030018 | COLD GLYCOL HEADER RETURN PRESSURE | X | | | |
| 030019 | <RESERVED> | | | | |
| 030020 | RINKS SUPPLY PRESSURE | X | | | |
| 030021 | <RESERVED> | | | | |
| 030022 | WARM GLYCOL HEADER SUPPLY PRESSURE | X | | | |
| 030023 | WARM GLYCOL HEADER RETURN PRESSURE | X | | | |
| 030024 | CONDENSER PUMP INLET PRESSURE | X | | | |

| IO-CONTROLLER 3 | | | | | |
|---|---|---|---|---|---|
| POINT NUMBER | POINT DESCRIPTION | INTEGRATED HARDWARE | | | |
| | | POINT TYPE | | | |
| | | ANALOG INPUT | ANALOG OUTPUT | DIGITAL INPUT | DIGITAL OUTPUT |
| 040001 | COLD GLYCOL HEADER SUPPLY TEMPERATURE SENSOR | X | | | |
| 040002 | NHL RINK COLD RETURN TEMPERATURE SENSOR | X | | | |
| 040003 | <RESERVED> | | | | |
| 040004 | NHL RINK COLD SLAB TEMPERATURE SENSOR | X | | | |
| 040005 | STUDIO RINK COLD RETURN TEMPERATURE SENSOR | X | | | |
| 040006 | STUDIO COLD SLAB TEMPERATURE SENSOR | X | | | |
| 040007 | WARM GLYCOL HEADER SUPPLY TEMPERATURE | X | | | |
| 040008 | WARM FLOOR SUPPLY TEMPERATURE SENSOR | X | | | |
| 040009 | <RESERVED> | | | | |
| 040010 | NHL RINK WARM FLOOR RETURN TEMPERATURE SENSOR | X | | | |
| 040011 | STUDIO RINK WARM FLOOR RETURN TEMPERATURE SENSOR | X | | | |
| 040012 | NHL RINK WARM SLAB TEMPERATURE SENSOR | X | | | |
| 040013 | STUDIO RINK WARM SLAB TEMPERATURE SENSOR | X | | | |
| 040014 | HYDRAULIC SEPARATOR RETURN TEMPERATURE | X | | | |
| 040015 | CONDENSER PUMP INLET TEMPERATURE | X | | | |
| 040016 | <RESERVED> | | | | |
| 040017 | <RESERVED> | | | | |
| 040018 | PLANT ROOM TEMPERATURE SENSOR | X | | | |
| 040019 | OUTDOOR WEATHER TEMPERATURE SENSOR | X | | | |
| 040020 | <RESERVED> | | | | |
| 040021 | <RESERVED> | | | | |

| IO-CONTROLLER 4 | | | | | |
|---|---|---|---|---|---|
| POINT NUMBER | POINT DESCRIPTION | INTEGRATED HARDWARE | | | |
| | | POINT TYPE | | | |
| | | ANALOG INPUT | ANALOG OUTPUT | DIGITAL INPUT | DIGITAL OUTPUT |
| 050001 | WFP-1 START/STOP | | | | X |
| 050002 | WFP-1 STATUS | X | | | |
| 050003 | WFP-2 START/STOP | | | | X |
| 050004 | WFP-2 STATUS | X | | | |
| 050005 | WFP-3 START/STOP | | | | X |
| 050006 | WFP-3 STATUS | X | | | |
| 050007 | COLD FLOOR SUPPLY FLOWMETER | X | | | |
| 050008 | WARM GLYCOL HEADER FLOWMETER | X | | | |
| 050009 | <RESERVED> | | | | |
| 050010 | <RESERVED> | | | | |
| 050011 | PLANT ROOM CO2 SENSOR | X | | | |
| 050012 | OUTDOOR WEATHER HUMIDITY SENSOR | X | | | |
| 050013 | RELIEF REFRIGERANT ALARM | X | | | |
| 050014 | EXHAUST FAN 1 START/STOP | | X | | |
| 050015 | EXHAUST FAN 1 STATUS | X | | | |
| 050016 | NHLWARM FLOOR VALVE 203 OPEN/CLOSE | | | | X |
| 050017 | NHLWARM FLOOR VALVE 203 FEEDBACK | | | X | |
| 050018 | STUDIO WARM FLOOR VALVE 203 OPEN/CLOSE | | | | X |
| 050019 | STUDIO WARM FLOOR VALVE 203 FEEDBACK | | | X | |

AUTOMATION POINTS LIST (2/2)

**NOTES**

24021 MI601

**REFERENCE DEFINITION**

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**DRAWING NUMBER** 24010 MI601
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**CLIENT** COLUMBUS PARKS & RECREATION
**PROJECT** HAMILTON CC & ICE ARENA - PLANT CONVERSION
**DRAWN BY** H.AKAR | **CHECKED BY** J.RITCHIE
**DATE** 08-NOV-24 | **REVISION** 1.0
**SHEET SIZE** C | **SHEET NO.** 6 OF 7

## CONTRACTOR NOTES

ALL CONTROL WIRING, ELECTRICAL WIRING, CONDUIT, STARTERS, DISCONNECT, BREAKERS, ETC. REQUIRED BY THE EQUIPMENT OF THIS DOCUMENT SHALL BE BY THIS CONTRACTOR.
SUPPLY OF ALL FIELD SENSORS AND CONTROL DEVICES IS REQUIRED BY THE CONTRACTOR. INSTALLATION OF THE DEVICES IS TO BE DONE BY THE MECHANICAL CONTRACTOR IN COORDINATION WITH THIS CONTRACTOR
CONTRACTOR IS RESPONSIBLE FOR THE SUPPLY OF ALL CONTROLLER PANELS AND OPERATOR TERMINALS INCLUDING ANY REQUIRED HARDWARE, SOFTWARE OR LICENSES
CONTRACTOR IS RESPONSIBLE FOR ALL REQUIRED CONTROL PROGRAMMING AND DOCUMENTATION OF SAID PROGRAMMING
AUTOMATION IS TO COORDINATE WITH THE OTHER TRADES IN THE BUILDING TO ENSURE PROPER ELECTRICAL SUPPLY TO THE AUTOMATION PANELS
CONFORM TO ALL APPLICABLE STANDARDS AND THEIR AMENDMENTS INCLUDING BUT NOT LIMITED TO
A. MANUFACTURER REQUIREMENTS
B. NATIONAL BUILDING CODES
C. LOCAL INSPECTION AUTHORITY SERVICE REGULATIONS,
D. SUPPLY AUTHORITY SERVICE REGULATIONS,
E. LOCAL MUNICIPAL BYLAWS
OBTAIN NECESSARY PERMITS AND COVER COSTS OF SUCH PERMITS.
SUBMIT DRAWINGS BY THIS CONTRACTOR TO ELECTRICAL INSPECTION AUTHORITY FOR APPROVAL PRIOR TO START OF WORK.
IDENTIFY ELECTRICAL EQUIPMENT WITH 3MM THICK LAMACOID NAMEPLATES, BLACK FACE, WHITE CORE, MECHANICALLY ATTACHED: SIZE 25MM X 100MM, 2 LINES, 6MM HIGH LETTERS.
EQUIPMENT SHALL BE SUITABLE FOR THE ENVIRONMENT IN WHICH IT IS INSTALLED; I.E. ADEQUATE PROTECTION WHEN REQUIRED.
DISCONNECT SWITCHES TO BE HEAVY-DUTY RATED 4W. PROVISIONS FOR PAD LOCKING IN OFF POSITION BY TWO LOCKS.
STARTERS TO HAVE RELAY OVERLOAD HEATERS SIZED TO SUIT THE LOAD BEING CONTROLLED. UNLESS OTHERWISE STATED, CONTROL VOLTAGE SHALL BE 24V. PROVIDE MANUAL DISCONNECT AND INDICATING PILOT LIGHTS ON EACH STARTER. PROVIDE H-0-A SWITCH ON EACH STARTER. STARTERS SHALL BE BREAKER TYPE.
ALL CONTROLLED EQUIPMENT ARE TO HAVE HAND - OFF - AUTO SWITCHES TO ALLOW FOR MANUAL OPERATION IN CASES OF BAS FAILURE
ALL VARIABLE SPEED DRIVES ARE TO HAVE BYPASS SO THEY CAN BE RUN IN THE EVENT OF DRIVE FAILURE
ALTERNATE CONTROLLER ARCHITECTURE MAY BE PERMITTED, PROVIDED CONTROLLERS ARE APPROVED AS EQUIVALENT.

| CONTROLLER SCHEDULE | | | |
|---|---|---|---|
| DEVICE | BRAND | MODEL | QUANTITY |
| BACNET / MODBUS RTU CONTROLLER | HONEYWELL | JACE-8000 | 1 |
| IO CONTROLLER 1 | HONEYWELL | IO-R-34 | 1 |
| IO CONTROLLER 2 | HONEYWELL | IO-R-34 | 1 |
| > IO CONTROLLER 2 EXPANSION MODULES | HONEYWELL | IO-R-16 | 1 |
| IO CONTROLLER 3 | HONEYWELL | IO-R-34 | 1 |
| IO CONTROLLER 4 | HONEYWELL | IO-R-34 | 1 |

| INSTRUMENTATION SCHEDULE | | | |
|---|---|---|---|
| DEVICE | BRAND | MODEL | QUANTITY |
| BACNET POWER METERS | HONEYWELL | E-MON CLASS 5000 | 2 |
| BACNET VFDS FOR COLD FLOOR PUMPS | ABB | ACH580-01-046A-4 | 3 |
| BACNET VFDS FOR HEAT REJECTION PUMPS | ABB | ACH580-01-039A-4 | 2 |
| DUAL TURBINE FLUID FLOW METERS | ONICON | F-1200-10-C3-1221 | 2 |
| INDOOR TEMPERATURE SENSOR | HONEWELL | TR21 | 1 |
| OUTDOOR TEMPERATURE & HUMIDITY SENSOR | HONEYWELL | H7635C2015 | 1 |
| WALL CO2 SENSORS | GREYSTONE | CDD4A101 | 1 |
| IMMERSION PRESSURE SENSOR | HONEYWELL | MLH150PSM01B | 17 |
| IMMERSION TEMPERATURE SENSOR | HONEYWELL | C7041D2001 | 10 |
| IMMERSION TEMPERATURE WELL | HONEYWELL | 50001774-001 | 10 |
| REFRIGERANT DETECTOR CONTROLLER | QEL | Q-CONTROLLERX-00 | 1 |
| REFRIGERANT SENSOR | QEL | QIRF-513X-0 | 1 |
| MANUAL FAN SWITCH | QEL | Q-SWITCH | 2 |
| RESET FAN SWITCH | QEL | R-SWITCH | 1 |
| RED STROBE & HORN COMBINATION | QEL | M-STROBE | 2 |
| VENT LINE GAS DETECTOR | CTI | GG-VL2-R | 1 |

AUTOMATION CONTRACTOR NOTES & SCHEDULE

NOTE:
ALL AUTOMATION EQUIPMENT TO BE SUPPLIED BY
AUTOMATION CONTRACTOR INSTALLED BY MECHANICAL CONTRACTOR

NOTES

24021 MI601

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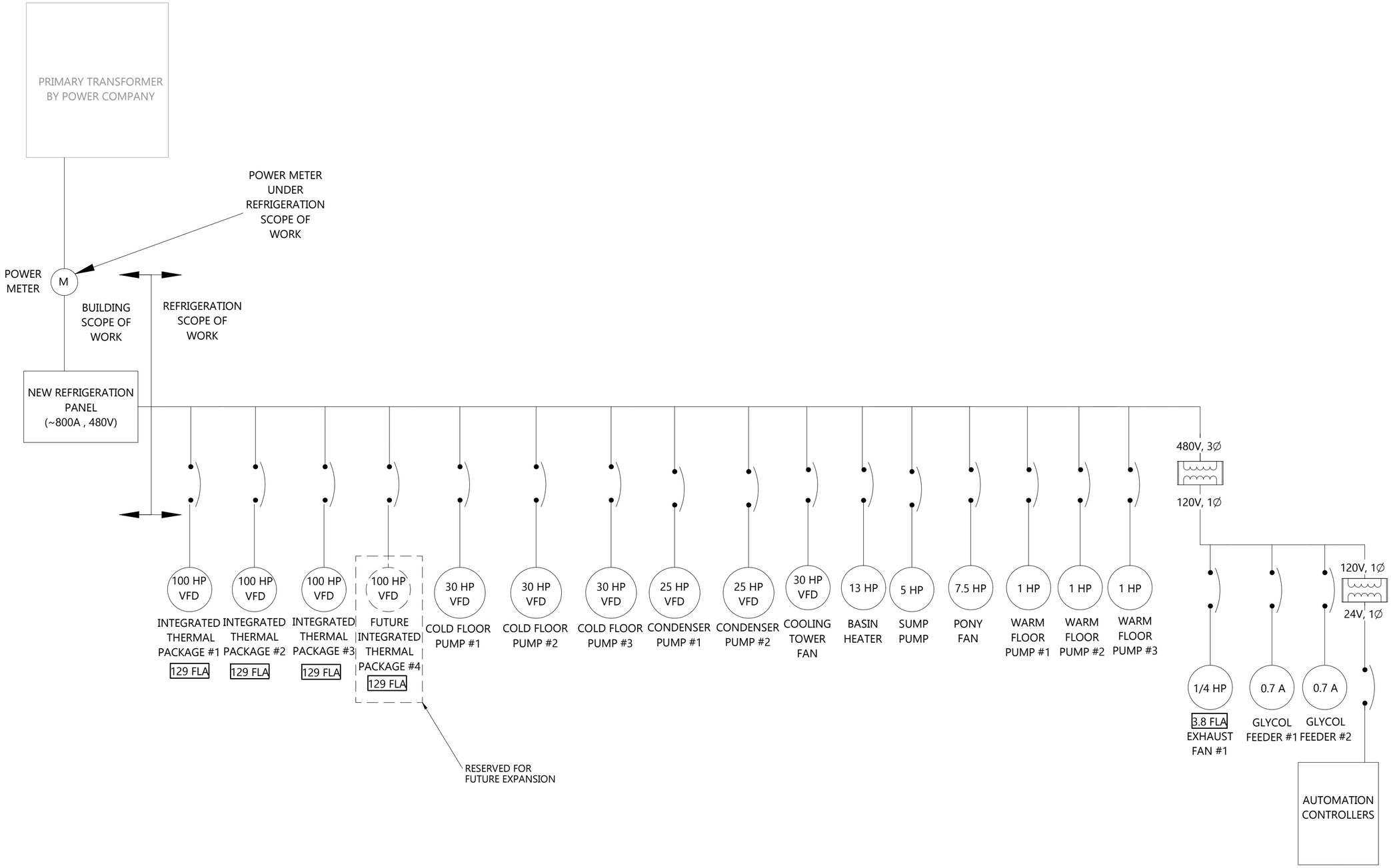
**DRAWING NUMBER** 24010 MI601
**DRAWING NAME** AUTOMATION SCHEMATICS
**CLIENT** COLUMBUS PARKS & RECREATION
**PROJECT** HAMILTON CC & ICE ARENA - PLANT CONVERSION

| DRAWN BY | CHECKED BY |
|---|---|
| H.AKAR | J.RITCHIE |
| **DATE** 08-NOV-24 | **REVISION** 1.0 |
| **SHEET SIZE** C | **SHEET NO.** 7 OF 7 |

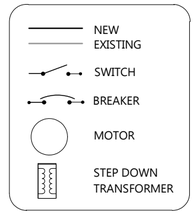
**NOTE:**

- DESIGN BUILD BY CONTRACTOR TO PROVIDE NEW REFRIGERANT PLANT FEED FROM BUILDING MAIN FEED.




SINGLE LINE DIAGRAM

**NOTES**




| | |
|---|---|
| | NEW |
| | EXISTING |
| | FUTURE EXPANSION |

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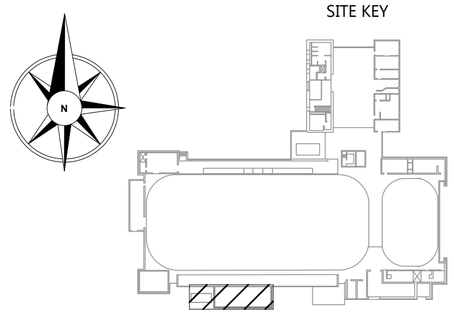
| **DRAWING NAME** | SINGLE LINE DIAGRAM |
| **CLIENT** | COLUMBUS PARKS & RECREATION |
| **PROJECT** | HAMILTON CC & ICE ARENA - PLANT CONVERSION |
| **DRAWN BY** | H.AKAR |
| **CHECKED BY** | J.RITCHIE |
| **DATE** | 08-NOV-24 |
| **REVISION** | 1.0 |
| **SHEET SIZE** | C |
| **SHEET NO.** | 1 OF 1 |

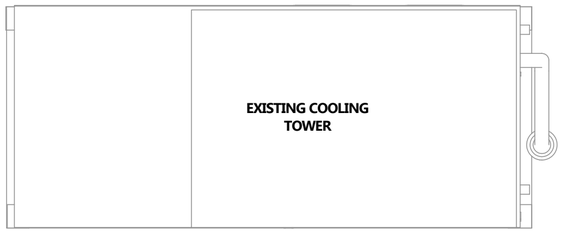
24021 E-703

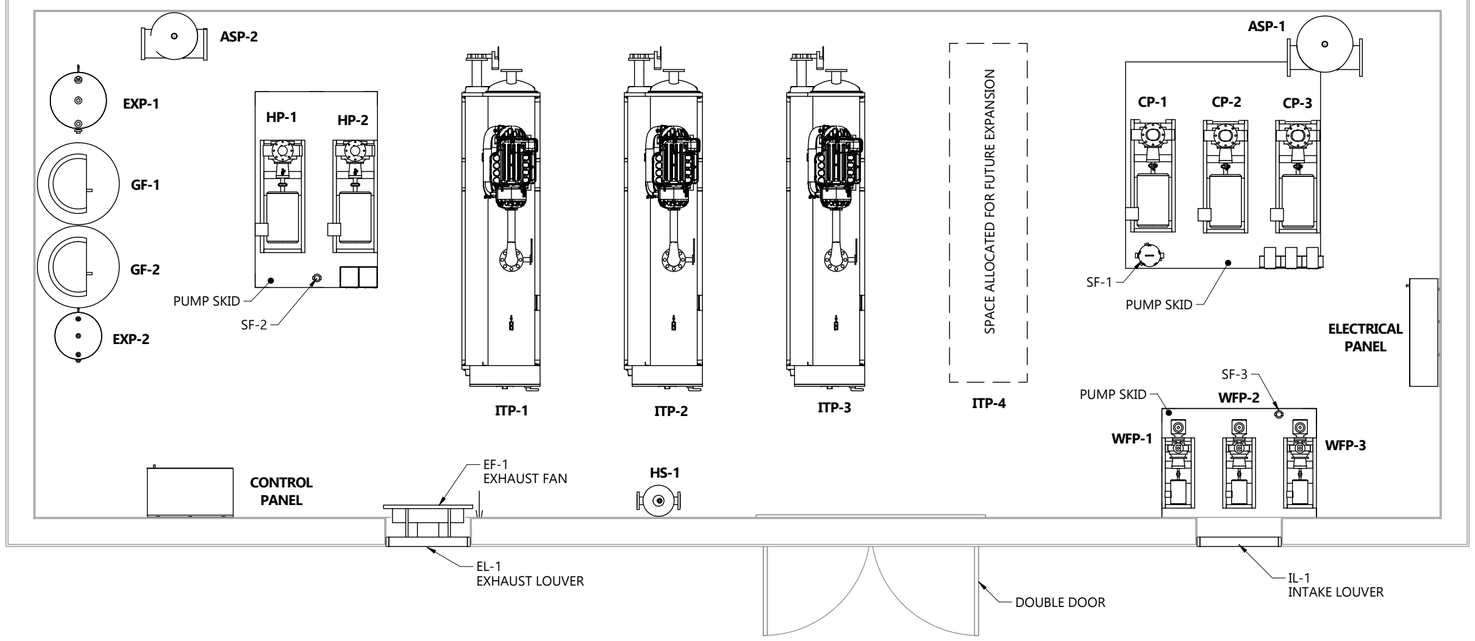
SITE KEY



| JIPMENTS PHYSICAL LOADS | | | |
|---|---|---|---|
| TAG | DESCRIPTION | WEIGHT (LBS) | NOTES |
| ITP-1 | ICE REFRIGERATION PKG | 5,600 | - |
| ITP-2 | ICE REFRIGERATION PKG | 5,600 | - |
| ITP-3 | ICE REFRIGERATION PKG | 5,600 | - |
| ITP-4* | ICE REFRIGERATION PKG | 5,600 | - |
| CP-1 | COLD FLOOR PUMP | 1,412 | - |
| CP-2 | COLD FLOOR PUMP | 1,412 | - |
| CP-3 | COLD FLOOR PUMP | 1,412 | - |
| HP-1 | CONDENSER PUMP | 1,082 | - |
| HP-2 | CONDENSER PUMP | 1,082 | - |
| WFP-1 | WARM FLOOR PUMP | 204 | - |
| WFP-2 | WARM FLOOR PUMP | 204 | - |
| WFP-3 | WARM FLOOR PUMP | 204 | - |
| CT-1 | EXISTING COOLING TOWER | 33,380 | - |
| EF-1 | EXHAUST FAN | 83 | WALL MOUNTED |
| EL-1 | EXHAUST LOUVER | 28 | WALL MOUNTED |
| IL-1 | INTAKE LOUVER | 28 | WALL MOUNTED |

| PLANT ROOM EQUIPMENTS PHYSICAL LOADS | | | |
|---|---|---|---|
| TAG | DESCRIPTION | WEIGHT (LBS) | NOTES |
| EXP-1 | COLD SIDE EXPANSION TANK | 1356 | - |
| EXP-2 | WARM SIDE EXPANSION TANK | 559 | - |
| ASP-1 | COLD SIDE AIR SEPERATOR | 1241 | SUSPENDED |
| ASP-2 | WARM SIDE AIR SEPERATOR | 715 | SUSPENDED |
| SF-1 | COLD SIDE STREAM FILTER | 144 | - |
| SF-2 | WARM SIDE STREAM FILTER | 21 | PIPE MOUNTED |
| SF-3 | WARM FLOOR SIDE STREAM FILTER | 21 | PIPE MOUNTED |
| GF-1 | COLD SIDE GLYCOL FEEDER | 983 | - |
| GF-2 | WARM SIDE GLYCOL FEEDER | 983 | - |
| HS-1 | WARM FLOOR HYDRAULIC SEPERATOR | 185 | SUSPENDED |




## EQUIPMENT WEIGHTS LAYOUT

SCALE 6/25" = 1'-0"

**NOTES**:

- * FOR FUTURE EXPANSION.
- ALL PIPING HIDDEN FOR CLARITY.

EQUIPMENT WEIGHTS LAYOUT

**NOTES**

24021 S-703

**REFERENCE DEFINITION**

SHEET COLUMN / SHEET ROW
SHEET NUMBER
(#, X#)



**- NOT FOR CONSTRUCTION -**

***CONFIDENTIAL & PROPRIETARY***

| VER # | REVISIONS | DATE | BY |
|---|---|---|---|
| 1.0 | ISSUED FOR TENDER | 08-NOV-24 | R.T. |

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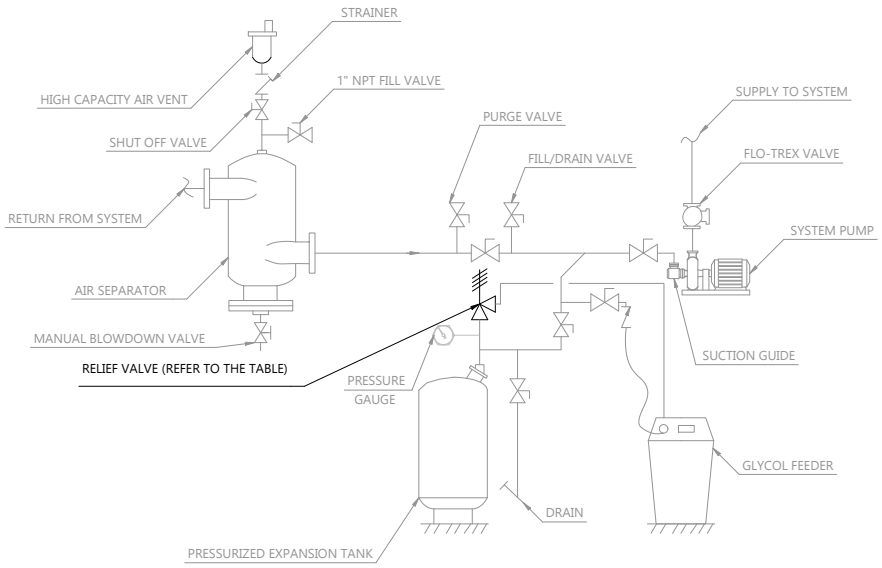
| | |
|---|---|
| **DRAWING NUMBER** | 24021 S-703 |
| **DRAWING NAME** | EQUIPMENT WEIGHTS LAYOUT |
| **CLIENT** | COLUMBUS PARKS & RECREATION |
| **PROJECT** | HAMILTON CC & ICE ARENA PLANT CONVERSION |
| **DRAWN BY** | R.THOMAS |
| **CHECKED BY** | J.RITCHIE |
| **DATE** | 08-NOV-24 |
| **REVISION** | 1.0 |
| **SHEET SIZE** | C |
| **SHEET NO.** | 1 OF 1 |

**NOTE:**
THIS STANDARD WAS ESTABLISHED TO PROVIDE ADDITIONAL INSIGHTS ON PIPING, CONNECTIONS, MODEL DESIGNATIONS, AND SIMILAR ASPECTS.
REFER TO THE DASH NUMBER INDICATED ON THE P&ID FOR THE REQUISITE MODEL IDENTIFICATIONS OF THE RELIEF VAVLE.
ONLY EMPLOY THE MODEL ASSOCIATED WITH THE DASH NUMBER DELINEATED ON THE P&ID.




**RELIEF VALVE TYPICAL CONNECTIONS (WARM GLYCOL LOOP)**

| GLYCOL RELIEF VALVE SCHEDULE | | | | | |
|---|---|---|---|---|---|
| **DASH NUMBER** | **MODEL NUMBER** | **MANUFACTURER** | **PRESSURE RANGE, PSI** | **MBH, RANGE** | **MAX. TEMP., F** |
| -01 | 174A | WATTS | 30 - 150 | 650 - 14,370 | 250 |
| -02 | 374A | WATTS | 30 | UP TO 550 | - |
| -03 | 740 | WATTS | 30 - 75 | 925 - 10,700 | 250 |

**MANUFACTURER INSTALL NOTES:**
- THE DISCHARGE LINE MUST BE THE SAME SIZE AS THE VALVE OUTLET, AND MUST PITCH DOWNWARD FROM THE VALVE TO A SAFE PLACE FOR DISPOSAL.
- VALVE LEVER MUST BE TRIPPED AT LEAST ONCE A YEAR TO ENSURE THAT WATERWAYS ARE CLEAR. THIS DEVICE IS DESIGNED FOR EMERGENCY SAFETY RELIEF AND SHALL NOT BE USED AS AN OPERATING CONTROL.

GLYCOL SYSTEM RELIEF VALVES

SHUT-OFF VALVE
MANUAL VALVE
CHECK VALVE
RELIEF VALVE
AIR VENT
MANUAL DRAIN

NEW EQUIPMENT

IBSDS M-801



FOR ILLUSTRATION ONLY

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| VER # | DATE | BY |
|---|---|---|
| 10.0 | 30-AUG-24 | H.A. |
| 9.0 | 25-MAR-24 | E.K. |
| 8.0 | 15-JUN-23 | T.VW. |

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**DRAWING NUMBER**
IBSDS M-801

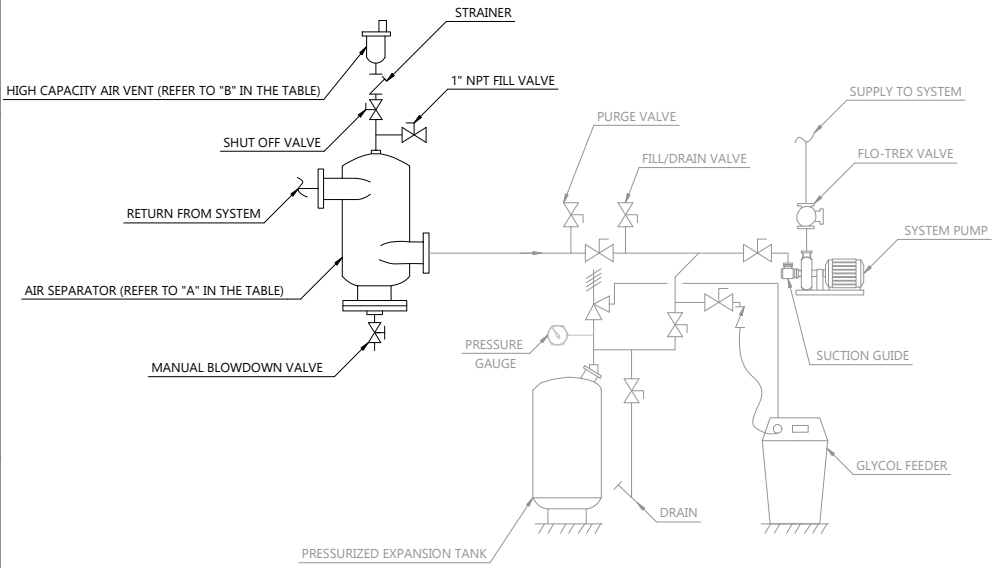
**DRAWING NAME**
GLYCOL RELIEF VALVE DESIGN STANDARD

**CLIENT**
I.B. STOREY INC.

**PROJECT**
IB STOREY DESIGN STANDARDS

| **DRAWN BY** | **CHECKED BY** |
|---|---|
| E.KADYROVA | J.RITCHIE |
| **DATE** | **REVISION** |
| 30-AUG-24 | 10.0 |
| **SHEET SIZE** | **SHEET NO.** |
| A | 1 OF 1 |

**NOTE:**
- THIS STANDARD WAS ESTABLISHED TO PROVIDE ADDITIONAL INSIGHTS ON PIPING, CONNECTIONS, MODEL DESIGNATIONS, AND SIMILAR ASPECTS.
- REFER TO THE DASH NUMBER INDICATED ON THE P&ID FOR THE REQUISITE MODEL IDENTIFICATIONS OF THE AIR SEPARATOR AND AIR VENT.
- ONLY EMPLOY THE MODEL ASSOCIATED WITH THE DASH NUMBER DELINEATED ON THE P&ID.




**AIR SEPARATOR TYPICAL PIPING CONNECTIONS**

**AIR SEPARATOR AND AIR VENT SCHEDULE**

| DASH NUMBER (NON-INSULATED AIR SEPARATOR) | DASH NUMBER (1" INSULATED AIR SEPARATOR) | MANUFACTURER A | MODEL NUMBER A | MAX. FLOW RATE, USGPM FOR LINE VELOCITY, FT/S | | | MANUFACTURER B | MODEL NUMBER B |
|---|---|---|---|---|---|---|---|---|
| | | | | 4 | 6 | 8 | | |
| -01 | -01/1 | ARMSTRONG | VA-2 1/2 | 60 | 90 | 120 | ARMSTRONG | AAE-750 |
| -02 | -02/1 | ARMSTRONG | VA-4 | 160 | 240 | 320 | ARMSTRONG | AAE-750 |
| -03 | -03/1 | ARMSTRONG | VA-5 | 250 | 375 | 500 | ARMSTRONG | AAE-750 |
| -04 | -04/1 | ARMSTRONG | VA-6 | 360 | 540 | 720 | ARMSTRONG | AAE-750 |
| -05 | -05/1 | ARMSTRONG | VA-8 | 630 | 940 | 1250 | ARMSTRONG | AAE-750 |
| -06 | -06/1 | ARMSTRONG | VA-10 | 990 | 1500 | 1980 | ARMSTRONG | AAE-750 |
| -07 | -07/1 | ARMSTRONG | VA-12 | 1400 | 2100 | 2800 | ARMSTRONG | AAE-750 |
| -08 | -08/1 | ARMSTRONG | VA-14 | 1720 | 2580 | 3460 | ARMSTRONG | AAE-750 |

**MANUFACTURER NOTE**:

- VISUALLY INSPECT THE AIR SEPARATOR FOR DAMAGE, WHICH MAY OCCUR DURING TRANSIT.
- A MANUAL DRAIN CAN BE ADDED TO HELP FACILITATE PURGING SEDIMENT FROM THE AIR SEPARATOR.
- AIR SEPARATORS SHOULD BE INSTALLED AT THE HIGHEST TEMPERATURE AND THE LOWEST PRESSURE POINTS IN THE SYSTEM. WHERE THIS IS NOT POSSIBLE, THE BEST LOCATION IS AT THE POINT OF HIGHEST TEMPERATURE. THE IDEAL LOCATION IN A HEATING SYSTEM FOR AN AIR SEPARATOR IS AT THE OUTLET OF THE HEAT SOURCE. FOR CHILLED WATER SYSTEMS, PLACE THE SEPARATOR IN THE RETURN TO THE CHILLER.

AIR SEPARATOR

SHUT-OFF VALVE
MANUAL VALVE
CHECK VALVE
RELIEF VALVE
AIR VENT
MANUAL DRAIN

NEW EQUIPMENT

IBSDS M-805



| VER # | DATE | BY |
|---|---|---|
| 12.0 | 30-AUG-24 | H.A. |
| 11.0 | 25-MAR-24 | E.K. |
| 10.0 | 04-OCT-23 | H.D. |

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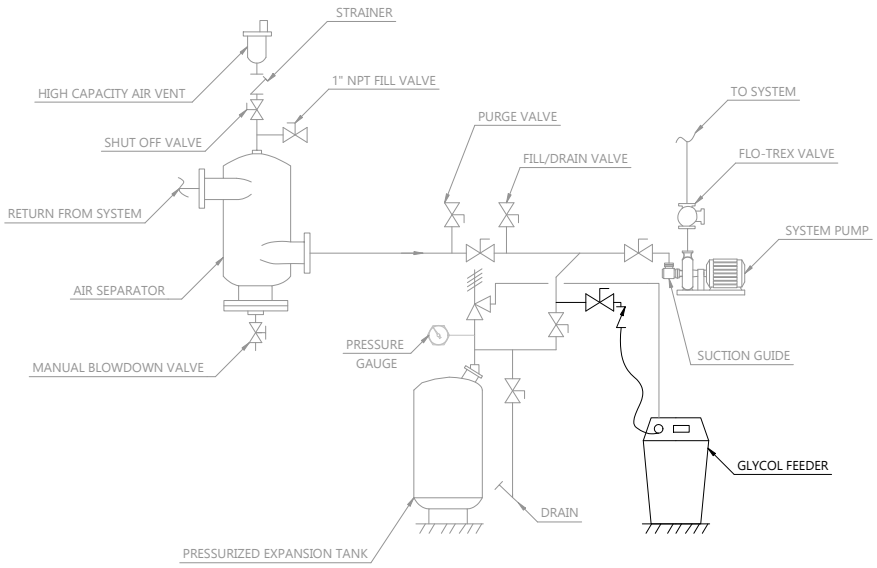
| | |
|---|---|
| **DRAWING NUMBER** | IBSDS M-805 |
| **DRAWING NAME** | AIR SEPARATOR DESIGN STANDARD |
| **CLIENT** | I.B. STOREY INC. |
| **PROJECT** | IB STOREY DESIGN STANDARDS |
| **DRAWN BY** | E.KADYROVA |
| **CHECKED BY** | J.RITCHIE |
| **DATE** | 30-AUG-24 |
| **REVISION** | 12.0 |
| **SHEET SIZE** | A |
| **SHEET NO.** | 1 OF 1 |

**NOTE:**
- THIS STANDARD WAS ESTABLISHED TO PROVIDE ADDITIONAL INSIGHTS ON PIPING, CONNECTIONS, MODEL DESIGNATIONS, AND SIMILAR ASPECTS.
- REFER TO THE DASH NUMBER INDICATED ON THE P&ID FOR THE REQUISITE MODEL IDENTIFICATIONS OF THE FEEDER.
- ONLY EMPLOY THE MODEL ASSOCIATED WITH THE DASH NUMBER DELINEATED ON THE P&ID.




**GLYCOL FEEDER TYPICAL PIPING CONNECTIONS**

**GLYCOL FEEDER SCHEDULE**

| DASH NUMBER | MANUFACTURER | MODEL NUMBER | VOLUME, USGAL | WEIGH WHEN FULL, LB | PUMP FLOWRATE. USGPM | POWER | V/H/PH |
|---|---|---|---|---|---|---|---|
| -0.1 | AXIOM | DMF150 | 4.6 | 50 | 1.0 | 50 W | 115/60/1 |
| -0.2 | AXIOM | DMF300 | 17 | 166 | 1.0 | 50 W | 115/60/1 |
| -0.3 | AXIOM | MF200 | 6.6 | 60 | 0.7 | 50 W | 115/60/1 |
| -0.4 | AXIOM | MF300 | 19 | 157 | 0.7 | 50 W | 115/60/1 |
| -0.5 | AXIOM | SF100 | 55 | 525 | 1.4 | 0.7 A | 115/60/1 |
| -0.6 | AXIOM | SF100L | 100 | 940 | 1.7 | 0.7 A | 115/60/1 |

**DMF SERIES MANUFACTURER INSTALL NOTES**
- SET SYSTEM FEEDER ON A SECURE AND LEVEL BASE OR ON THE PROVIDED WALL BRACKET.
- IF MOUNTING ON THE WALL, THE CARDBOARD CUT-OUT ON THE SIDE OF THE DMF BOX MAY BE USED TO LOCATE THE SCREW HOLES FOR THE WALL BRACKET.
- ENSURE THE WALL BRACKET IS LEVEL AND FASTENED SECURELY TO THE WALL.
- HANG AND FILL TANK PRIOR TO MAKING SYSTEM CONNECTION. THIS HELPS TO ENSURE THAT THE TANK IS SECURELY SEATED ON THE MOUNTING BRACKET

**MF SERIES MANUFACTURER INSTALL NOTES:**
- SET SYSTEM FEEDER ON A SECURE AND LEVEL BASE OR IN THE OPTIONAL TANK SHELF.
- CONNECT THE UNIT TO THE SYSTEM USING COPPER OR PLASTIC TUBING. ENSURE THAT THERE IS A SYSTEM ISOLATION VALVE INSTALLED TO ALLOW FOR ISOLATION OF THE UNIT. DO NOT INSTALL A CHECK VALVE OR PRESSURE REGULATOR BETWEEN SYSTEM FEEDER AND SYSTEM.
- MOUNT POWER SUPPLY AND SECURE WITH MOUNTING BRACKET. DO NOT POWER UP SYSTEM FEEDER UNTIL A SYSTEM CONNECTION IS MADE, ISOLATION VALVE IS CLOSED AND FEEDER VALVE IS SET TO MIX.
- TO CONNECT THE SYSTEM FEEDER TO THE RIA10-1-SAA ALARM PANEL REMOVE LOW LEVEL FLOAT SWITCH FROM CIRCUIT AND CONNECT TO AXIOM RIA10-1-SAA ALARM PANEL.
- INSTALL PROPER WATER/GLYCOL MIX IN THE TANK TO A LEVEL ABOVE MINIMUM LEVEL INDICATION ON TANK SCALE.
- CLOSE SYSTEM ISOLATION VALVE, TURN FEEDER VALVE TO VERTICAL POSITION (MIX POSITION).
- INSERT DC PLUG INTO THE SYSTEM FEEDER FIRST, AND THEN PLUG POWER SUPPLY INTO 120V OUTLET. THE RED LED IN THE POWER SUPPLY CORD SHOULD LIGHT UP. IF IT DOES NOT, CHECK THE FUSE AND POWER RECEPTACLE.
- ONCE THE PUMP IS PRIMED, TURN THE FEEDER VALVE HANDLE TO HORIZONTAL POSITION (RUN POSITION), OPEN SYSTEM ISOLATION VALVE AND ALLOW PUMP TO PRESSURIZE SYSTEM. IF SYSTEM PRESSURE IS BELOW PRESSURE SWITCH SETTING (18 PSI), THE PUMP WILL START. THE SYSTEM FEEDER WILL RUN UNTIL SYSTEM IS PRESSURIZED TO APPROXIMATELY 18 PSI. AND SHUT-OFF. IT MAY CYCLE RAPIDLY A NUMBER OF TIMES WHILE SYSTEM PRESSURE STABILIZES AND WHILE AIR IS REMOVED FROM THE SYSTEM. THE CYCLING WILL STOP ONCE SYSTEM PRESSURE RISES ABOVE 18 PSI DUE TO THERMAL EXPANSION.
- IF A HIGHER FILL PRESSURE IS REQUIRED (UP TO 25 PSI) THE INTERNAL PRESSURE SWITCH MAY BE ADJUSTED BY TURNING THE CENTER ADJUSTING SCREW COUNTER CLOCKWISE TO INCREASE PRESSURE. ACCESS TO THE PRESSURE SWITCH CAN BE GAINED BY LIFTING THE LEFT SIDE OF THE TOP COVER.

**SF100, SF100-L SERIES MANUFACTURER INSTALL NOTES:**
- SET THE SOLUTION FEEDER ON A SECURE AND LEVEL BASE.
- CONNECT THE FLEXIBLE HOSE SUPPLIED WITH THE UNIT TO YOUR SYSTEM CONNECTION POINT - USE A UNION AND ISOLATION VALVE TO ALLOW FOR FUTURE SERVICE.
- THE CHECK VALVE SUPPLIED WITH THE UNIT MUST BE ON THE SYSTEM END OF THE FLEXIBLE HOSE.
- RELIEF AND DRAIN VALVES MAY BE PIPED TO THE SF100 TANK, BUT ANY HOLES FOR ENTRY OF THESE PIPES SHOULD BE CUT INTO THE SIDE OF THE TANK NEAR THE TOP RATHER THAN THROUGH THE COVER. THIS WILL ALLOW THE COVER AND TOP TO BE EASILY REMOVED IF NECESSARY.
- FILL THE SF100 TANK WITH FLUID.
- THE UNIT IS SUITABLE FOR WATER OR GLYCOL/WATER SOLUTIONS OF UP TO 50% GLYCOL CONCENTRATION.

GLYCOL FEEDER

SHUT-OFF VALVE
MANUAL VALVE
CHECK VALVE
RELIEF VALVE
AIR VENT
MANUAL DRAIN

NEW EQUIPMENT

IBSDS M-809



| VER # | DATE | BY |
|---|---|---|
| 10.0 | 30-AUG-24 | H.A. |
| 9.0 | 25-MAR-24 | E.K. |
| 8.0 | 15-JUN-23 | T.VW. |

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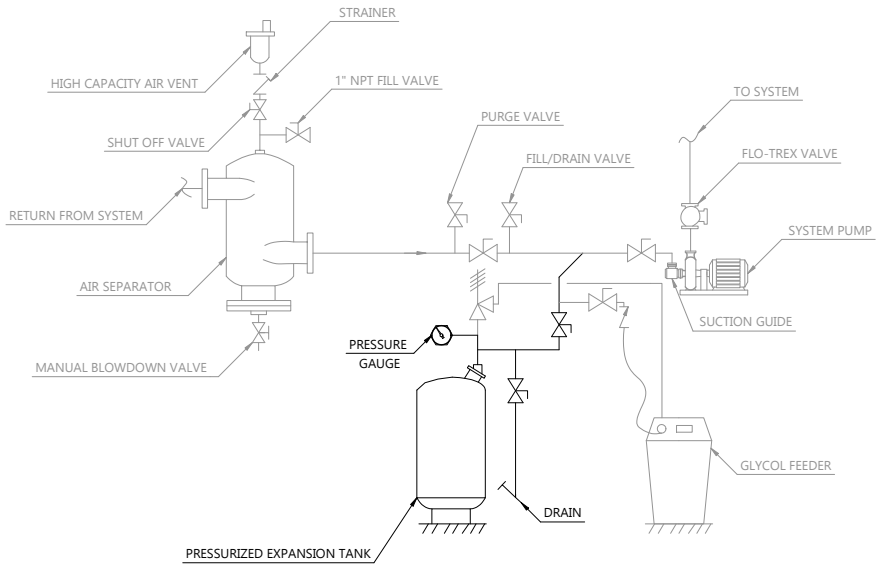
|---|---|
| **DRAWING NUMBER** | IBSDS M-809 |
| **DRAWING NAME** | GLYCOL FEEDER DESIGN STANDARDS |
| **CLIENT** | I.B. STOREY INC. |
| **PROJECT** | IB STOREY DESIGN STANDARDS |
| **DRAWN BY** E.KADYROVA | **CHECKED BY** J.RITCHIE |
| **DATE** 30-AUG-24 | **REVISION** 10.0 |
| **SHEET SIZE** A | **SHEET NO.** 1 OF 1 |

**NOTE:**
- THIS STANDARD WAS ESTABLISHED TO PROVIDE ADDITIONAL INSIGHTS ON PIPING, CONNECTIONS, MODEL DESIGNATIONS, AND SIMILAR ASPECTS.
- REFER TO THE DASH NUMBER INDICATED ON THE P&ID FOR THE REQUISITE MODEL IDENTIFICATIONS OF THE EXPANSION TANK.
- ONLY EMPLOY THE MODEL ASSOCIATED WITH THE DASH NUMBER DELINEATED ON THE P&ID.




**EXPANSION TANK TYPICAL PIPING CONNECTIONS**

**EXPANSION TANK SCHEDULE**

| DASH NUMBER | TANK VOLUME, GAL | ACCEPTANCE VOLUME, GAL | MANUFACTURER | MODEL NUMBERS | QTY. |
|---|---|---|---|---|---|
| -01 | 8 | 6.3 | ARMSTRONG | AX-15 | 1 |
| -02 | 11 | 8.8 | ARMSTRONG | AX-20 | 1 |
| -03 | 25 | 20.2 | ARMSTRONG | AX-40 | 1 |
| -04 | 35 | 28 | ARMSTRONG | AX-60 | 1 |
| -05 | 45 | 36 | ARMSTRONG | AX-80 | 1 |
| -06 | 60 | 48.5 | ARMSTRONG | AX-100 | 1 |
| -07 | 70 | 56.5 | ARMSTRONG | AX-120 | 1 |
| -08 | 80 | 65 | ARMSTRONG | AX-144 | 1 |
| -09 | 90 | 73 | ARMSTRONG | AX-180 | 1 |
| -10 | 115 | 93 | ARMSTRONG | AX-200 | 1 |
| -11 | 140 | 113.5 | ARMSTRONG | AX-240 | 1 |
| -12 | 158 | 128 | ARMSTRONG | AX-260 | 1 |
| -13 | 211 | 171 | ARMSTRONG | AX-280 | 1 |
| -14 | 53 | 53 | ARMSTRONG | A200-L | 1 |
| -15 | 80 | 80 | ARMSTRONG | A300-L | 1 |
| -16 | 106 | 106 | ARMSTRONG | A400-L | 1 |
| -17 | 132 | 132 | ARMSTRONG | A500-L | 1 |
| -18 | 158 | 158 | ARMSTRONG | A600-L | 1 |
| -19 | 211 | 211 | ARMSTRONG | A800-L | 1 |
| -20 | 264 | 264 | ARMSTRONG | A1000-L | 1 |
| -21 | 317 | 317 | ARMSTRONG | A1200-L | 1 |
| -22 | 370 | 370 | ARMSTRONG | A1400-L | 1 |
| -23 | 422 | 422 | ARMSTRONG | 1600-L | 1 |
| -24 | 528 | 528 | ARMSTRONG | 2000-L | 1 |
| -25 | 660 | 660 | ARMSTRONG | 2500-L | 1 |
| -26 | 792 | 792 | ARMSTRONG | 3000-L | 1 |
| -27 | 1056 | 1056 | ARMSTRONG | 4000-L | 1 |
| -28 | 1320 | 1320 | ARMSTRONG | 5000-L | 1 |

**MANUFACTURER NOTES:**
- VISUALLY INSPECT TANK FOR DAMAGE, WHICH MAY OCCUR DURING TRANSIT.
- FACTORY PRE-CHARGE PRESSURE MAY NOT BE CORRECT FOR THE INSTALLATION. TANK MUST BE PRE-CHARGED TO SYSTEM DESIGN FILL PRESSURE BEFORE PLACING INTO OPERATION. REMOVE PIPE PLUG COVERING THE VALVE ENCLOSURE. CHECK AND ADJUST THE CHARGE PRESSURE BY ADDING OR RELEASING AIR FOR EACH APPLICATION.
- IF THE SYSTEM HAS BEEN FILLED, THE TANK MUST BE ISOLATED FROM THE SYSTEM AND THE TANK EMPTIED BEFORE CHARGING. THIS ENSURES ALL FLUID HAS EXITED THE DIAPHRAGM AREA AND PROPER CHARGING WILL OCCUR.
- IF THE PRE-CHARGE ADJUSTMENT IS NECESSARY, OIL AND WATER FREE COMPRESSED AIR OR NITROGEN GAS MAY BE USED. CHECK THE PRE-CHARGE USING AN ACCURATE PRESSURE GAUGE AT THE CHARGING VALVE AND ADJUST AS REQUIRED. CHECK AIR VALVE FOR LEAKAGE. IF EVIDENT, REPLACE THE SCHRADER-TYPE TIRE VALVE CORE. DO NOT DEPEND ON THE VALVE CAP TO SEAL THE LEAK. AFTER MAKING SURE AIR CHARGE IS CORRECT, REPLACE PIPE PLUG OVER THE CHARGING VALVE FOR PROTECTION.
- SET TANK IN PLACE AND PIPE SYSTEM CONNECTION TO SYSTEM. BE SURE TO INCLUDE ISOLATION VALVE(S) AND DRAIN.
- PURGE AIR FROM SYSTEM BEFORE PLACING TANK INTO OPERATION. ALL MODELS HAVE SYSTEM WATER CONTAINED BEHIND DIAPHRAGM.
- WHEN FILLING THE SYSTEM WITH GLYCOL, OPEN VALVES TO TANK TO ENSURE THAT ANY RESIDUAL AIR IN THE TANK IS DISPLACED BY GLYCOL.
- IT IS RECOMMENDED THAT THE PRE-CHARGE BE CHECKED ANNUALLY TO ENSURE PROPER SYSTEM PROTECTION AND LONG LIFE FOR THE VESSEL.

GLYCOL SYSTEM EXPANSION TANK

SHUT-OFF VALVE
MANUAL VALVE
CHECK VALVE
RELIEF VALVE
AIR VENT
MANUAL DRAIN

NEW EQUIPMENT

IBSDS M-811



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| 11.0 | 30-AUG-24 | H.A. |
| 10.0 | 25-MAR-24 | E.K. |
| 9.0 | 15-JUN-23 | T.VW. |

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**DRAWING NUMBER**
IBSDS M-811

**DRAWING NAME**
EXPANSION TANK DESIGN STANDARDS

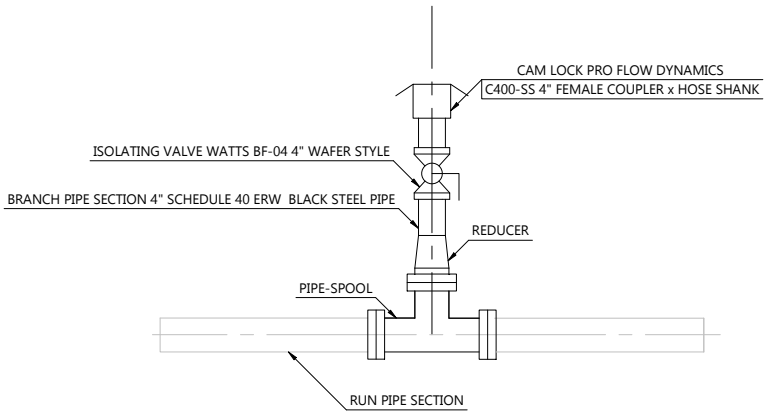
**CLIENT**
I.B. STOREY INC.

**PROJECT**
IB STOREY DESIGN STANDARDS

| DRAWN BY | CHECKED BY |
|---|---|
| E.KADYROVA | J.RITCHIE |
| **DATE** | **REVISION** |
| 30-AUG-24 | 11.0 |
| **SHEET SIZE** | **SHEET NO.** |
| A | 1 OF 1 |

IBSDS M-815

## RENTAL CHILLER CONNECTIONS DETAIL




**RENTAL CHILLER CONNECTIONS SCHEDULE**

| DASH NUMBER | PIPE SPOOL | QTY. | REDUCER | QTY. | CAM LOCK | ISOLATING VALVE | BRANCH PIPE SECTION |
|---|---|---|---|---|---|---|---|
| -01 | 6" FLANGES | 1 | 6" x 4" | 1 | PRO FLOW DYNAMICS, C400-SS, 4" FEMALE COUPLER x HOSE SHANK | WATTS, BF-04, 4" WAFER STYLE | 4" SCHEDULE 40 ERW BLACK STEEL PIPE |
| -02 | 8" FLANGES | 1 | 8" x 4" | 1 | PRO FLOW DYNAMICS, C400-SS, 4" FEMALE COUPLER x HOSE SHANK | WATTS, BF-04, 4" WAFER STYLE | 4" SCHEDULE 40 ERW BLACK STEEL PIPE |
| -03 | 10" FLANGES | 1 | 10" x 4" | 1 | PRO FLOW DYNAMICS, C400-SS, 4" FEMALE COUPLER x HOSE SHANK | WATTS, BF-04, 4" WAFER STYLE | 4" SCHEDULE 40 ERW BLACK STEEL PIPE |
| -04 | 12" FLANGES | 1 | 12" x 6" | 1 | PRO FLOW DYNAMICS, C600-SS, 6" FEMALE COUPLER x HOSE SHANK | WATTS, BF-06, 6" WAFER STYLE | 6" SCHEDULE 40 ERW BLACK STEEL PIPE |

**NOTE:**
- TO ENSURE UNINTERRUPTED OPERATION DURING EQUIPMENT FAILURE OR REPLACEMENT, A RENTAL CHILLER IS REQUIRED.
- ENSURE THAT THE PUMP BYPASS VALVE, AS INDICATED ON THE P&ID AS MANUALLY NORMALLY CLOSED, IS OPEN DURING RENTAL CHILLER OPERATION.



| VER # | DATE | BY |
|---|---|---|
| 4.0 | 27-MAR-24 | E.K. |
| 3.0 | 21-APR-23 | E.K. |
| 2.0 | 08-FEB-21 | E.K. |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| **DRAWING NUMBER** | IBSDS M-815 |
| **DRAWING NAME** | RENTAL CHILLER DESIGN STANDARDS |
| **CLIENT** | I.B. STOREY INC. |
| **PROJECT** | IB STOREY DESIGN STANDARDS |
| **DRAWN BY** E.KADYROVA | **CHECKED BY** J.RITCHIE |
| **DATE** 27-MAR-24 | **REVISION** 4.0 |
| **SHEET SIZE** A | **SHEET NO.** 1 OF 1 |