



Addendum / Addenda

No./N^o
5

Project Description / Description de projet M-22 Aircraft Cabin Comfort and Environmental Research Facility		
Solicitation No./ No de sollicitation 15-22004	Project No./N ^o de projet M-22 3788	W.O. No./N ^o d'ordre de travail
Departmental Representative / représentant ministériel Maurice Richard		Date 17 July 2015
<p>Notice: This addendum shall form part of the tender documents and all conditions shall apply and be read in conjunction with the original plans and specifications.</p>		<p>Nota: Cet addenda fait partie intégrale des dossiers d'appel d'offres; toutes les conditions énoncées doivent être lues et appliquées en conjonction avec les plans et les devis originaux.</p>

The bid requirements, contract requirements, specifications, schedules and drawings for
Cabin Comfort & Environmental Research Facility

are amended as follows:

GENERAL

A5.1 ADDENDUM NUMBER SHOWN ON DRAWINGS

- .1 Where drawings attached to this addendum show "issued for addendum 04" in the revision table, they actually refer to this addendum no 5.

A5.2 BIDDERS QUESTIONS #2

- .1 Answers for questions received from bidders are issued as an attachment to this addendum.

SPECIFICATIONS

A5.3 REVISED SPECIFICATIONS

- .1 The following revised specifications issued with this addendum supersede previously issued specifications of the same title and number
 - .1 Section No. Index_R3
 - .2 Section No. 01 52 00_R2, Construction Facilities
 - .3 Section No. 01 61 00_R1, Common Product Requirements
 - .4 Section No. 02 41 16_R2, Structure Demolition

- .5 Section No. 08 36 13.02_R1, Sectional Metal Doors
- .6 Section No. 08 71 00_R1, Door Hardware
- .7 Section No. 21 05 01_R2, Common Work Results For Mechanical
- .8 Section No. 22 15 00_R1, General Service Compressed Air Systems
- .9 Section No. 22 30 05_R1, Domestic Water Heaters
- .10 Section No. 23 36 00_R2, Air Terminal Units
- .11 Section No. 23 73 10_R2, Air Handling Units
- .2 The following specifications are revised by reference and are not re-issued with this addendum:
 - .1 Section No. 26 27 26 Wiring Devices
 - .1 Add 2.4.3 to read as follows:
 - .1 Contractor to ensure dimmer is compatible with LED driver for all luminaires provided under this contract.
 - .2 Replace 3.6.2 with the following
 - .1 Mounting as per manufacturer's installation requirements.
 - .2 Section No. 27 50 00 Distributed Communications and Monitoring
 - .1 Replace 2.20.4 with the following
 - .1 Using a one octave bandwidth of pink noise centered at 500 Hz and then 4 kHz, the sound pressure shall be adjusted to a level at least 6 dB above the ambient noise level in the room. Using the pink noise as a source, adjust the system for an average of 85 dB SPL throughout the room. Measure and record reading at ten locations to verify a deviation throughout the coverage area of no greater than +/- 2 dB, band limited to 400 to 4 kHz.
 - .2 Add 2.19.19 to read as follows;
 - .1 Maximum spacing for loudspeakers in corridors to be 4.6 meters (15').
 - .3 Add the following acceptable suppliers to item 2.1
 - .1 Soft dB
 - .2 LogiSon
 - .3 Section No. 26 50 00 Lighting and Controls
 - .1 Add 2.2.3 to read as follows:
 - .1 Contractor to ensure lighting control system provided is compatible with LED drivers of all luminaires supplied under this contract.
 - .2 Replace 2.2.2 with the following
 - .1 Remote dimming stations to be equipped with on/off push button(one button per zone), off button to turn on/off all the zones and raise/lower button for dimming.
 - .3 Replace 2.2.8 with the following
 - .1 Lamp heads: mounted as indicated, 360 degrees horizontal and 180 degrees vertical adjustment, MR16, 20W, (micro quartz) lamps.
 - .4 Revisions to 26 50 00.2.1.1.13
 - .1 Revise minimum CRI to 88.9 for new light fixture Type "M" added on addendum 3.
 - .2 Add acceptable alternate for fixture Type "M" Philips Daybrite HL-S-24-G-LR-41L-40-U-LAG

- .4 Section No. 27 05 28 00 Pathways for Communication Systems
 - .1 Replace 2.1.2 with the following
 - .1 Provide factory painted blue conduits for voice/data cables.
- .5 Section No. 26 24 01 Service Equipment
 - .1 Replace 2.6.6 with the following
 - .1 Circuit breakers minimum rating: 18K for 120/240V and 120/208V, 10K acceptable where short circuit study indicates lower available fault current at the panel location or when series rated breakers are provided for new panels. Minimum 25K for 600/347V or greater to match existing for new breakers provided on existing panels, whichever rating is higher.
 - .2 Replace 2.6.7 with the following
 - .1 400Hz circuit breakers to be rated for selected frequency as indicated on drawings minimum rating: 18K for 120/208V. 10K acceptable where short circuit study indicates lower available fault current at the panel location or series rated breakers are provided for new panels.
 - .3 Replace 2.5.1 with the following
 - .1 600 volt panelboards: bus rated for minimum 25,000 amp r.m.s. symmetrical interrupting capacity or higher to match existing main distribution board feeding new panels, whichever is higher. Coordinate with existing interrupting capacity of main distribution board "PD" and short circuit study.
 - .4 Replace 2.5.2 with the following
 - .1 120/208V and 120/240V branch circuit panelboards to have minimum interrupting capacity of 18,000 amp r.m.s. symmetrical. 10K acceptable where short circuit study indicates lower available fault current at the panel location.
- .6 Section No. 25 05 00 Common work for Building Automation
 - .1 Remove article 1.13 and 1.14

A5.4 **NEW SPECIFICATIONS**

- .1 Add the following new specifications issued with this Addendum.
 - .1 Section No. 01 21 00, Allowances
 - .2 Section No. 23 21 13.02, Hydronic Systems:Steel

DRAWINGS

A5.5 **REVISED DRAWINGS**

- .1 The following drawings are revised and re-issued with this addendum:
 - .1 Drawing no. 3788-M04 – PIPING LAYOUT
 - .1 All revisions have been bubbled. Refer to drawing for all changes.
 - .2 Drawing no. 3788-M05 – BASEMENT AND FIRST FLOOR STEAM PIPING
 - .1 All revisions have been bubbled. Refer to drawing for all changes.
 - .3 Drawing no. 3788-M07 – MECHANICAL SCHEMATIC
 - .1 Drawing issued in colour for clarity.
 - .4 Drawing no. 3788-M08 – MECHANICAL SCHEDULES
 - .1 All revisions have been bubbled. Refer to drawing for all changes.

- .2 The following drawings are revised by reference, or as indicated on sketches attached with this addendum, but not re-issued:
- .1 Drawing no. A01 - Assemblies & Fire Separation Plans
 - .1 Add new furring type F-1d: As F-1 with 19mm Plywood backing in lieu of GWB
 - .2 2/A01: Add new furring type F-1d to the existing wall between Room 141 – Receiving and Rooms 139/140 Flexible Cabin Laboratory. To be located on the Room 141 side.
 - .2 Drawing no. 3788-A02 Window & Door schedules
 - .1 1/A02 Door E09: Revise comment to read “ Sectional insulated metal overhead door on 2 inch track system – Mech. Operated”
 - .3 Drawing no. 3788-A06 Building Elevations & Sections
 - .1 1/A06: Between gridline 1 and the delineation between existing construction to remain and extent of new works, revise note: “ Patch/ make good ex lower wall exposed by earthwork” to read “ Patch/make good ex lower wall exposed by earthwork.Apply W-4 (waterproof membrane to suit length of insulation) w/ galv flashing (prefin colour to match existing)at top / left edge”
 - .4 Drawing no. 3788-M02 – Plumbing Layout
 - .1 Provide and install a 25mm condensate line from compressor and terminate at the pit inside Chiller Service Room 037.
 - .2 Provide an air tight cap above the pit and seal all penetrations. Extend sump vent to outside
 - .3 Provide and install new sanitary sump pump 22SHP03, Hydromatic Shef 30, 5 GPM, 20 FT W.C., 3/10 HP and 120V/1/60 complete with floats and audible alarm.
 - .4 Provide and install a 50mm sanitary line from effluent pump discharge and connect to 100mm sanitary main inside corridor.
 - .5 Pumps shall operate under OEM built-in float control and high level float and audible alarm. BAS to monitor high level float alarm.
 - .6 Pump material and installation shall be in accordance with mechanical specifications. Provide all material/labour required to achieve a fully operational system.
 - .5 Drawing no. 3788 –M04 Piping layout
 - .1 Revise all VAV box locations on M04 to match the locations shown on M03. Extend all hydronic piping to accommodate locations of boxes as shown on M03
 - .6 Drawing no. E07-Single line
 - .1 Feeders to panel L22 to be 4#3 AWG+Grnd in 41mmC.
 - .2 Revise rating of panel “EL2” from 225A to 100A.
 - .3 Remove requirement for metering panels indicated on panels “P6” and “LD”. Retain 15A circuit breakers and revise panel schedule to read “future metering panel”.
 - .7 Drawing no. E08-Panel and Schedules
 - .1 Revise circuit breaker on panel “P8” schedule (CCT-51,53,55) for mechanical equipment 22DRY1 from 15A/3P to 25A/3P. Revise panel schedule accordingly.Revise wiring size indicated on equipment schedule from #12AWG to #10AWG.
 - .2 Revise equipment ref.number for unit heater on mechanical schedule from 22UNH12 to 22UNH15 to match mechanical drawings.
 - .3 Revise circuit breakers for pumps 22GLP05 and 22GLP06 from 15A/3P to 20A/3P. Revise panel schedule accordingly.
 - .4 Add “+GRND” to the wiring column on mechanical equipment schedule. Typical for all equipment.

- .5 Revise location indicated on mechanical equipment schedule for pumps 22GLP12 and 22GLP16 from Basement mechanical room to Airport Terminal Room#135. Proper location shown on drawing E03.
- .6 Revise motor overload protection indicated on mechanical equipment schedule from starter to VFD for the following pumps 22GLP02, 22GLP03, 22GLP04, 22GLP05, 22GLP06, 22GLP07, 22GLP08, 22GLP09, 22GLP10, 22GLP11A, 22GLP11B, 22GLP13A, 22GLP13B, 22GLP14, 22GLP15. VFDs provided by mechanical. Installed and wired by electrical contractor.
- .7 Revise ref.number indicated on mechanical equipment schedule for pump 22SP01 to 22SHP01.
- .8 Revise ref.number indicated on mechanical equipment schedule for pump 22SP02 to 22SVP02.
- .9 Revise ref.number indicated on mechanical equipment schedule for pump 22SP03 to 22SVP03.
- .10 Revise ref.number indicated on mechanical equipment schedule for pump 22SVP02 (below 22PAS01) to 22PAS02.
- .11 Revise power requirements for Air handling units indicated on mechanical equipment schedule as follow:
 - .1 22AHU03: Revise circuit breaker to 25A/3P. Revise wiring size to #10AWG. Revise overlad protection to VFD (provided by mech., installed and wired by electrical)
 - .2 22AHU05: Revise circuit breaker to 15A/3P. Revise wiring size to #12AWG. Revise overlad protection to VFD (provided by mech., installed and wired by electrical)
 - .3 22AHU06: Revise circuit breaker to 15A/3P. Revise wiring size to #12AWG. Revise overlad protection to VFD (provided by mech., installed and wired by electrical)
 - .4 22AHU07: Revise circuit breaker to 15A/3P. Revise wiring size to #12AWG. Revise overlad protection to VFD (provided by mech., installed and wired by electrical)
- .8 Drawing no. E06-Lighting
 - .1 Replace light types A & D in rooms 129, 130, 131, 132 with new light type "M". Refer to addendum 3 for specifications. Provide emergency override relay for fixtures on emergency circuits.
 - .2 Add circuit numbers for fixtures type A1 within room 138 as follows:
 - .1 L19-2 for normal lighting
 - .2 EL2-11 for emergency lighting
 - .3 Battery unit shown on the corridor to be connected to un-switched portion of emergency circuit indicated for the space.
 - .4 Provide emergency power pack or relay for all switched emergency lighting identified on the drawings. Lighting fixtures identified as emergency are to be connected so that under normal conditions they work in conjunction with the switching as identified. Upon power failure emergency power pack or relay to override the switch and allow the emergency power to activate the lights.
 - .5 Revise lighting fixture within Flight Simulation Lab 137 indicated as type "A" to type "F"
 - .6 Revise lighting fixture within interview room 126 from type "C" to type "A".
 - .7 Revise light switch within room 127 to a wall mounted occupancy sensor switch.
- .9 Drawing no. E03 Power, Fire Alarm & Misc Systems
 - .1 Add one duplex receptacle to the north wall of exam rooms 130, 131 and 132. Connect to receptacle circuit within the room.

- .2 Delete reference to "EF-1" from room #133.
- .3 Delete reference to equipment 22CTR02.
- .4 Revise circuit breaker for compressor (equipment#4) indicated on equipment schedule from 15A/3P to 20A/3P. (HP revised to 7.5HP) on equipment schedule. Revise panel schedule accordingly.
- .10 Drawing no. E04 Key Plan
 - .1 Revise reference to Note 13 indicated on 3/E04 to Note 1.
- .11 Drawing no. E02 Power, Fire Alarm & Misc Systems
 - .1 Delete reference to panel L28 in electrical room. Refer to drawing E03 for proper location. (Room FCL 139).
 - .2 Delete duplicated reference to panel L22. Location of panel L22 closer to north wall in room 137 is correct.
 - .3 Proper location for panel "L26" is FSL lab 026 as shown on drawing E02 and indicated on single line. Delete duplicate reference on the drawing.
 - .4 Revise name for pump indicated near gridlines 8-B from 22SU03 to 22SVP03.
 - .5 Provide 15A/120V power connection to controller for gas detection system (provided by mechanical) in mechanical room. Provide ¾" empty conduit complete with pull strings to each sensor for low voltage wiring. Refrigerant sensors will be mounted at each chiller approximately 300mm above floor. Coordinate work with mechanical contractor prior to rough-ins.
 - .6 Note 12 revised to delete requirement for final connection to 90kVA 400HZ converter.
 - .7 Provide 120V power connection complete with switch disconnect for new sump pump 22SHP03 in Chiller Service room 037. Provide a new 15A/1P circuit breaker on panel L27 for connection to new pump.
- .12 Drawing no. E05-Communication & Security Systems
 - .1 Revise reference to detail 9-E09 on note 4 to detail 11-E09.

End of Addendum No.5

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Part 1 General

1.1 CASH ALLOWANCES

- .1 Include in Contract Price specified cash allowances.
- .2 Cash allowances, unless otherwise specified, cover net cost to Contractor of services, products, construction machinery and equipment, freight, handling, unloading, storage, installation and other authorized expenses incurred in performing Work.
- .3 Contract Price, and not cash allowance, includes Contractor's overhead and profit in connection with such cash allowance.
- .4 Contract Price will be adjusted by written order to provide for excess or deficit to each cash allowance.
- .5 Where costs under a cash allowance exceed amount of allowance, Contractor will be compensated for excess incurred and substantiated plus allowance for overhead and profit as set out in Contract Documents.
- .6 Unexpended amounts of cash allowances maybe reallocated to other specific cash allowances at the sole discretion of the NRC Departmental Representative.
- .7 Unexpended amounts of cash allowances shall be deducted from the Contract Price at completion of the Work.
- .8 Include progress payments on accounts of work authorized under cash allowances in monthly certificate for payment.
- .9 Prepare schedule jointly with NRC Departmental Representative and Contractor to show when items called for under cash allowances must be authorized by NRC Departmental Representative for ordering purposes so that progress of Work will not be delayed.
- .10 The cash allowances in lawful monies of Canada included in the Contract Price are as follows:
 - .1 Supply and installation of Building Signage: \$15,000.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.
 - .2 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA-A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA-0121-M1978(R2003), Douglas Fir Plywood.
 - .3 CAN/CSA-S269.2-M1987(R2003), Access Scaffolding for Construction Purposes.
 - .4 CAN/CSA-Z321-96(R2001), Signs and Symbols for the Occupational Environment.

1.2 INSTALLATION AND REMOVAL

- .1 Prepare site plan indicating proposed location and dimensions of area to be fenced and used by Contractor, number of trailers to be used, avenues of ingress/egress to fenced area and details of fence installation.
- .2 Identify areas which have to be gravelled to prevent tracking of mud.
- .3 Indicate use of supplemental or other staging area.
- .4 Provide construction facilities in order to execute work expeditiously.
- .5 Remove from site all such work after use.

1.3 SCAFFOLDING

- .1 Scaffolding in accordance with CAN/CSA-S269.2.
- .2 Provide and maintain scaffolding, ramps, ladders, swing staging, platforms temporary stairs.

1.4 SITE STORAGE/LOADING

- .1 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.
- .2 Do not load or permit to load any part of Work with weight or force that will endanger Work.

1.5 CONSTRUCTION PARKING

- .1 Parking will be permitted on site with approval/discretion of NRC Departmental Representative, provided it does not disrupt performance of Work.
- .2 Provide and maintain adequate access to project site.

1.6 EQUIPMENT, TOOL AND MATERIALS STORAGE

- .1 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.
- .2 Locate materials not required to be stored in weatherproof sheds on site in manner to cause least interference with work activities.

1.7 SANITARY FACILITIES

- .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.
- .2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition. **Remove sanitary facilities upon completion of work.**
- ~~.3 When permanent water and drain connections are completed, provide temporary water closets and urinals complete with temporary enclosures, inside building. Permanent facilities may be used on approval of NRC Departmental Representative.~~

1.8 CONSTRUCTION SIGNAGE

- .1 No other signs or advertisements, other than warning signs, are permitted on site.
- .2 Signs and notices for safety and instruction in both official languages Graphic symbols to CAN/CSA-Z321.

1.9 PROTECTION AND MAINTENANCE OF TRAFFIC

- .1 Provide access and temporary relocated roads as necessary to maintain traffic.
- .2 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by NRC Departmental Representative .
- .3 Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs
- .4 Protect travelling public from damage to person and property.

- .5 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.
- .6 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.
- .7 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.
- .8 Dust control: adequate to ensure safe operation at all times.
- .9 Lighting: to assure full and clear visibility for full width of work areas during night work operations.
- .10 Provide snow removal during period of Work.

1.10 CLEAN-UP

- .1 Remove construction debris, waste materials, packaging material from work site daily.
- .2 Clean dirt or mud tracked onto paved or surfaced roadways.
- .3 Store materials resulting from demolition activities that are salvageable.
- .4 Stack stored new or salvaged material not in construction facilities.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Conform to these reference standards, in whole or in part as specifically requested in specifications.
- .2 If there is question as to whether products or systems are in conformance with applicable standards, NRC Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.
- .3 Cost for such testing will be born by NRC Departmental Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.

1.2 QUALITY

- .1 Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- ~~.2 Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.~~
- ~~.3~~**.2** Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- ~~.4~~**.3** Should disputes arise as to quality or fitness of products, decision rests strictly with NRC Departmental Representative based upon requirements of Contract Documents.
- ~~.5~~**.4** Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- ~~.6~~**.5** Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.3 STORAGE, HANDLING AND PROTECTION

- .1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Store cementitious products clear of earth or concrete floors, and away from walls.
- .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- .6 Store sheet materials and lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- .8 Remove and replace damaged products at own expense and to satisfaction of NRC Departmental Representative.
- .9 Touch-up damaged factory finished surfaces to NRC Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.4 TRANSPORTATION

- .1 Pay costs of transportation of products required in performance of Work.

1.5 MANUFACTURER'S INSTRUCTIONS

- .1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
- .2 Notify NRC Departmental Representative in writing, of conflicts between specifications and manufacturer's instructions, so that NRC Departmental Representative will establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes NRC Departmental Representative to require removal and re-installation at no increase in Contract Price or Contract Time.

1.6 QUALITY OF WORK

- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify NRC Departmental Representative if required Work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. NRC Departmental Representative reserves right to require dismissal from site, workers deemed incompetent or careless.
- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with NRC Departmental Representative whose decision is final.

1.7 CO-ORDINATION

- .1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.
- .2 Be responsible for coordination and placement of openings, sleeves and accessories.

1.8 CONCEALMENT

- .1 In finished areas conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- .2 Before installation inform NRC Departmental Representative if there is interference. Install as directed by NRC Departmental Representative.

1.9 REMEDIAL WORK

- .1 Refer to Section 01 73 00 - Execution Requirements.
- .2 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate adjacent affected Work as required.
- .3 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.10 LOCATION OF FIXTURES

- .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
- .2 Inform NRC Departmental Representative of conflicting installation. Install as directed.

1.11 FASTENINGS

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- .2 Prevent electrolytic action between dissimilar metals and materials.
- .3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.
- .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.12 FASTENINGS - EQUIPMENT

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.
- .3 Bolts may not project more than one diameter beyond nuts.
- .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.13 PROTECTION OF WORK IN PROGRESS

- .1 Prevent overloading of parts of building. Do not cut, drill or sleeve load bearing structural member, unless specifically indicated without written approval of NRC Departmental Representative.

1.14 EXISTING UTILITIES

- .1 When breaking into or connecting to existing services or utilities, execute Work **as specified in Section 00 10 00, General Instructions.** ~~at times directed by local governing authorities, with minimum of disturbance to Work, and pedestrian and vehicular traffic.~~
- ~~.2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.~~

Part 2 Products

Not Used.

Part 3 Execution

Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Definitions:

- .1 Hazardous Materials: dangerous substances, dangerous goods, hazardous commodities and hazardous products, include but not limited to: poisons, corrosive agents, flammable substances, ammunition, explosives, radioactive substances, or materials that endanger human health or environment if handled improperly.

.2 Reference Standards:

- .1 CSA International
 - .1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Pre-Installation Meetings:

- .1 Convene pre-installation meeting 1 week prior to beginning work of this Section and on-site installation, with Contractor's Representative and NRC Departmental Representative to:
 - .1 Verify project requirements.
 - .2 Verify existing site conditions adjacent to demolition work.
 - .3 Co-ordination with other construction subtrades.

1.3 ACTION AND INFORMATION SUBMITTALS

.1 Shop Drawings:

- .1 Submit for review and approval demolition drawings, diagrams or details showing sequence of demolition work, and supporting structures, shoring and underpinning.
- .2 Submit demolition drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

1.4 QUALITY ASSURANCE

- .1 Regulatory Requirements: Ensure Work is performed in compliance with Provincial and Municipal regulations.

1.5 SITE CONDITIONS

.1 Environmental protection:

- .1 Ensure Work does not adversely affect adjacent watercourses, groundwater and wildlife, or contribute to excess air and noise pollution.

- .2 Fires and burning of waste or materials is not permitted on site.
- .3 Do not bury rubbish waste materials.
- .4 Do not dispose of waste or volatile materials including but not limited to: mineral spirits, oil, petroleum based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers.
 - .1 Ensure proper disposal procedures are maintained throughout project.
- .5 Do not pump water containing suspended materials into watercourses, storm or sanitary sewers, or onto adjacent properties.
- .6 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with authorities having jurisdiction.
- .7 Protect trees, plants and foliage on site and adjacent properties where indicated.
- .8 Prevent extraneous materials from contaminating air beyond application area, by providing temporary enclosures during demolition work.
- .9 Cover or wet down dry materials and waste to prevent blowing dust and debris. Control dust on all temporary roads.

1.6 EXISTING

- .1 Structures to be demolished are based on their condition on date that tender is accepted, and at time of examination prior to tendering.
 - ~~.1 Remove, protect and store salvaged items as directed by NRC Departmental Representative. Deliver to NRC Departmental Representative as directed.~~

Part 2 Products

2.1 EQUIPMENT

- .1 Leave machinery running only while in use, except where extreme temperatures prohibit shutting machinery down.

Part 3 Execution

3.1 PREPARATION

- .1 Temporary Erosion and Sedimentation Control:
 - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to: requirements of authorities having jurisdiction.
 - .2 Inspect, repair, and maintain erosion and sedimentation control measures during demolition.

- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal after completion of demolition work.
- .2 Protection of in-place conditions:
 - .1 Prevent movement, settlement or damage of adjacent structures, services, walks, paving, trees, landscaping, adjacent grades properties parts of existing building to remain.
 - .1 Provide bracing, shoring and underpinning as required.
 - .2 Repair damage caused by demolition as directed by NRC Departmental Representative.
 - .2 Support affected structures and, if safety of structure being demolished or adjacent structures or services appears to be endangered, take preventative measures, stop Work and immediately notify NRC Departmental Representative.
 - .3 Prevent debris from blocking surface drainage system, mechanical and electrical systems which must remain in operation.
- .3 Surface Preparation:
 - .1 Disconnect and re-route electrical service lines entering buildings to be demolished.
 - .1 Post warning signs on electrical lines and equipment which must remain energized to serve other properties during period of demolition.
 - .2 Do not disrupt active or energized utilities traversing premises designated to remain undisturbed.

3.2 DEMOLITION

- .1 Do demolition work in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.
- .2 Blasting operations not permitted during demolition.
- .3 Remove contaminated or dangerous materials as defined by authorities having jurisdiction, relating to environmental protection, from site and dispose of in safe manner to minimize danger at site or during disposal.
- .4 Demolish parts of structure structures.
- .5 To permit construction of addition and as indicated.
- .6 Remove existing equipment, services, and obstacles where required for refinishing or making good of existing surfaces, and replace as work progresses.
- .7 At end of each day's work, leave Work in safe and stable condition.
 - .1 Protect interiors of parts not to be demolished from exterior elements at all times.

- .8 Demolish to minimize dusting.
- .9 Remove and dispose of demolished materials except where noted otherwise and in accordance with authorities having jurisdiction.
- .10 Use natural lighting to do Work where possible.
 - .1 Shut off lighting except those required for security purposes at end of each day.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM D523-08, Standard Test Method for Specular Gloss.
 - .2 ASTM D822-01(2006), Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
- .2 CSA International
 - .1 CAN/CSA-G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meetings:
 - .1 Convene pre-installation meeting 1 week prior to beginning work of this Section to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other construction subtrades.
 - .4 Review manufacturer's written installation instructions and warranty requirements.
- .2 Arrange for site visit with NRC Departmental Representative prior to start of Work to examine existing site conditions adjacent to demolition Work.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for doors, hardware, and accessories and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate sizes, service rating, types, materials, operating mechanisms, glazing locations and details, hardware and accessories, required clearances and electrical connections.
- .4 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .5 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.

- .6 Manufacturers Reports:
 - .1 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in Part 3 - FIELD QUALITY CONTROL.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for sectional metal doors for incorporation into manual.

1.5 QUALITY ASSURANCE

- .1 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .2 Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect sectional metal doors, hardware and accessories from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 DESIGN / PERFORMANCE CRITERIA

- .1 Design exterior door assembly to withstand wind loads in accordance with building code requirements with a maximum horizontal deflection of 1/240 of opening width.
- .2 Design door assembly to withstand minimum 100,000 cycles per annum, and minimum 20 years total life cycle.
- .3 Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components

2.2 MATERIALS

- .1 Galvanized steel sheet: commercial quality Z275 zinc coating.

- .2 Insulation: CFC-free and HCFC-free polyurethane, fully encapsulated.
 - .1 Thermal Values: R-value of 17.50; U-value of 0.057.
- .3 Glazing: Partial glazing of steel panels set in 2-piece high-impact black polymer frame:
 - .1 12.5 mm Insulated Tempered Glass.
- .4 Cable: multi-strand galvanized steel aircraft cable.

2.3

FABRICATION

- .1 Fabricate 51 mm thick insulated steel sectional overhead doors, with flush panels of roll formed steel sections as indicated.
 - .1 Door Sections: Shall be of steel/polyurethane/steel sandwich type construction with thermal break.
 - .2 Exterior Steel: 0.38 mm, hot-dipped galvanized.
 - .3 Ends: Hot-dipped galvanized steel, full height with end caps, 18 gauge.
- .2 Fabricate work with materials and with component dimensions and gauges, reinforcing, attached anchors and fastenings of adequate strength to prevent warping, buckling, opening of joints and seams, loosening of hardware, distortion and displacement within limits of intended and specified use.
- .3 Conceal and weld connections wherever possible.
- .4 Fit joints and junctions between components tightly and in true planes.
- .5 Isolate from each other dissimilar metals, and metal from concrete or masonry to prevent electrolysis.
- .6 Install glazing, sizes and number of lights as indicated.
- .7 Assemble components by means of spot or arc welding or coated rivet system or adhesive and self tapping screws to manufacturer's recommendations.

2.4

HARDWARE

- .1 Track: standard hardware with 75 mm size minimum 2.28 mm core thickness galvanized steel track to suit loading required and clearances available.
- .2 Track Supports: 2.3 mm core thickness continuous galvanized steel angle track supports.
- .3 Spring Counterbalance: Sized to weight of the door, with a helically wound, oil tempered torsion spring mounted on a steel shaft; cable drum of die cast aluminum with high strength galvanized aircraft cable. Sized with a minimum 5 to 1 safety factor.
- .4 Top roller carrier: galvanized steel minimum 2.28 mm thick, adjustable.
- .5 Rollers: full floating, grease packed hardened steel, ball bearing minimum 75 mm diameter, stamped tire.
- .6 Roller brackets: adjustable, galvanized steel, minimum 2.5 mm thick.
- .7 Hinges: standard duty industrial 2.28 mm thick, galvanized steel.
- .8 Cable: minimum 4 mm diameter galvanized steel aircraft cable.

2.5 ACCESSORIES

- .1 Overhead horizontal track and operator supports: galvanized steel, type and size to suit installation.
- .2 Track guards: 5 mm thick formed sheet 1500 mm high track guards.
- .3 Pusher springs.
- .4 Weatherstripping:
 - .1 Sills: double contact, bulb type full width extruded neoprene weatherstrip.
 - .2 Jambs and head: extruded aluminum and arctic grade vinyl weatherstrip to manufacturer's standard.
- .5 Finish ferrous hardware items with minimum zinc coating of 300 g/m² to CAN/CSA-G164.

2.6 PREFINISHED STEEL SHEET

- .1 Prefinished steel with factory applied silicone modified polyester.
 - .1 Class F2S.
 - .2 Colour selected by NRC Departmental Representative from manufacturer's standard range.
 - .3 Specular gloss: 30 units +/-5 in accordance with ASTM D523.
 - .4 Coating thickness: not less than 25 micrometres.
 - .5 Resistance to accelerated weathering for chalk rating of 8, colour fade 5 units or less and erosion rate less than 20% to ASTM D822 as follows:
 - .1 Outdoor exposure period 1000 hours.
 - .2 Humidity resistance exposure period 1000 hours.

~~2.7 OPERATORS~~

- ~~.1 Equip doors for operation by:
 - ~~.1 Hand, two handles on inside outside face of door.~~
 - ~~.2 Chain hoist with nylon rope galvanized steel chain.~~~~
- ~~.2 Cable fail safe device.
 - ~~.1 Able to stop door immediately if cable breaks on door free fall. Breaking capacity 500 kg.~~~~

~~2.8~~ 2.7 ELECTRICAL OPERATOR

- .1 Electrical motors, controller units, remote pushbutton stations, relays and other electrical components: to CSA approval with CSA enclosure type ~~EEMAC 4~~ **to suit the location of operator.**
- .2 Power supply: 600 V, 3 phase, 60 Hz.
 - .1 Motor Heavy Duty, **jackshaft, with chain hoist built-in**, of size and type as recommended by manufacturer.

- .3 Controller units with integral motor reversing starter, solenoid operated brake, 3 heater elements for overload protection, including pushbuttons and control relays as applicable.
- .4 Operation:
 - .1 Remote pushbutton stations: surface mounted, with "OPEN-STOP-CLOSE" designations on pushbuttons in English and French.
 - .2 Cable control: pendant hung control to open and electric eyes to close.
 - .3 Control locations: Interior.
- .5 Safety switch: combination roll rubber with limit switches for full length of bottom rail of bottom section of door, to reverse door to open position when coming in contact with object on closing cycle.
- .6 Provide disconnect device to allow for manual operation in event of power failure.
- .7 Automatic illumination complete with time delay, self extinguishing.
- .8 Door speed: ~~300~~200 mm per second.
- .9 Control transformer: for 24 VAC control voltage.
- .10 Mounting brackets: galvanized steel, size and gauge to suit conditions.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for sectional metal doors installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of NRC Departmental Representative.
 - .2 Verify electric power is available and of correct characteristics.
 - .3 Inform NRC Departmental Representative of unacceptable conditions immediately upon discovery.
 - .4 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Departmental Representative.

3.2 INSTALLATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Install doors and hardware in accordance with manufacturer's instructions.
- .3 Rigidly support rail and operator and secure to supporting structure.
- .4 Touch-up steel doors with primer where galvanized finish damaged during fabrication.
- .5 Install operator including electrical motors, controller units, pushbutton stations, relays and other electrical equipment required for door operation.

- .6 Lubricate and adjust door operating components to ensure smooth opening and closing of doors.
- .7 Adjust weatherstripping to form a weather tight seal.
- .8 Adjust doors for smooth operation.

3.3 ELECTRICAL WIRING

- .1 Power shall be brought up to circuit breaker/disconnect switch adjacent to controller under Electrical Division and in conformance with requirements specified therein.
- .2 Wiring from motor to switches, controls, starters, safety devices and other items requiring power shall be carried out under this section.
- .3 Use EMT conduit for fixed wiring. Use purpose-made and approved type flexible cables or cords at applicable locations; adequately support so as not to impede access or foul moving parts of equipment.

3.4 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Obtain written reports from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product within 3 days of review.
 - .2 Submit manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule manufacturer's representative site visits to review Work at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work on which Work of this Section depends is complete, but before installation begins.
 - .2 Once during progress of Work.
 - .3 Upon completion of Work, after cleaning is carried out.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove traces of primer; clean doors and frames.
 - .2 Clean glass and glazing materials with approved non-abrasive cleaner.

3.6 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by sectional metal door installation.

- .3 Do not permit construction traffic through overhead door openings after adjustment and cleaning.
- .4 Protect installed products until completion of project.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 08 11 00 - Metal Doors and Frames.
- .2 Section 08 14 16 – Flush Wood Doors.
- .3 Section 08 34 43 - Hinged Safety Glass Doors.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA)
 - .1 ANSI/BHMA A156.1-2000, American National Standard for Butts and Hinges.
 - .2 ANSI/BHMA A156.2-2003, Bored and Preassembled Locks and Latches.
 - .3 ANSI/BHMA A156.3-2001, Exit Devices.
 - .4 ANSI/BHMA A156.4-2000, Door Controls - Closers.
 - .5 ANSI/BHMA A156.5-2001, Auxiliary Locks and Associated Products.
 - .6 ANSI/BHMA A156.8-2005, Door Controls - Overhead Stops and Holders.
 - .7 ANSI/BHMA A156.10-1999, Power Operated Pedestrian Doors.
 - .8 ANSI/BHMA A156.13-2002, Mortise Locks and Latches Series 1000.
 - .9 ANSI/BHMA A156.15-2006, Release Devices - Closer Holder, Electromagnetic and Electromechanical.
 - .10 ANSI/BHMA A156.16-2002, Auxiliary Hardware.
 - .11 ANSI/BHMA A156.17-2004, Self-closing Hinges and Pivots.
 - .12 ANSI/BHMA A156.18-2006, Materials and Finishes.
 - .13 ANSI/BHMA A156.19-2002, Power Assist and Low Energy Power - Operated Doors.
 - .14 ANSI/BHMA A156.20-2006, Strap and Tee Hinges and Hasps.
- .2 Canadian Steel Door and Frame Manufacturers' Association (CSDMA)
 - .1 CSDMA Recommended Dimensional Standards for Commercial Steel Doors and Frames - 2009.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for door hardware and include product characteristics, performance criteria, physical size, finish and limitations.

- .2 Samples:
 - .1 Submit for review and acceptance of each unit.
 - .2 Samples will be returned for inclusion into work.
 - .3 Identify each sample by label indicating applicable specification paragraph number, brand name and number, finish and hardware package number.
 - .4 After approval samples will be returned for incorporation in Work.
- .3 Hardware List:
 - .1 Submit contract hardware list **prepared by architectural hardware consultant-**
 - .2 Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.
 - .4 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
 - .5 Manufacturer's Instructions: submit manufacturer's installation instructions.
 - ~~.5.6~~ **Submit electrical elevation drawings for all electronic doors. Provide matrix comparison of electronic hardware devices between hardware schedule and electrical drawings for co-ordination.**

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for door hardware for incorporation into manual.

1.5 MAINTENANCE MATERIALS SUBMITTALS

- .1 Extra Stock Materials:
 - .1 Supply maintenance data, parts list, and manufacturer's instructions for each type of door closers, locksets, door holders and all hardware specified for incorporation into maintenance manual.
 - .2 Tools:
 - .1 Supply 2 sets of wrenches for door closers locksets and fire exit hardware.

1.6 QUALITY ASSURANCE

- .1 Regulatory Requirements:
 - .1 Hardware for doors in fire separations and exit doors certified by a Canadian Certification Organization accredited by Standards Council of Canada.

- .2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Provide letter of conformance from certified architectural consultant that all product are installed as per manufacturers instructions by certified door hardware factory trained installers. Include for minimum 3 site visits by architectural hardware consultant.**
- .4 Provide final door by door report on all mechanical and electrical hardware device commissioning and signed by GC, Electrical contractor and hardware consultant**
- .2.5 Provide services of an AHC familiar with this type of work being performed for preparation of hardware schedule shop drawings, keying and electrical co-ordination and consultation with owner and consultant for onsite meetings and inspections**

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Package items of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.
- .4 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect door hardware from nicks, scratches, and blemishes.
 - .3 Protect prefinished surfaces with wrapping strippable coating.
 - .4 Replace defective or damaged materials with new.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials.

Part 2 Products

2.1 HARDWARE REQUIREMENTS

- .1 Hardware standards listed in Paragraph 2.2 shall be obtained through NRC standing offer program.
- .2 NRC has a bonded locksmith for the NRC keying system on standing contract. See contract coordinator for information.

- .3 All cylinders to be keyed by **N**NRC bonded locksmith on standing offer contract.
- ~~.4 Contractor to be responsible for all associated costs for cylinders and keying of same with NRC bonded standing offer locksmith.~~

2.2 DOOR HARDWARE

- .1 Locks and latches:
 - .1 Lockset: Yale AU-5407-L x 626.
 - .2 Latchset: Yale AU-5401-L x 626.
- .2 Butts and hinges:
 - .1 Hinges: Interior Doors: Dorex 114.3mm x 101.6mm x 179 454 NRP X C15.
 - .2 Hinges: Exterior Doors: Dorex 114.3mm x 101.6mm x BB2222 NRP X C15.
 - .3 Strap and tee hinges and hasps: to ANSI/BHMA A156.20, designated by letter A and numeral identifiers listed in Hardware Schedule, size listed in Hardware Schedule in accordance with ANSI/BHMA A156.20, table I, finished to 602 (cadmium plated) or 603 (zinc plated).
 - .4 Top and bottom offset pivots (fully glazed doors only): to ANSI/BHMA A156.4**
- .3 Exit devices: to ANSI/BHMA A156.3, grade 1, modern-narrow stile.
- .4 Door Closers and Accessories:
 - .1 Door controls (closers): Interior Doors: Norton 1600BC-Reg x AL. parallel arm.
 - .2 Door controls (closers): Exterior Doors: LCN 4110 x AL.
 - .3 Door controls (holders): Hager Kick down 270C.S1, sprayed aluminum finish.
- .5 Door Operators:
 - .1 Power-operated pedestrian doors: to ANSI/BHMA A156.10.
 - .2 Power assist and low energy power operated doors: to ANSI/BHMA A156.19.
- .6 Architectural door trim: to ANSI/BHMA A156.6, as listed below.
 - .1 Door protection plates: kick plate type, 1.27 mm thick stainless steel 304**
 - ~~.4 mechanically fastened.~~
 - .2 Push plates: 1.27 mm thick stainless steel 304.
 - .3 Push/Pull units: stainless steel 304.
- .7 Auxiliary hardware: to ANSI/BHMA A156.16, as listed below.
 - .1 Door silencer: type neoprene, clear.

- .2 Automatic flush bolts: **Fully Automatic: Opening active door automatically retracts top and bottom bolts. Closing active door automatically extends both top and bottom bolts 3/4" into frame and sill strikes, locking inactive door.**~~type.~~
- .8 Door bottom seal: heavy duty, door seal of extruded aluminum frame and solid closed cell neoprene, recessed in door bottom closed ends, adjustable automatic retract mechanism when door is open, clear anodized finish.
- .9 Thresholds: 125mm wide x full width of door opening, extruded aluminum mill finish, serrated surface, with thermal break of rigid PVC, with lip and vinyl door seal insert.
- .10 Weatherstripping:
 - .1 Head and jamb seal:
 - .1 Extruded aluminum frame and solid closed cell neoprene insert, clear anodized finish.
 - .2 Door bottom seal:
 - .1 Extruded aluminum frame and closed cell neoprene sweep, clear anodized finish.
- .11 Astragal: extruded aluminum frame with vinyl insert.
- .12 Barrier Free Pneumatic Door Operator:
 - .1 Heavy duty pneumatically assisted door closer, capable of multi-door operation, complete with actuators, control boxes, pneumatic tubing and compressed air source.
 - .2 Self-contained control box/compressor combination for independent operation of two door leaves.
 - .3 Control boxes: complete with electric strike relay.
 - .4 Mount operators on either push or pull sides of doors as required to place them inside rooms.
 - .5 Electrical box and actuator: Hardwired low voltage actuator with stainless steel 114 mm round plate, engraved blue filled with handicap symbol. Box 51 mm wide x 102 mm high x 50 mm deep single gang electrical box, flush mounted in wall, locations indicated.
 - .6 Supply switched line voltage to control box. Locate switch adjacent to box.
 - .7 Supply low voltage wiring to each actuator and 6 mm diameter air tubing to each operator.
- .13 **Electric Strikes:**
 - .1 **Request to exit or Enter signaling switch:**
 - .1 **two switches mounted internally in lock body, independent monitoring of inside and outside lever rotation.**

.2 Deadbolt monitor: single switch, mounted internally in lock body that indicates deadbolt position.

.3 Assa Abloy 8271 RX DX or equal.

.13.14 Sliding (Bypass) Door Hardware:

- .1 Top mount hanger: Eight ball bearing, nylon tire wheels, one per door, concealed type.
 - .1 Vertical adjustment by threaded door top plate and locknut.
- .2 Top mount track:
 - .1 Extruded aluminum, 6063T5 alloy width to suit door opening.
- .3 Floor guides:
 - .1 Nylon, two per door.
- .4 Door stop:
 - .1 Rubber, concealed in top mount track, two per door.
- .5 Door pull:
 - .1 Extruded aluminum, 6063T5 alloy, recessed, one per door.
- .6 Fascia:
 - .1 Extruded aluminum, 6063T5 alloy, width to suit door opening.

2.3 FASTENINGS

- .1 Use only fasteners provided by manufacturer. Failure to comply may void warranties and applicable licensed labels.
- .2 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.
- .3 Exposed fastening devices to match finish of hardware.
- .4 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.
- .5 Use fasteners compatible with material through which they pass.

2.4 KEYING

- .1 Supply construction cores.
- .2 Hand over permanent cores and keys to NRC Departmental Representative.

Part 3 Execution

3.1 INSTALLATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Supply metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.
- .3 Supply manufacturers' instructions for proper installation of each hardware component.
- .4 Install hardware to standard hardware location dimensions in accordance with CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction).
- .5 Where door stop contacts door pulls, mount stop to strike bottom of pull.
- .6 Install key control cabinet.
- .7 Use only manufacturer's supplied fasteners.
 - .1 Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.
- .8 Remove construction cores locks when directed by NRC Departmental Representative.
 - .1 Install permanent cores and ensure locks operate correctly.

3.2 ADJUSTING

- .1 Adjust door hardware, operators, closures and controls for optimum, smooth operating condition, safety and for weather tight closure.
- .2 Lubricate hardware, operating equipment and other moving parts.
- .3 Adjust door hardware to ensure tight fit at contact points with frames.

3.3 CLEANING

- .1 Progress Cleaning:
 - .1 Leave Work area clean at end of each day.
 - .2 Clean hardware with damp rag and approved non-abrasive cleaner, and polish hardware in accordance with manufacturer's instructions.
 - .3 Remove protective material from hardware items where present.
 - .4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

- .2 Waste Management: separate waste materials for reuse and recycling.
- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by door hardware installation.

~~3.5 SCHEDULE~~

~~Refer to the Schedule of Finishing Hardware.~~

~~.1 E01:~~

~~.1 Active Leaf:~~

- ~~.1 1 1/2 pairs hinges, 5 bearing, regular.~~
- ~~.2 Narrow stile exit device.~~
- ~~.3 Electric strike 12VDC (fail safe).~~
- ~~.4 Overhead door stop.~~
- ~~.5 Cylinder.~~
- ~~.6 Door closure.~~
- ~~.7 Door operator.~~
- ~~.8 Removable astragal~~
- ~~.9 Door contact~~
- ~~.10 Door Pull~~
- ~~.11 Interlocking threshold and weatherstrip.~~
- ~~.12 1 set weatherstripping~~

~~.2 Inactive Leaf:~~

- ~~.1 1 1/2 pairs hinges, 5 bearing, regular.~~
- ~~.2 Narrow stile exit device.~~
- ~~.3 Overhead door stop.~~
- ~~.4 Door closure.~~
- ~~.5 Manual flush bolt (bottom only).~~
- ~~.6 Constant latching bolt (top only).~~
- ~~.7 Door contact~~
- ~~.8 Door Pull~~
- ~~.9 Interlocking threshold and weatherstrip.~~
- ~~.10 1 set weatherstripping~~

~~.2 E03, E04, E05, E07, E10:~~

- ~~.1 1 1/2 pairs hinges, 2 bearing, NRP.~~
- ~~.2 Narrow stile exit device.~~

- ~~.3 — Overhead door stop.~~
- ~~.4 — Door closure.~~
- ~~.5 — 2 kickplates width of door, 630mm high.~~
- ~~.6 — Interlocking threshold and weatherstrip.~~
- ~~.7 — 1 set weatherstripping.~~
- ~~.8 — Door silencers~~
- ~~.9 — Door contact~~
- ~~.3 — E02:~~
 - ~~.1 — 1 1/2 pairs hinges, 2 bearing, NRP.~~
 - ~~.2 — Narrow stile exit device.~~
 - ~~.3 — Overhead door stop.~~
 - ~~.4 — Door closure.~~
 - ~~.5 — 2 kickplates width of door, 630mm high.~~
 - ~~.6 — Interlocking threshold and weatherstrip.~~
 - ~~.7 — 1 set weatherstripping.~~
 - ~~.8 — Door silencers~~
 - ~~.9 — Door contact~~
 - ~~.10 — Electric strike 12VDC (fail safe)~~
- ~~.4 — D021:~~
 - ~~.1 — Active Leaf:-~~
 - ~~.1 — 1 1/2 pairs hinges, 5 bearing, regular.~~
 - ~~.2 — Narrow stile exit device.~~
 - ~~.3 — Electric strike 12VDC (fail safe).~~
 - ~~.4 — Overhead door stop.~~
 - ~~.5 — Cylinder.~~
 - ~~.6 — Door closure.~~
 - ~~.7 — 2 kickplates width of door, 630mm high.~~
 - ~~.8 — Removable Astragal~~
 - ~~.9 — Door contact~~
 - ~~.10 — Door Pull~~
 - ~~.2 — Inactive Leaf:-~~
 - ~~.1 — 1 1/2 pairs hinges, 5 bearing, regular.~~
 - ~~.2 — Narrow stile exit device.~~
 - ~~.3 — Overhead door stop.~~
 - ~~.4 — Door closure.~~
 - ~~.5 — 2 kickplates width of door, 630mm high.~~
 - ~~.6 — Manual flush bolt (bottom only).~~
 - ~~.7 — Constant latching bolt (top only).~~
 - ~~.8 — Door contact~~

~~.9 — Door Pull~~

~~.5 — D038, D142:~~

- ~~.1 — 1 1/2 pairs hinges, 5 bearing, regular.~~
- ~~.2 — Narrow stile exit device.~~
- ~~.3 — Mortise lockset (Storeroom function), exterior side, D pull.~~
- ~~.4 — Electric strike 12VDC (fail safe).~~
- ~~.5 — Overhead door stop.~~
- ~~.6 — Door closure.~~
- ~~.7 — Door silencers~~

~~.6 — D021a, D021b, D124a:~~

- ~~.1 — 1 1/2 pairs hinges, 5 bearing, regular.~~
- ~~.2 — Narrow stile exit device.~~
- ~~.3 — Electric strike 12VDC (fail safe).~~
- ~~.4 — Overhead door stop.~~
- ~~.5 — Door closure.~~
- ~~.6 — Door silencers~~
- ~~.7 — Door contact~~
- ~~.8 — 2 kickplates width of door, 630mm high.~~
- ~~.9 — Door Pull on exterior side~~

~~.7 — D022, D023:~~

- ~~.1 — 1 1/2 pairs hinges, 5 bearing, regular.~~
- ~~.2 — Mortise lockset (Storeroom function).~~
- ~~.3 — Overhead door stop.~~
- ~~.4 — Cylinder.~~
- ~~.5 — Door closure.~~
- ~~.6 — Door silencers~~
- ~~.7 — 2 kickplates width of door, 630mm high.~~

~~.8 — D024, D025:~~

- ~~.1 — Active Leaf:
 - ~~.1 — 1 1/2 pairs hinges, 5 bearing, regular.~~
 - ~~.2 — Mortise lockset (Storeroom function).~~
 - ~~.3 — Overhead door stop.~~
 - ~~.4 — Cylinder.~~
 - ~~.5 — Door closure.~~
 - ~~.6 — 2 kickplates width of door, 630mm high.~~
 - ~~.7 — Removable Astragal~~~~
- ~~.2 — Inactive Leaf:
 - ~~.1 — 1 1/2 pairs hinges, 5 bearing, regular.~~~~

- ~~.2 — Dummy set~~
- ~~.3 — Overhead door stop.~~
- ~~.4 — Door closure.~~
- ~~.5 — 2 kickplates width of door, 630mm high.~~
- ~~.6 — Manual flush bolt (bottom only).~~
- ~~.7 — Constant latching bolt (top only).~~
- ~~.9 — D030, D033, D034, D136, D037, D027, D028, D029:~~
 - ~~.1 — 1 1/2 pairs hinges, 2 bearing, regular.~~
 - ~~.2 — Mortise lockset (Storeroom function).~~
 - ~~.3 — Overhead door stop.~~
 - ~~.4 — Door closure~~
 - ~~.5 — Door silencers~~
 - ~~.6 — 2 kickplates width of door, 630mm high.~~
- ~~.10 — D141:~~
 - ~~.1 — 1 1/2 pairs hinges, 2 bearing, NRP.~~
 - ~~.2 — Mortise lockset (Hotel function), no exterior.~~
 - ~~.3 — Overhead door stop.~~
 - ~~.4 — Cylinder.~~
 - ~~.5 — Door closure.~~
 - ~~.6 — 2 kickplates width of door, 630mm high.~~
 - ~~.7 — Interlocking threshold and weatherstrip.~~
 - ~~.8 — Door silencers~~
- ~~.11 — D130, D130a, D131, D131a, D132, D132a:~~
 - ~~.1 — 1 1/2 pairs hinges, 5 bearing, regular.~~
 - ~~.2 — Mortise lockset (Classroom function).~~
 - ~~.3 — Overhead door stop.~~
 - ~~.4 — Cylinder.~~
 - ~~.5 — Door closure.~~
 - ~~.6 — 2 kickplates width of door, 630mm high.~~
 - ~~.7 — Door silencers~~
- ~~.12 — D129:~~
 - ~~.1 — 1 1/2 pairs hinges, 5 bearing, regular.~~
 - ~~.2 — Mortise lockset (Storeroom function).~~
 - ~~.3 — Electric strike 12VDC (fail secure).~~
 - ~~.4 — Overhead door stop.~~
 - ~~.5 — Cylinder.~~
 - ~~.6 — Door closure.~~
 - ~~.7 — 2 kickplates width of door, 630mm high.~~

- ~~.8 — Door silencers~~
- ~~.9 — Door operator~~
- ~~.13 — D128:
 - ~~.1 — 1 1/2 pairs hinges, 5 bearing, regular.~~
 - ~~.2 — Mortise lockset (Privacy function).~~
 - ~~.3 — Electric strike 12VDC (fail secure).~~
 - ~~.4 — Overhead door stop.~~
 - ~~.5 — Door closure.~~
 - ~~.6 — 2 kickplates width of door, 630mm high.~~
 - ~~.7 — Door operator.~~
 - ~~.8 — Door silencers~~~~
- ~~.14 — D125, D125a:
 - ~~.1 — Bottom rail lock mechanism, mortise cylinder, round bolt dead lock.~~
 - ~~.2 — Overhead door stop.~~
 - ~~.3 — Door closure.~~
 - ~~.4 — Top and floor bearing pivot, 180 degree action.~~
 - ~~.5 — Mortise lockset (Storeroom function).~~~~
- ~~.15 — D123, D124:
 - ~~.1 — 1 1/2 pairs hinges, 5 bearing, regular.~~
 - ~~.2 — Mortise lockset (Storeroom function).~~
 - ~~.3 — Electric strike 12VDC (fail secure).~~
 - ~~.4 — Overhead door stop.~~
 - ~~.5 — Cylinder.~~
 - ~~.6 — Door closure.~~
 - ~~.7 — 2 kickplates width of door, 630mm high.~~
 - ~~.8 — Door operator.~~
 - ~~.9 — Door silencers~~
 - ~~.10 — Door contact~~~~
- ~~.16 — D122:
 - ~~.1 — 1 1/2 pairs hinges, 5 bearing, regular.~~
 - ~~.2 — Mortise lockset (Storeroom function).~~
 - ~~.3 — Overhead door stop.~~
 - ~~.4 — Cylinder.~~
 - ~~.5 — Door closure.~~
 - ~~.6 — 2 kickplates width of door, 630mm high.~~
 - ~~.7 — Door operator.~~
 - ~~.8 — Door silencers~~
 - ~~.9 — Electric strike 12VDC (fail secure).~~~~

~~.17 — D121:~~

~~.1 — Active Leaf:~~

- ~~.1 — 1 1/2 pairs hinges, 5 bearing, regular.~~
- ~~.2 — Mortise lockset (Storeroom function).~~
- ~~.3 — Electric strike 12VDC (fail secure).~~
- ~~.4 — Overhead door stop.~~
- ~~.5 — Cylinder.~~
- ~~.6 — Door closure.~~
- ~~.7 — 2 kickplates width of door, 630mm high.~~
- ~~.8 — Door operator.~~
- ~~.9 — Removable Astragal~~

~~.2 — Inactive Leaf:~~

- ~~.1 — 1 1/2 pairs hinges, 5 bearing, regular.~~
- ~~.2 — Dummy set~~
- ~~.3 — Overhead door stop.~~
- ~~.4 — Door closure.~~
- ~~.5 — 2 kickplates width of door, 630mm high.~~
- ~~.6 — Manual flush bolt (bottom only).~~
- ~~.7 — Constant latching bolt (top only).~~

~~.18 — D121a, D121b~~

- ~~.1 — Top mount hanger.~~
- ~~.2 — Top mount track.~~
- ~~.3 — Floor guides.~~
- ~~.4 — Door stop.~~
- ~~.5 — Door pull.~~
- ~~.6 — Fascia.~~

~~.19 — D026, D138, D139, D139a, D140, D140b, D031, D032, D035, D036, D036a,
D126, D127:~~

- ~~.1 — 1 1/2 pairs hinges, 2 bearing, regular.~~
- ~~.2 — Mortise lockset (Storeroom function).~~
- ~~.3 — Overhead door stop.~~
- ~~.4 — Door closure~~
- ~~.5 — Door silencers~~
- ~~.6 — 2 kickplates width of door, 630mm high.~~

~~.20 — D137:~~

- ~~.1 — 1 1/2 pairs hinges, 2 bearing, regular.~~
- ~~.2 — Mortise lockset (Storeroom function).~~
- ~~.3 — Overhead door stop.~~

- ~~.4 — Door closure~~
- ~~.5 — Door silencers~~
- ~~.6 — Door contact~~
- ~~.7 — Electric strike 12VDC (fail safe).~~
- ~~.8 — 2 kickplates width of door, 630mm high.~~
- ~~.21 — D140a~~
- ~~.1 — 1 1/2 pairs hinges, 2 bearing, regular.~~
- ~~.2 — Mortise lockset (Storeroom function).~~
- ~~.3 — Overhead door stop.~~
- ~~.4 — Door closure~~
- ~~.5 — Door silencers~~
- ~~.6 — Drop Threshold (STC rated door)~~
- ~~.7 — Door Contact~~

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop drawings:
 - .1 Drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .2 Drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.
 - .3 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.2 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
 - .1 Operation and maintenance manual approved by, and final copies deposited with, NRC Departmental Representative before final inspection.
 - .2 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.

- .3 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
- .4 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .5 Approvals:
 - .1 Submit [2] copies of draft Operation and Maintenance Manual to NRC Departmental Representative for approval. Submission of individual data will not be accepted unless directed by NRC Departmental Representative.
 - .2 Make changes as required and re-submit as directed by NRC Departmental Representative.
- .6 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
 - .1 NRC Departmental Representative will provide [1] set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
- .8 As-Built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to NRC Departmental Representative for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.

- .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Furnish spare parts as follows:
 - .1 One set of packing for each pump.
 - .2 One casing joint gasket for each size pump.
 - .3 One head gasket set for each heat exchanger.
 - .4 One glass for each gauge glass.
 - .5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 HVAC R Equipment:
 - .1 Refrigerant:
 - .1 HCFC based refrigerant.
 - .2 HFC based refrigerant.

.2 Alternate Equipment Manufacturers

- .1 All alternate products shall be submitted in accordance with specifications. The onus is on Contractor to meet the specifications.**
- .2 If Contractor intends on using non-base specified equipment, they will be responsible to ensure that it can be delivered to and accommodated within the specified locations. Contractor is solely responsible for any required provisions for all associated equipment including but not limited to mechanical, electrical and structural.**
- .3 Consultant reserves the right to reject products from the alternative manufacturers that do not meet specifications.**
- .4 Alternate Manufacturers**
 - .1 VAV Boxes: Krueger, Metalaire**
 - .2 Air Valves: Rosemex**
 - .3 Pumps: Armstrong**
 - .4 Silencers: Kinetics Noise Control**
 - .5 Plenums: Kinetics Noise Control**
 - .6 Motorized dampers: Alumavent**
 - .7 Fire Dampers: Alumavent**
 - .8 GRD's: Metalaire**
 - .9 Louvers: Ventex**
 - .10 Electric duct heaters: Thermolec**
 - .11 Baseboard convectors: Sigma**
 - .12 Unit heaters: Sigma**
 - .13 Horizontal Unit heater: Sigma**
 - .14 Fans - Loren Cook**

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of NRC Departmental Representative.
 - .2 Inform NRC Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Departmental Representative.

3.2 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Section 09 91 23 - Interior Painting.
- .2 Prime and touch up marred finished paintwork to match original.

- .3 Restore to new condition, finishes which have been damaged.

3.3 SYSTEM CLEANING

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units in accordance with NADCA Standard 2013 requirements.

3.4 TEMPORARY USE OF SYSTEMS

Building HVAC systems are not to be used for heating or cooling during construction.

3.5 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.6 DEMONSTRATION

- .1 NRC Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to following equipment and systems:
 - .1 Chiller
 - .2 Cooling Tower
 - .3 Air handlers
 - .4 Pumps
 - .5 Automation system
 - .6 Vacuum System
- .3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .4 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .5 Instruction duration time requirements as specified in appropriate sections.
- .6 NRC Departmental Representative will record these demonstrations on video tape for future reference.

3.7 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.8 PROTECTION

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

3.9 SEISMIC

- .1 Seismic restraint systems for all mechanical work to conform to requirements of Section 23 05 48.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME Boiler and Pressure Vessel Code Section VIII Pressure Vessels.
 - .1 BPVC-VIII B - 2004 , BPVC Section VIII - Rules for Construction of Pressure Vessels Division 1.
 - .2 BPVC-VIII-2 B - 2004 , BPVC Section VIII - Rules for Construction of Pressure Vessels Division 2 - Alternative Rules.
 - .3 BPVC-VIII-3 B - 2004 , BPVC Section VIII - Rules for Construction of Pressure Vessels Division 3 - Alternative Rules High Press Vessels.
 - .2 ASME B16.5- 03 , Pipe Flanges and Flanged Fittings.
 - .3 ASME B16.11- 01 , Forged Fittings, Socket-Welding and Threaded.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A53/A53M- 04 , Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A181/A181M- 01 , Standard Specification for Carbon Steel Forgings for General Purpose Piping.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA B51- 03 , Boiler, Pressure Vessel, and Pressure Piping Code.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.
 - .2 Submit WHMIS MSDS in accordance with Section 02 81 01 - Hazardous Materials. Indicate VOC's for adhesive and solvents during application and curing.
- .3 Shop Drawings:
 - .1 Submit shop drawings to indicate project layout including layout, dimensions and extent of piping system.
 - .1 Vertical and horizontal piping locations and elevations and connections details.
 - .2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Instructions: submit manufacturer's installation instructions.
- .5 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals include data as follows:

1.3 QUALITY ASSURANCE

- .1 Pre-Installation Meeting:
 - .1 Convene pre-installation meeting one week prior to beginning work of this Section.
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan (WMP).
 - .4 Separate for recycling and place in designated containers Steel Metal Plastic waste in accordance with Waste Management Plan (WMP).
 - .5 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal, regulations.
 - .6 Divert unused metal materials from landfill to metal recycling facility as approved by NRC Departmental Representative.

Part 2 Products

2.1 AIR COMPRESSOR

- .1 General: ~~Two~~ **Single** stage, air-cooled, reciprocating, horizontal, tank-mounted, V-belt driven.

- .2 Motor: standard protected.
- .3 Control:
 - .1 Manual control with H-0-A starter switch.
 - .2 Pressure switch to cut out at 688 kPa and with minimum differential pressure.
- .4 Accessories: belt guard and pressure gauges. Complete with discharge check valve.
- .5 Air intakes: complete with bird screen, replaceable cartridge type intake filter and silencer.
- .6 Capacity: 11L/s of free air. 688 kPa at 1750 r/min. **27.5hp**, 600V/3PH
- .7 Vibration isolation: 95% minimum efficiency.

2.2 AIR RECEIVER

- .1 76 Liter, ASME stamped tank
- .2 Accessories: adjustable pressure regulator, safety valve, 125 mm diameter gauge with pressure range of 0 to 1500 kPa, drain cock and automatic condensate trap.
- .3 Provincial inspector's certificate and label.
- .4 Finish: shop primed, ready for field painting.

2.3 REFRIGERATED AIR DRYER

- .1 Self-contained, hermetically sealed, complete with air cooled heat exchanger, compressor, automatic controls, moisture removal trap, wiring, piping and refrigerant charge.
- .2 Inlet and outlet connections to be factory insulated.
- .3 Capacity:
 - .1 13 L/s at compressor air saturated at 38°C and 688kPa and operating in a 38°C ambient environment.
 - .2 Size to operate at 40% of time at design capacity.
- .4 Electrical supply: 120V, 1 phase, 60cycle.

2.4 COMBINATION FILTER-REGULATOR

- .1 Factory assembled, heavy-duty with mounting bracket and low pressure side relief valve.
- .2 Maximum inlet pressure: 800 kPa.
- .3 Operating temperature: minus 18 degrees C to plus 52 degrees C.
- .4 Filter element: 40 micron. Bowls: polycarbonate.
- .5 Pressure range in regulator: 34 kPa to 800 kPa.
- .6 Gauge range: 0 kpa to 1100 kPa.

2.5 PIPING

- .1 Piping: to ASTM A53/A53M, schedule 80 seamless black steel.

- .2 Fittings:
 - .1 NPS2 and smaller: to ASME B16.11, schedule 80 steel, socket welded.
 - .2 NPS2 1/2 and larger: to ASME B16.11, schedule 80 steel, butt or socket welded.
- .3 Couplings: to ASME B16.11, socket welded or threaded half coupling type.
- .4 Unions: 1000 kPa malleable iron with brass-to-iron ground seat.
- .5 Dissimilar metal junctions: use dielectric unions.
- .6 Flanges:
 - .1 NPS2 and smaller: to ASME B16.5, forged steel, raised face and socket welded.
 - .2 NPS2 1/2 and larger: to ASME B16.5, forged steel, raised face and slip-on or weld neck.
- .7 Joints:
 - .1 NPS2 and smaller: socket welded.
 - .2 NPS2 1/2 and larger: butt welded.

2.6 BALL VALVES

- .1 Three piece design or top entry for ease of in-line maintenance.
 - .1 To ASTM A181/A181M, Class 70, carbon steel body screwed ends, carbon steel ball and associated trim suitable for compressed air application.
 - .2 To withstand 1034 kPa maximum pressure.

2.7 COUPLERS/CONNECTORS

- .1 Industrial interchange series, full-bore.
- .2 Maximum inlet pressure: 1700 kPa.
- .3 Valve seat: moulded nylon.
- .4 Body: zinc plated steel.
- .5 Threads: NPT.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 COMPRESSOR STATION

- .1 Install on vibration isolators on housekeeping pad as indicated.

3.3 REFRIGERATED AIR DRYER

- .1 Install on three-valve bypass.

- .2 Install tee connection after dryer for emergency connection to instrument control air system.

3.4 COMPRESSED AIR LINE FILTER

- .1 Install on discharge line from refrigerated air dryer.

3.5 MAIN AIR PRESSURE REGULATORS

- .1 Install at air compressor station.
- .2 Install additional regulators on connections to equipment.

3.6 COMPRESSED AIR PIPING CONNECTIONS AND INSTALLATION

- .1 Install flexible connection in accordance with Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping.
- .2 Install shut-off valves at outlets, major branch lines and in locations as indicated.
- .3 Install quick-coupler chucks and pressure gauges on drop pipes.
- .4 Install unions to permit removal or replacement of equipment.
- .5 Install tees in lieu of elbows at changes in direction of piping. Install plug in open ends of tees.
- .6 Grade piping at 1% slope minimum.
- .7 Install compressed air trap and pressure equalizing pipe at moisture collecting points. Drain pipe to nearest floor drain.
- .8 Make branch connections from top of main.
- .9 Install compressed air trap at bottom of risers and at low points in mains, piped to nearest drain. Distance between drain points to be 30 m maximum.
- .10 Provide drain from refrigerated air dryer.
- .11 Weld steel piping in accordance with Section 23 05 17 - Pipe Welding and;
 - .1 To ASME code and requirements of authority having jurisdiction.
 - .2 Weld concealed and inaccessible piping regardless of size.

3.7 FIELD QUALITY CONTROL

- .1 Site Tests/Inspection:
 - .1 Testing: pressure test in accordance with requirements of Section 21 05 01 - Common Work Results for Mechanical, for 4 h minimum, to 1100 kPa, with outlets closed and with compressor isolated from system. Pressure drop not to exceed 10 kPa.
- .2 Manufacturer's Field Services:
 - .1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its products, and submit written reports, in acceptable format, to verify compliance of work with Contract.

- .2 Provide manufacturer's field services, consisting of product use recommendations and periodic site visits for inspection of product installation, in accordance with manufacturer's instructions.
- .3 Schedule site visits to review work at stages listed:
 - .1 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.
 - .2 Twice during progress of work at 25% and 60% complete.
 - .3 Upon completion of Work, after cleaning is carried out.
- .3 Obtain reports within 3 days of review and submit immediately to NRC Departmental Representative.

3.8 CLEANING

- .1 Refer to Section 23 08 01 - Performance Verification of Mechanical Piping Systems.
- .2 Cleaning: blow out piping to clean interior thoroughly of oil and foreign matter.
- .3 Check entire installation is approved by authority having jurisdiction.
- .4 Perform cleaning operations in accordance with manufacturer's recommendations.
- .5 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA B51- 03(R2007) , Boiler, Pressure Vessel, and Pressure Piping Code.
 - .2 CAN/CSA C22.2 No.110- 94(R2004) , Construction and Test of Electric Storage Tank Water Heaters.
 - .3 CAN/CSA-C191- 04 , Performance of Electric Storage Tank Water Heaters for Household Service.
 - .4 CAN/CSA-C309- M90(R2003) , Performance Requirements for Glass-Lined Storage Tanks for Household Hot Water Service.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for domestic water heater, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate:
 - .1 Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and field assembled.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for return of pallets crates padding packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.5 WARRANTY

- .1 For the Work of this Section 22 30 05 - Domestic Water Heaters, 12 months warranty period prescribed in subsection GC 32.1 of General Conditions "C" is extended to number of years specified for each product.

- .2 Contractor hereby warrants domestic water heaters in accordance with CCDC2, but for number of years specified for each product.

Part 2 Products

~~2.1~~ COMPONENTS

~~.1 Sustainable Requirements:~~

- ~~.1 Materials and products in accordance with Section 01 47 15 Sustainable Requirements: Construction.~~

~~2.2.1~~ ELECTRIC WATER HEATER

- .1 To CAN/CSA C22.2 No.110, CAN/CSA-C191 and CAN/CSA-C309. UL listed. To NSF Standard 5.
- .2 With 3 immersion type elements each controlled by an individual thermostat and high temperature cut off switch. All internal circuits fused.
- .3 Tank: 305 L, foam insulation, glass-lined, steel with extruded high density anode, 3 year warranty certificate.
- .4 Factory-installed and wired control panel
- .5 Factory-installed electrical junction box with heavy duty terminal block.
- .6 Drain valve
- .7 ASME rated temperature and pressure relief

~~2.3.2~~ TRIM AND INSTRUMENTATION

- .1 Drain valve: NPS 1 with hose end.
- .2 Thermometer: 100 mm dial type with red pointer and thermowell filled with conductive paste.
- .3 Pressure gauge: 75 mm dial type with red pointer, and shut-off cock.
- .4 Thermowell filled with conductive paste for control valve temperature sensor.
- .5 ASME rated temperature and pressure relief valve sized for full capacity of heater, having discharge terminating over floor drain and visible to operators.
- .6 Magnesium anodes adequate for 20 years of operation and located for easy replacement.

~~2.4.3~~ ANCHOR BOLTS AND TEMPLATES

- .1 Supply anchor bolts and templates for installation in concrete support pad in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .2 Size anchor bolts to withstand seismic zone 4 acceleration and velocity forces.

Part 3 Execution

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install in accordance with manufacturer's recommendations and authority having jurisdiction.
- .2 Provide insulation between tank and supports.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's factory trained, certified Engineer to start up and commission DHW heaters.

3.4 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA C111/A21.11-06, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .2 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.1-10, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - .2 ASME B16.3-06, Malleable Iron Threaded Fittings: Classes 150 and 300.
 - .3 ASME B16.5-09, Pipe Flanges and Flanged Fittings: NPS through NPS 24 Metric/Inch Standard.
 - .4 ASME B16.9-07, Factory-Made Wrought Butt welding Fittings.
 - .5 ASME B18.2.1-10, Square Hex, Heavy Hex and Askew Head Bolts and Hex, Heavy Hex, Hex Flange. Loded Head and Lag Screws (Inch Series).
 - .6 ASME B18.2.2-10, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).
- .3 ASTM International
 - .1 ASTM A47/A47M-99(2009), Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A53/A53M-10, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
 - .3 ASTM A536-84(2009), Standard Specification for Ductile Iron Castings.
 - .4 ASTM B61-08, Standard Specification for Steam or Valve Bronze Castings.
 - .5 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .6 ASTM E202-10, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.
- .4 CSA International
 - .1 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
- .5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS)
 - .1 MSS-SP-67-2002a, Butterfly Valves.
 - .2 MSS-SP-70-06, Gray Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-71-05, Gray Iron Swing Check Valves Flanged and Threaded Ends.
 - .4 MSS-SP-80-08, Bronze Gate, Globe, Angle and Check Valves.
 - .5 MSS-SP-85-02, Gray Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for hydronic systems and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate on drawings:
 - .1 Components and accessories.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for hydronic systems for incorporation into manual.
 - .1 Include special servicing requirements.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect hydronic systems from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 PIPE

- .1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:
 - .1 To NPS 6: Schedule 40.
 - .2 NPS 8 and over, 10.

2.2 PIPE JOINTS

- .1 NPS 2 and under: screwed fittings with PTFE tape or lead-free pipe dope.
- .2 NPS 2-1/2 and over: welding fittings and flanges to CSA W48.

- .3 Flanges: to ANSI/AWWA C111/ A21.11.
- .4 Orifice flanges: slip-on raised face, 2100 kPa.
- .5 Flange gaskets: to ANSI/AWWA C111/ A21.11.
- .6 Pipe thread: taper.
- .7 Bolts and nuts: to ASME B18.2.1.

2.3 FITTINGS

- .1 Screwed fittings: malleable iron, to ASME B16.3, Class 150.
- .2 Pipe flanges and flanged fittings:
 - .1 Cast iron: to ASME B16.1, Class 125.
 - .2 Steel: to ASME B16.5.
- .3 Butt-welding fittings: steel, to ASME B16.9.
- .4 Unions: malleable iron, to ASTM A47/A47M ASME B16.3.

2.4 VALVES

- .1 Connections:
 - .1 NPS 2 and smaller: screwed ends.
 - .2 NPS 2-1/2 and larger: flanged ends.
- .2 Gate valves: for isolating equipment, control valves, pipelines:
 - .1 NPS 2 and under:
 - .1 Mechanical Rooms : Class 125, rising stem, split wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 Elsewhere: Class 125, non- rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 NPS 2-1/2 and over:
 - .1 Mechanical Rooms: rising stem, split wedge disc, lead free bronze trim, gear operator.
 - .2 Elsewhere: non- rising stem, solid wedge disc, lead free bronze trim.
- .3 Butterfly valves: for isolating cells or section of multiple component equipment (i.e. multi-section coils, multi-cell cooling towers):
 - .1 NPS 2-1/2 and over: lug type
- .4 Globe valves: for throttling, flow control, emergency bypass:
 - .1 NPS 2 and under:
 - .1 Mechanical Rooms: with PTFE disc, as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 Elsewhere: globe, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 NPS 2-1/2 and over:
 - .1 With composition disc, lead free bronze trim.

- .5 Balancing, for TAB:
 - .1 Sizes: calibrated balancing valves, as specified this section.
 - .2 NPS 2 and under:
 - .1 Mechanical Rooms: globe, with plug disc as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 Elsewhere: globe, with plug disc as specified Section 23 05 23.01 - Valves - Bronze.
- .6 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.
- .7 Swing check valves: to MSS-SP-71.
 - .1 NPS 2 and under:
 - .1 Class 125, swing, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 NPS 2-1/2 and over:
 - .1 Flanged ends.
- .8 Silent check valves:
 - .1 NPS 2 and under:
 - .1 As specified Section 23 05 23.01 - Valves - Bronze.
 - .2 NPS 2-1/2 and over:
 - .1 Flanged ends.
- .9 Ball valves:
 - .1 NPS 2 and under: as specified Section 23 05 23.01 - Valves - Bronze.

Part 3 Execution

3.1 PIPING INSTALLATION

- .1 Install pipework in accordance with Section 23 05 05 - Installation of Pipe Work.

3.2 CIRCUIT BALANCING VALVES

- .1 Install flow measuring stations and flow balancing valves as indicated.
- .2 Remove handwheel after installation and when TAB is complete.
- .3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

3.3 CLEANING, FLUSHING AND START-UP

- .1 In accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems.

3.4 TESTING

- .1 Test system in accordance with Section 21 05 01 - Common Work Results for Mechanical.

- .2 For glycol systems, retest with propylene glycol to ASTM E202, inhibited, for use in building system after cleaning. Repair leaking joints, fittings or valves.

3.5 BALANCING

- .1 Balance water systems to within plus or minus 5 % of design output.
- .2 In accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

3.6 GLYCOL CHARGING

- .1 Include mixing tank and positive displacement pump for glycol charging.
- .2 Retest for concentration to ASTM E202 after cleaning.

3.7 PERFORMANCE VERIFICATION

- .1 In accordance with Section 23 08 01 - Performance Verification Mechanical Piping Systems.

3.8 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by hydronic systems installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)
 - .1 ANSI/AMCA Standard 210-[2007]/(ANSI/ASHRAE 51-07), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .2 International Organization of Standardization (ISO)
 - .1 ISO 3741-[2010], Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Methods for Reverberation Rooms.
- .3 National Fire Protection Association (NFPA)
 - .1 NFPA 90A-[12], Standard for the Installation of Air Conditioning and Ventilating Systems.
- .4 Underwriter's Laboratories (UL)
 - .1 UL 181-[2005(R2008)], Factory-Made Air Ducts and Air Connectors.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for air terminal units and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate the following:
 - .1 Capacity.
 - .2 Pressure drop.
 - .3 Noise rating.
 - .4 Leakage.
- .4 Samples:
 - .1 Submit duplicate samples of air valves for testing and client acceptance.
- .5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .6 Test and Evaluation Reports:
 - .1 Test data: to ANSI/AMCA Standard 210.
 - .1 Submit published test data on DIN (Direct Internal Noise), in accordance with ISO 3741 made by independent testing agency for 0, 2.5 and 6 m/s branch velocity or inlet velocity.

- .2 Sound power level with minimum inlet pressure of 0.25 kPa in accordance with ISO 3741 for 2nd through 7th octave band, also made by independent testing agency.
- .3 Pressure loss through silencer shall not exceed 60% of inlet velocity pressure maximum.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for air terminal units for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect air terminal units from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from certified ADC (Air Diffusion Council) testing agency signifying adherence to codes and standards.

2.2 MANUFACTURED UNITS

- .1 Terminal units of the same type to be product of one manufacturer.

2.3 VARIABLE VOLUME BOXES

- .1 Pressure independent factory reset to air flow between zero and maximum air volume.
- .2 Sizes, capacities, differential pressures and sound ratings: as indicated.
- .3 Differential pressure not to exceed 25 Pa at inlet air velocity of 10 m/s.
- .4 Sound ratings of assembly not to exceed 20 NC at 25 Pa.

- .5 Complete with:
 - .1 Operator and controller
 - .2 Sound attenuator
 - .3 Multiport outlet adapter: as indicated.
 - .4 Reheat coil: as indicated.
- .6 Operator to be factory mounted and calibrated:
- .7 Casing: constructed of 18ga galvanized steel, internally lined with 25 mm, 0.7 kg density fibrous glass, to UL181. Mount control components inside protective metal shroud.
- .8 Damper: 18 ga galvanized steel with peripheral gasket and self lubricating bearings. Air leakage past closed damper not to exceed 2% of nominal rating at 750 Pa inlet static pressure, in accordance with Air Diffusion Council test procedure.
- .9 Air velocity sensor pitot rack as standard to manufacturer.
- .10 Electronic control package factory calibrated and set at factory. Features to accommodate field calibration and readjustment of air volume settings to include:
 - .1 Metre taps for balancing with digital DC voltmeter.
 - .2 Adjustable flow settings at thermostat.
- .11 Factory installed 20 VA transformer, 115 V to 24 V. Power consumption of terminal not to exceed 15 VA.
- .12 Terminal unit to be CSA certified.

2.4 VENTURI AIR VALVES

- .1 Pressure independent factory reset to air flow between zero and maximum air volume.
- .2 Sizes, capacities, differential pressures and sound ratings: as indicated.
- .3 Internal plunger assembly responds to static pressure changes in less than one second.
- .4 Turndown-~~20:1~~**16:1**
- .5 Factory calibrated and characterized by by flow to valve position with N.I.S.T traceable equipment.
- .6 Accurate to +/-5% of flow
- .7 14 ga aluminum valve body, 16 ga aluminum cone, Teflon coated 316 stainless steel shaft, 316 stainless steel shaft supports, 316 stainless steel internal hardware.
- .8 Low pressure application: 75Pa to 750Pa.
- .9 Electronic control package factory calibrated and set at factory. Features to accommodate field calibration and readjustment of air volume settings to include:
 - .1 Metre taps for balancing with digital DC voltmeter.
 - .2 Adjustable flow settings at thermostat.
 - .3 Flow feedback module.**
- .10 Factory installed 20 VA transformer, 115 V to 24 V. Power consumption of terminal not to exceed 15 VA.

- .11 Terminal unit to be CSA certified.
- .12 Equivalent to EH Price Venturi Valve.

2.5 LOW PRESSURE SHUT-OFF AIR VALVES

- .1 Pressure independent factory calibrated venture-type air valve with shut-off mode to provide isolation of HVAC system.
- .2 16 ga. Spun aluminum valve body with continuous welded seam
- .3 Composite Teflon shaft bearings
- .4 Spring grade stainless steel spring and polyester slide assembly
- .5 Operating range: 32°C-122°C ambient. 10%-90% non-condensing RH
- .6 Pressure independent over a 75 – 750PA pressure drop across valve
- .7 Volume accurate to +/- 5%, 5 cfm of airflow command signal throughout normal operating range
- .8 No additional straight duct runs needed before or after valve
- .9 Less than 1 minute response time
- .10 10VA – 70VA power consumption. 24VAC power at 60Hz
- .11 VAV controller with 3 universal inputs, 1 digital output, 2 analog outputs, 1 digital output. Volts, mA, ohms or NTC 2 or 3 thermistor signals.
 - .1 Input accuracy: voltage, current, resistance: +/- 1% full scale
 - .2 Output accuracy:
 - .1 0 to 10VDC: +/- 1% full scale into 10 kOhms minimum
 - .2 4 to 20 mA: +/- 1% full scale into 500 Ohms +/-50 Ohms
- .12 CSA compliant

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for air terminal units installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of NRC Departmental Representative.
 - .2 Inform NRC Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Departmental Representative.

3.2 INSTALLATION

- .1 Install in accordance with manufacturers recommendations.

- .2 Support independently of ductwork.
- .3 Install with at least 1000 mm of flexible inlet ducting and minimum of four duct diameters of straight inlet duct, same size as inlet.
- .4 Locate controls, dampers and access panels for easy access.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Definitions:
 - .1 Catalogued or published ratings: ratings obtained from tests carried out by manufacturer or manufacturer's designated independent testing agency which signify adherence to codes and standards in force.
- .2 Reference Standards:
 - .1 American National Standards Institute/American Society of Heating, Refrigeration and Air Condition Engineers/Illuminating Engineering Society (ANSI/ASHRAE/IES)
 - .1 ANSI/ASHRAE 52.2-2012, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
 - .2 ANSI/ASHRAE/IES 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - .2 Green Seal (GS)
 - .1 GS-11-11, Standard for Paints and Coatings.
 - .3 Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - current edition.
 - .1 MPI #18.
 - .4 National Fire Protection Association (NFPA)
 - .1 NFPA 90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems.
 - .5 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA)
 - .6 South Coast Air Quality Management District (SCAQMD)
 - .1 SCAQMD Rule 1113-11, Architectural Coatings.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for refrigerant, insulation, filters, and paints and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate on drawings:
 - .1 Actual cooling and heating fluid entering and leaving conditions for stated air side requirements.
 - .2 Dimensions, including service clearance requirements.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for air handling equipment for incorporation into manual.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect air handling equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan.

Part 2 Products

2.1 GENERAL

- .1 Factory assembled components to form units supplying air at design conditions as indicated.

2.2 FANS

- .1 In accordance with Section 23 34 00 - HVAC Fans.

2.3 BUILDING 22-AHU-3 BUILDING CONDITIONING UNIT

- .1 Air Handling Units
 - .1 General Description
 - .1 Indoor air handling units shall include filters, supply fans, chilled water coil, hot water coil, humidifier section, energy wheel, mixing box, and unit controls.

- .1 Variable volume control with inverter-duty motor and variable speed drive.
 - .2 Unit shall discharge air vertically.
 - .3 Unit shall be factory assembled and tested including leak testing of the cooling coil, leak testing of the hot water coil, and run testing of the supply fans and factory wired electrical system. Run test report shall be supplied with the unit.
 - .4 Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
 - .5 Unit components shall be labeled, including pipe stub outs, electrical and controls components.
 - .6 Installation, Operation and Maintenance manual shall be supplied within the unit.
 - .7 Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.
 - .8 Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.
- .2 Construction
- .1 All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid G90 galvanized steel panels with R-13 insulating foam injected between panels.
 - .2 Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, prevents heat transfer through the panel, and prevents exterior condensation on the panel.
 - .3 Unit shall be designed to reduce air leakage and infiltration through the cabinet. Sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.
 - .4 Access to filters, cooling coil, heating coil, supply fans, and electrical and controls components shall be through hinged access doors.
 - .5 Access doors shall be flush mounted to cabinetry. Coil access door and supply fan access door shall include quarter-turn lockable handles. Supply fan access door shall include removable pin hinges.
 - .6 Units with a cooling coil shall include sloped 304 stainless steel drain pan. Drain pan connection shall be on the right hand side of unit.
 - .7 Cooling coil shall be mechanically supported above the drain pan by multiple supports that allow drain pan cleaning and coil removal.
- .3 Electrical
- .1 Unit shall be provided with an external control panel with separate low voltage control wiring with conduit and high voltage power wiring with

- conduit between the control panel and the unit. Control panel shall be field mounted.
- .2 Unit shall include a factory installed 24V control circuit transformer.
 - .3 Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.
 - .4 Unit shall be provided with a single point connection.**
- .4 Supply Fans
 - .1 Unit shall include direct drive, unhooded, airfoil fans.
 - .2 Blower and motor assembly shall be dynamically balanced.
 - .3 Blower and motor assembly shall be mounted on vibration isolators.
 - .5 Cooling Coil
 - .1 Chilled Water Cooling Coil
 - .1 Coil shall be certified in accordance with AHRI Standard 410 and be hydrogen or helium leak tested.
 - .2 Coil shall be constructed of copper tubes with aluminum fins mechanically bonded to the tubes.
 - .3 Coil shall have half serpentine circuitry, **68** rows and 10 fins per inch.
 - .4 Coil shall have right hand external piping connections. Coil connections shall be labeled, extend beyond the unit casing, and be factory sealed on both the interior and exterior of the unit casing, to minimize air leakage.
 - .6 Heating Coil
 - .1 Hot Water Heating Coil
 - .1 Coil shall be certified in accordance with AHRI Standard 410 and be hydrogen or helium leak tested.
 - .2 Coil shall be constructed of copper tubes with aluminum fins mechanically bonded to the tubes.
 - .3 Coil shall be 1 row and 12 fins per inch.
 - .4 Coil connections shall be labeled, extend beyond the unit casing and be factory sealed on both the interior and exterior of the unit casing, to minimize air leakage.
 - .5 Control valves shall be field supplied and field installed.
 - .7 Filters
 - .1 Unit shall include 2 inch thick, pleated panel filters with an ASHRAE efficiency of 30% and MERV rating of 8, in a prefilter box upstream of the cooling coil.
 - .2 A MERV 13 cartridge type final filter shall be provided.
 - .3 Unit shall include a clogged filter switch.
 - .4 Filter section to be complete with magnahelic gauge.

- .8 Mixing Box
 - .1 Unit shall contain a mixing box with top return air opening and front outside air opening.
 - .2 Return air opening shall contain an adjustable, motor operated outside air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven. Dampers shall be fixed position controlled by a fully modulating actuator.
 - .3 Outside air opening shall contain an adjustable, motor operated outside air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven. Dampers shall be fixed position controlled by a fully modulating actuator.
- .9 Controls
 - .1 Unit shall be provided with terminal wiring strip for external wiring of controls for damper actuators, fan start/stop, clogged filter switch, proof of air flow.
- .10 Energy Recovery Wheel
 - .1 VFD controlled energy recovery wheel for sensible and latent heat recovery.
 - .2 Media: Synthetic fibre, 4 angstrom
 - .3 Complete with access door, prewired VFD, bypass dampers
- .11 Humidifier Section
 - .1 Dispersion tube system shall be welded seam stainless steel tube and header system spanning the full width of the duct, insulated with plenum-rated insulation and provide absorption to preclude water accumulation within 500mm of dispersion tube.
 - .2 Two rows of steam discharge tubelets discharging steam in diametrically opposite directions perpendicular to airflow.
 - .3 Header pitched toward drain to prevent condensate accumulation in header.
- .12 VFD
 - .1 Factory-installed variable frequency drive for exhaust fan, supply fan and energy wheel speed control.
 - .2 Complete with keypad, bypass, line reactors and non-fused disconnect in NEMA-1 enclosure.

2.4 22-AHU-4 DESICCANT OUTDOOR AIR UNIT

- .1 AIR HANDLING UNIT CASING:
 - .1 Components forming an Air Handling Unit shall be completely factory assembled and shipped as one (1) piece.
 - .2 Casing shall be double wall construction supported by an internal channel "C" framing. This includes the side panels, the roof and the floor.

- .3 Base shall be installed on the full perimeter of the unit. The base, the intermediate ribs and the structural supports shall form a channel made of heavy gauge steel. Structural girders and lifting lugs supporting the unit from below shall be dimensioned according to proven structural design methods.
 - .4 Floor, 4 in. (100mm) thick, shall have adequate structural supports to allow for access to maintenance personnel. The floor shall be made of a minimum of 12 gauge galvanized steel. All joints shall be continuously welded and protected with Galvicon. The floor shall act as an airtight drain pan. Fiberglass insulation, 2 in. (50 mm) thick, shall be installed underneath the floor and protected with a 22 gauge galvanized steel sheet. Walls and ceiling shall be double wall and shall be constructed with acoustical panels including 2" (50 mm) thick fiberglass insulation. All interior wall panels shall be screwed together. Exterior wall panels shall be sealed with a strip of polyurethane base caulking to allow for visual detection of impermeability. All units shall withstand pressure differences of up to 10" H₂O (3750 Pa). Maximum air leakage rate guaranteed by the manufacturer shall be 1%, in specified operating conditions.
 - .5 Exterior wall panels shall be made of 16 gauge galvanized steel. Insulating medium, consisting of long fibers bound together with a thermosetting resin, shall have a density 3 lbs./ft³, and shall be compressed at least 10% during assembly.
- .2 FAN SECTION:
- .1 The fans and motors shall be installed on an integral or inertia base supported by anti-vibration springs ensuring a 1" (25mm) deflection. All fans shall be statically and dynamically balanced and shall be of a construction type complying to the requirements of AMCA (Air Moving and Conditioning Association) 99 Standard.
 - .2 Variable volume control with inverter – duty motor and variable speed drive.
 - .3 Fan bearings shall be designed for an average life of at least 200 000 hours, according to AFBMA (Anti-friction Bearing Manufacturers Association) L-50 Standard.
 - .4 Fan discharge shall be connected to the fan cabinet using a flexible connection to ensure a vibration-free operation.
- .3 BELT DRIVE:
- .1 Motors shall be mounted on a sliding base for adequate alignment and adjustment for belt tension. Both fan belt and belt drives shall be protected by a metal belt guard permitting a reading of the revolutions on the shaft of the fan. Electrical motors shall be the high efficiency type, according to the requirements of the specifications.
- .4 COILS
- .1 Surface area of heat transfer coils shall consist of aluminum corrugated fins. Fins shall cover the entire surface of each tube in order to optimize heat transfer.
 - .2 Coil casings to be constructed of 16 gauge galvanized steel, with both ends containing a 1-1/2" flange.

- .3 All unit coils shall be removable from the unit by the removal of a single screwed-on wall panel without disturbing the roof or adjoining panels of the unit. Panel construction shall be double wall with 2" (50 mm) thick insulation. An industrial quality neoprene gasket is provided on the full perimeter of the panel to obtain maximum airtightness and durability. Coils shall be placed on a slide base in order to remove the coils easily from the unit. Once the coil is in place, its distributor shall fit entirely inside the casing with only the connections extending to the exterior.
- .4 Where coils are to be stacked, or under every cooling coil, intermediate drain pans, (double sloped), made of stainless steel and a drain of 1.5" dia. (40 mm) shall be provided.
- .5 Coil impermeability shall be controlled by means of water immersion testing under 350 psi air pressure. Coils shall be designed to operate continuously at 250 psi. Supply and return connections to be NTP type steel.
- .6 All coils shall have performance certified in accordance with ARI Standard 410.
- .7 Pipefitting connections to the coils shall agree with industry standards. Pipes shall be supported separately from the coils and have sufficient flexibility to allow for thermal expansion. No load should be applied to the coil connections.
- .5 FILTER SECTION:
 - .1 Flat or angled filters shall slide on rails. They shall be accessed through lateral panels mounted on hinges and fitted with latches.
 - .2 Access to high efficiency filters (cartridge or bag) shall be front or side loaded, through the adjoining section. Front loading filters shall be installed on restraint frames, permanently mounted on the inside of the section.
 - .3 Filter frames shall be provided with neoprene gaskets on the discharge side of the filter for increased airtightness.
- .6 DAMPERS:
 - .1 All dampers are made of aluminum and high efficiency type. Dampers are insulated or uninsulated, opposite or parallel blades, all complying to the requirements of AMCA.
- .7 ACCESS DOOR:
 - .1 Double wall access doors shall be provided to allow access and maintenance of air handling parts and components including fans, filters, air mixers, coils or other as indicated on drawings. Doors shall be of the same thickness and construction as the wall panels, i.e. made of 16 gauge galvanized steel on both sides including 2" (50 mm) thick insulation. Frame shall be made of 12 gauge galvanized steel. Door frame perimeter shall include 3" (75 mm) spokes in corners, as well as a neoprene sponge gasket (industrial quality), for maximum airtightness and durability.
 - .2 Each door shall be fitted with a heavy duty hinge made of stainless steel and two inside/outside operational handles. Doors shall be completely removable by removing the spindles from the hinges when desired. Doors shall always open against air pressure side.

- .8 ACCESSORIES:
 - .1 Accessories such as low leak/ultra-low leak dampers, installation of controls, air blenders, economizers, diffusers, heat exchangers, silencers, and other special equipment, to be factory installed.
- .9 All electrical installations inside the unit shall be CSA and UL certified.
- .10 DEHUMIDIFIER – Desiccant wheel section
 - .1 Dehumidifier unit casing (for units with desiccant wheels below 61" diameter)
The unit casing shall be fabricated of strain-hardened aluminum with a minimum thickness of 0.125" for torsional rigidity and corrosion resistance. The casing shall be formed, welded and sealed as a single unified structure. Steel construction is not acceptable. Aluminum structures depending on screws for casing construction are not acceptable. In addition, the unit casing shall include:
 - .2 Insulation
 - .1 To avoid either condensation, heat loss or loss of cooling capacity, the unit casing shall be insulated such that the heat transfer rate through casing walls is less than 0.27 Btu/sq. ft./°F if the wall separates air streams which differ in temperature by more than 25°F.
 - .3 Wiring
 - .1 All wiring between dehumidifier components shall comply with the current National Electrical Code (NEC). Wiring unprotected by flexible conduit shall not be acceptable.
 - .4 Process and reactivation air flow gauges
 - .1 To set and verify the specified air flow rates through the unit, the casing shall be equipped with differential pressure gauges which measure and display the pressure drop across the desiccant wheel. The dial of the gauges shall include a warning zone to indicate when the air flow is above the recommended operating range of the equipment.
 - .5 Coating
 - .1 The exterior of the unit casing and all surfaces of access panels shall be degreased and cleaned, then primed with one coat of industrial wash primer and finished with one coat of catalyzed polyurethane enamel. All pieces shall be painted individually prior to assembly to assure complete protection.
 - .6 Weather tight construction
 - .1 The dehumidifier shall be capable of continuous outdoor operation when the air inlets are protected from flowing water by optional weather hoods or connected duct work. Consequently, all access panels shall be weather tight, as shall all joints between casing and electrical conduits and between the unit casing and any components mounted in separate enclosures.
 - .1 Weather Air Inlets
 - .1 Because the unit will pull in air directly from the weather, the inlets shall be protected from precipitation by weather hoods, and air flow control dampers.

- .2 Weather hoods
 - .1 The weather hoods shall be welded aluminum and shall be finished to match the unit casing. The inlet air velocity shall not exceed 600 fpm.
- .3 Air flow dampers
 - .1 Inlets shall be equipped with manual flow control dampers with locking hardware. For air inlets smaller than 15" in height or width, single-blade dampers shall be acceptable. When any inlet dimension exceeds 15", the manufacturer shall provide opposed-blade dampers with stainless steel end seals, elastomeric edge seals and oil-impregnated blade shaft bushings.
- .7 Maintenance access and inspection panels
 - .1 The unit casing shall include access panels for inspection and for any maintenance required by the operating and maintenance manual. These panels shall be fastened by captive hardware permanently fixed to either the panel or the unit casing. The panels shall be airtight to the extent of not leaking more than 1% of the rated airflow when the interior of the casing is under 5" WC positive air pressure, nor more than 0.5% of the rated flow when the casing is under 5" WC of negative pressure. Panels without gaskets shall not be acceptable. Panels held in place by drill-screws shall not be acceptable. Equipment which requires disassembly of components rather than access through removable panels for any maintenance required by the operating and maintenance manual shall not be acceptable.
- .11 Electrical control cabinet
 - .1 The electrical control cabinet shall be weather tight to NEMA 4 standards and shall include:
 - .1 Wiring to comply with the current National Electrical Code with further fuse and wiring sizing to meet or exceed UL 508A *Industrial Control Panel*.
 - .2 Wires shall be color-coded or numbered at both ends and all terminal block connection points shall be numbered. These markings shall correspond with the electrical diagram provided in the operating and maintenance manual.
 - .3 Components shall be UL or CSA approved.
 - .4 Programmable logic controller
 - .1 The unit sequence of operations shall be controlled by a programmable logic controller which includes separate indication for:
 - .1 Power on
 - .2 Unit running
 - .3 Desiccant wheel rotation fault
 - .4 Reactivation air overheat after heaters
 - .5 Reactivation air leaving below set point

- .6 Motor overload
- .5 Operating and maintenance manual
 - .1 The control cabinet shall include a copy of the O & M manual, mounted in a separate compartment or pocket to allow access to critical information by maintenance personnel after installation.
- .6 Run-hour meter
 - .1 To allow for recording maintenance practices and to assist fault diagnosis, the cabinet shall have a run-hour meter mounted and visible from the exterior of the unit.
- .12 Reactivation circuit
 - .1 The reactivation circuit shall conform in all respects to the current National Electrical Code.
 - .2 Steam Gas Reactivation
- .13 Desiccant Wheel
 - .1 The desiccant wheel media shall be a monolithic, extended-surface contact medium, fabricated entirely of inert, inorganic binders and glass fibers formed into narrow passages in the direction of airflow. The wheel shall be bacteriostatic and non-toxic. It shall also meet the following requirements:
 - .1 Materials
 - .1 The glass fibers which form the support matrix shall be made from uniform continuous strands larger than five microns in diameter which are nonrespirable and are not considered a possible health risk by the International Agency for Research on Cancer (IARC).
 - .2 Flame spread and smoke generation
 - .1 The wheel shall be tested according to ASTM E84-90 (Standard Test Method for Surface Burning of Building Materials) and shall achieve the following results:
 - .1 Flame spread index = 0
 - .2 Smoke developed index = 10
 - .3 Desiccant impregnation
 - .1 The desiccant shall be evenly impregnated throughout the structure for predictable, consistent performance and for maximum wheel life. Coatings applied on top of the contact medium shall not be acceptable unless the manufacturer can provide independent life tests demonstrating less than a 5% decline in desiccant capacity over a five year period of normal operation.
 - .4 Desiccant type
 - .1 Titanium-reinforced silica gel
 - .2 The Honeycombe® desiccant wheel shall be a fabricated extended surface contact media with a multitude of small passages parallel to the airflow. The rotary structure shall be a monolithic composite consisting of inert silicates with

microscopic pores designed to remove water in a vapor phase. The desiccant shall be hydrothermally-stabilized silica gel reinforced with titanium for maximum strength and stability over time. The fabricated structure shall be smooth and continuous having a depth of 400 millimeters in the direction of airflow without interruptions or sandwich layers which restrict air flow or create a leakage path at joining surfaces. Nominal face velocity shall not exceed 600 fpm. The Honeycombe® wheel shall be manufactured in the United States. The manufacturer shall provide documentation to establish that:

- .1 The desiccant retains more than 90% of its original capacity after ten years of continuous operation in clean air, with inlet air conditions up to an including 100% relative humidity.
- .2 The wheel as impregnated with silica gel is capable of withstanding five complete water immersion cleaning cycles while retaining more than 95% of its original adsorption capacity.

.14 Desiccant Wheel Support and Drive Assembly

- .1 For wheels of 60" diameter and smaller, the wheel shall be a single piece for fast removal and simple handling. In the smaller case, the desiccant wheel shall be supported by four rollers at the base of the unit so the wheel can be easily removed for maintenance by lifting it over the rollers using the drive belt. Center-axle support or any arrangement which requires disassembly of the support structure for wheel removal shall not be acceptable. In addition, the wheel drive assembly shall provide:
 - .1 Rotation speed
 - .1 To avoid excessive heat carryover from reactivation to the process air, the wheel rotation speed shall not exceed 10 rph while achieving the required moisture removal rate at the specified conditions.
 - .2 Drive belt
 - .1 The drive belt shall be the flat, toothed type, with aramid fiber reinforcement.
 - .3 Drive motor
 - .1 The drive motor shall be fractional horsepower and rated for continuous duty for a period of 20,000 hours under the load conditions imposed by the drive assembly.
 - .4 Rotation detection
 - .1 The drive assembly shall be equipped with a rotation detection circuit which shuts down the dehumidifier and signals the operator through an indicating light on the control cabinet if the wheel is not rotating.

.15 Air seals and internal air leakage

.1 The process and reactivation air streams shall be separated by air seals and internal partitions so that the humid reactivation air does not mix with the dry process air. The proposed equipment shall meet the following minimum requirements:

.1 Wheel face seals

.1 For units with desiccant wheels under 61" in diameter, the dehumidifier shall have full-face seals on both the process air entering and the process air leaving sides of the wheel. These shall seal the entire perimeter of both air streams as they enter and leave the wheel. Partial seals shall not be acceptable. The seals shall be the silicone rubber bulb-type, with a protective strip of low-friction, abrasive-resistant tape to extend seal life and reduce the force needed to turn the desiccant wheel. Neither wiper-type seals nor brush-type nor any non-contact-type seal shall be acceptable. The seals shall be documented to have a minimum working life of 25,000 hours of normal operation.

.2 Total casing air leakage

.1 The unit shall not allow leakage to exceed the greater of the following values:

.1 One percent of the process air flow

.2 SMACNA (Sheet Metal & Air Conditioning Contractors National Association) Leakage class 6, which is defined by:

$$F = C \times P^{0.65}$$

$$L = F \times A$$

Where:

F = Leakage flow (cfm/sq.ft. housing area)

C = Leakage class (equal to 6)

P = Design static pressure (in. WC)

L = Total leakage (cfm)

A = Housing area (sq.ft.)

.3 Determine leakage using the testing methods described by SMACNA Publication 15d, *HVAC Air Duct Leakage Test Manual (Air Distribution Equipment and Ducts)*.

.4 Terms are defined as follow:

.1 Design static pressure: Maximum positive or negative pressure referenced to the unit exterior (inches W.C.).

.2 Design airflow: Maximum unit air flow at the discharge connection (ft³/min).

.3 Housing area: Total area of the unit air containment, including fan wall area (ft²).

- .16 Reactivation air fans
 - .1 Reactivation air fans shall be the single-inlet, single-width, centrifugal-type.
 - .1 Fan wheel type
 - .1 Fans driven by motors of 2 hp and below shall be the direct-drive, forward-curve centrifugal type. Fans driven by motors of 3 hp through 7.5 hp shall be backward-inclined, direct-drive centrifugal type. Fans driven by motors of 7.5 hp and larger shall be the backward-inclined, belt-driven centrifugal type.
 - .2 Balancing
 - .1 Fans shall be balanced after assembly and after coating at the speed the unit is scheduled to operate. Fans shall be balanced such that the maximum displacement in any plane is less than 1.0 mils, peak to peak.
 - .3 Fan motors
 - .1 Fan motors shall be the totally-enclosed, fan-cooled, high-efficiency type and shall be selected for a service factor of 1.15.
- .17 Moisture removal capacity control
 - .1 The dehumidifier shall operate automatically, in response to the control system supplied by the manufacturer as follows:
 - .1 Process air face & bypass modulation
 - .1 The volume of process air passing through the dehumidifier shall be modulated by means of electric or pneumatic motor-driven dampers which cover the process air inlet and the bypass air inlet to the dehumidifier casing. The bypass air duct shall be included inside the dehumidifier casing such that no additional external ductwork need be added to the unit to achieve control. The bypass duct shall be equipped with an orifice plate to balance the pressure drop of the bypass to equal that of the desiccant wheel at full flow.
 - .1 Dampers
 - .1 Dampers shall be opposed-blade type, with galvanized steel frames, stainless steel end-seals, elastomeric blade edge seals and oil-impregnated blade shaft bushings.
 - .2 Damper frames and casing
 - .1 The damper frames shall be fastened and sealed to eliminate air bypass around the damper assembly. The operator(s) and connecting linkages shall be mounted in a separate compartments sealed from the supply air stream and from the ambient environment. The compartment shall be equipped with an access panel for ease of adjustment and servicing without the need to disturb the supply air flow.

- .3 Damper actuators
 - .1 Damper actuators shall be the proportional type with spring return on power loss. They shall operate in response to a continuous signal input signal. Pneumatic actuators shall be equipped with positive positioning relays.
- .4 Responsibility for the control system shall be divided as follows:
 - .1 Dehumidifier manufacturer
 - .1 Provide the dehumidifier complete with dampers and motors mounted, wired and tested in the factory prior to shipment. The manufacturer shall provide the sensor/controller suitable for operation and control at the specified location and humidity control range.
 - .2 Installing contractor
 - .1 Install the humidity sensor in the location specified, and wire the sensor and controller to the dehumidifier. Reset the fixed-position bypass flow control damper such that pressure drop through the bypass equals the pressure drop through the desiccant wheel at the specified process air flow rate.

2.5 22-AHU-5, 6, 7 LAB UNITS

- .1 General
 - .1 Equipment to include:
 - .1 ~~ECM driven~~ Direct drive backward curved plenum supply fans
 - .2 Double wall cabinet construction
 - .3 Insulation with a minimum R-value of 6.25
 - .4 Double sloped stainless steel drain pans
 - .5 Hinged access doors with lockable handles
- .2 Air Handling Units
 - .1 General Description
 - .1 Indoor air handling units shall include filters, supply fans, chilled water coil, mixing box, and unit controls.
 - .2 Unit shall have a draw-through supply fan configuration and discharge air horizontally.
 - .3 Unit shall be factory assembled and tested including leak testing of the chilled water coil, and run testing of the supply fans and factory wired electrical system. Run test report shall be supplied with the unit.

- .4 Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
- .5 Unit components shall be labeled, including pipe stub outs, electrical and controls components.
- .6 Installation, Operation and Maintenance manual shall be supplied within the unit.
- .7 Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.
- .8 Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.

.3 Construction

- .1 All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.
- .2 Unit insulation shall have a minimum thermal resistance R-value of 6.25. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D1929-11 for a minimum flash ignition temperature of 610°F.
- .3 Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, prevents heat transfer through the panel, and prevents exterior condensation on the panel.
- .4 Unit shall be designed to reduce air leakage and infiltration through the cabinet. Sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.
- .5 Access to filters, cooling coil, supply fans, and electrical and controls components shall be through hinged access doors.
- .6 Access doors shall be flush mounted to cabinetry. Coil access door and supply fan access door shall include quarter-turn lockable handles. Supply fan access door shall include removable pin hinges.
- .7 Units with a cooling coil shall include sloped 304 stainless steel drain pan. Drain pan connection shall be on the right hand side of unit.
- .8 Cooling coil shall be mechanically supported above the drain pan by multiple supports that allow drain pan cleaning and coil removal.

.4 Electrical

- .1 Unit shall be provided with an external control panel with separate low voltage control wiring with conduit and high voltage power wiring with conduit between the control panel and the unit. Control panel shall be field mounted.
- .2 Unit shall be provided with standard power block for connecting power to the unit.
- .3 Unit shall include a factory installed 24V control circuit transformer.

- .4 Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.
 - .5 Unit shall be provided with a single point connection.**
- .5 Supply Fans
 - .1 Unit shall include direct drive, unhooded, backward curved, plenum supply fans.
 - .2 Blower and motor assembly shall be dynamically balanced.
 - .3 Blower and motor assembly shall be isolated with neoprene gasket.
 - ~~.4 Motor shall be a high efficiency electronically commutated motor (ECM).~~
 - .4 Variable volume control with inverter-duty motor and variable speed drive.**
- .6 Cooling Coil
 - .1 Chilled Water Cooling Coil shall be certified in accordance with AHRI Standard 410 and be hydrogen or helium leak tested.
 - .2 Coil shall be constructed of copper tubes with aluminum fins mechanically bonded to the tubes and aluminum end casings. Fin design shall be sine wave rippled.
 - .3 Coil shall have right hand external piping connections. Supply and return connections shall be sweat connection. Coil connections shall be labeled, extend beyond the unit casing, and be factory sealed on both the interior and exterior of the unit casing, to minimize air leakage.
 - .4 22-AHU-05 and 22-AHU-07 coil shall have 12 rows and 12 fins per inch circuitry.**
 - .5 22-AHU-06 coil shall have 10 rows and 8 fin per inch circuitry.**
- .7 Filters
 - .1 Unit shall include 2 inch thick, pleated panel filters with an ASHRAE efficiency of 30% and MERV rating of 8, upstream of the cooling coil.
 - .2 Unit shall include a clogged filter switch.
- .8 Mixing Box
 - .1 Unit shall contain a mixing box with top return air opening and front outside air opening.
 - .2 Return air opening shall contain an adjustable, motor operated outside air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven. Dampers shall be fixed position controlled by a fully modulating actuator.
 - .3 Outside air opening shall contain an adjustable, motor operated outside air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven. Dampers shall be fixed position controlled by a fully modulating actuator.
- .9 Controls
 - .1 Unit shall be provided with terminal wiring strip for external wiring of controls for damper actuators, fan start/stop, clogged filter switch, proof of air flow.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for air handling equipment installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of NRC Representative.
 - .2 Inform NRC Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Installation, Operation and Maintenance manual shall be supplied with the unit.
- .2 Installing contractor shall install unit, including field installed components, in accordance with Installation, Operation and Maintenance manual instructions.
- .3 Start up and maintenance requirements shall be complied with to ensure safe and correct operation of the unit.

3.3 DRIP PAN

- .1 Install deep seal P trap and trap seal primer on drain lines.
 - .1 Depth of water seal to be 1.5 minimum times static pressure at this point.

3.4 ADDITIONAL WORK FOR AHU-4

- .1 Start-up BY MANUFACTURER
 - .1 The service technician shall start up and adjust the unit in accordance with instructions contained in the operating and maintenance manual provided by the manufacturer. The start up technician must pay particular attention to the following items:
 - .1 Air flow
 - .1 The air flow volume of the process and reactivation air streams shall be set so that the reading on the manometers on the unit matches the values outlined on the technical data sheet provided by the manufacturer.
 - .2 Utilities
 - .1 The power and reactivation energy connections shall be made carefully and checked against the unit specifications outlined on the technical data sheet provided by the manufacturer.
 - .3 Documentation
 - .1 The start-up technician shall provide written documentation of compliance with procedures outlined by the manufacturer in the operating and maintenance manual. As a minimum, the technician shall measure and record the values for the electrical power, the air flow manometers and the run-hour meter. The technicians full name and telephone number and the start-up date

shall be printed legibly on the start up documentation and on the copy of the technical data sheet in the operating and maintenance manual which is mounted inside the unit control cabinet.

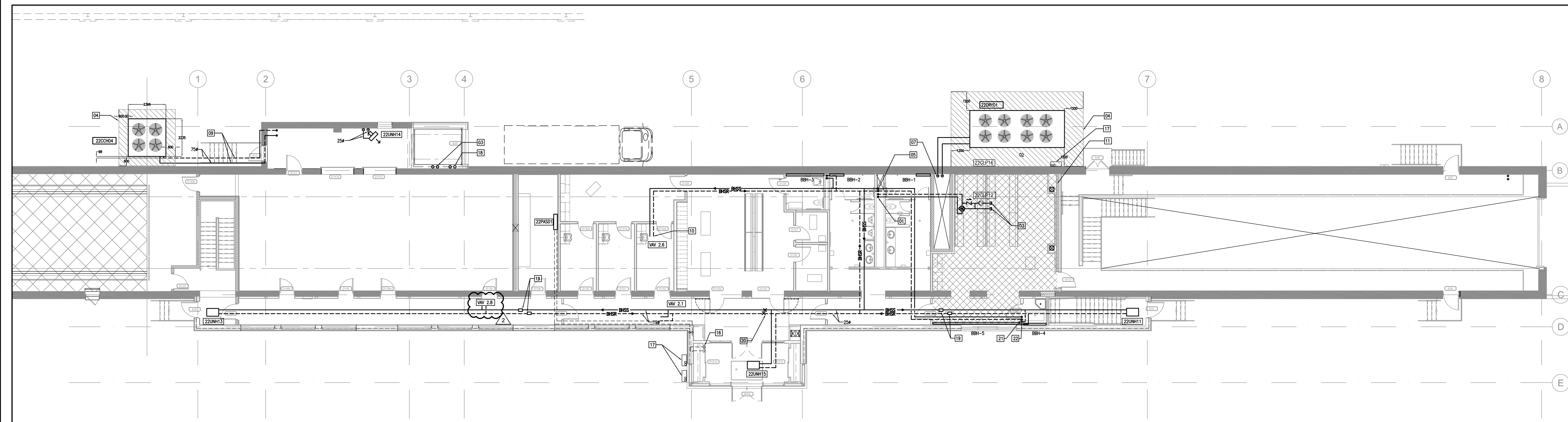
3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

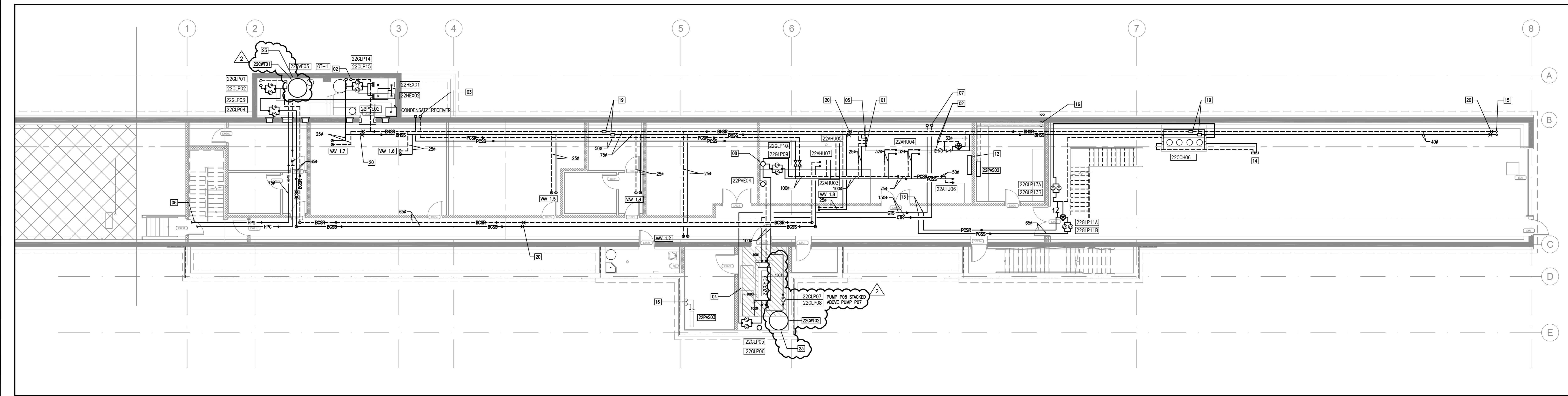
END OF SECTION

GENERAL NOTES

- CONTRACTORS TO CHECK AND VERIFY ALL DIMENSIONS ON SITE PRIOR TO DEMOLITION OR CONSTRUCTION AND REPORT ANY ERRORS OR OMISSIONS TO DEPARTMENTAL REPRESENTATIVE.
- CONTRACTORS MUST VISIT THE SITE & FULLY FAMILIARIZE THEMSELVES WITH THE SCOPE OF THE WORK.
- PREVENT THE SPREAD OF DUST & DEBRIS BEYOND THE WORK AREA AND CLEAN ALL SURFACES AT COMPLETION.
- MAKE GOOD ALL SURFACES AFFECTED BY THIS WORK.
- COORDINATE ALL SHUTDOWNS WITH THE DEPARTMENTAL REPRESENTATIVE.
- PROVIDE ALL LABOUR AND MATERIAL REQUIRED TO FORM A COMPLETE, FUNCTIONAL SYSTEM AS DESCRIBED ON DRAWINGS.



1 UPPER LEVEL PIPING
M04 SCALE = 1:100



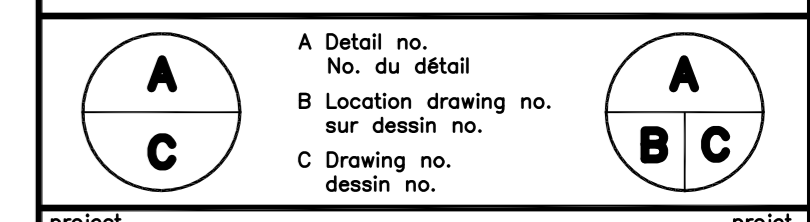
2 LOWER LEVEL PIPING
M04 SCALE = 1:100

- MECHANICAL GENERAL NOTES:**
- ALL FLOOR-MOUNTED EQUIPMENT TO BE ON 100MM HIGH HOUSEKEEPING PADS.
 - INSULATE ALL HOT AND COLD WATER AND GLYCOL PIPING.
- MECHANICAL PLAN NOTES:**
- CHILLED GLYCOL SUPPLY AND RETURN UP IN WASHROOM PLUMBING CHASE TO SERVE UPPER FLOOR.
 - BHS/R UP TO INFLOOR RADIAN HEATING MANIFOLD.
 - CHILLED GLYCOL SERVICE TO AIRPORT TERMINAL ROOM & FLEXIBLE CABIN LABORATORY.
 - EQUIPMENT SERVICE CLEARANCE.
 - GLYCOL SUPPLY AND RETURN UP TO UPPER LEVEL.
 - STEAM PIPING CONTRAID ON DRAWING NOS.
 - 150W CONDENSER WATER PIPING UP TO 220RY01.
 - CHILLED GLYCOL SYSTEM LOW LOSS HEADER.
 - PIPING MOUNTED TO WALL 600MM ABOVE GRADE. PIPING TO BE STACKED AND ROUTED BETWEEN EXTERIOR STAIR AND WALL.
 - CONNECTION TO REHEAT COIL (TYPICAL).
 - AREA OF IN-FLOOR HEATING.
 - IN-FLOOR RADIAN HEATING MANIFOLD CABINET AT FLOOR LEVEL C/W PUMP PACKAGE
 - CLOSELY-SPACED TEES MAXIMUM 300MM APART.
 - PROVIDE 65# CAPPED TEES FOR FUTURE CHILLER CONNECTION.
 - BUILDING HEATING SUPPLY UP TO DUCT HEATING COIL ABOVE DAWALK.
 - RETROFITTING PIPE UP.
 - CONDENSING UNIT ON WALL.
 - PROVIDE TWO 7MM SLEEVES THROUGH SLAB FOR FUTURE PIPING.
 - PROVIDE EXPANSION JOINT AND PIPE GUIDES IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS. ANCHORS TO BE EQUIVALENT TO METAFLEX SMALL DIAMETER COMPENSATORS WITH 50MM COMPRESSION. FLANGED CONNECTIONS FOR 50MM PIPE SIZE AND OVER. THREADED CONNECTIONS FOR 20MM AND UNDER.
 - PROVIDE PIPE ANCHORS.
 - 19MM SERVICE TO B8H-5
 - 19MM SERVICE TO B8H-4
 - SITE VERIFY DIMENSIONS OF ENTRY AND ALLOW FOR ALL REQUIRED MEANS FOR DELIVERY OF TANK TO MECHANICAL ROOM.

KEY PLAN

No.	Date	Revision	By	For
2	20 07 2015	ISSUED FOR ADDENDUM 04		
1	10 07 2015	ISSUED FOR ADDENDUM 03		
0	29 05 2015	ISSUED FOR TENDER		

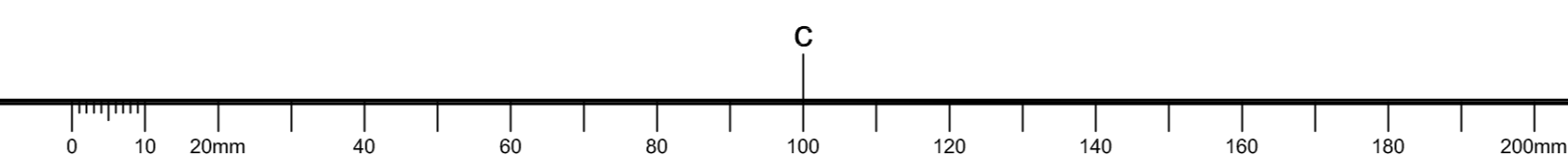
Date Printed 18 May 2011 Date Imprimée
 ● Verify all dimensions and site conditions and be responsible for same
 ● Vérifier toutes les dimensions et l'état des lieux et en assumer la responsabilité



Project: **NRC CABIN COMFORT + ENVIRONMENTAL RESEARCH FACILITY**
 MONTREAL ROAD CAMPUS
 PIPING LAYOUT

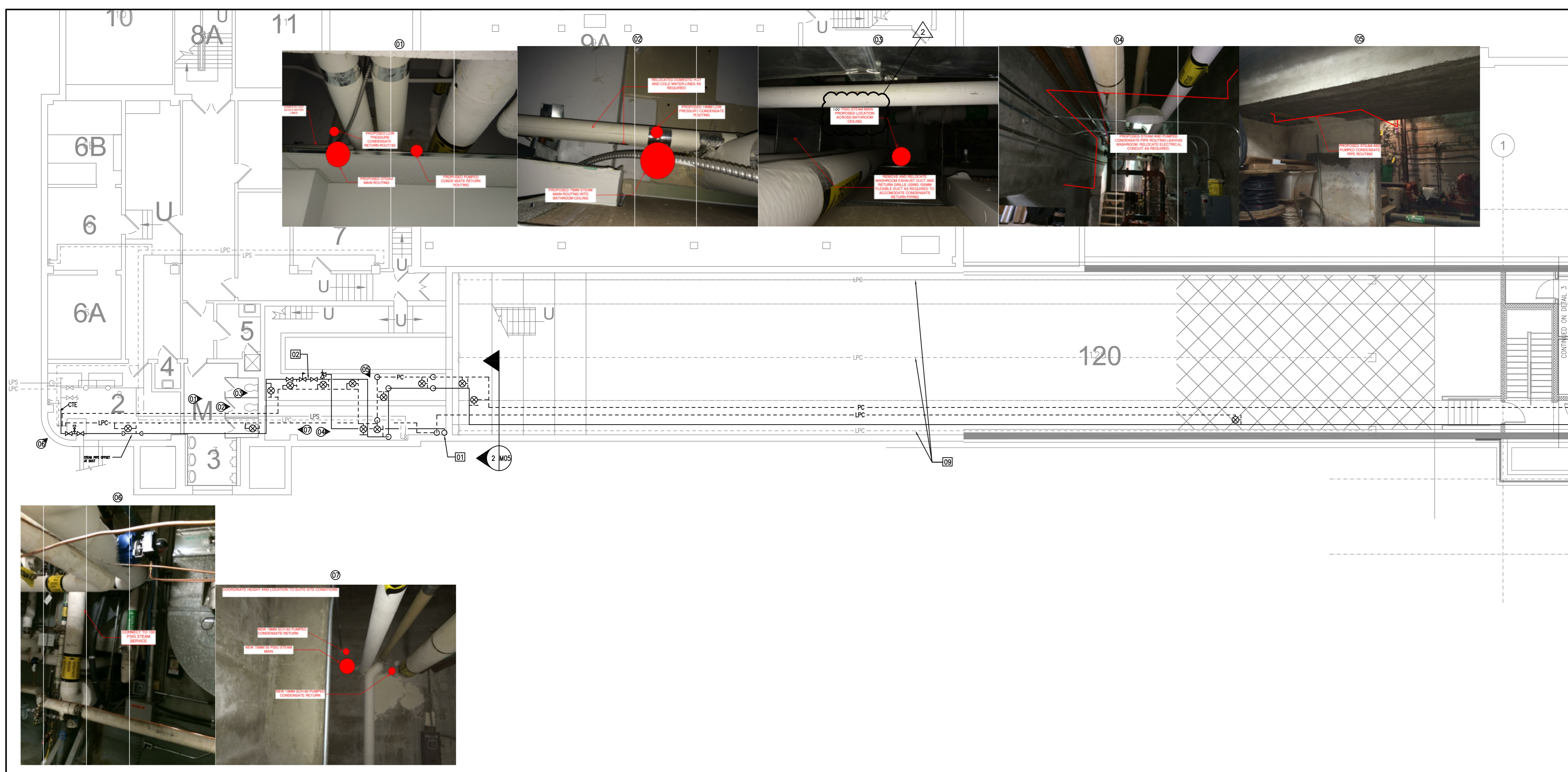
Designed	Conc'd	Scale	Date
KC		AS SHOWN	MAY '14
Drawn	Checked	Approved	Date
ALM	KC		
Checked	Approved	Date	Scale
KC			AS SHOWN
Approved	Date	Scale	Date

dwg.no. 3788-M04

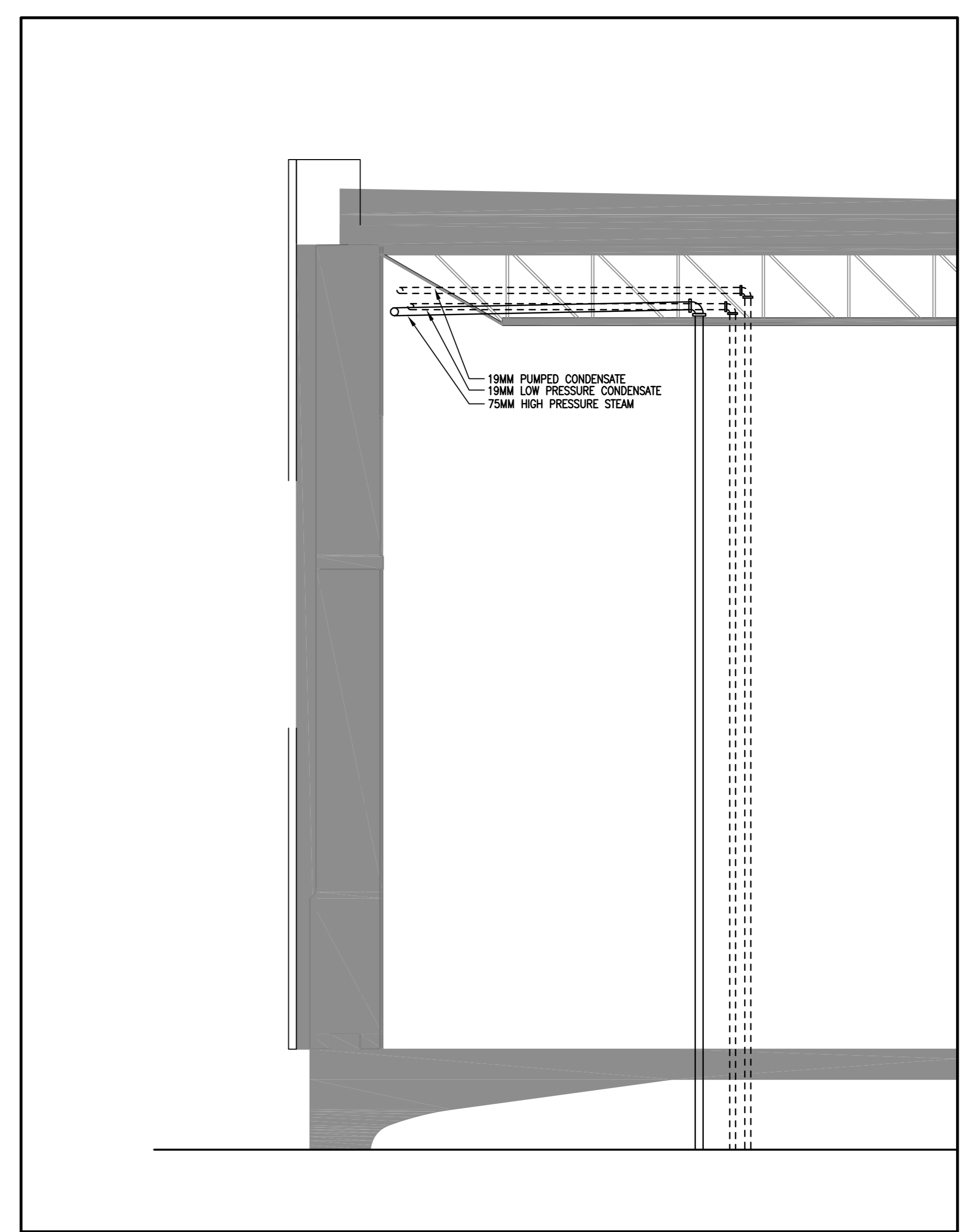


GENERAL NOTES

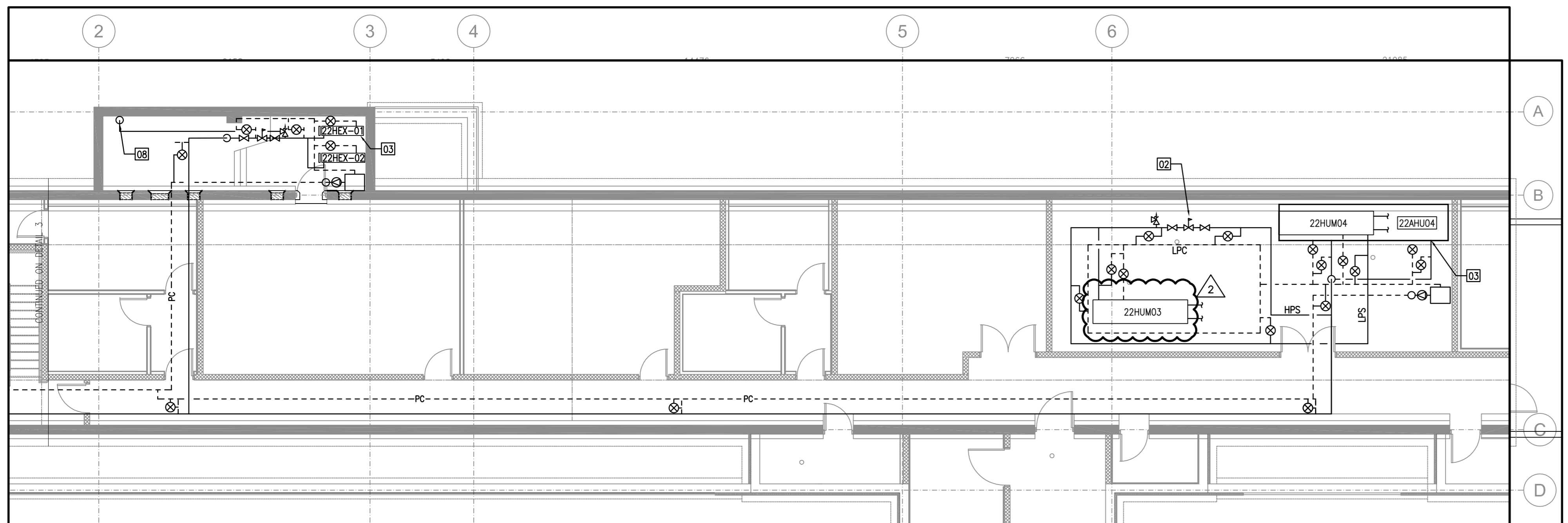
- CONTRACTORS TO CHECK AND VERIFY ALL DIMENSIONS ON SITE PRIOR TO DEMOLITION OR CONSTRUCTION AND REPORT ANY ERRORS OR OMISSIONS TO DEPARTMENTAL REPRESENTATIVE.
- CONTRACTORS MUST VISIT THE SITE & FULLY FAMILIARIZE THEMSELVES WITH THE SCOPE OF THE WORK.
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1 BASEMENT AND FIRST FLOOR STEAM PIPING
 SCALE = 1:100

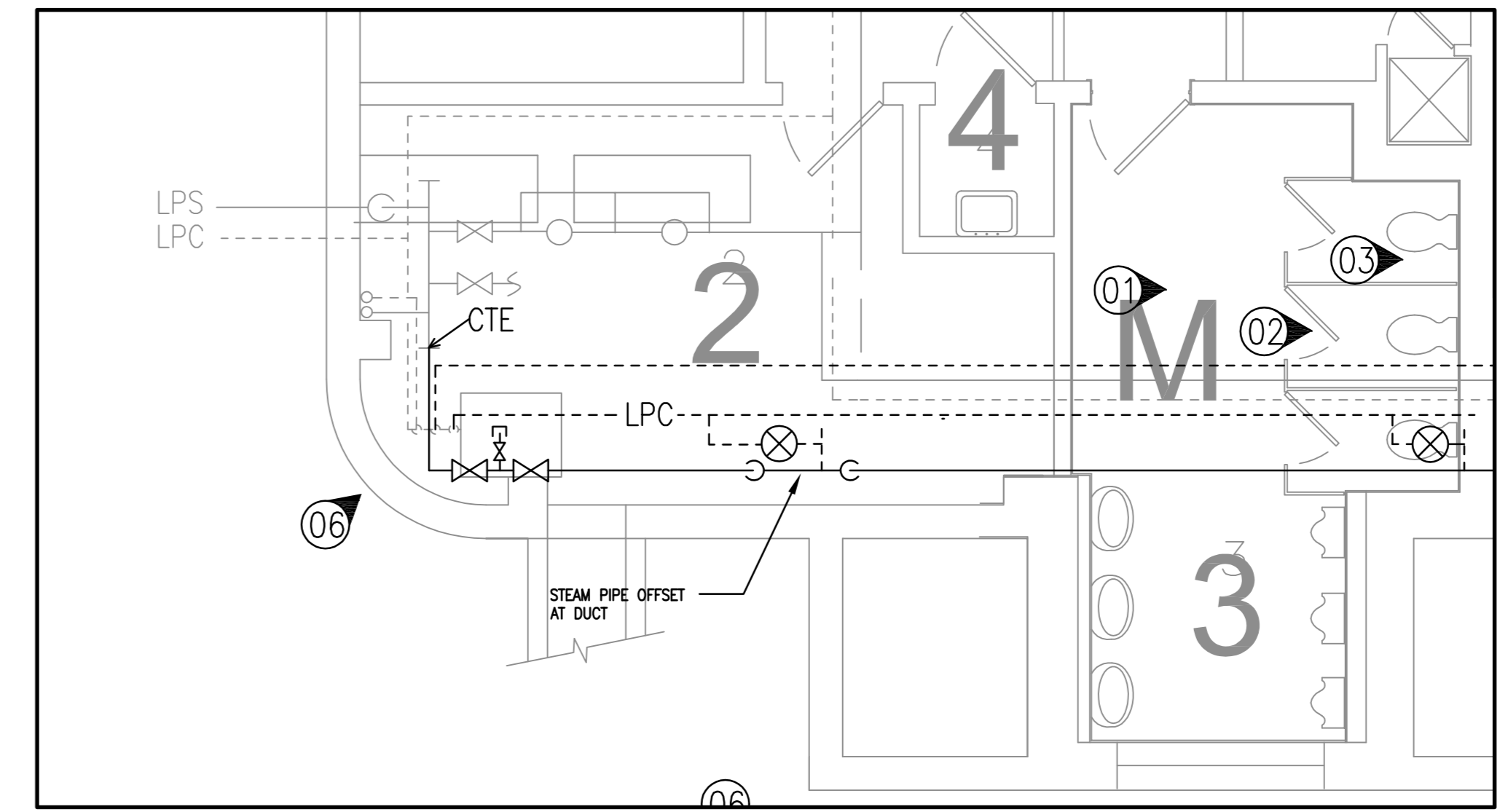


2 STEAM & CONDENSATE RISER DETAIL
 SCALE = 1:100

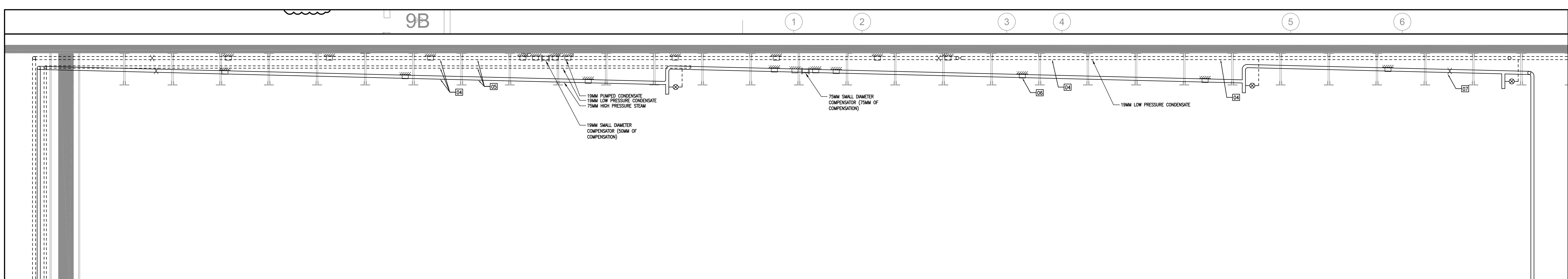


3 BASEMENT AND FIRST FLOOR STEAM PIPING
 SCALE = 1:100

- MECHANICAL GENERAL NOTES:**
- PROVIDE STEAM TRAPS, AS INDICATED IN DETAIL 5 OF DRAWING M10, BEFORE ANY CHANGE IN ELEVATION AND SEND.
 - PROVIDE STEAM TRAPS AFTER ANY PIECE OF EQUIPMENT AS PER DETAIL 01 OF DRAWING M05.
 - REFER TO DETAIL 07 OF DRAWING M10 FOR STEAM AND CONDENSATE PIPING SCHEMATIC.
 - INSTALLATION OF EXPANSION JOINTS, PIPE ANCHORS AND PIPE GUIDES TO BE IN ACCORDANCE WITH EXPANSION JOINT MANUFACTURERS ASSOCIATIONS STANDARDS.
- MECHANICAL PLAN NOTES:**
- ROUTE PRESSURE RELIEF VALVE PIPING ALONG EXTERIOR TO CORNER OF BASEMENT AS INDICATED. BRING STRAIGHT UP THROUGH TO ROOF FROM CORNER. COORDINATE WITH ARCHITECTURAL AND STRUCTURAL FOR ROOF PENETRATION. ONCE COMPLETE REPAIR ROOF TO AS-BUILD CONDITION. REFER TO ARCHITECTURAL FOR PIPE SHELTERING IN OCCUPIED SPACE.
 - PRESSURE RELIEF VALVE STATION, REFER TO DETAILS 06 & 07 OF DRAWING M10 FOR PIPING SCHEMATIC. ENSURE THAT PIPING SYSTEM DOES NOT INTERFERE WITH REQUIRED, 1M, CLEARANCES OF NEARBY ELECTRICAL EQUIPMENT.
 - REFER TO DETAIL 08 OF DRAWING M10 FOR STEAM AND CONDENSATE PIPING SCHEMATIC FOR HEAT EXCHANGERS AND AIR HANDLING UNIT AND HANDERS.
 - DOWNWARD SLOPE IN DIRECTION OF FLOW TO THE EXTENT POSSIBLE (NOT > 50MM/3048MM RUN).
 - COORDINATE INSTALLATION OF HIGH PRESSURE STEAM, LOW PRESSURE CONDENSATE AND PUMPED CONDENSATE WITH SITE CONDITIONS PRIOR TO THE START OF ANY WORK.
 - TYPICAL PIPE GUIDES MUST BE FASTENED TO UNDERSIDE OF SLAB AND NOT THE JOISTS. PROVIDE EXTENSION FOR PIPE GUIDES TO ANCHOR TO SLAB IN AREAS WHERE IT IS REQUIRED. INSTALLATION OF GUIDES AND EXTENSION SHALL BE IN ACCORDANCE WITH EXPANSION JOINT MANUFACTURERS ASSOCIATION.
 - TYPICAL PIPE ANCHORS MUST BE FASTENED TO UNDERSIDE OF SLAB AND NOT THE JOISTS. PROVIDE EXTENSION FOR PIPE GUIDES TO ANCHOR TO SLAB IN AREAS WHERE IT IS REQUIRED. INSTALLATION OF GUIDES AND EXTENSION SHALL BE IN ACCORDANCE WITH EXPANSION JOINT MANUFACTURERS ASSOCIATION.
 - ROUTE PRESSURE RELIEF PIPING UP THROUGH LOADING DOCK AND OUT THROUGH ROOF. COORDINATE WITH ARCHITECTURAL AND STRUCTURAL FOR ROOF PENETRATION. ONCE COMPLETE REPAIR ROOF TO AS-BUILD CONDITION.
 - REINSULATE EXISTING PIPING.



5 ENLARGED MECHANICAL ROOM STEAM PLAN
 SCALE = 1:50



4 FIRST FLOOR STEAM PIPING ELEVATION DETAIL
 SCALE = 1:100

No.	Date	Revision	By
2	20 07 2015	ISSUED FOR ADDENDUM 04	
1	10 07 2015	ISSUED FOR ADDENDUM 03	
0	29 05 2015	ISSUED FOR TENDER	

Date Printed: 18 MAY 2011

- Verify all dimensions and site conditions and be responsible for same.
- Vérifier toutes les dimensions et l'état des lieux et en assumer la responsabilité.

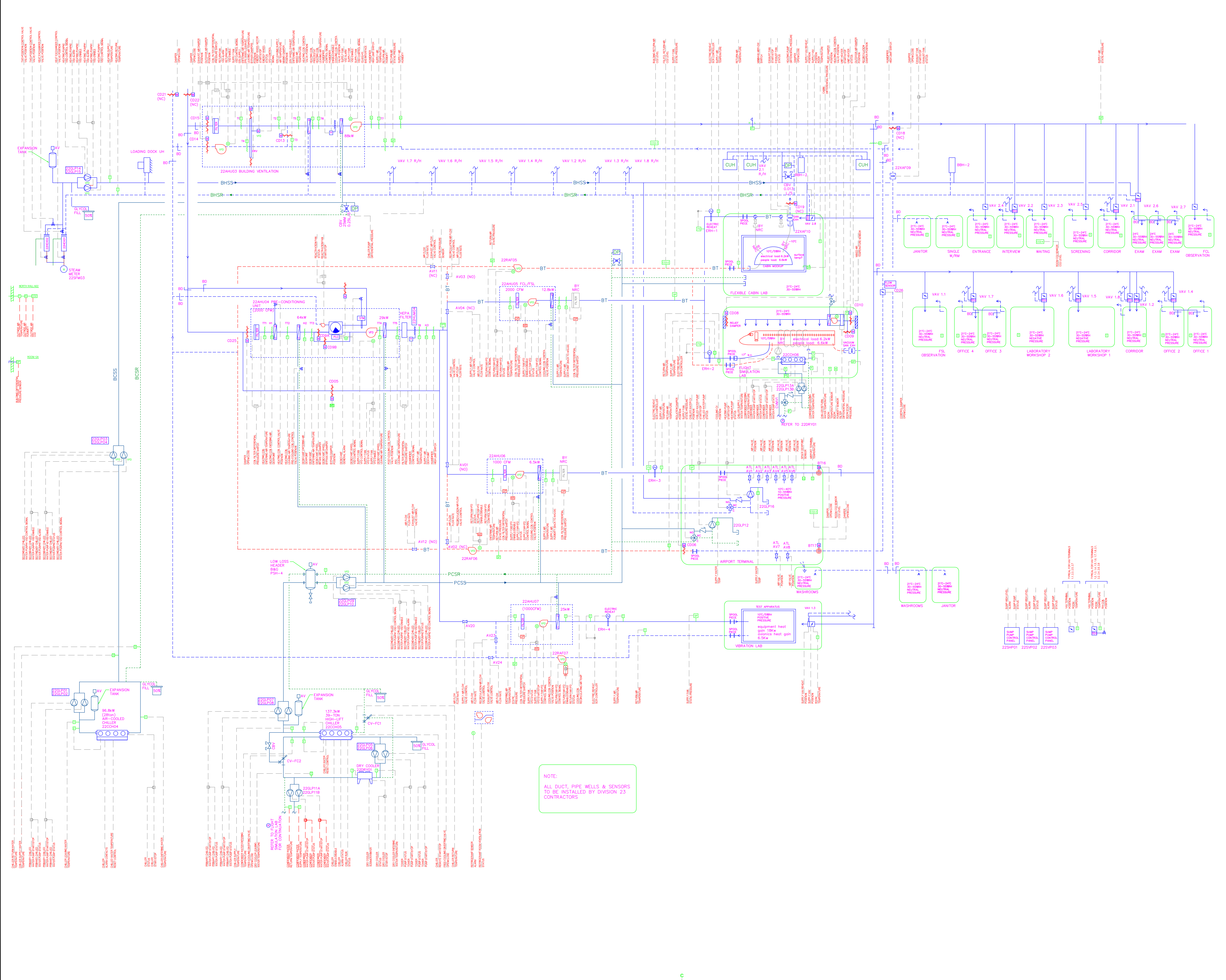
A	Detail no.	A
B	No. du détail	B
C	Location drawing no. sur dessin no.	C
	Drawing no. dessin no.	

project
ARC CABIN COMFORT + ENVIRONMENTAL RESEARCH FACILITY

drawing
BASEMENT AND FIRST FLOOR STEAM PIPING

designed	convy	date	date
M. FILIC		MAY '15	
drawn	designé	scale	échelle
M. FILIC		1:100	
checked	vérifié	sheet	feuille
KC			
approved	approuvé	W.D.no.	D.T.no.
desig.no.	desig.no.		
3788-M05			

- GENERAL NOTES**
- CONTRACTORS TO CHECK AND VERIFY ALL DIMENSIONS ON SITE PRIOR TO DEMOLITION OR CONSTRUCTION AND REPORT ANY ERRORS OR OMISSIONS TO DEPARTMENTAL REPRESENTATIVE.
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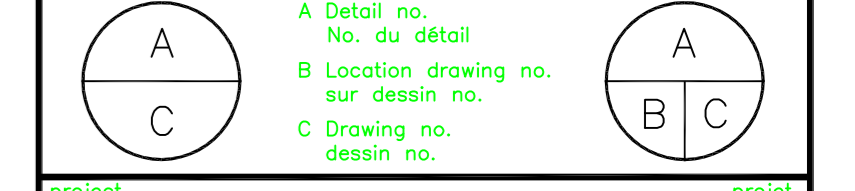
NOTE:
 ALL DUCT, PIPE WELLS & SENSORS TO BE INSTALLED BY DIVISION 23 CONTRACTORS

KEY PLAN



No.	Date	Revision	By
2	20 07 2015	ISSUED FOR ADDENDUM 04	
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0	29 05 2015	ISSUED FOR TENDER	

- Verify all dimensions and site conditions and be responsible for same
- Vérifier toutes les dimensions et l'état des lieux et en assumer la responsabilité



NRC CABIN COMFORT + ENVIRONMENTAL RESEARCH FACILITY

MONTREAL ROAD CAMPUS

MECHANICAL SCHEMATIC

Designed	Checked	Approved	W.D.No.	Date	Echelle	feuille	D.T.No.
KC	ALM	KC		MAY '15	AS SHOWN		

PUMP SCHEDULE table with columns: No, Service, Model, GPM, KPA, FT WC, BHP, MOTOR HP, Min. Eff, VFD, EMERG. POWER, V/FPHZ, Speed, Comments. Includes items like BLDG CHILLER PRIMARY LOOP PUMPS DUTY, BLDG CHILLED WATER SECONDARY DISTRIBUTION DUTY, etc.

AIR VALVES table with columns: TAG, TYPE, SERVICE, ROOM, MAKE, MODEL, SIZE (INLET), AIR FLOW, NOTES. Includes items like CO01 VENTURI AHUX SUPPLY, CO02 VENTURI AHUX RETURN, etc.

NORR logo and GENERAL NOTES section. Notes include: CONTRACTORS TO CHECK AND VERIFY ALL DIMENSIONS ON SITE PRIOR TO DEMOLITION OR CONSTRUCTION AND REPORT ANY ERRORS OR OMISSIONS TO DEPARTMENTAL REPRESENTATIVE, PREVENT THE SPREAD OF DUST & DEBRIS BEYOND THE WORK AREA AND CLEAN ALL SURFACES AT COMPLETION, etc.

AIR HANDLING UNITS SCHEDULE table with columns: TAG, SYSTEM, LOCATION, MANUF., TYPE, SUPPLY, EXHAUST, FLOW, E.S.P., COIL DUTY, SENSIBLE LOAD, LATENT LOAD, COIL EWT, LEAVING AIR TEMP, FLOW, PRESSURE, COIL DUTY, SENSIBLE LOAD, LATENT LOAD, COIL EWT, LEAVING AIR TEMP, FLOW, HUMIDITY, REACTIVATION ENERGY, REACTIVATION AIRFLOW, ENTERING AIR TEMP, LEAVING AIR TEMP, COIL DUTY, SENSIBLE LOAD, LATENT LOAD, COIL EWT, LEAVING AIR TEMP, FLOW, AIRFLOW, RETURN AIR, RETURN AIR, SUMMER DA, WINTER DA, TOTAL EFFECTIVENESS.

VAV BOX / BOOSTER COILS table with columns: TAG, TYPE, SERVICE, MAKE, MODEL, STYLE, SIZE (INLET), AIR FLOW, RE-HEAT COIL, NOTES. Includes items like VAV 1.1 VAV FSL OBSERVATION, VAV 1.2 VAV CORRIDOR, etc.

SPLIT SYSTEM AC SCHEDULE table with columns: TAG, SERVICE, MAKE, EER, EVAPORATOR DIM. (W X L X H), CONDENSER DIM. (W X L X H), CAPACITY (KW), ELECTRICAL, MEDU M, WEIGHT, NOTES. Includes items like 22PAS01 OBSERVATION RM, 22PAS02 OBSERVATION RM, etc.

HEAT RECOVERY VENTILATOR SCHEDULE table with columns: TAG, SYSTEM, LOCATION, MANUF., TYPE, MOTOR, ELECT V/PC, TAG, FLOW, FAN PERFORMANCE, TAG, FLOW, E.S.P., WEIGHT, DIMENSIONS, REMARKS. Includes item 22RH001 REFRIGERANT RM VENTIL.

CHILLER SCHEDULE table with columns: TAG, MAKE, TYPE, LOCATION, MODEL, APPLICATION, CAPACITY, POWER INPUT, MCA, EMERGENCY, EWT, LWT, FLOW, PRESS DROP, EWT, LWT, FLOW, PRESS DROP, REFRIGERANT, I/P/L, HEIGHT, WIDTH, LENGTH, WEIGHT. Includes items 22COH04 DAKIN, 22COH05 AERMEC, etc.

HEATER SCHEDULE table with columns: TAG, SERVICE, MAKE, MODEL, STYLE, VOLTAGE, SIZE (W X H X D), AIR FLOW, FAN SPEED, MOTOR POWER, EAT, EWT, LWT, FLOW, WPD, CAPACITY. Includes items 22JNH11 WEST STAIRWELL, 22JNH15 EAST STAIRWELL, etc.

BASEBOARD HEATER SCHEDULE table with columns: TAG, LOCATION, MAKE, MODEL, STYLE, LENGTH (MM), ENCLOSURE, ACTIVE, C, EAT, AVGWT, FLOW, CAPACITY, NOTES. Includes items 22BH01 WOMEN'S WASHROOM, 22BH02 MEN'S WASHROOM, etc.

EXPANSION TANKS table with columns: TAG, SYSTEM, TANK VOLUME (GAL), ACCEPT VOLUME (GAL), DIMENSIONS, DIAMETER (IN), MAX DESIGN PRESSURE (PSI), INITIAL PRESSURE (PSI), MAX DESIGN PRESSURE (PSI), DESIGN BASIS. Includes items 22PVE03 BUILDING HEATING SYSTEM, 22PVE04 PROCESS COOLING SYSTEM, etc.

HEAT EXCHANGER SCHEDULE table with columns: TAG, SERVICE, MAKE, MODEL, STYLE, CAPACITY (KW), SHELL SIDE, TUBE SIDE, NOTES. Includes items 22HE01 BUILDING HOT WATER, 22HE02 LABS GLYCOL.

GRILLES AND DIFFUSER SCHEDULE table with columns: TAG, TYPE, MATERIAL, BALANCE DAMPER, FINISH, MAKE, MODEL, REMARKS. Includes items A SQUARE DIFFUSER, B GRILLE, C LINEAR DIFFUSER, D GRILLE.

TANK SCHEDULE table with columns: No, SERVICE, LOCATION, MAKE, MODEL, TYPE, ELEMENTS, VOLTAGE, HEIGHT (MM), DIAMETER (MM), FLUID, D, ORIENT, NOTES. Includes items 22COW01 CHILLED WATER SYSTEM BUFFER TANK, 22COW02 CHILLED WATER SYSTEM BUFFER TANK.

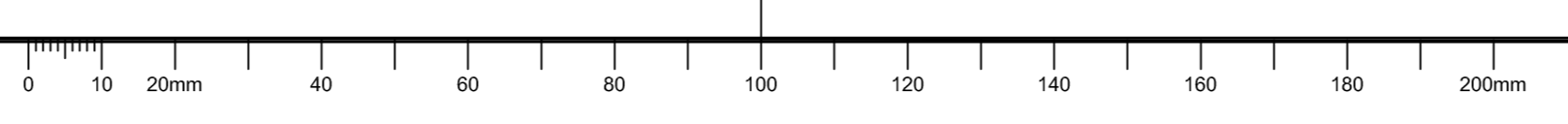
DRY COOLER SCHEDULE table with columns: REF. NO, MAKE, TYPE, MODEL, LOCATION, CAPACITY, FAN, MCA, POWER, EMERGENCY, EWT, LWT, FLOW, PRESS DROP, HEIGHT, WIDTH, LENGTH, WEIGHT, SOUND LEVEL. Includes item 22DRY01 REPLUIS FLUID COOLER.

FANS SCHEDULE table with columns: TAG, SYSTEM, LOCATION, MANUF., MODEL, TYPE, BHP, MOTOR HP, ELECTRICAL, FLOW, E.S.P., NOTES. Includes items 22FAF09 BUILDING SANITARY EXHAUST, 22FAF10 FLEX CABIN SAN EXHAUST, etc.

DUCT HEATING COIL SCHEDULE table with columns: TAG, SYSTEM, LOCATION, TYPE, COIL DUTY, AIRFLOW, SENSIBLE LOAD, Power, Leaving Air Temp, PRESS DROP, NOTES. Includes items ERH4 FLEX CABIN UPPER LEVEL HEATING, ERH3 FUSELAGE LOWER LEVEL HEATING, etc.

HUMIDIFIER SCHEDULE table with columns: TAG, SERVICE, ENTERING AIR, LEAVING AIR, HUMIDITY, PROCESS STEAM INLET PRESSURE, CLEAN STEAM OUTLET PRESSURE, MANUFACTURER, MODEL, NOTES. Includes item 22HU03 HUMIDIFIER.

NORR ARCHITECTS ENGINEERS PLANNERS logo and project information. Includes: KEY PLAN, 3 20 07 2015 ISSUED FOR ADDENDUM 04, 2 10 07 2015 ISSUED FOR ADDENDUM 03, 1 30 06 2015 ISSUED FOR ADDENDUM 02, 0 29 05 2015 ISSUED FOR TENDER, Date Issued 30 OCT 2014, Date Imprint, MONTREAL ROAD CAMPUS, MECHANICAL SCHEDULES, designed by KC, conceived by ALM, checked by KC, approved by ALM, dwg.no. 3788-M08.



This document is issued to address requests for information and/or clarifications received from the bidders.

1. Q What equipment is the owner supplying under Section 25 05 00, item 1.13? If we are required to transport and hook-up this equipment please provide sizes, weights and electrical connection details. We are also assuming that the equipment will not be required to be assembled.
A **Clarified by addendum 5**
2. Q is Armstrong acceptable for the pumps?
A **Typically we accept pumps manufactured by Armstrong, as long as they match the specified performance and all the other requirements.**
3. Q Compressor states 2 stage, but pressure required is only 688kPa/ 96 psi, why not single stage?
A **This has been revised to single stage and will be issued with next addendum**
4. Q -Compressor states 2HP motor , but request is for 23 CFM/ 11L/s, not possible with 2 HP , this works out to a 7.5 HP motor , best we can do with 2HP , single stage pump is around 9 cfm
A **This has been revised to 7.5HP and will be issued with next addendum**
5. Q Asbestos Abatement Maximum Precautions (Item 1.8.1.5) – The quantity given for asbestos containing cementitious parging that is to be removed within this scope of work is approximately 1,600 square metres. Can you clarify if this provided quantity includes for ALL architectural, mechanical and structural penetrations/ openings required for this project, or would the required openings be considered an additional quantity to be abated?
A **This quantity refers to the area of asbestos containing cementitious parging in the ceiling and bulkhead areas only. The deemed area of parging to be removed for all wall openings or penetrations will be provided in an addendum.**
6. Q Would you be able to provide us with the list of ALL General Contractors that are bidding on this project or were at least present at one of the job showings?
A **This information is available from the NRC Contracting Authority. Contact Marc Bedard, Senior Contracting Officer, at: Marc.Bedard@nrc-cnrc.gc.ca**
7. Q The door schedule is asking to remove the big door and reinstall it with new parts as needed to make it bigger in “length”. If they are making the door bigger, they will be needing a new door. If they are only making it higher, that COULD be done, but it may just be feasible to buy a new one anyways to be cost effective. Can you clarify what they actually mean? and if it is getting bigger (height or width, by how much)
A **The existing over head door size is as per the door schedule 1/A02 -approx. 4254mm (w) x 3937mm (h). As per the description, the door is to be lengthened only. For clarity the door width will remain the same. The door will require to be lengthened by approx. 912mm**
8. Q Please show the locations for the following mechanical equipment? They are indicated as being in the Basement Mechanical Rm but there not shown on the electrical drawings? Have they been removed? 22HWP04, 22SP01, 22SP02, 22SP03, 22CCH04 and ERH3.
A **ERH3 is shown on drawing E02 room 026. Refer to single line for additional circuit information. Rest of equipment clarified in next addendum**

9. Q can you please find out who supplies the gas detection system; and if it's electrical please provide specs.
A **Mechanical is providing a refrigerant gas detection system. Electrical to provide power connection to control panel and rough-ins for low voltage wiring to individual sensors. Equipment and low voltage wiring by mechanical. Refer to addendum 5**
10. Q Provide name and serial number for the existing distribution switchboard that is to receive the 2 new 400 amp breakers?
A **Information on existing panels (serial number/manufacturer) not available at this time. To be confirmed on site/by building manager.**
11. Q There is a symbol on the electrical drawings that looks like a bird house with a number in it? What does it mean and does it have anything to do with our work?
A **Please refer to the legend on 3788-E01**
12. Q Please provide specs for the single metal channel raceway in the Observation Room.
A **Standard of acceptance and requirements are included on section 26 05 33 for 120mm metal raceway. Requirements are the same, different series number to match size indicated on the drawings. Communications provider/designer providing cabling/equipment and terminations to confirm.**
13. Q Please provide specs for the 300 mm metal channel raceway for communications outlets in the Observation room.
A **Same answer as question 12.**
14. Q I need the specifications for the floor boxes, there is no spec as to what kind of floor boxes they want.
A **Size and part number indicated on detail 10/E09. Further requirements to be confirmed by communications designer/provider responsible for cabling/equipment/terminations.**
15. Q Is item 2.3.11 of Section 03 30 00 actually a requirement on this project? If so. Please indicate where it is required.
A **Yes, this is a requirement for all sump pits in the lower floor which are otherwise unprotected.**
16. Q Dwg E02: There are (2) Panel L22's shown on the electrical drawings. Please clarify which panel is in the correct location.
A **Clarified by addendum 5**
17. Q Electrical Specifications: Please provide a fixture specification for Fixture Type "L".
A **Refer to addendum 4**
18. Q Dwg E07: Please confirm Panel "EL2" is fed with a 3 Pole 30A breaker and (4) #4 conductors.
A **Yes**
19. Q Dwg's E07 + E08: Is Panel "EL2" to be rated for 100A or 225A? Please clarify.
A **100A. Clarified by addendum 5**
20. Q Dwg E-07- Note 01: Please confirm all private metering required for the branch panels is not part of Division 26's scope of work.
A **Clarified by Addendum 5. The digital sub-metering panels for termination of CTs/ PTs**

originally to be installed on branch circuit panels was removed from scope. Branch circuit panels are still indicated with wide tub to allow for installation of future private digital sub-metering system. New ION 7350 power meters are the only meters to remain for distribution boards "P6", "P7" and are to be connected back to base building metering panel. Refer to revised section on addendum 4 for additional requirements.

21. Q Dwg's E02 + E03- Electrical Room+ Room 139-Panel "L28": There are (2) Panel L26's shown on the electrical drawings. Please clarify which Panel "L26" is in the correct location.
A **Clarified by addendum 5**
22. Q Dwg's E02 + E06- Electrical Room+ Room 026- Panel "L26": There are (2) Panel L26's shown on the electrical drawings. Please clarify which Panel "L26" is in the correct location.
A **Proper location for panel "L26 is FSL lab 026 on drawing E02.**
23. Q Dwg E03 -Note 08 + Dwg E09- Note 10: Please provide a specification for the type "NI-362407" Junction Box.
A **Sizes and part numbers indicated on the drawings. Manufacturer is Ralston Metal.**