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Document Identification

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VOLUME 1 SPECIFICATIONS

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PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Read and be governed by conditions of the *Contract Documents*, including Sections of Division 1.

1.2 INFORMATION AVAILABLE FOR REVIEW

- .1 Be advised the neither the *Owner* nor the *Consultant* guarantees the accuracy or completeness of any data contained therein. Bidders must satisfy themselves with regard to all matters relating to conditions that may affect either the methods of construction or the cost of the *Work* before submitting bids or commencing the *Work*.
- .2 The Architect's seal, if applied to the *Project Manual*, governs only Section 00 30 00 proper, and not the documents listed herein.
- .3 The following documents have been made available by the *Owner* for review:
 - .1 Geotechnical report:
 - .1 "Geotechnical Investigation Report, Proposed Paramedic Response Station, 53 Jacob Keffer Parkway, Concord Ontario", dated January 9, 2020, prepared by Sola Engineering.
 - .2 Soil Characterization memo:
 - .1 Environmental Soil Characterization, Paramedic Response Station, 53 Jacob Keefer Parkway, Vaughan Ontario, dated December 20, 2022
 - .3 Soil Management Plan:
 - .1 Soil Management Plan, Paramedic Response Station, 53 Jacob Keefer Parkway, Vaughan Ontario, dated December 20, 2022.
 - .4 Environmental Site Assessment reports:
 - .1 "Phase One Environmental Site Assessment, 53 Jacob Keffer Parkway Vaughan, Ontario", dated November 20, 2019, prepared by S2S Environmental Inc.
 - .5 Hydrogeological report:
 - .1 "Hydrogeological Assessment, 53 Jacob Keffer Parkway Vaughan, Ontario", dated January 18, 2021, prepared by S2S Environmental Inc.
 - .6 Archaeological Assessment reports:
 - .1 "Stage 1 Archaeological Assessment, 53 Jacob Keffer Parkway, Part of Lot 15, Concession 3, Geographic Township of Vaughan, County of York, City of Vaughan, Regional Municipality of York", dated November 25, 2020, prepared by ASI.
 - .7 Stormwater Management report:
 - .1 "Paramedic Response Station 53 Jacob Keffer Parkway, Concord, ON FSR & Stormwater Management Report" dated, March 16, 2021, prepared by MGM Consulting Inc.
- .4 *Contractor* must confirm receipt of these documents prior to commencement of construction.

END OF SECTION

PART 1- GENERAL

1.1 GENERAL INSTRUCTIONS

- .1 Read and be governed by conditions of the *Contract Documents*, including Sections of Division 01.

1.2 SECTION INCLUDES

- 1.1 General Instructions
- 1.2 Section Includes
- 1.3 Summary
- 1.4 Administrative Requirements
- 1.5 Submittals
- 1.6 Closeout Submittals
- 1.7 Quality Assurance
- 1.8 Delivery, Storage, and Handling
- 1.9 Field Conditions
- 2.1 Performance/Design Requirements
- 2.2 General
- 2.3 Wood Materials
- 2.4 Panel Materials
- 2.5 Fasteners and Adhesives
- 2.6 Hardware
- 2.7 Finishes – Interior Architectural Woodwork
- 2.8 Fabrication
- 3.1 Preparation
- 3.2 Installation
- 3.3 Installation – Tolerances
- 3.4 Adjusting and Cleaning
- 3.5 Protection

1.3 SUMMARY

- .1 The work of this Section includes architectural woodwork including, but not limited to, the following:
 - .1 Standing and running trim.
 - .2 Cabinetry and hardware.
 - .3 Plastic wood benches and fabrications.
 - .4 Solid surfacing countertops and fabrications.
 - .5 Wood wall panels.

- .6 Factory and *Site* finishing of architectural woodwork.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate with other subcontractor's work for satisfactory and expeditious completion of the work of this Section. Coordinate with partition accessories, electrical, communications, and finish components to ensure that proper provisions are made for the installation of the work of this Section and for work by others.
 - .2 Where woodwork is to be fitted to other construction, check actual dimension of other construction by accurate field measurements before manufacturing woodwork; show recorded measurements on final *Shop Drawings*. Coordinate manufacturing schedule with construction progress to avoid delays in the *Work*.
 - .3 *Provide* forms, templates, anchors, sleeves, inserts and accessories required to be fixed to or inserted in the work of this Section and set in place. Instruct applicable *Subcontractors* as to their locations.
 - .4 *Provide* cut-outs for raceways, sleeves, grommets and other manufactured accessories which are required for the work of this Section.

1.5 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data for each type of *Product* and process proposed for use in the work of this Section and incorporated into items of architectural woodwork.
- .3 Shop drawings:
 - .1 Submit *Shop Drawings* for the work of this Section complying with the Architectural Woodwork Standards, Edition 2, 2014 requirements.
 - .2 Indicate quality standards and grades.
 - .3 Include full scale drawings of all exposed-to-view edge conditions.
 - .4 Include plans, sections and large scale details, and indicate components and methods of assembly, fastenings, and other fabrication information required for the work of this Section. Indicate assembly joint lines.
 - .5 Include materials and their characteristics and finishes as applicable including the following:
 - .1 Panel core and material types, thicknesses, compliance with specified standards, special treatments.
 - .2 Adhesive types to be used and locations.
 - .3 Finishing requirements including Architectural Woodwork Standard finish system number, sheen, and required application steps.
 - .6 Submit coordination drawings indicating locations of concealed grounds, cut- outs, plates, and other required fabrications.

- .7 Show relation to adjoining construction, details of outside and inside corners and door openings.
- .4 Verification samples:
 - .1 Submit samples for purpose of verification of compliance with specified requirements.
 - .2 Submit 3 sets of 200 mm x 200 mm (8" x 8") samples, or 200 mm (8") long as applicable, of each specified *Product*, material and finish, including but not limited to the following:
 - .1 Shop finished materials, showing each type of finish and colour.
 - .2 Samples of each specified *Product*, in each specified colour and finish.

1.6 CLOSEOUT SUBMITTALS

- .1 Submit closeout submittals in accordance with Section 01 77 00 – Contract Closeout Procedures and Submittals.
- .2 Operation and maintenance data:
 - .1 Submit maintenance and cleaning instructions for finishes requiring specific care, noting particularly those procedures or materials which will cause damage to finished surfaces to be included in maintenance manuals.

1.7 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Manufacturers:
 - .1 The *Contractor* shall ensure that architectural woodwork is manufactured by a firm having a minimum of five years' experience on work of similar size and quality.
 - .2 The *Contractor* shall ensure that the manufacturer is a member in good standing of the Architectural Woodwork Institute or the Architectural Woodwork Manufacturers Association of Canada or the Woodwork Institute or equivalent membership acceptable to the Consultant.
 - .3 Fabricator solid surfacing: Fabrication to be performed by a solid surface manufacturer's certified fabricator. The *Contractor* shall submit the manufacturer's certification letter prepared by the solid surfacing manufacturer.
 - .2 Installers / applicators / erectors: Engage an installer who has successfully completed two architectural woodwork projects similar in scope, materials and design to this *Project* within the last five years.
- .2 Quality standard:
 - .1 The work shall be in accordance with the Architectural Woodwork Standards, Edition 2, 2014, Premium Grade, or the highest grade available for performance and appearance characteristics of materials in Sections 3 – 5 used that apply to *Product* fabrication and installation requirements governed by Sections 6 – 12.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Protect architectural woodwork during transit, delivery, storage and handling to prevent damage, spoilage, and deterioration.

- .2 Do not deliver woodwork until painting, wet work, grinding, and similar operations that could damage, soil, or deteriorate architectural woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified under subsection 1.10 - Field Conditions.
- .3 The *Contractor* shall be solely responsible to make certain that architectural woodwork is not delivered until the building and storage areas are sufficiently dry so that the architectural woodwork will not be damaged by excessive changes in moisture content. The *Contractor* shall coordinate the delivery of the woodwork with the architectural woodwork manufacturer.

1.9 FIELD CONDITIONS

- .1 Environmental conditions:
 - .1 During storage and installation: Obtain and comply with Architectural Woodwork Standard's for optimum temperature and relative humidity conditions for woodwork during its storage and installation. Do not install woodwork until these conditions have been attained. Woodwork shall be acclimatized for a minimum of 72 hours prior to commencing woodwork installation.
 - .2 During finishing: Comply with Architectural Woodwork Standard's temperature and humidity requirements before, during, and after application of finishes.
 - .3 During service life of woodwork: Obtain and comply with woodwork manufacturer's advice for optimum temperature and humidity conditions for woodwork. Note that building humidity control is not in operation 24 hours per *Day* or 365 *Days* per year and system is intermittent during winter and summer months. As a result, fabrication of wood components should anticipate major changes in humidity levels.

PART 2 – PRODUCTS

2.1 PERFORMANCE/DESIGN REQUIREMENTS

- .1 Casework integrity shall meet the minimum acceptance levels in accordance with SEF 8- 1999 as outlined in the Architectural Woodwork Standards, Edition 2, 2014 and additional or greater loading capacities as specified throughout the Architectural Woodwork Standards.
- .2 Maximum allowable adjustable shelf lengths shall comply with shelves assembly rules per the Architectural Woodwork Standards, Edition 2, 2014.
- .3 Welding:
 - .1 Weld components in steel to conform to requirements of CSA W59-15, and by a fabricator fully certified by the Canadian Welding Bureau or equivalent certification acceptable to the *Consultant* in accordance with the conditions of CSA W47.1-09(2014) and CSA W55.3-08 (R2013) as applicable.
 - .2 Weld components in aluminum to conform to the requirements of CSA W59.2-M1991 (R2013), and by a fabricator certified by the Canadian Welding Bureau or equivalent certification acceptable to the *Consultant* in accordance with the conditions of CSA W47.2-12.
 - .3 Weld stainless steel components to conform to requirements of CSA W59-15 and ANSI/AWS D1.6/D1.6M as applicable, and by a fabricator fully certified by the Canadian Welding Bureau or equivalent certification acceptable to the *Consultant* in accordance with the conditions of CSA W47.1-09(2014).

2.2 GENERAL

- .1 Single-source manufacturing and Installation responsibility: Engage a qualified manufacturer to assume undivided responsibility for woodwork specified in this Section, including fabrication, finishing, and installation.

2.3 WOOD MATERIALS

.1 Lumber:

- .1 Hardwood for concealed blocking and framing: Economy grade, any species that, when painted, will not show any defects.
- .2 Moisture content: *Provide* kiln-dried (KD) lumber with moisture content range between 6% to 12% for interior architectural woodwork. Maintain temperature and relative humidity during fabrication, storage and finishing operations so that moisture content values for woodwork at time of installation do not exceed 5% to 10%.
- .3 Solid hardwood painted finish.

.1 Species:

- .1 White Birch.

.2 Cut:

- .1 Rift.

.2 Wood veneers:

- .1 Allowable wood veneer face grade characteristics shall comply with Architectural Woodwork Standards, Edition 2, 2014 referenced grade and referenced standards.

.1 For applications other than solid wood doors:

.1 Species

- .1 White Birch.

.2 Veneer cut:

- .1 Rotary.

.3 Veneer leaf matching:

- .1 Random.

.2 For solid wood doors:

.1 Species

- .1 White Oak.

.2 Veneer cut:

- .1 Plain/Flat.

.3 Veneer leaf matching:

- .1 Book.

- .2 Edgeband exposed panel edges with 6 mm (1/4") thick solid hardwood trim, unless otherwise indicated in the Contract Documents.
- .3 Medium density fibreboard (MDF):
 - .1 In accordance with ANSI A208.2-2009, 720 kg/m3 (45 lbs/ft3) minimum density and as follows:
 - .1 Grade:
 - .1 Grade 130.
 - .2 Formaldehyde emission: F21 for panel thicknesses greater than 8mm 8 mm (5/16") and F13 for panels equal to or thinner than 8 mm (5/16").
 - .3 Acceptable *Products*:
 - .1 Uniboard Canada Inc.
 - .1 Finish: Riva - H52.
 - .2 Or *Equivalent*.

2.4 PANEL MATERIALS

- .1 Panel material schedule; except where indicated otherwise in the *Contract Documents*:
 - .1 Thickness: 19 mm (3/4") minimum.
 - .2 Core panels:
 - .1 At veneered work: MDF, except at shelving use veneer core plywood.
 - .2 Plywood backing; countertops, backsplashes, and where indicated in the contract drawings: Veneer core plywood with Type II adhesive, sanded good one side or good two sides (when both sides exposed or to receive applied finish materials) plywood, with no added urea-formaldehyde used in composition.
 - .3 Maximum moisture content at time of installation: 10% to 12%.
- .2 Plywood:
 - .1 Veneer core plywood non telegraphing grain:
 - .1 Softwood plywood: in accordance with ANSI/HPVA HP-1-2009.
 - .2 Douglas Fir plywood: in accordance with US Plywood Standard APA PS-1-09.
- .3 Medium density fibreboard (MDF):
 - .1 In accordance with ANSI A208.2-2009, 720 kg/m3 (45 lbs/ft3) minimum density and as follows:
 - .1 Grade:
 - .1 Grade 130.
 - .2 Formaldehyde emission: F21 for panel thicknesses greater than 8mm 8 mm (5/16") and F13 for panels equal to or thinner than 8 mm (5/16").

- .3 Acceptable *Products*:
 - .1 Uniboard.
 - .1 Finish: Riva - H52.
 - .2 Or *Equivalent*.
- .4 Engineered stone; quartz-based fabricated stone surfacing:
 - .1 Composition: 93% crushed quartz aggregate combined with resins and pigments and fabricated into slabs using a vacuum vibro-compaction process, and as follows:
 - .1 Thickness: as indicated in the *Contract Documents*.
 - .2 Colour:
 - .1 Type 1: Caesarstone #2141.
 - .3 Finish:
 - .1 Polished.
 - .4 Acceptable *Product*: CaesarStone Quartz Surfacing, by U.S. Quartz Products Inc. or *Equivalent*.
 - .5 Flame Spread Value (FSV): Maximum 25.
 - .6 Smoke Developed Value (SDV): Maximum 50.
- .5 Shower benches and boards for coat hooks:
 - .1 Plastic wood; as manufactured by Trex Company Inc. or *Equivalent*, colour to later selection by the *Consultant* from the manufacturer's full range.

2.5 FASTENERS AND ADHESIVES

- .1 Wood screws: FF-S-111D Amendment 1 (1989), type, size, material and finish as required for the condition of use.
- .2 Nails: FED FF-N-105, type, size material and finish as required for the condition of use.
- .3 Anchors: Type, size material and finish as required for the condition of use.
- .4 Fastening devices shall be set or countersunk flush with surface of framing member. No exposed fasteners permitted. Where accepted by the *Consultant*, exposed fasteners shall be flat head hex socket cap screws and matching joint connector sex bolts (also known as Chicago screws or post and screw) by Murakoshi, distributed by Richelieu or *Equivalent*, Spaenaur Joint Connector bolt with decorative head, hex drive series; finish as selected by the *Consultant*.
- .5 At butt joints in railing caps and counter surfaces, employ assembling bolts to ensure tight structural joint.
- .6 Adhesives: Type II water resistant, except use Type I waterproof in wet environments.

2.6 HARDWARE

- .1 Casework hardware; to be furnished and installed by the architectural woodwork manufacturer.
 - .1 As far as practical, use one manufacturer's products for all Products in this section.

- .2 All costs associated with the *Products* of this Section will not be covered by a cash allowance and shall be included in the *Contract Price*.
- .3 Cabinet and auxiliary hardware: Where casework hardware is not specified or indicated on the *Drawings* or scheduled, casework hardware shall comply with ANSI/BHMA Standards, latest edition, minimum grades, loading and other basic rules per the Architectural Woodwork Standards, Edition 1, 2009.
- .4 All casework hinges and drawer slides shall be soft close type.
- .5 Stainless steel hat and coat hook: Specified under Section 10 28 00 – Washroom Accessories and Janitor Accessories for installation as part of the work of this Section.

2.7 FINISHES – INTERIOR ARCHITECTURAL WOODWORK

- .1 Paint and stain finish, in accordance with Section 09 91 00 - Painting.

2.8 FABRICATION

- .1 Fabricate woodwork to dimensions, profiles, and details indicated in the Contract drawings with openings and mortises pre-cut, where possible, to receive hardware and other items of work.
- .2 Complete fabrication, assembly, finishing, hardware application, and other work before shipment to maximum extent possible. Trial fit in shop and disassemble components only as necessary for shipment and installation. Where necessary, *Provide* ample allowance for scribing, trimming, and fitting. Reassemble with concealed fasteners.
- .3 *Provide* woodwork, solid tops and other materials with pre-cut openings, where possible, for hardware, appliances, plumbing fixtures, electrical work, telephone cut-outs and similar items. Locate openings accurately and *Provide* proper size and shape. Smooth edges of cut-outs and, where located in countertops, seal edges of cut-outs with a water-resistant coating.
- .4 *Provide* lumber framing for architectural woodwork, complete with all bracing and fastening devices as required for a rigid installation, and as required to sustain the imposed loads.
- .5 Reinforcing shown is minimum. *Provide* additional reinforcing as required to ensure a rigid assembly. Take responsibility for the stability of furniture and fitments.
- .6 Do fabrication from field measurements with provisions for scribing as required to meet built-in conditions.
- .7 *Provide* balancing sheets as required, and specified, complying with the Architectural Woodwork Standards, Edition 2, 2014.
- .8 *Provide* surface mount blocking and strapping necessary to support the work of this Section. Such blocking shall not be exposed upon completion of work.
- .9 Prefinish work at the factory, except where specified or indicated otherwise in the Contract documents.
- .10 Solid wood edging: No end grain shall be visible; mitre external corners; house internal corners.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Condition woodwork to average prevailing humidity conditions in installation areas before installing.

- .2 Ensure that environmental conditions have been provided as requested and specified.
- .3 Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including back priming and removal of packing.
- .4 *Provide* all grounds, nailers and other required fabrications which are to be built into other work when required.
- .5 Ensure that wall and ceiling variations are not in excess of 6.4 mm (1/4") in 3658 mm (144") and that floors are not in excess of 12.7 mm (1/2") in 3658 mm (144") of being plumb, level, flat, straight, square, of the correct size. Variations shall be corrected prior to installation of work of this Section.
- .6 Report conditions contrary to requirements preventing proper installation to the *Consultant*. Do not proceed with the installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- .1 Install woodwork to comply with Architectural Woodwork Standards, Edition 2, 2014 for same grade specified in Part 1 of this Section for type of woodwork involved.
- .2 Install woodwork plumb, level, true, and straight with no distortions.
- .3 Scribe and cut woodwork to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.
- .4 Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where prefinished matching fastener heads are required, use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork and matching final finish where transparent finish is indicated in the shop drawings.
- .5 Complete the finishing work specified in this Section to whatever extent not completed at shop or before installation of woodwork.
- .6 Plastic wood:
 - .1 Install plastic wood in accordance with manufacturer's instructions and recommendations.
 - .2 Install with the following minimum expansion/contraction gaps, wider as recommended by manufacturer:
 - .1 Width-to-width: 9.5 mm (3/8").
 - .2 End-to-end: 3.2 mm (1/8").
 - .3 Perimeter and abutting solid objects: 6.4 mm (1/4").
 - .3 Screw-down installation: Use manufacturer's recommended screws, exterior grade. Install screws at least 25 mm (1") in from board edges.

3.3 INSTALLATION – TOLERANCES

- .1 Install to a tolerance of 3 mm in 2400 mm (1/8" in 8'-0") for plumb and level (including tops) and with no variations in flushness of adjoining surfaces unless otherwise acceptable in accordance with the Architectural Woodwork Standards, Edition 1, 2009.

3.4 ADJUSTING AND CLEANING

- .1 Repair damaged and defective woodwork where possible to eliminate defects functionally and visually; where not possible to repair, replace woodwork, at the *Contractor's* expense.
- .2 Clean, lubricate, and adjust hardware.
- .3 Clean woodwork on exposed and semi-exposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

3.5 PROTECTION

- .1 Protect architectural woodwork during remainder of construction period to ensure that work will be without damage or deterioration at time of acceptance.
- .2 *Provide* final protection and maintain conditions, in a manner acceptable to manufacturer and installer, that ensure that woodwork is without damage or deterioration at time of *Substantial Performance of the Work*.

END OF SECTION

PART 1 – GENERAL

1.1 GENERAL INSTRUCTIONS

- .1 Read and be governed by conditions of the *Contract Documents*, including Sections of Division 01.

1.2 SECTION INCLUDES

- 1.1 General Instructions
- 1.2 Section Includes
- 1.3 Summary
- 1.4 Administrative Requirements
- 1.5 Submittals
- 1.6 Closeout Submittals
- 1.7 Quality Assurance
- 1.8 Delivery, Storage, and Handling
- 1.9 Field Conditions
- 1.10 Extended Warranty
- 2.1 Roofing System Manufacturer
- 2.2 Performance/Design Requirements – General
- 2.3 Performance/Design Requirements – Fire Protection
- 2.4 Roofing Membrane and Flashing Sheets
- 2.5 Auxiliary Roofing Membrane Materials
- 2.6 Asphalt Materials
- 2.7 Substrate Boards
- 2.8 Air and Vapour Barriers
- 2.9 Roof Insulation
- 2.10 Insulation Accessories
- 2.11 Fasteners and Restraints
- 2.12 Walkway Pavers
- 2.13 Expansion Joints
- 2.14 Flashings and Penetration Flashings
- 3.1 Examination
- 3.2 Preparation
- 3.3 Method of Installation
- 3.4 Substrate Board (Sheathing/Underlay)
- 3.5 Application of Primer
- 3.6 Air and Vapour Barrier
- 3.7 Asphalt Application

- 3.8 Insulation Application – Conventional Roofing
- 3.9 Cover Board
- 3.10 Installation of Reinforced Gussets
- 3.11 Roofing Details
- 3.12 Installation of Torch-Applied Cap Sheet Membrane
- 3.13 Installation of Torch-Applied Cap Sheet Flashing Membrane
- 3.14 Waterproof Expansion Joint Installation
- 3.15 Roof Drains
- 3.16 Roof Penetrations
- 3.17 Metal Flashings
- 3.18 Paver Installation
- 3.19 Field Quality Control
- 3.20 Adjusting and Cleaning

1.3 SUMMARY

- .1 Section includes:
 - .1 Two-ply styrene-butadiene-styrene (SBS) modified bituminous membrane roofing; as follows:
 - .1 Exposed membrane roofing system.
 - .2 Roofing insulation.
 - .3 Air and vapour barrier.
 - .4 Associated roofing accessories and *Products*.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate with Divisions 21, 22 and 23 to ensure that roof drains are suitable for roofing system design.
 - .2 Coordinate with *Subcontractors* of roof mounted items, equipment, and mechanical and electrical work at roof so that installation will not subvert the integrity of the roofing system.
 - .3 Coordinate with installation of air barrier at walls to ensure complete continuity of air barrier system for building. Roofing air barrier membrane to lap by 75 mm (3") minimum and terminate with wall system air barrier membrane.
 - .4 The *Contractor* shall ensure that the manufacturer meets with the necessary parties at the *Site* to review and discuss *Project* conditions as it relates to the integrity of the roofing assembly.

1.5 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 *Product* data sheets:

- .1 Submit manufacturer's *Product* data sheets for each type of *Product* indicated in the Shop Drawings.
- .3 *Shop Drawings*; general details:
 - .1 Include plans, elevations, sections, details, and attachments to other work for the following:
 - .1 Base flashings, cants, and membrane terminations.
 - .2 Tapered insulation, including slopes.
 - .3 Crickets, saddles, and tapered edge strips, including slopes.
 - .4 Insulation fastening patterns.
 - .4 Certificates:
 - .1 Installer certificates: The *Contractor* shall *Provide* installer certificates signed by the roofing system manufacturer certifying that installer is approved, authorized, or licensed by manufacturer to *Install* roofing system.
 - .2 Manufacturer certificates: The *Contractor* shall *Provide* manufacturer certificates signed by the roofing manufacturer certifying that roofing system complies with requirements specified in subsection 2.2 - Performance/Design Requirements– of this Section.
 - .1 Submit evidence of compliance with performance requirements.
 - .5 Roofing manufacturer's warranty and design criteria:
 - .1 Submit copy of completed roofing manufacturer's pre-installation notification form at least 10 *Working Days* prior to commencement of roofing installation.
 - .2 Submit copy of roofing manufacturer's warranty specimen and warranty design criteria for roofing system prior to commencement of roofing installation.
 - .6 Samples:
 - .1 Submit samples complete with the manufacturer's labels intact, of materials to be used for work of this Section prior to commencement of work. Allowing 5 working days for review and acceptance by the *Consultant* and roofing inspection company. Do not proceed with work until samples are accepted.

1.6 CLOSEOUT SUBMITTALS

- .1 Submit closeout submittals in accordance with Section 01 77 00 – Contract Closeout Procedures and Submittals.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's maintenance instructions for incorporation into the operation and maintenance manuals.

1.7 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Manufacturers: Company specializing in manufacturing the *Products* specified in this Section, with a minimum of 10 years' experience.

- .2 Installers / applicators / erectors: The *Contractor* shall *Provide* work of this Section, executed by competent installers with minimum five years' experience in application of *Products*, systems and assemblies specified and with approval and training of *Product* manufacturers.
- .1 The *Work* of this Section shall be installed by a *Subcontractor* that is a member in good standing of the Canadian Roofing Contractors Association (CRCA) and Ontario Industrial Roofing Contractors Association (OIRCA) or equivalent certificate acceptable to the *Consultant*, who has been a member for at least five years.
- .2 The roofing *Subcontractor* must be approved by the membrane manufacturer for the warranty program specified. Submit *Subcontractor's* certification letter prepared by the membrane manufacturer.
- .2 Execute work of this Section only under full time supervision of qualified *Subcontractor's Site* supervisor.
- .3 Mock-up:
 - .1 Prepare a 10 m² (100 ft²) mock-up of the work of this Section. Incorporate materials and methods of fabrication and installation identical with project requirements.
 - .2 Install mock-up at roof area location directed by the *Consultant*. Retain accepted mock-up of sufficient size and scope to show typical pattern of seams, fastening details, edge construction, and workmanship.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver roofing materials to the *Site* in original containers with seals unbroken and labelled with the manufacturer's name, *Product* brand name and type, date of manufacture, and directions for storage.
- .2 Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- .3 Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.
- .4 Handle materials carefully to preclude damage. Follow manufacturer's written recommendations.
- .5 Package materials and identify on attached labels the manufacturer, brand, contents, weight as applicable, and *Product* and specification numbers.
- .6 Protect edges of roll goods from damage during handling, and store rolls on end to prevent flattening.
- .7 Do not store roofing materials on roof. Store them in a dry area protected from inclement weather while roofing installation is not in progress. Store above materials under opaque, breathable and waterproof tarpaulins or in sheds.
- .8 Prevent compression of insulation panels at any point and breakage of edges and corners. Discard wet, cupped, bowed, or otherwise damaged insulation from *Place of the Work*.
- .9 Protect edges and corners of precast concrete paving slabs to prevent damage.

1.9 FIELD CONDITIONS

- .1 Weather limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.10 EXTENDED WARRANTY

- .1 *Provide* Ontario Industrial Roofing Contractors Association (OIRCA) two-year warranty for labour, materials, and workmanship.
- .2 Warrant work of this Section in accordance with Section 01 78 36 - Warranties for a period of two years from the date of Substantial Performance.
- .3 In addition, roofing manufacturer shall *Provide* total system warranty including the following:
 - .1 Roofing membrane manufacturer will issue a written document in the *Owner's* name, valid for warranty duration, for the repair of leaks in the roofing membrane to restore the roofing system to dry and watertight condition, to the extent that membrane manufacturing or installation defects caused water infiltration. Include copy of required warranty with close out documentation.
 - .2 Warranty shall cover entire cost of the repair(s) required to maintain dry and watertight roofing system during the full warranty duration.
 - .3 Warranty shall include for labour, materials, and workmanship.
 - .4 Warranty shall be non-prorated with no dollar limit (NDL) for duration of warranty.
 - .5 10-year warranty duration from the date of Substantial Performance.

PART 2- PRODUCTS

2.1 ROOFING SYSTEM MANUFACTURER

- .1 General:
 - .1 Single source responsibility: each roofing component to be by one manufacturer.
- .2 Acceptable roof system manufacturers: Subject to compliance with requirements, *Provide Products* by one of the following:
 - .1 Firestone Building Products.
 - .2 GAF Materials Corporation.
 - .3 IKO Industries.
 - .4 Siplast.
 - .5 Soprema.
 - .6 Johns Mansville
 - .7 Or *Equivalent*.

2.2 PERFORMANCE/DESIGN REQUIREMENTS – GENERAL

- .1 Roofing system: The roofing system shall include roofing system materials required to achieve roofing membrane manufacturer's warranty.
- .2 Roofing materials, components, and assemblies shall resist environmental and wind (uplift) loads, and effects of those loads in accordance with the Ontario Building Code.
- .3 General performance: Installed roofing system and base flashings shall withstand wind uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing system and base flashings shall remain watertight.
- .4 Material compatibility: *Provide* roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.
- .5 Roofing system: Prevent water from entering building and roofing assembly through roofing membrane.
- .6 Roofing system design:
 - .1 Roofing system assemblies shall have been successfully tested by a qualified testing agency to resist project roofing uplift pressures in accordance with the Ontario Building Code.
 - .2 Roofing system shall meet roofing system manufacturer's 145 kph (90 mph) wind speed requirements or equivalent FM Class 60 Windstorm Classification for wind uplift pressures, and to cladding design wind loads indicated in wind study report, as applicable.
- .7 Roof covering classification: Roof assembly shall have a Class C classification as determined in conformance with CAN/ULC S107-10 "Standard Methods of Fire Tests of Roof Coverings".
- .8 Air barrier system shall accommodate substrate movement, construction material changes, and transitions at perimeter conditions without deterioration and air leakage exceeding the following specified limits and requirements:
 - .1 Air permeance of air barrier material: Maximum 0.02 L/s m² at 75 Pa (0.004 cfm/ft² at 1.57 psf) in accordance with ASTM E2178-13.
 - .2 Rate of air leakage of air barrier system: Maximum 0.15 L/s m² at 75 Pa (0.030 cfm/ft² at 1.57 psf) in accordance with ASTM E283-04 (2012).
 - .3 Water vapour transmission for air / vapour barriers: Maximum 5.7 ng/Pa.m².s. (0.1 perms).
 - .4 Pull-off strength of liquid or sheet applied membrane and laps: Cohesive or substrate failure permitted when tested to specified wind load. Air barrier system shall transfer wind load to structure and shall resist 100% of design wind load or minimum of 2.15 kPa (45 psf), whichever is greater.
 - .5 Low temperature flexibility: to -30°C (-22°F) in accordance with CGSB 37-GP-56M-1985.
- .9 Air barrier system shall be joined in an airtight and flexible manner to air barrier material of adjacent building envelope air barrier systems, allowing for relative movement of systems due to thermal and moisture variations and creep. Connection shall be made between the following unless otherwise applicable:
 - .1 Walls and openings.

- .2 Across construction, control, and expansion joints.
- .3 Penetrations.
- .10 Solar Reflectance: roof shall have a minimum Solar Reflectance Index (SRI) of 78.

2.3 PERFORMANCE/DESIGN REQUIREMENTS – FIRE PROTECTION

- .1 At the end of each *Working Day*, use a heat detector gun or equipment as recommended by the membrane manufacturer to spot smouldering or concealed fire. Schedule the work to ensure workers are still on location at least two hours after torch application.
- .2 Never apply the torch directly to any wood surfaces. Conform with fire safety recommendations of the manufacturer and the CRCA.
- .3 Throughout roofing installation, maintain the *Place of the Work* in a clean condition and have one approved ABC fire extinguisher within 6 m of each roofing torch. Torches must never be placed near combustible or flammable *Products*.

2.4 ROOFING MEMBRANE AND FLASHING SHEETS

- .1 Roof membrane base sheet and base sheet flashing: CGSB 37.56, SBS-modified asphalt membrane sheet.
 - .1 Reinforcement:
 - .1 180 gm/m² non-woven polyester.
 - .2 Thickness:
 - .1 3 mm (0.160") minimum.
- .2 Roofing membrane cap sheet and cap sheet flashing: CGSB 37.56, SBS-modified asphalt membrane sheet with non-woven polyester reinforced elastomeric bitumen, protected by coloured granules.
 - .1 Reinforcement:
 - .1 180 gm/m² non-woven polyester.
 - .2 Thickness:
 - .1 4 mm (0.140") minimum.

2.5 AUXILIARY ROOFING MEMBRANE MATERIALS

- .1 General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing system.
- .2 Mastic sealant: Polyisobutylene, plain or modified bitumen, non-hardening, non-migrating, non-skinning, and non-drying.
- .3 Metal flashing sheet: Metal flashing sheet is specified in Section 07 62 00 – Metal Flashing.
- .4 Miscellaneous accessories: *Provide* miscellaneous accessories recommended by roofing manufacturer.
- .5 Aggregate surfacing: gravel with no foreign material, ASTM D1863/D1863M- 05(2011) e1, water washed, dry, free of dirt and dust, hard, dry, clean, and graded in sizes from 9 mm to 12 mm.

2.6 ASPHALT MATERIALS

- .1 Asphalt primer: CGSB 37-GP-9Ma-1983.
- .2 Roofing asphalt: CAN/CSA A123.4-04, Type 2 or Type 3.

2.7 SUBSTRATE BOARDS

- .1 Substrate board: ASTM C1177/C1177M-08, glass-mat, water-resistant gypsum substrate, factory primed.
 - .1 Thickness:
 - .1 12.7 mm (1/2").
 - .2 Acceptable *Products*:
 - .1 Georgia Pacific 'Dens Deck Prime'.
 - .2 Or *Equivalent*.

2.8 AIR AND VAPOUR BARRIERS

- .1 Glass fibre sheet: ASTM D2178/D2178M-15, Type IV, asphalt-impregnated, glass-fibre felt (to be used in conjunction with asphalt).
- .2 Aluminized bitumen sheet: Air / vapour barrier membrane shall be manufactured by coating an aluminum foil with oxidized bitumen. Water vapour resistance: 16 ng/Pa.s.m2. Both surfaces lightly sanded.
- .3 SBS modified bitumen membrane, reinforced with a fibreglass mat in conformance with Prefabricated membrane, complying with CGSB 37-GP-56M-1985.

2.9 ROOF INSULATION

- .1 General: Preformed roof insulation boards manufactured or approved by roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses required to meet the R-values indicated.
- .2 Rigid polyisocyanurate insulation board, inorganic felt faced:
 - .1 Description: Closed-cell polyisocyanurate foam core integrally laminated to heavy, durable and dimensionally stable inorganic coated-glass facers, CAN/ULC S704-03 Type 2 and Class 3, HCFC free, 138 kPa (20 psi) minimum compressive strength (at 10% deformation), CAN/ULC-S126-06, LTTR value in accordance with CAN/ULC S770-00.
 - .2 Board size:
 - .1 1220 mm x 1220 mm (4 ft x 4 ft).
- .3 Tapered insulation: *Provide* factory-tapered insulation boards fabricated to slope of 1:48 (1/4 inch per 12 inches) unless otherwise indicated.
- .4 *Provide* preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated in the shop drawings for sloping to drain. Fabricate to slopes indicated, and no less than 1:48 (1/4 inch per 12 inches) in addition to roof structure slope or to tapered insulation slope as applicable.

2.10 INSULATION ACCESSORIES

- .1 General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with roofing assembly.
- .2 Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate and acceptable to roofing manufacturer.
- .3 Insulation adhesive:
 - .1 Modified asphaltic insulation adhesive: Insulation manufacturer's recommended modified asphaltic, asbestos-free, cold-applied adhesive formulated to attach roof insulation to substrate or to another insulation layer.
- .4 Cant strips:
 - .1 Insulation cant strips; perlite: ASTM C728-13, perlite insulation board, cut to *Provide* 45 degree transition from horizontal to vertical surfaces.
- .5 Cover board:
 - .1 Cover board; cellulose fibreboard: Asphalt treated and coated fiberboard in accordance with CAN/ULC S706-02, 12.7 mm (1/2") thick.
 - .1 Thickness: 12.7 mm (1/2").
- .6 Substrate joint tape: 150 mm (6") wide, coated, glass fibre.

2.11 FASTENERS AND RESTRAINTS

- .1 General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing system.
- .2 Factory-coated steel fasteners and plates complying with corrosion-resistance provisions in FM 4470, designed for fastening roofing components to substrate, tested by manufacturer for required pullout strength and wind uplift resistance, and acceptable to roofing manufacturer.
- .3 Termination bars: Pre-punched aluminum bar 25 mm (1") wide x 1.5 mm (1/16") thick x 3048 mm (10 ft) long with 6.4 mm (1/4") x 9.5 mm (3/8") slotted holes on 200 mm (8") centres.

2.12 WALKWAY PAVERS

- .1 Precast paver slabs: CSA A231.1-14/A231.2-14, 610 mm (24") square x 45 mm (1-3/4") height, slip resistant textured finish, minimum 45 MPa (6526 psi) compressive strength, minimum 4.5 MPa (653 psi) (mean) flexural strength, minimum 4.5% (by mass) water absorption, maximum allowable average loss of mass of not greater than 50 g/m² (0.16 oz/ft²) after 28 cycles.
- .2 Precast support pads: 25 mm (1") thick, extruded expanded polystyrene insulation, in accordance with CAN/ULC S701-11, Type 4, Class B, self-extinguishing, 35 psi at 5% deflection compressive strength, thermal conductivity (k) factor of 0.029 at 23.8 °C.

2.13 EXPANSION JOINTS

- .1 Description:
 - .1 Manufactured from a proprietary copolymer with internal polyester reinforcement, monolithic seam vulcanization.

- .2 Movement and fabrication: Tri-directional movement capability, joint waterproofing system shall be factory fabricated in one piece for the entire contiguous expansion joint or where length of joint exceeds manufacturer's shipping and handling guidelines shall be lapped and vulcanized by manufacturer's mechanics on *Site*, repair of damaged materials shall be performed by manufacturer's mechanics.
- .3 Compatible with adhesives and membranes associated with expansion joint construction in accordance with manufacturer's installation instructions.
- .4 Warranted by manufacturer to cover full warranty duration specified in this Section.
- .5 Hydrostatic pressure limit: Working pressure in column of water shall perform under static limit not to exceed 10 m (33 ft).
- .2 Acceptable *Products*; to suit type of roofing assembly and movement design requirements:
 - .1 Situra Inc. 'RedLINE'.
 - .2 Situra Inc. 'FlamLINE'.
 - .3 Or *Equivalent*.

2.14 FLASHINGS AND PENETRATION FLASHINGS

- .1 Prefinished metal flashings in accordance with Section 07 62 00 – Metal Flashing.
- .2 Roof drains; Stainless steel bolts, leader diameter size maximized to suit existing drain outflow pipe, deck clamps, stainless steel control flow insert, ballast guard, bitumen coated flanges, vandalproof hinged access gate (Allen-key operable) complete with drain seals:
 - .4 Drain body construction:
 - .1 Aluminum.
 - .5 Lexcor 'Flash-Tite Superdrains-FSD-FLAT,
 - .6 Thaler Metal Industries 'RD-FLAT'.
 - .7 Or *Equivalent*.
- .3 Prefabricated plastic pans; insulation filler and sealer; designed and provided for roof penetrating component in each case and for specified roofing system. Use gooseneck types for wiring and conduit.
 - .1 Lexcor 'Roof Protrusion Flashing'.
 - .2 Thaler Roofing Specialties 'Stack Jack Flashing'.
 - .3 Or *Equivalent*.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Examine substrates, areas, and conditions, with roofing installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
 - .1 Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.

- .2 Verify that blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
- .3 Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 05 31 23 – Steel Roof Decking.
- .4 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- .1 Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing manufacturer's written instructions. Remove sharp projections.
- .2 Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 METHOD OF INSTALLATION

- .1 Prepare surfaces and complete waterproofing work in conformance with roofing manufacturer's printed installation instructions.
- .2 Install roofing elements on clean and dry surfaces, in conformance with manufacturer's instructions and recommendations.
- .3 Roofing work must be completed in a continuous fashion as surfaces are readied and weather conditions permit.
- .4 Seal seams that are not covered by a cap sheet membrane in the same *Day*. Do not install cap sheet when moisture is present at/in the base sheet seams.
- .5 Whenever membranes are torch-applied, a continuous and even bead of molten bitumen must be visible as the membrane is unrolled and torched.
- .6 Lay roofing membrane free from wrinkles, air pockets, fishmouths, tears, and prominent lap joints. Full bond cap sheet to base sheet. Seams shall be lapped and fully bonded.
- .7 Prior to installation of base sheet and cap sheet, allow sheet to relax after unrolling. Relax time to be as recommended by manufacturer based on concurrent ambient temperature.
- .8 Extend roofing to outer edges of roof and up vertical surfaces at least 200 mm (8") above horizontal roofing, and full height beneath counter flashing and top of curb flashing.
- .9 Complete roofing up to line of termination for each *Working Day*.

3.4 SUBSTRATE BOARD (SHEATHING/UNDERLAY)

- .1 Lay substrate board with tightly butted joints. Longitudinal joints must be at right angles to flute direction. Joints occurring along widths of board to be continuously supported on top flange of metal deck. Stagger end joints of adjacent board by 1/2 the board width.
- .2 Ensure substrate board is immediately protected with membrane.
- .3 Mechanical fasteners to penetrate top flutes only; by no less than 19 mm (3/4") and by no more than 25.4 mm (1"). Check underside of deck before installation to eliminate damaging existing conditions below deck.

- .4 Tape all seams in substrate board prior to the installation of the air / vapour barrier. Use 150 mm (6") wide strips of self-adhering base sheet to prevent leakage into the building.

3.5 APPLICATION OF PRIMER

- .1 Roofing substrates surfaces shall receive a coat of primer at a rate required by roofing manufacturer's printed installation instructions.
- .2 Surfaces to be primed must be free of rust, dust or any residue that may hinder adherence.
- .3 Cover primed surfaces with roofing membrane as soon as possible (same Day coverage for self-adhesive membranes).

3.6 AIR AND VAPOUR BARRIER

- .1 Built-up two-ply asphalt and fibreglass felt: Install two glass-fibre felt plies lapping each felt 483 mm (19 inches) over preceding felt. Embed each felt in a solid mopping of hot roofing asphalt. Glaze-coat completed surface with hot roofing asphalt. Apply hot roofing asphalt within plus or minus 14°C (25°F) of equiviscous temperature.
- .2 Completely seal air and vapour barrier at terminations, obstructions, and penetrations to prevent air movement into roofing.

3.7 ASPHALT APPLICATION

- .1 Asphalt Heating: Heat roofing asphalt and apply within plus or minus 14°C (25°F) of equiviscous temperature unless otherwise required by roofing system manufacturer. Do not raise roofing asphalt temperature above equiviscous temperature range more than one hour before time of application. Do not exceed roofing asphalt manufacturer's recommended temperature limits during roofing asphalt heating. Do not heat roofing asphalt within 14°C (25°F) of flash point. Discard roofing asphalt maintained at a temperature exceeding finished blowing temperature for more than four hours.
- .2 Apply asphalt at Equiviscous Temperature (EVT) and do not spread more than 1830 mm (6 ft) of hot asphalt in front of each roll and reduce distance accordingly during cold weather. Ensure hot asphalt in kettle is in constant use and circulation to avoid distillation.
- .3 Apply asphalt at minimum rate of 1.2 kg/m² (25 lb/100 ft²) and as specified herein for aggregate surfacing flood coat.

3.8 INSULATION APPLICATION – CONVENTIONAL ROOFING

- .1 Comply with up roofing manufacturer's written instructions for installing roof insulation.
- .2 Adhesively applied insulation: Install insulation adhesive in accordance with roofing manufacturer's installation instructions.
- .3 Mechanically fastened insulation: Fasteners must be attached to steel deck's upper flutes and at spacing to meet performance requirements, in accordance with roofing manufacturer's installation instructions
- .4 Nailer strips: Mechanically fasten 90 mm (3-1/2") width wood nailer strips of same thickness as insulation perpendicular to sloped roof deck at the following spacing:
 - .1 4877 mm (16 ft) apart for roof slopes greater than 1:12 (1 inch per 12 inches) but less than 3:12 (3 inches per 12 inches).

- .2 1220 mm (48") apart for roof slopes greater 3:12 (3 inches per 12 inches).
- .5 Stagger and offset vertical joints from preceding insulation boards, 305 mm (12").
- .6 Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- .7 Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.
- .8 Install only as much insulation as can be covered with membrane roofing in the same *Day*.
- .9 Install insulation boards with edges in moderate contact without forcing and fill gaps greater than 6 mm (1/4") with insulation.
- .10 Cut insulation to fit to blocking, upstands, and penetrations through roof; fill gaps greater than 6 mm (1/4") with insulation.
- .11 Reduce thickness of insulation at roof drains by 13 mm (1/2") for a distance of 610 mm (24") from centre drain.
- .12 Install tapered insulation under area of roofing to conform to slopes indicated.
 - .1 Apply insulation adhesive to underside and immediately bond tapered insulation to substrate.
 - .2 Apply hot roofing asphalt to underside and immediately bond tapered insulation to substrate.
- .13 Protect and keep insulation dry (in new condition). Do not install insulation which is not in dry condition.

3.9 COVER BOARD

- .1 Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 300 mm (12") in each direction. Loosely butt cover boards together. Tape joints if required by roofing manufacturer.
 - .1 Apply insulation adhesive to underside and immediately bond cover board to substrate.
 - .2 Apply hot roofing asphalt to underside and immediately bond cover board to substrate.

3.10 INSTALLATION OF REINFORCED GUSSETS

- .1 Install reinforcing gussets on inside and outside corners of base sheet flashing membrane.
 - .1 *Provide* self-adhesive base sheet flashing membrane gussets, adhered over base sheet membrane flashing into intersecting corner, with edges of gusset sealed with a bead of compatible mastic.

3.11 ROOFING DETAILS

- .1 *Install* as indicated on the *Drawings* and with various roofing details illustrated in roofing manufacturer's printed installation instructions.

3.12 INSTALLATION OF TORCH-APPLIED CAP SHEET MEMBRANE

- .1 Once base sheet, base sheet flashing, and stripping are applied and do not show defects, and installation has been reviewed by the roofing system manufacturer and the inspection and testing company, cap sheet can then be laid.

- .2 Cap sheet shall be unrolled starting from lowest point of roof. Cap sheet shall be rerolled from both ends prior to torching. Care must be taken to ensure alignment of first roll (parallel with edge of roof).
- .3 Cap sheet shall be torch welded on to base sheet membrane. During this application, both surfaces shall be simultaneously melted, forming an asphalt bead that shall be pushed out in front of cap sheet. Maintain a consistent 3 mm (1/8") wide asphalt bead at seams.
- .4 Avoid overheating.
- .5 Base sheet and cap sheet seams shall be staggered a minimum of 305 mm (12").
- .6 Overlap side laps by 75 mm (3") and end laps by 150 mm (6").
- .7 Make sure 2 membranes are properly welded without unwelded areas. Torch welding speed varies depending on weather. In cold conditions, it slows down, in warm and dry conditions, it speeds up.
- .8 After installation of cap sheet, check lap seams on cap sheet.

3.13 INSTALLATION OF TORCH-APPLIED CAP SHEET FLASHING MEMBRANE

- .1 Cap sheet flashing shall be laid in strips one metre wide. Side laps shall be 75 mm (3") and shall be staggered a minimum of 100 mm (4") from cap sheet laps and base sheet laps, in order to avoid excessive thickness.
- .2 Draw parallel chalkline at termination line of cap sheet flashing at horizontal roof deck surface. Sink surface granules into bed of hot bitumen with torch and round-nosed trowel in area between chalk line and base of upstand or parapet, as well as over any granulated vertical surfaces to be overlapped.
- .3 Cap sheet flashing shall be torch welded directly on its base sheet, proceeding from bottom to top. Torching shall soften the two membranes and ensure a uniform weld, as described under "Cap Sheet Installation". When allowed by support, cap sheet top edge shall be nailed on 305 mm (12") centres.

3.14 WATERPROOF EXPANSION JOINT INSTALLATION

- .1 *Install* all components of the system in accordance with the manufacturer's printed instructions.
- .2 The system is to be wholly encapsulated between the plies of the modified bitumen membrane in a roofing system.

3.15 ROOF DRAINS

- .1 Ensure that roof drains are set to permit drainage, located at lowest possible location, and properly secured. Cut and slope insulation at each drain to form a sump and to accommodate flashing immediately surrounding drain. Review final locations with the *Consultant* prior to installation of drains.
- .2 Drain sumps to be *Provided* by the tapered insulation manufacturer.
- .3 Temporarily block drain pipes during application of membrane. Remove blocking when work is not in progress and after work of this Section is completed.

- .4 Carry membrane and insulation to edge of drain base and trim around drain opening. Top ply to be granulated cap sheet flashing to minimum 200 mm (8") from edge of drains.
- .5 Ensure that installation of drain and membrane is performed in accordance with recommendations of drain manufacturer.
- .6 Prime drain flange and allow to dry.
- .7 Embed first felt ply in a coat of waterproofing mastic and extend plies of felt into the drain opening of drains, and trim as required.
- .8 Fill void between drain body and roof insulation board/base structure support with two- component polyurethane foam insulation.

3.16 ROOF PENETRATIONS

- .1 *Install* curb flashings around ducts, pipes, structural steel, and other projections through membrane systems in conformance with manufacturer's written instruction and as detailed.
- .2 Install penetration flashing supplied under work of mechanical and under the work of this Section, in accordance with roofing manufacturer's installation instructions.
- .3 Prime metal flanges with primer and allow solvents to flash off prior to installation.
- .4 Remove poly film on areas to receive metal flashing. Set metal flange in full layer of waterproofing mastic to *Provide* positive bond and seal.
- .5 *Install* base ply to the base of the metal flashing staying short of curved metal section.
- .6 *Install* cap ply to the base ply flashing ensuring a full bond to the base ply and apply bead of waterproofing sealer at the termination point.

3.17 METAL FLASHINGS

- .1 *Install* metal flashings in accordance with Section 07 62 00 – Metal Flashing.

3.18 PAVER INSTALLATION

- .1 Public area pavers:
 - .1 *Install* paver pedestals in accordance with manufacturer's recommended installation instructions.
 - .2 Paver installation:
 - .1 *Install* pavers in accordance with paver manufacturer's written instructions. Align the top cap joint spacers with paver edges. Level pavers in succeeding rows.
 - .2 *Install* pavers tightly butted into pedestals. Form minimum joint widths.
 - .3 Shim or adjust to level and as necessary to prevent rocking of pavers.
 - .4 Installation tolerances:
 - .1 Step in face alignment between paver faces: Plus or minus 1.5 mm (1/16").
 - .2 Jog in joint alignment between paver sections: Maximum 1.5 mm (1/16").

- .5 Do not use pavers with chips, cracks, voids, stains, or other defects which might be exposed to view in the finished work.
- .6 Machine cut pavers as necessary to fit the conditions indicated. Joints shall be no wider than the typical paver to paver joint.

3.19 FIELD QUALITY CONTROL

- .1 Conduct quality control in accordance with Section 01 45 00 – Quality Control and as follows:
 - .1 Inspection and testing:
 - .1 Prior to installation of cap sheet membrane, base sheet membrane installation shall be reviewed by manufacturer and inspection and testing company, who shall each submit field review reports to the *Consultant*.
 - .2 Independent inspection and testing company shall perform:
 - .1 Inspections and *Provide* inspection reports.
 - .2 Tests and *Provide* test reports:
 - .3 Core cuts (if requested).
 - .2 Manufacturer's field review to be in accordance with Section 01 45 00 – Quality Control.

3.20 ADJUSTING AND CLEANING

- .1 Remove applicator's equipment and debris as work progresses, and at completion of the work of this Section in accordance with Sections 01 77 00 – Contract Closeout Procedures and Submittals.
- .2 Remove bituminous markings from finished surfaces.
- .3 Repair or replace defaced or disfigured finishes caused as a result of the work of this Section.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 SUMMARY

- .1 Section Includes
 - .1 Roof and floor drains.
 - .2 Floor drain trap seal primers.
 - .3 Cleanouts.
 - .4 Hose bibs.
 - .5 Hydrants.
 - .6 Backwater valves.
 - .7 Water hammer arrestors.
 - .8 Oil Interceptor.
 - .9 Thermostatic mixing valves.
 - .10 Backflow preventers.

PART 2 PRODUCTS

2.1 ROOF DRAINS

- .1 Aluminum or galvanized cast iron drain with sump, removable cast aluminum, coated cast iron or cast bronze domed strainer with vandal proof screws and including the following accessories.
 - .1 Membrane flange and membrane clamp with integral gravel stop.
 - .2 Adjustable under deck clamp.
 - .3 Roof sump receiver.
 - .4 Waterproofing flange.
 - .5 Levelling frame.
 - .6 Adjustable extension sleeve for roof insulation.
 - .7 Perforated or slotted ballast guard extension for inverted roof.
 - .8 Perforated stainless steel ballast guard extension.
 - .9 Control flow weir, in locations shown on drawings denoted as 'CFRD', for number of weirs shown on drawing.
 - .10 Plastic components are not acceptable.
 - .11 *Provide* drains by single manufacturer throughout.
 - .12 Acceptable Manufacturers:
 - .1 Zurn.
 - .2 Lexcor.

- .3 Jay R. Smith.
- .4 Mifab.
- .5 Watts.

2.2 FLOOR DRAINS AND SHOWER DRAINS

- .1 Unless otherwise specified or scheduled, floor drains are to be vandal-proof drains, each complete with a cast iron body and a trap seal primer connection. All cast iron components are to be factory finished with latex based paint coating.
- .2 MIFAB or equal J.R. Smith, Watts or Zurn, of the following types (*Contractor* to choose applicable type. Refer also to drawings.) Selection of bronze or stainless finishes by Architect. (Refer also to drawings.)
 - .1 *Provide* on floor areas except as noted below, MIFAB F1100-1-5-7, 125mm dia. round nickel bronze, or F1100-3-5-7, 125mm dia. round stainless steel strainer.
 - .2 *Provide* on ceramic tile, quarry tile or terrazzo floor areas, MIFAB F1100-S-1-5-7, 150 x 150 mm square nickel bronze, or F1100-S-3-5-7, 150 x 150 mm square stainless-steel strainer.
 - .3 *Provide* on ceramic tile for a shower drain, MIFAB FD212TC-S5-49 132 x 132 mm square heavy duty polished chrome strainer.
 - .4 Hub drains shall be provided where indicated on the drawing(s), MIFAB F1100-DD-1-5-7, 125mm dia. round nickel bronze, or F1100-DD-3-5-7, 125mm dia. round stainless steel hub.
 - .5 Funnel floor drains shall be provided where indicated on the drawing(s). *Provide* next to equipment where only one (1) pipe has to relieve to drain, MIFAB F1100-EF-1-5-7, 125mm dia. round nickel bronze, or F1100-EF-3-5-7, 125mm dia. round stainless steel strainer and 100mm funnel.
 - .6 Funnel floor drains receiving more than one (1) pipe relief to drain, shall be revised to MIFAB F-1100-EG type, supplied with a 4" x 9" (100 x 230mm) funnel in lieu of the 100mm funnel above.
 - .7 All floor and funnel drains shall be complete with adjustable top assemblies, cast iron frames, sediment buckets and trap seal primmer tapings.
 - .8 Floor and funnel drains installed in water-proofed areas shall be revised to MIFAB F1100C type supplied with clamp collar and weep holes.
- .3 Lacquered finish is standard. Use clamping collar on floors above grade. The following is a standard floor drain.

2.3 FLOOR DRAIN TRAP SEAL PRIMERS

- .1 Electronic type
 - .1 CSA certified electronic automatic trap priming manifold, sized and located to suit the quantity of traps, complete with:
 - .1 16 ga. galvanized steel cabinet with door, flush recessed mounting for exposed areas and surface mounted in services areas (e.g. mechanical rooms, custodial rooms);
 - .2 20 mm (3/4") dia. NPT copper pipe inlet with shut-off valve, solenoid valve, atmospheric vacuum breaker, calibrated discharge manifold for equal water distribution, compression fitting connections to suit quantity of traps to be primed;
 - .3 UL certified electronic assembly including manual override / test switch, 24-hour adjustable timer, circuit breaker.

- .2 Acceptable manufacturers:
 - .1 Precision Plumbing Products PT series;
 - .2 Mifab, Inc.;
 - .3 or approved equal.

2.4 CLEANOUTS - GENERAL

- .1 Horizontal Piping: TY pipe fitting with an extra heavy brass plug screwed into the fitting.
- .2 Vertical Piping: Bronze or copper cleanout tees in copper piping, each complete with a bronze ferrule, and, for cast iron piping, "BARRETT" type cast iron cleanout tees, each gas and water-tight and complete with a bolted cover.
- .3 Urinal(s): Wall access cleanout assemblies, each complete with a tapered plug, threaded brass insert, urethane rubber seal, and polished stainless-steel access cover with vandal-proof stainless-steel securing screw. Acceptable products are:
 - .1 Zurn #ZSS-1666-1;
 - .2 Jay R. Smith #SQ4-1819;
 - .3 Mifab #C1440-RD;
 - .4 Watts Industries (Canada) Ltd. #CO-440.

2.5 CLEANOUTS – VEHICLE BAY

- .1 Epoxy-coated cast iron floor cleanout with adjustable gasketed extra heavy duty stainless steep top, and removable gas tight gasketed brass cleanout plug. Suitable for live loads up to 10,000 pounds.
 - .1 Acceptable products:
 - .1 Watts CO-1200-RX;
 - .2 Or approved equal.

2.6 FLOOR CLEANOUT TERMINATIONS

- .1 Factory finished cast iron terminations, each adjustable and complete with a cast iron body with neoprene sleeve, solid, gasketed, polished nickel-bronze scoriated top access cover to suit the floor finish, a seal plug, and captive, vandal-proof, stainless steel securing hardware.
- .2 MIFAB or equal J.R. Smith, Watts or Zurn, of the following types (*Contractor* to choose applicable type. Selection of bronze or stainless finishes by Architect. Refer also to drawings.)
 - .1 *Provide* on floor areas except as noted below, MIFAB C1100-R-1-34, round nickel bronze, or C1100-R-3-34, round stainless steel access cover.
 - .2 *Provide* on vinyl tile floor areas, MIFAB C1100-TS-1-34, square nickel bronze, or C1100-TS-3-34, square stainless steel access cover.
 - .3 *Provide* on ceramic tile, quarry tile or terrazzo floor areas, MIFAB C1100-US-1-34, square nickel bronze, or C1100-US-3-34, square stainless steel recessed access cover.
 - .4 All floor cleanouts shall be complete with adjustable top assemblies, cast iron frames, primary gasket seals and secondary plugs.
 - .5 Floor cleanouts installed in water-proofed areas shall be revised to MIFAB C1100C type supplied with clamp collar and weep holes.

- .6 *Provide* at the base of each vertical stacks MIFAB C1450 or C1460.
- .7 *Provide* on exposed walls, accessible pipe chases and outside grade, MIFAB C1450.
- .8 *Provide* on plaster walls, MIFAB C1450-RD-6.
- .9 *Provide* at urinals, MIFAB C1440-RD-6 with round stainless steel access cover and neoprene plug.
- .10 In plastic piping (where not terminating through building finishes), *Provide* plastic cleanouts.
- .11 Access doors shall be provided as specified elsewhere in the specification.
- .3 Acceptable products are:
 - .1 Zurn # ZN-1602-SP Series;
 - .2 Jay R. Smith #4020-F-C Series;
 - .3 Mifab # as noted above
 - .4 Watts Industries (Canada) Ltd. # CO-200-R-1.

2.7 INTERIOR HOSE BIBBS

- .1 Flush-Concealed: Recessed, 92 mm (3 5/8") deep, recessed, encased wall hydrant with lockable bronze or stainless-steel box with hinged cover identified "WATER", bronze interior parts, a screwdriver operated stop in the supply, key operated control valve, 20 mm (3/4") dia. hose connection, and a vacuum breaker. Acceptable products are:
 - .1 Jay R. Smith #5509QT-CL-SAP;
 - .2 Zurn #Z1350;
 - .3 Mifab #MHY-55.
- .2 Semi-Recessed - Finished Areas: Anti-siphon type, 100 mm (4") deep hose bib with stainless steel face with operating key, bronze interior parts, 20 mm (3/4") dia. solder inlet, 20 mm (3/4") dia. hose connection, and integral vacuum breaker. Acceptable products are:
 - .1 Jay R. Smith #5619-SAP-98;
 - .2 Zurn #Z1333 "ECOLOTROL";
 - .3 Mifab #MHY-30. HOSE BIBS
- .3 Surface - Exposed – Cold Water -Unfinished Areas: Brass or bronze hose bibb with hose end vacuum breaker. Acceptable products are:
 - .1 Watts Industries (Canada) Inc. #SC8-1;
 - .2 Zurn/Wilkins # Z1341 with hose end vacuum breaker;
 - .3 Chicago Faucets #293-E27CP;
 - .4 Jay R. Smith #5609QT-SAP.
- .4 Exposed – Unfinished Areas – Hot and Cold Water: Mixing faucet for surface mounting. Acceptable products are:
 - .1 Delta Commercial #28T8083;
 - .2 Zurn #Z841L1-RC;
 - .3 Jay R. Smith #5560QT-LB-SAP.

2.8 EXTERIOR NON-FREEZE WALL HYDRANTS

- .1 Flush-Concealed: Recessed, encased, self-draining hydrants, each complete with a copper casing, operating rod assembly to suit the wall thickness, polished nickel bronze box with hinged locking cover, 20 mm ($\frac{3}{4}$ ") dia. threaded hose connection outlet, vacuum breaker, and a loose tee handle operating key. Acceptable products are:
 - .1 Jay R. Smith #5519-98;
 - .2 Zurn #Z1320;
 - .3 Mifab #MHY-26.

2.9 BACKWATER VALVES

- .1 Heat bonded powder epoxy coated cast iron in-line type, each complete with a bolted and gasketed cover, bronze flapper, stainless steel extension, and stainless-steel hardware. Acceptable products are:
 - .1 Zurn #Z-1095-15-MJ;
 - .2 Jay R. Smith #7022.

2.10 WATER HAMMER ARRESTORS.

- .1 Piston type, sealed, pressurized water hammer arrestors suitable for either horizontal or vertical installation, each complete with a hard-drawn copper body, "O"-ring piston seals, an air charge, and an inlet opening equal to the diameter of the pipe in which the arrestor is required. Acceptable products are:
 - .1 Zurn #Z1705;
 - .2 Precision Plumbing Products Inc. #SC;
 - .3 Watts Industries (Canada) Inc.;
 - .4 Mifab MWH Series.

2.11 OIL INTERCEPTOR

- .1 Oil interceptor with extra heavy duty cover and extension as required. Acceptable products are:
 - .1 Watts Drainage OI-525-X

2.12 THERMOSTATIC MIXING VALVES.

- .1 Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment, check valve on inlets, volume control shut-off valve on outlet, stem thermometer on outlet and strainer stop checks on inlets.
 - .1 Watts or equal manufacturer.

2.13 BACKFLOW PREVENTER

- .1 Reduced pressure zone dual check valve design backflow preventers in accordance with CAN/CSA B64 (including supplements), each of bronze or epoxy coated cast iron bronze fitted construction depending on size, and complete with inlet strainer, inlet and outlet shut-off valves, an intermediate relief valve, ball valve type test cocks, and a proper air gap fitting. Acceptable products are:

- .1 Watts Industries #009QT-S for 12 mm (½") size, #909QT-S for 20 mm to 50 mm (¾" to 2") size, and #909-NRS-S for 65 mm (2½") and larger size;
- .2 Zurn/Wilkins 975XL and 375 Series;
- .3 Conbraco Industries Inc. Series 40-200;
- .4 Danfoss Flomatic Corp. Series RPZ. SUMPS

PART 3 EXECUTION

3.1 INSTALLATION

.1 Roof Drains

- .1 Supply roof drains and place roof drain bodies in position for flashing into roof construction as part of the roofing work. Connect with piping and *Provide* accessories.
- .2 Protect roof drains from damage and entrance of debris until roofing work is complete and refinish any areas where the cast iron factory finish has been damaged or removed, including rusted areas.

.2 Floor Drains

- .1 *Provide* floor drains where shown on the drawings. Confirm the exact location of drains prior to roughing in.
- .2 Equip each drain with a trap.
- .3 In equipment rooms and similar areas, exactly locate floor drains to suit the location of mechanical equipment and equipment indirect drainage piping. In washrooms, exactly locate floor drains to avoid interference with toilet partitions.
- .4 Temporarily plug and cover floor drains during construction procedures. Remove plugs and covers during final cleanup work and when requested, demonstrate free and clear operation of each drain. Replace any damaged grates and refinish any areas of the drain where the cast iron finish has been damaged or removed, including rusted areas.

.3 Cleanouts

- .1 *Provide* cleanouts in drainage piping in locations as follows:
 - .1 in the building drain or drains as close as possible to the inner face of the outside wall, and, if a building trap is installed, locate the cleanout on the downstream side of the building trap;
 - .2 at or as close as practicable to the foot of each drainage stack;
 - .3 at maximum 15 m (50') intervals in horizontal pipe 100 mm (4") dia. and smaller;
 - .4 at maximum 30 m (100') intervals in horizontal pipe larger than 100 mm (4") dia.;
 - .5 in the wall at each new urinal or bank of urinals in a washroom;
 - .6 wherever else shown on the drawings.
- .2 Cleanouts are to be the same diameter as the pipe in piping to 100 mm (4") dia., and not less than 100 mm (4") dia. in piping larger than 100 mm (4") dia.
- .3 Where cleanouts in vertical piping are concealed behind walls or partitions, install the cleanouts near the floor and so that the cover is within 25 mm (1") of the finished face of the wall or partition.

.4 Floor Cleanout Terminations

- .1 Where cleanouts occur in horizontal inaccessible underground piping, extend the cleanout TY fitting up to the floor, and *Provide* a cleanout termination set flush with the finished floor.
- .2 In waterproof floors, ensure that each cleanout termination is equipped with a flashing clamp device. Cleanout terminations are to suit the floor finish.
- .3 Where cleanout terminations occur in finished areas, confirm locations prior to rough-in and arrange piping to suit.
- .4 Ensure that cleanout termination covers in tiled floor are square in lieu of round.

.5 Hose Bibbs

- .1 *Provide* hose bibbs where shown and/or specified on the drawings.
- .2 Unless otherwise shown, specified, or required, mount hose bibbs approximately 1 m (3') above the floor. Confirm exact locations prior to roughing-in.

.6 Exterior Non-Freeze Wall Hydrants

- .1 *Provide* non-freeze wall hydrants where shown.
- .2 Install hydrants level and plumb such that hose outlets are approximately 600 mm (2') above grade level. Confirm exact locations prior to roughing-in.
- .3 *Provide* a shut-off valve inside the building to each exterior non-freeze wall hydrant.
- .4 *Provide* sign "Non potable water – do not drink"

.7 Backwater Valves

- .1 *Provide* backwater valves in drainage piping where shown on the drawings and connect with piping as indicated.

.8 Water Hammer Arrestors

- .1 *Provide* accessible water hammer arrestors in domestic water piping in locations as follows:
 - .1 in headers at groups of plumbing fixtures;
 - .2 at the top of risers;
 - .3 at ends of long horizontal runs of piping;
 - .4 in piping connecting solenoid valves or equipment with integral solenoid valves;
 - .5 wherever else shown or required by Code.
- .2 Install each unit in a piping tee either horizontally or vertically in the path of potential water shock in accordance with the manufacturer's published instructions and details.

.9 Thermostatic Mixing Valves

- .1 *Provide* a domestic hot water thermostatic mixing valves at DHW tanks and as required by local code.
- .2 Adjust each valve to design requirements and check and test operation. Set maximum temperature limit stops.

.10 Backflow Preventers

- .1 *Provide* a backflow preventer on incoming DCW incoming service and in each direct domestic cold water connection to equipment other than plumbing fixtures and fittings. Backflow preventers are not required at fixtures connected to non-potable water.

- .2 Locate each backflow preventer on floor or wall between 765 mm and maximum 1.5 m (30" and 60") above the floor such that it is easily accessible for maintenance and testing. Equip each backflow preventer with an air gap fitting and pipe the reduced pressure zone water outlet to drain.
- .3 Test operation of each backflow preventer in accordance with requirements of CAN/CSA B64 by personnel certified for such testing by governing authorities, and submit signed test results and a properly and clearly identified and marked inspection and test record card for each backflow preventer.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 SUMMARY

- .1 Section Includes
 - .1 Piping insulation.
 - .2 Jackets and accessories.

1.3 SCOPE OF WORK

- .1 Supply and install insulation for piping systems in all areas, including:
 - .1 Domestic cold water, domestic hot water, hot water re-circulating, and tempered water piping and fittings.
 - .2 Condensate drain piping and fittings serving refrigeration and cooling equipment.
 - .3 Refrigerant piping/tubing inside and outside the building.
 - .4 Roof drain sumps and storm piping inside the building.
 - .5 Miscellaneous piping indicated on the drawing(s).

1.4 SUBMITTALS

- .1 *Product Data*: *Provide* product description, list of materials and thickness for each service, and locations.

PART 2 PRODUCTS

2.1 PERFORMANCE

- .1 Fire Hazard Ratings: Unless otherwise specified, all insulation system materials inside the building must have a fire hazard rating of not more than 25 for flame spread and 50 for smoke developed when tested in accordance with CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
- .2 Thermal Performance: Unless otherwise specified, thermal performance of insulation is to meet or exceed the values given in the National Energy Code of Canada for Buildings 2011 or Tables 6.8.2.A, 6.8.2.B, 6.8.3.A, and 6.8.3.B of ASHRAE/IES Standard 90.1-2007.
 - .1 In the event of a contradiction between two specified requirements, the higher thermal performance requirement shall govern.

2.2 FLEXIBLE FOAM ELASTOMERIC

- .1 Manufacturers:
 - .1 Armacell;
 - .2 K-Flex.

- .2 Closed cell, sleeve type, longitudinally split self-seal, foamed plastic pipe insulation with a water vapour transmission rating of 0.10 in accordance with ASTM E96-90, Procedure B, and all required installation accessories.

- .1 Use for refrigerant gas and liquid tubing/piping.

2.3 FIRE-RATED PREMOULDED MINERAL WOOL

- .1 Manufacturers:

- .1 Roxul;
 - .2 Johns Manville;
 - .3 Paroc Group.

- .2 Non-combustible, fire-rated, rigid, sectional, longitudinally split mineral wool or basalt pipe insulation with a reinforced vapour barrier jacket and compatible with CAN4-S115 and CAN/ULC-S01 firestopping.

- .1 Use only where insulated piping penetrates fire-rated construction.
 - .2 Apply where the pipe penetrates the fire barrier and is required to form a component of the ULC firestop system at the penetration.
 - .3 Coordinate with firestopping work.

2.4 PRE-MOULDED MINERAL FIBRE

- .1 Manufacturers:

- .1 Johns Manville;
 - .2 Knauf;
 - .3 Manson Insulation;
 - .4 Owens Corning.

- .2 Rigid, sectional, sleeve type insulation to ASTM Standard C 547-00, with a factory applied vapour barrier jacket.

- .1 Use for all piping inside the building and above ground, except as noted.
 - .2 Not acceptable for refrigerant piping.

2.5 BLANKET MINERAL FIBRE

- .1 Manufacturers:

- .1 Johns Manville;
 - .2 Knauf;
 - .3 Manson Insulation;
 - .4 CertainTeed.

- .2 Blanket type roll insulation to CGSB 51-GP-11M, 24 kg/m³ (1½ lb/ft³) density, with a factory applied vapour barrier facing.

- .1 Use in conjunction with premoulded mineral fibre for insulating valves and similar odd shaped items.

2.6 INSULATION FASTENINGS

- .1 Aluminium Banding: Equal to ITW Insulation Systems Canada "FABSTRAPS" minimum 12 mm wide, 0.6 mm (1/16") thick aluminium strapping.
 - .1 for securing fiberglass insulation for tanks, shell and tube heat exchangers, etc., and for securing metal jacket on weather-proofed pipe insulation
- .2 Stainless Steel Banding: Equal to ITW Insulation Systems Canada "FABSTAPS" 0.6 mm (1/16") thick, minimum 12 mm wide type 304 stainless steel strapping.
 - .1 for securing stainless steel insulation jacket in place
- .3 Duct Insulation Fasteners: Weld-on 2 mm (3/32") diameter zinc coated steel spindles of suitable length, complete with minimum 40 mm square plastic or zinc plated steel self-locking washers.
 - .1 for securing mineral fibre duct and casing insulation in place
- .4 Tape Sealant: Equal to MACtac Canada Ltd. self-adhesive insulation tapes, types PAF, FSK, ASJ, or SWV as required to match the surface being sealed.
 - .1 for sealing and securing joints in mineral fibre pipe and duct insulation
- .5 Adhesive - Mineral Fibre Insulation: Clear, pressure sensitive, brush consistency adhesive, suitable for a temperature range of -20°C to 82°C (-4°F to 180°F), compatible with the type of material to be secured, and WHMIS classified as non-hazardous.
 - .1 for adhering board or blanket mineral fibre insulation to pipe, ducts and equipment
- .6 Adhesive – Flexible Elastomeric Insulation: Armacell "Armaflex" #520 air-drying contact adhesive.
- .7 Adhesive – Closed Cell Foamed Glass Insulation: Pittsburgh Corning PC88 multi-purpose two-component adhesive.
- .8 Lagging Adhesive: White, brush consistency, ULC listed and labelled, 25/50 fire/smoke rated lagging adhesive for canvas jacket fabric, suitable for colour tinting, complete with fungicide and washable when dry.
 - .1 for securing and finishing canvas jacket on exposed mineral fibre insulation
- .9 Sheet Metal Screws: No. 10 stainless steel sheet metal screws.

2.7 INSULATION JACKETS AND FINISHES

- .1 White PVC:
 - .1 Manufacturers:
 - .1 Proto Corp. "LoSMOKE";
 - .2 The Sure-Fit System "SMOKE-LESS 25/50";
 - .3 Johns Manville Inc. "Zeston" 300.
 - .2 Roll form sheet and fitting covers, minimum 15 mil thick white PVC, 25/50 rated, complete with installation and sealing accessories.
 - .1 for finishing exposed pipe insulation inside building
- .2 Rigid Aluminium:

- .1 Equal to ITW Insulation Systems Canada "Lock-on" 0.406 mm (0.016") thick embossed aluminum jacket material to ASTM B209, factory cut to size and complete with polysurlyn moisture barrier and continuous modified Pittsburgh Z-Lock, and "Fabstraps" and butt straps with weatherproof the end to end joints. Fittings are to be two-piece epoxy coated pressed aluminum with weather locking edges.
- .2 For jacket on insulation outside building to protect from damage and *Provide* additional weather-proofing. May also be used inside building as alternate to PVC.
- .3 Stainless Steel:
 - .1 Equal to ITW Insulation Systems Canada "Lock-on" 0.254 mm (0.010") thick type 304 embossed stainless steel to ASTM A240, factory cut to size and complete with moisture barrier and continuous modified Pittsburgh Z-Lock, and butt straps with "Fabstraps" to cover end to end joints. Fittings are to be two piece pressed stainless steel with weather locking edges.
 - .2 For use as a protective jacket as for rigid aluminum specified above but where a more corrosion-resistant material is required. May also be used inside building.
- .4 Adhesive Backed Flexible Aluminium:
 - .1 MFM Building Products Corp. "Flex-Clad 400" roll form sheet material with an aggressive rubberized asphalt adhesive backing, high density polyethylene reinforcement, and an embossed aluminum facing.
 - .2 For use as an alternative to rigid aluminum jacket material for exposed exterior pipe and duct insulation and for underground pipe insulation, where approved by Engineer. Note that ambient temp. must be 65°F or better for installation
- .5 Insulation Cement:
 - .1 Heat resistant, trowel consistency thermal insulating and finishing cement to CAN/CGSB 51.12, and suitable in all respects for the application.
- .6 Protective Coating - Foamed Glass Insulation:
 - .1 Pittsburgh Corning "PITTCOTE 404" flexible acrylic latex weather barrier coating, white unless otherwise specified.
 - .2 For "FOAMGLAS" insulation when used above ground and does not require a metal jacket or other jacket
- .7 Protective Coating - Flexible Foam Elastomeric Insulation:
 - .1 Equal to Armacell "WB Armaflex" weatherproof, water-based latex enamel finish.
 - .2 for Armacell "Armaflex" type flexible elastomeric insulation exposed to weather.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verify that piping has been tested before applying insulation materials.
- .2 Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

- .1 Install materials to manufacturer's written instructions.
- .2 On exposed piping, locate insulation and cover seams in least visible locations.

- .3 Insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature:
 - .1 *Provide* vapour barrier jackets, factory applied or field applied.
 - .2 Insulate fittings, joints, and valves with moulded insulation of like material and thickness as adjacent pipe.
 - .3 Finish with glass cloth and vapour barrier adhesive.
 - .4 PVC fitting covers may be used.
 - .5 Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
 - .6 Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, [pump bodies] and expansion joints.
- .4 For insulated pipes conveying fluids above ambient temperature:
 - .1 *Provide* standard jackets, with or without vapour barrier, factory applied or field applied.
 - .2 Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
 - .3 Finish with glass cloth and adhesive.
 - .4 PVC fitting covers may be used.
 - .5 For hot piping conveying fluids 60 degrees C (140 degrees F) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
 - .6 For hot piping conveying fluids over 60 degrees C (140 degrees F), insulate flanges and unions at equipment.
- .5 Inserts and Shields:
 - .1 Application: Piping 40 mm (1-1/2 inch) diameter or larger.
 - .2 Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 - .3 Insert Location: Between support shield and piping and under the finish jacket.
 - .4 Insert Configuration: Minimum 150 mm >(6 inches) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 - .5 Insert Material: hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- .6 Finish insulation at supports, protrusions, and interruptions.
- .7 For pipe exposed in mechanical equipment rooms or in finished spaces finish with PVC jacket and fitting covers.
- .8 For exterior applications, *Provide* vapour barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapour barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
- .9 For buried piping, *Provide* factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with 0.025 mm (1.0 mil) thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.
- .10 For heat traced piping, insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.3 TOLERANCE

- .1 Substituted insulation materials: Thermal resistance within 10% at normal conditions, as materials indicated.

3.4 SCHEDULES

- .1 Insulate piping as per the following table, using insulation K factor of 0.034 W/m·°C at 24°C (0.24 BTU·in/hr·ft² at 75°F). Thickness of alternate products shall *Provide* equivalent R-value.

PIPING SYSTEM / Piping Diameter	MINIMUM INSULATION THICKNESS	
	32 mm diameter & smaller	38 mm diameter & larger
Domestic Hot Water Supply, Recirculation, and Tempered	25 mm	38 mm
Domestic Cold Water	25 mm	25 mm
Roof Drainage and Piping within building	25 mm	25 mm
Plumbing Vents	38 mm	38 mm
Heating Water and Glycol Supply & Return	25 mm	38 mm
Chilled Water Supply & Return	25 mm	25 mm
Refrigerant Lines within building	25 mm	38 mm
Refrigerant Lines outside building	38 mm	38 mm
Miscellaneous Piping and Fittings	25 mm	25 mm
Steam Lines from <input type="checkbox"/> umidifier	<input type="checkbox"/> mm	<input type="checkbox"/> mm
Condensate Line from <input type="checkbox"/> umidifier	<input type="checkbox"/> mm	<input type="checkbox"/> mm

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.
- .2 This document outlines the minimum equipment and performance standards for a completely interoperable Building Automation System (BAS).
- .3 The work shall include design, supply, installation, and commissioning a complete microprocessor based automatic control system to achieve the performance specified in the following Sections.
- .4 The BAS shall be capable of total integration of facility infrastructure systems with user access to all system data, locally over a secure Intranet within the building and by remote access by a standard Web Browser over the Internet.
- .5 The entire BAS shall be peer-to-peer networked, stand-alone, distributed control in accordance with American National Standards Institute/American Society of Heating, Refrigerating and Air Conditioning Engineers (ANSI/ASHRAE) Minimum Standard 135-2015, BACnet – A Data Communication Protocol for Building Automation and Control Networks.
- .6 All labour, material, equipment and software not specifically referred to herein or on the plans, but is required to meet the functional intent, shall be provided without additional cost to the *Owner*.
- .7 Contractors shall be manufacturers or licensed factory representatives and installers of the manufacturers, specified for the local area in which the *Site* is located.
- .8 The automation vendor must have least 2 dealers in Ontario that can *Provide* parts and services to upon request.
- .9 The BAS contractor shall *Provide* the necessary engineering, installation, supervision, commissioning and programming for a complete and fully operational system. The contractor will *Provide* as many trips to the job site for installation, supervision, and commissioning as are necessary to complete the project to the satisfaction of the consultant and/or project supervisor.
- .10 The controls contractor will specifically read all mechanical and electrical drawings, specifications, and addenda and determine the controls work provided by the mechanical contractor, his subcontractors, and the electrical contractor. The controls contractor is expected to have the expertise to coordinate the work of other contractors and to make a completely coordinated Building Automation Control System (BAS) for the mechanical systems.
- .11 The BAS shall be compatible with future control Products for 10 years or more.
- .12 When the BAS is installed all devices must be the latest publicly released version of hardware, firm ware and software.
- .13 Ensure compliance with all applicable codes and authorities having jurisdiction.
- .14 The system shall be installed by trade certified electricians regularly employed by the controls contractor. The system shall be tested and calibrated by factory certified technicians qualified for this type of work and in the regular employment of the BAS manufacturer or its exclusive factory authorized installing contracting field office representative. The installing office shall have a minimum of five years of installation

experience with the manufacturer. Supervision, calibration and commissioning of the system shall be by the employees of the factory authorized BAS branch or representative.

1.2 BUILDING MANAGEMENT SYSTEM SUB-CONTRACTOR

- .1 All work of this Section shall be coordinated and provided by a single BMS *Subcontractor*.
- .2 The work of this Section shall be scheduled, coordinated, and interfaced with the associated work of other trades. Reference the Mechanical Division Sections for details.
- .3 The work of this Section shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, warranties, services, and items which are required for the complete, fully functional and commissioned BMS, even if these are not specifically mentioned or fully described under this Section.
- .4 If the BMS subcontractor believes there are conflicts or missing information in the project documents, the subcontractor shall promptly request clarification and instruction from the design team.

1.3 ACCEPTABLE BMS CONTRACTORS

- .1 The Building Automation System shall be one of the following systems:
 - .1 Automated Logic
 - .2 Delta Controls
 - .3 Reliable Controls.

1.4 SCOPE

- .1 This project scope shall include, but not be limited to, the following work:
 - .1 Preparation of control shop drawings for review and approval. See Submittals.
 - .2 Supply and install a network of Building Automation Control System (BAS) panels and field devices. See Hardware, Software and Field Devices.
 - .3 Supply and install customized graphics software as specified. See Software.
 - .4 Install, wire and label all BAS control system components. See Installation.
 - .5 Calibrate and commission the installed control system. See Commissioning.
 - .6 *Provide* maintenance manuals and as-built drawings. See As-Built Documentation.
 - .7 *Provide* customized training for operations, maintenance and technical staff. See Training.

1.5 DRAWINGS AND SUBMISSIONS

- .1 Submit the following information to the consultant and/or the project manager for review and approval:
 - .1 Control Schematics.

- .2 Detailed sequence of operation for each control schematic or controlled system.
- .3 System Architecture indicating the proposed interconnection and location of all BAS panels, network connections and key peripheral devices (workstations, modems, printers, repeaters, etc.)
- .4 BAS Points List indicating the panel ID, panel location, hardware address, point acronym, point description, field device type, point type (i.e, AO/DO/AI/DI), end device fail position, end device manufacture and model number, and wire tag ID). Terminal identification for all control wiring shall be shown on the shop drawings.
- .5 Wiring diagrams including complete power system, interlocks, control and data communications.
- .6 Hard copy graphical depiction of the application control programs.
- .7 Manufacturers' data / specification sheets for all material supplied.

1.6 MATERIALS

- .1 All points shall be available to BACnet.
- .2 Points shall be field reconfigurable. No set points shall be hard coded in the programs.
- .3 All controllers shall be loaded to a maximum of 80%. 20% of each of the inputs, outputs and variables shall remain unused to allow for future growth and expandability.
- .4 The system shall consist of all operator interfaces, microprocessor-based controllers, sensors, wells, automatic control valves, control dampers, transducers, and relays, automatic control valves, and damper actuators.
- .5 All equipment, points, etc. shall have common labelling.
- .6 Software shall be completely programmable and capable of all control and mathematical functions.
- .7 BAS shall come with copies of all software and licenses required to operate and configure the system. Software shall be the latest version as of substantial completion. Software updates, new versions and patches shall be provided to the Region as they are released free of charge for 2 years from substantial completion."
- .8 All temperature units for BAS and controlled equipment shall be in °C (degrees Celsius).
- .9 Operator Activity Tracking - An audit trail report to track system changes, accounting for operator initiated actions, changes made by a particular person or changes made to a specific piece of equipment designated time frame, shall be printable and archived for future use. The operator activity tracking shall be in a tamper-proof buffer file.
- .10 Operator workstation interface software shall optimize operator understanding through the use of English language prompting, English language point identification and industry standard PC application software. The software shall *Provide*, as a minimum, the following functionality:
 - .1 Real-time graphical viewing and control of environment
 - .2 Scheduling and override of building operations
 - .3 Collection and analysis of historical data and dynamic data (trend plot)
 - .4 Definition and construction of dynamic color graphic displays
 - .5 Editing, programming, storage and downloading of global controller databases
 - .6 Alarm reporting, routing, messaging, and acknowledgment

- .11 *Provide* a graphical user interface, which shall minimize the use of the keyboard through the use of a mouse or a similar pointing device and a “point and click” approach to menu selection.
- .12 Battery backup: Automatic restart after power failure: Upon restoration of power after an outage, the BAS shall automatically, and without human intervention, update all monitored functions, resume operation based on current synchronized time and status and implement special start-up strategies as required.
- .13 Refresh rate – The maximum permissible refresh rate is ONE (1) second. The refresh rate is defined as the time it takes the controller central processing unit (CPU) to sample all inputs, calculate all variables, update all timers and proportional integral derivative (PID) controllers, check all schedules, update all trend logs and runtime logs, execute all programs and assign values to all outputs.
- .14 The HVAC equipment shall be supplied as “Thermostat-Ready”. The building automation system shall have direct control of dampers, heating and cooling stages without the requirement of BACnet, Lonworks or any other type of communication interface. Factory installed interlocks, safeties and anti-cycle timers shall be provided as required.
- .15 Reports shall be generated on demand or via a pre-defined schedule and directed to video displays, printers or hard drive. As a minimum, the system shall allow the user to easily obtain the following types of reports:
 - .1 A general listing of all or selected points in the network
 - .2 List of all points currently in alarm
 - .3 List of all points currently in override status
 - .4 List of all disabled points
 - .5 List of all points currently locked out
 - .6 List of user accounts and access levels
 - .7 List all weekly schedules
 - .8 List of limits and dead-bands
 - .9 Excel reports
 - .10 System diagnostic reports including a list of BAS panels on line and communicating, and the status of all BAS terminal unit device points
 - .11 List of programs
- .16 *Provide* a means for the operator to view the communication status of all controllers connected to the system. The status should show whether the controller is communicating or not.
- .17 *Provide* a means for the operator to reset the error count for all controllers to zero.
- .18 *Provide* a means for the operator to display and change the system configuration. This shall include, but not be limited to, system time, day of the week, date of day light savings set forward/ set back, printer type and port addresses, modem port and speed, etc. Items shall be modified utilizing easy to understand terminology using simple mouse/cursor key movements.
- .19 *Provide* a security system that prevents unauthorized use unless the operator is logged on. Access shall be limited to the operator’s terminal functions unless the user is logged on.
- .20 Where possible, utilize Optimized Start features on equipment to reduce hydro demand charges.
- .21 During the initial design The *Region* shall supply the controls contractor a range of BACnet addresses the BAS will run on. The BAS network will run either BACnet over IP or BACnet

over MSTP. All BAS points will be network visible so that other BACnet systems can auto discover them. *Contractor* shall consult with York *Region Project* Manager during the development of addresses.

1.7 WAN ACCESS

- .1 *Provide* necessary interface and cabling to connect the BAS to the YR WAN. Obtain the particular WAN system details from the Engineer or *Project* Supervisor.
- .2 The *Region* shall supply the WAN IP address, Gateway and Subnet mask for the BBMD router in the network. The controls contractor will facilitate integration into the *Region's* existing BAS BACNET network.
- .3 On the network a BACnet IP device that is capable of BBMD will route information from other sites and the operator work station. In addition there shall be a CAT6A wire that is run to the *Region's* IT switch with a 4' pigtail and connector.

1.8 TREND DATA

- .1 *Provide* trend logs for every hardware input and output.
- .2 All trends should be accessible via the graphical interface.
- .3 Trends should contain all related variables of a control loop (i.e. setpoint, measured variable and control output) and have the ability to be plotted simultaneously on the same graph. Field Devices Individual trends should *Provide* an appropriate "snapshot" of the variable. Trends should contain a minimum of 5 days worth of trend data.
- .4 *Provide* trending capabilities at 5 minute intervals that allow the user to easily monitor and preserve records of system activity over a one year period. Any system point may be trended automatically at time-based intervals or change of value, both of which shall be user-definable. Trend data may be stored on hard drive for future diagnostics and reporting. Additionally, trend data may be archived to network drives or removable disk media for future retrieval.
- .5 Trending shall be accessible from the graphics screens for each point. Each point shall have its associated trend capability accessible from the graphic via an icon located beside the point name on the graphic page.
- .6 Trend data reports shall be provided to allow the user to view all trended point data. Reports may be customized to include individual point or predefined groups of at least six points. *Provide* sufficient capacity to allow for trending a minimum of 100 points at 2000 samples each. Reports should be easily transferable on-line to Microsoft Excel. The *Contractor* shall *Provide* custom designed spreadsheet reports for use by the *Owner* to track energy usage and cost, equipment run-times, equipment efficiency, and/or building environmental conditions.
- .7 The operator shall be able to change trend log setup information. This includes information to be trend logged as well as the interval at which the information is to be logged. All points in the system may be logged. All operations shall be password protected. Setup and viewing may be accessed directly from any and all graphics where the point is displayed.
- .8 Trending shall include the ability to track energy management aspects including, but not limited to, the following:
 - .1 Daily use
 - .2 Monthly use
 - .3 Daily Hi and Low

- .4 Monthly Hi and Low
- .5 Demand Limiting and Load Shedding Program
- .6 Run time accumulation for any specified equipment
- .7 After hour use log
- .9 The primary input sensor for all control loops must connect to the same panel containing the control loop output.
- .10 Trend data storage must be in the same panel as the hardware or logical points being trended.

1.9 ALARMS

- .1 The BAS shall be configured to 3 categories: notifications, urgent alarms and critical alarms with different priorities.
- .2 Notification alarms will reside on BAS interface only. Urgent and critical alarms will email out to addresses specified by *Owner*. Please consult with *Owner* to develop alarm strategy.
 - .1 Example email message

Medium : 380 Bayview BAS YR_BYV_GEN_ST (602211.B11) Normal -> Alarm change-of-state ----- 380 Bayview Ave., generator is running, possibly loss of power. Time@ 2021-02-10 07:21:44



System Name:	CHS_9060 Jane
Source:	9060Jane Main Router (601100)
Message:	Urgent_alarm : 9060 Jane Street HPL Cooler Fan failed
State:	Alarm
Alarm Time:	10-03-2021 01:02:37 PM



- .3 The BAS will be configured to *Provide* for remote alarm capabilities.
- .4 Alarms shall be capable of being routed to The *Region's* IT server so that they can be sent to Operator's email addresses.
- .5 The operator workstation shall provided with audible, visual and printed means of alarm indication. The Alarm Dialog box shall always become the Top Dialog box regardless of the application(s) being run at the time (such as a word processor). A printout of all alarms shall be sent to the assigned terminal and port.
- .6 *Provide* a log of alarm messages. The alarm log shall be archived to the hard drive of the operator workstation. Each entry shall include a point descriptor and address, time and

date of alarm occurrence, point value at the time of alarm, time and date of point return to normal condition and time and date of alarm acknowledge.

- .7 The Controls *Contractor* shall work with the *Region* to determine the alarms unless specified otherwise.
- .8 Alarm messages shall be in plain English and shall be user definable on site or via remote communication.

1.10 FIELD DEVICES

- .1 Automatic Control Valves
 - .1 Valves used for throttling applications shall have a linear percentage-to-flow characteristic.
 - .2 Ball valves are the preferred valve type for zone and HVAC control valves. Globe and butterfly valves shall be used where required to *Provide* the desired pressure drop and CV.
 - .3 Automatic Control valves shall be manufactured by Belimo.
- .2 Control Valve Actuators
 - .1 Size control valve actuators to *Provide* a tight close off against system head pressures and pressure differentials.
 - .2 Valve actuators shall accept a 0-10VDC control voltage for all proportional applications.
 - .3 Floating point control of valves is not acceptable under any circumstances.
 - .4 Heating valves shall spring-return fail open and cooling valves shall spring-return fail closed. Non-spring-return control valves may be used for terminal reheat coils and large HVAC control valves requiring a higher close off pressure.
- .3 Damper Actuators
 - .1 Actuators shall be direct coupled for either modulating or two position control. Actuators shall be powered by an overload-proof synchronous motor. *Provide* 0-10 VDC control voltage for all proportional applications and either line or low voltage actuators for all two position applications.
 - .2 Damper actuators are to be manufactured by Belimo or approved equal.
- .4 Automatic Control Dampers
 - .1 Motorized control dampers, unless otherwise specified elsewhere, shall be as follows:
 - .1 Control dampers shall be parallel or opposed blade type as below or as scheduled on drawings
 - .1 Outdoor and/or return air mixing dampers and face and bypass (F&BP) dampers shall be parallel blade, arranged to direct airstreams toward each other.
 - .2 Other modulating dampers shall be the opposed blade type.
 - .3 Two-position shutoff dampers may be parallel or opposed blade type with blade and side seals.

- .2 Extruded aluminum damper frame and airfoil blades, EPDM blade gaskets, TPR thermoplastic frame seals, celcon/polycarbonate bearings. Blades are to be suitable for medium velocity performance (10 m/s [2000 fpm]).
 - .3 Two-position dampers for shutoff service to must be "flanged-to-duct" type, such that there is no reduction in duct cross section through the damper. Dampers may only be "installed-in-duct" type where indicated as such on drawings.
 - .4 Individual damper sections shall not be larger than 125 cm × 150 cm (48 in. × 60 in.).
 - .5 Exterior Dampers (intake and exhaust applications) to be Tamco Series 9000 or approved equal insulated dampers and thermally broken frame and leakage Class 1A type at 0.25 kPa (1 in w.g.) static pressure differential with silicon blade and frame seals. Blades are internally insulated with foam and thermally broken with an insulating factor of R-2.29.
- .2 All automatic control dampers not furnished with packaged equipment shall be supplied by the controls subcontractor and installed by the sheet metal subcontractor (except for VAV Boxes or line voltage dampers which shall be supplied by the Mechanical Contractor).
- .5 Room Sensors/Thermostats
 - .1 Office: Temp Display, Set point Display, Set point Adjust, Schedule Override, High and Low Limit on set points.
 - .2 All areas except offices: Set point Adjust, Schedule Override, High and Low Limit on set points.
 - .3 Mount sensors at a height of 1200 mm above finish floor unless otherwise indicated. Confirm exact location and mounting height with architect or Owner prior to final installation.
 - .4 Mount thermostats and space sensors as noted on the drawing. Do not mount on outside walls without permission of consultant.
 - .5 Thermostats (or with programming through the BAS) shall allow for deadbands of at least 3°C.
- .6 Current Switches (Digital)
 - .1 Provide BAS status for fan and pump motors using a mosfet type digital switch. Acceptable manufactures are ACI, Enercorp, Greystone, Veris and Elkor.
 - .2 All CTs should have a range close to 2 times of rated reading.
- .7 Pressure Transmitters
 - .1 Technical Performance - Solid State design, operating on capacitance principle, with non-interactive fine resolution, zero and span adjustments. End-to-end accuracy +/- 2% of full scale pressure range, including temperature compensation. 4-20mA, 0-5 VDC output, or 0-10 VDC output.
 - .2 Standard of Acceptance – ACI, Enercorp, Greystone, Modus.
- .8 Duct Temperature Sensor

- .1 Probe - Technical Performance – 10 k ohm thermistor sensor encapsulated in a 200mm long, 6mm OD copper or stainless steel probe. Operating range 0-60 degrees C. End-to-end accuracy +/- 0.3 degC. Assembly complete with wiring housing and mounting flange.
- .2 Averaging - Technical Performance - 10 k ohm thermistor constructed of FT6 plenum rated cable or soft copper tubing, incorporating numerous temperature sensors encapsulated at equal distances along the length of the element. The assembly acts as a single sensor reporting the average temperature from all individual sensors. End-to-end accuracy +/- 0.3°C. Assembly complete with wiring housing and mounting flange. Mount in a zig-zag manner to *Provide* continuous coverage of the entire duct cross-sectional area.
- .9 Outdoor Air Temperature Sensor
 - .1 Two outdoor air temperature sensors shall be installed and shall be programmed to check each other for accuracy. In the event of sensor failure the sensor deemed to be accurate shall be used to control the systems. The outdoor air sensors shall be located on a north wall if possible and a minimum of three (3) feet from any opening in the building envelope which could affect the sensor readings. The back face of the sensor enclosure shall be insulated to prevent temperature pick up from the building wall.
 - .2 Technical Performance, 10 k ohm thermistor -50oC to 50oC in a weatherproof enclosure mounted on north exposure. End accuracy of +/- 0.3 °C over the entire operating range.
- .10 Pipe Temperature Sensor
 - .1 Well - Technical Performance - 10k ohm thermistor sensor encapsulated in a 6mm OD, 50mm long probe, with screw fitting for insertion into a standard thermowell. Operating range -10 - +100°C. End-to-end accuracy +/- 0.3°C over the entire operating range. Complete with brass thermowell. Use heat transfer paste when mounting the sensor in thermowell. No surface mount strap on temperature sensors shall be used to monitor fluid temperature unless approved by the engineer.
- .11 CO2 Detector
 - .1 Technical Performance – Infrared CO2 monitor c/w 4-20mA or 0-5 VDC output, accuracy of +/- 40 ppm +3% reading.
 - .2 Standard of Acceptance – ACI-CO2-D or Telaire duct mount.

1.11 SECURITY SYSTEM MONITORING TO BAS

- .1 *Provide* digital input from security system.
- .2 All outside lighting control shuts off 20 minutes after building alarm system is armed.
- .3 When building security armed, all HVAC system shall be changed to unoccupied mode immediately when armed regardless of scheduled times.
- .4 All critical alarms as determined by York *Region*.

1.12 ENCLOSURE

- .1 The BAS control and power supply cabinets shall conform with the following:
 - .1 Panel enclosures shall be a locking type, metal cabinet, with common keying.
 - .2 CSA certified 150359 and UL listed E109310.

- .3 16 or 14 gauge steel.
- .4 Slip hinges enabling door removal for easier access and mounting. Door shall be lockable.
- .5 1/4 turn keyed latch standardized to G549 keyset.
- .6 14 or 12 gauge galvanized steel panel on collar studs natural finish.
- .7 Grounding stud on inner cover surface.
- .8 Grounding hole on mounting panel with grounding screw.
- .9 ANSI/ASA61 grey polyester - epoxy textured powder coating inside out.
- .10 3" deep wire duct shall be installed to neatly conceal controller wiring.
- .11 Power supply cabinets shall be provided with a ESA Field Evaluation approval.
- .12 2-100VA 120/24 Transformers Class II UL5085-3.
- .13 Over Current Protection by Circuit Breaker.
- .14 Outlet Receptacle for Service Laptop Power.

1.13 BAS DATABASE NAMING CONVENTIONS & PROGRAMS

- .1 All BAS programs shall follow the equipment manufacturer's sequence recommendations.
- .2 All BAS programs should include comments embedded in the program to describe the function and steps of the coding.
- .3 All BAS programs shall be created in each panel in logical order as determined by the equipment being controlled by each panel on the network.
- .4 All programs and program code is to follow proper coding practices including internal comments to describe the function of the statements and also ensure the source code is formatted in a consistent and logical manner. Programming coding should be kept as simple as possible.
- .5 System Schedules shall be submitted for approval and will include global and local scheduling.
- .6 The Outdoor Air Temperature Program shall be in its own program named OAT PG.
- .7 Network Status Panel Naming Conventions should indicate the building, panel location and panel number. The building name can be abbreviated as necessary to fit in the space.

1.14 GRAPHIC DISPLAY SCREENS

- .1 All Graphic Display Screens shall have the following common elements and functions regardless of system manufacturer. Every site shall have a graphic display screen for *Site* Graphic, System Architecture, each air handler, boilers, emergency generator, lighting, exhaust fans, heat reclaim, and for each room controlled by the BAS system.
- .2 All operator accessible points shall be yellow text and all information points shall be blue.
- .3 Trending shall be accessible from the graphics screens for each point. Each point shall have its associated trend capability accessible from the graphic via an icon located beside the point name on the graphic page.
- .4 Appendix A at the end of this document shows examples of typical graphic screens. These are examples only. Graphics shall comply with the following specific screen content. Not

all equipment and systems are listed below but the format will be the same for other equipment:

- .5 Graphic Screens General All Screens
 - .1 Navigation buttons to each major system in the building which indicate current screen display by a change in button colour
 - .2 Background colour shall be black
 - .3 Outdoor air temperature shall be displayed on every graphic screen
- .6 *Site* Graphic
 - .1 The York *Region* Logo on the site or opening graphic screen
 - .2 Artist concept or scanned in picture of the front of the building
 - .3 Access links to all global schedules or specific screens affecting entire building operation
 - .4 Access buttons links to Set Time, Holiday Schedule, Schedule, Alarms, Points on Manual
- .7 System Architecture
 - .1 Control panel layout and network architecture
 - .2 Indicating BAS panels and panel type(model)
 - .3 Panel locations room number text on screen
 - .4 Systems controlled by each panel
 - .5 Links to points list accessible from each panel
- .8 Architecture Panel Layout (Locations on Floor Plans)
 - .1 Locations of each panel on each floor plan level
 - .2 Panel types indicated by different icon
 - .3 Controls transformers locations
 - .4 Main network wiring and sub-network wiring layout
- .9 Floor Plans graphics
 - .1 Room numbers accurate as per room signage
 - .2 Mechanical rooms locations & signage tags
 - .3 Space temperatures for every temperature on each floor in appropriate room
 - .4 Space focus pick area for individual room control where applicable shall be yellow text
 - .5 Air Handler symbols indicating areas of the floor plan serviced by each air handler by a corresponding colour
 - .6 Status of Air Handler by colour change Red for off status, or text indication
 - .7 Supply air temperature for each air handler
- .10 AHU / Fan Coil graphic
 - .1 Accurate representation of the AHU / Fan Coil design

- .2 All associated control points to be displayed
- .3 All points to be monitored for automatic mode and shall be displayed when in Manual mode
- .4 A calculated percentage of fresh air shall be indicated on the AHU / Fan Coil graphic
- .5 Operator offset adjustment of the supply air setpoint, adjustable directly from the graphic
- .6 AHU / Fan Coil physical location shall be indicated on the graphic
- .7 Weekly occupied time of day schedule for the associated AHU / Fan Coil shall be accessible directly from the graphic by selecting an icon
- .8 Trend logs shall be accessible directly from the graphic by selecting an icon
- .11 Water Heater graphic
 - .1 Water heater graphic piping layout shall be accurate as per piping layout
 - .2 All associated control points for the water heating system to be displayed
 - .3 Operator offset adjustment of the scheduled water setpoint, adjustable directly from the graphic
 - .4 Status shall be indicated graphically
 - .5 Operator offset editable directly from the graphic screen
 - .6 Weekly time of day schedule for the building occupied schedule shall be accessible directly from the graphic by selecting an icon
 - .7 Trend logs shall be accessible directly from the graphic by selecting an icon
- .12 Exhaust fans graphic
 - .1 Exhaust fans control shall be editable directly from the graphic
 - .2 Exhaust fan status shall be indicated in text and a change in the exhaust fan icon
 - .3 Exhaust fan physical location shall be indicated on the graphic
 - .4 Area of the building being exhausted shall be indicated on the graphic
- .13 ERV graphic
 - .1 ERV control shall be editable directly from the graphic
 - .2 ERV status (normal/boost/off) shall be indicated in text and a change in the icon.

1.15 INSTALLATION

- .1 All wiring line and low voltage shall be installed in EMT conduit unless specifically specified otherwise.
- .2 All wiring shall be in accordance with the Ontario Electrical Code and any applicable local codes. All BAS wiring shall be installed in conduit unless otherwise allowed by the Ontario Electrical Code or applicable local codes. Where BAS plenum-rated cable wiring is allowed, it shall be run parallel to, or at right angles to, the structure, properly supported and installed in a neat and workmanlike manner. BAS wiring that runs in exposed ceiling spaces (eg garages, mechanical rooms) shall be installed in conduit.

- .3 In accessible ceilings, wiring from BAS controllers to sensors and actuators, control system network and low voltage wiring only may be installed with plenum-rated yellow jacket cable.
- .4 BX or flex conduit may only be used for the final (approximately one meter) run to controls devices, where the controls equipment is mounted on vibrating machinery.
- .5 Install EMT and cable at right angles to building lines, securely fastened, and in accordance with the standards set out in Division 16.
- .6 No wire smaller than 18 gauge is to be used on the project except for: wiring between terminal computer devices, wire in standard communication cables, such as printers and short haul modems, wire used in communication networks, i.e. any cable transferring digital data, using twisted shielded pairs.
- .7 All field wiring including sensor wiring and wiring from panels to devices shall be continuous. The use of wire connectors, wire nuts or splicing is not allowed.
- .8 *Provide* wells for all specified temperature sensors in hydronic piping system. Strap-on sensors may be only be used where a well installation is not possible. Obtain approval of Engineer for the use of any strap-on sensors.
- .9 Power for control system shall not be obtained by tapping into miscellaneous circuits that could be inadvertently be switched off.
- .10 Mount transformers and other peripheral equipment in panels located in serviceable areas. *Provide* line side breakers/fuses for all transformers.
- .11 All 120 VAC power for any controls equipment shall be from dedicated circuits. *Provide* a breaker lock for each breaker used to supply the control system. Update the panel circuit directory.
- .12 The controller may be powered from the equipment that it is directly controlling (i.e. heat pump, roof-top unit) only if the controller controls no other equipment and the power supply to the controller remains energized independently of unit operation or status. If power for the control system is taken from the equipment it serves, it should be clearly marked "Powered from Equipment".
- .13 All BAS control wiring shall be yellow jacket for identification purposes. BAS control inputs wiring shall be one colour, output should be another, and communication wires another.
- .14 The breaker or power isolation location shall be clearly marked on the inside door of each BAS panel enclosure.
- .15 Wiring in ceiling spaces to be installed clear of ceiling tiles and lights to allow access and removal of tiles and lights.
- .16 *Contractor* shall prepare a wiring mock-up of a typical system/device/main panel to demonstrate quality and workmanship for approval by the *Region*. This approved mock-up quality shall be maintained throughout the entire installation. System requiring mock-up to be discussed with the *Region's Project Manager*.
- .17 All wiring shall be routed orthogonally and drops shall have additional wiring coiled in ceilings to facilitate future sensor relocation.
- .18 Wiring in ceiling spaces to be secured/tied every 48" minimum.
- .19 Surge suppression shall comply, as a minimum, with the manufacturer's requirements.
- .20 All equipment including controllers shall be grounded.
- .21 All end-of-wire connectors shall be certified.
- .22 All components shall be labelled and detailed in manuals.

- .23 All wiring systems shall be colour coded to simplify maintenance.
- .24 All equipment shall be located for ease of service access.
- .25 *Contractor* shall maintain a list of deficiencies when close to completion, and shall update this list on a regular basis for review by the *Owner's* representative.
- .26 If the project is a retrofit of an existing system:
 - .1 *Contractor* shall remove all old redundant wiring following system verification
 - .2 Re-use of existing wiring is not allowed. Run continuous new wiring
 - .3 Re-use of components (eg enclosures, transformers) is not allowed unless approved by the *Region's Project Manager*

1.16 EQUIPMENT LOCATION

- .1 All distributed equipment such as VAV boxes, Roof top units, unit ventilators, fan coil units, etc. that utilize dedicated BAS controllers, shall have locally mounted controllers, in accessible locations within the building envelope. All locally mounted controllers shall be installed in enclosures suitable for that location. BAS controllers for mechanical equipment other than those listed above shall be mounted in mechanical rooms as noted below, unless specifically approved by the Engineer for this project.
- .2 All other BAS controllers, and interface devices that require regular inspection or that serve multiple HVAC systems shall be located in mechanical rooms, or in pre-approved storage rooms, or janitor closets.
- .3 No BAS panel shall be located inside the rooftop fan enclosure under any circumstances. All BAS panels shall be located within the building envelope, and shall be enclosed in a metal locking enclosure, as specified in 16.4.
- .4 All equipment located in mechanical rooms, storage rooms or janitor closets shall be installed in metal cabinets with hinged, lockable covers.
- .5 Transformers or power supplies shall not be located in ceiling spaces unless approved by the engineer for terminal control valves, actuators or zone controllers. When transformers are installed above ceilings, transformers shall be installed in metal enclosures, and the location shall be clearly labeled on the t-bar ceiling to indicate power transformer location.
- .6 A 120 VAC duplex receptacle for laptop power shall be provided if the cabinet is located further than 5' laterally from the nearest outlet.

1.17 IDENTIFICATION AND LABELLING EQUIPMENT

- .1 All panels must have a lamacoid tag (min. 3"x1") affixed to the front face indicating panel designation and function (i.e. "BAS Panel 1" or "Relay Panel 3").
- .2 All field sensors or devices must have a lamacoid tag (min. 3"x1") attached with tie-wrap or adhesive indicating the point software name and hardware address (i.e. F-1_MAT, 2.IP4).
- .3 Room sensors and other sensors in finished areas will require a device tag.
- .4 All devices within a field enclosure will be identified via a label or tag.
- .5 All BAS panel power sources must be identified by an adhesive label indicating the source power panel designation and circuit number on the outside of the enclosure door (i.e. "120vac fed from LP-2A cct #1).

- .6 All field equipment panels fed from more than one power source must have a warning label on the front cover.
- .7 All wires will be identified with self-adhesive wire labels or clip-on plastic wire markers at both ends.
- .8 All rotating equipment controlled by the BAS will have a tag or label affixed indicating that the equipment may start without warning.
- .9 All BAS panels will have a points list sheet (within a plastic sleeve) attached to the inside door. The points list will identify the following for each point: Panel number, panel location, hardware address, software name, point description, field device type, point type (i.e. AI or DO), device fail position, device manufacturer and model number or reference and wire tag reference.
- .10 Where required, field panels will have wiring diagrams attached to the inside door.
- .11 *Provide* new or modify existing equipment wiring diagrams (i.e. boilers, chillers, etc.) wherever the BAS interfaces to other equipment.

1.18 COMMISSIONING

- .1 Perform all necessary calibration, testing and de-bugging and perform all required operational checks to ensure that the system is functioning.
- .2 Upon completion of the performance tests, repeat these tests, point-by-point in the presence of the *Owner's* representative, as required. Properly schedule these tests so that testing is completed by the time directed by the *Owner's* representative.
- .3 Confirm and demonstrate to the Engineer and the *Owner's* agent that all systems are programmed and operating correctly. When project is complete the contract shall allow sufficient programming time in order to customize the sequences to meet operational needs, fine tuning of the system and other duties as required. The *Owner* shall determine the schedule.
- .4 Submit a copy of the system commissioning report to the Engineer for review and approval.
- .5 Each analogue input (i.e. temperatures, pressure, etc.) shall be verified with an approved calibration device. All actual temperature readings should be with +/- 1°C of the readings observed at the workstation.
- .6 Each analogue output shall be verified by manually commanding the output channel from the operator workstation to two or more positions within the 0-100% range and verifying the actual position of the actuator or device. All devices shall operate over their entire 0-100% range from a minimum control range of 10-90%.
- .7 Digital outputs shall be verified by witnessing the actual start/stop operation of the equipment under control.
- .8 Digital inputs shall be verified by observing the status of the input point as the equipment is manually cycled on and off.
- .9 Record all out-of-season or unverified points in the commissioning report as "uncommissioned".
- .10 The BAS field panel power source shall be toggled on and off to ensure reboot functionality and power down memory retention of all parameters. During the power down test, all connected system components should go to their fail-safe state.
- .11 All trends should be reviewed to ensure that setpoints are being maintained and excessive cycling of equipment is not occurring.

- .12 Control loop tuning parameters can be verified by applying a change to the current setpoint and observing the resulting trend log. Setpoint should be reached in a "reasonable" period of time without excessive cycling or hunting of the controlled device.

1.19 TRAINING

- .1 Once 5 consecutive Days of alarm-free operation are complete and documented, operator training may begin.
- .2 *Provide* 1 day of instruction to the *Owner's* designated personnel on the operation of the BAS and describe its intended use with respect to the programmed functions. Operator orientation of the BAS shall include, but not be limited to, the overall operation program, equipment functions (both individually and as part of the total integrated system), commands, systems generation, advisories, and appropriate operator intervention required in responding to the system's operation.

1.20 WARRANTY

- .1 Warranty all components supplied under this contract for a period of two years from substantial completion. Replace all controls equipment that fails during this period without cost to the owner.
- .2 All Controllers shall have a 5 year manufacturer's warranty.

1.21 AS-BUILT DOCUMENTATION

- .1 Within two weeks following substantial completion of the project, update the original submittal documents to reflect the "As Built" conditions of the project and submit four copies as required by the consultant and/or the *Project Manager*.
- .2 *Provide* a separate laminated copy of the control drawings for mounting in the mechanical room or in the controls panels.
- .3 *Provide* final point lists, shop drawings and all installed equipment data and operations sheets.
- .4 Submit USB drive containing up to date copies of the programs in each controller. *Provide* original program disks and documentation proving registration for all software programs provided as a part of this contract including: the BAS operator interface software, and the BAS graphics (bitmap files). *Provide* one set of original disks for every computer supplied under this contract or that the software has been loaded onto.
- .5 Submit (4) printed copies of the final programs that include all point definitions, weekly and annual schedule setting, controller setpoints and tuning parameters, and documented programmed sequences of operation.

1.22 CONTROL POINTS AND POINT LIST

- .1 A typical points list for system control and monitoring shall be used as a guide for system design.
- .2 This points list is not intended to be complete. It is intended to be a typical list to capture all foreseeable equipment types. *Project* specific points list must be created on a project- by-project basis by the BAS contractor and shall be reviewed by *York Region*.
- .3 *York Region* staff shall be consulted to develop the sequence of operations. *York Region* will *Provide* the BACnet address range for each building.
- .4 All control points shall have built in time delays to prevent short cycling.

- .5 Point Naming conventions shall be submitted for review by York *Region Project* team.
Names may be changed to comply with the Regions naming conventions.

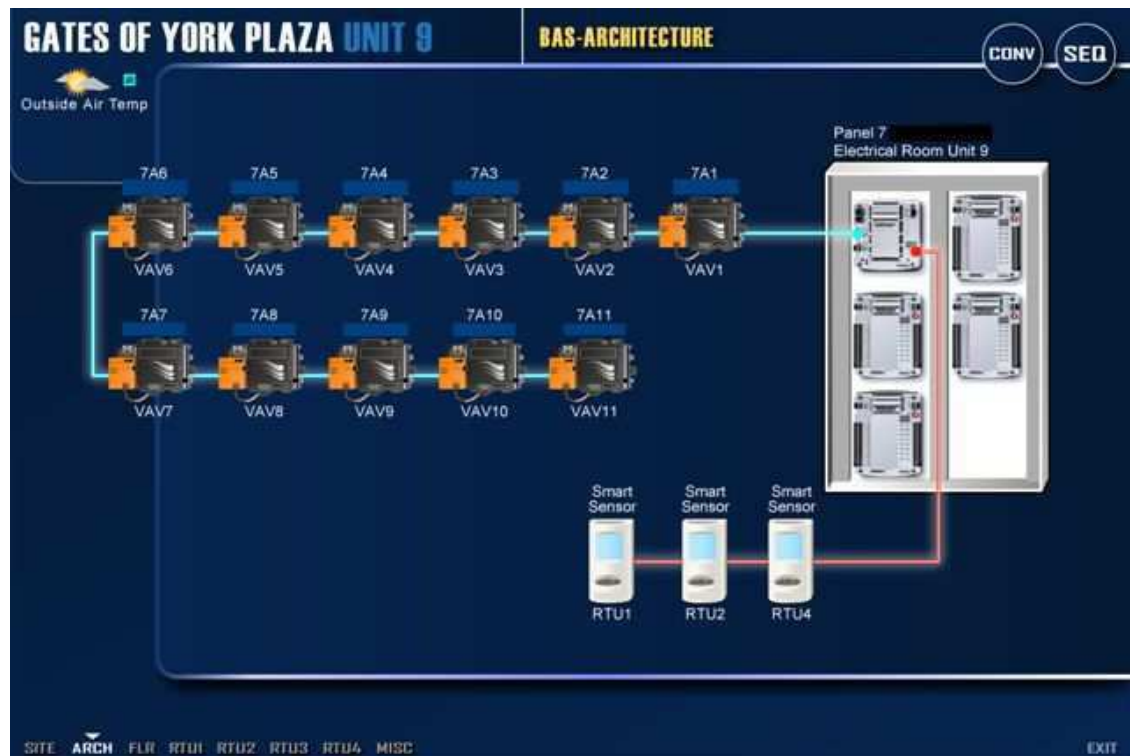
PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED.

Appendix A – Typical Graphic Screens









END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 1.
- .2 Section includes
 - .1 Sequence of operation
 - .1 RF fan coil units and Air Source Heat Pump ASHP
 - .2 RF
 - .3 Fresh Air Heater
 - .4 Humidification
 - .5 IT Room Air Conditioning
 - .6 Medical Storage Room
 - .7 Ceiling Radiant Tube Heaters
 - .8 Ceiling Air Ceiling Fan
 - .9 Ceiling Exhaust Fan EF
 - .10 CO₂ Ventilation System for Ceiling Air
 - .11 Testable Heater
 - .12 Mechanical Room Heater
 - .13 Generator Delay
 - .14 Domestic Hot Water System
 - .15 Trending

PART 2 PRODUCTS

- .1 RF fan coil units and Air Source Heat Pump ASHP
 - .1 The RF fan coil units will operate in either heating or cooling mode simultaneous heating and cooling not available through a programmable thermostat to maintain room temperature at set point.
 - .2 In the mechanical room the wall mounted fan coil unit will serve as the first stage of heating and the first stage of cooling. If there is inadequate heating due to extreme low temperatures leading to condenser unit lockout or exterior door left open the second stage of heating electric unit heater will be activated and the BAS will alert the operator. Fan coil unit and electric unit heater is controlled by BAS.
 - .3 FC01.1 serves the Writeup room medical storage and pass rooms. The fan coil unit will heat or cool based on the temperature reading from the fan coil controller located in the Writeup room. The BAS will receive the temperature reading through the fan coil's BAS communication device (Intelliscope).
 - .4 FC01.2 serves the Reception/Creo room 100 Creo Lounge and will heat or cool based on the temperature reading from the fan coil controller located in that space. The BAS will receive the temperature reading through the fan coil's BAS communication device (Intelliscope).

- . □□S to control temperature setpoint function range of the local area control of the □□□ limit locouts. Current temperature and setpoints are available in □□S operator.
- . Thermostats to be supplied and installed by the mechanical contractor. Thermostats shall have deadband of at least □□C.
- . □□S will monitor the status to generate an alarm if the fan coils units or □□□ condenser unit fail to operate when commanded on.
- . Fan status heating cooling on/off and mode status is available in □□S available in operator.

. R

- .1 The system is expected to control the ORV will run at all times but not during defrost mode controlled by ORV when ventilation to the building cannot be provided. Fans will run at airflow rates set locally through ORV so that supply is greater than exhaust airflow rate to assist in the pressurization. ORV on/off status is available in the SCADA operator.
- .2 ORV has local controller and it has a timer set for cumulative in each gas room to boost supply airflow and exhaust airflow for 10 minutes to exhaust cumulative odor or smells from the gas rooms in less time. This function is not tied to the SCADA.

. Fresher

1. The on/off status of the fresh air heater after the RH will be monitored and the SCOUR trend is recorded.
2. The discharge air setpoint is provided and the SC set at 100°C operator adjustable.

Definition

- .1 Humidifier is only enabled when FCU's Creol Lounge is running during heating season.
- .2 Upon call for humidification through humidity sensor located in Creol Lounge, S turns on humidifier unit until fan coil turns off or set point of R Radustale is reached. Status on/off is available in SS Serviceable operator.
- .3 If humidity level monitored in Write Room exceeds R Radustale, turn off the humidifier.

□ T Room □ r Condition □

1. When the temperature reaches the set point, the system monitors the temperature in the space. The first stage of cooling is shoulder or heating season only is enabled when the temperature reaches 26°C adjustable through the SS and uses a transfer fan to blow air to the mechanical room. When the temperature reaches 26°C adjustable through the SS, the second stage of cooling is enabled. The transfer fan turns off and the split air conditioning unit turns on until the unit has run for at least 10 minutes adjustable through the SS and the set point to turn cooling off 24°C adjustable through the SS is reached. During cooling season, the transfer fan is not used for cooling, only the split air conditioning unit is used. Trend fan and air conditioner usage.
2. If the temperature reaches 26°C adjustable through the SS, the SS will generate an alarm to alert the building operator. Temperature of room is available at the SS to the operator. Status of transfer fan and split air conditioning unit on/off is available to the operator.

Medical Storage Room

- 1 The medical storage room has a dedicated modulating damper that will open/close in increments to maintain a relative stable temperature between 65 to 70°F. The damper shall have the ability to open and close all the way if the temperature drops below 65°F turn on furnace heating even if main thermostat located in Crew Lounge is satisfied. If the temperature rises above 70°F turn on furnace cooling even if main thermostat is satisfied. Tractorous SS each time the furnace or air conditioning is turned on to solely serve the medical storage room the temperature of the medical storage room and the outdoor air temperature.
- 2 If the temperature reaches below 65°F or above 70°F the SS shall generate alarm to alert building operator. Temperature of room is available at SS readable operator.

2.1 Radiant Tube Heaters

- 1 The remote user interface is used to connect the radiant tube heaters to the SS. The SS uses the temperature reading from the dual radiant temperature sensor and the air temperature sensor to set an average temperature. The SS modulates the radiant gas tube heater output based on the outdoor air temperature and how far from setpoint the calculated indoor temperature is. When the outdoor air temperature is above 65°F adjustable the radiant tube heaters do not operate. The radiant tube heaters turn off once setpoint is reached.

2.2 Ceiling Fan

- 1 This fan will be operated through local speed controller installed in the apparatus area.
- 2 The operation of the fans shall be disabled when outdoor air temperature is below 65°F operator adjustable through SS limit make disabled through SS. Default is for limit to be disabled.
- 3 Timer enabled on function provided so building occupant turns on fan SS automatic shuts off after specified time default is SS operator adjustable building occupant may also turn off fan locally.

2.3 Exhaust Fan (F)

- 1 F shall run continuously to slightly negative pressure the space and on/off status shall be monitored SS readable operator. If the fan ceases to operate alert the operator unless the stoppage is due to generator delay.

3.1 CO and Ventilation System for Radiant Gas

- 1 CO and gas monitoring system shall be controlled by one-cell model SS point. Upon first alarm the monitoring system shall signal the intake air louvers damper and exhaust louvers damper to open. Once open the exhaust fans F1.1 and F1.2 will be allowed to run. If gas concentration continues to rise upon second alarm audible alarm will sound. Program a 5 minute relay delay off. Gas alarm concentrations and placement details below.

	First Alarm	Second Alarm	Sensor Detail
Carbon monoxide (CO)	10 ppm	20 ppm	1000 mm Hg
Propane (LPG)	100 ppm	200 ppm	1000 mm Hg

2.2 RECOMMENDED BASELINE SETPOINTS

Occupied				
	Heating		Cooling	
	Temperature Setpoint	Relative Humidity	Temperature Setpoint	Relative Humidity
Cre Lounge Lobby Area	20°C	50%	20°C	50%
Reception Area	18°C	50%	18°C	50%
IT Room Air Conditioning	18°C	50%	18°C	50%
Medical Storage Room	20°C	50%	20°C	50%
Restroom Heater	18°C	50%	18°C	50%
Mechanical Room	18°C	50%	18°C	50%

PART 3 EXECUTION

NOT S.D.

END OF SECTION

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Read and be governed by conditions of the *Contract Documents*, including Sections of Division 01.

1.2 DESCRIPTION

- .1 This Section specifies the supply and installation of *Site* furnishings.

1.3 RELATED WORK

- .1 Section 32 13 16 - Concrete Paving:

1.4 SUBMITTALS

- .1 Submit detailed Shop Drawings of *Products* including overall dimensions and options for approval by the *Consultant*.
- .2 Submit samples of *Products* and/ or components upon request by the *Consultant*.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver *Products* to the *Site* in the manufacturer's original, unopened containers and packaging. Upon delivery, examine packages immediately to ensure all *Products* are complete and undamaged.
- .2 Store *Products* in a protected, dry area in manufacturer's unopened containers and packaging.
- .3 Protect *Product's* finish from damage during handling and installation.

1.6 COORDINATION

- .1 Coordinate installation of *Site* furnishings with *Site* work and other appropriate Sections of the *Specifications* to maintain proper provisions of the work specified.
- .2 All *Site* furnishings shall be laid out in the field by the *Contractor* and approved by the *Consultant* prior to installation.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Bench:

- .1 Manufacturer: Maglin Site Furniture Inc.
Model: MLB870-PC
Colour: silver
Slats: HDPC Charcoal
Mounting: Surface mount to concrete pad

- .2 Or *Equivalent*

- .2 Picnic Table:

- .1 Manufacturer: Maglin Site Furniture Inc.
Model: 2400mm (96") long accessible picnic table

Colour: MLPT210
Slats: HDPE Cedar
Frame: Black
Mounting: Surface mount to concrete pad

.2 Or *Equivalent*

.3 Trash Receptacles:

.1 Manufacturer: Maglin Site Furniture Inc.
Model: MLWR1400-32
Colour: Frame: Silver
Slats: HDPC Charcoal
Mounting: Surface mount to concrete pad

.2 Or *Equivalent*

.4 Bike Rack:

.1 Manufacturer: Maglin Site Furniture Inc.
Model: MBR400-11-S
Colour: silver
Mounting: Surface mount to concrete pad

.2 Or *Equivalent*

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Place *Site* furnishings for approval by the *Consultant* prior to installation.
- .2 Do not locate anchor bolts until *Site* furnishings are in place.
- .3 Surface mount *Site* furnishings to concrete pad or wall as per the *Drawings* and Details and/or the manufacturers' instructions and specifications.

END OF SECTION