Project A

SPECIFICATIONS - ISSUED FOR TENDER

VOLUME 2 OF 3
MECHANICAL + ELECTRICAL
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END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 35 29.06 - Health and Safety Requirements.

.4 Section 01 61 00 - Common Product Requirements.

.5 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.6 Section 01 78 00 - Closeout Submittals.

.7 Section 01 91 13 - General Commissioning (Cx) Requirements.

.8 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

1.2 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

.2 Shop drawings to show:
.1 Mounting arrangements.
.2 Operating and maintenance clearances.

.3 Shop drawings and product data accompanied by:
.1 Detailed drawings of bases, supports, and anchor bolts.
.2 Acoustical sound power data, where applicable.
.3 Points of operation on performance curves.
.4 Manufacturer to certify current model production.
.5 Certification of compliance to applicable codes.
.6 Design parameters all indicated on schedules and specifications to be incorporated on shop drawings.

1.2 SUBMITTALS (Cont'd)

.4 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedure provide "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
.1 In case such a template is not provided Contractor shall create one and provide sample for review prior to shop drawings submission.
.2 Shop drawings without the "Shop Drawing Submittal Title Sheet" will not be reviewed.

.5 Closeout Submittals:
.1 Provide as specified in Section 01 78 00 - Closeout Submittals.
.2 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
.3 Operation data to include:
.1 Control schematics for systems including environmental controls.
.2 Description of systems and their controls.
.3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
.4 Operation instruction for systems and components.
.5 Description of actions to be taken in event of equipment failure.
.6 Valves schedule and flow diagram.
.7 Colour coding chart.
.4 Maintenance data to include:
.1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
.2 Data to include schedules of tasks, frequency, tools required and task time.
.5 Performance data to include:
.1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
.2 Equipment performance verification test results.
.3 Special performance data as specified.
.4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
.6 Approvals:

1.2 SUBMITTALS (Cont'd)

.5 (Cont'd)

.6 (Cont'd)

.1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted.

.2 Make changes as required and re-submit as directed by the Departmental Representative.

.7 Site records:

.1 Mark changes on drawings as work progresses and as changes occur. Include changes to control systems and low voltage control wiring.

.2 Use different colour waterproof ink for each service.

.3 Make available for reference purposes and inspection.

.8 As-built drawings:

.1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.

.2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).

.3 Submit to Departmental Representative for approval and make corrections as directed.

.4 Perform testing, adjusting and balancing for HVAC using as-built drawings.

.5 Submit completed as-built drawings with Operating and Maintenance Manuals.

.9 Submit copies of as-built drawings for inclusion in final TAB report.

1.3 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 45 00 - Quality Management System.

.2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 EQUIPMENT REQUIREMENTS AND INSTALLATION

.1 Unions or flanges: provide for ease of maintenance and disassembly.

.2 Space for servicing, disassembly and removal of equipment and components: provide as recommended by manufacturer or as indicated.

.3 Equipment drains: pipe to floor drains.

.4 All plumbing fixtures drain and sanitary venting connection to be installed in accordance with the latest edition of all local codes.

.5 Install equipment, rectangular cleanouts and similar items parallel to, or perpendicular to, building lines.

.6 Provide new materials and equipment of proven design, quality and or current models with published ratings for which replacement parts are readily available.

.7 The word "provide" shall mean "supply and install".

.8 Uniformity:
.1 Use product of one manufacturer unless otherwise specified, for equipment or material of the same type of classification.
.2 Installation:
.1 Unless otherwise specified, follow manufacturer's recommendations for safety, adequate access for inspection, maintenance and repairs.
.2 Permit equipment maintenance and disassembly with minimum disturbance to connecting piping and duct systems without interference with building structure or other equipment.
.3 Lubrication:
.1 Provide accessible lubricating means for bearings, including permanent lubrication "Lifetime" bearings. Extended grease nipples to be supplied.

.9 Site condition:
.1 Drawings indicate approximate location of equipment and services. Perform site measurements prior to installation. Do not scale drawings.

1.4 EQUIPMENT REQUIREMENTS AND INSTALLATION (Cont'd)

.9 (Cont'd)
.2 To avoid interference closely coordinate installation of mechanical services and equipment with other trades. Advise of any possible interference in timely fashion. Do not proceed with system or equipment installation without Departmental Representative's instruction. In case that system has to be relocated within 1500mm radius from anticipated location, no additional charge or credit will be expected and approved.
.3 Each mechanical trade to prepare and submit for review, set of site specific interference drawings for each area affected by this contract.

1.5 COMMON ELEMENTS

.1 Each trade to review complete set of documents and provide as rquired:
.1 SRS System.
.2 RF Protection/separation for services crossing designated walls.

1.6 DELIVERY STORAGE AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal, and Section 21 05 01 - Common Work Results - Mechanical

1.7 WASTE MANAGEMENT AND

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordante with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 ANCHOR BOLTS AND TEMPLATES

.1 Provide, locate and set all anchor bolts and fastening devices and equipment.

PART 3 - EXECUTION

3.1 PAINTING REPAIRS AND RESTORATION

.1 Do painting in accordance with Section 09 91 23 Interior Painting.

.2 Prime and touch up marred finished paintwork to match original.

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

3.2 CLEANING

.1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.3 DEMONSTRATION

.1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

.2 Trial usage to apply to following equipment and systems:
.1 Air Systems.
.2 Heating Systems.
.3 Cooling Systems.
.4 Plumbing Systems.
.5 Control Systems.
.6 Fire Protection Systems.

.3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.4 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.

3.3 DEMONSTRATION (Cont'd)

.5 Instruction duration time requirements as specified in appropriate sections.

.6 Departmental Representative will record these demonstrations on video tape for future reference.

.7 Allow for 6 hour training session for each system.

3.4 PROTECTION

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

3.5 INSTALLATION OF DEVICES PROVIDED BY DIVISION 25

.1 Where the work of Division 25 required control devices to be installed in the work provided by Divisions 21, 22 and 23 installation of such will form part of this contract.

.2 Where the work of Division 25 requires coordination with the work of Divisions 21, 22 and 23, these divisions will cooperate/coordinate as required.

3.6 COMMISSIONING

.1 Review requirements of Section 01 91 13 - General Commissioning (Cx) Requirements and arrange for staff familiar with the project to be present during Cx activity.Provide equipment and system information and data, provide small tools and assist during commissioning.

3.7 SPECIAL REQUIREMENTS

.1 Each device and any component for equipment or accessories must not allow WiFi, bluetooth or any form of wireless access.
.1 Provide manufacturer written certificate stating above fact for all material supplied and installed under this contract.

3.7 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 00 10 - General Instructions.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 35 29.06 - Health and Safety Requirements.

.4 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.5 Section 01 78 00 - Closeout Submittals.

.6 Section 01 91 13 - General Commissioning (Cx) Requirements.

.7 Section 21 05 01 - Common Work Results - Mechanical.

1.2 REFERENCES

.1 National Fire Protection Association (NFPA)
.1 NFPA 13-2013, Standard for the Installation of Sprinkler Systems.
.2 NFPA 25-2011, Water-Based Fire Protection Systems Handbook.

.2 Underwriter's Laboratories of Canada (ULC)
.1 CAN4 S543-M1984, Standard for Internal Lug Quick Connect Coupling for Fire Hose.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submittals:
.1 Manufacturer's Catalog Data, including specific model, type, and size for:
.1 Pipe and fittings.
.2 Alarm valves.
.3 Valves, including gate, check, and globe.
.4 Sprinkler heads.
.5 Pipe hangers and supports.
.6 Pressure or flow switch.
.7 Fire department connections.

1.3 ACTION AND INFORMATIONAL SUBMITTALS (Cont'd)

.2 (Cont'd)
.2 Drawings:
.1 Sprinkler heads and piping system layout.
.1 Prepare 760 mm by 1050 mm detail working drawings of system layout in accordance with NFPA 13, "Working Drawings (Plans)".
.2 Show data essential for proper installation of each system.
.3 Show details, plan view, elevations, and sections of systems supply and piping.
.4 Show piping schematic of systems supply, devices, valves, pipe, and fittings. Show point to point electrical wiring diagrams.
.2 Electrical wiring diagrams.
.3 Submit copy of working drawings to all other trades for review and co-ordination. Obtain and keep for record signed copies with acknowledgement of review.
.3 Design Data:
.1 Calculations of sprinkler system design.
.2 Indicate type and design of each system and certify that each system has performed satisfactorily in the manner intended for not less than 18 months.

.3 Product Data:
.1 Provide manufacturer's printed product literature and data sheets for equipment and systems, applicable series designation or style and include product characteristics, performance criteria, physical size, finish and limitations.

.4 Shop Drawings:
.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province Territory of Canada.

.5 Samples:
.1 Submit samples of following:
.1 Each type of sprinkler head.
.2 Signs and valve tags.

.6 Test reports:

1.3 ACTION AND INFORMATIONAL SUBMITTALS (Cont'd)

.6 (Cont'd)
.1 Test hydrostatically to meet requirements of fire protection system to which it will be connected.

.7 Certificates:
.1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.8 Manufacturers' Instructions:
.1 Instructions: provide manufacturer's installation instructions.

.9 Field Quality Control Submittals:
.1 Manufacturer's Field Reports: submit manufacturer's field reports specified.

1.4 CLOSEOUT SUBMITTALS

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

.2 Provide detailed hydraulic calculations including: summary sheet, Contractor's Material and Test Certificate for above ground piping, as well as other deliverables for incorporation into manual specified in Section 01 78 00 - Closeout Submittals, in accordance with NFPA 13.

1.5 QUALITY ASSURANCE

.1 Qualifications:
.1 Installer: company or person specializing in dry sprinkler systems with documented experience.

.2 Supply fittings, valves, and specialties from a single manufacturer. Use date stamped castings for, fittings, valve bodies, for quality assurance and traceability.

1.6 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials:
.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
.2 Provide spare sprinklers and tools in accordance with NFPA 13.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements:
.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.8 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 ENGINEERING DESIGN CRITERIA

.1 Design system in accordance with NFPA 13, using following parameters:
.1 Hazard:
.1 To suit occupancy as indicated.
.2 Pipe size and layout:
.1 The system shall be hydraulically designed.
.2 Sprinkler head layout: to NFPA 13 or as directed by authority having jurisdiction.
.3 Water supply:

2.1 ENGINEERING DESIGN CRITERIA (Cont'd)

.1 (Cont'd)

.3 (Cont'd)

.1 Conduct and pay at cost flow test on closest hydrant. A copy of the hydrant test used for design is supplied in Appendix A. Verify if correct conditions are same as provided for preliminary design.

.2 All new automatic sprinkler systems shall be hydraulically designed using water supply test data obtained by testing to NFPA 291 Recommended Practice for Fire Flow Testing and Marking of Hydrants. Tests shall be conducted by, or under direct supervision of Departmental Representative.

.3 Record Flow test on schedule as per Figure 4.11.2 Sample Report of a Hydrant Flow Test in NFPA 291.

.4 Pressure gauges shall be ULC listed, not ASME.

2.2 PIPE, FITTINGS AND VALVES

.1 Pipe:

.1 Ferrous: to NFPA 13.

.2 Where Steel pipe is used, piping shall be painted with one coat of primer and one coat of red paint.

.2 Fittings and joints to NFPA 13:

.1 Ferrous:grooved, welded, flanged.

.3 Auxiliary valves:

.1 ULC listed for fire protection service.

.2 Up to NPS 2: bronze, grooved or screwed ends, OS & Y gate.

.3 NPS 2 1/2 and over: cast or ductile iron, flanged or grooved indicating butterfly valve.

.4 Swing or spring-actuated check valves.

.5 Ball drip.

.6 Tamper devices wired back to fire alarm panel.

.4 Pipe hangers:

.1 ULC listed for fire protection services.

2.3 SPRINKLER HEADS

.1 General: to ANSI/NFPA 13 and ULC listed for dry pipe fire services. TEmperature ratings of sprinkler heads to be in accordance with NFPA 13.
.1 Upright bronze glass bulb type with wire guard.
.2 Recessed, flush, chrome, glass bulb type with cover plate. With cup and cover to match ceiling finish.
.3 Side wall chrome fusible link and level type.

2.4 AUXILIARY SUPERVISORY SWITCHES

.1 General: to NFPA 13 and ULC listed for fire service.

.2 Valves:
.1 Mechanically attached to valve body, with normally open and normally closed contacts and supervisory capability.

.3 Flow switch type:
.1 With normally open and normally closed contacts and supervisory capability.

.4 Pressure alarm switch:
.1 With normally open and normally closed contacts and supervisory capability.

2.5 FIRE DEPARTMENT CONNECTION

.1 Provide connections approximately 1.5 m above finish grade, location as indicated.

.2 To ANSI/NFPA 13 and ULC S543 listed,Siamese type.

.3 Polished bronze chrome plated recessed exposed of approved two-way type with 2.5 inch National Standard female hose threads with plug, chain, and identifying fire department connection escutcheon plate.

.4 Thread specifications: compatible with local fire department.

.5 Fire department connection to be Storz Connection.

2.5 FIRE DEPARTMENT CONNECTION (Cont'd)

.6 Fire deparment connection shall have a sign located above it meeting the requirements of NFPA.

2.6 DRY PIPE VALVE

.1 ULC listed.

.2 Cast or ductile iron, flanged sized to suit water main.

.3 Components:
.1 Accelerator.
.2 Air maintenance device with low pressure alarm.
.3 Alarm pressure switch with supervisory capability.
.4 Pressure gauges.
.5 Drain valve.
.6 Test valve with associated piping.
.7 Shut off valve - OS & Y with tamper-proof device wired back to fire alarm panel.
.8 Required air pressure 90 kPa (13 psi).

.4 Provide valve complete with internal components that are replaceable without removing valve from installed position.

2.7 COMPRESSED AIR SUPPLY

.1 115 volt, single phase, 15 amp, 5hp Automatic Air Compressor

.2 ULC listed.

.3 Capacity:
.1 To restore normal air pressure in system within 30 minutes.
.2 To provide air pressure in accordance with instruction sheet furnished with dry pipe valve. connected in reserve.

.4 Piping: ferrous, NPS 3/4 screwed joints and fittings, to NFPA 13.

2.8 PRESSURE GAUGES

.1 112 mm, dial type: to ASME B40.100, Grade 2A, stainless steel phosphor bronze bourdon tube having 0.5% accuracy full scale unless otherwise specified.

.2 Provide:
.1 Siphon for steam service.
.2 Snubber for pulsating operation.
.3 Diaphragm assembly for corrosive service.
.4 Gasketted pressure relief back with solid front.
.5 Bronze stop cock.
.6 Oil filled for high vibration applications.

.3 Maximum limit of not less than twice normal working pressure at point where installed.

2.9 RELIEF VALVE

.1 ULC listed.

2.10 SPARE PARTS CABINET

.1 For storage of maintenance materials, spare sprinkler heads and special tools.

.2 Construct to sprinkler head manufacturers standard.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install, inspect and test to acceptance in accordance with NFPA 13 and NFPA 25.

.2 Testing to be witnessed by Authority Having Jurisdiction.

.3 Install fire department connections as indicated.

3.2 INSTALLATION (Cont'd)

.4 Install spare parts cabinet as indicated.

.5 Pressure gauges:
.1 Location:
.1 On water side and air side of dry pipe valve.
.2 At air receiver.
.3 In each independent pipe from air supply to dry pipe valve.
.4 At exhausters and accelerators.
.2 Install to permit removal.
.3 Locate so as not subjected to freezing.

.6 Valve identification:
.1 Identify drain valve, by-pass valves and main shut-off valve and all auxiliary valves.

3.3 FIELD QUALITY CONTROL

.1 Site Test, Inspection:
.1 Perform test to determine compliance with specified requirements in presence of Departmental Representative.
.2 Test, inspect, and approve piping before covering or concealing.
.3 Preliminary Tests:
.1 Hydrostatically test each system at 200 psig for a 2 hour period with no leakage or reduction in pressure.
.2 Flush piping with potable water in accordance with NFPA 13.
.3 Piping above suspended ceilings: tested, inspected, and approved before installation of ceilings.
.4 Test alarms and other devices.
.5 Test water flow alarms by flowing water through inspector's test connection. When tests have been completed and corrections made, submit signed and dated certificate in accordance with NFPA 13.
.4 Formal Tests and Inspections:
.1 Do not submit request for formal test and inspection until preliminary test and corrections are completed and approved.
.2 Submit written request for formal inspection at least 15 days prior to inspection date.
.3 Repeat required tests as directed.

3.3 FIELD QUALITY CONTROL (Cont'd)

.1 (Cont'd)

.4 (Cont'd)

.4 Correct defects and make additional tests until systems comply with contract requirements.

.5 Furnish appliances, equipment, instruments, connecting devices, and personnel for tests.

.6 Authority of Jurisdiction, will witness formal tests and approve systems before they are accepted.

.2 Site Tests:

.1 Testing to be witnessed by Authority Having jurisdiction.

.2 Develop, with Departmental Representative assistance, detailed instructions for O & M of this installation.

3.4 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 35 29.06 - Health and Safety Requirements.

.4 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.5 Section 01 78 00 - Closeout Submittals.

.6 Section 01 91 13 - General Commissioning (Cx) Requirements.

.7 Section 21 05 01 - Common Work Results - Mechanical.

.8 Section 23 05 05 - Installation of Piping.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME)
.1 ANSI/ASME B16.15-06, Cast Bronze Threaded Fittings, Classes 125 and 250.
.2 ANSI/ASME B16.18-2001(R2005), Cast Copper Alloy Solder Joint Pressure Fittings.
.3 ANSI/ASME B16.24-06, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500.

.2 ASTM International Inc.
.1 ASTM A 307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
.2 ASTM A 536-84(2004)e1, Standard Specification for Ductile Iron Castings.
.3 ASTM B 88M-05, Standard Specification for Seamless Copper Water Tube (Metric).

.3 American National Standards Institute/American Water Works Association (ANSI)/(AWWA)

1.2 REFERENCES (Cont'd)

.3 (Cont'd)
.1 ANSI/AWWA C111/A21.11-07, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.4 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
.1 MSS-SP-67-02a, Butterfly Valves.
.2 MSS-SP-70-06, Gray Iron Gate Valves, and Flanged Threaded Ends.
.3 MSS-SP-71-05, Gray Iron Swing Check Valves, Flanged and Threaded Ends.
.4 MSS-SP-80-03, Bronze Gate, Globe, Angle and Check Valves.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
.1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE, AND HANDLING

.1 In accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 PIPING

.1 Domestic hot, cold and recirculation systems, within building.
.1 Above ground: copper tube, hard drawn, type L: to ASTM B 88M.
.2 Buried or embedded: copper tube, soft annealed, type K: to ASTM B 88M, in long lengths and with no buried joints.

2.2 FITTINGS

.1 Bronze pipe flanges and flanged fittings, Class 150: to ANSI/ASME B16.24.

.2 Cast bronze threaded fittings, Class 125: to ANSI/ASME B16.15.

.3 Cast copper, solder type: to ANSI/ASME B16.18.

.4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.

2.3 JOINTS

.1 Rubber gaskets, latex-free 1.6 mm thick: to AWWA C111.

.2 Bolts, nuts, hex head and washers: to ASTM A 307, heavy series.

.3 Solder: 95/5.

.4 Teflon tape: for threaded joints.

.5 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.

2.4 GLOBE VALVES

.1 NPS 2 and under, soldered:
.1 To MSS-SP-80, Class 125, 860 kPa, bronze body, renewable composition disc, screwed over bonnet as specified Section 23 05 23.01 - Valves - Bronze.

.2 NPS 2 and under, screwed:

2.4 GLOBE VALVES (Cont'd)

.2 (Cont'd)
.1 To MSS-SP-80, Class 150, 1 MPa, bronze body, screwed over bonnet, renewable composition disc as specified Section 23 05 23.01 -Valves - Bronze.

2.5 SWING CHECK VALVES

.1 NPS 2 and under, soldered:
.1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23.01 - Valves - Bronze.

.2 NPS 2 and under, screwed:
.1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23.01 - Valves - Bronze.

.3 NPS 2 1/2 and over, flanged:
.1 To MSS-SP-71, Class 125, 860 kPa, cast iron body, flat flange faces, regrindable seat, bronze disc, bolted cap specified Section 23 05 23.02 - Valves - Cast Iron: Gate, Globe, Check.

2.6 BALL VALVES

.1 NPS 2 and under, screwed:
.1 Class 150.
.2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and Bunan seat, steel lever handle as specified Section 23 05 23.01 - Valves - Bronze.

.2 NPS 2 and under, soldered:
.1 To ANSI/ASME B16.18, Class 150.
.2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and Bunan seat, steel lever handle, with NPT to copper adaptors as specified Section 23 05 23.01 - Valves - Bronze.

PART 3 - EXECUTION

3.1 APPLICATION

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

3.2 INSTALLATION

.1 Install in accordance with National Building Code and local authority having jurisdiction.

.2 Install pipe work in accordance with Section 23 05 05 - Installation of Pipework, supplemented as specified herein.

.3 Assemble piping using fittings manufactured to ANSI standards.

.4 Install CWS piping below and away from HWS and HWC and other hot piping so as to maintain temperature of cold water as low as possible.

.5 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.

.6 Buried tubing:
.1 Lay in well compacted washed sand in accordance with AWWA Class B bedding.
.2 Bend tubing without crimping or constriction. Minimize use of fittings.

3.3 VALVES

.1 Isolate equipment, fixtures and branches with ball valves.

.2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.

3.4 PRESSURE TESTS

.1 Conform to requirements of Section 21 05 01 - Common Work Results for Mechanical.

.2 Test pressure: greater of 1 times maximum system operating pressure or 860 kPa.

3.5 FLUSHING AND CLEANING

.1 Flush entire system for 8 h. Ensure outlets flushed for 2 hours. Let stand for 24 hours, then draw one sample off longest run. Submit to testing laboratory to verify that system is clean to Provincial and Federal potable water guidelines. Let system flush for additional 2 hours, then draw off another sample for testing.

3.6 PRE-START-UP INSPECTIONS

.1 Systems to be complete, prior to flushing, testing and start-up.

.2 Verify that system can be completely drained.

.3 Ensure that air chambers, expansion compensators are installed properly.

3.7 START-UP

.1 Timing: start up after:
.1 Pressure tests have been completed.
.2 Disinfection procedures have been completed.
.3 Certificate of static completion has been issued.
.4 Water treatment systems operational.

.2 Provide continuous supervision during start-up.

.3 Start-up procedures:
.1 Establish circulation and ensure that air is eliminated.
.2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
.3 Bring HWS storage tank up to design temperature slowly.
.4 Monitor piping HWS and HWC piping systems for freedom of movement, pipe expansion as designed.
.5 Check control, limit, safety devices for normal and safe operation.

.4 Rectify start-up deficiencies.

3.8 PERFORMANCE VERIFICATION

.1 Scheduling:
.1 Verify system performance after pressure and leakage tests and disinfection are completed, and Certificate of Completion has been issued by authority having jurisdiction.

.2 Procedures:
.1 Verify that flow rate and pressure meet Design Criteria.
.2 TAB HWC in accordance with Section 23 05 93 -.Testing, Adjusting and Balancing for HVAC
.3 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.

3.8 PERFORMANCE VERIFICATION (Cont'd)

.2 (Cont'd)
.4 Sterilize HWS systems for Legionella control.
.5 Verify performance of temperature controls.
.6 Verify compliance with safety and health requirements.
.7 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.
.8 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.

.3 Reports:
.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Reports, using report forms as specified in Section 01 91 13 - General Commissioning (Cx) Requirements: Report Forms and Schematics.
.2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

3.9 OPERATION REQUIREMENTS

.1 Co-ordinate operation and maintenance requirements including, cleaning and maintenance of specified materials and products with Section 23 05 05 - Installation of Pipework.

3.10 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 35 29.06 - Health and Safety Requirements.

.4 Section 01 61 00 - Common Product Requirements.

.5 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.6 Section 01 78 00 - Closeout Submittals.

.7 Section 01 91 13 - General Commissioning (Cx) Requirements.

.8 Section 21 05 01 - Common Work Results - Mechanical.

.9 Section 23 05 05 - Installation of Piping.

1.2 REFERENCES

.1 ASTM International Inc.
.1 ASTM B 32-08, Standard Specification for Solder Metal.

.2 Canadian Standards Association (CSA International).
.1 CSA B67-1972(R1996), Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.
.2 CAN/CSA-B70-06, Cast Iron Soil Pipe, Fittings and Means of Joining.
.3 CAN/CSA-B125.3-05, Plumbing Fittings.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
.1 Provide manufacturer's printed product literature and datasheets for adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 ACTION AND INFORMATIONAL SUBMITTALS (Cont'd)

.2 (Cont'd)
.2 Provide two copies WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29.06 - Health and Safety Requirements

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE, AND HANDLING

.1 In accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

.1 Above ground sanitary and vent Type DWV to: ASTM B 306.
.1 Fittings.
.1 Cast brass: to CAN/CSA-B125.3.
.2 Wrought copper: to CAN/CSA-B125.3.
.2 Solder: lead free, 95:5, to ASTM B 32.

2.2 CAST IRON PIPING AND FITTINGS

.1 Above ground sanitary, storm and vent NPS 3 and up to: CAN/CSA-B70, with one layer of protective coating of.
.1 Joints:
.1 Mechanical joints:
.1 Neoprene or butyl rubber compression gaskets: to CAN/CSA-B70.
.2 Stainless steel clamps.
.2 Hub and spigot:
.1 Caulking lead: to CSA B67.

2.2 CAST IRON PIPING AND FITTINGS (Cont'd)

.1 (Cont'd)
.1 (Cont'd)
.2 Cold caulking compounds.

.2 Above ground sanitary, storm and vent: to CAN/CSA-B70.
.1 Joints:
.1 Hub and spigot:
.1 Caulking lead: to CSA B67.
.2 Mechanical joints:
.1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

PART 3 - EXECUTION

3.1 APPLICATION

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

3.2 INSTALLATION

.1 In accordance with Section 23 05 01 - Use of HVAC Systems During Construction.

.2 Install in accordance with National Plumbing Code and local authority having jurisdiction.

3.3 TESTING

.1 Pressure test buried systems before backfilling.

.2 Hydraulically test to verify grades and freedom from obstructions.

3.4 PERFORMANCE VERIFICATION

.1 Cleanouts:
.1 Ensure accessibility and that access doors are correctly located.
.2 Open, cover with linseed oil and re-seal.
.3 Verify that cleanout rods can probe as far as the next cleanout, at least.

.2 Test to ensure traps are fully and permanently primed.

3.4 PERFORMANCE VERIFICATION (Cont'd)

.3 Storm water drainage:
.1 Verify domes are secure.
.2 Ensure weirs are correctly sized and installed correctly.
.3 Verify provisions for movement of roof system.

.4 Ensure that fixtures are properly anchored, connected to system and effectively vented.

.5 Affix applicable label (storm, sanitary, vent, pump discharge etc.) c/w directional arrows every floor or 4.5 m (whichever is less).

3.5 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 35 29.06 - Health and Safety Requirements.

.4 Section 01 61 00 - Common Product Requirements.

.5 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.6 Section 01 78 00 - Closeout Submittals.

.7 Section 01 91 13 - General Commissioning (Cx) Requirements.

.8 Section 21 05 01 - Common Work Results - Mechanical.

.9 Section 23 05 05 - Installation of Piping.

1.2 REFERENCES

.1 ASTM International Inc.
.1 ASTM D 2235-04, Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
.2 ASTM D 2564-04e1, Standard Specification for Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Piping Systems.

.2 Canadian Standards Association (CSA International)
.1 CAN/CSA-Series B1800-06, Thermoplastic Non pressure Pipe Compendium - B1800 Series.

.3 Green Seal Environmental Standards (GSES)
.1 Standard GS-36-00, Commercial Adhesives.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
.1 Material Safety Data Sheets (MSDS).

.5 South Coast Air Quality Management District (SCAQMD), California State

1.2 REFERENCES (Cont'd)

.5 (Cont'd)
.1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
.1 Provide manufacturer's printed product literature and datasheets for piping and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.
.2 Provide two copies WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29.06 - Health and Safety Requirements

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE, AND HANDLING

.1 In accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

.1 For buried storm and sanitary piping to:
.1 CAN/CSA B1800.

2.2 JOINTS

.1 Solvent weld for PVC: to ASTM D 2564.

.2 Solvent weld for ABS: to ASTM D 2235.

PART 3 - EXECUTION

3.1 APPLICATION

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

3.2 INSTALLATION

.1 In accordance with Section 23 05 05 - Installation of Pipework.

.2 Install in accordance with National Plumbing Code Provincial Plumbing Code and local authority having jurisdiction except .

3.3 TESTING

.1 Pressure test buried systems before backfilling.

.2 Hydraulically test to verify grades and freedom from obstructions.

3.4 PERFORMANCE VERIFICATION

.1 Cleanouts:
.1 Ensure accessibility and that access doors are correctly located.
.2 Open, cover with linseed oil and re-seal.
.3 Verify cleanout rods can probe as far as the next cleanout, at least.

.2 Test to ensure traps are fully and permanently primed.

.3 Ensure fixtures are properly anchored, connected to system and effectively vented.

3.5 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work

.2 Section 01 33 00 - Submittal Procedures

.3 Section 01 35 29.06 - Health and Safety Requirements

.4 Section 01 61 00 - Common Product Requirements

.5 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.6 Section 01 78 00 - Closeout Submittals.

.7 Section 01 91 13 - General Commissioning (Cx) Requirements.

1.2 REFERENCE STANDARDS

.1 American Society of Mechanical Engineers (ASME)

.1 ASME Boiler and Pressure Vessel Code Section VIII Pressure Vessels.

.1 BPVC-VIII B - 2004, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 1.

.2 BPVC-VIII-2 B - 2004, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 2 - Alternative Rules.

.3 BPVC-VIII-3 B - 2004, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 3 - Alternative Rules High Press Vessels.

.2 ASME B16.5-03, Pipe Flanges and Flanged Fittings.

.3 ASME B16.11-01, Forged Fittings, Socket-Welding and Threaded.

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM A 53/A 53M-04, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.2 ASTM A 181/A 181M-01, Standard Specification for Carbon Steel Forgings for General Purpose Piping.

1.2 REFERENCE STANDARDS (Cont'd)

.3 Canadian Standards Association (CSA International)
.1 CSA B51-03, Boiler, Pressure Vessel, and Pressure Piping Code.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
.1 Material Safety Data Sheets (MSDS).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 Submittal Procedures.

.2 Product Data:
.1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.

.3 Shop Drawings:
.1 Submit shop drawings to indicate project layout including layout, dimensions and extent of piping system.
.1 Air Compressor
.2 Vertical and horizontal piping locations and elevations and connections details.
.3 Instructions: submit manufacturer's installation instructions.
.4 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals

1.4 QUALITY ASSURANCE

.1 Health and Safety: safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 CLOSEOUT SUBMITTALS

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

1.6 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:
.1 Separate waste materials for reuse and recycling in accordance with Section01 74 21 - Construction/Demolition Waste Management and Disposal, and Section 21 05 01 - Common Work Results - Mechanical.
.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MATERIALS

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

2.2 AIR COMPRESSOR

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

.2 Capacity: See Drawings

.3 Control:
.1 Manual control with H-0-A starter switch.
.2 Pressure switch to cut out at 800 kPa and with minimum differential pressure.

.4 Accessories: belt guard and pressure gauges.

.5 Air intakes: complete with bird screen, replaceable cartridge type intake filter and silencer.

.6 Vibration isolation: 95% minimum efficiency.

2.3 AIR RECEIVER

.1 Horizontal tank: to CSA B51, ASME Section VIII and provincial regulations, for working gauge pressure of 1034 kPa. Capacity: See Drawings

.2 Accessories: adjustable pressure regulator, safety valve, 125 mm diameter gauge with pressure range of 0 to 1500 kPa, drain cock and automatic condensate trap.

.3 Provincial inspector's certificate and label.

.4 Finish: shop primed, ready for field painting.

2.4 REFRIGERATED AIR DRYER

.1 Self-contained, hermetically sealed, complete with air cooled heat exchanger, compressor, automatic controls, moisture removal trap, wiring, piping and refrigerant charge.

.2 Inlet and outlet connections to be factory insulated.

.3 Capacity: See Drawings
.1 Size to operate at 40% of time at design capacity.

.4 Electrical supply: 120V, 1 phase, 60cycle.

2.5 COMBINATION FILTER-REGULATOR

.1 Factory assembled, heavy-duty with mounting bracket and low pressure side relief valve.

.2 Maximum inlet pressure: 800 kPa.

.3 Operating temperature: minus 18 degrees C to plus 52 degrees C.

.4 Filter element: 40 micron. Bowls: polycarbonate.

.5 Pressure range in regulator: 34 kPa to 800 kPa.

.6 Gauge range: 0 kpa to 1100 kPa.

2.6 PIPING

.1 Piping: to ASTM A 53/A 53M, schedule 80 seamless black steel.

.2 Fittings:
.1 NPS2 and smaller: to ASME B16.11, schedule 80 steel, socket welded.

.3 Couplings: to ASME B16.11, socket welded or threaded half coupling type.

.4 Unions: 1000 kPa malleable iron with brass-to-iron ground seat.

.5 Dissimilar metal junctions: use dielectric unions.

.6 Flanges:
.1 NPS2 and smaller: to ASME B16.5, forged steel, raised face and socket welded.

.7 Joints:
.1 NPS2 and smaller: socket welded.

2.7 BALL VALVES

.1 Three piece design or top entry for ease of in-line maintenance.
.1 To ASTM A 181/A 181M, Class 70, carbon steel body socket welded or screwed ends, carbon steel ball and associated trim suitable for compressed air application.
.2 To withstand 1034 kPa maximum pressure.

2.8 COUPLERS/CONNECTORS

.1 Industrial interchange series, full-bore.

.2 Maximum inlet pressure: 1700 kPa.

.3 Valve seat: moulded nylon.

.4 Body: zinc plated steel.

.5 Threads: NPT.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 COMPRESSOR STATION

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

3.3 REFRIGERATED AIR DRYER

.1 Install on three-valve bypass.

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

3.4 COMPRESSED AIR LINE FILTER

.1 Install on discharge line from refrigerated air dryer.

3.5 MAIN AIR PRESSURE REGULATORS

.1 Install at air compressor station.

.2 Install additional regulators on connections to equipmentas indicated.

3.6 COMPRESSED AIR PIPING CONNECTIONS AND INSTALLATION

.1 Install shut-off valves at outlets, major branch lines and in locations as indicated.

.2 Install quick-coupler chucks and pressure gauges on drop pipes.

.3 Install unions to permit removal or replacement of equipment.

.4 Install tees in lieu of elbows at changes in direction of piping. Install plug in open ends of tees.

.5 Grade piping at 1% slope minimum.

3.6 COMPRESSED AIR PIPING CONNECTIONS AND INSTALLATION (Cont'd)

.6 Install compressed air trap and pressure equalizing pipe at moisture collecting points. Drain pipe to nearest floor drain.

.7 Make branch connections from top of main.

.8 Install compressed air trap at bottom of risers and at low points in mains, piped to nearest drain. Distance between drain points to be 30 m maximum.

.9 Provide drain from refrigerated air dryer.

3.7 FIELD QUALITY CONTROL

.1 Site Tests/Inspection:
.1 Testing: pressure test for 4 hours minimum, to 1100 kPa, with outlets closed and with compressor isolated from system. Pressure drop not to exceed 10 kPa.

.2 Manufacturer's Field Services:
.1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its products, and submit written reports, in acceptable format, to verify compliance of work with Contract.

3.8 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 Cleaning: blow out piping to clean interior thoroughly of oil and foreign matter.

.3 Check entire installation is approved by authority having jurisdiction.

.4 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 0135 29.06 - Health and Safety Requirements.

.4 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.5 Section 01 78 00 - Closeout Submittals.

.6 Section 01 91 13 - General Commissioning (Cx) Requirements.

.7 Section 21 05 01 - Common Work Results - Mechanical.

.8 Section 23 05 05 - Installation of Piping.

1.2 REFERENCES

.1 American National Standards Institute/Canadian Standards Association (ANSI/CSA)

.1 ANSI Z21.10.1-2009/CSA 4.1-2009, Gas Water Heaters - Volume I, Storage Water Heaters With Input Ratings of 75,000 Btu Per Hour or Less.

.2 ANSI Z21.10.1A-2009/CSA 4.1A-2009, Addenda 1 to ANSI 4.1-2009, Z21.10.1-2004/CSA Gas Water Heaters Volume I, Storage Water Heaters With Input Ratings of 75,000 Btu Per Hour or Less.

.3 ANSI Z21.10.1b-2006/CSA 4.1b-2006, Addenda 2 to ANSI Z21.10.1-2004/CSA 4.1-2004, Gas Water Heaters - Volume I, Storage Water Heaters With Input Ratings of 75,000 Btu Per Hour or Less.

.4 ANSI Z21.10.3A-2007/CSA 4.3-2007, Gas Water Heaters - Volume III - Storage Water Heaters, with Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous.

.2 Canadian Standards Association (CSA International)

1.2 REFERENCES (Cont'd)

.2 (Cont'd)

.1 CSA B51-2009, Boiler, Pressure Vessel, and Pressure Piping Code.

.2 CAN/CSA-B139-2009, Installation Code for Oil Burning Equipment.

.3 CAN/CSA-B140.0-2003, Oil Burning Equipment: General Requirements.

.4 CAN/CSA-B149.1-2010, Natural Gas and Propane Installation Code.

.5 CSA B140.12-2003, Oil-Burning Equipment: ServiWater,er Hot Heaters for Domestic Space Heating, and Swimming Pools.

.6 CAN/CSA C22.2 No.110-1994(R2004), ConstTankion and Test of Electric Storage Water Heaters.

.7 CAN/CSA-C191-2004, Performance of Electric Storage Tank Water Heaters for Household Service.

.8 CAN/CSA-C309-M90(R2009), Performance Requiforents for Tanks Glass-Lined Storage Household Hot Water Service.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Provide manufacturer's printed product literature and water datasheets for domestic heater, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Provide drawings stamped and signed by profelicensed engineer registered or in Province of Ontario, Canada.

.2 Indicate:

.1 Equipment, including connections, fittings, control assemblies and ancilidentifying factory and

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

.1 Separate recycle waste materials in accordance with Secti01 74 - Construction/Demolition Waste Management, and Section 21 05 01 - Common Work Results - Mechanical.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Construction Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 GAS FIRED WATER HEATER (DHW-1)

.1 ENERGY STAR certify commercial grade water heater.

.2 Water heater shall be Tank Saver design to prolong tank life.
.1 Ultra-quiet blower.
.2 Factory installed T&P valve and drip tube.
.3 Glass lining for protection against tank corrosion.
.4 Factory installed heat trap nipples.
.5 Sealed combustion chamber design, eliminating the need for a flammable vapour sensor.
.6 Gas control with advanced self diagnostic capability for easy troubleshooting.
.7 Auto-reset temperature switch monitoring vent temperature.
.8 Flexible venting option:
.1 Heater can be vented with 2 Provide complete vent and combustible air intake system including connection to the tank and exterior all termination.

.3 Capacity:
.1 Tank 189 L.
.2 Input 45 MBh.
.3 Recovery rate at 90deg 189 L/Hr
.4 Dimensions 1.50 m high x 0.54m dia
.5 Blower 120Vsp

PART 3 - EXECUTION

3.1 APPLICATION

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

3.2 INSTALLATION

.1 Install in accordance with manufacturer's recommendations and authority having jurisdiction.

.2 Provide all natural gas and domestic water piping, valves and accessories.Provide Thermal Expansion Tank as recommended by tank manufacturer.

.3 Provide tank venting and air intake as recommended by the manufacturer and governn by the codes.

.4 Provide insulation between tank and supports.

3.3 FIELD QUALITY CONTROL

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

3.4 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.
.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal 01 35 21 - LEED Requirements.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work

.2 Section 01 33 00 - Submittal Procedures

.3 Section 01 35 29.06 - Health and Safety Requirements

.4 Section 01 61 00 - Common Product Requirements

.5 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.6 Section 01 78 00 - Closeout Submittals.

.7 Section 01 91 13 - General Commissioning (Cx) Requirements.

1.2 REFERENCES

.1 CSA-B356-00 (R2005), Water Pressure Reducing Valves for Domestic Water Supply Systems.

.2 Plumbing and Drainage Institute (PDI).
.1 PDI-WH201-92, Water Hammer Arresters Standard.

.3 CSA-A251.00 (R2005), Precast Concrete-Materials Products

.4 CSA-B64 Construction/Qualification Code and Association Architectural and Structural Precast Concrete (CSA Vacuum Products.)

1.3 SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets for fixtures and equipment.

.3 Shop Drawings:

1.3 SUBMITTALS (Cont'd)

.3 (Cont'd)

.1 Indicate on drawings to indicate materials, finishes, method of anchorage, number of anchors, dimensions, construction and assembly details and accessories.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Instructions: submit manufacturer's installation instructions.

.6 Manufacturer's Field Reports: manufacturer's field reports specified.

.7 Submit maintenance and engineering data for incorporation into manual include:

.1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.

.2 Details of operation, servicing and maintenance.

.3 Recommended spare parts list.

1.4 CLOSEOUT SUBMITTALS

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

1.5 QUALITY ASSURANCE

.1 Health and Safety: safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal, and Section 21 05 01 - Common Work Results - Mechanical.

PART 2 - PRODUCTS

2.1 FLOOR DRAINS

.1 Floor Drains and Trench Drains: to CSA B79

.2 FD-1: general duty; cast iron body round, adjustable head, primer tapping nickel bronze strainer, integral seepage pan, and clamping collar to suit flooring.

.3 FFD-1:combination funnel floor drain; cast iron body with integral seepage pan,primer tapping clamping collar, nickel-bronze adjustable head strainer with integral funnel.

2.2 ROOF DRAINS

.1 Aluminum body, under deck clamp and sump receiver to suit roof construction, flashing clamp ring with integral gravel stop, bearing pan,aluminum dome.

2.3 CLEANOUTS

.1 Cleanout Plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.

.2 Access Covers:

.1 Wall Access: face or wall type, polished nickel bronze square or round cover with flush brass or bronze head securing screws, bevelled edge frame complete with anchoring lugs.

.2 Floor Access: rectangular cast box with anchor lugs and:

.1 Plugs: bolted bronze with neoprene gasket

.2 Cover for Unfinished Concrete Floors: nickel bronze square, gasket, vandal-proof screws.

.3 Cover for Terrazo Finish: polished nickel bronze with recessed cover for filling with terrazo, vandal-proof locking screws.

2.3 CLEANOUTS (Cont'd)

.2 (Cont'd)

.2 (Cont'd)

.4 Cover for Tile and Linoleum Floors: polished nickel bronze with recessed cover forlinoleum or tile infill, complete w ith vandal-proof locking screws.

2.4 NON-FREEZE WALL HYDRANTS

.1 Recessed with integral vacuum breaker, NPS 3/4 hose outlet, removable operating key. Chrome plated finish.

2.5 WATER HAMMER ARRESTORS

.1 Stainless steel construction, bellows or piston type: to PDI-WH201.

2.6 BACK FLOW PREVENTERS

.1 Preventers: to CSA-B64 Series, application reduced pressure principle type back flor preventer with intermediate atmospheric vent or vacuum.

2.7 VACUUM BREAKERS

.1 Breakers: to CSA-B64 Series, vacuum breaker atmospheric.

2.8 HOSE BIBBS AND SEDIMENT FAUCETS

.1 Bronze construction complete with integral back flow preventer, hose thread spout, replaceable composition disc, and chrome plated in finished areas.

2.9 TRAP SEAL PRIMERS

.1 Brass, with integral vacuum breaker, NPS 1/2 solder ends, NPS 1/2 drip line connection.

2.10 STRAINERS

.1 860 kPa, Y type with 20 mesh, monel, bronze or stainless steel removable screen.

.2 NPS 2 and under, bronze body, screwed ends, with brass cap.

2.10 STRAINERS (Cont'd)

.3 NPS 2-1/2 and over, cast iron body, flanged ends, with bolted cap.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install in accordance with National Plumbing Code of Canada (NPC)and local authority having jurisdiction.

.2 Install in accordance with manufacturer's instructions and as specified.

3.3 CLEANOUTS

.1 Install cleanouts at base of soil and waste stacks, and rainwater leaders, at locations required code, and as indicated.

.2 Bring cleanouts to wall or finished floor unless serviceable from below floor.

.3 Building drain cleanout and stack base cleanouts: line size to maximum NPS4.

3.4 NON-FREEZE WALL HYDRANTS

.1 Install 600 mm above finished grade unless otherwise indicated.

3.5 WATER HAMMER ARRESTORS

.1 Install on branch supplies to fixtures or group of fixtures.

3.6 HOSE BIBBS AND SEDIMENT FAUCETS

.1 Install at botton of risers, at low points to drain systems, and as indicated.

3.7 TRAP SEAL PRIMERS

.1 Install for floor drains and elsewhere, as indicated.

.2 Install on cold water supply to nearest frequently used plumbing fixture in concealed space, to approval of Departmental Representative.

.3 Install soft copper tubing to floor drain.

3.8 STRAINERS

.1 Install sufficient room to remove basket for maintenance.

3.9 START-UP

.1 General:
.1 In accordance with Section01 91 13 - General Commissioning (CX) Requirements: General Requirements, supplemented as specified herein.

.2 Timing: start-up only after:
.1 Pressure tests have been completed.
.2 Disinfection procedures have been completed.
.3 Certificate of static completion has been issued.

.3 Provide continuous supervision during start-up.

3.10 TESTING AND ADJUSTING

.1 General:
.1 Test and adjust plumbing specialties and accessories in accordance with Section 01 91 13 - General Commissioning (CX) Requirements: General Requirements, supplemented as specified.

.2 Timing:
.1 After start-up deficiencies rectified.
.2 After certificate of completion has been issued by authority having jurisdiction.

.3 Application tolerances:
.1 Pressure at fixtures: +/- 70 kPa.
.2 Flow rate at fixtures: +/- 20%.

.4 Adjustments:
.1 Verify that flow rate and pressure meet design criteria.

3.10 TESTING AND ADJUSTING (Cont'd)

.4 (Cont'd)
.2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.

.5 Floor drains:
.1 Verify operation of trap seal primer.
.2 Prime, using trap primer. Adjust flow rate to suit site conditions.
.3 Check operations of flushing features.
.4 Check security, accessibility, removability of strainer.
.5 Clean out baskets.

.6 Vacuum breakers, backflow preventers, backwater valves:
.1 Test tightness, accessibility for O&M of cover and of valve.
.2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.
.3 Verify visibility of discharge from open ports.

.7 Roof drains:
.1 Check location at low points in roof.
.2 Check security, removability of dome.
.3 Adjust weirs to suit actual roof slopes, meet requirements of design.
.4 Clean out sumps.
.5 Verify provisions for movement of roof systems.

.8 Cleanouts:
.1 Verify covers are gas-tight, secure, yet readily removable.

.9 Water hammer arrestors:
.1 Verify proper installation of correct type of water hammer arrester.

.10 Wall hydrants:
.1 Verify complete drainage, freeze protection.
.2 Verify operation of vacuum breakers.

.11 Strainers:
.1 Clean out repeatedly until clear.
.2 Verify accessibility of cleanout plug and basket.
.3 Verify that cleanout plug does not leak.

3.10 TESTING AND ADJUSTING (Cont'd)

.12 Commissioning Reports:
.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Reports, supplemented as specified.

.13 Training:
.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Training of O&M Personnel, supplemented as specified.
.2 Demonstrate full compliance with Design Criteria.

3.11 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 35 29.06 - Health and Safety

.4 Section 01 61 00 - Common Product Requirements.

.5 Section 01 74 21 - Construction/Demolition Waste

.6 Section 01 78 00 - Closeout Submittals.

.7 Section 01 91 13 - General Commissioning (Cx)

.8 Section 21 05 01 - Common Work Results -

.9 Section 23 05 05 - Installation of Piping.

1.2 REFERENCES

.1 CSA Group
.1 CAN/CSA-B45 Series-02(R2013), Plumbing Fixtures, (Consists of B45.0, B45.1, B45.2, B45.3, B45.4, B45.5, B45.6, B45.7, B45.8 and B45.9).
.2 CSA B125.3-12, Plumbing Fittings.
.3 CSA B651-12, Accessible Design for the Built Environment.

.2 Green Seal (GS)
.1 GS-36-2013, Adhesives for Commercial Use.

.3 South Coast Air Quality Management District (SCAQMD)
.1 SCAQMD Rule 1168-A2011, Adhesive and Sealant Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 Submittal Procedures.

.2 Product Data:

1.3 ACTION AND INFORMATIONAL SUBMITTALS (Cont'd)

.2 (Cont'd)
.1 Submit manufacturer's instructions, printed product literature and data sheets for washroom fixtures and include product characteristics, performance criteria, physical size, finish and limitations.
.2 Indicate fixtures and trim:
.1 Dimensions, construction details, roughing-in dimensions.
.2 Factory-set water consumption per flush at recommended pressure.
.3 (For water closets, urinals): minimum pressure required for flushing.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirementsandwith manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Store materials off groundindoorsin dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect specified materials from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

1.6 WASTE MANAGEMENT AND

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

.1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.

.2 Trim, fittings: manufacture in accordance with CSA B125.3.

.3 Exposed plumbing brass to be chrome plated.

.4 Number, locations: as indicated on the drawings. Architectural plans and layouts to govern.

.5 Fixtures in any one location to be product of one manufacturer and of same type.

.6 Trim in any one location to be product of one manufacturer and of same type.

.7 Water closets:

.1 WC-1: wall-mounted, exposed flush valve, top spud ultra-low flush, maximum 6 litres/flush. Barrier free use.

.1 Bowl: vitreous china with anti-microbial surface inhibitor,elongated bowl, 54 mm fully glazed trapway, syphon jet action,38mm top spud.

.2 Chrome plated exposed flush valve,dual filtered by-pass diaphgram type, non-hold open feature,back check angle stop,high pressure vacuum breaker,VP trim, lever handle with triple seal,6 LPF low consumpltion design.Extended seat bumper.

.3 Double Flush feature,chrome plated exposed flush valve,dual filtered by-pass diaphgram type, non-hold open feature,back check angle stop,high pressure vacuum breaker,VP trim,green antimicrobial coated lever handle with triple seal ,6 LPF (down flush), 4.2 LPF (up flush) low consumpltion design.Extended seat bumper.

2.1 MANUFACTURED UNITS (Cont'd)

.7 (Cont'd)

.1 (Cont'd)

.4 Chrome plated exposed flush valve,dual filtered by-pass diaphgram type, non-hold open feature,back check angle stop,high pressure vacuum breaker,VP trim,"No Touch" battery operated with "courtesy" flush over-ride button,6 LPF low consumpltion design.406mm rough in,extended flush tube,pipe ring with seat bumper.

.5 Chrome plated exposed flush valve,dual filtered by-pass diaphgram type, non-hold open feature,back check angle stop,high pressure vacuum breaker,VP trim,"No Touch" 5VA hard wired operated with "courtesy" flush over-ride button in stainless steel wall access plate,6 LPF low consumpltion design.406mm rough in,extended flush tube,pipe ring with seat bumper.120/24 VAC transformer.

.6 Seat:white, elongated, open front, moulded solid plastic, with cover, stainless steel check hinges, stainless steel insert post.

.7 Horizontal or vertical style, single or double wall carrier with block base feet, bolts,caps and nuts, adjustable nipple,gasket, test plug and protective cap. Mount fixture 406mm above finish floor.

.8 Urinals:

.1 U-1: wall mounted, ultra-low flush, exposed flush valve, top spud, barrier free.

.1 Urinal: vitreous china 680mm high x 445mm wide , siphon jet flush action, integral flushing rim, extended side shields, integral trap, removable stainless steel strainer,19mm top outlet connections for use with flush valve.

.2 Chrome plated exposed flush valve,diaphgram type, non-hold open feature,back check angle stop,high pressure vacuum breaker,VP trim, lever handle,3.8 LPF low consumpltion design.

2.1 MANUFACTURED UNITS (Cont'd)

.8 (Cont'd)
.1 (Cont'd)
.3 Chrome plated exposed flush valve,dual filtered by-pass diaphgram type, non-hold open feature,back check angle stop,high pressure vacuum breaker,VP trim,"No Touch" battery operated,3.8 LPF low consumpltion design.
.4 Chrome plated exposed flush valve,dual filtered by-pass diaphgram type, non-hold open feature,back check angle stop,high pressure vacuum breaker,VP trim,"No Touch" 5VA hard wired operated in stainless steel wall access plate,3.8 LPF low consumpltion design.120/24 VAC transformer.
.5 Cleanout with 108mm dia VP stainless steel wall access cleanout cover.
.6 Urinal carrier with block base feet suppor , bolts,caps and nuts. Mount fixture as requite by Code.

.9 Washroom Lavatories:
.1 L-1: counter-top barrier free use.
.1 102mm centers,533mm x 445mm x 133mm deep, semi-oval bowl,vitreous china, self-rimming, with rear overflow, gaskeswivel clamps
.1 Provide accessories to limit maximum flow rate to 5.7 l/minute at 413 kPa.
.2 Waste fitting:open grid.
.3 CP polished cast brass adjustable body offset P trap 32mm dia with cleanout plug.
.2 1/4 turn CP angle stop valve with handle,escucheons and braided hose supply lines.
.3 Prefab isulating jackets for water supply lines and drain pipe.

.10 Washroom Lavatory Electronic Trim:
.1 Barrier-free electronic faucet:
.1 Infra-red motion sensor activated by hand motion in lavatory.

2.1 MANUFACTURED UNITS (Cont'd)

.10 (Cont'd)
.1 (Cont'd)
.2 Sensor: waterproof, incorporated in body of unitdeck-mounted, with impact-resistant plastic lens and anti-scratch coating, inside spout gooseneck, sensitivity adjustable from 100 mm to 450 mm.
.3 Water conservation: 0-60 second maximum run time.
.4 Controls: vandal-proof, interchangeable receptacles for stainless steel sheathed sensor and modular plug-type solenoid connections, single24 VAC slow-closing commercial solenoids for 860 kPa, 85 degrees C.
.5 Transformer: 120/ 24 VDC Class 2, UL and CSA listed, hard wirebox type, sized for up to 8 solenoids.
.6 SpoutGooseneck: Chrome plated, with integral flow control aerator rated at 8.35 l/minute at 413 kPa maximum.
.7 Under-counter temperatures mixing controlsControls in body of unit.

.11 Stainless steel counter-top sinks.
.1 SK-1: single compartment, ledge-back.
.1 From 1.0 mm thick type 302 stainless steel, self-rimming, undercoated, clamps. Overall sizes: 520 x 510 x 180 mm.
.2 Trim: chrome plated brass, with swing spout, aerator, single lever handle, washerless controls, accessories to limit maximum flow rate to 8.35 litres/minute at 413 kPa, spray fitting
.3 Waste fitting: integral stainless steel basket strainer/stopper, tailpiece, cast brass P-trap with cleanout.

.12 Mop sinks:
.1 MS: moulded stone,with integral drain and strainer, 300 mm high undrilled integral back. Size: 610 x 610 x 254 mm.
.2 Supply fitting: with built-in elevated vacuum breaker, indexed cross handles, 1400 mm long rubber hose, escutcheons, union inlets, heavy cast brass spout with pail hook, aerator, brace to wall, integral stop valves. Provide accessories to limit maximum flow rate to 8.35 l/minute at 413 kPa.

2.1 MANUFACTURED UNITS (Cont'd)

.13 Fixture piping:
.1 Hot and cold water supplies to fixtures:
.1 Chrome plated rigidorflexible supply pipes with handwheel stop, reducers, escutcheon.
.2 Waste:
.1 Brass P trap with clean out on fixtures not having integral trap.
.2 Chrome plated in exposed places.

.14 Chair carriers:
.1 Factory manufactured floor-mounted or wall mounted carrier systems for wall-mounted fixtures.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

.1 Mounting heights:
.1 Standard: to manufacturer's recommendations
.2 Barrier-free: to most stringent NBCCSA B651.

3.3 ADJUSTING

.1 Conform to water conservation requirements specified this section.

.2 Adjustments:

3.3 ADJUSTING (Cont'd)

.2 (Cont'd)
.1 Adjust water flow rate to design flow rates.
.2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
.3 Adjust flush valves to suit actual site conditions.
.4 Adjust urinal flush timing mechanisms.
.5 Set controls of automatic flush valves for WCs and urinals to prevent unnecessary flush cycles.

.3 Checks:
.1 Water closets, urinals: flushing action.
.2 Aerators: operation, cleanliness.
.3 Vacuum breakers, backflow preventers: operation under all conditions.

.4 Thermostatic controls:
.1 Verify temperature settings, operation of control, limit and safety controls.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 USE OF SYSTEMS .1 Use of new permanent heating and/or ventilating systems for supplying temporary heat or ventilation is not permitted.

PART 2 - PRODUCTS

2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 35 29.06 - Health and Safety Requirements.

.4 Section 01 61 00 - Common Product Requirements.

.5 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.6 Section 01 91 13 - General Commissioning (Cx) Requirements.

.7 Section 21 05 01 - Common Work Results - Mechanical.

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB)
.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

1.3 QUALITY ASSURANCE

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not used.

PART 3 - EXECUTION

3.1 APPLICATION

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

3.2 CONNECTIONS TO EQUIPMENT

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

.3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.3 CLEARANCES

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer without interrupting operation of other system, equipment, components.

3.4 DRAINS

.1 Install piping with grade in direction of flow except as indicated.

.2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.

.3 Pipe each drain valve discharge separately to above floor drain.
.1 Discharge to be visible.

.4 Drain valves: NPS 3/4 ball valves unless indicated otherwise, with hose end male thread, cap and chain.

3.5 AIR VENTS

.1 Install automatic air vents at high points in piping systems.

.2 Install isolating valve at each automatic air valve.

.3 Install drain piping to approved location and terminate where discharge is visible.

3.6 DIELECTRIC COUPLINGS

.1 General: compatible with system, to suit pressure rating of system.

.2 Locations: where dissimilar metals are joined.

.3 NPS 2 and under: isolating unions or bronze valves.

.4 Over NPS 2: isolating flanges.

3.7 PIPEWORK INSTALLATION

.1 Screwed fittings jointed with Teflon tape.

.2 Protect openings against entry of foreign material.

.3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

3.7 PIPEWORK INSTALLATION (Cont'd)

.4 Assemble piping using fittings manufactured to ANSI standards.

.5 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.6 Install concealed pipework to minimize furring space, maximize headroom, conserve space.

.7 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

.8 Install, except where indicated, to permit separate thermal insulation of each pipe.

.9 Group piping wherever possible and as indicated

.10 Ream pipes, remove scale and other foreign material before assembly.

.11 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.12 Provide for thermal expansion as indicated.

.13 Valves:
.1 Install in accessible locations.
.2 Remove interior parts before soldering.
.3 Install with stems above horizontal unless position indicated.
.4 Valves accessible for maintenance without removing adjacent piping.
.5 Install globe valves in bypass around control valves.
.6 Use ball valves at branch take-offs for isolating purposes except where specified.
.7 Install ball valves for glycol service.

.14 Check Valves:
.1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and as indicated.
.2 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

3.8 SLEEVES

.1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.

.2 Material: schedule 40 black steel pipe.

.3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.

.4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.

.5 Installation:
.1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
.2 Other floors: terminate 25 mm above finished floor.
.3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.

.6 Sealing:
.1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
.2 Elsewhere:
.1 Provide space for firestopping.
.2 Maintain fire rating integrity.
.3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.
.4 Ensure no contact between copper pipe or tube and sleeve.

3.9 ESCUTCHEONS

.1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.

.2 Construction: one piece type with set screws.
.1 Chrome or nickel plated brass or type 302 stainless steel.

.3 Sizes: outside diameter to cover opening or sleeve.
.1 Inside diameter to fit around pipe or outside of insulation if so provided.

3.10 PREPARATION FOR FIRE STOPPING

.1 Install firestopping within annular space between pipes, ducts, insulation and adjacent fire separation in accordance with Section 07 84 00 - Fire Stopping.

.2 Uninsulated unheated pipes not subject to movement: no special preparation.

.3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging fires topping material or installation.

.4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

3.11 FLUSHING OUT OF PIPING SYSTEMS

.1 Flush system in accordance with Section 23 08 02 Cleaning and Start-up of Mechanical Piping Systems.

.2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.12 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise Departmental Representative 48 hours minimum prior to performance of pressure tests.

.2 Pipework: test as specified in relevantsections of heating, ventilating and air conditioning work.

.3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.

.4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

.5 Conduct tests in presence of Departmental Representative.

.6 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.

3.12 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK (Cont'd)

.7 Insulate or conceal work only after approval and certification of tests by Departmental Representative.

3.13 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 35 29.06 - Health and Safety Requirements.

.4 Section 01 61 00 - Common Product Requirements.

.5 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.6 Section 01 91 13 - General Commissioning (Cx) Requirements.

.7 Section 21 05 01 - Common Work Results - Mechanical.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
.1 ASHRAE 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).

.2 Electrical Equipment Manufacturer's Association Council (EEMAC)

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
.1 Material Safety Data Sheets (MSDS).

.4 Supplementary Standard SB-10 Requirements

1.3 QUALITY ASSURANCE

.1 Regulatory Requirements: work to be performed in compliance with CEPA, and applicable Provincial regulations.

.2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
.2 Shop Drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Alberta.

1.5 CLOSEOUT SUBMITTALS

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

1.6 DELIVERY, STORAGE AND HANDLING

.1 In accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Motors: high efficiency, in accordance with local Hydro company standards,B-10 requirements and to ASHRAE 90.1.

2.2 MOTORS

.1 Provide motors for mechanical equipment as specified.

2.2 MOTORS (Cont'd)

.2 Motors under 373 W 1/2 HP: speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.

.3 Motors 373 W 1/2 HP and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, 3 phase, 208 V, unless otherwise indicated.

2.3 TEMPORARY MOTORS

.1 If delivery of specified motor will delay completion or commissioning work, install motor approved by Departmental Representative for temporary use. Work will only be accepted when specified motor is installed.

2.4 BELT DRIVES

.1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.

.2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.

.3 For motors under 7.5 kW 10 HP: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.

.4 For motors 7.5 kW 10 HP and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.

.5 Correct size of sheave determined during commissioning. Allow for providing extra set of sheave and belts as recommended by balancing contractor.

.6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.

.7 Motor slide rail adjustment plates to allow for centre line adjustment.

2.5 DRIVE GUARDS

.1 Provide guards for unprotected drives.

.2 Guards for belt drives;
.1 Expanded metal screen welded to steel frame.
.2 Minimum 1.2 mm thick sheet metal tops and bottoms.
.3 Removable for servicing.

.3 Install belt guards to allow movement of motors for adjusting belt tension.

.4 Guard for flexible coupling:
.1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
.2 Securely fasten in place.
.3 Removable for servicing.

.5 Unprotected fan inlets or outlets:
.1 Wire or expanded metal screen, galvanized, 19 mm mesh.
.2 Net free area of guard: not less than 80% of fan openings.
.3 Securely fasten in place.
.4 Removable for servicing.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Fasten securely in place.

.2 Make removable for servicing, easily returned into, and positively in position.

.3 Make provision to supply and install 1(one) extra set of sheevas and belts for each belt driven device. Replace and adjust as directed by TBA personnel.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:
.1 Employ services of manufacturer representative and obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product.

3.4 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 35 29.06 - Health and Safety Requirements.

.4 Section 01 74 21 - Construction/Demolition Waste Management And Disposal.

.5 Section 01 78 00 - Closeout Submittals.

.6 Section 01 91 13 - General Commissioning (Cx) Requirements.

.7 Section 21 05 01 - Common Work Results - Mechanical.

.8 Section 23 05 01 - Installation of Pipework.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME).
.1 ANSI/ASME B1.20.1-2012, Pipe General Threads, Purpose (Inch).
.2 ANSI/ASME B16.18-2012, Cast Copper Alloy Solder Joint Pressure Fittings.

.2 American Society for Testing and Materials International, (ASTM).
.1 ASTM A 276-13a, Specification for Stainless Steel Bars and Shapes.
.2 ASTM B 62-09, Specification for Composition Bronze or Ounce Metal Castings.
.3 ASTM B 283-14, Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
.4 ASTM B 505/B 505M-14a, Specification for Copper-Base Alloy Continuous Castings.

.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
.1 MSS-SP-80-2008, Bronze Gate Globe, Angle and Check Valves.

1.3 QUALITY ASSURANCE

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Procedures and Section 21 05 01 - Common Work Results Mehanical.

.2 Submit data for valves specified in this section.

1.5 CLOSEOUT SUBMITTALS

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

1.6 DELIVERY, STORAGE, AND HANDLING

.1 In accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Valves:
.1 Except for specialty valves, to be single manufacturer.
.2 All products to have CRN registration numbers.

.2 End Connections:
.1 Connection into adjacent piping/tubing:
.1 Steel pipe systems: Screwed ends to ANSI/ASME B1.20.1.
.2 Copper tube systems: Solder ends to ANSI/ASME B16.18.

2.1 MATERIALS (Cont'd)

.2 (Cont'd)
.1 (Cont'd)
.3 Check Valves:
.1 Requirements common to check valves, unless specified otherwise:
.1 Standard specification: MSS SP-80.
.2 Connections: screwed with hexagonal shoulders.
.2 NPS 2 and under, swing type, composition disc, Class 200:
.1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
.2 Disc: renewable rotating disc of number 6 composition to suit service conditions, bronze two-piece hinge disc construction.

.4 Ball Valves:
.1 NPS 2 and under:
.1 Body and cap: cast high tensile bronze to ASTM B 62.
.2 Pressure rating: Class 125, 860 kPa steam.
.3 Connections: Screwed ends to ANSI B1.20.1 and with hexagonal shoulders.
.4 Stem: tamper proof ball drive.
.5 Stem packing nut: external to body.
.6 Ball and seat: replaceable stainless steel solid ball and Teflon seats.
.7 Stem seal: TFE with external packing nut.
.8 Operator: removable lever handle.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Remove internal parts before soldering.

.2 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.

3.2 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 35 29.06 - Health and Safety Requirements.

.4 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.5 Section 01 78 00 - Closeout Submittals.

.6 Section 01 91 13 - General Commissioning (Cx) Requirements.

.7 Section 21 05 01 - Common Work Results - Mechanical.

.8 Section 23 05 05 - Installation of Piping.

1.2 REFERENCES

.1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
.1 ANSI/ASME B31.1-07, Power Piping.

.2 American Society for Testing and Materials International (ASTM)
.1 ASTM A 307-07, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
.2 ASTM A 563-07a, Specification for Carbon and Alloy Steel Nuts.

.3 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
.1 MSS SP 58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.
.2 ANSI/MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.

1.3 QUALITY ASSURANCE

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Procedures and Section 21 05 01 - Common Work Results Mehanical.

.2 Submit shop drawings and product data for following items:
.1 Bases, hangers and supports.
.2 Connections to equipment and structure.
.3 Structural assemblies.

1.5 CLOSEOUT SUBMITTALS

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

1.6 DELIVERY, STORAGE, AND HANDLING

.1 In accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.8 SYSTEM DESCRIPTION

.1 Design Requirements:
.1 Construct hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
.2 Base maximum load ratings on allowable stresses prescribed by MSS SP 58 and ASME B31.1.
.3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
.4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.

1.8 SYSTEM DESCRIPTION (Cont'd)

.1 (Cont'd)

.5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP 58.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP 58.

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.2 PIPE HANGERS

.1 Finishes:

.1 Pipe hangers and supports: galvanized after manufacture.

.2 Use hot dipped galvanizing process.

.3 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.

.2 Upper attachment to concrete:

.1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.

.2 Concrete inserts: wedge shaped body with knockout protector plate UL listed to MSS SP 69.

.3 Hanger rods: threaded rod material to MSS SP 58:

.1 Ensure that hanger rods are subject to tensile loading only.

.2 Provide linkages where lateral or axial movement of pipework is anticipated.

.3 Do not use 22 mm or 28 mm rod.

.4 Pipe attachments: material to MSS SP 58:

.1 Attachments for steel piping: carbon steel galvanized.

.2 Attachments for copper piping: copper plated black steel.

.3 Use insulation shields for hot pipework.

.4 Oversize pipe hangers and supports.

2.2 PIPE HANGERS (Cont'd)

.5 Adjustable clevis: material to MSS SP 69, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
.1 Ensure "U" has hole in bottom for riveting to insulation shields.

.6 U-bolts: carbon steel to MSS SP 69 with 2 nuts at each end to ASTM A 563.
.1 Finishes for steel pipework: galvanized.
.2 Finishes for copper, glass, brass or aluminum pipework: black, with formed portion plastic coated epoxy coated.

2.3 RISER CLAMPS

.1 Steel or cast iron pipe: black carbon steel to MSS SP 58, type 42.

.2 Copper pipe: carbon steel copper plated to MSS SP 58, type 42.

.3 Bolts: to ASTM A 307.

.4 Nuts: to ASTM A 563.

2.4 INSULATION PROTECTION SHIELDS

.1 Insulated cold and hot piping:
.1 Galvalized steel curved plate 300 mm long with edges turned up, 64 kg/m^3 density insulation: MSS SP 69, length designed for maximu 3 m span.

2.5 EQUIPMENT SUPPORTS

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings. Submit calculations with shop drawings.

2.6 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

.1 Provide templates to ensure accurate location of anchor bolts.

2.7 OTHER AUXILIARY EQUIPMENT SUPPORTS

.1 Provide all required supplementary supports required to achieve suitable hangers and support system. Fabricate supports from structural grade steel (all welded or bolted construction. Use iron angle, U-channels or Unistrut. Secure supports to building structure.

.2 Submit fabrication drawings for review.

2.8 SUPPLEMENTARY STRUCTURAL STEEL MEMBERS

.1 Where existing building structure is not sufficient provide all required supplementary structural steel members required to achieve suitable hanger and support system. Submit support details for review prior to fabrication and installation.

2.9 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

.1 Provide templates to ensure accurate location of anchor bolts.

.2 House -keeping pads
.1 For base-mounted equipment provide adequate housekeeping pads. Pads shall be pour concrete, at least 75 mm high and minimum 75 mm larger all around than equipment perimeter and with chamfered edges. Coordinate installation with General Contractor pay all cost.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install in accordance with:
.1 Manufacturer's instructions and recommendations.

.2 Vibration Control Devices:
.1 Install on piping systems at pumps, chillers, and as indicated.

3.2 INSTALLATION (Cont'd)

.3 Clamps on riser piping:
.1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
.2 Bolt-tightening torques to industry standards.
.3 Steel pipes: install below coupling or shear lugs welded to pipe.
.4 Cast iron pipes: install below joint.

.4 Clevis plates:
.1 Attach to concrete with 4 minimum concrete inserts, one at each corner.

.5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

3.3 HANGER SPACING

.1 Plumbing piping: to Canadian Plumbing Code Provincial Code and authority having jurisdiction.

.2 Fire protection: to applicable fire code.

.3 Gas and fuel oil piping: To Apllicable code.

.4 Copper piping: up to NPS 1/2: every 1.5 m.

.5 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.

.6 Within 300 mm of each elbow.

Maximum Pipe Size: NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.1 m	1.8 m
1-1/2	2.7 m	2.4 m
2	3.0 m	2.7 m
2-1/2	3.6 m	3.0 m
3	3.6 m	3.0 m
3-1/2	3.9 m	3.3 m
4	4.2 m	3.6 m
5	4.8 m	
6	5.1 m	

3.4 HANGER INSTALLATION

.1 Install hanger so that rod is vertical under operating conditions.

3.4 HANGER INSTALLATION (Cont'd)

.2 Adjust hangers to equalize load.

.3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.5 HORIZONTAL MOVEMENT

.1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.

.2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 FINAL ADJUSTMENT

.1 Adjust hangers and supports:
.1 Ensure that rod is vertical under operating conditions.
.2 Equalize loads.

.2 Adjustable clevis:
.1 Tighten hanger load nut securely to ensure proper hanger performance.
.2 Tighten upper nut after adjustment.

.3 C-clamps:
.1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

.4 Beam clamps:
.1 Hammer jaw firmly against underside of beam.

3.7 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 35 29.06 - Health and Safety Requirements.

.4 Section 01 35 30 - Health and Safety Requirements.

.5 Section 01 78 00 - Closeout Submittals.

.6 Section 01 91 13 - General Commissioning (Cx) Requirements.

.7 Section 21 05 01 - Common Work Results - Mechanical.

.8 Section 23 05 93 - Testing, Adjusting and Balancing of HVAC.

1.2 REFERENCES

.1 National Fire Protection Association (NFPA)
.1 NFPA 13-2007, Installation of Sprinkler Systems.

.2 National Building Code of Canada 2005(NBC)

1.3 DEFINITIONS

.1 Priority Two (P2) Buildings: buildings in which life safety is paramount concern. It is not necessary that P2 buildings remain operative during or after an earthquake.

.2 SRS: acronym for Seismic Restraint System.

1.4 LIMITATIONS

.1 Each trade shall be responsible for all applicable seismic restraint systems for all systems and equipment forming part of their respective contracts. All trades shall coordinate SRS design and implementation.

1.5 SYSTEM DESCRIPTION

.1 This section covers design, supply and installation of complete SRS for all systems, equipment specified for installation on this project. This includes fume hoods, piping, ductwork, mechanical equipment and systems, both vibration isolated and statically supported.

.2 SRS to be fully integrated into, compatible with:
.1 Noise and vibration controls specified elsewhere in this project specification.
.2 Structural, mechanical, electrical design of project.

.3 During seismic event, SRS to prevent systems and equipment from causing personal injury and from moving from normal position.

.4 Design to be by Professional Engineer specializing in design of SRS and registered in Province of Ontario.

1.6 QUALITY ASSURANCE

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.7 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
.1 Submittals to include: Full details of design criteria and system components and installation.

.2 Submit additional copy of shop drawings and product data to Departmental Representative for review by all parties having interest in SRS design.

1.8 CLOSEOUT SUBMITTALS

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

1.9 DELIVERY, STORAGE AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal, and Section 21 05 01 - Common Work Results - Mechanical.

1.10 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 SRS MANUFACTURER

.1 SRS to be from one manufacturer regularly engaged in production of same.

2.2 GENERAL

.1 SRS to provide gentle and steady cushioning action and avoid high impact loads.

.2 SRS to restrain seismic forces in all directions.

.3 Fasteners and attachment points to resist same load as seismic restraints.

.4 SRS of Piping systems to be compatible with:
.1 Expansion, anchoring and guiding requirements.
.2 Equipment vibration isolation and equipment SRS.

.5 SRS utilizing cast iron, threaded pipe, other brittle materials not permitted.

.6 Attachments to RC structure:
.1 Use high strength mechanical expansion anchors.
.2 Drilled or power driven anchors not permitted.

2.3 SRS FOR STATIC EQUIPMENT, SYSTEMS

.1 Floor-mounted equipment, systems:
.1 Anchor equipment to equipment supports.

2.3 SRS FOR STATIC EQUIPMENT, SYSTEMS (Cont'd)

.1 (Cont'd)
.2 Anchor equipment supports to structure.
.3 Use size of bolts scheduled in approved shop drawings.

.2 Suspended equipment, systems:
.1 Use one or combination of following methods:
.1 Install tight to structure.
.2 Cross-brace in all directions.
.3 Brace back to structure.
.4 Slack cable restraint system.
.2 SRS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.
.3 Hanger rods to withstand compressive loading and buckling.

2.4 SRS FOR VIBRATION ISOLATED EQUIPMENT

.1 Suspended equipment, systems:
.1 Use one or combination of following methods:
.1 Slack cable restraint system.
.2 Brace back to structure via vibration isolators and snubbers.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Attachment points and fasteners:
.1 To withstand same maximum load that seismic restraint is to resist and in all directions.

.2 Install SRS at least 25 mm from equipment, systems, services.

.3 Miscellaneous equipment not vibration-isolated:
.1 Bolt through house-keeping pad to structure.

.4 Co-ordinate connections with all disciplines.

.5 Vertical tanks:
.1 Anchor through house-keeping pad to structure.
.2 Provide steel bands above centre of gravity.

3.1 INSTALLATION (Cont'd)

.6 Submit all requirements for roof top equipment and coordinate roof structure installation with general contractor. Assure all componnents required for SRS are incorporated in roof installation.

3.2 INSPECTION AND CERTIFICATION

.1 SRS to be inspected and certified by Seismic Engineer who designed the system and by Manufacturer upon completion of installation.

.2 Provide written report to Departmental Representative with certificate of compliance.

3.3 COMMISSIONING DOCUMENTATION

.1 Upon completion and acceptance of certification, hand over to Departmental Representative complete set of construction documents, revised to show "as-built".

3.4 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 35 29.06 - Health and Safety Requirements.

.4 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.5 Section 01 78 00 - Closeout Submittals.

.6 Section 09 91 16 - Painting.

.7 Section 21 05 01 - Common Work Results - Mechanical.

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB)
.1 CAN/CGSB-24.3-92, Identification of Piping Systems.

.2 National Fire Protection Association
.1 NFPA 13-2013, Installation of Sprinkler Systems.

.3 Canadian Gas Association
.1 CAN/CGA B149.1-05, Natural Gas and Propane Installation Code.

1.3 QUALITY ASSURANCE

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Procedures and Section 21 05 01 - Common Work Results Mehanical.

1.4 SUBMITTALS (Cont'd)

.2 Submit shop drawings to indicate materials, finishes, method of installation, dimensions construction and assembly details, submit manufacturer's installation instructions and accessories list.

1.5 CLOSEOUT SUBMITTALS

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

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

.1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer. Where nameplates are not provided by manufacturer Division 23 to supply the nameplates. See para 2.2 for required informations.

.2 Information to include, as appropriate:
.1 Equipment: Manufacturer's name, model, size, serial number, capacity.
.2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

.1 Colours:
.1 Hazardous: red letters, white background.

2.2 SYSTEM NAMEPLATES (Cont'd)

.1 (Cont'd)
.2 Elsewhere: black letters, white background (except where required otherwise by applicable Codes).

.2 Construction:
.1 3 mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:
.1 Conform to following table:
.2 Use maximum of 25 letters/numbers per line.
.3 Locations:
.1 Equipment in Mechanical Rooms: Use #9. size

.4 Identification for Preventive Maintenance Support System (PMSS):
.1 Use arrangement of Main identifier, Source identifier, Destination identifier.
.2 Equipment in Mechanical Room:
.1 Main identifier: Size #9.
.2 Source and Destination identifiers: Size #6.
.3 Terminal cabinets, control panels: Size #5.
.3 Equipment elsewhere: Sizes as appropriate.

2.3 IDENTIFICATION OF PIPING SYSTEMS

.1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.

.2 Legend:
.1 Block capitals to sizes and colours listed in CAN/CGSB-24.3.

.3 Arrows showing direction of flow:
.1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
.2 Outside diameter of pipe or insulation 75mm and greater: 150 mm long x 50 mm high.
.3 Use double-headed arrows where flow is reversible.

.4 Extent of background colour marking:
.1 To full circumference of pipe or insulation.

2.3 IDENTIFICATION OF PIPING SYSTEMS (Cont'd)

.4 (Cont'd)
.2 Length to accommodate pictogram, full of length legend and arrows.

.5 Materials for background colour marking, legend, arrows:
.1 Pipes and tubing 20 mm and smaller: Waterproof and heat-resistant pressure sensitive plastic marker tags.
.2 All other pipes: Pressure sensitive plastic-coated cloth or vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100%RH and continuous operating temperature of 150°C and intermittent temperature of 200°C.

.6 Colours and Legends:
.1 Where not listed, obtain direction from Departmental Representative.
.2 Colours for legends, arrows: To following table:

Background colour:	Legend, arrows:
Yellow	BLACK
Green	WHITE
Red	WHITE

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.3 Background colour marking and legends for piping systems:

2.6 CONTROLS COMPONENTS

.1 By Division 25 according to this section requirements.

2.8 LANGUAGE

.1 Identification to be in English and French.

PART 3 - EXECUTION

3.1 TIMING

.1 Provide identification only after all painting specified in Division 09.

3.2 INSTALLATION

.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.

.2 Provide ULC and CSA registration plates as required by respective agency.

.3 Identify systems, equipment to conform to PWGSC PMSS. Provide detailed list of equipment and systems installed under this contract and obtain numbering list from the Departmental Representative.

3.3 NAMEPLATES

.1 Locations:
.1 In conspicuous location to facilitate easy reading and identification from operating floor.

.2 Protection:
.1 Do not paint, insulate or cover in any way.

3.4 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

.1 On long straight runs in open areas: At not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.

.2 Adjacent to each change in direction.

.3 On both sides of visual obstruction or where run is difficult to follow.

.4 On both sides of separations such as walls, floors, partitions.

.5 At branch take-offs on both main and branch.

.6 Identification to be easily and accurately readable from usual operating areas and from access points.
.1 Position of identification to be approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.5 VALVES

.1 Valves, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.

.2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Departmental Representative. Provide one copy (reduced in size if required) in each operating and maintenance manual.

.3 Number valves in each system consecutively.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 35 29.06 - Health and Safety Requirements.

.4 Section 01 78 00 - Closeout Submittals.

.5 Section 01 91 13 - General Commissioning (Cx) Requirements.

.6 Section 21 05 01 - Common Work Results - Mechanical.

1.2 GENERAL

.1 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.3 PURPOSE OF TAB

.1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads

.2 Adjust and regulate equipment and systems so as to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

.3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.4 EXCEPTIONS

.1 TAB of systems and equipment regulated by codes, standards to be to satisfaction of authority having jurisdiction.

1.5 CO-ORDINATION

.1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule so as to ensure completion before acceptance of project.

.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.6 PRE-TAB REVIEW

.1 Review contract documents before project construction is started and confirm in writing to Departmental Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to Departmental Representative in writing all proposed procedures which vary from standard.

.3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.7 START-UP

.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

.2 Follow special start-up procedures specified elsewhere in each Division.

1.8 OPERATION OF SYSTEMS DURING TAB

.1 Operate systems for length of time required for TAB and as required by Departmental Representative for verification of TAB reports.

1.9 START OF TAB

.1 Notify Departmental Representative 7 days prior to start of TAB.

.2 Start TAB when building is essentially completed, including:
.1 Installation of ceilings, doors, windows, other construction affecting TAB.
.2 Application of weatherstripping, sealing, caulking.

1.9 START OF TAB (Cont'd)

.2 (Cont'd)
.3 All pressure, leakage, other tests specified elsewhere in each Division are completed and reports verified by TAB agency.
.4 All provisions for TAB installed and operational.

.3 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
.1 Proper thermal overload protection in place for electrical equipment.
.2 Air systems:
.1 Filters in place, clean.
.2 Duct systems clean.
.3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
.4 Correct fan rotation.
.5 Fire, smoke, volume control dampers installed and open.
.6 Coil fins combed, clean.
.7 Access doors, installed, closed.
.8 Outlets installed, volume control dampers open.

1.10 APPLICATION TOLERANCES

.1 Do TAB to following tolerances of design values:
.1 HVAC systems: plus 5%, minus 5%.

1.11 ACCURACY TOLERANCES

.1 Measured values to be accurate to within plus or minus 5% of actual values.

1.12 INSTRUMENTS

.1 Prior to TAB, submit to Departmental Representative list of instruments to be used together with serial numbers.

.2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

.3 Calibrate within 3 months of TAB. Provide certificate of calibration to Departmental Representative.

1.13 SUBMITTALS

.1 Submit, prior to commencement of TAB:
.1 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.14 PRELIMINARY TAB REPORT

.1 Submit for checking and approval of Departmental Representative, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
.1 Details of instruments used.
.2 Details of TAB procedures employed.
.3 Calculations procedures.
.4 Summaries.

1.15 TAB REPORT

.1 TAB report to show results in SI units and to include:
.1 Project record drawings.
.2 System schematics.

.2 Submit 6 copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs.

1.16 VERIFICATION

.1 Reported results subject to verification by Departmental Representative.

.2 Provide manpower and instrumentation to verify up to 100% of reported results.

.3 Number and location of verified results to be at discretion of Departmental Representative.

.4 Bear costs to repeat TAB as required to satisfaction of Departmental Representative.

1.17 SETTINGS

.1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.

1.17 SETTINGS (Cont'd)

.2 Permanently mark settings to allow restoration at any time during life of facility. Markings not to be eradicated or covered in any way.

1.18 COMPLETION OF TAB

.1 TAB to be considered complete when final TAB Report received and approved by Departmental Representative.

1.19 AIR SYSTEMS

.1 Standard: TAB to be to most stringent of this section or TAB standards of AABC,NEBB,SMACNA and ASHRAE.

.2 Qualifications: personnel performing TAB to be qualified to standards of AABC or NEBB.

.3 Quality assurance: Perform TAB under direction of supervisor qualified to standards of AABC or NEBB.

.4 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dew point), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.

.5 Locations of equipment measurements: To include, but not be limited to, following as appropriate:
.1 Inlet and outlet of dampers, filter, coil, fans, air handling units, other equipment causing changes in conditions.
.2 At controllers, controlled device.

.6 Locations of systems measurements to include, but not be limited to, following as appropriate: Main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.20 PLUMBING SYSTEMS

.1 Meet requirements as specified for hydronic systems.

1.20 PLUMBING SYSTEMS (Cont'd)

.2 Locations of equipment measurements: To include, but not be limited to, following as appropriate: Roof drain, controlled device, hot water recirculating system.

PART 2 - PRODUCTS ÿ

2.1 Not Used

.1 Not used.

PART 3 - EXECUTIONÿ

3.1 Not Used

.1 Not used.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 35 29.06 - Health and Safety Requirements.

.4 Section 01 78 00 - Closeout Submittals.

.5 Section 01 91 13 - General Commissioning (Cx) Requirements.

.6 Section 21 05 01 - Common Work Results - Mechanical.

1.2 REFERENCES

.1 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
.1 SMACNA HVAC Air Duct Leakage Test Manual, 1985(R2003).

1.3 QUALITY ASSURANCE

.1 Health and Safety:
.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Test Reports:
.1 Submit proposed report form and test report indicating compliance with specifications for specified performance characteristics and physical properties. Include pressure test information and results as follows:
.1 Schematic of section under test.
.2 Required and achieved static pressures.
.3 Orifice differential pressure at test sites.
.4 Permissible and actual leakage flow rate (L/s) for test sites.

1.4 SUBMITTALS (Cont'd)

.2 (Cont'd)
.1 (Cont'd)
.5 Witnessed certification of results.

1.5 CLOSEOUT SUBMITTALS

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

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 TEST INSTRUMENTS

.1 Test apparatus to include:
.1 Fan capable of producing required static pressure.
.2 Duct section with calibrated orifice plate mounted and accurately located pressure taps.
.3 Flow measuring instrument compatible with the orifice plate.
.4 Calibration curves for orifice plates used.
.5 Flexible duct for connecting to ductwork under test.
.6 Smoke bombs for visual inspections.

.2 Test apparatus: accurate to within +/- 3 % of flow rate and pressure.

.3 Submit details of test instruments to be used to Departmental Representative at least one month before anticipated start date.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 TEST PROCEDURES

.1 Maximum lengths of ducts to be tested consistent with capacity of test equipment.

.2 Section of duct to be tested to include:
.1 Fittings, branch ducts, tap-ins.

.3 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition of tests.

.4 Base partial system leakage calculations on SMACNA HVAC Air Duct Leakage Test Manual.

.5 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

.6 At the end of the test submit written copy of test results. Indicate each section of duct tested, method of testing and results.

3.3 SITE TOLERANCES

.1 System leakage tolerances specified are stated as percentage of total flow rate handled by system. Pro-rate specified system leakage tolerances. Leakage for sections of duct systems: not to exceed total allowable leakage.

.2 Leakage tests on following systems not to exceed specified leakage rates.
.1 Small duct systems up to 250 Pa: leakage 2 %.
.2 VAV box and duct on downstream side of VAV box: leakage 2 %.
.3 Large low pressure duct systems up to 500 Pa: leakage 2 %.

.3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

3.4 TESTING

.1 Test ducts before installation of insulation or other forms of concealment.

.2 Test after seals have cured.

.3 Test when ambient temperature will not affect effectiveness of seals, and gaskets.

3.5 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Division 1 - General Requirements.

.2 Section 21 05 01 - Common Work Results - Mechanical.

.3 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

1.2 REFERENCES

.1 American Society for Testing and Materials International, (ASTM)
.1 ASTM B 209M-2014, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
.2 ASTM C335/C335M-10e1, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
.3 ASTM C449-07(2013), Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
.4 ASTM C921-10, Practice for Determining the Properties of Jacketing materials for Thermal Insulation.

.2 Canadian General Standards Board (CGSB)
.1 CGSB 51-GP-52MA, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.3 National Fire Protection Association (NFPA)
.1 NFPA (Fire) 90A, Standard for the Installation of Air Conditioning and Ventilating Systems, 2015 Edition.
.2 NFPA (Fire) 90B, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems, 2015 Edition.

.4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (R1999).

.5 Underwriters Laboratories of Canada (ULC)
.1 CAN/ULC-S102-11, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.2 REFERENCES (Cont'd)

.5 (Cont'd)
.2 CAN/ULC S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.3 DEFINITIONS

.1 For purposes of this section:
.1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
.2 "EXPOSED" - will mean "not concealed" as defined herein.
.3 Insulation systems - insulation material, fasteners, jackets, and other accessories.

.2 TIAC Codes:
.1 CRD: Code Round Ductwork.
.2 CRF: Code Rectangular Finish.

1.4 QUALITY ASSURANCE

.1 Health and Safety:
.1 Do construction occupational health and safety in accordance with Section 01 70 12 - Safety Requirements.

.2 Product Data:
.1 Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.

1.5 SUBMITTALS

.1 Submit shop drawings in accordance with Section 01 33 23 - Shop Drawings, Product Data and Samples.

1.6 MANUFACTURERER'S INSTRUCTIONS

.1 Submit manufacturer's installation instructions in accordance with Section 01 33 23 - Shop Drawings,Product Data and Samples.

.2 Installation instructions to include procedures to be used, installation standards to be achieved.

1.7 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 23 - Operation and Maintenance Manual.

1.8 QUALIFICATIONS

.1 Installer to be specialist in performing work of this section and be qualified to standards of TIAC.

1.9 WASTE MNAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 21- Waste Management And Disposal and Section 21 05 01 Common Work Results Mechanical.

1.10 DELIVERY, STORAGE AND HANDLING

.1 While delivering materials to site follow requirements of Section 01 62 10 - Material and Equipment, and Section 21 05 01 - Common Work Results - Mechanical.

PART 2 - PRODUCTS

2.1 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC-S102.
.1 Maximum flame spread rating: 25.
.2 Maximum smoke developed rating: 50.

2.2 Insulation

.1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code C-1: Rigid mineral fibre board to ASTM C 612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).

.4 TIAC Code C-2: Mineral fibre blanket faced with factory applied vapour retarder jacket.
.1 Mineral fibre: to CAN/ULC-S701.

2.2 Insulation (Cont'd)

.4 (Cont'd)
.2 Jacket: to CGSB 51-GP-52Ma.
.3 Maximum "k" factor: to CAN/ULC-S701.

2.3 JACKETS

.1 Canvas:
.1 220 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
.2 Lagging adhesive: Compatible with insulation.

.2 Aluminum:
.1 To ASTM B 209.
.2 Thickness: 0.50 mm sheet.
.3 Finish: stucco embossed.
.4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
.5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5mm thick at 300 mm spacing.

2.4 ACCESSORIES

.1 Vapour retarder lap adhesive:
.1 Water based, fire retardant type, compatible with insulation.

.2 Indoor Vapour Retarder Finish:
.1 Vinyl emulsion type acrylic, compatible with insulation.

.3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C 449.

.4 Tape: self-adhesive, reinforced aluminum, 50 mm wide minimum.

.5 Contact adhesive: quick-setting.

.6 Canvas adhesive: washable.

.7 Tie wire: 1.5 mm stainless steel.

.8 Banding: 12 mm wide, 0.5 mm thick stainless steel.

2.4 ACCESSORIES (Cont'd)

.9 Fasteners: 2 mm diameter pins with 35 mm diameter round or square clips, length to suit thickness of insulation.

PART 3 - EXECUTION

3.1 APPLICATION

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

.2 Pressure test ductwork systems complete, witness and certify.

3.2 PRE- INSULATION REQUIREMENTS

.1 Surfaces to be clean, dry, free from foreign material.

3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards, ANSI/NFPA 90A and ANSI/NFPA 90B.

.2 Apply materials in accordance with manufacturer's instructions and this specification.

.3 Use two layers with staggered joints when required nominal thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
.1 Hangers, supports to be outside vapour retarder jacket.

.5 Supports, Hangers in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
.1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

.6 Fasteners: At 300 mm oc in horizontal and vertical directions, minimum two rows each side.

3.4 DUCTWORK INSULATION SCHEDULE

.1 Insulation types and thicknesses: Conform to following table:

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular Air Duct (Indoor)	C-1	Yes	25
Rectangular Air Duct (Outdoor)	C-1	Yes	50
Round Air Duct (Indoor)	C-2	Yes	25
Round Air Duct (Outdoor)	C-2	Yes	50

.2 All acoustically lined ductwork to be insulated according to para 3.4.1.

.3 Finishes:
.1 Indoor conceled - None
.2 Indoor exposed - Canvas
.3 Outdoor - watertight aluminum jacketing or flexible all welded PVC membrane.

3.5 CLEANING

.1 Clean in accordance with Section 01 74 13 - Cleaning.
.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 35 29.06 - Health and Safety Requirements

.4 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.5 Section 07 92 10 - Joint Sealing.

.6 Section 01 78 00 - Closeout Submittals.

.7 Section 07 91 13 - General Commissioning (Cx) Requirements.

.8 Section 21 05 01 - Common Work Results - Mechanical.

.9 Section 23 05 05 - Installation of Piping.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
.1 ASHRAE Standard 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).

.2 American Society for Testing and Materials International (ASTM)
.1 ASTM B 209M-07, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.
.2 ASTM C 335-05ae1, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
.3 ASTM C 449/C 449M-07, Standard Specification for MineralFiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
.4 ASTM C 533-2009, Calcium Silicate Block and Pipe Thermal Insulation.

1.2 REFERENCES (Cont'd)

.3 Canadian General Standards Board (CGSB)
.1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
.2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketting Sheet, for Insulated Pipes, Vessels and Round Ducts

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
.1 Material Safety Data Sheets (MSDS).

.5 Manufacturer's Trade Associations
.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).

.6 Underwriter's Laboratories of Canada (ULC)
.1 CAN/ULC-S102.2-07, Surface Burning Characteristics of Building Materials and Assemblies.
.2 CAN/ULC-S702-1997, Thermal Insulation, Mineral Fibre, for Buildings

1.3 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.3 Shop Drawings:
.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

1.4 DEFINITIONS

.1 For purposes of this section:

1.4 DEFINITIONS (Cont'd)

.1 (Cont'd)
.1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
.2 "EXPOSED" - will mean "not concealed" as specified.

.2 TIAC ss:
.1 CRF: Code Rectangular Finish
.2 CPF: Code Piping Finish

1.5 QUALITY ASSURANCE

.1 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to standards member of TIAC.

.2 Health and Safety:
.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6 CLOSEOUT SUBMITTALS

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

1.7 DELIVERY, STORAGE AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.8 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC-S102.
.1 Maximum flame spread rating: 25.
.2 Maximum smoke developed rating: 50.

2.2 INSULATION

.1 Mineral fibre specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C 335.

.3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.
.1 Mineral fibre: to CAN/ULC-S702.
.2 Maximum "k" factor: to CAN/ULC-S702.

.4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
.1 Mineral fibre: to CAN/ULC-S702.
.2 Jacket: to CGSB 51-GP-52Ma.
.3 Maximum "k" factor: to CAN/ULC-S702.

.5 TIAC Code C-2: mineral fibre blanket faced with factory applied vapour retarder jacket.
.1 Mineral fibre: to CAN/ULC-S702.
.2 Jacket: to CGSB 51-GP-52Ma.
.3 Maximum "k" factor: to CAN/ULC-S702.

.6 TIAC Code A-6: flexible unicellular tubular elastomer.
.1 Insulation: with vapour retarder jacket .
.2 Jacket: to CGSB 51-GP-52Ma.
.3 Maximum "k" factor:.
.4 Certified by manufacturer: free of potential stress corrosion cracking corrodants.

2.3 INSULATION SECUREMENT

.1 Tape: self-adhesive, aluminum,reinforced, 50 mm wide minimum.

2.3 INSULATION SECUREMENT (Cont'd)

.2 Contact adhesive: quick setting.

.3 Canvas adhesive: washable.

2.4 CEMENT

.1 Thermal insulating and finishing cement:
.1 Hydraulic setting on mineral wool, to ASTM C 449/C 449M.

2.5 VAPOUR RETARDER LAP ADHESIVE

.1 Water based, fire retardant type, compatible with insulation.

2.6 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 OUTDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: fibrous glass, untreated 305 g/m^2.

2.8 JACKETS

.1 Polyvinyl Chloride (PVC):
.1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
.2 Colours: White.
.3 Minimum service temperatures: -20 degrees C.
.4 Maximum service temperature: 65 degrees C.
.5 Moisture vapour transmission: 0.02 perm.
.6 Fastenings:
.1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
.2 Tacks.
.3 Pressure sensitive vinyl tape of matching colour.

.2 Aluminum:
.1 To ASTM B 209.
.2 Thickness: 0.50 mm sheet.

2.8 JACKETS (Cont'd)

.2 (Cont'd)
.3 Finish: stucco embossed.
.4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
.5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5mm thick at 300 mm spacing.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PRE-INSTALLATION

.1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.

.2 Surfaces clean, dry, free from foreign material.

3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturers instructions and this specification.

.3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
.1 Install hangers, supports outside vapour retarder jacket.

.5 Supports, Hangers:

3.3 INSTALLATION (Cont'd)

.5 (Cont'd)
.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

.1 Application: at expansion joints, valves,flanges and unions at equipment.

.2 Design: to permit periodic removal and replacement without damage to adjacent insulation.

.3 Insulation:
.1 Insulation, fastenings and finishes: same as system.
.2 Jacket: to match piping.

3.5 INSTALLATION OF ELASTOMERIC JOINTS. INSULATION

.1 Insulation to remain dry. Overlaps to manufacturers instructions. Ensure tight joints.

.2 Provide vapour retarder as recommended by manufacturer.

3.6 PIPING INSULATION SCHEDULES

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

.2 TIAC Code: A-1.
.1 Securements: tape.
.2 Seals: lap seal adhesive, lagging adhesive.
.3 Installation: TIAC Code 1501-H.

.3 TIAC Code: A-3.
.1 Securements: VR lap seal adhesive, VR lagging adhesive.
.2 Installation: TIAC Code: 1501-C.

.4 TIAC Code: A-6.
.1 Seals: lap seal adhesive, lagging adhesive.

3.6 PIPING INSULATION SCHEDULES (Cont'd)

.5 TIAC Code: C-2 with vapour retarder jacket.
.1 Seals: lap seal adhesive, lagging adhesive.
.2 Installation: TIAC Code: 1501-C.

.6 Thickness of insulation as listed in following table.
.1 Run-outs to individual units and equipment not exceeding 4000 mm long.
.2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Application Temp Degrees C	TIAC Run-Out	Pipe sizes (NPS) and insulation thickness(mm)					
		to 1 to2	1 1/4 to4	2 1.2 6	5 to 8& over		
Domestic HWS	A-1	25	25	25	38	38	38
Domestic CWS	A-1	25	25	25	25	25	25
Refrigerant 4-13 hot gas liquid suction	A-6	25	25	25	25	25	25
Refrigerant below 4 hot gas liquid suction	A-6	25	25	25	25	25	25
Storm	C-2	25	25	25	25	25	25

.7 Finishes
.1 Exposed indoors: PVC jacket.
.2 Exposed in mechanical rooms: PVC jacket.
.3 Concealed, indoors: canvas on valves, fittings. No further finish.
.4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
.5 Outdoors: water-proof aluminum jacket.
.6 Finish attachments: SS bands, at 150 mm on centre. Seals: wing.
.7 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.7 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 35 29.06 - Health and Safety Requirements.

.4 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.5 Section 01 78 00 - Closeout Submittals.

.6 Section 01 91 13 - General Commissioning (Cx) Requirements.

.7 Section 21 05 01 - Common Work Results - Mechanical.

.8 Section 23 05 01 - Installation of Pipework.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)
.1 ASME B16.5-13, Pipe Flanges and Flanged Fittings.
.2 ASME B16.18-12, Cast Copper Alloy Solder Joint Pressure Fittings.
.3 ASME B16.22-13, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
.4 ASME B18.2.1-12, Square and Hex Bolts and Screws Inch Series.

.2 American Society for Testing and Materials International (ASTM)
.1 ASTM A 47/A 47M-99(2004), Standard Specification for Ferritic Malleable Iron Castings.
.2 ASTM A 53/A 53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
.3 ASTM B 75M-99, Standard Specification for Seamless Copper Tube Metric.
.4 ASTM B 837-01, Standard Specification for Seamless Copper Tube for Natural Gas and Liquified Petroleum (LP) Gas Fuel Distribution Systems.

1.2 REFERENCES (Cont'd)

.3 Canadian Standards Association (CSA International)
.1 CSA W47.1-03, Certification of Companies for Fusion Welding of Steel.

.4 Canadian Standards Association (CSA)/Canadian Gas Association (CGA)
.1 CAN/CSA B149.1HB-05, Natural Gas and Propane Installation Code Handbook.

1.3 QUALITY ASSURANCE

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 SUBMITTALS

.1 Submittal in accordance with Section 01 33 00 - Procedures and Section 21 05 01 - Common Work Results Mechanical.

.2 Product Data:
.1 Submit shop drawings to indicate materials, finishes, method of installation, dimensions construction and assembly details, submit manufacturer's installation instructions and accessories list.

1.5 CLOSEOUT SUBMITTALS

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

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 PIPE

.1 Steel pipe: to ASTM A 53/A 53M, Schedule 40, seamless as follows:
- .1 NPS 1/2 to 2, screwed.
- .2 NPS2 1/2 and over, plain end.

.2 Copper tube: to ASTM B 837.

2.2 JOINTING MATERIAL

.1 Screwed fittings: pulverized lead paste.

.2 Welded fittings: to CSA W47.1.

.3 Flange gaskets: nonmetallic flat.

.4 Brazing: to ASTM B 837.

2.3 FITTINGS

.1 Steel pipe fittings, screwed, flanged or welded:
- .1 Malleable iron: screwed, banded, Class 150.
- .2 Steel pipe flanges and flanged fittings: to ASME B16.5.
- .3 Welding: butt-welding fittings.
- .4 Unions: malleable iron, brass to iron, ground seat, to ASTM A 47/A 47M.
- .5 Bolts and nuts: to ASME B18.2.1.
- .6 Nipples: schedule 40, to ASTM A 53/A 53M.

.2 Copper pipe fittings, screwed, flanged or soldered:
- .1 Cast copper fittings: to ASME B16.18.
- .2 Wrought copper fittings: to ASME B16.22.

2.4 VALVES

.1 Provincial Code approved, lubricated ball type.

2.5 PRESSURE REDUCING REGULATORS

.1 Factory assembled, general purposes with low pressure side relief valve. Cast iron body, aluminum diaphragm case, neoprene rubber closing gap gasket, nitrile rubber diaphragm and disk. Self operated, spring loaded.

2.5 PRESSURE REDUCING REGULATORS (Cont'd)

.2 Maximum inlet pressure: 1.0 bar.

.3 Operating temperature: minus 29°C to plus 66°C.

.4 Spring case interchangeable for field repositioning to suit application.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PIPING

.1 Install in accordance with Section 23 05 01 - Installation of Pipework, applicable Provincial Codes, and CAN/CSA B149.1, supplemented as specified.

.2 Install drip points:
.1 At low points in piping system.
.2 At connections to equipment.

3.3 VALVES

.1 Install valves with stems upright or horizontal unless otherwise approved by Departmental Representative

.2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

3.4 PRESSURE REDUCING REGULATORS

.1 Verify site conditions and select valves to suit system capacity and gas pressure (high and low side). Submit list for approval.

.2 Install valves as indicated and according to manufacturer instructions.

.3 Extend relief vent and terminate with gooseneck 500 mm above roof level. Assure recommended distance from any air intakes.

3.5 FIELD QUALITY CONTROL

.1 Site Tests/Inspection:
.1 Test system in accordance with CAN/CSA B149.1 and requirements of authorities having jurisdiction.
.2 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.

3.6 ADJUSTING

.1 Purging: purge after pressure test in accordance with CAN/CSA B149.1.

.2 Pre-Start-Up Inspections:
.1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.
.2 Check gas trains, entire installation is approved by authority having jurisdiction.

.3 Check gas trains, verify the entire installation is Code compliant and approved by authority having jurisdiction.

3.7 NEW SERVICES

.1 Survey list of gas fired equipment, prepare summary of new load. Submit list to gas company and obtain approval to connect new load. Coordinate meter installation. Extend gas main from meter to the building and connect to new equipment.

.2 Make arrangements and pay all cost for services of the gas company to provide adequate gas service,gas meter upgrade/replacement and line relocation.

.3 Proceed with gas service arrangements within 10 days of contract award.
.1 Submit all correspondence to Departmental Representative for information and record.

3.8 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 35 29.06 - Health and Safety Requirements.

.4 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.5 Section 01 78 00 - Closeout Submittals.

.6 Section 01 91 13 - General Commissioning (Cx) Requirements.

.7 Section 21 05 01 - Common Work Results - Mechanical.

.8 Section 23 05 01 - Installation of Pipework.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)
.1 ASME B16.22-01, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
.2 ASME B16.24-02, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
.3 ASME B16.26-88, Cast Copper Alloy Fittings for Flared Copper Tubes.
.4 ASME B31.5-01, Refrigeration Piping and Heat Transfer Components.

.2 American Society for Testing and Materials International (ASTM)
.1 ASTM A 307-04, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
.2 ASTM B 280-03, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

.3 Canadian Standards Association (CSA International)

1.2 REFERENCES (Cont'd)

.3 (Cont'd)
.1 CSA B52-99, Mechanical Refrigeration Code.

.4 Environment Canada (EC)
.1 EPS 1/RA/1-96, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

.5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
.1 Material Safety Data Sheets (MSDS).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 Submittal Procedures.

.2 Product Data:
.1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.
.2 Submit WHMIS MSDS in accordance with Section 01 35 21 LEED Requirements. Indicate VOC's for adhesive and solvents during application and curing.

.3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Instructions: submit manufacturer's installation instructions.

.6 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

.1 Pre-Installation Meeting:
.1 Convene pre-installation meeting one week prior to beginning work of this Section.
.1 Verify project requirements.
.2 Review installation and substrate conditions.
.3 Co-ordination with other building subtrades.
.4 Review manufacturer's installation instructions and warranty requirements.

.2 Health and Safety:
.1 Do construction occupational health and safety in accordance with Section 01 70 03 - Safety Requirements.

1.5 CLOSEOUT SUBMITTALS

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

1.6 DELIVERY, STORAGE AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal, and Section 21 05 01 - Common Work Results - Mechanical.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 TUBING

.1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
.1 Hard copper: to ASTM B 280, type ACR.

2.2 FITTINGS

.1 Service: design pressure 2070 kPa and temperature 121 degrees C.

.2 Brazed:
.1 Fittings: wrought copper to ASME B16.22.
.2 Joints: silver solder, 15% Ag-80% Cu-5%P or copper-phosphorous, 95% Cu-5%P and non-corrosive flux.

.3 Flanged:
.1 Bronze or brass, to ASME B16.24, Class 150 and Class 300.
.2 Gaskets: suitable for service.
.3 Bolts, nuts and washers: to ASTM A 307, heavy series.

.4 Flared:
.1 Bronze or brass, for refrigeration, to ASME B16.26.

2.3 PIPE SLEEVES

.1 Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.

2.4 VALVES

.1 22 mm and under: Class 500, 3.5 Mpa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.

.2 Over 22 mm: Class 375, 2.5 Mpa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.1 MANUFACTURER'S INSTRUCTIONS (Cont'd)

.1 (Cont'd)
.1 Submit to equipment manufacturer for review and approval. Piping layout and sizing.

3.2 GENERAL

.1 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5 Section 23 05 01 - Installation of Pipework.

3.3 BRAZING PROCEDURES

.1 Bleed inert gas into pipe during brazing.

.2 Remove valve internal parts, solenoid valve coils, sight glass.

.3 Do not apply heat near expansion valve and bulb.

3.4 PIPING INSTALLATION

.1 General:
.1 Hard drawn copper tubing: do not bend. Minimize use of fittings.

.2 Hot gas lines:
.1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.
.2 Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter.
.3 Provide inverted deep trap at top of risers.
.4 Provide double risers for compressors having capacity modulation.
.1 Large riser: install traps as specified.
.2 Small riser: size for 5.1 m/s at minimum load. Connect upstream of traps on large riser.

3.5 PRESSURE AND LEAK TESTING

.1 Close valves on factory charged equipment and other equipment not designed for test pressures.

3.5 PRESSURE AND LEAK TESTING (Cont'd)

.2 Leak test to CSA B52 before evacuation to 2MPa and 1MPa on high and low sides respectively.

.3 Test Procedure: build pressure up to 35 kPa. Supplement with nitrogen and soap to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

3.6 FIELD QUALITY CONTROL

.1 Site Tests/Inspection:
.1 Close service valves on factory charged equipment.

.2 Ambient temperatures to be at least 13 degrees C for at least 12 hours before and during dehydration.

.3 Use copper lines of largest practical size to reduce evacuation time.

.4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5Pa absolute and filled with dehydrated oil.

.5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.

.6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:
.1 Twice to 14 Pa absolute and hold for 4 h.
.2 Break vacuum with refrigerant to 14 kPa.
.3 Final to 5 Pa absolute and hold for at least 12 h.
.4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
.5 Submit test results to DCC Representative.

.7 Charging:
.1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.

3.6 FIELD QUALITY CONTROL (Cont'd)

.7 (Cont'd)
.2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.
.3 Re-purge charging line if refrigerant container is changed during charging process.

.8 Checks:
.1 Make checks and measurements as per manufacturer's operation and maintenance instructions.
.2 Record and report measurements to DCC Representative.

.9 Manufacturer's Field Services:
.1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.
.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
.3 Schedule site visits, to review Work, at stages listed:
.1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
.2 Twice during progress of Work at 25% and 60% complete.
.3 Upon completion of the Work, after cleaning is carried out.
.4 Obtain reports, within 3 days of review, and submit, immediately, to DCC Representative.

3.7 DEMONSTRATION

.1 Instructions:
.1 Post instructions in frame with glass cover in accordance with Section 01 78 00 - Closeout Submittals and CSA B52.

3.8 CLEANING

.1 Perform cleaning operations as specified in accordance with manufacturer's recommendations.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 35 29.06 - Health and Safety Requirements.

.4 Section 07 84 00 - Firestopping.

.5 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.6 Section 23 05 94 - Pressure Testing of Ducted Air Systems.

.7 Section 01 61 00 - Common Product requirements.

.8 Section 01 74 21 - Construction/Demolition Waste Management and Disposal..

.9 Section 01 91 13 - General Commissioning (Cx) Requirements.

.10 Section 21 05 01 - Common Work Results - Mechanical.

1.2 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

.2 American Society for Testing and Materials International, (ASTM).
.1 ASTM A 635/A 635M-14, Standard for Steel, Specification Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.

.3 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA).
.1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition 1995 and Addendum No. 1, 1997.
.2 SMACNA HVAC Air Duct Leakage Test Manual, 1985, 1st Edition.
.3 IAQ Guideline for Occupied Buildings Under Construction 1995, 1st Edition.

1.3 QUALITY ASSURANCE

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

.2 Certification of Ratings:
.1 Catalogue or published ratings shall be those obtained fom tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards

1.4 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets for the following:
.1 Sealants.
.2 Tape.
.3 Proprietary Joints.

1.5 CLOSEOUT SUBMITTALS

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

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Seaparate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 SEAL CLASSIFICATION

.1 Classification as follows:

2.1 SEAL CLASSIFICATION (Cont'd)

Maximum Pressure Pa	SMACNA Seal Class
500	A

.2 Seal classification:
.1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

2.2 SEALANT .1 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C.

2.3 TAPE .1 Tape: polyvinyl treated, open weave fibreglass tape, 50 mm wide.

2.4 DUCT LEAKAGE .1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

2.5 FITTINGS .1 Fabrication: to SMACNA.

.2 Radius elbows.
.1 Rectangular: standard radius.
.2 Round: five piece.

.3 Mitred elbows, rectangular:
.1 To 400 mm: with single thickness turning vanes.
.2 Over 400 mm: with double thickness turning vanes.

.4 Branches:
.1 Rectangular main and branch: with 45 entry degrees on branch.
.2 Round main and branch: enter main duct with conical connection.
.3 Provide volume control damper in branch duct near connection to main duct.
.4 Main duct branches: with splitter damper.

2.5 FITTINGS (Cont'd)

.5 Transitions:
.1 Diverging: 15 degrees maximum included angle.
.2 Converging: 15 degrees maximum included angle.

.6 Offsets:
.1 as indicated.

.7 Obstruction deflectors: maintain full cross-sectional area.

2.6 FIRE STOPPING

.1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00 - Firestopping.

.2 Fire stopping material and installation must not distort duct.

2.7 GALVANIZED STEEL

.1 Lock forming quality: to ASTM A 653/A 653M, Z90 zinc coating.

.2 Thickness, fabrication and reinforcement: to SMACNA.

2.8 HANGERS AND SUPPORTS

.1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
.1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
.1 Maximum size duct supported by strap hanger: 500mm. .2 Hanger configuration: to SMACNA.
.2 Hangers: galvanized steel angle with galvanized steel rods to following table

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

.3 Upper hanger attachments:

2.8 HANGERS AND SUPPORTS (Cont'd)

.1 (Cont'd)

.1 For concrete: manufactured concrete inserts.

2.9 SPIRAL DUCT

.1 Structural Criteria-the functional criteria for round and flat-oval spiral ducts and fittings shall be in conformance with the SMACNA Duct Performance Test Standard No. DPTS-2005

.1 Wall deflection:

.1 Round (positive Pressure)-NA

.2 Round (negative Pressure) - diameter/200;

.3 Oval up to 900mm width or less 6mm at atmospheric pressure.

.4 Oval larger than 900mm width 12mm at atmospheric pressure.

.2 Leakage Criteria:

.1 Spiral pipe seams- no need to seal.

.2 all radial and longitudinal seams --- seams shall be sealed. Methods may include welding, tack welding and sealing, mechanically closed standing seams, continuous resistance welds, gaskets or other methods. Sealing methods should be consistent with maintaining a total system leakage performance of less than class 4 at rated pressure (4 CFM per 100 square feet of duct surface area) in accordance with ASHRAE Standard 90.1-2010.

.3 Transverse joints --- all transverse joints shall be sealed during installation. Sealing methods should be consistent with maintaining a total system leakage performance of less than class 4 at rated pressure (4 CFM per 100 square feet of duct surface area) in accordance with ASHRAE Standard 90.1-2010.

.2 Material:

.1 Galvanize steel to to ASTM A 653/A 653M, Z90.

.3 Fittings fabrication: to SMACNA PVC coated.

PART 3 - EXECUTION

3.1 GENERAL

.1 Do work in accordance with SMACNA.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.
.1 Insulate strap hangers 100 mm beyond insulated duct.

.3 Support risers in accordance with as indicated

.4 Install breakaway joints in ductwork on sides of fire separation.

.5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

.6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining

.7 Exposed ductwork to be finished. Co-ordinate finish colour with architect.

3.2 HANGERS

.1 Strap hangers: install in accordance with SMACNA.

.2 Angle hangers: complete with locking nuts and washers.

.3 Hanger spacing: in accordance with as follows:

Duct Size (mm)	Spacing (mm)
to 1500	3000
1501 and over	2500

3.3 WATERTIGHT DUCT

.1 Provide watertight duct for:
.1 Fresh air intake.
.2 Minimum 3000 mm from duct mounted in all humidifier directions.
.3 As indicated.

.2 Form bottom of horizontal duct without longitudinal seams.
.1 Weld joints of bottom and side sheets.

3.3 WATERTIGHT DUCT (Cont'd)

.2 (Cont'd)
.2 Seal other joints with duct sealer.

3.4 SEALING AND TAPING

.1 Apply sealant to outside of joint to manufacturer's recommendations.

.2 Bed tape in sealant and re-coat with minimum of one coat of sealant to manufacturers recommendations.

3.5 LEAKAGE TESTS

.1 Refer to Section 23 05 94 - Pressure Testing of Ducted Air Systems.

.2 In accordance with SMACNA HVAC Duct Leakage Test Manual.

.3 Do leakage tests in sections.

.4 Make trial leakage tests as instructed to demonstrate workmanship.

.5 Do not install additional ductwork until trial test has been passed.

.6 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degrees elbows.

.7 Complete test before application of insulation or concealment of Work.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 35 29.06 - Health and Safety Requirements.

.4 Section 01 61 00 - Common Product requirements.

.5 Section 01 74 21 - Construction/Demolition Waste Management and Disposal..

.6 Section 01 91 13 - General Commissioning (Cx) Requirements.

.7 Section 21 05 01 - Common Work Results - Mechanical.

1.2 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
.1 Material Safety Data Sheets (MSDS).

.2 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA).
.1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 95.

1.3 QUALITY ASSURANCE

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Procedures and Section 21 05 01 - Common Work Results Mehanical.

.2 Product Data:
.1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:
.1 Flexible connections.

1.4 SUBMITTALS (Cont'd)

.2 (Cont'd)
.1 (Cont'd)
.2 Duct access doors.
.3 Turning vanes.
.4 Instrument test ports.
.2 Submit WHMIS MSDS. Indicate VOC's for adhesive and solvents during application and curing.

1.5 CLOSEOUT SUBMITTALS

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

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 FLEXIBLE CONNECTIONS

.1 Frame: galvanized sheet metal frame with fabric clenched by means of double locked seams.

.2 Material:
.1 Fire resistant, self extinguishing, coated neoprene glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m^2.

2.3 ACCESS DOORS IN DUCTS

.1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.

.2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.

.3 Gaskets: neoprene.

.4 Hardware:
.1 Up to 300 x 300 mm: two sash locks.
.2 301 to 450 mm: four sash locks complete with safety chain.
.3 451 to 1000 mm: piano hinge and minimum two sash locks.
.4 Doors over 1000 mm: piano hinge and two handles operable from both sides.
.5 Hold open devices.

2.4 TURNING VANES

.1 Factory or shop fabricated double thickness with trailing edge, to recommendations of SMACNA and as indicated.

2.5 INSTRUMENT TEST

.1 1.6 mm thick steel zinc plated after manufacture.

.2 Cam lock handles with neoprene expansion plug and handle chain.

.3 28 mm minimum inside diameter. Length to suit insulation thickness.

.4 Neoprene mounting gasket.

2.6 SPIN-IN COLLARS

.1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.

.2 Sheet metal thickness to co-responding round duct standards.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Flexible Connections:
- .1 Install in following locations:
  - .1 Inlets and outlets to supply air units and fans.
  - .2 Inlets and outlets of exhaust and return air fans.
  - .3 As indicated.
- .2 Length of connection: 100 mm.
- .3 Minimum distance between metal parts when system in operation: 75 mm.
- .4 Install in accordance with recommendations of SMACNA.
- .5 When fan is running:
  - .1 Ducting on sides of flexible to be in connection alignment.
  - .2 Ensure slack material in flexible connection.

.2 Access Doors and Viewing Panels:
- .1 Size:
  - .1 900 x 900 mm for person size entry.
  - .2 450 x 450 mm for servicing entry.
  - .3 300 x 300 mm for viewing.
  - .4 As indicated.
- .2 Locations:
  - .1 Fire and smoke dampers.
  - .2 Control dampers.
  - .3 Devices requiring maintenance.
  - .4 Required by code.
  - .5 Elsewhere as indicated.

.3 Instrument Test Ports:
- .1 General:
  - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .2 Locate to permit easy manipulation of instruments.

3.2 INSTALLATION (Cont'd)

.3 (Cont'd)
.3 Install insulation port extensions as required.
.4 Locations:
.1 For traverse readings:
.1 Inlets and outlets of fan systems.
.2 Main and sub-main ducts.
.3 And as indicated.
.2 For temperature readings:
.1 At outside air intakes.
.2 At inlet and outlet of coils.
.3 And as indicated.

.4 Turning vanes:
.1 Install in accordance with recommendations of SMACNA and as indicated.
.2 Install on elbows on inlet and outlet to any unit.

3.3 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 35 29.06 - Health and Safety Requirements.

.4 Section 01 61 00 - Common Product requirements.

.5 Section 01 74 21 - Construction/Demolition Waste Management and Disposal..

.6 Section 01 91 13 - General Commissioning (Cx) Requirements.

.7 Section 21 05 01 - Common Work Results - Mechanical.

1.2 REFERENCES

.1 Sheet Metal and Air Conditioning National Association (SMACNA)
.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-1985.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
.1 Material Safety Data Sheets (MSDS).

1.3 QUALITY ASSURANCE

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Procedures and Section 21 05 01 - Common Work Results Mehanical.

.2 Product Data:

1.4 SUBMITTALS (Cont'd)

.2 (Cont'd)
.1 Submit shop drawings to indicate materials, finishes, method of installation, dimensions construction and assembly details, submit manufacturer's installation instructions and accessories list.

1.5 CLOSEOUT SUBMITTALS

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

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Manufacture to SMACNA standards.

2.2 SPLITTER DAMPERS

.1 Fabricate from same material as duct but one sheet metal thickness heavier, with appropriate stiffening.

.2 Double thickness construction.

.3 Control rod with locking device and position indicator.

.4 Rod configuration to prevent end from entering duct.

.5 Pivot: piano hinge.

2.2 SPLITTER DAMPERS (Cont'd)

.6 Folded leading edge.

2.3 SINGLE BLADE DAMPERS

.1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.

.2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm.

.3 Locking quadrant with shaft extension to accommodate insulation thickness.

.4 Inside and outside nylon end bearings.

.5 Channel frame of same material as adjacent duct, complete with angle stop.

2.4 MULTI-BLADED DAMPERS

.1 Factory manufactured of material compatible with duct.

.2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.

.3 Maximum blade height: 100 mm.

.4 Bearings: self-lubricating nylon.

.5 Linkage: shaft extension with locking quadrant.

.6 Channel frame of same material as adjacent duct, complete with angle stop.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

.2 Prior to installation review ductwork layout with Tab company. Establish location of dampers for proper Tab procedures.

3.2 INSTALLATION

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.3 Locate balancing dampers in each branch duct, for supply, return and exhaust systems and where required by Tab Company.

.4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.

.5 Dampers: vibration free.

.6 Ensure damper operators are observable and accessible.

.7 Provide additional dampers as requested by TAB company.

3.3 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 35 29.06 - Health and Safety Requirements.

.4 Section 01 61 00 - Common Product requirements.

.5 Section 01 74 21 - Construction/Demolition Waste Management and Disposal..

.6 Section 01 91 13 - General Commissioning (Cx) Requirements.

.7 Section 21 05 01 - Common Work Results - Mechanical.

.8 Section 07 84 00 - Firestopping.

.9 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.10 Section 23 05 94 - Pressure Testing of Ducted Air Systems.

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)
.1 ASTM A 653/A 653M-13a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
.1 Material Safety Data Sheets (MSDS).

1.3 QUALITY ASSURANCE

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Procedures and Section 21 05 01 - Common Work Results Mehanical.

.2 Product Data:
.1 Submit shop drawings to indicate materials, finishes, method of installation, dimensions construction and assembly details, submit manufacturer's installation instructions and accessories list.

1.5 CLOSEOUT SUBMITTALS

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1.6 DELIVERY, STORAGE, AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MULTI-LEAF DAMPERS

.1 Apply to all dampers installed outside packaged HVAC equipment.

.2 Opposed and or parallel blade type as indicated.

.3 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, extruded aluminum frame.

.4 Pressure fit self-lubricated bronze bearings.

2.1 MULTI-LEAF DAMPERS (Cont'd)

.5 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.

.6 Performance:
.1 Leakage: in closed position less than 2% of rated air flow at 1000 Pa differential across damper.

.7 Insulated aluminum dampers:
.1 Frames: insulated with extruded polystyrene foam with RSI 0.88.
.2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.

.8 Operators by Division 25.

2.2 BACK DRAFT DAMPERS

.1 Automatic gravity operated, multi leaf, aluminum construction with nylon bearings, counterweighted.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.

.3 Seal multiple damper modules with silicon sealant.

.4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.

.5 Ensure dampers are observable and accessible.

3.3 CLEANING .1 Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 35 29.06 - Health and Safety Requirements.

.4 Section 01 61 00 - Common Product requirements.

.5 Section 01 74 21 - Construction/Demolition Waste Management and Disposal..

.6 Section 01 91 13 - General Commissioning (Cx) Requirements.

.7 Section 21 05 01 - Common Work Results - Mechanical

.8 Section 07 84 00 - Firestopping.

.9 Section 23 05 94 - Pressure Testing of Ducted Air Systems.

1.2 REFERENCES

.1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
.1 ANSI/NFPA 90A-2014, Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
.1 Material Safety Data Sheets (MSDS).

.3 Underwriters Laboratories of Canada (ULC)
.1 CAN4-S112-M90(R2001), Fire Test of Fire Damper Assemblies.

1.3 QUALITY ASSURANCE

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Procedures and Section 21 05 01 - Common Work Results Mehanical.

.2 Product Data:
.1 Submit shop drawings to indicate materials, finishes, method of installation, dimensions construction and assembly details, submit manufacturer's installation instructions and accessories list.

1.5 CLOSEOUT SUBMITTALS

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

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal, and Section 21 05 01 - Common Work Results Mechanical.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 FIRE DAMPERS

.1 Fire dampers: arrangement Type C, bear label of ULC Warnock Hersey, meet requirements of provincial fire authority Fire Commissioner of Canada (FCC) and ANSI/NFPA 90A authorities having jurisdiction. Fire damper assemblies fire tested in accordance with CAN4-S112.

.2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
.1 Fire dampers: 1-1/2 hour fire rated unless otherwise indicated.

2.1 FIRE DAMPERS (Cont'd)

.2 (Cont'd)

.2 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.

.3 Top hinged: offset, round or square; multi-blade hinged or interlocking type; sized to maintain full duct cross section.

.4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.

.5 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.

.6 Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair damper operation.

.7 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.

.8 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.

.9 Dampers shall be installed so that the centreline of the damper depth or thickness is located in the centreline of the wall, partition of floor slab depth or thickness.

.10 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.

2.2 SMOKE DAMPERS

.1 Smoke Dampers: to be ULC or UL listed and labelled.

2.2 SMOKE DAMPERS (Cont'd)

.2 Normally open smoke/seal : folding blade type, closing when actuated by means of dual responsive fusible link which melts when subjected to local heat of 74 degrees C and from remote alarm signalling device. Blade edge seals of flexible stainless steel to provide required constant sealing pressure. Provide stainless steel negator springs with locking devices to ensure positive closure for units mounted horizontally in vertical ducts.

.3 Combined actuator: electrical control system actuated from smoke sensor or smoke detection system and from fusible link.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.

.2 Maintain integrity of fire separation.
.1 Review architectural drawings for fire separation. Provide Fire Dampers in each location where duct pass through fire separation.

.3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.

.4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.

.5 Co-ordinate with installer of firestopping.

.6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.

.7 Install break-away joints on each side of fire separation.

3.2 INSTALLATION (Cont'd)	.8	Installer shall test all fire dampers to ensure they close properly.
3.3 FIELD QUALITY CONTROL	.1	Provide Departmental Representative with 48 hours notice prior to inspections, tests, and demonstrations. Submit written report of inspections and test results.
3.4 CLEANING	.1	Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 35 29.06 - Health and Safety Requirements.

.4 Section 01 61 00 - Common Product requirements.

.5 Section 01 74 21 - Construction/Demolition Waste Management and Disposal..

.6 Section 01 91 13 - General Commissioning (Cx) Requirements.

.7 Section 21 05 01 - Common Work Results - Mechanical

1.2 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
.1 Material Safety Data Sheets (MSDS).

.2 Sheet Metal and Air-Conditioning Contractor's National Association (SMACNA).
.1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 95 (Addendum No.1, November 1997).
.2 SMACNA IAQ Guideline for Occupied Buildings under Construction, 1st Edition 1995.

.3 Underwriter's Laboratories of Canada (ULC).
.1 CAN/ULC-S110-1986(R2001), Fire Tests for Air Ducts.

1.3 QUALITY ASSURANCE

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.

1.4 SUBMITTALS (Cont'd)

.2 Product Data: submit WHMIS MSDS for the following:
.1 Thermal properties.
.2 Friction loss.
.3 Acoustical loss.
.4 Leakage.
.5 Fire rating.

1.5 CLOSEOUT SUBMITTALS

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

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Factory fabricated to CAN/ULC-S110.

.2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.

.3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.2 METALLIC - INSULATED

.1 Spiral wound flexible aluminum with factory applied, 37 mm thick flexible glass fibre thermal insulation with vapour barrier and vinyl jacket.

.2 Performance:
.1 Factory tested to 2.5 kPa without leakage.

2.2 METALLIC - INSULATED (Cont'd)

.2 (Cont'd)
.2 Maximum relative pressure drop coefficient:

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

.1 Install in accordance with: CAN/ULC-S110 and SMACNA.

.2 Install where indicated section of 1.5m of Flex duct is allowed for diffusers connections in a conceled location.

3.2 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 35 29.06 - Health and Safety Requirements.

.4 Section 01 74 21 - Construction/Demolition Waste Management And Disposal.

.5 Section 01 78 00 - Closeout Submittals.

.6 Section 23 05 00 - Common Work Results - Mechanical.

1.2 REFERENCES

.1 American Society for Testing and Materials International, (ASTM).
.1 ASTM C177-04, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
.2 ASTM C 423-02a, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
.3 ASTM C 1338-00, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
.4 ASTM G 21-96(2002), Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

.2 Canadian General Standards Board (CGSB)
.1 CGSB 51-GP-52MA-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
.1 Material Safety Data Sheets (MSDS).

.4 National Fire Protection Association (NFPA).
.1 NFPA 90A-02, Standard for the Installation of Air Conditioning and Ventilating Systems.

1.2 REFERENCES (Cont'd)

.4 (Cont'd)
.2 NFPA 90B-05, Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

.5 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA).
.1 SMACNA, HVAC DCS, HVAC, Duct Construction Standards, Metal and Flexible-95 (Addendum No.1, Nov. 97).
.2 SMACNA IAQ Guideline for Occupied Buildings 95.

.6 Underwriter's Laboratories of Canada (ULC).
.1 CAN/ULC-S102-03-EN, Methods of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.3 QUALITY ASSURANCE

.1 Health and Safety:
.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit for approval manufacturer's catalogue literature related to material data and recommended installation for duct and fittings as well as jointing recommendations.

.3 Submit ductwork layout drawings indicating to scale location and size of preliminary selected silencers.

1.5 CLOSEOUT SUBMITTALS

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

1.6 WASTE MANAGEMENT and DISPOSAL

.1 Separate and recycle waste materials in accordancewith section 01 74 21 - Construction/Demolition Waste Management and Disposal

1.7 DELIVERY STORAGE and HANDLING

.1 While delivering materials to site follow requirements of section 23 05 00 - Common Work Results - Mechanical.

PART 2 - PRODUCTS

2.1 DUCT LINER

.1 General:
.1 Fibrous glass or mineral fibre duct liner: air stream side faced with mat facing.
.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with CAN/ULC-S102.
.3 Recycled Content: EcoLogo certified with minimum 30% by weight of recycled content.
.4 Fungi resistance: to ASTM C 1338 and ASTM G 21.

.2 Rigid:
.1 Use, where indicated on flat surfaces.
.2 25 mm thick, to CGSB 51-GP-52MA, fibrous glass rigid board duct liner.
.3 Density: 36 kg/m^3 minimum.
.4 Thermal resistance to be minimum 0.76 m^2.°C/W for 25 mm thickness when tested in accordance with ASTM C 177, at 24°C mean temperature.
.5 Sound absorption coefficient when tested in accordance with ASTM C 423-02a at:
.1 0.04@ 125 Hz.
.2 0.26@ 250 Hz.
.3 0.69@ 500 Hz.
.4 1.00@ 1000 Hz.
.5 1.07@ 2000 Hz.
.6 1.02@ 4000 Hz.

.3 Flexible:
.1 Use, where indicated on round or oval surfaces.
.2 25 mm thick, to CGSB 51-GP-52MA, fibrous glass blanket duct liner.
.3 Density: 24 kg/m^3 minimum.

2.1 DUCT LINER (Cont'd)

.3 (Cont'd)

.4 Thermal resistance to be minimum 0.74 m^2.°C/W for 25 mm thickness when tested in accordance with ASTM C 177, at 24°C mean temperature.

.5 Sound absorption coefficient when tested in accordance with ASTM C 423-02a at:

.1 0.09@ 125 Hz.
.2 0.31@ 250 Hz.
.3 0.67@ 500 Hz.
.4 0.91@ 1000 Hz.
.5 1.01@ 2000 Hz.
.6 0.98@ 4000 Hz.

2.2 ADHESIVES

.1 Meet requirements of NFPA 90A and NFPA 90B.

.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 29°C to plus 93°C.

2.3 FASTENERS

.1 Weld pins 2.0 mm diameter, length to suit thickness of insulation. Metal retaining clips, 32 mm square.

2.4 JOINT TAPE

.1 Poly-Vinyl treated open weave fiberglass membrane 50 mm wide.

2.5 SEALER

.1 Meet requirements of NFPA 90A and NFPA 90B.

.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 68°C to plus 93°C.

2.6 SILENCERS

.1 Silencer shall be manufactured of prime coated or galvanized steel, compatible with ductwork specified elsewhere and to ASHRAE and SMACNA standards.

2.6 SILENCERS (Cont'd)

.2 Outer casing and galvanized steel inner casing with clean cut circular perforations to enclose acoustic media. Inner casing to have half-splitters or pods running full length of silencer where any cross sectional dimension exceeds 450 mm. Protect media from erosion with glass fibre cloth, Tedlar or Mylar between media and perforated metal.
.1 Performance: As indicated on the Drawings.
.2 Silencers design and selection shall take into consideration limited space for duct installation (See para 1.4.3)if linear style silencers will not fit alocated space selection shall consider "Z" type. For each silencer contractor to allow additional 8.0m of ductwork and 4 only fittings to accomodate installation.

PART 3 - EXECUTION

3.1 GENERAL

.1 Do work in accordance with recommendations of SMACNA duct liner standards as indicated in SMACNA HVAC Duct Construction Standards, Metal and Flexible, except as specified otherwise.

.2 Line inside of all supply, return and exhaust air ducts.

.3 Line inside of each air plenum for return and supply air grille.

.4 Duct dimensions, as indicated, are clear inside duct lining.

3.2 DUCT LINER

.1 Install in accordance with manufacturer's recommendations, and as follows:
.1 Fasten to interior sheet metal surface with 100% coverage of adhesive.
.2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 425 mm on centres.

3.3 JOINTS

.1 Seal butt joints, exposed edges, weld pin and clip penetrations and damaged areas of liner with joint tape and sealer. Install joint tape in accordance with manufacturer's written recommendations, and as follows:
.1 Bed tape in sealer.
.2 Apply two coats of sealer over tape.

.2 Replace damaged areas of liner at discretion of Engineer.

3.4 SILENCERS

.1 As indicated install silencers in the ductwork system.Assure proper support,seal joints.
.1 Employ manufacturer representative to review silencers installation,provide written report.

3.5 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 35 29.06 - Health and Safety Requirements.

.4 Section 01 61 00 - Common Product requirements.

.5 Section 01 74 21 - Construction/Demolition Waste Management and Disposal..

.6 Section 01 91 13 - General Commissioning (Cx) Requirements.

.7 Section 21 05 01 - Common Work Results - Mechanical.

1.2 REFERENCES

.1 Air Conditioning and Mechanical Contractors Association (AMCA)
.1 AMCA 201-11, Fans and Systems.
.2 AMCA 300-2008, Reverberant Room Method for Sound Testing of Fans.
.3 AMCA 301-2014, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
.4 AMCA 302-12, Application of Sone Ratings for Non-Ducted Air Moving Devices.
.5 AMCA 303-12, Application of Sound Power Level Ratings for Fans.

.2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
.1 ANSI/AMCA 210-2007, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
.1 Material Safety Data Sheets (MSDS).

1.3 QUALITY ASSURANCE

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Procedures and Section 21 05 01 - Common Work Results Mehanical.

.2 Submit shop drawings to indicate materials, finishes, method of installation, dimensions construction and assembly details, submit manufacturer's installation instructions and accessories list.

1.5 CLOSEOUT SUBMITTALS

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

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 FANS - GENERAL

.1 Standard of rating:
.1 AMCA 201 for fan application.
.2 AMCA 302 for application of sone loudness ratings for non-ducted air moving devices.
.3 AMCA 303 for application of sound power ratings for ducted air moving devices.
.4 Performance: to ANSI/AMCA 210. Unit to bear AMCA certified seal.

2.1 FANS - GENERAL (Cont'd)

.1 (Cont'd)

.5 Sound level ratings to comply with AMCA 301, tested to AMCA 300 Unit to bear AMCA certified sound rating seal.

.6 Fan characteristics and construction:

.1 As centrifugal fans

.2 Capasity: See schedule on the drawings

2.2 ROOF EXHAUSTERS

.1 Centrifugal V belt or direct driven.

.1 Housings: spun aluminum complete with resilient mounted motor and fan.

.2 Impeller: aluminum non-overloading.

.3 Adjustable motor sheave.

.4 12 mm mesh 2.0 mm diameter aluminum birdscreen.

.5 Automatic gasketted aluminum backdraft dampers.

.6 Disconnect switch within fan housing.

.7 Continuous curb gaskets, cadmium plated securing bolts and screws, and 300 mm high curb. Hinge curb plate for access to internals for maintenance.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install in accordance with manufacturer's recommendations.

3.3 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 35 29.06 - Health and Safety Requirements.

.4 Section 01 61 00 - Common Product Requirements.

.5 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.6 Section 01 91 13 - General Commissioning (Cx) Requirements.

.7 Section 21 05 01 - Common Work Results - Mechanical.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)
.1 ANSI/AMCA 210-1999, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
.2 ANSI/NFPA 90A-2002, Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
.1 Material Safety Data Sheets (MSDS).

.3 International Organization of Standardization (ISO)
.1 ISO 3741-2001, Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Methods for Reverberation Rooms.

.4 Underwriter's Laboratories (UL)
.1 UL 181-2003, Factory-Made Air Ducts and Air Connectors.

1.3 SUBMITTALS

.1 Product Data:

1.3 SUBMITTALS (Cont'd)

.1 (Cont'd)

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Test data: to ANSI/AMCA 210.

.1 Submit published test data on DIN (Direct Internal Noise), in accordance with ISO 3741 made by independent testing agency for 0, 2.5 and 6 m/s branch velocity or inlet velocity.

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate the following:

.1 Capacity.

.2 Pressure drop.

.3 Noise rating.

.4 Leakage.

1.4 CLOSEOUT SUBMITTALS

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

1.5 QUALITY ASSURANCE

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 70 12 - Health and Safety Requirements.

1.6 SYSTEM DESCRIPTION

.1 Performance Requirements:

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

1.7 MAINTENANCE

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals

1.7 MAINTENANCE (Cont'd)

.1 (Cont'd)

.2 Furnish list of individual manufacturer's recommended spare parts for equipment include:

.1 Bearings and seals.

.2 Addresses of suppliers.

.3 List of specialized tools necessary for adjusting, repairing or replacing.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.9 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

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

2.2 ELECTRONIC VARIABLE AIR VOLUME BOXES

.1 Pressure independent, reset to air flow between zero and maximum air volume.

.2 At inlet velocity of 10 m/s, differential static pressure not to exceed 25 Pa.

.3 Air velocity sensor resistance wire or pitot rack as standard to manufacturer.

.4 Signals between temperature sensing device, velocity controller, velocity sensor and damper actuator analogue and or digital. Shielded or twisted wire requirements are not acceptable.

2.2 ELECTRONIC VARIABLE AIR VOLUME BOXES (Cont'd)

.5 Electronic thermostat furnished by terminal unit manufacturer and have set points and velocity adjustments located in thermostat. Heating and cooling set point range 13 to 30 degrees C. Set points not overlapping. Thermostat to have 1 C proportional band at velocity settings.

.6 Electronic control package factory calibrated and set at factory. Features to accommodate field calibration and readjustment of air volume settings to include:
.1 Metre taps for balancing with digital DC voltmeter.
.2 Adjustable flow settings at thermostat.
.3 AUX port for corridor extension to EMCS.

.7 Factory installed 20 VA transformer, 115 V to 24 V. Power consumption of terminal not to exceed 15 VA.

.8 Terminal unit to be CSA certified.

.9 Casing: 13 mm thick galvanized steel, internally lined with 25 mm. 0.7 kg density fibrous glass, to UL 181 and ANSI/NFPA 90A. Mount control components inside protective metal shroud.

.10 Damper: 13 mm thick steel with peripheral gasket and self lubricating bearings. Air leakage past closed damper not to exceed 2% of nominal rating at 750 Pa inlet static pressure, in accordance with Air Diffusion Council test procedure.

.11 Sizes and capacity: as indicated.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install in accordance with manufacturer's recommendations.

3.2 INSTALLATION (Cont'd)

.2 Support independently of ductwork.

.3 Install with at least 1000 mm of flexible inlet ducting and minimum of four duct diameters of straight inlet duct, same size as inlet.

.4 Locate controls, dampers and access panels for easy access.

3.3 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 35 29.06 - Health and Safety Requirements.

.4 Section 01 61 00 - Common Product Requirements.

.5 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.6 Section 01 91 13 - General Commissioning (Cx) Requirements.

.7 Section 21 05 01 - Common Work Results - Mechanical.

1.2 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Indicate following:

.1 Capacity.

.2 Throw and terminal velocity.

.3 Noise criteria.

.4 Pressure drop.

.5 Neck velocity.

.2 Samples:

.1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

1.3 QUALITY ASSURANCE

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 70 12 - Health and Safety Requirements.

1.4 MAINTENANCE

.1 Extra Materials:

1.4 MAINTENANCE (Cont'd)

.1 (Cont'd)
.1 Submit as specified in Section 01 78 00 - Closeout Submittals.
.2 Submit maintenance and engineering data for incorporation into operation manual as specified in Appendix E.
.3 Include:
.1 Keys for volume control adjustment.
.2 Keys for air flow pattern adjustment.

1.5 CLOSEOUT SUBMITTALS

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

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demoliton Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 GENERAL

.1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.

.2 Frames:
.1 Full perimeter gaskets.
.2 Plaster frames where set into plaster or gypsum board and as specified.
.3 Concealed fasteners.

.3 Concealed manual volume control damper operators.

.4 Colour: standard.

2.2 MANUFACTURED UNITS

.1 Grilles, registers and diffusers of same generic type, products of one manufacturer.

2.3 GRILLES AND REGISTERS

.1 General: See schedule on the drawings
.1 Verify the size of diffuser and grille match required air flow shown on the drawings.

.2 Type A: steel, 600x600 square type, having adjustable pattern, lay-in, and/or surface mounted. Finish: white.

.3 Type B: steel, 19 mm border, 25 x 25 mm egg crate type face bars. Finish: white. For all type B grilles installed without return air connection provide accousticly limed booth plenum with side opening adequate to air flow indicated

.4 Type C: steel, 21 mm border, single deflection with airfoil shape, vertical face bars. Finish: white.

.5 Type D: steel, 21 mm border, double deflection spaced on 19 mm centers, vertical face bars, horizontal rear bars. Finish: white

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install in accordance with manufacturers instructions.

.2 Install with flat head screws in countersunk holes where fastenings are visible.

3.3 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Setion 01 35 29.06 - Health and Safety Requirements.

.4 Section 01 61 00 - Common Product Requirements.

.5 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.6 Section 01 91 13 - General Commissioning (Cx) Requirements.

.7 Section 21 05 01 - Common Work Results - Mechanical.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/ National Fire Protection Association (NFPA)
.1 ANSI/NFPA 96-04, Standard for Ventilation ContrCommercial› Protection of Cooking Operations.

.2 American Society for Testing and Materials International (ASTM)
.1 ASTM E 90-04, Standard Test Method for LaborSound Airborne Measurement of Transmission Loss of Building Partitions and Elements.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
.1 Material Safety Data Sheets (MSDS).

.4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.5 Society of Automotive Engineers (SAE)

1.3 SYSTEM DESCRIPTION

.1 Performance Requirements:
.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:
.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
.2 Indicate following:
.1 Pressure drop.
.2 Face area.
.3 Free area.

.2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
.1 Certificates: submit certificates signed by mamaterials: certifying that comply with specified performance characteristics and physical properties.
.2 Instructions: submit manufacturer's installation instructions.

.3 Test Reports:
.1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E 90.

1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

.1 Safety Requirements: do construction occupational health and safety in accordance with Section 01 70 03 - Safety Requirements.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal, and Section 21 05 01 - Common Work Results - Mechanical.

1.8 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 GOOSENECK HOODS

.1 Thickness: to ASHRAE and SMACNA.

.2 Fabrication: to ASHRAE and SMACNA.

.3 Joints: to ASHRAE and SMACNA.

.4 Supports: as indicated.

.5 Complete with integral birdscreen of 2.7 mm diameter ss wire. Use 12 mm mesh on exhaust.

.6 Horizontal backdraft dampers on two faces.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 In accordance with manufacturer's and SMACNA recommendations.

.2 Reinforce and brace as indicated.

3.2 INSTALLATION (Cont'd)

.3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

3.3 CLEANING

.1 Proceed in accorddance with Section 01 74 11 - Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 35 29.06 - Health and Safety Requirements.

.4 Section 01 61 00 - Common Product requirements.

.5 Section 01 74 21 - Construction/Demolition Waste Management and Disposal..

.6 Section 01 91 13 - General Commissioning (Cx) Requirements.

.7 Section 21 05 01 - Common Work Results - Mechanical.

.8 Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation

1.2 REFERENCES

.1 Air-Conditioning and Refrigeration Institute (ARI)
- .1 1ARI 430-99, Central Station Air Handling

.2 Canadian General Standards Board (CGSB)
- .1 1CAN/CGSB 1.181-99, Ready-Mixed Organic

.3 Canadian Standards Association
- .1 1CSA B52-99, Mechanical Refrigeration Code.
- .2 2CSA/ULC-1995, Heating and Cooling equipment

1.3 QUALITY ASSURANCE

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Procedures and Section 21 05 01 - Common Work Results Mehanical.

1.4 SUBMITTALS (Cont'd)

.2 Submit shop drawings to indicate materials, finishes, method of installation, dimensions construction and assembly details, submit manufacturer's installation instructions and accessories list.

1.5 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporatiinto manual specified in Secttion 01 78 00 - Closeout Submittals.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Roof mounted variable air volume, self-contained single zone unit with gas burner and DX refrigeration and bear label of CSA and CGA.

.2 As indicated on schedule, units to consist of cabinet and frame, supply and return fans, stainless steel heat exchanger, burner heater control, air filter, refrigerant cooling coil, compressor, condeser, coil and fans, motorized outside air damper, return damper, gravity exhaust damper and economizer.

.3 Cabinets: weatherproofing tested and certified to AGA rain test standards and soundproofing tested to ARI 270.

2.2 CABINET

.1 Framing and supports: 2mm welded steel, galvanized after manufacture, with lifting lugs.

.2 Outer casing: weathertight galvanized steel with baked enamel finish, complete with flashing.

.3 Access: removable gasketted hinged doors or panels with screwdriver operated flush cam type fasteners.

.4 Insulation: neoprene coated glass fiber on all surfaces where conditioned air is handled, 25mm thick, 32kg/mu density.

2.3 FANS

.1 Centrifugal, forward curved impellers, rubber spring mounted, statically and dynamically balanced. V-belt drive with adjustable variable pitch motor pulley rubber isolated hinge mounted motor. Vibration isolators: 95% efficiency.

2.4 FILTERS

.1 25mm thick,throwaway filters.

2.5 HEAT EXCHANGERS AND BURNERS

.1 Gas fired, multiple flue passes, with primary heating surface of steel; secondary heating surface, steel tubes.

.2 Gas burner: factory mounted, wired and fire tested complete with operating and safety controls.
.1 Forced draft type
.2 Spark ignited pilot with pilot flame safety shut-off

2.6 REFRIGERATION

.1 Conform to CSA B52 and UL 1995 requirements.

.2 Condensing section:
.1 Hermetic compressors, vibration isolated with flexible suvtion and discharge connections, oil sight glass, oil pressure switch and crankcase heater with control to liquid line solenoid valve.
.2 Fans: Propeller type with single piece spun venturi outlets and zinc plated guards. Motors shall be sequenced for head pressure control.

2.6 REFRIGERATION (Cont'd)

.2 (Cont'd)
.3 Electrical system shall have operating controls, oil and refrigerant pressure protection, motor overload protection, weather proof electrical wiring with weatherproof, raintight disconnect.
.4 Include refrigerant piping with sight glass filter and valves.
.5 Condenser: staggered copper tube aluminum fin coil assembly.

.3 Evaporator:
.1 Rated to ANSI/ARI 210/240
.2 Thermostatic expansion valve, with adjustable super heat.
.3 Coil: NPS 3/8 of staggered seamless copper tubes expanded into aluminum fins and insulated condesation pan.

2.7 CONTROLS

.1 In addition to combustion safety controls for single Zone Heat-Cool Unit provide the following:
.1 Low voltage, adjustable room thermostat controls burner operation, heater stages in sequence with delay between stages, compressor and supply fan shall maintain room temperature setting.

.2 Refer Section 25 30 02 - EMCS: Field Control Devices and Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation

2.8 ECONOMIZER

.1 Fully modulating 0-100% motor and damper, barometric relief, minimym setting, preset linkage complete with wiring harness.

2.9 ROOF CURB

.1 Insulated modified roof curb suitable for the horizontal duct intake and discharge.

2.10 CAPACITY

.1 Capacities as listed on the roof top unit schedule are based on 35C ambient temperature and entering air at 26.7C dry bulb and 19.4C wet bulb. Units to be capable to handle up to 30% of outdoor air. For details see schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install as per manufacturers' instructions on roof curbs provided by unit manufacturer. Assure units are installed level. Coordinate installation, size and location of housekeeping pad. Coordinate gas piping connection.

.2 Manufacturer to certify installation, supervise start-up and commission unit.

.3 Run trapped drain line from cooling coil, condensate drain pan to discharge on the ground.

.4 Ensure adequate clearance for servicing and maintenance.

.5 Install low voltage wiring and EMCS components. Verify unit operation.

.6 Manufacturer to approve installation, to supervise startup and to instruct operators. In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements and Section 01 91 41 - Commissioning Training. Include 2 days per unit.

3.2 FANS

.1 Provide pulleys and sheaves as required for final air balance.

.2 Install vibration isolators. Refer to Section 23 05 48 - Vibration and Seismic Controls for HVAV piping and Equipment.

3.3 DRIP PANS

.1 Install deep seal P-traps on drip lines.
.1 Depth of water seal to be 1.5 times static pressure at this point.

3.4 DEMONSTRATION .1 In accordance with Section 01 91 13- General Commissioning (Cx) Requirements

3.5 CLEANING .1 Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 00 10 - General Instructions.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 35 29.06 - Health and Safety Requirements.

.4 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.5 Section 01 78 00 - Closeout Submittals.

.6 Section 01 91 13 - General Commissioning (Cx) Requirements.

.7 Section 21 05 01 - Common Work Results - Mechanical.

.8 Section 23 23 00 - Copper Tubing and Fittings Refrigerant.

1.2 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
.1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Product Data:
.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
.1 Product data to include:
.1 Filters, fan accessibility.
.2 Suspension and anchoring of cabinet.
.3 Physical size.
.4 Finish.
.5 kW rating, voltage, phase.
.6 Cabinet material thicknesses.

.2 Shop Drawings:

1.3 SUBMITTALS (Cont'd)

.2 (Cont'd)
.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

1.4 QUALITY ASSURANCE

.1 Health and Safety:
.1 Do construction occupational health and safety in accordance with Section 01 70 12 - Health and Safety Requirements.

1.5 CLOSEOUT SUBMITTALS

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

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 FAN COIL UNITS

.1 Elements: stainless steel sheathed with corrosion protected aluminum fins covering full length of element.

.2 Blower motors: one speed, single phase.

.3 Designed for connection to an external DDC system.

.4 Fan delay switch.

.5 On-Off switch (for wall mount unit only).

2.1 FAN COIL UNITS (Cont'd)

.6 Two position selector switch (for wall mount unit only).

.7 Inlet and outlet duct collars.

.8 Filter: replaceable.

.9 Assembly fully wired to one outlet location.

.10 Multiple knockouts for up to 38 mm diameter conduit.

.11 Coil.

2.2 CONDENSING UNIT

.1 Base: formed 10 gauge galvanized steel, type G90.

.2 Fan section: deep punched fan orifice 25mm high for minimum noise and maximum efficiency.

.3 Casing: heavy gauge pre-painted (white) with punched louvres. Casings are hinged for full access to all components.

.4 Coils: manufactured using seamless de-oxidized heavy wall smooth copper tubes, mechanically expanded in self spaced full collared aluminum corrugated plate fins for permanent bond and maximum heat transfer. Connection and bends are brazed with high temperature brazing alloy. Coils are factory tested at 400 psig and purge using dry air. All condenser coils are provided with a sub cooling circuit.

.5 Fan guards and motor mounts: spot welded wire construction with baked on powder epoxy coating.

.6 Fan blades: aluminum blade 25 mm diameter, 4 blade 1075 rpm, statically and dynamically balanced, riveted to steel hub.

.7 Fan motors: permanently lubricated sealed ball bearing, thermally protected, outdoor condenser duty, continuous air, class B insulation.

.8 Compressors: rigid mount hermetic scroll refrigeration duty, suction cooled, thermally protected.

2.2 CONDENSING UNIT (Cont'd)

.9 Control Panel: formed 16 gauge galvanized steel type G90 with hinged access door.

.10 Wiring: single power connection. Internal wiring for fan motors, compressors, and controls are wired using flexible metallic conduit with outdoor duty wire.

.11 Electrical Controls: complete with control transformer, compressor contactors and fan contactors, compressor time delay, adjustable LP switch and fixed high-pressure control, complete with flexible hoses and a pump down service switch. Unit wired for continuous pump down cycle.

.12 Refrigeration System: Refrigeration valves supplied with fixed flooding control valves. Low ambient operation below 4 deg C and down to -34 deg C. Receivers equipped with heating and insulation as well as Pressure relief valves and inlet and outlet isolation valves. Receiver to have CRN number. A liquid line sight glass is installed and a liquid line solenoid valve is supplied shipped loose for field installation. Refrigeration copper tubes are ASTM certified and are factory bent and manufactured with minimum number of fittings to reduce risk of leaks.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Suspend units as per manufacturer's instructions.

3.3 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 78 00 - Closeout Submittals.

.3 Section 01 91 13 - General Commissioning (Cx) Requirements.

.4 Section 25 05 01 - EMCS: General Requirements.

1.2 DEFINITIONS

.1 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

.2 AEL: ratio between total test period less any system downtime accumulated within that period and test period.

.3 Downtime: results whenever EMCS is unable to fulfil required functions due to malfunction of equipment defined under responsibility of EMCS contractor. Downtime is measured by duration, in time, between time that Contractor is notified of failure and time system is restored to proper operating condition. Downtime not to include following:

.1 Outage of main power supply in excess of back-up power sources, provided that:

.1 Automatic initiation of back-up was accomplished.

.2 Automatic shut-down and re-start of components was as specified.

.2 Failure of communications link, provided that:

.1 Controller automatically and correctly operated in stand-alone mode.

.2 Failure was not due to failure of any specified EMCS equipment.

.3 Functional failure resulting from individual sensor inputs or output devices, provided that:

.1 System recorded said fault.

.2 Equipment defaulted to fail-safe mode.

.3 AEL of total of all input sensors and output devices is at least 99% during test period.

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Final Report: submit report to Departmental Representative.
.1 Include measurements, final settings and certified test results.
.2 Bear signature of commissioning technician and supervisor
.3 Report format to be approved by Departmental Representative before commissioning is started.
.4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to Departmental Representative in accordance with Section 01 78 00 - Closeout Submittals.
.5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

1.4 CLOSEOUT SUBMITTALS

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

.2 Provide following:
.1 6 fusible links of each type.

1.5 DESIGN REQUIREMENTS

.1 Confirm with Departmental Representative that Design Criteria and Design Intents are still applicable.

.2 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intents.

1.6 COMMISSIONING

.1 Do commissioning in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.

.2 Carry out commissioning under direction of Departmental and in presence of Departmental Representative .

1.6 COMMISSIONING (Cont'd)

.3 Inform, and obtain approval from Departmental Representative in writing at least 14 days prior to commissioning of each test. Indicate:
.1 Location and part of system to be tested or commissioned.
.2 Testing/commissioning procedures, anticipated results.
.3 Names of testing/commissioning personnel.

.4 Correct deficiencies, re-test in presence of Departmental Representative until satisfactory performance is obtained.

.5 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.

.6 Load system with project software.

.7 Perform tests as required.

1.7 COMPLETION OF COMMISSIONING

.1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by Departmental Representative.

1.8 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION

.1 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

1.9 DELIVERY, STORAGE, AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.10 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 EQUIPMENT

.1 Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.

.2 Instrumentation accuracy tolerances: higher order of magnitude than equipment or system being tested.

.3 Independent testing laboratory to certify test equipment is accurate to within approved tolerances no more than 2 months prior to tests.

.4 Locations to be approved, readily accessible and readable.

.5 Application: to conform to normal industry standards.

PART 3 - EXECUTION

3.1 PROCEDURES

.1 Test each system independently and then in unison with other related systems.

.2 Commission each system using procedures prescribed by the Departmental Representative.

.3 Commission integrated systems using procedures prescribed by Departmental Representative.

.4 Debug system software.

.5 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.

.6 Test full scale emergency evacuation and life safety procedures including operation and integrity of smoke management systems under normal and emergency power conditions as applicable.

3.2 FIELD QUALITY CONTROL

.1 Pre-Installation Testing.

.1 General: consists of field tests of equipment just prior to installation.

.2 Testing may be on site or at Contractor's premises as approved by Departmental Representative.

.3 Configure major components to be tested in same architecture as designed system. Include BECC equipment and 2 sets of Building Controller's including MCU's, LCU's, and TCU's.

.4 Equip each Building Controller with sensor and controlled device of each type (AI, AO, DI, DO).

.5 Additional instruments to include:

.1 DP transmitters.

.2 VAV supply duct SP transmitters.

.3 DP switches used for dirty filter indication and fan status.

.6 In addition to test equipment, provide inclined manometer, digital micro-manometer, milli-amp meter, source of air pressure infinitely adjustable between 0 and 500 Pa, to hold steady at any setting and with direct output to milli-amp meter at source.

.7 DP switches to open and close within 2% of setpoint.

.2 Completion Testing.

.1 General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.

.2 Include following activities:

.1 Test and calibrate field hardware including stand-alone capability of each controller.

.2 Verify each A-to-D converter.

.3 Test and calibrate each AI using calibrated digital instruments.

.4 Test each DI to ensure proper settings and switching contacts.

.5 Test each DO to ensure proper operation and lag time.

.6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.

.7 Test operating software.

.8 Test application software and provide samples of logs and commands.

3.2 FIELD QUALITY CONTROL (Cont'd)

.2 (Cont'd)

.2 (Cont'd)

.9 Verify each CDL including energy optimization programs.

.10 Debug software.

.11 Blow out flow measuring and static pressure stations with high pressure air at 700 kPa.

.12 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space on commissioning technician and Departmental. This document will be used in final startup testing.

.3 Final Startup Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of Departmental and provide:

.1 2 technical personnel capable of re-calibrating field hardware and modifying software.

.2 Detailed daily schedule showing items to be tested and personnel available.

.3 Departmental acceptance signature to be on executive and applications programs.

.4 Commissioning to commence during final startup testing.

.5 O&M personnel to assist in commissioning procedures as part of training.

.6 Commissioning to be supervised by qualified supervisory personnel and Departmental Representative.

.7 Commission systems considered as life safety systems before affected parts of the facility are occupied.

.8 Operate systems as long as necessary to commission entire project.

.9 Monitor progress and keep detailed records of activities and results.

.4 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.

3.2 FIELD QUALITY CONTROL (Cont'd)

.2 (Cont'd)

.4 (Cont'd)

.1 Prior to beginning of 30 day test demonstrate that operating parameters (setpoints, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.

.1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.

.2 Test to last at least 30 consecutive 24 hour days.

.3 Tests to include:

.1 Demonstration of correct operation of monitored and controlled points.

.2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.

.4 System will be accepted when:

.1 EMCS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.

.2 Requirements of Contract have been met.

.5 In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.

.6 Correct defects when they occur and before resuming tests.

.5 Departmental Representative to verify reported results.

3.3 ADJUSTING

.1 Final adjusting: upon completion of commissioning as reviewed by Departmental Representative, set and lock devices in final position and permanently mark settings.

3.4 DEMONSTRATION

.1 Demonstrate to Departmental Representative operation of systems including sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lock-outs in accordance with Section 01 91 13 - General Commissioning (CX) requirements.

3.5 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 91 41 - Commissioning: Training.

.3 Section 25 05 01 - EMCS: General Requirements.

1.2 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures, supplemented and modified by requirements of this Section.

.2 Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to Departmental Representative 30 days prior to anticipated date of beginning of training.
.1 List name of trainer, and type of visual and audio aids to be used.
.2 Show co-ordinated interface with other EMCS mechanical and electrical training programs.

.3 Submit reports within one week after completion of Phase 1 and Phase 2 training program that training has been satisfactorily completed.

1.3 CLOSEOUT SUBMITTALS

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

1.4 DEFINITIONS

.1 CDL - Control Description Logic.

.2 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.5 QUALITY ASSURANCE

.1 Provide bilingual, competent instructors thoroughly familiar with aspects of EMCS installed in facility.

1.5 QUALITY ASSURANCE (Cont'd)

.2 Departmental Representative reserves right to approve instructors.

1.6 INSTRUCTIONS

.1 Provide instruction to designated personnel in adjustment, operation, maintenance and pertinent safety requirements of EMCS installed.

.2 Training to be project-specific.

1.7 TIME FOR INSTRUCTION

.1 Number of days of instruction to be as specified in this section (1 day = 8 hours including two 15 minute breaks and excluding lunch time).

1.8 TRAINING MATERIALS

.1 Provide equipment, visual and audio aids, and materials for classroom training.

.2 Supply manual for each trainee, describing in detail data included in each training program.
.1 Review contents of manual in detail to explain aspects of operation and maintenance (O&M).

1.9 TRAINING PROGRAM

.1 To be in 2 phases over 6 month period and in accordance with section 01 91 41 - Commissioning: Training.

.2 Phase 1: 2 day program to begin before 30 day test period at time mutually agreeable to Contractor and Departmental.
.1 Train O&M personnel in functional operations and procedures to be employed for system operation.
.2 Supplement with on-the-job training during 30 day test period.
.3 Include overview of system architecture, communications, operation of computer and peripherals, report generation.
.4 Include detailed training on operator interface functions for control of mechanical systems, CDL's for each system, and elementary preventive maintenance.

1.9 TRAINING PROGRAM (Cont'd)

.3 Phase 2: 5 day program to begin 8 weeks after acceptance for operators, equipment maintenance personnel and programmers.

.1 Provide multiple instructors on pre-arranged schedule. Include at least the following:

.1 Operator training: provide operating personnel, maintenance personnel and programmers with condensed version of Phase 1 training.

.2 Equipment maintenance training: provide personnel with 2 days training within 5 day period in maintenance of EMCS equipment, including general equipment layout, trouble shooting and preventive maintenance of EMCS components, maintenance and calibration of sensors and controls.

.3 Programmers: provide personnel with 2 days training within 5 day period in following subjects in approximate percentages of total course shown:

Software and Architecture:	10%
Application Programs	15%
Controller Programming:	50%
Trouble shooting and debugging:	10%
Colour graphic generation:	15%

1.10 ADDITIONAL TRAINING

.1 List courses offered by name, duration and approximate cost per person per week. Note courses recommended for training supervisory personnel.

1.11 MONITORING OF TRAINING

.1 Departmental Representative to monitor training program and may modify schedule and content.

1.12 DELIVERY, STORAGE, AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.13 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 3 - EXECUTION

3.1 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 70 12 - Health and Safety Requirements.

.3 Section 01 47 17 - Sustainable Requirements: Contractor's Verification.

.4 Section 01 74 21 - Construction/Demolition Waste Management And Disposal.

.5 Section 09 91 23 - Interior Painting.

.6 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

.7 Section 25 05 54 - EMCS: Identification.

.8 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).
.1 ANSI/ISA 5.5-1985, Graphic Symbols for Process Displays.

.2 American National Standards Institute (ANSI)/ Institute of Electrical and Electronics Engineers (IEEE).
.1 ANSI/IEEE 260.1-1993, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).

.3 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
.1 ASHRAE STD 135-R2001, BACNET - Data Communication Protocol for Building Automation and Control Network.

.4 Canadian Standards Association (CSA International).
.1 CAN/CSA-Z234.1-89(R1995), Canadian Metric Practice Guide.

1.2 REFERENCES (Cont'd)

.5 Consumer Electronics Association (CEA).
.1 CEA-709.1-B-2002, Control Network Protocol Specification.

.6 Department of Justice Canada (Jus).
.1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
.2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.

.7 Electrical and Electronic Manufacturers Association (EEMAC).
.1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.

.8 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
.1 Material Safety Data Sheets (MSDS).

.9 Transport Canada (TC).
.1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.3 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures and 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

.2 Co-ordinate submittal requirements and provide submittals required by Section 01 47 15 - Sustainable Requirements: Construction.

.3 Submit for review:
.1 Equipment list and systems manufacturers withing 10 days after award of contract.

.4 Quality Control:
.1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.
.2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.

1.3 SUBMITTALS (Cont'd)

.4 (Cont'd)
.3 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process. Label or listing of specified organization is acceptable evidence.
.4 In lieu of such evidence, submit certification from testing organization, approved by Departmental Representative conforms to their standard/code.
.5 For materials whose compliance with organizational standards/codes/specifications is not regulated by organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.
.6 Permits and fees: in accordance with general conditions of contract.
.7 Submit certificate of acceptance from authority having jurisdiction to Departmental Representative
.8 Existing devices intended for re-use: submit test report.

1.4 CLOSEOUT

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

1.5 DEFINITIONS

.1 Point: may be logical or physical.
.1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.
.2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties, or providing status conditions of contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.

.2 Point Name: composed of two parts, point identifier and point expansion.

1.5 DEFINITIONS (Cont'd)

.2 (Cont'd)
.1 Point identifier: comprised of three descriptors, "area" descriptor, "system" descriptor and "point" descriptor, for which database to provide 25 character field for each point identifier. "System" is system that point is located on.
.1 Area descriptor: building or part of building where point is located.
.2 System descriptor: system that point is located on.
.3 Point descriptor: physical or logical point description. For point identifier "area", "system" and "point" will be short forms or acronyms. Database must provide 25 character field for each point identifier.
.2 Point expansion: comprised of three fields, one for each descriptor. Expanded form of short form or acronym used in "area", "system" and "point" descriptors is placed into appropriate point expansion field. Database must provide 32 character field for each point expansion.
.3 Bilingual systems to include additional point identifier expansion fields of equal capacity for each point name for second language.
.1 System to support use of numbers and readable characters including blanks, periods or underscores to enhance user readability for each of the above strings.

.3 Point Object Type: points fall into following object types:
.1 AI (analog input).
.2 AO (analog output).
.3 DI (digital input).
.4 DO (digital output).
.5 Pulse inputs.

.4 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISA S5.5.
.1 Printouts: to ANSI/IEEE 260.1.
.2 Refer also to Section 25 05 54 - EMCS: Identification.

1.6 QUALITY ASSURANCE

.1 Health and Safety:
.1 Do construction occupational health and safety in accordance with Section 01 70 12 - Health and Safety Requirements.

1.7 ACCEPTABLE VENDORS

.1 Delta.

.2 Automatic Logic.

.3 Siemens.

1.8 ACRONYMS AND ABBREVIATIONS

.1 Acronyms used in EMCS:

.1 AEL - Average Effectiveness Level.
.2 AI - Analog Input.
.3 AIT - Agreement on International Trade.
.4 AO - Analog Output.
.5 BACnet - Building Automation and Control Network.
.6 BC(s) - Building Controller(s).
.7 BECC - Building Environmental Control Center.
.8 CAD - Computer Aided Design.
.9 CDL - Control Description Logic.
.10 CDS - Control Design Schematic.
.11 COSV - Change of State or Value.
.12 CPU - Central Processing Unit.
.13 DI - Digital Input.
.14 DO - Digital Output.
.15 DP - Differential Pressure.
.16 ECU - Equipment Control Unit.
.17 EMCS - Energy Monitoring and Control System.
.18 HVAC - Heating, Ventilation, Air Conditioning.
.19 IDE - Interface Device Equipment.
.20 I/O - Input/Output.
.21 ISA - Industry Standard Architecture.
.22 LAN - Local Area Network.
.23 LCU - Local Control Unit.
.24 MCU - Master Control Unit.
.25 NAFTA - North American Free Trade Agreement.
.26 NC - Normally Closed.
.27 NO - Normally Open.
.28 OS - Operating System.
.29 O&M - Operation and Maintenance.
.30 PC - Personal Computer.
.31 PCI - Peripheral Control Interface.
.32 PCMCIA - Personal Computer Micro-Card Interface Adapter.
.33 PID - Proportional, Integral and Derivative.
.34 RAM - Random Access Memory.
.35 SP - Static Pressure.
.36 ROM - Read Only Memory.
.37 TCU - Terminal Control Unit.
.38 USB - Universal Serial Bus.

1.8 ACRONYMS AND ABBREVIATIONS (Cont'd)

.1 (Cont'd)
.39 UPS - Uninterruptible Power Supply.
.40 VAV - Variable Air Volume.

1.9 SYSTEM DESCRIPTION

.1 Division 25 to prepare and submit control schematics for system architecture.

.2 Work covered by sections referred to above consists of a local EMCS system that is not connected to the outside but should still have full capability if the client wishes to connect it, including, but not limited to, following:
.1 Building Controllers.
.2 Control devices as listed in I/O point summary tables.
.3 OWS(s).
.4 Data communications equipment necessary to effect EMCS data transmission system.
.5 Field control devices.
.6 Software/Hardware complete with full documentation.
.7 Complete operating and maintenance manuals.
.8 Training of personnel.
.9 Acceptance tests, technical support during commissioning, full documentation.
.10 Wiring interface co-ordination of equipment supplied by others.
.11 Miscellaneous work as specified in these sections and as indicated.

.3 Design Requirements:
.1 Design and provide conduit and wiring linking elements of system.
.2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by Departmental prior to installation.
.3 Location of controllers as reviewed by Departmental prior to installation.
.4 Provide utility power to EMCS and emergency power to EMCS.
.5 Metric references: in accordance with CAN/CSA Z234.1.

.4 Language Operating Requirements:
.1 Provide English operator selectable access codes.

1.9 SYSTEM DESCRIPTION (Cont'd)

.4 (Cont'd)

.2 Use non-linguistic symbols for displays on graphic terminals wherever possible. Other information to be in English.

.3 Operating system executive: provide primary hardware-to-software interface specified as part of hardware purchase with associated documentation to be in English.

.4 System manager software: include in English system definition point database, additions, deletions or modifications, control loop statements, use of high level programming languages, report generator utility and other OS utilities used for maintaining optimal operating efficiency.

.5 Include, in English:

.1 Input and output commands and messages from operator-initiated functions and field related changes and alarms as defined in CDL's or assigned limits (i.e. commands relating to day-to-day operating functions and not related to system modifications, additions, or logic re-definements).

.2 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points. To be in English at specified OWS and to be able to operate one terminal in English. Point name expansions in English.

.3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

1.10 DELIVERY, STORAGE, AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.11 WASTE MANAGEMENT AND

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 ADAPTORS .1 Provide adaptors between metric and imperial components.

PART 3 - EXECUTION

3.1 MANUFACTURER'S RECOMMENDATIONS .1 Installation: to manufacturer's recommendations.

3.2 PAINTING .1 Painting: in accordance with Section 09 91 23- Interior Painting, supplemented as follows:
.1 Clean and touch up marred or scratched surfaces of factory finished equipment to match original finish.
.2 Restore to new condition, finished surfaces too extensively damaged to be primed and touched up to make good.
.3 Clean and prime exposed hangers, racks, fastenings, and other support components.
.4 Paint unfinished equipment installed to EEMAC 2Y-1.

3.3 CLEANING .1 Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 25 05 01 - EMCS: General Requirements.

.3 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.2 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures and coordinate with requirements in this Section.

.2 Shop Drawings to consist of 3 hard copies and 1 soft copy of design documents, shop drawings, product data and software.

.3 Hard copy to be a completely indexed and coordinated package to assure compliance with contract requirements, arranged in same sequence as specification and cross-referenced to specification section and paragraph number.

.4 Soft copy to be in AutoCAD - latest version and Microsoft Word latest version format, structured using menu format for easy loading and retrieval on OWS.

1.3 CLOSEOUT SUBMITTALS

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

1.4 DEFINITIONS

.1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.5 PRELIMINARY SHOP DRAWING REVIEW

.1 Submit preliminary shop drawings within 30 working days of award of contract and include following:

1.5 PRELIMINARY SHOP DRAWING REVIEW (Cont'd)

.1 (Cont'd)

.1 Specification sheets for each item. To include manufacturer's descriptive literature, manufacturer's installation recommendations,specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.

.2 Spare point capacity of each controller by number and type.

.3 Controller locations.

.4 Auxiliary control cabinet locations.

.5 Single line diagrams showing cable routing conduit sizes, spare conduit capacity between control centre, field controllers and systems being controlled.

.6 Valves: complete schedule listing including following information: designation, service, manufacturer, model, point ID, design flow rate, design pressure drop, required Cv, Valve size, actual Cv, spring range, pilot range, required torque, actual torque and close off pressure (required and actual).

.7 Dampers: sketches showing module assembly, interconnecting hardware, operator locations, operator spring range, pilot range, required torque, actual torque.

.8 Flow measuring stations: complete schedule listing designation, service, point ID, manufacturer, model, size, velocity at design flow rate, manufacturer, model and range of velocity transmitter.

.9 Compressor schematic and sizing data.

1.6 DETAIL SHOP DRAWING REVIEW

.1 Submit detailed shop drawings within 60 working days after award of contract and before start of installation and include following:

.1 Corrected and updated versions (hard copy only) of submissions made during preliminary review.

.2 Wiring diagrams.

.3 Piping diagrams and hook-ups.

.4 Interface wiring diagrams showing termination connections and signal levels for equipment to be supplied by others.

1.6 DETAIL SHOP DRAWING REVIEW (Cont'd)

.1 (Cont'd)

.5 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including:

.1 Sensing element type and location.

.2 Transmitter type and range.

.3 Associated field wiring schematics, schedules and terminations.

.4 Complete Point Name Lists.

.5 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.

.6 Software and programming details associated with each point.

.7 Manufacturer's recommended installation instructions and procedures.

.8 Input and output signal levels or pressures where new system ties into existing control equipment.

.6 Control schematics, narrative description, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of EMCS.

.7 Graphic system schematic displays of air and water systems with point identifiers and textual description of system, and typical floor plans as specified.

.8 Complete system CDL's including companion English language explanations on same sheet but with different font and italics. CDL's to contain specified energy optimization programs.

.9 Listing and example of specified reports.

.10 Listing of time of day schedules.

.11 Mark up to-scale construction drawing to detail control room showing location of equipment and operator work space.

.12 Type and size of memory with statement of spare memory capacity.

.13 Full description of software programs provided.

.14 Sample of "Operating Instructions Manual" to be used for training purposes.

.15 Outline of proposed start-up and verification procedures. Refer to Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.8 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 3 - EXECUTION

2.1 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 78 00 - Closeout Submittals.

.2 Section 25 05 01 - EMCS: General Requirements.

.3 Section 25 05 02 - EMCS: Submittals and Review Process.

.4 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.2 SUBMITTALS

.1 Submittals in accordance with Section 01 78 00 - Closeout Procedures and Appendix E, supplemented and modified by requirements of this Section.

.2 Submit As-built drawings and Operation and Maintenance Manual to Departmental in English.

.3 Provide soft copies and hard copies in hard-back, 50 mm 3 ring, D-ring binders.
.1 Binders to be 2/3 maximum full.
.2 Provide index to full volume in each binder.
.3 Identify contents of each manual on cover and spine.
.4 Provide Table of Contents in each manual.
.5 Assemble each manual to conform to Table of Contents with tab sheets placed before instructions covering subject.

1.3 CLOSEOUT SUBMITTALS

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

1.4 DEFINITIONS

.1 BECC - Building Environmental Control Centre.

.2 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.5 AS-BUILTS

.1 Provide 1 copy of detailed shop drawings generated in Section 25 05 02 - EMCS: Submittals and Review Process and include:
.1 Changes to contract documents as well as addenda and contract extras.
.2 Changes to interface wiring.
.3 Routing of conduit, wiring and control air lines associated with EMCS installation.
.4 Locations of obscure devices to be indicated on drawings.
.5 Listing of alarm messages.
.6 Panel/circuit breaker number for sources of normal/emergency power.
.7 Names, addresses, telephone numbers of each sub-contractor having installed equipment, local representative for each item of equipment, each system.
.8 Test procedures and reports: provide records of start-up procedures, test procedures, checkout tests and final commissioning reports as specified in Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
.9 Basic system design and full documentationon system configuration.

.2 Submit for final review by Departmental.

.3 Provide before acceptance 4 Hard and 1 soft copy incorporating changes made during final review.

1.6 O&M MANUALS

.1 Custom design O&M Manuals (both hard and soft copy) to contain material pertinent to this project only, and to provide full and complete coverage of subjects referred to in this Section.

.2 Provide 2 complete sets of hard and soft copies prior to system or equipment tests

.3 Include complete coverage in concise language, readily understood by operating personnel using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics or in-depth control theory.

.4 Functional description to include:
.1 Functional description of theory of operation.

1.6 O&M MANUALS (Cont'd)

.4 (Cont'd)
.2 Design philosophy.
.3 Specific functions of design philosophy and system.
.4 Full details of data communications, including data types and formats, data processing and disposition data link components, interfaces and operator tests or self-test of data link integrity.
.5 Explicit description of hardware and software functions, interfaces and requirements for components in functions and operating modes.
.6 Description of person-machine interactions required to supplement system description, known or established constraints on system operation, operating procedures currently implemented.

.5 System operation to include:
.1 Complete step-by-step procedures for operation of system including required actions at each OWS.
.2 Operation of computer peripherals, input and output formats.
.3 Emergency, alarm and failure recovery.
.4 Step-by-step instructions for start-up, back-up equipment operation, execution of systems functions and operating modes, including key strokes for each command so that operator need only refer to these pages for keystroke entries required to call up display or to input command.

.6 Software to include:
.1 Documentation of theory, design, interface requirements, functions, including test and verification procedures.
.2 Detailed descriptions of program requirements and capabilities.
.3 Software modules, fully annotated source code listings, error free object code files ready for loading via peripheral device.
.4 Complete program cross reference plus linking requirements, data exchange requirements, necessary subroutine lists, data file requirements, other information necessary for proper loading, integration, interfacing, program execution.
.5 Software for each Controller and single section referencing Controller common parameters and functions.

1.6 O&M MANUALS (Cont'd)

.7 Maintenance: document maintenance procedures including inspection, periodic preventive maintenance, fault diagnosis, repair or replacement of defective components, including calibration, maintenance, repair of sensors, transmitters, transducers, controller and interface firmware, plus diagnostics and repair/replacement of system hardware.

.8 System configuration document:
.1 Provisions and procedures for planning, implementing and recording hardware and software modifications required during operating lifetime of system.
.2 Information to ensure co-ordination of hardware and software changes, data link or message format/content changes, sensor or control changes in event that system modifications are required.

.9 Programmer control panel documentation: provide where panels are independently interfaced with BECC, including interfacing schematics, signal identification, timing diagrams, fully commented source listing of applicable driver/handler.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.8 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 3 - EXECUTION

2.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 25 05 01 - EMCS: General Requirements.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).
.1 CSA C22.1-02, The Canadian Electrical Code, Part I (19th Edition), Safety Standard for Electrical Installations.

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures supplemented and modified by requirements of this Section.

.2 Submit to Departmental for approval samples of nameplates, identification tags and list of proposed wording.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DEFINITIONS

.1 For acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.6 SYSTEM DESCRIPTION

.1 Language Operating Requirements: provide identification for control items in English.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.8 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 NAMEPLATES FOR PANELS

.1 Identify by 3 mm thick Melamine, matt white finish, black core, square corners, lettering accurately aligned and engraved into core.

.2 Sizes: 25 x 67 mm minimum.

.3 Lettering: minimum 7 mm high, black.

.4 Inscriptions: machine engraved to identify function.

2.2 NAMEPLATES FOR FIELD DEVICES

.1 Identify by plastic encased cards attached by plastic tie.

.2 Sizes: 50 x 100 mm minimum.

.3 Lettering: minimum 5 mm high produced from laser printer in black.

.4 Data to include: point name and point address.

.5 Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.

2.3 NAMEPLATES FOR ROOM SENSORS

.1 Identify by stick-on labels using point identifier.

.2 Location: as directed by Departmental.

.3 Letter size: to suit, clearly legible.

2.4 WARNING SIGNS

.1 Equipment including motors, starters under remote automatic control: supply and install orange coloured signs warning of automatic starting under control of EMCS.

.2 Sign to read: "Caution: This equipment is under automatic remote control of EMCS" as reviewed by Departmental.

2.5 WIRING

.1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.

.2 Colour coding: to CSA C22.1. Use colour coded wiring in communications cables, matched throughout system.

.3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.

2.6 PNEUMATIC TUBING

.1 Numbered tape markings on tubing to provide uninterrupted tracing capability.

2.7 CONDUIT

.1 Colour code EMCS conduit.

.2 Pre-paint box covers and conduit fittings.

.3 Coding: use fluorescent orange paint and confirm colour with Departmental during "Preliminary Design Review".

PART 3 - EXECUTION

3.1 NAMEPLATES AND LABELS

.1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times.

3.2 CLEANING .1 Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 78 00 - Closeout Submittals.

.3 Section 25 05 01 - EMCS: General Requirements.

1.2 REFERENCES

.1 Canada Labour Code (R.S. 1985, c. L-2)/Part I - Industrial Relations.

.2 Canadian Standards Association (CSA International).
.1 CSA Z204-94(R1999), Guidelines for Managing Indoor Air Quality in Office Buildings.

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit detailed preventative maintenance schedule for system components to Departmental.

.3 Submit detailed inspection reports to Departmental.

.4 Submit dated, maintenance task lists to Departmental and include the following sensor and output point detail, as proof of system verification:
.1 Point name and location.
.2 Device type and range.
.3 Measured value.
.4 System displayed value.
.5 Calibration detail
.6 Indication if adjustment required,
.7 Other action taken or recommended.

.5 Submit network analysis report showing results with detailed recommendations to correct problems found.

.6 Records and logs: in accordance with Section 01 78 00 - Closeout Submittals and Appendix E.

1.3 SUBMITTALS (Cont'd)

.6 (Cont'd)
.1 Maintain records and logs of each maintenance task on site.
.2 Organize cumulative records for each major component and for entire EMCS chronologically.
.3 Submit records to Departmental after inspection indicating that planned and systematic maintenance have been accomplished.

.7 Revise and submit to Departmental in accordance with Section 01 78 00 - Closeout Submittals "As-built drawings" documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DEFINITIONS

.1 BC(s) - Building Controller(s).

.2 OWS - Operator Work Station.

.3 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.6 QUALITY ASSURANCE

.1 Health and Safety:
.1 Do construction occupational health and safety in accordance with Section 01 70 12 - Health and Safety Requirements.

1.7 MAINTENANCE SERVICE DURING WARRANTY PERIOD

.1 Provide services, materials, and equipment to maintain EMCS for specified warranty period. Provide detailed preventative maintenance schedule for system components as described in Submittal article.

.2 Emergency Service Calls:
.1 Initiate service calls when EMCS is not functioning correctly.

1.7 MAINTENANCE SERVICE DURING WARRANTY PERIOD (Cont'd)

.2 (Cont'd)
.2 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost.
.3 Furnish Departmental with telephone number where service personnel may be reached at any time.
.4 Service personnel to be on site ready to service EMCS within 2 hours after receiving request for service.
.5 Perform Work continuously until EMCS restored to reliable operating condition.

.3 Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.

.4 Work requests: record each service call request, when received separately on approved form and include:
.1 Serial number identifying component involved.
.2 Location, date and time call received.
.3 Nature of trouble.
.4 Names of personnel assigned.
.5 Instructions of work to be done.
.6 Amount and nature of materials used.
.7 Time and date work started.
.8 Time and date of completion.

.5 Provide system modifications in writing.
.1 No system modification, including operating parameters and control settings, to be made without prior written approval of Departmental Representative.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.9 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

.1 Perform as minimum (3) three minor inspections and one major inspection (more often if required by manufacturer) per year. Provide detailed written report to Departmental as described in Submittal article.

.2 Perform inspections during regular working hours, 0800 to 1630 h, Monday through Friday, excluding statutory holidays.

.3 Following inspections are minimum requirements and should not be interpreted to mean satisfactory performance:
.1 Perform calibrations using test equipment having traceable, certifiable accuracy at minimum 50% greater than accuracy of system displaying or logging value.
.2 Check and Calibrate each field input/output device in accordance with Canada Labour Code - Part I and CSA Z204.
.3 Provide dated, maintenance task lists, as described in Submittal article, as proof of execution of complete system verification.

.4 Minor inspections to include, but not limited to:
.1 Perform visual, operational checks to BC's, peripheral equipment, interface equipment and other panels.
.2 Check equipment cooling fans as required.
.3 Review system performance with Departmental to discuss suggested or required changes.

.5 Major inspections to include, but not limited to:
.1 Minor inspection.
.2 Clean OWS(s) peripheral equipment, BC(s), interface and other panels, micro-processor interior and exterior surfaces.

3.1 FIELD QUALITY CONTROL (Cont'd)

.5 (Cont'd)

.3 Check signal, voltage and system isolation of BC(s), peripherals, interface and other panels.

.4 Verify calibration/accuracy of each input and output device and recalibrate or replace as required.

.5 Provide mechanical adjustments, and necessary maintenance on printers.

.6 Run system software diagnostics as required.

.7 Install software and firmware enhancements to ensure components are operating at most current revision for maximum capability and reliability.

.1 Perform network analysis and provide report as described in Submittal article.

.6 Rectify deficiencies revealed by maintenance inspections and environmental checks.

.7 Continue system debugging and optimization.

.8 Testing/verification of occupancy and seasonal-sensitive systems to take place during four (4) consecutive seasons, after facility has been accepted, taken over and fully occupied.

.1 Test weather-sensitive systems twice: first at near winter design conditions and secondly under near summer design conditions.

3.2 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTION .1 Section 25 05 01 - EMCS: General Requirements.

1.2 REFERENCES .1 Canadian Standards Association (CSA International).
.1 CSA T529-95(R2000), Telecommunications Cabling Systems in Commercial Buildings (Adopted ANSI/TIA/EIA-568-A with modifications).
.2 CSA T530-99(R2004), Commercial Building Standard for Telecommunications Pathways and Spaces (Adopted ANSI/TIA/EIA-569-A with modifications).

.2 Institute of Electrical and Electronics Engineers (IEEE)/Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements.
.1 IEEE Std 802.3TM -2002, Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.

.3 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA)
.1 TIA/EIA-568-March 2004, Commercial Building Telecommunications Cabling Standards Set, Part 1 General Requirements, Part 2 Balanced Twisted-Pair Cabling Components, Part 3 Optical Fiber Cabling Components Standard.
.2 TIA/EIA-569-A-December 2001, Commercial Building Standard for Telecommunications Pathways and Spaces.

.4 Treasury Board Information Technology Standard (TBITS).
.1 TBITS 6.9-2000, Profile for the Telecommunications Wiring System in Government Owned and Leased Buildings - Technical Specifications.

1.3 DEFINITIONS .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS - General Requirements.

1.4 SYSTEM DESCRIPTION

.1 Data communication network to link BACnet router and Master Control Units (MCU) in accordance with CSA T529.
.1 Provide reliable and secure connectivity of adequate performance between different sections (segments) of network.
.2 Allow for future expansion of network, with selection of networking technology and communication protocols.

.2 Data communication network to include, but not limited to:
.1 EMCS-LAN.
.2 Modems.
.3 Network interface cards.
.4 Network management hardware and software.
.5 Network components necessary for complete network.

1.5 DESIGN REQUIREMENTS

.1 EMCS Local Area Network (EMCS-LAN).
.1 High speed, high performance, local area network over which MCUs and BACnet router communicate with each other directly on peer to peer basis in accordance with IEEE 802.3/Ethernet Standard.
.2 EMCS-LAN to: BACnet.
.3 Each EMCS-LAN to be capable of supporting at least 50 devices.
.4 Support of combination of MCUs and OWSs directly connected to EMCS-LAN.
.5 High speed data transfer rates for alarm reporting, quick report generation from multiple controllers, upload/download information between network devices. Bit rate to be 10 Megabits per second minimum.
.6 Detection and accommodation of single or multiple failures of either OWSs, MCUs or network media. Operational equipment to continue to perform designated functions effectively in event of single or multiple failures.
.7 Commonly available, multiple sourced, networking components and protocols to allow system to co-exist with other networking applications including office automation.

.2 Dynamic Data Access.

1.5 DESIGN REQUIREMENTS (Cont'd)

.2 (Cont'd)
.1 LAN to provide capabilities for OWSs, either network resident or connected remotely, to access point status and application report data or execute control functions for other devices via LAN.
.2 Access to data to be based upon logical identification of building equipment.

.3 Network Medium.
.1 Network medium: twisted cable, shielded twisted cable, or fibre optic cable compatible with network protocol to be used within buildings.

1.6 CLOSEOUT SUBMITTALS

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

.2 Provide following:
.1 6 fusible links of each type.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.8 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 25 05 01 - EMCS: General Requirements.

.2 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

.3 Section 25 05 03 - EMCS: Project Record Documents.

.4 Section 25 30 02 - EMCS: Field Control Devices.

.5 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE).
.1 ASHRAE 2003, Applications Handbook, SI Edition.

.2 Canadian Standards Association (CSA International).
.1 C22.2 No.205-M1983(R1999), Signal Equipment.

.3 Institute of Electrical and Electronics Engineers (IEEE).
.1 IEEE C37.90.1-02, Surge Withstand Capabilities (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.

.4 Public Works and Government Services Canada (PWGSC)/Real Property Branch/Architectural and Engineering Services.
.1 MD13800-September 2000, Energy Management and Control Systems (EMCS) Design Manual. English: ftp://ftp.pwgsc.gc.ca/rps/docentre/mechanica /me214-e.pdf

1.3 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures and Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
.1 Submit product data sheets for each product item proposed for this project.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DEFINITIONS

.1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.6 SYSTEM DESCRIPTION

.1 General: Network of controllers comprising of MCU('s), LCU('s), ECU('s) or TCU('s) to be provided as indicated in System Architecture Diagram to support building systems and associated sequence(s) of operations as detailed in these specifications.

.1 Provide sufficient controllers to meet intents and requirements of this section.

.2 Controller quantity, and point contents to be approved by Departmental at time of preliminary design review.

.2 Controllers: stand-alone intelligent Control Units.

.1 Incorporate programmable microprocessor, non-volatile program memory, RAM, power supplies, as required to perform specified functions.

.2 Incorporate communication interface ports for communication to LANs to exchange information with other Controllers.

.3 Capable of interfacing with operator interface device.

.4 Execute its logic and control using primary inputs and outputs connected directly to its onboard input/output field terminations or slave devices, and without need to interact with other controller(s). Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).

.1 Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).

.3 Interface to include provisions for use of dial-up modem for interconnection with remote modem.

.1 Dial-up communications to use 56 Kbit modems and voice grade telephone lines.

.2 Each stand-alone panel may have its own modem or group of stand-alone panels may share modem.

1.7 DESIGN REQUIREMENTS

.1 To include:
.1 Scanning of AI and DI connected inputs for detection of change of value and processing detection of alarm conditions.
.2 Perform On-Off digital control of connected points, including resulting required states generated through programmable logic output.
.3 Perform Analog control using programmable logic, (including PID) with adjustable dead bands and deviation alarms.
.4 Control of systems as described in sequence of operations.
.5 Execution of optimization routines as listed in this section.

.2 Total spare capacity for MCUs and LCUs: at least 25% of each point type distributed throughout the MCUs and LCUs.

.3 Field Termination and Interface Devices:
.1 To: CSA C22.2 No.205.
.2 Electronically interface sensors and control
.3 Include, but not be limited to, following:
.1 Programmed firmware or logic circuits to meet functional and technical requirements.
.2 Power supplies for operation of logics devices and associated field equipment.
.3 Lockable wall cabinet.
.4 Required communications equipment and wiring (if remote units).
.5 Leave controlled system in "fail-safe" mode in event of loss of communication with, or failure of, processor unit.
.6 Input Output interface to accept as minimum AI, AO, DI, DO functions as specified.
.7 Wiring terminations: use conveniently located screw type or spade lug terminals.
.4 AI interface equipment to:
.1 Convert analog signals to digital format with 10 bit analog-to-digital resolution.
.2 Provide for following input signal types and ranges:
.1 4 - 20 mA;
.2 0 - 10 V DC;
.3 100/1000 ohm RTD input;
.3 Meet IEEE C37.90.1 surge withstand capability.
.4 Have common mode signal rejection greater than 60 dB to 60 Hz.

1.7 DESIGN REQUIREMENTS (Cont'd)

.3 (Cont'd)
.4 (Cont'd)
.5 Where required, dropping resistors to be certified precision devices which complement accuracy of sensor and transmitter range specified.
.5 AO interface equipment:
.1 Convert digital data from controller processor to acceptable analog output signals using 8 bit digital-to-analog resolution.
.2 Provide for following output signal types and ranges:
.1 4 - 20 mA.
.2 0 - 10 V DC.
.3 Meet IEEE C37.90.1 surge withstand capability.
.6 DI interface equipment:
.1 Able to reliably detect contact change of sensed field contact and transmit condition to controller.
.2 Meet IEEE C37.90.1 surge withstand capability.
.3 Accept pulsed inputs up to 2 kHz.
.7 DO interface equipment:
.1 Respond to controller processor output switch respective outputs. Each DO hardware to be capable of switching up to 0.5 amps at 24 V AC.
.2 Switch up to 5 amps at 220 V AC using optional interface relay.

.4 Controllers and associated hardware and software: operate in conditions of 0 degrees C to 44 degrees C and 20% to 90% non-condensing RH.

.5 Controllers (MCU, LCU): mount in wall mounted cabinet with hinged, keyed-alike locked door.
.1 Provide for conduit entrance from top, bottom or sides of panel.
.2 ECUs and TCUs to be mounted in equipment enclosures or separate enclosures.
.3 Mounting details as approved by Departmental for ceiling mounting.

.6 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.

.7 Provide surge and low voltage protection for interconnecting wiring connections.

1.8 MAINTENANCE PROCEDURES

.1 Provide manufacturers recommended maintenance procedures for insertion in Section 25 05 03 - EMCS: Project Record Documents.

1.9 DELIVERY, STORAGE, AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.10 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MASTER CONTROL UNIT (MCU)

.1 General: primary function of MCU is to provide co-ordination and supervision of subordinate devices in execution of optimization routines such as demand limiting or enthalpy control.

.2 Include high speed communication LAN Port for Peer to Peer communications with OWS(s) and other MCU level devices.
.1 MCU must support BACnet.

.3 MCU local I/O capacity as follows:
.1 MCU I/O points as allocated in I/O Summary Table referenced in MD13800.
.2 LCUs may be added to support system functions.

.4 Central Processing Unit (CPU).
.1 Processor to consist of minimum 16 bit microprocessor capable of supporting software to meet specified requirements.
.2 CPU idle time to be more than 30% when system configured to maximum input and output with worst case program use.

2.1 MASTER CONTROL UNIT (MCU) (Cont'd)

.4 (Cont'd)

.3 Minimum addressable memory to be at manufacturer's discretion but to support at least performance and technical specifications to include but not limited to:

.1 Non-volatile EEPROM to contain operating system, executive, application, sub-routine, other configurations definition software. Tape media not acceptable.

.2 Battery backed (72 hour minimum capacity) RAM (to reduce the need to reload operating data in event of power failure) to contain CDLs, application parameters, operating data or software that is required to be modifiable from operational standpoint such as schedules, setpoints, alarm limits, PID constants and CDL and hence modifiable on-line through operator panel or remote operator's interface. RAM to be downline loadable from OWS.

.4 Include uninterruptible clock accurate to plus or minus 5 secs/month, capable of deriving year/month/day/hour/minute/second, with rechargeable batteries for minimum 72 hour operation in event of power failure.

.5 Local Operator Terminal (OT): Provide OT for each MCU unless otherwise specified in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

.1 Mount access/display panel in MCU or in suitable enclosure beside MCU as approved by Departmental Representative

.2 Support operator's terminal for local command entry, instantaneous and historical data display, programs, additions and modifications.

.3 Display simultaneously minimum of 16 point identifiers to allow operator to view single screen dynamic displays depicting entire mechanical systems. Point identifiers to be in English.

.4 Functions to include, but not be limited to, following:

.1 Start and stop points.

.2 Modify setpoints.

.3 Modify PID loop parameters.

.4 Override PID control.

.5 Change time/date.

.6 Add/modify/start/stop weekly scheduling.

.7 Add/modify setpoint weekly scheduling.

2.1 MASTER CONTROL UNIT (MCU) (Cont'd)

.5 (Cont'd)
.4 (Cont'd)
.8 Enter temporary override schedules.
.9 Define holiday schedules.
.10 View analog limits.
.11 Enter/modify analog warning limits.
.12 Enter/modify analog alarm limits.
.13 Enter/modify analog differentials.
.5 Provide access to real and calculated points in controller to which it is connected or to other controller in network. This capability not to be restricted to subset of predefined "global points" but to provide totally open exchange of data between OT and other controller in network.
.6 Operator access to OTs: same as OWS user password and password changes to automatically be downloaded to controllers on network.
.7 Provide prompting to eliminate need for user to remember command format or point names. Prompting to be consistent with user's password clearance and types of points displayed to eliminate possibility of operator error.
.8 Identity of real or calculated points to be consistent with network devices. Use same point identifier as at OWS's for access of points at OT to eliminate cross-reference or look-up tables.

2.2 LOCAL CONTROL UNIT (LCU)

.1 Provide multiple control functions for typical built-up and package HVAC systems, hydronic systems and electrical systems.

.2 Minimum of 16 I/O points of which minimum be 4 AOs, 4 AIs, 4 DIs, 4 DOs.

.3 Points integral to one Building System to be resident on only one controller.

.4 Microprocessor capable of supporting necessary software and hardware to meet specified requirements as listed in previous MCU article with following additions:
.1 Include minimum 2 interface ports for connection of local computer terminal.
.2 Design so that shorts, opens or grounds on input or output will not interfere with other input or output signals.

2.2 LOCAL CONTROL UNIT (LCU) (Cont'd)

.4 (Cont'd)
.3 Physically separate line voltage (70V and over) circuits from DC logic circuits to permit maintenance on either circuit with minimum hazards to technician and equipment.
.4 Include power supplies for operation of LCU and associated field equipment.
.5 In event of loss of communications with, or failure of, MCU, LCU to continue to perform control. Controllers that use defaults or fail to open or close positions not acceptable.
.6 Provide conveniently located screw type or spade lug terminals for field wiring.

2.3 TERMINAL/EQUIPMENT CONTROL UNIT (TCU/ECU)

.1 Microprocessor capable of supporting necessary software and hardware to meet TCU/ECU functional specifications.
.1 TCU/ECU definition to be consistent with those defined in ASHRAE HVAC Applications Handbook section 45.

.2 Controller to communicate directly with EMCS through EMCS LAN and provide access from EMCS OWS for setting occupied and unoccupied space temperature setpoints, flow setpoints, and associated alarm values, permit reading of sensor values, field control values (% open) and transmit alarm conditions to EMCS OWS.

.3 VAV Terminal Controller.
.1 Microprocessor based controller with integral flow transducer, including software routines to execute PID algorithms, calculate airflow for integral flow transducer and measure temperatures as per I/O Summary required inputs. Sequence of operation to ASHRAE HVAC Applications Handbook.
.2 Controller to support point definition; in accordance with Section 25 05 01 - EMCS: General Requirements.
.3 Controller to operate independent of network in case of communication failure.
.4 Controller to include damper actuator and terminations for input and output sensors and devices.

2.4 SOFTWARE

.1 General.

2.4 SOFTWARE (Cont'd)

.1 (Cont'd)

.1 Include as minimum: operating system executive, communications, application programs, operator interface, and systems sequence of operation - CDL's.

.2 Include "firmware" or instructions which are programmed into ROM, EPROM, EEPROM or other non-volatile memory.

.3 Include initial programming of controllers, for entire system.

.2 Program and data storage.

.1 Store executive programs and site configuration data in ROM, EEPROM or other non-volatile memory.

.2 Maintain CDL and operating data including setpoints, operating constants, alarm limits in battery-backed RAM or EEPROM for display and modification by operator.

.3 Programming languages.

.1 Program Control Description Logic software (CDL) using English like or graphical, high level, general control language.

.2 Structure software in modular fashion to permit simple restructuring of program modules if future software additions or modifications are required. GO TO constructs not allowed unless approved by Departmental.

.4 Operator Terminal interface.

.1 Operating and control functions include:

.1 Multi-level password access protection to allow user/manager to limit workstation control.

.2 Alarm management: processing and messages.

.3 Operator commands.

.4 Reports.

.5 Displays.

.6 Point identification.

.5 Pseudo or calculated points.

.1 Software to provide access to value or status in controller or other networked controller in order to define and calculate pseudo point. When current pseudo point value is derived, normal alarm checks must be performed or value used to totalize.

2.4 SOFTWARE (Cont'd)

.5 (Cont'd)

.2 Inputs and outputs for process: include data from controllers to permit development of network-wide control strategies. Processes also to permit operator to use results of one process as input to number of other processes (e.g. cascading).

.6 Control Description Logic (CDL):

.1 Capable of generating on-line project-specific CDLs which are software based, programmed into RAM or EEPROM and backed up to OWS. Owner must have access to these algorithms for modification or to be able to create new ones and to integrate these into CDLs on BC(s) from OWS.

.2 Write CDL in high level language that allow algorithms and interlocking programs to be written simply and clearly. Use parameters entered into system (e.g. setpoints) to determine operation of algorithm. Operator to be able to alter operating parameters on-line from OWS and BC(s) to tune control loops.

.3 Perform changes to CDL on-line.

.4 Control logic to have access to values or status of points available to controller including global or common values, allowing cascading or inter-locking control.

.5 Energy optimization routines including enthalpy control, supply temperature reset, to be LCU or MCU resident functions and form part of CDL.

.6 MCU to be able to perform following pre-tested control algorithms:

.1 Two position control.

.2 Proportional Integral and Derivative (PID) control.

.7 Control software to provide ability to define time between successive starts for each piece of equipment to reduce cycling of motors.

.8 Provide protection against excessive electrical-demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.

2.4 SOFTWARE (Cont'd)

.6 (Cont'd)

.9 Power Fail Restart: upon detection of power failure system to verify availability of Emergency Power as determined by emergency power transfer switches and analyze controlled equipment to determine its appropriate status under Emergency power conditions and start or stop equipment as defined by I/O Summary. Upon resumption of normal power as determined by emergency power transfer switches, MCU to analyze status of controlled equipment, compare with normal occupancy scheduling, turn equipment on or off as necessary to resume normal operation.

.7 Event and Alarm management: use management by exception concept for Alarm Reporting. This is system wide requirement. This approach will insure that only principal alarms are reported to OWS. Events which occur as direct result of primary event to be suppressed by system and only events which fail to occur to be reported. Such event sequence to be identified in I/O Summary and sequence of operation. Examples of above are, operational temperature alarms limits which are exceeded when main air handler is stopped, or General Fire condition shuts air handlers down, only Fire alarm status shall be reported. Exception is, when air handler which is supposed to stop or start fails to do so under event condition.

.8 Energy management programs: include specific summarizing reports, with date stamp indicating sensor details which activated and or terminated feature.

.1 MCU in coordination with subordinate LCU, TCU, ECU to provide for the following energy management routines:

.1 Time of day scheduling.
.2 Calendar based scheduling.
.3 Holiday scheduling.
.4 Temporary schedule overrides.
.5 Optimal start stop.
.6 Night setback control.
.7 Enthalpy (economizer) switchover.
.8 Peak demand limiting.
.9 Temperature compensated load rolling.
.10 Fan speed/flow rate control.
.11 Cold deck reset.
.12 Hot deck reset.

2.4 SOFTWARE (Cont'd)

.8 (Cont'd)
.1 (Cont'd)
.13 Hot water reset.
.14 Chilled water reset.
.15 Condenser water reset.
.16 Chiller sequencing.
.17 Night purge.
.2 Programs to be executed automatically without need for operator intervention and be flexible enough to allow customization.
.3 Apply programs to equipment and systems as specified or requested by the Departmental.

.9 Function/Event Totalization: features to provide predefined reports which show daily, weekly, and monthly accumulating totals and which include high rate (time stamped) and low rate (time stamped) and accumulation to date for month.
.1 MCUs to accumulate and store automatically run-time for binary input and output points.
.2 MCU to automatically sample, calculate and store consumption totals on daily, weekly or monthly basis for user-selected analog or binary pulse input-type points.
.3 MCU to automatically count events (number of times pump is cycled off and on) daily, weekly or monthly basis.
.4 Totalization routine to have sampling resolution of 1 min or less for analog inputs.
.5 Totalization to provide calculations and storage of accumulations up to 99,999.9 units (eg. kWH, litres, tonnes, etc.).
.6 Store event totalization records with minimum of 9,999,999 events before reset.
.7 User to be able to define warning limit and generate user-specified messages when limit reached.

2.5 LEVELS OF ADDRESS

.1 Upon operator's request, EMCS to present status of any single 'point', 'system' or point group, entire 'area', or entire network on printer or OWS as selected by operator.
.1 Display analog values digitally to 1 place of decimals with negative sign as required.
.2 Update displayed analog values and status when new values received.

2.5 LEVELS OF ADDRESS (Cont'd)

.1 (Cont'd)
.3 Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm.
.4 Updates to be change-of-value (COV)-driven or if polled not exceeding 2 second intervals.

2.6 POINT NAME SUPPORT

.1 Controllers (MCU, LCU) to support PWGSC point naming convention as defined in Section 25 05 01 - EMCS: General Requirements.

PART 3 - EXECUTION

3.1 LOCATION

.1 Location of Controllers to be approved by Departmental Representative.

3.2 INSTALLATION

.1 Install Controllers in secure locking enclosures.

.2 Provide necessary power from local 120 V branch circuit panel for equipment.

.3 Install tamper locks on breakers of circuit breaker panel.

.4 Use uninterruptible Power Supply (UPS) and emergency power when equipment must operate in emergency and co-ordinating mode.

3.3 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 73 03 - Execution Requirements.

.2 Section 07 84 00 - Firestopping.

.3 Section 23 33 15 - Dampers - Operating.

.4 Section 25 01 11 - EMCS: Start-Up, Verification and Commissioning.

.5 Section 25 05 01 - EMCS: General Requirements.

.6 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

.7 Section 25 05 54 - EMCS: Identification.

.8 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

.9 Section 26 05 00 - Common Work Results - Electrical.

.10 Section 26 27 26 - Wiring Devices.

1.2 REFERENCES

.1 American National Standards Institute (ANSI).
.1 ANSI C12.7-1993(R1999), Requirements for Watthour Meter Sockets.
.2 ANSI/IEEE C57.13-1993, Standard Requirements for Instrument Transformers.

.2 American Society for Testing and Materials International, (ASTM).
.1 ASTM B 148-97(03), Standard Specification for Aluminum-Bronze Sand Castings.

.3 National Electrical Manufacturer's Association (NEMA).
.1 NEMA 250-03, Enclosures for Electrical Equipment (1000 Volts Maximum).

.4 Air Movement and Control Association, Inc. (AMCA).
.1 AMCA Standard 500-D-98, Laboratory Method of Testing Dampers For Rating.

1.2 REFERENCES (Cont'd)

.5 Canadian Standards Association (CSA International).
.1 CSA-C22.1-02, Canadian Electrical Code, Part 1 (19th Edition), Safety Standard for Electrical Installations.

1.3 SUBMITTALS

.1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 25 05 02 - EMCS: Submittals and Review Process.

.2 Pre-Installation Tests.
.1 Submit samples at random from equipment shipped, as requested by Departmental for testing before installation. Replace devices not meeting specified performance and accuracy.

.3 Manufacturer's Instructions:
.1 Submit manufacturer's installation instructions for specified equipment and devices.

1.4 CLOSEOUT SUBMITTALS

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

.2 Provide following:
.1 6 fusible links of each type.

1.5 DEFINITIONS

.1 Acronyms and Definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Control devices of each category to be of same type and manufacturer.

.2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof, heat resistant assembly.

.3 Operating conditions: 0 - 32 degrees C with 10 - 90 % RH (non-condensing) unless otherwise specified.

.4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified. Designed to accept 0-10Vdc, 4-20mA optional.

.5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.

.6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

.7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.

.8 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.

.9 Range: including temperature, humidity, pressure, as indicated in I/O summary in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

2.2 TEMPERATURE SENSORS

.1 General: except for room sensors to be resistance or thermocouple type to following requirements:
.1 Thermocouples: limit to temperature range of 200 degrees C and over.
.2 10K ohm thermistors
.3 Sensing element: hermetically sealed.
.4 Stem and tip construction: copper or type 304 stainless steel.
.5 Time constant response: less than 3 seconds to temperature change of 10 degrees C.
.6 Immersion wells: NPS 3/4, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length 100 150 mm as indicated.

.2 Room temperature sensors and display wall modules.
.1 Temperature sensing and display wall module.
.1 LCD display to show space temperature ed and temperature setpoint.
.2 Buttons for occupant selection of temperature setpoint and occupied/unoccupied mode.
.3 Jack connection for plugging in laptop personal computer contractor supplied zone terminal unit contractor supplied palm compatible handheld device for access to zone bus.
.4 Integral thermistor sensing element 10,000 ohm at 24 degrees.
.5 Accuracy 0.2 degrees C over range of 0 to 70 degrees C.
.6 Stability 0.02 degrees C drift per year.
.7 Separate mounting base for ease of installation.
.2 Room temperature sensors.
.1 Wall mounting, in slotted type covers having brushed aluminum finish.
.2 Element 10-50 mm long RTD with ceramic tube or equivalent protection or thermistor, 10,000 ohm, accuracy of plus or minus 0.2 degrees C.

.3 Duct temperature sensors:
.1 General purpose duct type: suitable for insertion into ducts at various orientations, insertion length 460 mm or as indicated.

2.2 TEMPERATURE SENSORS (Cont'd)

.3 (Cont'd)
.2 Averaging duct type: incorporates numerous sensors inside assembly which are averaged to provide one reading. Minimum insertion length 6000 mm. Bend probe at field installation time to 100 mm radius at point along probe without degradation of performance.

.4 Outdoor air temperature sensors:
.1 Outside air type: complete with probe length 100 - 150 mm long, non-corroding shield to minimize solar and wind effects, threaded fitting for mating to 13 mm conduit, weatherproof construction in NEMA 4 enclosure.

2.3 PRESSURE TRANSDUCERS

.1 Requirements:
.1 Combined sensor and transmitter measuring pressure.
.1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, as applicable.
.2 Output signal: 4 - 20 mA into 500 ohm maximum load, 10Kohm thermistors, 0-5Vdc or 0-10Vdc.
.3 Output variations: less than 0.2% full scale for supply voltage variations of plus or minus 10%.
.4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5% of full scale output over entire range.
.5 Temperature effects: not to exceed plus or minus 1.5% full scale/ 50 degrees C.
.6 Over-pressure input protection to at least twice rated input pressure.
.7 Output short circuit and open circuit protection.
.8 Accuracy: plus or minus 1% of Full Scale.

2.4 DIFFERENTIAL PRESSURE TRANSMITTERS

.1 Requirements:
.1 Internal materials: suitable for continuous contact with water.
.2 Output signal: 4 - 20 mA into 500 ohm maximum load, 10Kohm thermistors, 0-5Vdc or 0-10Vdc.
.3 Output variations: less than 0.2% full scale for supply voltage variations of plus or minus 10%.

2.4 DIFFERENTIAL PRESSURE TRANSMITTERS (Cont'd)

.1 (Cont'd)
.4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5% of full scale output over entire range.
.5 Integral zero and span adjustment.
.6 Temperature effects: not to exceed plus or minus 1.5% full scale/50 degrees C.
.7 Over-pressure input protection to at least twice rated input pressure.
.8 Output short circuit and open circuit protection.
.9 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

2.5 STATIC PRESSURE SENSORS

.1 Requirements:
.1 Multipoint element with self-averaging manifold.
.1 Maximum pressure loss: 160 Pa at 10 m/s. (Air stream manifold).
.2 Accuracy: plus or minus 1 % of actual duct static pressure.

2.6 STATIC PRESSURE TRANSMITTERS

.1 Requirements:
.1 Output signal:
.2 Output signal: 4 - 20 mA linear into 500 ohm maximum load, 10Kohm thermistors, 0-5Vdc or 0-10VDC.
.3 Calibrated span: not to exceed 150 % of duct static pressure at maximum flow.
.4 Accuracy: 0.4 % of span.
.5 Repeatability: within 0.5 % of output.
.6 Linearity: within 1.5 % of span.
.7 Dead band or hysteresis: 0.1 % of span.
.8 External exposed zero and span adjustment.
.9 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit

2.7 VELOCITY PRESSURE SENSORS

.1 Requirements:
.1 Multipoint static and total pressure sensing element with self-averaging manifold with integral air equalizer and straightener section.
.2 Maximum pressure loss: 37 Pa at 1000 m/s.
.3 Accuracy: plus or minus 1 % of actual ductvelocity.

2.8 VELOCITY PRESSURE TRANSMITTERS

.1 Requirements:
.1 Output signal: 4 - 20 mA linear into 500 ohm maximum load, 10Kohm thermistors, 0-5Vdc or 0-10Vdc.
.2 Calibrated span: not to exceed 125 % of duct velocity pressure at maximum flow.
.3 Accuracy: 0.4 % of span.
.4 Repeatability: within 0.1 % of output.
.5 Linearity: within 0.5 % of span.
.6 Deadband or hysteresis: 0.1 % of span.
.7 External exposed zero and span adjustment.
.8 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

2.9 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES

.1 Requirements:
.1 Internal materials: suitable for continuous contact with compressed air, water, etc., as applicable.
.2 Adjustable setpoint and differential.
.3 Switch: snap action type, rated at 120V, 15 amps AC or 24 V DC.
.4 Switch assembly: to operate automatically and reset automatically when conditions return to normal. Over-pressure input protection to at least twice rated input pressure.
.5 Accuracy: within 2 % repetitive switching.
.6 Provide switches with isolation valve and snubber, where code allows, between sensor and pressure source.
.7 Switches on high temperature hot water service: provide pigtail syphon.

2.10 TEMPERATURE SWITCHES

.1 Requirements:
.1 Operate automatically. Reset automatically, except as follows:
.1 Low temperature detection: manual reset.
.2 High temperature detection: manual reset.
.2 Adjustable setpoint and differential.
.3 Accuracy: plus or minus 1 degrees C.
.4 Snap action rating: 120V, 15 amps or 24V DC as required. Switch to be DPST for hardwire and EMCS connections.
.5 Type as follows:

2.10 TEMPERATURE SWITCHES (Cont'd)

.1 (Cont'd)

.5 (Cont'd)

.1 Room: for wall mounting on standard electrical box with without protective guard as indicated.

.2 Duct, general purpose: insertion length = 460 mm.

.3 Thermowell: stainless steel, with compression fitting for NPS 3/4 thermowell. Immersion length: 100 mm.

.4 Low temperature detection: continuous element with 6000 mm insertion length, duct mounting, to detect coldest temperature in any 30 mm length.

.5 Strap-on: with helical screw stainless steel clamp.

2.11 ELECTROMECHANICAL RELAYS

.1 Requirements:

.1 Double voltage, DPDT, plug-in type with termination base.

.2 Coils: rated for 24V DC. Other voltage: provide transformer.

.3 Contacts: rated at 5 amps at 120 V AC.

.4 Relay to have visual status indication

2.12 SOLID STATE RELAYS

.1 General:

.1 Relays to be socket or rail mounted.

.2 Relays to have LED Indicator

.3 Input and output Barrier Strips to accept 14 to 28 AWG wire.

.4 Operating temperature range to be -20 degrees C to 70 degrees C.

.5 Relays to be CSA Certified.

.6 Input/output Isolation Voltage to be 4000 VAC at 25 degrees C for 1 second maximum duration.

.7 Operational frequency range, 45 to 65 HZ.

.2 Input:

.1 Control voltage, 3 to 32 VDC.

.2 Drop out voltage, 1.2 VDC.

.3 Maximum input current to match AO (Analog Output) board.

.3 Output.

.1 AC or DC Output Model to suit application.

2.13 CURRENT TRANSDUCERS

.1 Requirements:

.2 Purpose: combined sensor/transducer, to measure line current and produce proportional signal in one of following ranges:
.1 4-20 mA DC.
.2 0-1 volt DC.
.3 0-10 volts DC.
.4 0-20 volts DC.

.3 Frequency insensitive from 10 - 80 hz.

.4 Accuracy to 0.5% full scale.

.5 Zero and span adjustments. Field adjustable range to suit motor applications.

.6 Adjustable mounting bracket to allow for secure/safe mounting inside MCC.

2.14 CURRENT SENSING RELAYS

.1 Requirements:
.1 Suitable to detect belt loss or motor failure.
.2 Trip point adjustment, output status LED.
.3 Split core for easy mounting.
.4 Induced sensor power.
.5 Relay contacts: capable of handling 0.5 amps at 30 VAC / DC. Output to be NO solid state.
.6 Suitable for single or 3 phase monitoring. For 3-Phase applications: provide for discrimination between phases.
.7 Adjustable latch level.

2.15 ELECTRONIC CONTROL DAMPER ACTUATORS

.1 Requirements:
.1 Direct mount proportional type as indicated.
.2 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated.
.3 Operator: size to control dampers against maximum pressure and dynamic closing/opening pressure, whichever is greater.
.4 Power requirements: 5 VA maximum at 24 V AC.
.5 Operating range: 0 - 10 V DC or 4 - 20 mA DC.
.6 For VAV box applications floating control type actuators may be used.
.7 Damper actuator to drive damper from full open to full closed in less than 120 seconds.

2.16 WATTHOUR METERS AND CURRENT TRANSFORMERS

.1 Requirements:
.1 Include three phases, test and terminal blocks for watthour meter connections and connections for monitoring of current. Provide two transformers for 600 V 3 wire systems for watthour meter use. Accuracy: plus or minus 0.25 % of full scale. For chiller applications: to have instantaneous indicator with analog or digital display.
.2 Watthour meter sockets: to ANSI C12.7.
.3 Potential and current transformers: to ANSI/IEEE C57.13.
.4 Potential transformers: provide two primary fuses.
.5 Demand meters: configure to measure demand at 15 minute intervals.

2.17 PANELS

.1 Wall mounted enamelled steel cabinets with hinged and key-locked front door.

.2 Multiple panels as required to handle requirements with additional space to accommodate 25% additional capacity as required by Departmental without adding additional cabinets.

.3 Panels to be lockable with same key.

2.18 WIRING

.1 In accordance with 26 27 26 - Wiring Devices.

.2 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.

.3 Wiring must be continuous without joints.

.4 Sizes:
.1 Field wiring to digital device: #18AWG.
.2 Analog input and output: shielded #18 minimum solid copper.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

.2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.

.3 Temperature transmitters, humidity transmitters, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.

.4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.

.5 Fire stopping: provide space for fire stopping in accordance with Section 07 84 00 - Firestopping. Maintain fire rating integrity.

.6 Electrical:

.1 Complete installation in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.

.3 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

.4 Install communication wiring in conduit.

.1 Provide complete conduit system to link Building Controllers, field panels andBACnet router.

.2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.

.3 Maximum conduit fill not to exceed 40%.

.4 Design drawings do not show conduit layout.

.5 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Departmental to review before starting Work. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.

3.1 INSTALLATION (Cont'd)

.7 VAV Terminal Units: supply, install and adjust as required.
.1 Air probe, actuator and associated vav controls.
.2 Tubing from air probe to dp sensor as well as installation and adjustment of air flow sensors and actuators.
.3 Co-ordinate air flow adjustments with balancing trade.

3.2 TEMPERATURE AND HUMIDITY SENSORS

.1 Stabilize to ensure minimum field adjustments or calibrations.

.2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.

.3 Outdoor installation:
.1 Protect from solar radiation and wind effects by non-corroding shields.
.2 Install in NEMA 4 enclosures.

.4 Duct installations:
.1 Do not mount in dead air space.
.2 Locate within sensor vibration and velocity limits.
.3 Securely mount extended surface sensor used to sense average temperature.
.4 Thermally isolate elements from brackets and supports to respond to air temperature only.
.5 Support sensor element separately from coils, filter racks.

.5 Averaging duct type temperature sensors.
.1 Install averaging element horizontally across the ductwork starting 300 mm from top of ductwork. Each additional horizontal run to be no more than 300 mm from one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.
.2 Wire multiple sensors in series for low temperature protection applications.
.3 Wire multiple sensors separately for temperature measurement.
.4 Use software averaging algorithm to derive overall average for control purposes.

3.2 TEMPERATURE AND HUMIDITY SENSORS (Cont'd)

.6 Thermowells: install for piping installations.
.1 Locate well in elbow where pipe diameter is less than well insertion length.
.2 Thermowell to restrict flow by less than 30%.
.3 Use thermal conducting paste inside wells.

3.3 PANELS

.1 Arrange for conduit and tubing entry from top, bottom or either side.

.2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.

.3 Identify wiring and conduit clearly.

3.4 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES AND SENSORS

.1 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.
.1 Protect sensing elements on high temperature hot water service with pigtail syphon between valve and sensor.

3.5 IDENTIFICATION

.1 Identify field devices in accordance with Section 25 05 54 - EMCS: Identification.

3.6 AIR FLOW MEASURING STATIONS

.1 Protect air flow measuring assembly until cleaning of ducts is completed.

3.7 TESTING AND COMMISSIONING

.1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 11 - E.CS: Start-up, Verification and Commissioning

3.8 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 73 00 - Execution Requirements.

.2 Section 07 84 00 - Firestopping.

.3 Section 23 33 15 - Dampers - Operating.

.4 Section 25 01 11 - EMCS: Start-Up, Verification and Commissioning.

.5 Section 25 05 01 - EMCS: General Requirements.

.6 Section 25 05 02 - EMCS: Shop Drawings, Product Date and Review Process.

.7 Section 25 05 54 - EMCS: Identification.

.8 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

.9 Section 26 05 00 - Common Work Results - Mechanical.

.10 Section 26 27 26 - Wiring Devices.

1.2 REFERENCES

.1 Public Works and Government Services Canada (PWGSC)/Real Property Branch/Architectural and Engineering Services.
.1 MD13800-September 2000, Energy Management and Control Systems (EMCS) Design Manual. English. ftp://ftp.pwgsc.gc.ca/rps/docentre/mechanica /me214-e.pdf

1.3 CLOSEOUT SUBMITTALS

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

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 21 05 01 - Common Work Results - Mechanical.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 3 - SEQUENCE OF OPERATIONS

2.1 DEFINITIONS

.1 The following section describes in detail what the abbreviations on the point schedule mean. Please note that an analog setpoint can be either a fixed number or a reset schedule (RS). If the reset schedule is not provided in the specifications then it shall be provided by the Engineer at the commissioning stage.

.1 Point type: BO = Binary Output, BI = Binary Input, AI = Analog Input, AO = Analog Output.

.2 Panel /Controller #:MCU = Master Control, Unit LCU = Local Control, Unit ECU = Equipment Control Unit, TCU = Terminal Control Unit. These Units are then followed by their appropriate number.

.3 Contact Type: NO = Normally Open, NC = Normally Closed, MC = Momentary Contacts.

.4 Voltage: Any AC or DC voltage describing the starter circuit. For most Binary Inputs, dry contacts will be specified.

.5 Contact Type: CS = Current Switch, AUX. C = Auxiliary Contacts.

.6 Output/Sensor Range: This defines the range of either the output or input signal. Use this value in conjunction with the engineering units to determine range of device.

.7 Output/Sensor Type: This describes the type of Analog Device, such as damper motor DM, valve actuator VLV, Variable Frequency Drive VFD, or on the sensor side Temperature Transmitter Electronic TTE, Humidity Transmitter Electronic HTE, Differential Pressure Transmitter DPT. There is a large number of types available.

2.1 DEFINITIONS (Cont'd)

.1 (Cont'd)

.8 Engineering Units: This is used in conjunction with the range or Voltage to describe the point. ON/OFF usually refers to binary points, OPEN/CLOSE usually refers to a two position damper/valve, DEG F/C usually refers to temperature sensors, PCT is percentage. Make sure the engineering units specified show up in the point database.

.9 LSA: A life safety alarm is used for life critical situation that the building operator must immediately respond to.

.10 CA: A critical alarm is used for situations that may, if ignored, cause major problems in the building.

.11 MA: A maintenance alarm is used for situations that require operator intervention at his/her convenience. For example, a filter alarm would be considered a maintenance alarm.

2.2 SEQUENCE OF OPERATION

.1 Air Handling Units:

.1 General:

.1 The variable volume air handling unit consists of a mixed air section with outdoor air, exhaust air and return air dampers, pre-filter, hot water heating coil, chilled water cooling coil, heat recovery wheel (where applicable) supply and return fans with variable frequency drives and steam humidifier. The unit is DDC controlled using electric actuation.

.2 The air handling unit is scheduled for automatic operation on a time of day basis for Occupied and Unoccupied modes. Within the Occupied mode, the system can enter the Warm-Up mode when the space temperature is below set point or the Cool-Down mode when the space temperature is above set point. The system stays in the Warm-Up or Cool-Down mode until the mode set point is satisfied. The latest start time is the scheduled occupancy for the space.

.3 The air handling unit operates in Warm-Up, Cool-Down, Occupied, Unoccupied, Humidity Control and Safety modes as follows (All suggested set points and settings are adjustable.):

.1 Warm-Up:

2.2 SEQUENCE OF OPERATION (Cont'd)

.1 (Cont'd)

.1 (Cont'd)

.1 The supply and return fans start. The mixing dampers are positioned for 100% return air and the cooling coil valve remains closed. The heating coil valve modulates to maintain the supply air temperature set point. If time reaches the latest start time during the Warm-Up mode, the outdoor air damper opens to its minimum position. The system is prevented from entering the Warm-Up mode more than once per day.

.2 Cool-Down:

.1 The supply and return fans start. The heating coil valve remains closed. The cooling coil valve and the mixing dampers modulate to maintain the supply air temperature set point. When the outside air dry bulb temperature is above the economizer changeover value, the mixing dampers are positioned for 100% return air. If time reaches the latest start time during the Cool-Down mode, the outdoor air damper opens to its minimum position or is controlled in economizer operation. The system is prevented from entering the Cool-Down mode more than once per day.

.3 Occupied:

.1 The fans start or continue to run and the unit is controlled as follows:

2.2 SEQUENCE OF OPERATION (Cont'd)

.1 (Cont'd)

.1 (Cont'd)

.1 When the outside air dry bulb temperature is below the economizer changeover value, the heating coil valve, cooling coil valve and mixed air dampers modulate in sequence without overlap to maintain the supply air temperature set point with a low limit of 9 degrees C at the mixed air sensor. The mixing dampers ramp opens slowly to minimize overshooting.

.2 When the outside air dry bulb temperature is above the economizer changeover value, the mixing dampers are placed in the minimum outdoor air position. The heating coil valve and cooling coil valve modulate in sequence without overlap to maintain the supply air temperature set point.

.4 Unoccupied (Normal Off):

.1 The supply and return fans stop, the cooling coil valve closes and the mixing dampers close to the outdoor air. If the OAT is less than 7 degrees C, the heating coil valve modulates to maintain the unoccupied mixed air set point. If the OAT is 7 degrees C or above, the heating coil valve closes.

.5 Supply Duct and Building Pressurization Control:

2.2 SEQUENCE OF OPERATION (Cont'd)

.1 (Cont'd)

.1 (Cont'd)

.1 The supply fan variable frequency drive modulates to maintain a constant duct static pressure of 375 Pa as sensed at least two-thirds of the way downstream of the supply fan in the longest or most critical duct. The return fan variable frequency drive modulates to maintain the differential L/s set point to maintain a positive building pressure differential. The supply L/s to return L/s differential set point is 0% if the OA damper is closed. Upon initial startup of the air handling system, the supply and return fan speed slowly ramps to the desired static pressure set point. Upon shutdown of the air handling system, the supply and return fan variable frequency drives are stopped and the speed signal shall go to zero speed.

.2 The air flow measuring station in the outdoor air duct shall be used to maintain the minimum outdoor air volume independently of the supply and return fan volumes.

.6 Demand Ventilation:

.1 During the occupied time, the DDC system will control the amount of outdoor air entering the space via the air handling unit(s) to maintain the return air carbon dioxide level to between 700 and 900 ppm.

.2 This control feature shall be limited by the mixed air temperature sensor.

.3 The demand ventilation control may be overridden by the economizer cycle.

.7 Safety:

2.2 SEQUENCE OF OPERATION (Cont'd)

.1 (Cont'd)

.1 (Cont'd)

.1 During normal operation should the velocity through the flow station drop below 20% volume the system will shut down the fans since one or more fire dampers may have closed. Supply and return fan VFD fault alarms de-energize the supply and return fans upon activation. When the OAT is less than 7 degrees C, the heating coil valve modulates to maintain the mixed air temperature at 7 degrees C. When the OAT is 7 degrees C or above, the heating coil valve closes. All other dampers and valves position to their normal position after the fans are de-energized.

.2 A low temperature detector in the discharge of the heating coil de-energizes the supply and return fans when temperatures below 3 degrees C are sensed. The heating coil valve modulates to maintain the mixed air temperature at 7 degrees C. All other dampers and valves position to their normal position after the fans are de-energized.

.3 Current switches are installed on the load side of the supply and return fan VFDs. The DDC system uses the switches to confirm the fans are in the desired state (i.e. on or off) and generates an alarm if status deviates from DDC start/stop control. The DDC system generates a VFD trouble alarm independent from the fan status.

.4 Unit to shut-down upon signal from fire-alarm system.

.2 Terminal Devices:

.1 VAV Box:

2.2 SEQUENCE OF OPERATION (Cont'd)

.2 (Cont'd)
.1 (Cont'd)
.1 The cooling variable volume (VAV) terminal unit is controlled independent of system pressure fluctuations by an application specific DDC controller using electric actuation. The space served by the VAV terminal unit is controlled in Occupied and Unoccupied modes as follows:
.1 Occupied:
.1 The VAV terminal unit is controlled within user defined maximum and minimum supply air volume settings. The controller monitors the room temperature sensor and air velocity sensor and modulates the supply air damper.
.2 Unoccupied:
.1 The terminal unit is controlled using the night set point. The controller may reset to the Occupied mode for a predetermined time period upon a signal from the control system or manually at the room sensor.

.3 Domestic Hot Water Re-circulation System:
.1 The DDC system shall start the domestic hot water re-circulation pump based on time of day.
.2 Pump status shall be indicated at the BACnet router.

.4 Building Power Consumption:
.1 DDC system to monitor incoming electrical system power consumption.

3.3 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 General

.1 This Section covers items common to Sections of Division 26 and 28. This section supplements requirements of Division 1.

1.2 Related Sections

.1 Section 01 00 10 - General Instructions.

.2 Section 01 61 00 - Common Product Requirements.

.3 Section 26 05 32 - Outlet Boxes, Conduits Boxes and Fittings.

1.3 Codes and Standards

.1 Except where specified otherwise, do complete installation in accordance with the following:
.1 CE Code, Part 1 (Canadian Electrical Code), CSA C22.1-15.
.2 National Building Code, 2010.
.3 CAN 3 - C235-83(R2015), Preferred Voltage Levels for AC Systems, 0 to 50 000 V.

.2 Do overhead and underground systems in accordance with CSA C22.3 No.1-15 except where specified otherwise.

.3 Electrical and Electronic Manufacturers Association of Canada - (EEMAC).
.1 2Y-1-1958, CEMA Standard for Light Grey Colour for Indoor Switchgear.
.2 Y1-2-1979, Finishing Systems for Outdoor Electrical Equipment.

1.4 Care, Operation and Start-up

.1 Instruct Departmental respresentative and operating personnel in the operation, care and maintenance of systems, system equipment and components.

1.4 Care, Operation and Start-up (Cont'd)

.2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

1.5 Voltage Ratings

.1 Operating voltages: to CAN3-C235.

.2 Motors, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.6 Permits, Fees and Inspection

.1 Refer to Section 01 00 10 - General Instructions.

.2 Submit to Electrical Safety Authority and Supply Authority, necessary number of drawings and specifications for examination and approval prior to commencement of work.

.3 Pay associated fees.

.4 Departmental respresentative will provide drawings and specifications required by Electrical Safety Authority and Supply Authority at no cost.

.5 Notify Departmental respresentative of changes required by Electrical Safety Authority prior to making changes.

.6 Furnish Certificates of Acceptance from Electrical Safety Authority on completion of work to Departmental respresentative.

1.7 Materials and Equipment

.1 Provide materials and equipment in accordance with Section 01 61 00 - Common Product Requirements.

.2 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Safety Authority.

.3 Factory assemble control panels and component assemblies.

1.8 Electric Motors, Equipment and Controls

.1 Supplier and installer responsibility is indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.

.2 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 23 and shown on mechanical drawings.

1.9 Finishes

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two (2) coats of finish enamel.
.1 Paint outdoor electrical equipment "equipment green" finish to EEMAC Y1-1.
.2 Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1.

.2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

1.10 Equipment Identification

.1 Identify electrical equipment with nameplates and labels as follows:

.2 Nameplates:
.1 Lamicoid 3 mm thick plastic engraving sheet, black face, white core, mechanically attached with self tapping screws.

NAMEPLATE SIZES

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

.3 Labels:
.1 Embossed plastic labels with 6 mm high letters unless specified otherwise.

.4 Wording on nameplates and labels to be approved by Departmental respresentative prior to manufacture.

.5 Allow for average of twenty-five (25) letters per nameplate and label.

.6 Identification to be English and French.

.7 Use one (1) nameplate or label for each language.

.8 Indicate circuit number and associated panelboard with type written label on receptacles.

.9 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.10 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.11 Terminal cabinets and pull boxes: indicate system and voltage.

1.10 Equipment Identification (Cont'd)

.12 Transformers: indicate capacity, primary and secondary voltages.

.13 Contractor shall label all equipment with PMMS / CMMS identification. Provide list for co-ordination of all equipment and devices final numbering of last two digits of PMMS identifier. The remaining information will be supplied by the Departmental Representative.

1.11 Wiring Identification

.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour code: to CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

1.12 Conduit and Cable Identification

.1 Colour code conduits, boxes and metallic sheathed cables.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

.3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency	Red	Blue

1.12 Conduit and Cable Identification (Cont'd)

Other	Voice	Red	Yellow

1.13 Wiring Terminations

.1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper conductors.

1.14 Manufacturers and CSA Labels

.1 Visible and legible, after equipment is installed.

1.15 Warning Signs

.1 As specified and to meet requirements of Electrical Safety Authority and Departmental respresentative.

.2 Decal signs, minimum size 175 x 250 mm.

1.16 Single Line Electrical Diagrams

.1 Provide single line electrical diagrams in glazed frames as follows:
.1 Electrical distribution system: locate in main electrical room.

.2 Provide fire alarm riser diagram, plan and zoning of building in glazed frame at fire alarm control panel and annunciator.

.3 Drawings: 600 x 600 mm minimum size.

1.17 Location of Outlets

.1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduits Boxes and Fittings.

1.17 Location of Outlets (Cont'd)

.2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.

.3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

.4 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor. Refer to latest architectural drawings for final door layouts.

1.18 Mounting Heights

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.3 Install electrical equipment at following heights unless indicated otherwise.

.1 Local switches: 1200 mm.
.2 Wall receptacles:
  .1 General: 400 mm.
  .2 Above top of continuous baseboard heater: 200 mm.
  .3 Above top of counters or counter splash backs: 175 mm.
  .4 In mechanical rooms: 1400 mm.
.3 Panelboards: as required by Code or as indicated.
.4 Telephone and interphone outlets: 400 mm.
.5 Wall mounted telephone and interphone outlets: 1200 mm.
.6 Fire alarm stations: 1200 mm.
.7 Fire alarm bells: 2100 mm.
.8 Television outlets: 400 mm.
.9 Wall mounted speakers: 2100 mm.
.10 Clocks: 2100 mm.
.11 Door bell pushbuttons: 1200 mm.

1.19 Load Balance

.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.3 Submit, at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

1.20 Conduit and Cable Installation

.1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: plastic, sized for free passage of conduit, and protruding 50 mm.

.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

.3 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

1.21 Field Quality Control

.1 All electrical work to be carried out by qualified, licensed electricians or apprentices as per the conditions of the Provincial Act respecting manpower vocational training and qualification. Employees registered in a provincial apprentices program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks - the activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties.

1.21 Field Quality Control (Cont'd)

.2 The work of this division to be carried out by a contractor who holds a valid Master Electrical contractor license as issued by the Province that the work is being contructed.

.3 Tests:
.1 Carry out testing and commissioning for electrical systems and equipment in accordance with relevant standards such as CSA, ULC, ANSI. Provide detailed test plan for Departmental Representative review fourteen (14) days before before testing. Test plan shall include all tests, descriptions, schedules, test equipment, shutdowns required, test sheets for all tests.
.2 Division 26 shall pay all associated costs for testing, studies and commissioning.
.3 Conduct and pay for following tests:
.1 Power generation and distribution system including phasing, voltage, grounding and load balancing.
.2 Circuits originating from branch distribution panels.
.3 Lighting and its control.
.4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
.5 Systems: fire alarm system, emergency battery lighting system, telecommunications.

.4 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.

.5 Insulation resistance testing.
.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
.2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
.3 Check resistance to ground before energizing.

.6 Carry out tests in presence of Departmental Respresentative.

.7 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

1.21 Field Quality Control (Cont'd)

.8 Submit test results for Departmental Representative's review.

1.22 Co-ordination of Protective Devices

.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

.2 Include in this contract preparation of coordination study for all breakers on the utility side and load (down stream) side of the new distribution system throughout the building.

.3 Fault current capacitites of distribution panels and branch circuit panels and breaker trip settings to be provided conforming to the submitted calculations.

.4 Include in this contract a complete co-ordination and arc flash study for all breakers from Hydro connection point at 26kV for the distribution system throughout the building, including outside equipment such as power transformer an generator.

PART 2 - PRODUCTS

2.1 Not Used

.1 Not Used.

PART 3 - EXECUTION

3.1 Not Used

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Materials and installation for wire and box connectors.

1.2 RELATED SECTIONS

.1 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)
.1 CAN/CSA-C22.2 No.18-98 (R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
.2 CSA C22.2 No.65-13, Wire Connectors.

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
.1 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

.3 National Electrical Manufacturers Association (NEMA)

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused wiring materials from landfill Departmental respresentativeto metal recycling facility as approved by.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Pressure type wire connectors to: CSA C22.2 No.65, with current carrying parts of copper alloy sized to fit copper conductors as required.

.2 Fixture type splicing connectors to: CSA C22.2 No.65, with current carrying parts of copper alloy sized to fit copper conductors 10 AWG or less.

.3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:
.1 Connector body and stud clamp for stranded round copper conductors.
.2 Clamp for stranded round copper conductors.
.3 Stud clamp bolts.
.4 Bolts for copper bar.
.5 Sized for conductors as indicated.

.4 Clamps or connectors for armoured cable, flexible conduit, as required to: CAN/CSA-C22.2 No.18.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors and:
.1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
.2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.
.3 Install fixture type connectors and tighten. Replace insulating cap.
.4 Install bushing stud connectors in accordance with EEMAC 1Y-2.

END OF SECTION

PART 1 - GENERAL

1.1 Related Sections

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

.3 Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

.4 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.2 References

.1 CAN/CSA-C22.2 No. 131-14, Type TECK 90 Cable.

1.3 Product Data

.1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

1.4 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal, and with the Waste Reduction Workplan.

.2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

.3 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 - PRODUCTS

2.1 Building Wires

.1 Conductor material (wire in conduit): Annealed commercial grade, 98% conductivity copper; stranded for 10 AWG and larger. Minimum size: 12 AWG.

2.1 Building Wires (Cont'd)

.2 Copper conductors: size as indicated, with 600 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.

2.2 Armoured Cables

.1 Conductors: insulated, copper, size as indicated.

.2 Type: AC90.

.3 Armour: interlocking type fabricated from galvanized steel strip.

.4 Connectors: as recommended by the manufacturer.

PART 3 - EXECUTION

3.1 Installation of Building Wires

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
.2 In cabletroughs in accordance with Division 26.

3.2 Installation of Armoured Cables

.1 Group cables wherever possible.

.2 Install cable in trenches in accordance with Division 26.

.3 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

END OF SECTION

PART 1 – GENERAL

1.1 Related Sections

.1 Section 01 74 19 – Construction/Demolition Waste Management and Disposal.

.2 Section 26 05 01 – Common Work Results – Electrical.

1.2 References

.1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE).
.1 ANSI/IEEE 837–2014, Qualifying Permanent Connections Used in Substation Grounding.

.2 Canadian Standards Association (CSA)
.1 CSA C22.2 No.0.4–04(R2014), Bonding of Electrical Equipment.

1.3 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction/Demolition Waste Management And Disposal, and with the Waste Reduction Workplan.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

PART 2 – PRODUCTS

2.1 Materials

.1 Rod electrodes: copper clad steel, 19 mm dia by 3 m long.

.2 Conductors: bare, stranded, tinned soft annealed copper wire, size No 4/0 AWG for ground bus, electrode interconnections, metal structures, gradient control mats, transformers, switchgear, motors, ground connections.

2.1 Materials (Cont'd)

.3 Conductors: bare, stranded tinned soft annealed copper wire, size No. 4 AWG for grounding cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers, etc.

.4 Accessories: non-corroding, necessary for complete grounding system, type, size material as indicated, including:
.1 Grounding and bonding bushings,
.2 Protective type clamps,
.3 Bolted type conductor connectors,
.4 Thermit welded type conductor connectors,
.5 Bonding jumpers, straps,
.6 Pressure wire connectors.

PART 3 - EXECUTION

3.1 Grounding Installation

.1 Install continuous grounding system including, electrodes, conductors, connectors and accessories in accordance with CSA C22.2 No.0.4 and requirements of local authority having jurisdiction.

.2 Install connectors in accordance with manufacturer's instructions.

.3 Protect exposed grounding conductors from mechanical injury.

.4 Make buried connections, and connections to electrodes, structural steel work, using permanent mechanical connectors to ANSI/IEEE 837.

.5 Use mechanical connectors for grounding connections to equipment provided with lugs.

.6 Use No. 4/0 AWG bare copper cable for main ground bus of substation for taps on risers from main ground bus to equipment.

3.2 Electrode Installation

.1 Install ground rod electrodes at transformer and switchgear locations.

3.2 Electrode Installation (Cont'd)

.2 Make special provision for installing electrodes that will give acceptable resistance to ground value, where rock or sand terrain prevails.

3.3 Equipment Grounding

.1 Install grounding connections as indicated to typical station equipment including: metallic water main, neutral. Non current carrying parts of: transformers, generators, motors, circuit breakers, reclosers, current transformers. Cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers. Meter and relay cases. Any exposed building metal, within or forming part of station enclosure.

.2 Ground hinged doors to main frame of electrical equipment enclosure with flexible jumper.

3.4 Field Quality Control

.1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Perform earth loop test and resistance tests using method appropriate to site conditions and to approval of Departmental respresentative and local authority having jurisdiction.

.3 Perform test before energizing electrical system.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE).
.1 ANSI/IEEE 837-2014, Qualifying Permanent Connections Used in Substation Grounding.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal materials from landfill to Departmental respresentativemetal recycling facility as approved by.

.5 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 - PRODUCTS

2.1 EQUIPMENT

.1 Clamps for grounding of conductor: size as indicated to electrically conductive underground water pipe.

.2 System and Circuit, equipment, grounding conductor, bare stranded copper, un-tinned, soft annealed, un-armoured, size 4/0 AWG.

.3 Insulated grounding conductors: green, type RW 90 XLPE.

2.1 EQUIPMENT (Cont'd)

.4 Ground bus in new electrical, server, and telecom rooms; copper, size 6 mm x 75 mm x 1200 mm with supports, fastenings and connectors. Refer to electrical drawings for exact grounding requirements.

.5 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
.1 Grounding and bonding bushings.
.2 Protective type clamps.
.3 Bolted type conductor connectors.
.4 Bonding jumpers, straps.
.5 Pressure wire connectors.
.6 Compression-type bonding and connections.

PART 3 - EXECUTION

3.1 INSTALLATION GENERAL

.1 Install the complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories as indicated to confirm to the requirements of the Departmental respresentative and the local authority having jurisdiction over installation. Where EMT is used, run separate green ground wire in conduit.

.2 Install connectors in accordance with manufacturer's instructions.

.3 Protect exposed grounding conductors from mechanical injury.

.4 Make buried connections, and connections to conductive water main, electrodes, using permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837.

.5 Use mechanical connectors for grounding connections to equipment provided with lugs.

.6 Soldered joints not permitted.

3.1 INSTALLATION GENERAL (Cont'd)

.7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.9 Install separate ground conductor to outdoor lighting standards.

.10 Make grounding connections in radial configuration only, with connections terminating at street side of water pipe. Avoid loop connections.

.11 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.

.12 Ground secondary service pedestals.

3.2 ELECTRODES

.1 Make ground connections to continuously conductive underground water pipe on street side of water meter.

.2 Install water meter shunt.

.3 Install concrete encased electrodes in building foundation footings, with terminal connected to grounding network.

.4 Install, plate electrodes and make grounding connections.

.5 Bond separate, multiple electrodes together.

.6 Use size 4/0 AWG copper conductors for connections to electrodes.

.7 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

3.3 SYSTEM AND CIRCUIT GROUNDING

.1 Install system and circuit grounding connections to neutral of secondary 120/208 V system.

3.4 EQUIPMENT GROUNDING

.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, cable trays, distribution panels, outdoor lighting.

3.5 GROUNDING BUS

.1 Install copper grounding bus mounted on insulated supports on wall of electrical room.

.2 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections.

3.6 COMMUNICATION SYSTEMS

.1 Install grounding connections for telephone, sound, fire alarm, intercommunication systems as follows:
.1 Telephones: make telephone grounding system in accordance with telephone company's requirements.
.2 Sound, fire alarm, intercommunication systems as indicated.

3.7 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental respresentative and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal materials from landfill to metal recycling facility as approved by the Departmental Representative.

.5 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 - PRODUCTS

2.1 SUPPORT CHANNELS

.1 Provide galvanized steel support channels.

.2 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted, suspended and set in poured concrete walls and ceilings as indicated.

2.2 Threaded Rod Hangers

.1 Provide galvanized steel threaded rod support hangers throughout.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.

.5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.6 Fasten exposed conduit or cables to building construction or support system using straps.
.1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
.2 Two-hole steel straps for conduits and cables larger than 50 mm.
.3 Beam clamps to secure conduit to exposed steel work.

.7 Suspended support systems.
.1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
.2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.

.8 For surface mounting of two or more conduits use channels at 1500mm on centre spacing.

.9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

3.1 INSTALLATION (Cont'd)

.10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.11 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental representative.

.13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

.3 Section 26 05 01 - Common Work Results - Electrical.

1.2 Shop Drawings and Product Data

.1 Submit shop drawings and product data for cabinets in accordance with Section 01 33 00 - Submittal Procedures.

1.3 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal, and with the Waste Reduction Workplan.

.2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

.3 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 - PRODUCTS

2.1 Splitters

.1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.

.3 At least three spare terminals on each set of lugs in splitters less than 400 A.

2.2 Junction and Pull Boxes

.1 Welded steel construction with screw-on flat covers for surface mounting.

.2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

PART 3 - EXECUTION

3.1 Splitter Installation

.1 Install splitters and mount plumb, true and square to the building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 Junction and Pull Boxes Installation

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Install terminal block as indicated in Type T cabinets.

.3 Only main junction and pull boxes are indicated on drawings. Provide pull boxes so as not to exceed 30 m or three 90° elbows of conduit run between pull boxes and not more than two 90° elbows in feeder conduits, unless bends are long sweep type.

3.3 Identification

.1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Install size 2 identification labels indicating system name, voltage and phase in accordance with Section 26 05 01 - Common Work Results - Electrical.

END OF SECTION

PART 1 - GENERAL

1.1 Related Sections

.1 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

1.2 References

.1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations.

1.3 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal, and with the Waste Reduction Workplan.

.2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

PART 2 - PRODUCTS

2.1 Outlet and Conduit Boxes General

.1 Size boxes in accordance with CSA C22.1.

.2 102 mm square or larger outlet boxes as required for special devices.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 Sheet Steel Outlet Boxes

.1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.

.2 102 mm square or octagonal outlet boxes for lighting fixture outlets.

.3 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster/tile walls.

2.3 Masonry Boxes

.1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.4 Concrete Boxes

.1 Electro-glavanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 Floor Boxes

.1 Concrete tight electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brushed aluminum faceplate. Device mounting plate to accommodate short or longer duplex receptacles. Minimum depth: 28 mm for receptacles; 73 mm for communication equipment.

.2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 12 mm and 19 mm conduit. Refer to detail on drawings.

2.6 Conduit Boxes

.1 Cast FS or FD feraloy boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.

2.7 Fittings - General

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

PART 3 - EXECUTION

3.1 Installation

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

END OF SECTION

PART 1 - GENERAL

1.1 Related Sections

.1 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

1.2 References

.1 Canadian Standards Association (CSA)
.1 CSA C22.2 No. 45-M1981(R2003), Rigid Metal Conduit.
.2 CSA C22.2 No. 56-13, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
.3 CSA C22.2 No. 83-M1985(R2013), Electrical Metallic Tubing.
.4 CSA C22.2 No. 211.2-06(R2011), Rigid PVC (Unplasticized) Conduit.

1.3 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal, and with the Waste Reduction Workplan.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

.4 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

PART 2 - PRODUCTS

2.1 Conduits

.1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded.

.2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.

2.1 Conduits (Cont'd)

.3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.

.4 Rigid pvc conduit: to CSA C22.2 No. 211.2.

.5 Flexible metal conduit: to CSA C22.2 No. 56, steel liquid-tight flexible metal.

2.2 Conduit Fastenings

.1 One hole galvanized steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits at 1500 mm oc.

.4 12 mm diameter galvanized Threaded rods to support suspended channels.

2.3 Conduit Fittings

.1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.

.2 Factory "ells" where 90° bends are required for 25 mm and larger conduits.

.3 All couplings and connectors at the sprinkler - proof equipment shall be steel-compression type (binding collar). For all other applications, steel set screw type couplings and connectors shall be used.

2.4 Fish Cord

.1 Polypropylene.

PART 3 - EXECUTION

3.1 Installation

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

3.1 Installation (Cont'd)

.2 Conceal conduits except in mechanical and electrical service rooms.

.3 In unfinished areas, run wiring concealed, except as otherwise specified or indicated on the drawings. Run exposed conduits neatly, parallel to building lines and maintain maximum headroom.

.4 Use electrical metallic tubing (EMT) above 2.4 m not subject to mechanical injury.

.5 Use rigid pvc conduit underground.

.6 Use flexible metal conduit for connection to motors in dry areas, connection to recessed incandescent fixtures without a prewired outlet box, connection to surface or recessed fluorescent fixtures work in movable metal partitions.

.7 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.

.8 Use explosion proof flexible connection for connection to explosion proof motors.

.9 Minimum conduit size for lighting and power circuits: 19 mm.

.10 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.11 Mechanically bend steel conduit over 19 mm dia.

.12 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.13 Install fish cord in empty conduits.

.14 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.

.15 Dry conduits out before installing wire.

3.2 Surface Conduits

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on suspended and surface channels.

.5 Do not pass conduits through structural members except as indicated.

.6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.3 Concealed Conduits

.1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in masonry walls.

.3 Do not install conduits in terrazzo or concrete toppings.

3.4 Conduits in Cast-in-place Concrete

.1 Locate to suit reinforcing steel. Install in centre one third of slab.

.2 Protect conduits from damage where they stub out of concrete.

.3 Install sleeves where conduits pass through slab or wall.

.4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.

.5 Do not place conduits in slabs in which slab thickness is less than 4 times conduit diameter.

3.4 Conduits in Cast-in-place Concrete (Cont'd)

.6 Encase conduits completely in concrete with minimum 25 mm concrete cover.

.7 Organize conduits in slab to minimize cross-overs.

3.5 Conduits in Cast-in-place Slabs on Grade

.1 Run conduits 25 mm and larger below slab and encased in 75 mm concrete envelope. Provide 50 mm of sand over concrete envelope below floor slab.

3.6 Conduits Underground

.1 Slope conduits to provide drainage.

.2 Waterproof joints (pvc excepted) with heavy coat of bituminous paint.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA International)
.1 CAN/CSA C22.1 No.126.1-17, Metal Cable Tray Systems (Binational standard with NEMA VE 1-2017).
.2 CAN/CSA C22.1 No.126.2-(R2017), Non Metallic Cable Tray Systems (Binational standard with UL 568).

.2 National Electrical Manufacturers Association (NEMA)
.1 NEMA FG 1-1993, Fibreglass and Cable Tray Systems.
.2 NEMA VE 1-2002, Metal Cable Tray Systems.
.3 NEMA VE 2-2001, Cable Tray Installation Guidelines.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data: submit manufacturer's product data sheets for cable tray indicating dimensions, materials, and finishes, including classifications and certifications.

.3 Shop Drawings: submit shop drawings showing materials, finish, dimensions, accessories, layout, and installation details.

.4 Identify types of cabletroughs used.

.5 Show actual cabletrough installation details and suspension system.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 CABLETROUGH

.1 Cabletroughs and fittings: to NEMA and CAN/CSA C22.1 No. 126.1 126.2.

.2 Ladderandwire mesh types, ClassA to CAN/CSA C22.2 No.126.1 126.2.

.3 Trays: extruded aluminum or galvanized steel, 150 and 300mm wide with depth of 50 75 and 100 mm as required.

.4 Fittings: horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers where required, manufactured accessories for cabletrough supplied.
.1 Radii on fittings: 300 600 900 mm minimum.

.5 Solid covers for complete cabletrough system including fittings.

.6 Barriers where different voltage systems are in same cabletrough.

.7 Ground cable trays with #2 AWG bare copper conductor attached to each tray section for continuity in accordance with CEC requirements.

.8 Provide fire stop material at firewall penetrations.

2.2 SUPPORTS

.1 Provide splices, supports for a continuously grounded system as required.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install complete cabletrough system in accordance with NEMA VE 2.

.2 Support cabletrough on both sides.

3.1 INSTALLATION (Cont'd)

.3 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

3.2 CABLES IN CABLETROUGH

.1 Install cables individually.

.2 Lay cables into cabletrough. Use rollers when necessary to pull cables.

.3 Secure cables in cabletrough at 6 m centres, with nylon ties.

.4 Identify cables every 30 m with size 2 nameplates.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)
.1 CSA G40.20/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
.1 Material Safety Data Sheets (MSDS).

.3 National Building Code (NBC) 2015

1.2 DEFINITIONS

.1 Priority Two (P2) Buildings: buildings in which life safety is of paramount concern. It is not necessary that P2 buildings remain operative during or after earthquake activity.

.2 SRS: acronym for Seismic Restraint System.

1.3 SYSTEM DESCRIPTION

.1 This section covers design, supply and installation of complete SRS for all systems, equipment specified for installation on this project. This includes electrical light fixtures, transformers, fire protection, conduit, communications, electrical equipment and systems, both vibration isolated and statically supported.

.2 SRS fully integrated into, and compatible with:
.1 Noise and vibration controls specified elsewhere.
.2 Structural, mechanical, electrical design of project.

.3 During seismic event, SRS to prevent systems and equipment from causing personal injury and from moving from normal position.

1.3 SYSTEM DESCRIPTION (Cont'd)

.4 Designed by Professional Engineer specializing in design of SRS and registered in Province of Ontario. Division 26 to include all costs associated with this work as it relates to Division 26 installations. Submit design sketches complete with professional stamp prior to start of installations, complete with installation requirements.

PART 2 - PRODUCTS

2.1 SRS MANUFACTURER

.1 SRS from one manufacturer regularly engaged in SRS production.

.2 Acceptable materials: Korfund-Sampson, Mason Industries, Tecoustics, Vibra-Sonic Control, Vibron.

2.2 GENERAL

.1 SRS to provide gentle and steady cushioning action and avoid high impact loads.

.2 SRS to restrain seismic forces in every direction.

.3 Fasteners and attachment points to resist same load as seismic restraints.

.4 SRS of Piping systems compatible with:
.1 Expansion, anchoring and guiding requirements.
.2 Equipment vibration isolation and equipment SRS.

.5 SRS utilizing cast iron, threaded pipe, other brittle materials not permitted.

.6 Attachments to RC structure:
.1 Use high strength mechanical expansion anchors.
.2 Drilled or power driven anchors not permitted.

.7 Seismic control measures not to interfere with integrity of firestopping.

2.3 SRS FOR STATIC EQUIPMENT, SYSTEMS

.1 Floor-mounted equipment, systems:

.1 Anchor equipment to equipment supports.
.2 Anchor equipment supports to structure.
.3 Use size of bolts scheduled in approved shop drawings.

.2 Suspended equipment, systems:
.1 Use one or combination of following methods:
.1 Install tight to structure.
.2 Cross-brace in every direction.
.3 Brace back to structure.
.4 Slack cable restraint system.
.2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.
.3 Hanger rods to withstand compressive loading and buckling.

2.4 SRS FOR VIBRATION ISOLATED EQUIPMENT

.1 Floor mounted equipment, systems:
.1 Use one or combination of following methods:
.1 Vibration isolators with built-in snubbers.
.2 Vibration isolators and separate snubbers.
.3 Built-up snubber system approved by Departmental Representative, consisting of structural elements and elastomeric layer.
.2 SRS to resist complete isolator unloading.
.3 SRS not to jeopardize noise and vibration isolation systems. Provide 4-8 mm clearance between seismic restraint snubbers and equipment during normal operation of equipment and systems.
.4 Cushioning action: gentle and steady by utilizing elastomeric material or other means in order to avoid high impact loads.

.2 Suspended equipment, systems:
.1 Use one or combination of following methods:
.1 Slack cable restraint system.
.2 Brace back to structure via vibration isolators and snubbers.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Attachment points and fasteners:
.1 To withstand same maximum load that seismic restraint is to resist and in every direction.

.2 Install SRS at least 25 mm from equipment, systems, services.

.3 Miscellaneous equipment not vibration-isolated:
.1 Bolt through house-keeping pad to structure.

.4 Co-ordinate connections with other disciplines.

3.2 FIELD QUALITY CONTROL

.1 Inspection and Certification:
.1 SRS: inspected and certified by Manufacturer upon completion of installation.
.2 Provide written report to Departmental Representative with certificate of compliance.

.2 Commissioning Documentation:
.1 Upon completion and acceptance of certification, hand over to Departmental Representative complete set of construction documents, revised to show "as-built" conditions.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

.2 Section 26 05 01 - Common Work Results - Electrical.

.3 Section 31 23 10 - Excavating, Trenching and Backfilling.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Unused sealant material must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.

.5 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Departmental representative

.6 Do not dispose of preservative treated wood through incineration.

.7 Do not dispose of preservative treated wood with other materials destined for recycling or reuse.

.8 Dispose of treated wood, end pieces, wood scraps and sawdust at sanitary landfill approved by Departmental representative.

1.2 WASTE MANAGEMENT AND DISPOSAL (Cont'd)

.9 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 - PRODUCTS

2.1 CABLE PROTECTION

.1 38 x 140 mm planks pressure treated with water repellent preservative.

2.2 MARKERS

.1 Concrete type cable markers: 600 x 600 x 100 mm with words: cable, joint or conduit impressed in top surface, with arrows to indicate change in direction of cable and duct runs.

PART 3 - EXECUTION

3.1 DIRECT BURIAL OF CABLES

.1 After sand bed specified in Section 31 23 10 - Excavating, Trenching and Backfilling, is in place, lay cables maintaining 75 mm clearance from each side of trench to nearest cable. Do not pull cable into trench.

.2 Provide offsets for thermal action and minor earth movements. Offset cables 150 mm for each 60 m run, maintaining minimum cable separation and bending radius requirements.

.3 Underground cable splices not acceptable.

.4 Minimum permitted radius at cable bends for rubber, plastic or lead covered cables, 8 times diameter of cable; for metallic armoured cables, 12 times diameter of cables or in accordance with manufacturer's instructions.

.5 Cable separation:
.1 Maintain 75 mm minimum separation between cables of different circuits.
.2 Maintain 300 mm horizontal separation between low and high voltage cables.

3.1 DIRECT BURIAL OF CABLES (Cont'd)

.5 (Cont'd)
.3 When low voltage cables cross high voltage cables maintain 300 mm vertical separation with low voltage cables in upper position.
.4 At crossover, maintain 75 mm minimum vertical separation between low voltage cables and 150 mm between high voltage cables.
.5 Maintain 300 mm minimum lateral and vertical separation for fire alarm and control cables when crossing other cables, with fire alarm and control cables in upper position.
.6 Install treated planks on lower cables 0.6 m in each direction at crossings.

.6 After sand protective cover specified in Section 31 23 10 - Excavating, Trenching and Backfilling, is in place, install continuous row of overlapping 38 x 140 mm pressure treated planks as indicated to cover length of run.

3.2 CABLE INSTALLATION IN DUCTS

.1 Install cables as indicated in ducts.
.1 Do not pull spliced cables inside ducts.

.2 Install multiple cables in duct simultaneously.

.3 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.

.4 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.

.5 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.

.6 After installation of cables, seal duct ends with duct sealing compound.

3.3 MARKERS

.1 Mark cable every 150 m along cable or duct runs and changes in direction.

.2 Mark underground splices.

.3 Where markers are removed to permit installation of additional cables, reinstall existing markers.

.4 Install concrete cable markers within 180 m from each side of runway centreline; 45 m from each side of taxi way centreline; 50 m from edge of taxi ramps or aprons.

.5 Lay concrete markers flat and centred over cable with top flush with finish grade.

3.4 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Perform tests using qualified personnel. Provide necessary instruments and equipment.

.3 Check phase rotation and identify each phase conductor of each feeder.

.4 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.

.5 Pre-acceptance tests:
.1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.
.2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

.6 Acceptance Tests:
.1 Ensure that terminations and accessory equipment are disconnected.
.2 Ground shields, ground wires, metallic armour and conductors not under test.
.3 High Potential (Hipot) Testing.

3.4 FIELD QUALITY CONTROL (Cont'd)

.6 (Cont'd)

.3 (Cont'd)

.1 Conduct hipot testing at 300% of original factory test voltage in accordance with manufacturer's recommendations.

.7 Provide Departmental representative with list of test results showing location at which each test was made, circuit tested and result of each test.

.8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

PART 1 - GENERAL

1.1 General

.1 Performance Requirements:
.1 Provide all system components that have been manufactured, assembled, and installed to maintain performance criteria stated by manufacturer without defects, damage, or failure.

1.2 References

.1 Canadian Standards Association (CSA)
.1 CSA C22.2 No.184.1-15, Solid-State Dimming Controls (Bi-national standard with UL 1472).

.2 American National Standards Institute - (ANSI).
.1 ANSI C82.11-2011, High Frequency Fluorescent Lamp Ballasts.

.3 Federal Communications Commission (FCC).

1.3 Product Data

.1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 61 33 - Hazardous Materials.

.3 Submit product data sheets for fluorescent lighting control equipment. Include product characteristics, performance criteria, physical size, limitations and finish.

.4 Submit complete list of all parts needed to fully install selected System components.

1.4 Shop Drawings

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate shielded wiring requirements.

1.5 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

.4 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

.5 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 - PRODUCTS

2.1 General

.1 Lighting control manufacturer to provide interface to EMCS through Lanworks or BACnet protocol. EMCS will have the ability to schedule the lights via the open protocol. Refer to Section 25 90 01 - EMCS: Site Requirements, Applications and Systems Sequence of Operation.

2.2 Product Data

.1 Lighting Control System:
.1 The system shall provide central energy control for the lighting administrator to perform energy management, configuration maintenance, monitoring operations, and providing support to building occupants.

.2 Central Control:
.1 Energy Control Software interface shall provide current status and enable configuration of all system zones including selected individual fixture availability, current light level, maximum light level, on/off status, occupancy status, emergency mode status.

.3 Reports:

2.2 Product Data (Cont'd)

.3 (Cont'd)

.1 Energy performance reports shall be printable in a printer friendly format and downloadable for use in spreadsheet applications, etc.

.4 Daylight Harvesting (Light Regulation Averaging):

.1 In a photo sensor-equipped system, the Energy Control Unit shall rationalize changes to light levels when ambient (natural) light is available and shall maintain a steady light level when subjected to fluctuating ambient conditions. System shall utilize light level inputs from common and/or remote sensor locations to minimize the number of photo sensors required. The system shall operate with multiple users in harmony and not react adversely to manual override inputs. Daylight harvesting shall not impede lighting control and the ability to adjust light levels on a per fixture basis.

.5 Time Clock Scheduling:

.1 The system shall be programmable for scheduling lights on or off via the Energy Control Software interface.

.1 Override: Manual adjustments and occupancy sensor detection shall temporarily override off status imposed by time clock schedule.

.2 Response to Power Failure: In the event of a power failure, the time clock shall execute schedules that would still be in progress had they begun during the power outage.

.3 Flick Warning: Five minutes prior to a scheduled lights-off event or expiry of a temporary override, the system shall provide two short light level drops as a warning to the affected occupants.

2.2 Product Data (Cont'd)

.5 (Cont'd)

.1 (Cont'd)

.4 Emergency Mode: There shall be a mode,when activated through the system, that will immediately adjust lights to full light output and retain that level until the mode is deactivated. This setting shall override all other inputs. The system shall interface with the building emergency monitoring system at a convenient point and not require multiple connections.

.5 Addressing: I/O Modules shall be centrally addressable, on a per fixture basis, through the Energy Control Software. To simplify installation and maintenance, the system shall not require manual recording of addresses for commissioning or reconfiguration.

.6 Programmable Task Tuning: Maximum light level programmability shall be available by individual fixture.

.7 Unoccupied State: The system shall provide two states when occupancy status is vacant as per an occupancy sensor: lights turn off or lights adjust to configurable light level.

.8 Occupied State: The system shall not isolate occupants by turning off lights that are still required for convenience and safety, such as a hallway path to exit the premises.

.9 Low-Voltage Wiring: Wiring shall be topology independent and not require splicing or termination. Prefabricated, quick connecting wiring shall be utilized. The maximum connected length of wiring shall be no less than 425 metres per channel.

.10 Lamp Burn In: The system shall not permit dimming of new lamps prior to completion of manufacturer recommended 100 hour accumulated operation at full brightness.

2.2 Product Data (Cont'd)

.5 (Cont'd)

.1 (Cont'd)

.11 Reconfigurability: The assignment of individual fixtures to zones shall be centrally configurable by Energy Control Software such that physical rewiring will not be necessary when workspace reconfiguration is performed. Removal of covers, faceplates, ceiling tiles, etc. shall not be required.

2.3 I/O MODULE

.1 I/O Module shall be the common interface to a ballast or sensor.

.2 Addressing: I/O Module shall be individually addressable via Energy Control Software.

.3 Voltage Compatability: Universal voltage control capability to 208 VAC maximum.

.4 Primary Relay Rating: 1.2A/120V.

.5 Compatability: Suitable for use with electronic dimming using a 0 to 10 VDC dimming signal.

.6 Power: Shall supply 12 VDC @ 25 mA power to attached sensor.

.7 Control Signal: Shall supply 0 to 10 VDC dimming signal to attached ballast or receive control signals from attached sensor.

.8 Memory: Retains all system settings in non-volatile memory.

2.4 Wall Controllers

.1 Addressing: All controllers shall be individually addressable via Energy Control Software.

.2 Ratings: Shall be low voltage input.

.3 Operations: Localized on/off switching, dimming up/down, and programmable scene selection for dimming loads shall be provided, as required.

2.4 Wall Controllers (Cont'd)

.4 LED's: All controllers shall feature LED's to indicate light on and light off status, as required.
.1 Operating Temperature Range: 0°C to 55°C.
.2 Relative Humidity: 20% to 90% non-condensing.
.3 Style: All controllers shall feature Decorator styling.
.4 Colour: All controllers shall be available with an optional colour insert kit for changing colour without reinstalling switch.
.5 Accessories: Matching wall plate shall be available.

2.5 Photo Sensor

.1 A sensor that measures ambient light in a finite area shall be available.

.2 Specifications:
.1 The sensor shall measure light from any source in the visible spectrum within at least a 60° cone. It shall measure light between 0 and minimum 750 lux.

.3 Electrical Ratings:
.1 Maximum 24VDC input voltage.

.4 Mechanical:
.1 Mounting: The sensor shall be flush mounted on or recessed inside ceiling tile.

.5 Environmental Specifications:
.1 Operating temperature range: 0°C to 55°C.
.2 Relative humidity: 20% to 90% non-condensing.

2.6 Occupancy Sensors

.1 Sensors using passive infrared, ultrasonic, acoustic, and multi-technology adaptive technology shall be available.

.2 Sensor timeouts shall be configurable by system software.

.3 Electrical:
.1 Rating: Maximum 24 VDC input voltage, 25 mA current draw.

2.6 Occupancy Sensors (Cont'd)

.4 Mechanical:
.1 Mounting: Sensors for mounting on ceilings and walls, including corners, must be available to suit the view angle to cover the required field of view.

.5 Environmental:
.1 Operating temperature range: Operating temperature range: 0°C to 55°C.
.2 Relative humidity: 20% to 90% non-condensing.

PART 3 - EXECUTION

3.1 Installation

.1 The Electrical Contractor, as part of the work of this section, shall coordinate, receive, mount, connect, and place into operation all equipment. The Electrical Contractor shall furnish all conduit, wire, connectors, hardware, and other incidental items necessary for properly functioning lighting control as described herein and shown on the plans. The Electrical Contractor shall maintain performance criteria stated by manufacturer without defects, damage, or failure.

.2 Compliance: Contractor shall comply with manufacturer's product data, including shop drawings, technical bulletins, product catalog installation instructions, and product carton instructions for installation.

.3 Power: The contractor shall test that all branch load circuits are operational before connecting loads to sensor system load terminals, and then de-energize all circuits before installation.

.4 Related Product Installation: Refer to other sections listed in Related Sections for related products' installation.

3.1 Installation (Cont'd)

.5 Install Input / Output (I/O) Modules at each ballast, occupancy sensors, photo sensors, power pack / modules, switches and zone controllers and provide network wiring between each devices as required to the main control unit.

.6 Install wiring, shielding, grounding in accordance with manufacturer's instructions.

.7 Ensure shielded leads between intensity selector potentiometer and intensity controls have outer insulating jackets and are connected to ground at one point only.

.8 Keep radio, VCR, TV and intercom wiring a minimum of 1.8 m away from dimming circuitry. Where crossing of wiring is essential, ensure that grounded shields surround such intercom wiring, and that crossings take place at 90°.

.9 Locate intensity controls and "on-off" switches as indicated.

.10 Ensure positive, low resistance lamp to pin contact within lampholder.

.11 Season lamps by operating at full intensity for 100 h prior to final inspection. Operate ballasts in ambient temperature above 18°C.

.12 Ensure connections are correctly made and to same phase before energizing.

3.2 Testing

.1 Upon completion of all line, load and interconnection wiring, and after all fixtures are installed and lamped, a qualified factory representative shall completely configure and test the system.

.2 At the time of checkout and testing, the Departmental Representative shall be thoroughly instructed in the proper operation of the system.

3.3 Protection

.1 Contractor shall protect installed product and finished surfaces from damage during all phases of installation including preparation, testing, and cleanup.

3.4 Field Quality Control

.1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Demonstrate that dimming systems are installed as indicated.

.3 Demonstrate that dimming systems operate as intended and that there are no problems in starting lamps, nor in keeping them lit, and free of perceptible flicker at any setting of dimming intensity control.

.4 Demonstrate that no radio, VCR or TV interference is carried by system and that there is no interference between dimming system and locally used infrared-based remote/integral controls.

3.5 Commissioning

.1 Refer to Section 01 91 13 - General Commissioning (Cx) Requirements.

.2 Commissioning shall be performed by at least one representative of supplier for this section and one representative from installation contractor.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

.1 This contractor is responsible for the preparation of the fault current and co-ordination studies of the mini substation and power distribution systems described in Section 26 05 01.

1.2 RELATED REQUIREMENTS

.1 Cast in place or precast concrete, frost-free pad.

.2 Installation of anchor devices, setting templates.

1.3 REFERENCES

.1 American National Standards Institute (ANSI)
.1 ANSI C37.121-1989(R2000), Unit Substations - Requirements.

.2 Canadian Standards Association (CSA International)
.1 CSA-C22.2 No.58-M1989(R2005), High-Voltage Isolating Switches.
.2 CSA G40.20/G40.21-2004, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.3 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
.1 EEMACG1-1, 1958, Indoor and Outdoor Switch and Bus Insulators.

.4 Underwriters' Laboratories (UL)
.1 UL 1062-97, Unit Substations.

1.4 SYSTEM DESCRIPTION

.1 Outdoor mini substation with:
.1 Primary switchgear.
.2 Transformer.
.3 Secondary main breaker compartment

1.5 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate:
.1 Single line diagram.
.2 Equipment layout.
.3 Equipment dimensions including door openings, draw-out equipment positions and workspace requirements.
.4 Dimensioned foundation template.
.5 Dimensioned cable entrance and exit

locations.
.6 Dimensioned cable termination heights.
.7 Details of entry plate.

.3 Submit coordination study with shop drawings. Study to show coordination curves for protective devices from outdoor fuse cutouts circuit breaker and main secondary breakers. Recommend breaker settings and main secondary breakers settings. Shop drawings will not be accepted or reviewed without this co-ordination study.

1.6 CLOSEOUT SUBMITTALS

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

.2 Three copies maintenance data for complete mini substation assembly, including components, in one combined manual.

1.7 QUALITY ASSURANCE

.1 Submit 3 copies of production test results to the client representative. Do not ship equipment until test results have been accepted by the client representative.

1.8 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Departmental Representative Consultant.

.5 Fold up metal banding, flatten and place in designated area for recycling.

1.9 EXTRA MATERIALS

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Mini substation: To meet C22.2 No. 31, C22.2 No. 58, C22.2 No. 193.

.2 The mini substation to be a one piece designed, assembled unit, using SF6 switching and liquid filled padmount transformer, to form a complete unit substation.

2.2 PRIMARY SWITCHGEAR

.1 Primary switchgear: 27.6 kV, 600 A, 3 phase, 3 wire, interrupting capacity 25kA, BIL 95 kV.

2.3 ENCLOSURE

.1 Enclosure: metal enclosed solid welded, not bolted, free standing, floor mounted, dead front, outdoor, tamperproof, segregated and fully interlocked for safety.

.2 Metal pocket on inside surface of door to accommodate drawing and diagram prints.

2.5 GROUNDING

.1 Copper ground bus no smaller than 50 x 6 mm extending full width of cubicle and situated at bottom. Lugs at each end for size 4/0 AWG grounding cable.

.2 Bond non-current carrying metal parts, including switchgear framework, enclosure and bases to ground bus.

2.6 28 kV LOAD INTERRUPTER SWITCH

.1 The outlined requirements are for SF6 filled load break non-fused type switches. The switch shall be supplied in accordance with this specification and the accompanying single line diagrams, including the required number of incoming and outgoing circuits. Switch tank to include one load break switch for the transformer key interlocked with transformer fuse compartment.

.2 The switch assembly shall be designed and rated per ANSI C37.71,CSA 22.2 No.31, CSA 22.2 No.193
.1 Design Voltage: 27.6kV
.2 Impulse withstand Voltage: 125kV
.3 AC withstand voltage: 60kV
.4 DC withstand voltage : 78kV
.5 Load break continuous amps: 400
.6 Momentary fault closing : 40 kA asymmetrical
.7 Two second rating: 25kA symmetrical
.8 Open gap impulse withstand: 200 kV BIL
.9 Current limiting fuse:50A
.10 Temperature rating: -40 to 120 degrees F

.3 The sealed tank design shall be fully submersible dead front and corrosion resistant. The tank shall be 1/4" mild steel seam welded to provide ma hermetically sealed unit. Construction is designed to withstand 15 PSIG without causing operational problems. Tank flanges shall be welded to prevent leakage and turned to eliminate sharp corners.

.4 The base frame to be constructed of tubular steel welded to transformer. Side access to cable bushings to be provided by a full height bolt on cover minimum 12 gauge.

.5 Switch shall be equipped with an external operating handle for operation and shall include Quick make Quick break spring operation. Viewing window to show indicators of switch position. Pad lock provisions for all positions. Provisions for mounting key interlocks on switch.

.6 The switch shall include the following minimum construction requirements:
.1 Current carrying parts shall be high conductivity copper with plating and assembly for low resistance connectors. Contacts shall be self-aligning, self-cleaning, and designed to increase contact pressure with increasing current. Moving contacts shall be equipped with 1/2 cycle interrupter assistance to minimize arcing during switching and to eliminate arcing to the main contact surfaces. Contact supports shall be high strength molded polyester with skirts and barriers to prevent tracking and flash over. Flex connectors shall prevent contact misalignment due to high current or other mechanical forces.
.2 Switch to operation shall be controlled by quick make quick break spring operators with latches to prevent contact blowoff or movement after operation. Spring operators shall be mounted inside the tank to eliminate damage to critical parts.
.3 The switch shall be factory filled with SF6

per ASTM D-2472 and shall include a self-sealing valve and a mechanically protected color coded pressure gauge to monitor the SF6 gas as needed.
.4 A special internal absorbent shall neutralize arc by products.

.7 Cable terminators shall be 200 Amp elbow connector, rate for cable size as required.

.8 Name plates shall include the following properly secured to the tank
.1 Phase markings
.2 Factory rating and serial number
.3 Line diagram of internal switching
.4 Switch to be Arc Whipper type

2.7 INTERLOCKS

.1 Key interlock between the switch operating handle and the fuse cover to prevent access to live fuses.

2.8 PRIMARY FUSES

.1 Fuses to be Cooper Bay O Net interlocked with the switch.

.2 Backup current limiting fuses to be provided ahead of Bay O Net fuses for high current faults.

2.9 TRANSFORMERS

.1 CSA C2-M1982, single phase and three phase Distribution Transformers, Type KNAN/KNAF.

.2 Transformers to meet CSA C802-2013 minimum losses for power transformers.

.3 Transformers: to CSA 227.4.

.4 FR3 oil, outdoor, distribution transformers type KNAN/KNAF.

.5 Primary voltage: 27.6kV, 60 Hz, Wye connected, 3 phase, 3 wire, grounded delta connection.

.6 Secondary voltage: 347/600V, wye connected, 3 phase, 4 wire, grounded neutral suitable for Wye-wye connection.

.7 Capacity: 300/399 kVA

.8 Basic impulse level: 125 kV

.9 Polarity: subtractive.

.10 Impedance: Minimum 4%.

2.10 VOLTAGE TAPS

.1 Four - 2.5% taps, 2- FCAN, 2- FCBN

2.11 TAP CHARGER

.1 Externally operated off-load tap charger, with provision for padlocking on 3-phase unit.

2.12 HIGH VOLTAGE BUSHINGS

.1 Bushings: to ANSI/IEEE 386

.2 Bushings between the transformer and switch to be made to plug directly together and form a submersible sealed connection.

2.13 INSULATING LIQUID

.1 Insulating Liquid: FR3 oil.

2.14 ACCESSORIES

.1 Oil Celsius temperature thermometer, maximum indicating type, dial size 150mm with contacts.
.2 Oil level gauge with contacts.
.3 Auxiliary form 'C' contacts
.1 SF6 Low Pressure Alarm contact
.4 Top non-flammable insulating liquid sampling device.

2.16 SECONDARY compartment

.1 As part of the substation; Main circuit breakers – 300A, 150A and kA rating as per single line diagram.
.2 Qty (2) 100W Heaters /w Qty (1) Thermostat and Qty(1) fused disconnects.
.3 Qty (1) 120V PT to provide auxiliary power supply.

2.17 SHOP FABRICATION

.1 Shop assemble and test components of substation.
.2 After completion of factory assembly and high potential test, prepare for shipment to site in one assembly.

2.18 FINISHES

.1 Apply finishes
.2 Cubicle exteriors: Green
.3 Cubicle interiors: Green
.4 Provide anti graffiti coating to allow pressure washing of unwanted materials
.5 Supply 2 spray cans touch up paint.

2.19 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification
.1 Transformer name plate with ratings,
.2 Switch name plate with ratings,
.3 SF6 temperature/pressure name plate,
.4 HV warning signs,
.5 Single line diagram.

.2 Acceptable product:
.1 PowerSystems Technology "MiniSub" or approved equivalent.

2.20 WARNING SIGNS

.1 Provide warning signs in accordance with Section 26 05 00 - Common Work Results - Electrical.

2.21 SOURCE QUALITY CONTROL

.1 Client Representative Consultant to (optional):

.1 Inspect place of manufacture.
.2 Inspect testing of any component.
.3 Inspect testing of complete substation prior to shipment including Hipot and heat run test.

.2 Notify Client Representative Consultant in writing 5 days in advance that equipment is ready for inspection.

.3 Substation manufactured and factory assembled by one supplier.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Set and secure cubicles and transformers in place, rigid, plumb and square, on channel bases.

.2 Check factory-made connections for mechanical security and electrical continuity.

.4 Run one grounding conductor 4/0 AWG bare copper in 25 mm conduit from substation ground bus to electrical room ground bus.

.5 After finishing Work, remove foreign material, including dust, before energizing substation.

.6 Set transformer taps for secondary voltage of 600 V at no load.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 On-site Test for 24 consecutive hours, to include:
.1 Primary and secondary voltage at no load.
.2 Primary and secondary voltages at normal load once per hour.
.3 Primary and secondary current in each phase once per hour.
.4 kW and kVA once per hour.
.5 Transformer and ambient temperature once per hour.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 CSA International:
.1 CAN/CSA-C22.2 No.47-13, Air-Cooled Transformers (Dry Type).
.2 CSA C9-02(R2016), Dry-Type Transformers.
.3 CAN/CSA-C802.2-12, Minimum Efficiency Values for Dry Type Transformers.

.2 National Electrical Manufacturers Association (NEMA)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets for dry type transformers and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for dry type transformers for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

1.4 DELIVERY, STORAGE AND HANDLING (Cont'd)

.3 (Cont'd)

.1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect dry type transformers from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 DESIGN DESCRIPTION

.1 Design 1.

.1 Type: ANN.

.2 3 phase, kVA as indicated, 347/600 V input, 120/208 V output, 60 Hz.

.3 Voltage taps: standard.

.4 Insulation: Class H, 150 degrees C temperature rise.

.5 Coppper coil windings.

.5 Basic Impulse Level (BIL): standard.

.6 Hipot: standard.

.7 Average sound level: 5%

.8 Impedance at 17 degrees C: standard

.9 Enclosure: CSA, removable metal front panel.

.10 Mounting: floor / wall.

.11 Finish: in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Label size: 7.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Mount dry type transformers above 45 kVA on floor.

3.1 INSTALLATION (Cont'd)

.2 Ensure adequate clearance around transformer for ventilation.

.3 Install transformers in level upright position.

.4 Remove shipping supports only after transformer is installed and just before putting into service.

.5 Loosen isolation pad bolts until no compression is visible.

.6 Make primary and secondary connections in accordance with wiring diagram.

.7 Energize transformers after installation is complete.

.8 Make conduit entry into bottom 1/3 of transformer enclosure.

3.2 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.3 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by dry type transformers installation.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

.3 Section 01 91 13 - General Commissioning (Cx) Requirements.

.4 Section 06 10 10 - Rough Carpentry.

.5 Section 26 05 01 - Common Work Results - Electrical.

.6 Section 26 28 21 - Moulded Case Circuit Breakers.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)
.1 CSA C22.2 No.29-2015), Panelboards and enclosed Panelboards.

1.3 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.4 Plant Assembly

.1 Install circuit breakers in panelboards before shipment.

.2 In addition to CSA requirements, manufacture's name plate shall identify fault current that panel and breakers have been built to withstand.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental representative.

PART 2 - PRODUCTS

2.1 PANELBOARDS

.1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
.1 Install circuit breakers in panelboards before shipment.
.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.2 600 volts panelboards: bus and breakers rated for (symmetrical) interrupting capacity as indicated.

.3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

.4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.5 Two keys for each panelboard and key panelboards alike.

.6 Copper bus with neutral of same ampere rating as mains.

2.1 PANELBOARDS (Cont'd)

.7 Mains: suitable for bolt-on breakers.

.8 Trim with concealed front bolts and hinges.

.9 Trim and door finish: baked grey enamel.

2.2 BREAKERS

.1 Breakers: to Section 26 28 21 - Moulded Case Circuit Breakers.

.2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

.3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

.4 Lock-on devices for, fire alarm, emergency, door supervisory, intercom, stairway, exit and night light circuits.

2.3 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Nameplate for each panelboard size 4 engraved as indicated.

.3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.

.4 Complete circuit directory with typewritten legend showing location and load of each circuit.

2.4 Material

.1 Panelboard to be the product of one manufacturer.

2.5 Panel Schedule

.1 Refer to Annex B for panel schedules.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.2 Install surface mounted mounted panelboards on plywood backboards in accordance with Section 06 10 10 - Rough Carpentry. Where practical, group panelboards on common backboard.

.3 Mount panelboards to height specified in Section 26 05 01 - Common Work Results - Electrical or as indicated.

.4 Connect loads to circuits.

.5 Connect neutral conductors to common neutral bus with respective neutral identified.

.6 All panelboard shall be tested and commissioning forms completed for each panel.

3.2 Commissioning

.1 Refer to Section 01 91 13 - General Commissioning (Cx) Requirements.

.2 Commissioning shall be performed by at least one representative of supplier for this section and one representative of installion contractor.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

.3 Section 26 05 01 - Common Work Results - Electrical.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)
.1 CSA-C22.2 No.42-10(R2015), General Use Receptacles, Attachment Plugs and Similar Wiring Devices.
.2 CSA-C22.2 No.42.1-13, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
.3 CSA-C22.2 No.55-15, Special Use Switches.
.4 CSA-C22.2 No.111-10 (R2015), General-Use Snap Switches (Bi-national standard, with UL 20).

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

1.4 WASTE MANAGEMENT AND DISPOSAL (Cont'd)

.4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Departmental Representative.

PART 2 - PRODUCTS

2.1 SWITCHES

.1 20 A, 120 V, single pole, double pole, three-way, four-way switches to: CSA-C22.2 No.55 and CSA-C22.2 No.111.

.2 Manually-operated general purpose ac switches with following features:
.1 Terminal holes approved for No. 12 AWG wire.
.2 Silver alloy contacts.
.3 Urea or melamine moulding for parts subject to carbon tracking.
.4 Suitable for back and side wiring.
.5 Ivory toggle switch complete with stainless steel cover plate.
.6 Specification grade.

.3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.

.4 Switches of one manufacturer throughout project.

2.2 RECEPTACLES

.1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA-C22.2 No.42 with following features:
.1 Ivory urea moulded housing.
.2 Suitable for No. 12 AWG for back and side wiring.
.3 Break-off links for use as split receptacles.
.4 Eight back wired entrances, four side wiring screws.
.5 Triple wipe contacts and rivetted grounding contacts.
.6 Specification grade.

2.2 RECEPTACLES (Cont'd)

.2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:
.1 Ivory urea moulded housing.
.2 Suitable for No. 12 AWG for back and side wiring.
.3 Four back wired entrances, 2 side wiring screws.

.3 Other receptacles with ampacity and voltage as indicated.

.4 Receptacles of one manufacturer throughout project.

2.3 COVER PLATES

.1 Cover plates for wiring devices to: CSA-C22.2 No.42.1.

.2 Cover plates from one manufacturer throughout project.

.3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.

.4 Stainless steel, 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet box.

.5 cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

.6 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.

.7 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Switches:
.1 Install single throw switches with handle in "UP" position when switch closed.

3.1 INSTALLATION (Cont'd)

.1 (Cont'd)

.2 Install switches in gang type outlet box when more than one switch is required in one location.

.3 Mount toggle switches at height in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Receptacles:

.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

.2 Mount receptacles at height in accordance with Section 26 05 01 - Common Work Results - Electrical.

.3 Where split receptacle has one portion switched, mount vertically and switch upper portion.

.3 Cover plates:

.1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

END OF SECTION

PART 1 - GENERAL

1.1 Related Sections

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

.3 Section 01 78 00 - Closeout Submittals.

.4 Section 26 05 01 - Common Work Results - Electrical.

1.2 References

.1 Canadian Standards Association (CSA)
.1 CSA C22.2 No.248.12-11 (R2016), Low Voltage Fuses Part 12: Class R Fuses (Bi-National Standard with, UL 248-12 (1st Edition).

1.3 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

1.4 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal, and with the Waste Reduction Workplan.
.1 Place materials defined as hazardous or toxic waste in designated containers.
.2 Ensure emptied containers are sealed and stored safely for disposal away from children.
.3 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

1.5 Delivery and Storage

.1 Ship fuses in original containers.

.2 Do not ship fuses installed in switchboard.

1.5 Delivery and Storage (Cont'd)

.3 Store fuses in original containers in moisture free location.

PART 2 - PRODUCTS

2.1 Fuses General

.1 Fuse type references J1, etc. have been adopted for use in this specification.

.2 Fuses: product of one manufacturer for entire project.

.3 Plug and standard cartridge fuses based on CSA C22 No.248.

2.2 Fuse Types

.1 Class J fuses (formerly HRCI- J).
.1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.

2.3 Fuse Storage Cabinet

.1 Fuse storage cabinet, manufactured from 2.0 mm thick aluminum 750 mm high, 600 mm wide, 300 mm deep, hinged, lockable front access door finished in accordance with Section 26 05 01 - Common Work Results - Electrical.

PART 3 - EXECUTION

3.1 Installation

.1 Install fuses in mounting devices immediately before energizing circuit.

.2 Ensure correct fuses fitted to assigned electrical circuit.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).
.1 CSA-C22.2 No. 5-13, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE-2013).

1.3 SUBMITTALS

.1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 Construction/Demolition Waste Management and Disposal.

.2 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.3 Separate for reuse and recycling and place in designated containers Steel, Metal and Plastic waste in accordance with Waste Management Plan.

PART 2 - PRODUCTS

2.1 BREAKERS GENERAL

.1 Moulded-case circuit breakers, and Ground-fault circuit-interrupters: to CSA C22.2 No. 5.

.2 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.

.3 Common-trip breakers: with single handle for multi-pole applications.

.4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
.1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.

.5 Circuit breakers minimum symmetrical rms interrupting capacity rating shall be 10kA at 120/208V and 18kV at 347/600V. Confirm the rating with value in coordination study.

2.2 THERMAL MAGNETIC BREAKERS DESIGN 'A'

.1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3 MAGNETIC BREAKERS DESIGN 'B'

.1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.

.2 Series rated breakers to be manufacturer tested and listed. Breakers to be applied following manufacturer's guidelines and accepted best practice.
.1 Breakers applied following manufacturer's guidelines and accepted best practice.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install circuit breakers as indicated.

.2 Complete full operational test on all installed breakers.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 35 30 - Health and Safety Requirements.

.3 Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

.4 Section 26 05 01 - Common Work Results - Electrical.

.5 Section 26 28 14 - Fuses - Low Voltage.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).
.1 CAN/CSA C22.2 No.4-16, Enclosed and dead-front Switches. (Tri-National standard, with NMX-J-162-ANCE-2016 and UL 98)
.2 CSA C22.2 No.39-M89 (R2003), Fuseholder Assemblies.

1.3 SUBMITTALS

.1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

1.4 HEALTH AND SAFETY

.1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety Requirements.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 Construction/Demolition Waste Management and Disposal.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

1.5 WASTE MANAGEMENT AND DISPOSAL (Cont'd)

.3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Separate for reuse and recycling and place in designated containers Steel, Metal and Plastic waste in accordance with Waste Management Plan.

.5 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 - PRODUCTS

2.1 DISCONNECT SWITCHES

.1 Fusible and/or non-fusible, disconnect switch in sprinkler proof Enclosure, to CAN/CSA C22.2 No.4 size as indicated.

.2 Provision for padlocking in on-off switch position by three locks.

.3 Mechanically interlocked door to prevent opening when handle in ON position.

.4 Fuses: size as indicated, in accordance with Section 26 28 14 - Fuses - Low Voltage.

.5 Fuseholders: to CSA C22.2 No.39 relocatable and suitable without adaptors, for type and size of fuse indicated.

.6 Quick-make, quick-break action.

.7 ON-OFF switch position indication on switch enclosure cover.

.8 Finish ASA-61.

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.

2.2 EQUIPMENT IDENTIFICATION (Cont'd)

.2 Indicate name of load controlled on size 4 nameplate.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install disconnect switches complete with fuses if applicable.

.2 Mount on steel channel.

.3 Where practical, group disconnects in a common location.

.4 All disconnect switches shall be tested.

END OF SECTION

PART 1 - GENERAL

1.1 Related Sections

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 78 00 - Closeout Submittals.

.3 Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

.4 Section 26 05 01 - Common Work Results - Electrical.

1.2 References

.1 International Electrotechnical Commission (IEC)
.1 IEC 947-4-1-1990, Part 4: Contactors and Motor-starters.

1.3 Shop Drawings and Product Data

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate:
.1 Mounting method and dimensions.
.2 Starter size and type.
.3 Layout of identified internal and front panel components.
.4 Enclosure types.
.5 Wiring diagram for each type of starter.
.6 Interconnection diagrams.

1.4 Closeout Submittals

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

.2 Include operation and maintenance data for each type and style of starter.

1.5 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal, and with the Waste Reduction Workplan.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

PART 2 - PRODUCTS

2.1 Materials

.1 Starters: to IEC 947-4 with AC4 utilization category.

2.2 Manual Motor Starters

.1 Single and Three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
.1 Switching mechanism, quick make and break.
.2 One or Three overload heaters, manual reset, trip indicating handle.

.2 Accessories:
.1 Toggle switch: heavy duty labelled as indicated.
.2 Indicating light: heavy duty type and colour as indicated.
.3 Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 Full Voltage Magnetic Starters

.1 Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
.1 Contactor solenoid operated, rapid action type.
.2 Motor overload protective device in each phase, manually reset from outside enclosure.
.3 Wiring and schematic diagram inside starter enclosure in visible location.

2.3 Full Voltage Magnetic Starters (Cont'd)

.1 (Cont'd)
.4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

.2 Combination type starters to include fused disconnect switch with operating lever on outside of enclosure to control disconnect, and provision for:
.1 Locking in "OFF" position with up to 3 padlocks.
.2 Independent locking of enclosure door.
.3 Provision for preventing switching to "ON" position while enclosure door open.

.3 Accessories:
.1 Selector switches: heavy duty labelled as indicated.
.2 Indicating lights: heavy duty type and color as indicated.
.3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

.4 Accessories:
.1 Selector switches: standard heavy duty oil tight labelled as indicated.
.2 Indicating lights: standard heavy duty oil tight, type and color as indicated.
.3 Auxiliary control devices as indicated.

2.4 Magnetic Starter Reduced Voltage Part Winding

.1 Two-step reduced voltage, part winding starter of size, type, rating and enclosure type as indicated, with components as follows:

.1 Two-3 pole contactors.
.2 Adjustable pneumatic timer.
.3 Six automatic reset overload relays.

.2 Three step reduced voltage part winding starter of size, type, rating and enclosure type as indicated, with components as follows:
.1 Three-3 pole contactors.
.2 One set starting resistors.
.3 Six automatic reset overload relays.

.3 Accessories:
.1 Selector switches: heavy duty labelled as indicated.

2.4 Magnetic Starter Reduced Voltage Part Winding (Cont'd)

.3 (Cont'd)
.2 Indicating lights: heavy duty type and color as indicated.
.3 Auxiliary control devices as indicated.

2.5 Control Transformer

.1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.

.2 Size control transformer for control circuit load plus 20% spare capacity.

2.6 Finishes

.1 Apply finishes to enclosure in accordance with Section 26 05 01 - Common Work Results - Electrical.

2.7 Equipment Identification

.1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.

.3 Magnetic starter designation label, white plate, black letters, size engraved as indicated.

2.8 Motor Starter Schedule

.1 Refer to Annex C : Motor starter Schedules for details.

PART 3 - EXECUTION

3.1 Installation

.1 Install starters, connect power and control as indicated.

.2 Ensure correct fuses and overload devices elements installed.

3.2 Field Quality Control

.1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical and manufacturer's instructions.

.2 Operate switches, contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)
.1 CSA C813.1-01, Performance Test Method for Uninterruptible Power Supplies.
.2 CAN/CSA-C22.2 No.47-M90(R2001), Air-Cooled Transformers (Dry Type).
.3 CSA C9-M1981(R2001), Dry-Type Transformers.

.2 National Electrical Manufacturers Association (NEMA)

1.2 SYSTEM DESCRIPTION

.1 System to consist of:
.1 Rectifier cubicle;
.2 Invertor cubicle;
.3 Battery cubicle;
.4 Bypass switch cubicle;
.5 Controls and meters;

.2 System to use normal power supply mains and battery to provide continuous, regulated ac power to isolated load.

.3 Equipment to operate continuously and unattended.

.4 System power train shall be comprised of hot swappable/user replaceable 10kW power modules, which shall operate in parallel, and be configured for N+1 redundant operation at rated load.

.5 System shall be housed in a standard 600mm wide x 900mm deep 42U high equipment rack.

.6 System shall include an enclosure complete with input breaker, maintenance bypass breaker and an output breaker for service and maintenance of the UPS system.

1.3 SYSTEM PERFORMANCE

.1 Normal operation:
.1 System operates on mains power when mains voltage is within +/-10% of nominal value and mains frequency is between 59.5 and 60.5 Hz.

.2 Battery operation:
.1 System transfers automatically to battery operation.
.1 When manually selected at control panel;
.2 When normal power fails;
.3 When mains voltage varies more than 10% from nominal or mains frequency varies more than 0.5 Hz from 60 Hz;
.4 When mains power is restored and mains voltage is within 10% of nominal and mains frequency is within 0.3 Hz of 60 Hz, system automatically resynchronizes with mains;
.5 Slew rate of frequency during transition period of system output automatically synchronizing with mains and return to its internal frequency to be set between 0.5 to 1.0 Hz per second.

.3 Bypass operation:
.1 For maintenance purpose, system can be bypassed automatically by manual selection at control panel to connect load directly to ac mains. Transfer without load interruption and leaving inverter energized.
.2 Load transfer from mains back to system automatically by manual selection at control panel when maintenance completed.
.3 Automatic transfer of load to mains in not more than 1/4 cycle including sensing with inverter left energized but disconnected from load in case of:
.1 Inverter overloaded;
.2 Short circuit in load;
.4 Automatic retransfer of load to system without load interruption when above conditions disappear.
.5 Automatic transfer of load to mains in not more than 1/4 cycle including sensing and shutdown of inverter in case of inverter internal malfunctions.
.6 Automatic transfer of load to mains without load interruption and inverter shutdown in case of:

1.3 SYSTEM PERFORMANCE (Cont'd)

.3 (Cont'd)
.6 (Cont'd)
.1 Over temperature harmful to system.
.2 Loss of forced ventilation.
.3 Low voltage of dc supply to inverter.
.7 Bypass capable of closing onto and withstanding momentary fault current of 800% of rating for 0.01 s.

1.4 SYSTEM PROTECTION

.1 Circuit breakers in system used to isolate it from load and from mains for safe working on equipment, and for manual blocking of bypass automatic control to prevent inadvertent operation of bypass during Work on inverter.

.2 Automatic circuit breakers and protection included in:
.1 Ac input to rectifier;
.2 Battery input;
.3 Bypass circuit input;
.4 Inverter output.

.3 Surge suppressors:
.1 To protect system against supply voltage switching transients;
.2 To protect internal circuits where necessary against voltage transients.

.4 Current limiting devices, with panel front indication of device operation, to protect inverter SCR's.

.5 Suitable devices, with panel front indication of device operation, to protect rectifier diodes.

.6 Failure of circuit or component not to cause equipment to operate in dangerous or uncontrolled mode.

1.5 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittals Procedures.

.2 Include:

1.5 SHOP DRAWINGS (Cont'd)

.2 (Cont'd)

.1 Outline sketch showing arrangement of cubicles, meters, controls, recommended aisle spaces, battery rack, battery arrangement and dimensions.

.2 Shipping weight.

.3 Schematic diagram showing interconnection of rectifier, inverter, battery, bypass switch, meters, controls and indicating lamps.

.4 Description of system operation, referenced to schematic diagram, for:

.1 Manual control during initial start-up and load transfer to bypass and back to inverter output;

.2 Inverter;

.3 Bypass;

.5 System performance and reliability:

.1 Consider any deviation from the required output power waveform as failure in UPS and include estimate, with supporting calculations, of the Mean Time Between Failures (MTBF) expressed in hours.

.2 Provide estimate with supporting data for Mean Time to Repair factor (MTTR).

.6 Full load kVA output at unity power factor.

.7 Efficiency of system at 25%, 50%, 75% and 100% rated load.

.8 Type of ventilation: natural.

.9 Battery:

.1 Number of cells;

.2 Maximum and minimum voltages;

.3 Type of battery;

.4 Type of plates;

.5 Catalogue data with cell trade name and type;

.6 Size and weight of each cell;

.7 Cell charge and discharge curves of voltage, current, time and capacity;

.8 Derating factor for specified temperature range;

.9 Nominal ampere hour capacity of each cell;

.10 Maximum short circuit current;

.11 Maximum charging current expected for fully discharged condition;

.12 Recommended low voltage limit for fully discharged condition;

1.5 SHOP DRAWINGS (Cont'd)

.2 (Cont'd)

.9 (Cont'd)

.13 Expected life.

.10 Inverter:

.1 Type and catalogue number;

.2 Dc current at minimum battery voltage to produce full load ac output.

.11 Rectifier:

.1 Type and capacity, with catalogue number;

.2 Battery charging sequence;

.3 Current-time data for Silicon Controlled Rectifier (SCR) protective devices;

.4 Guaranteed noise level;

.5 Estimated life;

.6 Metering;

.7 Alarms.

.12 Manufacturer's field experience with UPS of similar ratings including engineering expertise, manufacturing facilities and listing of UPS units manufactured and installed during last 5 years including model, customer, location and installation dates.

.13 Evaluation of Canadian content.

.14 Heat losses at no load, 25%, 50%, 75% and 100% of rated output, in kW.

.15 Cooling air required in m^3/s.

.16 List of recommended spare parts, tools and instruments with catalogue numbers and current prices.

.17 Typical operation and maintenance manual.

.18 Description of factory test facilities.

.19 Manufacturer's maintenance capabilities including:

.1 Willingness to undertake maintenance contract;

.2 Number of trained personnel available;

.3 Location of trained personnel and repair facilities.

1.6 CLOSEOUT SUBMITTALS

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

1.6 CLOSEOUT SUBMITTALS (Cont'd)

.2 Submit interim, draft final, and final Operation and Maintenance (OM) Manual. Final manual to be reviewed and approved by the Departmental Representative. Submit interim copies to the Departmental Representative prior to notification of factory test date.

.3 Operation and Maintenance Manual to include:
.1 Operation and maintenance instructions concerning design elements, construction features, component functions and maintenance requirements to permit effective operations maintenance and repair.
.2 Technical data:
.1 Approved shop drawings;
.2 Characteristic curves for automatic circuit breakers and protective devices;
.3 Project data;
.4 Technical description of components;
.5 Parts lists with names and addresses of suppliers.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Crating:
.1 Adequately enclosed and protected from weather and shipping damage by use of minimum 12 mm plywood with vapour barrier inside.
.2 Sub-assemblies may be packed separately.
.3 Label crates:
.1 Shipping address.
.2 Weight and dimensions
.3 Serial number of unit and brief description of contents.
.4 Stencilled with durable paint on at least two sides of each crate.
.4 List of contents:
.1 In weatherproof envelope stapled on outside of each crate;
.2 Copy placed inside each crate.

1.8 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

1.8 WASTE MANAGEMENT AND DISPOSAL (Cont'd)

.3 Collect and separate for disposal paper, plastic, polystyrene, and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by the Departmental Representative.

1.9 WARRANTY

.1 For Work of this Section 26 33 53 - Uninterruptible Power Systems, 12 month warranty period prescribed in subsection GC 32.1 of General Conditions "C" is extended to 24 month maximum.

1.10 SYSTEM START-UP

.1 Arrange with the Departmental Representative:
.1 For factory service engineer to supervise start-up of system, checking, adjusting and testing on site;
.2 For instruction of minimum 5 personnel on theory, construction, installation, operation and maintenance of system:
.1 After installation and during site testing;
.2 At factory during shop testing.

.2 Advise on:
.1 Expected failure rate of equipment;
.2 Type of expected failures;
.3 Estimated time between major overhauls based on 20 year equipment life;
.4 Estimated cost of major overhaul based on current costs and excluding travelling expenses;
.5 Type and cost of test equipment needed for fault isolating and performing preventive maintenance.

1.11 EXTRA MATERIALS

.1 Provide maintenance materials in accordance with Section 01 00 10 - General Instructions.

.2 Include:

1.11 EXTRA MATERIALS (Cont'd)

.2 (Cont'd)
.1 Four sets of each type and size of fuses used;
.2 Four sets indicating lamps;
.3 Spare parts are provided and acknowledged by the Departmental Representative.

PART 2 - PRODUCTS

2.1 UNINTERRUPTIBLE POWER SYSTEM (UPS)

.1 General:
.1 UPS capacity shall be 100kW load and shall be configured ten (10) 10 kW power modules for N+1 layout.
.2 UPS battery shall be sized for 90 kW for 15 minutes.

.2 Input power:
.1 Three phase, 600 V, 3 wire, grounded neutral, 60 Hz.
.2 Emergency supply from standby automatic diesel-electric unit.

.3 Output power:
.1 Three phase, 120/208 V, 4 wire, grounded neutral, 60 Hz.
.2 Full load output at 0.99 power factor lagging 100 kW plus one spare 10 kW module.
.3 Overload capability: 125% of rated full load current at 0.8 power factor and rated voltage for 10 min.
.4 Frequency - nominal 60 Hz:
.1 Adjustable from 59.5 to 60.5 Hz.
.2 Maximum variation from set value under load changes, including transients, not to exceed 0.3 Hz.
.3 Drift from set value - after two months normal operation within ambient temperature range of 0 degrees to 40 degrees C, not to exceed 0.6 Hz.
.5 Duration of full load output after mains failure not less than 15 min.
.6 Output voltage control:
.1 Continuously adjustable on load at least 5% from rated value.

2.1 UNINTERRUPTIBLE POWER SYSTEM (UPS) (Cont'd)

.3 (Cont'd)

.6 (Cont'd)

.2 Voltage regulation: voltage not to change by more than 2% as load increases gradually from zero to 100%, or for specified duration of full load after mains failure.

.3 Transient voltage change not to exceed +/-10% of rated voltage upon 50% sudden load change, loss or return of ac input voltage to system when fully loaded or transfer of full load from inverter to bypass and vice versa, and return to normal within 3 Hz.

.4 Harmonics over entire load range:

.1 Total rms value not to exceed 5% rms value of total output voltage.

.2 Single harmonic not to exceed 3% of total output voltage.

.5 Proper angular phase relation maintained within 4 electrical degrees at up to 20% load unbalance.

.7 Efficiency: Overall system efficiency at rated load with battery fully charged not less than 75 %.

.8 Interference suppression:

.1 If UPS equipment generates electromagnetic rf interference at levels which adversely affects other equipment in vicinity, install suppression circuits or shielding as required to eliminate such interference.

.2 If harmonics reflected back to mains from rectifier adversely affect other loads connected to same bus, install suppression circuits to prevent that condition.

2.2 ELECTRICAL REQUIREMENTS

.1 In accordance with Section 26 05 00 - Common Work Results For Electrical.

.2 Bring out test points to protected coded pin jacks at convenient locations to permit testing without hazard, including:

.1 Inverter output ahead of output switch, 3phase and neutral.

.2 Mains power 3 phase and neutral.

2.2 ELECTRICAL REQUIREMENTS (Cont'd)

.2 (Cont'd)
.3 Voltage across each SCR.
.4 Points requiring monitoring for on-site alignment, for determination of faulty sub-assemblies or printed circuit cards, including indication of oscillator pulse and operation of voltage control.

.3 Wires number tagged or colour coded with same designation on drawings. Tags: non deteriorating type.

.4 Variable resistors: fine adjustment, rheostat type.

.5 Phasing marked on input and output terminals, viewed from front of equipment:
.1 Left to right;
.2 Top to bottom;
.3 Front to back.

.6 Solid state circuits used where more reliable than mechanical timers or control relays.

.7 Standard components available from commercial sources used throughout, with 10 years minimum shelf life.

.8 Arrangement to permit easy removal of defective components to facilitate servicing, by replacing with stock spares.

.9 Small components, related to specific function, removable plug-in modular sub-assembly or printed circuit card.

.10 Heavy sub-assemblies easily accessible, or slide on runners of anti-friction material, and have flexible leads and bolted connections.

.11 Components and sub-assemblies accurately made for interchangeability.

2.3 ENCLOSURE

.1 Dead front free standing sheet steel minimum 2.5 mm thick, CSA Enclosure 1, with 600mm wide x 900mm deep x 42U high to fit in the available space in the Equipment Room. Equipment dimension is critical and shall be fit in the room as indicated.

.2 Access preferably from front and rear.

.3 Meters, indicating lamps and controls group mounted in panel front.

.4 Panel front enclosed by hinged doors to prevent tampering and to protect instruments and controls during shipping. Doors formed wrap-around type, rigid, to open and close smoothly, locking type handle with 2 keys. Hinges to permit doors to be lifted off cubicle.

.5 External cable connections at top of cubicle through bolted plate for drilling at site to suit.

.6 Ambient temperature range during operation -20 degrees C to +40 degrees C. Natural or forced ventilation as required. For forced ventilation power from inverter output and fan directly driven by single phase motor mounted on vibration isolators. Each enclosure to have redundant fans, with fan failures alarmed. Air inlet and outlet openings protected with screens and metal guards.

.7 Disposable air filters on fan cooled enclosures. Method of attachment and opening locations to make removal convenient and safe.

.8 Maximum operating sound level not to exceed 80 db(A) as measured on sound level meter with A weighting and slow response, at distance of 1.8 m.

.9 Enclosure frames interconnected by ground bus with ground lug for connection to ground.

.10 Sprinkler proof drip shield.

2.4 RECTIFIER

.1 Input power supply from:
.1 Ac mains;
.2 Automatic diesel engine driven generating unit.

.2 Input disconnect: bolt-on moulded case three pole air circuit breaker, quick make, quick break type for manual or automatic operation, temperature compensated for 40 degrees C ambient, magnetic instantaneous trip element.

.3 Surge suppressor: to protect equipment from supply voltage switching transients.

.4 Rectifier:
.1 Silicon controlled rectifier assembly or sealed silicon diodes.

.5 Filter: for rectifier dc output.

.6 Fuse: to protect dc output.

.7 Meters:
.1 Dc voltmeter, switchboard type, accuracy +/-2% of full scale, to measure rectifier output voltage.
.2 Dc ammeter, switchboard type, accuracy +/-2% of full scale, to measure rectifier output current.

.8 Adjustments and controls:
.1 Line voltage adjusting taps to allow for +/-10% variation from nominal.
.2 Manual adjustment of float voltage with range of +/-5%.
.3 Manual adjustment of equalizing voltage.
.4 Automatic current limiting on rectifier adjustable between 80 and 120% of normal rating.
.5 Provision to disconnect rectifier from inverter and battery if rectifier dc output exceeds safe voltage limits of battery.

.9 Metres, adjustments and controls to be grouped on front panel.

.10 Performance of rectifier:

2.4 RECTIFIER (Cont'd)

.10 (Cont'd)
.1 Automatically maintain battery in fully charged state while mains power available, and maintain dc float voltage within +/-1% of setting, no load to full load, during mains voltage variations up to +/-10%.
.2 Battery charging rate such that after battery has provided full load power output for specified duration, charger returns battery to 95% of fully charged state in 4 hours.
.3 Automatic equalize charging circuit to initiate equalize charging of battery for 24 hours after discharge of 5% of ampere hour battery rating.
.4 Manually initiated equalize charging feature with automatic timer adjustable from 0 to 24 hours to return unit to float charge.

2.5 INVERTER

.1 Input power supply from:
.1 Rectifier dc output;
.2 Battery dc output.

.2 Input disconnect: bolt-on moulded case, circuit breaker, quick-make, quick-break type, for manual or automatic operation, temperature compensated for 40 degrees C ambient, magnetic instantaneous trip element.

.3 Input filter: with separately fused computer grade capacitor banks and indicator lights, to eliminate inverter source noise and restrictions on input cable length.

.4 Power stage: high frequency switching type, dual cooled disc type silicon controlled rectifier (SCR). Components, solid state devices capable of satisfactory operation under ambient conditions of -35 degrees C to +55 degrees C.

.5 Logic module:
.1 Integrated circuit logic.
.2 Silicon semiconductors.
.3 Plug-in modules.
.4 Gold plated plug-in connector.
.5 Front accessible field adjustments for voltage and frequency.

2.5 INVERTER (Cont'd)

.5 (Cont'd)
.6 Front accessible test points: suitably protected coded pin jacks.
.7 Frequency reference module.
.8 Current limiting module, automatic high speed by controlled reduction of output voltage.
.9 Voltage regulator.

.6 Output filter: output of high frequency switching stage contains elements of carrier frequency which are filtered to low harmonic sine wave.

.7 Metres:
.1 Ac voltmeter: switchboard type, accuracy +/-2% of full scale, to measure inverter output voltage with 7 position selector switch to select phase to neutral, phase to phase, off.
.2 Ac ammeter: switchboard type, accuracy +/-2% of full scale, to measure inverter output current with 4 position selector switch to select each phase and off.
.3 Wattmeter: switchboard type, accuracy +/-2% of full scale to measure inverter load.
.4 Frequency meter: switchboard type, scale 58 to 62 Hz, pointer type, to measure inverter output frequency.
.5 Synchroscope: with switch to check inverter output potential against supply mains potential.

.8 Output disconnect: bolt-on, moulded case, three pole circuit breaker, quick-make, quick-break type, for manual or automatic operation, temperature compensated for 40 degrees C ambient, magnetic instantaneous trip element.

.9 Metres and controls: grouped on front panel.

2.6 BATTERY

.1 The UPS Battery shall be modular construction made up of user replaceable, hot swappable, fused, battery modules. Each battery modules shall be monitored for voltages and temperature for use by the UPS battery diagnostic, and temperature compensated charger circuitry.

.2 The battery jars housed within each removable battery module shall be of the Valve Regulated Maintenance Free type.
.1 Discharge current to supply inverter at full load output, for 15 min.

.3 The UPS shall incorporate a battery management system to continuously monitor the health of each removable battery module. This system shall notify the user in the event that a failed or weak battery module is found.

2.7 STATIC BYPASS SWITCH

.1 Two solid state closed circuit automatic transfer switches.

.2 Logic unit with three normal source voltage sensors, which monitor overvoltage undervoltage and loss of voltage.

.3 High speed automatic transfer from normal voltage to alternate source when:
.1 Normal source voltage lost: transfer time and sensing 1/4 cycle;
.2 Normal source: undervoltage at 80% of nominal value; adjustable.
.3 Normal source: over voltage at 110% of nominal value.
.4 Loss of normal source static switch continuity.
.5 Short circuit on normal source trips normal source breaker.

.4 Return to normal source:
.1 When normal source remains within return voltage limits of 95% to 110% of nominal value (adjustable) for approximately 1 s timing interval, circuit checks voltage balance and phase synchronization, then initiates return with zero switching time.

2.7 STATIC BYPASS SWITCH (Cont'd)

.5 Switch position lights and contacts.

.6 Synchronizing verification light.

.7 Manual reset pushbutton.

.8 Transfer test switch.

.9 Alternate power source monitor light.

.10 Accessories:
.1 Manual bypass switch for maintenance and testing without load disturbance.
.2 Continuity monitor: automatic transfer to alternate source in event of static switch discontinuity.
.3 Alternate power source loss alarm contacts.

2.8 TRANSFORMERS

.1 Use transformers of one manufacturer throughout project and in accordance with CAN/CSA-C22.2 No.47.

.2 Design 1.
.1 Type: ANN.
.2 Three phase, 150 kVA, 600 V input, 120/208 V output, 60 Hz.
.3 Voltage taps: standard.
.4 Insulation: Class H, 150 degrees C temperature rise.
.5 Basic Impulse Level (BIL): standard.
.6 Hipot: standard.
.7 Average sound level: standard
.8 Impedance at 17 degrees C: standard
.9 Enclosure: CSA, removable metal front panel.
.10 Mounting: floor mounted on 100 mm concrete pad.
.11 Sprinkler proof drip shield.
.12 Finish: in accordance with Section 26 05 00 - Common Work Results For Electrical.

2.9 OPERATING DEVICES

.1 Operating accessories:
.1 Counter for number of failures of normal mains ac power: non-reset type, zero to 99,999 operations.

2.9 OPERATING DEVICES (Cont'd)

.1 (Cont'd)

.2 Elapsed time meter indicating accumulated time of battery discharge in minutes non-reset type, zero to 99,999.9 minutes.

.3 Elapsed time meter indicating accumulated time of inverter operation in hours, non-reset type, zero to 99,999.9 hours.

.2 Mode lights mounted on front panel to indicate:

.1 Ac output on inverter - green;

.2 Ac input available - green;

.3 Inverter and ac input synchronized - green;

.4 Inverter and ac input not synchronized - amber;

.5 Static bypass switch in bypass position - red;

.6 Overtemperature alarms:

.1 Rectifier - red;

.2 Inverter - red;

.3 Bypass switch - red;

.7 Cooling fan fuse open - red;

.8 Inverter output over voltage - red;

.9 Inverter output under voltage - red;

.10 Battery over voltage - red;

.11 Battery under voltage - red;

.12 Inverter fuse/breaker open - red;

.13 Rectifier fuse/breaker open - red;

.14 Static bypass switch fuse/breaker open - red;

.15 UPS on battery operation - red;

.16 Rectifier in equalize mode - amber;

.17 Battery discharging indicator - red, to change from steady to flashing during final 5 to 10 min of battery duration.

.3 Remote annunciator panel and alarms:

.1 One remote annunciator panel at the Commissionaire's desk on the ground floor including:

.1 Normal operating mode - green;

.2 UPS operating from battery - red;

.3 Bypass switch in operation - red;

.2 Buzzer to sound when any mode light at main UPS panel shows red.

.3 Size of cabinet as indicated.

.4 Wiring between UPS and remote annunciator panel by this contractor.

2.9 OPERATING DEVICES (Cont'd)

.3 (Cont'd)
.5 Power for remote lights and alarm from UPS output.
.6 Provide Environmental Monitoring system for remote monitoring for temperature, humidity, live video, leak detection and IP/SNMP Communication.
.7 Provide software to collect, organize and distribute the environmental info anywhere to data management team.

2.10 FABRICATION

.1 Shop assemble:
.1 Rectifier unit;
.2 Inverter unit;
.3 Bypass switch unit;
.4 Battery rack and battery.

.2 Interconnect units, and add remote mode lights, alarms and controls to produce complete uninterruptible power system before requesting Departmental representative to witness factory tests.

2.11 FINISHES

.1 Apply finishes in accordance with Section 26 05 00 - Common Work Results For Electrical.

.2 Cubicles:
.1 Inside finish: white;
.2 Exterior finish:TBD
.3 Exterior hardware and trim: corrosion resistant and not requiring painting such as stainless steel or aluminum.

2.12 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results For Electrical.

.2 For major components such as ac input breaker, inverter breakers, bypass switch: size 5 nameplates.

.3 For mode lights, alarms, meters: size 3 nameplates.

2.13 SOURCE QUALITY CONTROL

.1 Complete system including rectifier, inverter, bypass switch,, controls and battery factory tested in presence of the Departmental Representative.

.2 Travel arrangement, accommodation and notification to the Departmental Representative:
.1 Contractor shall include in the tender price the expenses for the Departmental Representative to and from home and accommodation to witness factory test at least 28 days in advance of test;
.2 That system has had preliminary testing and has met design requirements satisfactorily.

.3 Test procedures:
.1 Prepare blank forms and check sheet with spaces for recording data.
.2 Mark check sheet and record test data on forms in duplicate as test proceeds. Attach meter recordings.
.3 Provide the Departmental Representative's signature on form to indicate concurrence in results reported.
.4 Signed duplicate copies given to the Departmental Representative at end of factory test.
.5 Information from original presented as part of O&M Manual.

.4 Test equipment:
.1 Instruments used during test, including indicating meters installed as part of system to have recent calibration certificate.
.2 Dummy load for testing, adjustable to 150 % of system rated output at 0.8 power factor lagging. Load on each phase adjustable from zero to 100 % so that unbalanced output maybe tested for 3 phase systems.

.5 Tests:
.1 Visual inspection to determine:
.1 Materials, workmanship, and assembly conform with design requirements;
.2 Parts are new and free of defects;
.3 Battery and components are not damaged;

2.13 SOURCE QUALITY CONTROL (Cont'd)

.5 (Cont'd)

.1 (Cont'd)

.4 Battery cells are of identical construction;

.5 Electrolyte in each cell is at manufacturer's recommended full level;

.6 Each battery cell polarity and polarity of connections to inverter are correct;

.7 Proper size fuses are installed;

.8 Metres have suitable range;

.9 Accessories are present;

.10 Portable metres for acceptance tests are suitable and instrument transformers connected correctly.

.2 Demonstrate:

.1 System start-up and shut down;

.2 Operation during mains power failure, recording output during failure and return of mains power, using oscilloscope and camera attachment. Repeat several times;

.3 Adjustable settings;

.4 Record values measured at test points using oscilloscope, digital multimeter, visicorder and camera attachment;

.5 Protective devices and indications function as designed. Record actual settings, and note operation of remote indications and transfer to bypass. Tests to include:

.1 Annunciator lights correct indication;

.2 Overcurrent on inverter output;

.3 Over voltage and under voltage of inverter output;

.4 Dc input voltage to inverter too low. Gradually reduce dc input voltage to inverter while delivering full load output and load to transfer automatically to bypass and inverter shut down. Record input and output values.

.6 Simulate over temperature by applying heat to sensor with hot air blower.

.7 Simulate fuse blowing to test indication response.

.8 Simulate fan failure.

2.13 SOURCE QUALITY CONTROL (Cont'd)

.5 (Cont'd)
.2 (Cont'd)
.9 Bypass switch automatic operations. Record with camera/oscilloscope absence of load disturbance during automatic bypass switching.
.10 Over voltage of rectifier dc output.
.3 Harmonic test:
.1 With system fully loaded, one-half loaded, and at no load, determine total harmonic content with harmonic distortion meter at output terminals.
.2 Determine each harmonic magnitude with harmonic wave analyzer.
.3 Measure phase to neutral at lagging power factor.
.4 Transients:
.1 With normal power input, apply full load to system.
.2 Remove one half load from each phase.
.3 Reapply one half load instantly.
.4 Record voltages and currents.
.5 Steady load:
.1 Switch system onto ac mains, start inverter and connect dummy load.
.2 Operate each module at full rated load for 24 hours and at 125% load for 10 min in ambient temperature of 40 degrees C.
.3 Record data at start of test and at half hour intervals thereafter; including:
.1 Input frequency;
.2 Input voltage each phase;
.3 Input current each phase;
.4 Input kW;
.5 Output voltage phase to phase, phase to neutral;
.6 Output current each phase;
.7 Output kW;
.8 Temperature of ventilating air-in;
.9 Temperature of ventilating air-out;
.10 Temperature at critical zones;
.11 Dc voltage to inverter;
.12 Dc current to inverter;
.13 Rectifier dc current.
.6 Varying loads:

2.13 SOURCE QUALITY CONTROL (Cont'd)

.5 (Cont'd)

.6 (Cont'd)

.1 Take one set of readings as above of no load, 25% load, 50% load, 75% load and 125% load.

.2 Calculate efficiencies of rectifier, inverter, and complete system.

.7 Unbalanced loads:

.1 Adjust loads on inverter to full load on two phases, 80% load on third phase.

.2 Adjust loads on inverter to zero load on two phases, 20% load on third phase.

.3 For both cases, record phase and line voltages and currents with phase angles to prove that phase relation remains unchanged with unbalanced loads.

.8 Battery:

.1 Charge battery to ensure cells fully charged. When voltage reaches steady value at end of charge, record:

.1 Ambient temperature;

.2 Temperature of each cell;

.3 Voltage of each cell;

.4 Voltage of battery;

.5 Charging current;

.2 Discharge battery by operating uninterruptible power system with ac mains open, at full rated output for duration quoted in design requirements. Record, at 5 min intervals:

.1 Voltage of battery;

.2 Current;

.3 Voltage of 10% random cells;

.4 Ambient temperature;

.5 Battery temperature; ;

.3 Recharge battery automatically by closing ac mains supply to system for 4 hours period, with dummy load connected. Record at 15 min intervals.

.1 Battery voltage;

.2 Charging current.

.4 Repeat discharge test and readings to prove battery was at least 95% recharged in 4 hours charge period.

.5 Recharge battery.

.9 Operating sound level:

2.13 SOURCE QUALITY CONTROL (Cont'd)

.5 (Cont'd)

.9 (Cont'd)

.1 Measure sound level according to ANSI S1.13 using sound level meter with A weighting and slow response, conforming to ANSI S1.4.

.2 Operator to take reading by placing meter in front of him with microphone pointed at right angles to path of travel of generated sound, positioned at height of 1.5 m and distance of 1 m from equipment to be tested.

.3 Measure sound level during low ambient sound level.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Locate UPS bypass cabinets and battery as indicated.

.2 Assemble and interconnect components to provide complete UPS as specified.

.3 Ensure adequate clearance around transformer for ventilation.

.4 Ensure transformers are in level upright position.

.5 Connect ac mains to main input terminal.

.6 Make primary and secondary connections in accordance with wiring diagram.

.7 Energize transformers after installation is complete.

.8 Connect UPS output to load.

.9 Start-up UPS and make preliminary tests to ensure satisfactory performance.

3.2 TESTING

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results For Electrical and CSA-C813.1. Test procedures and forms to be reviewed and approved by the Departmental Representative before the test.

.2 Provide:
.1 Competent field personnel to perform test, adjustments and instruction on UPS equipment.
.2 Dummy load adjustable to 150% of system rated output.

.3 Notify the Departmental Representative 15 working days in advance of site test date.

.4 Tests:
.1 Inspection of cubicles, battery rack and battery.
.2 Inspection of electrical connections.
.3 Inspection of installation of remote mode lights and alarms.
.4 Demonstration of system start-up and shut-down.
.5 Run UPS for minimum period of 4 hours at full rated load to demonstrate proper operation with ac mains input, emergency generator input, no ac input.
.6 Discharge battery by operating UPS with ac mains open for specified duration of full load. Record readings of temperature of each cell.
.7 Recharge battery automatically with full rated load on UPS for 4hours and record readings of voltage of each cell.

3.3 TRAINING

.1 On-site lectures and demonstrations in use and maintenance of UPS system are to be provided by manufacturer to train operational personnel and any other group or individual so assigned by the Departmental Representative. Allow for four sessions of three hours, ensure four copies of maintenance instruction materials are provided prior to first session all training will be conducted in both official languages.

3.3 TRAINING (Cont'd)

.2 The maximum number of people attending each session will be seven. Additional training session to accomodate other personnel beyond the specified numbers will be reviewed addressed by the Departmental Representative. Training sessions will be conducted during normal working hours.

.3 Responsibilities:

.1 Contractor:

.1 Establish with the manufacturer a detailed outline of the anticipated training session and present to the Departmental Representative for review at the beginning of the project.

.2 During the training sessions, instruct and explain to the personnel present the general description of the systems.

.3 Contractor is to be present for all session to ensure that the manufacturer has presented the training in accordance with the specifications and to field questions that could relate to the system installation.

.2 Departmental Representative:

.1 To arrange the location and times for on site training.

.2 To ensure that all reviewed training documentation, such as operating and maintenance manuals, are available prior to the first training session. The manuals are to be reused each session.

.3 To make the arrangements for attendance of the personnel who will be trained on the system in each session.

.4 To ensure all chairs, tables and writing materials are made available for each session to prevent unnecessary delays.

.5 To attend at least the first session to ensure that the training sessions meet the expectations of the contract.

.6 To report any discrepancies in the training, that can be reviewed and addressed prior to the next session.

END OF SECTION

PART 1 - GENERAL

1.1 References

.1 American National Standards Institute (ANSI)
.1 ANSI C82.1-1998, Electric Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.
.2 ANSI C82.4-2004, Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps.

.2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
.1 ANSI/IEEE C62.41-2002, Surge Voltages in Low-Voltage AC Power Circuits.

.3 American Society for Testing and Materials (ASTM)
.1 ASTM F 1137-00(R2006), Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.

.4 Canadian Standards Association (CSA).

.5 Federal Communications Commission (FCC).

1.2 Shop Drawings and Product Data

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Engineer.

1.3 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

PART 2 - PRODUCTS

2.1 Lamps

.1 Rfer to Annex A for luminaire schedule and further detail.

.2 LED lamps:
.1 LED fixtures are to have LM-80, LM-79, and TM-21 testing, 4000K with dimming capabilities or as indicated, minimum 50,000 hour lamp life at L70, CRI 80 and above. LED fixtures are to be DLC or Energy Star listed. Fixtures are to be CSA/ULC certified.

2.2 Finishes

.1 Baked enamel finish:
.1 Conditioning of metal before painting:
.1 For corrosion resistance conversion coating to ASTM F 1137.
.2 For paint base, conversion coating to ASTM F 1137.
.2 Metal surfaces of luminaire housing and reflectors finished with high gloss baked enamel to give smooth, uniform appearance, free from pinholes or defects.
.3 Reflector and other inside surfaces finished as follows:
.1 White, minimum reflection factor 90%.

.2 Alzak finish:
.1 Aluminium sheet fabricated from special aluminum alloys and chemically brightened, subsequently anodically treated to specifications established by Alcoa, to produce:
.1 Finish for regular industrial service, minimum density of coating 14.8 g/m^2, minimum reflectivity 82% for specular and 73% for diffuse.

2.3 Light Control Devices

.1 Design.
.1 Lens thickness: 0.90 mm.
.2 Material: injection moulded clear prismatic virgin acrylic and open aluminum.

2.3 Light Control Devices (Cont'd)

.1 (Cont'd)
.3 Light distribution: direct/indirect as shown.
.4 Treatment: ultraviolet inhibited.
.5 Frame: hinged spring loaded extruded aluminum.

2.4 Luminaires

.1 Refer to Annex A of the specification for lighting fixture schedule.

.2 Refer to site plan drawing for exterior lighting fixture schedule.

PART 3 - EXECUTION

3.1 Installation

.1 Locate and install luminaires as indicated.

3.2 Wiring

.1 Connect luminaires to lighting circuits:
.1 Directly for luminaire.
.2 Through rigid conduit for luminaire.
Conduits shall be hidden within the roof/wall assembly in areas where there is no suspended ceiling installed.

3.3 Luminaire Supports

.1 For suspended ceiling installations support luminaires independently of ceiling from the roof structure.

3.4 Luminaire Alignment

.1 Align luminaires mounted in continuous rows to form straight uninterrupted line.

.2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)
.1 CSA C22.2 No.141-15, Unit Equipment for Emergency Lighting.

1.2 SUBMITTALS

.1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

.2 Data to indicate system components, mounting method, source of power and special attachments.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Engineer.

.5 Dispose of unused batteries at official hazardous material collections site approved by Engineer.

.6 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 - PRODUCTS

2.1 EQUIPMENT

.1 Emergency lighting equipment: to CSA C22.2 No. 141.

.2 Supply voltage: 120 V, ac.

.3 Output voltage: 24 V dc.

.4 Operating time: 30 min.

.5 Battery: sealed, maintenance free.

.6 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01V for plus or minus 10% input variations.

.7 Solid state transfer circuit.

.8 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.

.9 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.

.10 Lamp heads: integral on unit and remote, 345 degrees horizontal and 180 degrees vertical adjustment. Lamp type: High Intensity Tungsten 9, W, minimum 175 lumen output and 18, W, minimum 360 lumen output.

.11 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.

.12 Finish: beige.

.13 Auxiliary equipment:
.1 Ammeter.
.2 Voltmeter.
.3 Test switch.
.4 Time delay relay.
.5 Battery disconnect device.
.6 AC input and DC output terminal blocks inside cabinet.

2.1 EQUIPMENT (Cont'd)

.13 (Cont'd)
.7 Shelf.
.8 Cord and plug connection for AC.
.9 RFI suppressors.

2.2 WIRING OF REMOTE HEADS

.1 Conduit: type EMT, in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

.2 Conductors: RW90 XLPE type in accordance with Section 26 05 21 - Wires and Cables 0-1000 V, sized as indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install unit equipment and remote mounted fixtures.

.2 Direct heads accordingly.

3.2 FIELD TESTING INSTALLATION

.1 Complete test form and submit to the Engineer. Include completed test form on the Operation and Maintenance manual.

3.3 COMMISSIONING

.1 Refer to Section 01 91 13 - General Commissioning (Cx) Requirements.

.2 Commissioning shall be performed by at least one representative of supplier for this section and one representative from installation contractor.

END OF SECTION

PART 1 - GENERAL

1.1 Related Sections

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 74 19 - Construction/Demolition Waste Management.

.3 Section 01 91 13 - General Commissioning (Cx) Requirements.

1.2 References

.1 Canadian Code for Preferred Packaging.

.2 Canadian Standards Association (CSA)
.1 CSA C22.2 No.141-15, Unit Equipment for Emergency Lighting.
.2 CSA C860-01, Performance of Internally-Lighted Exit Signs.

.3 National Fire Protection Association (NFPA) requirements.

1.3 Submittals

.1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

1.4 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal, and with Waste Reduction Workplan.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

.4 Collect and separate plastic, paper, packaging and corrugated cardboard in accordance with Waste Management Plan.

.5 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 - PRODUCTS

2.1 Standard Units

.1 Exit lights: to CSA C22.2 No.141 and CSA C860, packaged in accordance with the Canadian Code for Preferred Packaging guidelines.

.2 Housing: cold rolled steel minimum 1.0 mm thick, satin aluminum enamel finish.

.3 Face and back plates: die formed cold rolled steel.

.4 Lamps: LED panel inserts and consumes less than 2 watts per face, rated for 120 volt normal operation. Emergency power supply is 24 VDC.

.5 Operation: designed for over 100,000 hours of continuous operation without relamping.

.6 Display: 150 mm high 'Running Man' pictogram, with 13 mm thick stroke, green in colour through a white stencil face plated.

.7 Downlight: translucent acrylic in bottom of unit.

.8 Face plate to remain captive for relamping.

PART 3 - EXECUTION

3.1 Installation

.1 Install exit lights.

.2 Connect fixtures to exit light circuits.

.3 Connect emergency lamp sockets to emergency circuits.

.4 Ensure that exit light circuit breaker is locked in on position.

3.2 Commissioning

.1 Refer to Section 01 91 13 - General Commissioning (Cx) Requirements.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 CSA Group
.1 CAN/CSA-A14-07(R2012), Concrete Poles.
.2 CSA C22.2 No.206-13, Lighting Poles.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

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

.3 Sustainable Design Submittals:
.1 Construction Waste Management:
.1 Submit project Waste Reduction Workplan highlighting recycling and salvage requirements.
.2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.
.2 Recycled Content:
.1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.
.3 Regional Materials: submit evidence that project incorporates required percentage 50% of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect roadway lighting from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

.4 Develop Waste Reduction Workplan related to Work of this Section and in accordance with Section 01 35 21 - LEED Requirements.

.5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials as specified in Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 CONCRETE POLES

.1 Concrete poles: round, finish plain grey, designed for underground wiring to CAN/CSA-A14 and CSA C22.2 No.206.
.1 Class:.
.2 Direct buriedBase mounting type.
.3 3.5, 6.0 and 10 m long.
.4 Access hand hole 450 mm above pole bottom for wiring connections, with reinforcing frame and cover.
.5 Grounding lug for wire size #6.

2.2 ALUMINUM POLES .1 Aluminum poles: to CSA C22.2 No.206 designed for underground wiring and:
.1 Mounting on concrete anchor base.
.2 Style: monotube, round tapered G063-T6 aluminum, wall thickness 4.5 mm.
.3 Straight for 1 and 2 luminaire mounting brackets.
.4 Tapered davit for 1 and 2 luminaires.
.5 Access handhole 450 mm above pole base for wiring connections, with welded-on reinforcing frames bolted-on cover.
.6 Size: 150 mm x 150 mm x 3.5 m.
.7 Anchor bolts: as per manufacturer's steel with shims, nuts, washers and covers.
.8 Finish: semi-lustrous satin by rotary sand process.
.9 Grounding lug.

2.3 LUMINAIRE MOUNTING BRACKETS .1 Mounting brackets steel aluminum for specified luminaires:
.1 Singleand twin brackets as indicated.
.2 Arm extension length: m.
.3 Type: cantilever single guy double guy Aframe single bend upsweep with underbrace double bend upsweep with underbrace straight pipe with underbrace.
.4 SingleDouble tapered davit type.

2.4 LUMINAIRES .1 Luminaire with cast aluminum weatherproof housing and:
.1 Lamp type: LED, wattage: As indicated.
.2 Driver: 347 V, in accordance with Section 26 50 00 - Lighting.
.3 Optical assembly:
.1 For LED fixtures:
.1 Reflector: sheet aluminum with Alzak finish.
.2 Refractor: one piece prismatic virgin acrylic.
.3 Gasket: neoprene seal between refractor and housing.
.4 Light Distribution:
.1 IES distribution Type based on luminaire by adjusting position of lamp socket.

2.4 LUMINAIRES (Cont'd)

.1 (Cont'd)
.5 Self-locking latches of stainless steel and aluminum.
.6 Factory wired including integral driver/ballast terminated at terminal block.
.7 Full cut-off as per IESNA.
.8 Refer to Annex A for luminaire schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

.1 Install poles true and plumb, complete with brackets in accordance with manufacturer's instructions.

.2 Install luminaires on pole davits and install lamps.

.3 Check luminaire orientation, level and tilt.

.4 Connect luminaire to lighting circuit.

.5 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

3.3 CLEANING (Cont'd)

.1 (Cont'd)

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

.2 Do not dispose of preservative treated wood through incineration.

.3 Do not dispose of preservative treated wood with other materials destined for recycling or reuse.

.4 Dispose of treated wood, end pieces, wood scraps and sawdust at sanitary landfill approved by Departmental Representative.

.5 Dispose of unused wood preservative material at official hazardous material collections site approved by Departmental Representative.

.6 Do not dispose of unused preservative material into sewer system, into streams, lakes, onto ground or in any other location where they will pose health or environmental hazard.

.7 Divert unused concrete materials from landfill to local facility approved by Departmental Representative.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 CSA International
.1 CSA C22.2 No.46-M1988(R2006), Electric Air-Heaters.

.2 Underwriters' Laboratories (UL)
.1 UL 1042-2009, Standard for Electric Baseboard Heating Equipment.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

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

.3 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, cleaning procedures.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for convectors for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

1.4 DELIVERY, STORAGE AND HANDLING (Cont'd)

.3 (Cont'd)
.1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect convectors from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 BASEBOARD CONVECTORS

.1 Heaters: to CSA C22.2 No.46 UL 1042 low standard wattage density with connection box oneat both ends. Type and capacity as per drawings.
.1 Element through-type fitted with aluminum convector vanes and resistor wire enclosed in mineral insulation in copper sheath.

.2 Element: locked to cabinet and supported at additional points throughout length to allow for linear expansion with non metallic supports.

.3 Cabinet: to CSA C22.2 No.46 UL 1042, pre-drilled back for securing to wall. Integral air diffusion reflector with wireway at bottom and built-in clamps.
.1 Panel: steel, metal thickness, bottom 1 mm, front 1.6 mm thick.
.2 Finish: phosphatized metalic surfaces.

.4 Blank cabinet sections and outside corners complete with wireway in sections including splice plates, to match heater cabinets in respects for continuous baseboard effect as indicated.

2.2 CONTROLS

.1 Wall mounted thermostats: type low voltage electronic, Energy Star certified , in accordance with Section 23 09 33 - Electric and Electronic Control System for HVAC.

2.2 CONTROLS (Cont'd)

.2 Integral thermostats 12 pole to control load as indicated.

.3 Relays and transformers temperature controller and power module to switch loads in excess of thermostat rating.

.4 Double pole, double throw switch and receptacle terminal box assembly for combination heater and air conditioner power supply.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

.1 Install baseboard convector heaters, blank sections and controls.

.2 When wireway is used, remove knock-outs and insert insulating bushing between units.

.3 Install grounding wire to maintain ground integrity between heating, blank, and auxiliary sections.

.4 Install thermostats in locations indicated.

.5 Make power and control connections.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Ensure heaters and controls operate correctly.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by commercial convectors installation.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 American National Standards Institute
.1 ANSI J-STD-607-A-2002, Joint Standard - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.

.2 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA)
.1 TIA/EIA-606-2002, Administration Standard for the Commercial Telecommunications Infrastructure.

.3 U.S. Department of Labor/Occupational Safety and Health Administration (OSHA)
.1 Nationally Recognized Testing Laboratory (NRTL).

1.2 SYSTEM DESCRIPTION

.1 Telecommunications grounding and bonding system consist of grounding busbars, bonding backbones, and other bonding conductors.

.2 Provides ground reference for telecommunications systems within building and bonding to it of telecommunications rooms.

.3 Metallic pathways, cable shields, conductors, and hardware within telecommunications spaces are bonded to telecommunications grounding and bonding system.

1.3 QUALITY ASSURANCE

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

1.4 DELIVERY, STORAGE AND HANDLING (Cont'd)

.2 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 TELECOMMUNICATIONS MAIN GROUNDING BUSBAR (TMGB)

.1 Predrilled copper busbar, listed approved by NRTL, electrotin plated with holes 8 mm diameter for use with standard-sized lugs to: ANSI J-STD-607-A.

.2 Dimensions 6 mm thick, 100 mm wide, 610 mm minimum long to: ANSI J-STD-607-A.

2.2 TELECOMMUNICATIONS GROUNDING BUSBAR (TGB)

.1 Predrilled copper busbar, approved by NRTL, electrotin plated with holes 8 mm diameter for use with standard-sized lugs to: ANSI J-STD-607-A.

.2 Dimensions 6 mm thick, 50 mm wide, 305 mm long to: ANSI J-STD-607-A.

2.3 BONDING CONDUCTOR FOR TELECOMMUNICATIONS

.1 3/0 AWG copper conductor, green insulated marked to: ANSI J-STD-607-A.

2.4 TELECOMMUNICATIONS BONDING BACKBONE (TBB)

.1 3/0 AWG copper conductor, green insulated marked to: ANSI J-STD-607-A.

2.5 GROUNDING EQUALIZER (GE)

.1 3/0 AWG copper conductor, green insulated marked to: ANSI J-STD-607-A.

2.6 WARNING LABELS

.1 Non-metallic warning labels in English and French to: ANSI J-STD-607-A.

2.6 WARNING LABELS (Cont'd)

.2 Identify labels with wording "If this connector is loose or must be removed, please call the building telecommunications manager".

PART 3 - EXECUTION

3.1 TELECOMMUNICATIONS MAIN GROUNDING BUSBAR (TMGB)

.1 Install TMGB in entrance room on insulated supports 50 mm high at location close to electrical power panel if one is installed in same room as indicated.

.2 Install #1/0 AWG copper bonding conductor from TMGB to alternating current equipment ground (ACEG) of serving electrical power panel (panelboard).

3.2 TELECOMMUNICATIONS GROUNDING BUSBAR (TGB)

.1 Install TGB in main terminal/equipment room and each telecommunications room.

.2 Install #1/0 AWG copper bonding conductor from TGB to alternating current equipment ground (ACEG) of serving electrical power panel (panelboard).

3.3 BONDING CONDUCTORS GENERAL

.1 When placed in ferrous metallic conduit or EMT longer than 1 m, bond to each end of conduit or EMT using grounding bushing 6 AWG copper conductor.

3.4 BONDING CONDUCTOR FOR TELECOMMUNICATIONS

.1 Install bonding conductor for telecommunications from TMGB to service equipment (power) ground.

.2 Use exothermic welding, approved 2 hole compression lugs lugs 1 hole non-twisting lugs for connection to TMGB.

3.5 TELECOMMUNICATIONS BONDING BACKBONE (TBB)

.1 Install TBBs from TMGB to each TGB as indicated.

.2 Use exothermic welding, approved 2 hole compression lugs , 1 hole non-twisting lugs for connection to TMGB and TGBs.

3.6 BONDING TO TMGB

.1 Bond metallic raceways in telecommunications entrance room to TMGB using #1/0 AWG green insulated copper conductor.

.2 For cables within telecommunications entrance room having shield or metallic member, bond shield or metallic member to TMGB using #1/0 AWG green insulated copper conductor.

.3 Bond equipment rack and cabinet located in telecommunications entrance room to TMGB using #1/0 AWG green insulated copper conductor. Bond each rack seperately.

3.7 BONDING TO TGB

.1 Bond metallic raceways in telecommunications room to TGB using #1/0 AWG green insulated copper conductor.

.2 For cables within telecommunications room and equipment room having shield or metallic member, bond shield or metallic member to TGB using #1/0 AWG green insulated copper conductor.

.3 Bond equipment rack and cabinet located in telecommunications room and equipment room to TGB using #1/0 AWG green insulated copper conductor. Bond each rack seperately.

3.8 LABELLING

.1 Apply warning labels to telecommunications bonding and grounding conductors.

.2 Apply additional administrative labels to: TIA/EIA-606.

END OF SECTION

PART 1 - GENERAL

1.1 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets for communication raceway systems and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Sustainable Design Submittals:
.1 Construction Waste Management:
.1 Submit project Waste Reduction Workplan highlighting recycling and salvage requirements.
.2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.

1.2 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect communication raceway systems from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

.4 Develop Waste Reduction Workplan related to Work of this Section.

1.2 DELIVERY, STORAGE AND HANDLING (Cont'd)

.5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials as specified in Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

.1 Empty telecommunications raceways system consists of outlet boxes, cover plates, terminal distribution cabinets, conduits, cable trays, pull boxes, sleeves and caps, fish wires, service poles, service fittings, concrete encased ducts.

.2 Overhead cable tray cellular distribution system.

2.2 MATERIAL

.1 Conduits: EMT type, in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

.2 Underground cable ducts: PVC type, in accordance with Section 33 65 76 - Direct Buried Underground Cable Ducts.

.3 Cable trays: type, in accordance with Section 26 05 36 - Cable Trays for Electrical Systems.

.4 Overhead distribution system: in accordance with Section 26 27 23 - Indoor Service Poles or J-hooks.

.5 Underfloor distribution system: in accordance with Section 26 05 39 - Underfloor Raceways for Electrical Systems.

.6 Cellular floor raceways: in accordance with Section 26 05 38 - Cellular Metal Floor Raceway Fittings.

.7 Junction boxes, cabinets type E: in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.

2.2 MATERIAL (Cont'd)

.8 Outlet boxes type, conduit boxes size, and fittings: in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.

.9 Fish wire: polypropylene type.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

.1 Install empty raceway system, including underfloor overhead distribution system, fish wire, terminal cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves and caps, cable tray, service poles, miscellaneous and positioning material to constitute complete system.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.3 CLEANING (Cont'd)

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by pathways for communications systems installation.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA International)
.1 CSA-C22.2 No. 214-02, Communications Cables (Bi-National standard with UL 444).
.2 CSA-C22.2 No. 232 -M1988(R2004), Optical Fiber Cables.

.2 Telecommunications Industry Association (TIA)/Electronic Industries Alliance (EIA)
.1 TIA/EIA-568-B.1-(2006), Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements.
.2 TIA/EIA-568-B.2-(2006), Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components.
.3 TIA/EIA-568-B.3-(2008), Optical Fiber Cabling Components Standard.
.4 TIA/EIA-606-A-(2006), Administration Standard for the Commercial Telecommunications Infrastructure.
.5 TIA TSB-140-2008, Telecommunications Systems Bulletin - Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems.
.6 TIA-598-C-(2008), Optical Fiber Cable Colour Coding.

1.2 DEFINITIONS

.1 Refer to TIA/EIA-598-C, Annex A for definitions of terms: optical-fiber interconnect, distribution, and breakout cables.

1.3 SYSTEM DESCRIPTION

.1 Structured telecommunications wiring system consist of unshielded-twisted-pair and optical fibre cables, terminations, connectors, cross-connection hardware and related equipment installed inside building for occupant's telecommunications systems, including voice (telephone), data, and image.

1.3 SYSTEM DESCRIPTION (Cont'd)

.2 Installed in physical star configuration with separate horizontal and backbone sub-systems.
.1 Horizontal cables link work areas to telecommunications room located on same floor.
.2 Telecommunications rooms linked to main terminal/equipment room (MT/ER) by backbone cables.
.3 MT/ER also linked to Entrance Room by backbone cables.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 As-built Records and Drawings:
.1 Provide Microsoft Access database reflecting cable installation and cross-connections.
.2 Provide electronic drawings in AutoCAD 2010 format depicting all construction.
.3 Provide two (2) bound complete hard-copy sets of as-built records to the Departmental Representative.
.1 Provide and place one hard copy of as-built records for each telecommunications room in plan holder in each telecommunications room.

1.5 QUALITY ASSURANCE

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 FOUR-PAIR 100 W BALANCED TWISTED PAIR CABLE

.1 Four-pair, 100 ohm balanced unshielded-twisted-pair (UTP) cable, flame test classification FT6 or MPP or CMP to: CSA-C22.2 No. 214, Category 6 (Cat 6A) and Enhanced Category 5 (Cat 5e) to: TIA/EIA-568-B.2.

2.2 MULTI-PAIR 100 W BALANCED TWISTED PAIR CABLE

.1 100 ohm, pairs, sheath consists of thermoplastic jacket with underlying metallic shield, Category 3 to: TIA/EIA-568-B.2, flame test classification FT4 or MPG or CMG to: CSA-C22.2 No. 214.

2.3 WORK AREA UTP 4-PAIR MODULAR JACK

.1 Eight-position modular jack ("RJ-45"), type T568B Category 6 to: TIA/EIA-568- B.2:
.1 In self-contained surface-mount box, 4 jacks per box.
.2 Mounted in compatible single gang faceplate, angle entry, 4 jack positions per faceplate.

.2 Multi-user telecommunications outlet assembly (MUTOA), 6 ports, each port equipped with factory installed "RJ-45" jacks, type T568B Category 6 to: TIA/EIA-568-B.2.

2.4 TERMINATION AND CROSS-CONNECTION HARDWARE FOR UTP

.1 IDC Terminal strips, 25 pair, for terminating multi 4 pair 100 balanced twisted pair cables and supporting cross-connections using jumper wires or compatible plug-ended patch cords: Category 6A to: TIA/EIA-568-B.2.

.2 Mount or block for housing 12 IDC terminal strips, mounted on rack or cabinet.
.1 Distribution rings or channels capable of externally mating with the above mount for managing cross-connection wires.

.3 Patch panel, 1 rack units high, 48 ports:

2.4 TERMINATION AND CROSS-CONNECTION HARDWARE FOR UTP (Cont'd)

.3 (Cont'd)
.1 Each port equipped with factory installed "RJ-45" jacks, type T568B Category 6A to: TIA/EIA-568-B.2.
.2 Horizontal cable-management unit for every 48 ports.

.4 Consolidation point, terminates 12 UTP horizontal cables from telecommunications room on IDC terminations. Cables extending to work areas terminate on IDC terminal strips RJ-45 jacks, type T568B. Category 6A to: TIA/EIA-568-B.2.

2.5 UTP CROSS-CONNECT WIRE

.1 Category 6A, 4 pairs to: TIA/EIA-568-B.2.

2.6 UTP PATCH CORDS

.1 6.0 metres long, with factory-installed male plug at one end to mate with "RJ-45" jack or terminal strip and with factory-installed male plug at other end to mate with "RJ-45" jack terminal strip Category 6A, 4 pairs to: TIA/EIA-568-B.2.

2.7 UTP EQUIPMENT CABLE

.1 4 pair "pigtail", 3.0 metres long, with factory-installed male plug on one end to mate with "RJ-45" jack and other end equipped with factory-installed male plug to mate with "RJ-45" jack, terminal strip: Category 6 to: TIA/EIA-568-B.2.

2.8 UTP WORK AREA CORDS

.1 3.0 metres long, each end equipped with "RJ-45" plug Category 6 to: TIA/EIA-568-B.2.

2.9 OPTICAL-FIBER CABLE	.1	DistributionBreakout, with conductive members, multi-mode 50/125, 500 MHz km capacity 50/125, laser-optimized, 2000 MHz km capacity 62.5/125 micron single mode, 12 strands to: CSA-C22.2 No. 232 and TIA/EIA-568- B.3, flame test classification FT6 or OFCP OFNP, each end terminated with duplex SC connectors.
2.10 CONSOLIDATION POINT FOR OPTICAL FIBER	.1	Consolidation point, terminates 12optical-fiber horizontal cables from telecommunications room on duplex SC compatible adapters.
2.11 OPTICAL-FIBER CONNECTORS AT WORK AREA	.1	Faceplate equipped with Duplex SC compatible adapters to: TIA/EIA-568-B.1.
2.12 OPTICAL-FIBER PATCH PANEL	.1	Mounted in rack or cabinet standard format, without lockable cover, capable of terminating 24 pairs of fiber, equipped with duplex SC compatible adapters.
2.13 OPTICAL-FIBER PATCH CORDS	.1	Interconnect cable, 2 strands, 6.0 metres long, each end equipped with duplex SC connectors. Multi-Mode 50/125, 500 MHz km capacity 50/125, laser-optimized, 2000 MHz km capacity 62.5/125 micron single mode to: TIA/EIA-568-B.3.
2.14 OPTICAL-FIBER WORK AREA CORDS	.1	Interconnect cable, 2 strands, metres long, each end equipped with Duplex SC connectors. Multi-Mode 50/125, 500 MHz km capacity 50/125, laser-optimized, 2000 MHz km capacity 62.5/125 micron single mode to: TIA/EIA-568-B.3.

PART 3 - EXECUTION

3.1 INSTALLATION OF TERMINATION AND CROSS-CONNECT HARDWARE

.1 Install termination and cross-connect hardware in rack or in cabinet as indicated and according to manufacturers' instructions. Identify and label as indicated to: TIA/EIA-606-A.

.2 Install consolidation points, as indicated according to manufacturer's instructions. Identify and label as indicated to: TIA/EIA-606-A.

3.2 INSTALLATION OF HORIZONTAL DISTRIBUTION CABLES

.1 Install horizontal cables as indicated in conduits, cable trays, perimeter raceways or "J" hooks from telecommunication rooms to consolidation point and individual work-area jacks or MUTOA. Identify and label as indicated to: TIA/EIA-606-A.

.2 Support horizontal cables at intervals not exceeding 2 metres.
.1 Where raceways are used to distribute cables to each zone, provide supplementary "J" hooks to support cables at intervals not exceeding 2 metres.

.3 Install horizontal cables from consolidation point to individual work-area jacks.
.1 Provide supplementary "J" hooks to support cables at intervals not exceeding 2metres.
.2 Identify and label as indicated to: TIA/EIA-606-A.

.4 Terminate horizontal cables in telecommunications room and at consolidation point and/or individual work-area jacks or MUTOA.
.1 Identify and label as indicated to: TIA/EIA-606-A.

.5 Harness slack cable in cabinets, racks, and wall-mounted termination and cross-connection hardware.

3.3 INSTALLATION OF BACKBONE CABLES

.1 Install backbone cables from each telecommunications room to main terminal/equipment room (MT/ER) as indicated and according to manufacturers' instructions.
.1 Identify and label as indicated to: TIA/EIA-606-A.

.2 Install backbone cables from MT/ER to carrier demarcation point in Entrance Room as indicated and according to manufacturer's instructions.
.1 Identify and label as indicated to: TIA/EIA-606-A.

3.4 INSTALLATION OF EQUIPMENT CABLES

.1 Install equipment cables from equipment terminal strips or patch panel as indicated.
.1 Identify and label as indicated to: TIA/EIA-606-A.

3.5 IMPLEMENT CROSS-CONNECTIONS

.1 Implement cross-connections using jumper wires or patch cords as specified.

3.6 FIELD QUALITY CONTROL

.1 Test horizontal UTP cables as specified below and correct deficiencies and provide record as hard copy or electronic record on CD.
.1 Perform tests for Permanent Link on installed cables, including spares:
.1 Category 5e using certified level IIe tester to: TIA/EIA-568-B.1.
.2 Category 6A using certified level III tester to: TIA/EIA-568-B.2.
.2 Perform tests for Channel on 20% of cross-connected data horizontal cabling installed from each telecommunications room, including shortest and longest drops from each telecommunications room: should more than 5% of tested cables fail, test remaining cross-connected data cables.
.1 Category 5e using certified level IIe tester to: TIA/EIA-568-B.1.
.2 Category 6A using certified level III tester to: TIA/EIA-568-B.2.

3.6 FIELD QUALITY CONTROL
(Cont'd)

.1 (Cont'd)

.2 (Cont'd)

.2 Test backbone UTP cables as specified below and correct deficiencies: provide record of results as hard copy electronic record on CD.

.1 Perform tests for Permanent Link on 4-pair cables:

.1 Category 5e using certified level IIe tester to: TIA/EIA-568-B.1.

.2 Category 6A using certified level III tester to: TIA/EIA-568-B.2.

.2 Perform Wire Map tests on multi-pair UTP cables to: TIA/EIA-568-B.1.

.3 Test Optical-fiber strands for attenuation to: TIA/EIA-568-B.1 and correct deficiencies: provide record of results as hard copy electronic record on CD.

.1 Test horizontal links need at only one wavelength (850 nm or 1300 nm) and in one direction.

.1 Attenuation to be less than 2.0 dB, unless consolidation point is used.

.2 If consolidation point is used, attenuation test result to be less than 2.75 dB when testing between horizontal cross-connect and telecommunications outlet/connector.

.2 Test backbone links in both directions. Backbone links:

.1 Test multi-mode fibre at both applicable wavelengths (850 nm and 1300 nm).

.2 Test single-mode fibre at both applicable wavelengths (1550 nm and 1310 m).

.3 Maximum attenuation: Cable attenuation + Connector loss + Splice loss.

.1 Multi-mode-fiber attenuation coefficients:

.1 3.5 db/km @ 850 nm; and

.2 1.5 db km @ 1300 nm

.2 Single-mode fibre attenuation coefficients at both 1310 nm and 1550 nm:

.1 1.0 db/km for inside plant cable; and

.2 0.5 db/km for outside plant cables.

3.6 FIELD QUALITY CONTROL (Cont'd)

.3 (Cont'd)
.3 (Cont'd)
.3 Maximum connector insertion loss: 0.75 db per pair and maximum splice insertion loss: 0.3 db.

.4 Perform additional Tier 2 tests using optical time domain reflectometer (OTDR) on backbone fibre pairs to: TSB-140.
.1 Correct deficiencies.
.2 Provide record of results as described in SUBMITTALS.

.5 Provide record of results as hard copy electronic record on CD to: TIA/TSB-140.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 American National Standards Institute/Telecommunications Industry Association (ANSI/TIA)
.1 ANSI/TIA-568-C.0-1-2010, Generic Telecommunications Cabling for Customer Premises.
.2 ANSI/TIA-568-C.1-2009, Commercial Building Telecommunications Cabling Standard.
.3 ANSI/TIA-568-C.3-2008, Optical Fiber Cabling Components Standard.
.4 ANSI/TIA-569-B-2004, Commercial Building Standard for Telecommunications Pathways and Spaces.

.2 CSA International
.1 CSA C22.2 No.214-08, Communications Cables (Bi-national standard, with UL 444).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

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

.3 Sustainable Design Submittals:
.1 Construction Waste Management:
.1 Submit project Waste Reduction Workplan highlighting recycling and salvage requirements.
.2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect connectors and conductors from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

.4 Develop Waste Reduction Workplan related to Work of this Section and in accordance with Section.

.5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials as specified in Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 DESIGN REQUIREMENTS

.1 Entrance facility: to ANSI/TIA-568-C.0-1, ANSI/TIA-568-C.1, ANSI/TIA-568-C.3, ANSI/TIA-569-B and CSA C22.2 No.214.

2.2 UNDERGROUND TELEPHONE CABLE TERMINALS

.1 Buried cable terminal for buried cables: base plate, cylindrical weatherproof housing, approximately 305 x 610 mm, terminal strips with binding posts and connectors.

2.2 UNDERGROUND TELEPHONE CABLE TERMINALS (Cont'd)

.2 Cable terminals for buried cables at reel ends: basic terminal designed to be driven into ground, weatherproof cover approximately 1015 mm from base to top, 2 pair terminal blocks as required, ground clamps and adhesive "ATTENTION" signs and numerals to identify cable circuits.

2.3 COAXIAL CABLE TERMINAL

.1 Outer connector nut, inside threaded, sliding over body of terminal.

.2 Terminal body, inside threaded, designed to screw on to outer sheath of cable.

2.4 OPTICAL-FIBRE TERMINAL

.1 For large installations, fibre distribution frame consisting of 2.13 m x 0.48 m equipment rack containing end and foot caps fibre routing guides horizontal jumper troughs and:
.1 connector module housings with transparent hinged door, each CMH equipped with LC connectors.
.2 splice module housings each equipped with splice trays for single-mode fibre, fusion splice.

.2 For smaller installations, rack mounted self-contained interconnect unit equipped with LC connectors, with splice tray.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for connectors and conductors installation in accordance with manufacturer's written instructions.
.1 Visually inspect substrate in presence of Departmental Representative.
.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

3.1 EXAMINATION (Cont'd)

.1 (Cont'd)

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

.1 Install drop cable terminals inside in accordance with manufacturer's instructions. Connect drop cable conductors to terminals and run ground conductor from ground terminal to building electrical system ground.

.2 Install buried cable terminals. Connect conductors in accordance with manufacturer's instructions. Replace weatherproof housing.

.3 Drive Z wire terminals into ground until base is flush with ground surface. Install cable, fasten to ground clamps and connect to terminal blocks in accordance with manufacturer's instructions.

.4 Install coaxial cable terminals in accordance with manufacturer's instructions.

.5 Install optical fibre terminals in accordance with manufacturer's instructions.

3.3 INSTALLATION OF TELEPHONE CABLES ENTRANCE

.1 Colour match conductors on terminal strips to telephone authority standard.

.2 Use appropriate tool for connecting conductors to terminals.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.4 CLEANING (Cont'd)

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by connectors and conductors installation.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section.

1.2 REFERENCE STANDARDS

.1 National Research Council Canada (NRC)
.1 National Building Code of Canada 2015 (NBC).

.2 Treasury Board of Canada Secretariat (TBS), Occupational Safety and Health (OSH)
.1 Fire Protection Standard-10.

.3 Canadian Fire Alarm Association (CFAA).

.4 Underwriter's Laboratories of Canada (ULC)
.1 CAN/ULC-S524-14, Standard for the Installation of Fire Alarm Systems.
.2 CAN/ULC-S525-16, Audible Signaling Devices for Fire Alarm Signaling Systems, Including Accessories.
.3 CAN/ULC-S526-16, Visible Signal Devices for Fire Alarm Systems, Including Accessories.
.4 CAN/ULC-S527-14, Standard for Control Units for Fire Alarm Systems.
.5 CAN/ULC-S528-14, Manual Stations for Fire Alarm Systems, Including Accessories.
.6 CAN/ULC-S529-16, Smoke Detectors for Fire Alarm Systems.
.7 CAN/ULC-S530-91(R1999), Heat Actuated Fire Detectors for Fire Alarm Systems.
.8 CAN/ULC-S531-02, Standard for Smoke Alarms.
.9 CAN/ULC-S537-13, Standard for the Verification of Fire Alarm Systems.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

1.3 ACTION AND INFORMATIONAL SUBMITTALS (Cont'd)

.2 (Cont'd)

.1 Submit manufacturer's instructions, printed product literature and data sheets for multiplex fire alarm system and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province, Canada.

.2 Indicate on shop drawings:

.1 Detail assembly and internal wiring diagrams for control units. Consoles Auxiliary cabinets.

.2 Overall system riser wiring diagram identifying control equipment initiating zones signaling circuits; identifying terminations, terminal numbers, conductors and raceways.

.3 Details for devices.

.4 Details and performance specifications for control, annunciation and peripherals with item by item cross reference to specification for compliance.

.5 Step-by-step operating sequence, cross referenced to logic flow diagram.

.4 Sustainable Design Submittals:

.1 Construction Waste Management:

.1 Submit project Waste Management Plan Waste Reduction Workplan highlighting recycling and salvage requirements.

.2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for fire alarm system for incorporation into manual.

.3 Include:

1.4 CLOSEOUT SUBMITTALS (Cont'd)

.3 (Cont'd)
.1 Instructions for complete fire alarm system to permit effective operation and maintenance.
.2 Technical data - illustrated parts lists with parts catalogue numbers.
.3 Copy of approved shop drawings with corrections completed and marks removed except review stamps.
.4 List of recommended spare parts for system.

1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect materials from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 01 35 21 - LEED Requirements.

PART 2 - PRODUCTS

2.1 DESCRIPTION

.1 Fully supervised, microprocessor-based, fire alarm system, utilizing digital techniques for data control and digital, and multiplexing techniques for data transmission.

.2 System to carry out fire alarm and protection functions; including receiving alarm signals; initiating general two-stage alarm; supervising components and wiring; actuating annunciators and auxiliary functions; initiating trouble signals and signalling to monitoring agency fire department.

.3 Zoned, non-coded coded single stage.

.4 Modular in design to allow for future expansion.

.5 Operation of system shall not require personnel with special computer skills.

.6 System to include:
.1 Central Control Unit in separate enclosure with power supply, stand-by batteries, central processor with microprocessor and logic interface, main system memory, input-output interfaces for alarm receiving, annunciation/display, and program control/signalling.
.2 Data Gathering Panels/Transponders with stand-alone capabilities.
.3 Power supplies.
.4 Initiating/input circuits.
.5 Output circuits.
.6 Auxiliary circuits.
.7 Wiring.
.8 Manual and automatic initiating devices.
.9 Audible and visual signalling devices.
.10 End-of-line resistors.
.11 LocalandRemoteannunciatorsdispla ys.
.12 PrinterEvent log memory chip.
.13 Historic event recorder.
.14 Y2K compliancy.

.7 Equipment and devices: ULC listed and labelled and supplied by single manufacturer.

2.1 DESCRIPTION (Cont'd)

.8 Power supply: to CAN/ULC-S524.

.9 Audible signal devices: to CAN/ULC-S524.

.10 Visual signal devices: to CAN/ULC-S526.

.11 Control unit: to CAN/ULC-S527.

.12 Manual pull stations: to CAN/ULC-S528.

.13 Thermal detectors: to CAN/ULC-S530.

.14 Smoke detectors: to CAN/ULC-S529.

.15 Smoke alarms: to CAN/ULC-S531.

.16 Regulatory Requirements:
.1 To TBS Fire Protection Standard.
.2 Subject to Fire Commissioner of Canada (FC) approval.
.3 Subject to FC inspection for final acceptance.
.4 To Royal Canadian Mounted Police Fire Marshal approval.
.5 System components: listed by ULC and comply with applicable provisions of NBC Local Provincial Building Code, and meet requirements of local authority having jurisdiction.

2.2 SYSTEM OPERATION: SINGLE STAGE - SIGNALS ONLY

.1 Actuation of any alarm initiating device to:
.1 Cause electronic latch to lock-in alarm state at central control unit and data gathering panel/transponder.
.2 Indicate zone of alarm at central control unit and remote annunciator display.
.3 Cause audible signalling devices to sound continuously throughout building and at central control unit.
.4 Transmit signal to fire department via master fire alarm box central station.
.5 Cause air conditioning and ventilation fans to shut down or to function to provide required control of smoke movement.
.6 Cause fire doors and smoke control doors, if normally held open, to close automatically.
.7 Cause elevators to return to floor of egress, or to alternate floor, as required.

2.2 SYSTEM OPERATION: SINGLE STAGE - SIGNALS ONLY (Cont'd)

.2 Acknowledging alarm: indicated at central control unit.

.3 Ensure that it is possible to silence signals by "alarm silence" switch at control unit, after 60 seconds period of operation.

.4 Subsequent alarm, received after previous alarm has been silenced, to re-activate signals.

.5 Actuation of supervisory devices to:
.1 Cause electronic latch to lock-in supervisory state at central control unit and data gathering panel/transponder.
.2 Indicate respective supervisory zone at central control unit and at remote annunciator display.
.3 Cause audible signal at central control unit to sound.
.4 Activate common supervisory sequence.

.6 Resetting alarm supervisory device not to return system indications/functions back to normal until control unit has been reset.

.7 Trouble on system to:
.1 Indicate circuit in trouble at central control unit.
.2 Activate "system trouble" indication, buzzer and common trouble sequence. Acknowledging trouble condition to silence audible indication; whereas visual indication to remain until trouble is cleared and system is back to normal.

.8 Trouble on system: suppressed during course of alarm.

.9 Trouble condition on any circuit in system not to initiate alarm conditions.

2.3 CONTROL PANEL

.1 Central control unit (CCU).
.1 Suitable for DCLB DCLA communication style: to CAN/ULC-S524.

2.3 CONTROL PANEL (Cont'd)

.1 (Cont'd)

.2 Features specified are minimum requirements for microprocessor-based system with digital data control and digital multiplexing techniques for data transmission.

.3 Minimum capacity of 250 500 1000 2000 3000 addressable monitoring and 250 500 1000 addressable control/signal points. Points may be divided between 2 communication channels in distributed system, each channel operating independently of other. Faults on one communication channel not to affect operation of other channel.

.4 System to provide for priority reporting levels, with fire alarm points assigned highest priority, supervisory and monitoring lower priority, and third priority for troubles. Possible to assign control priorities to control points in system to guarantee operation or allow emergency override as required.

.5 Integral power supply, battery charger and standby batteries.

.6 Basic life safety software: retained in non volatile Erasable Programmable Read-Only-Memory (EPROM). Extra memory chips: easily field-installed. Random-Access-Memory (RAM) chips in panel to facilitate password-protected field editing of simple software functions (i.e. zone labels, priorities) and changing of system operation software.

.7 Circuitry to continuously monitor communications and data processing cycles of microprocessor. Upon failure, audible and visual trouble indication to activate.

.8 Communication between CCU and remote DGP's/TPR's to be supervised, DCLB DCLA. Should communications fail between CCU and remote units, audible and visual trouble to be indicated at CCU. Data communication to be binary DC, baseband, time-division multiplex, half-duplex. Each data channel: capable of communicating up to distance of 3,000 m.

2.3 CONTROL PANEL (Cont'd)

.1 (Cont'd)

.8 (Cont'd)

.1 Communication between nodes in networked system to be supervised, DCLA. Should communications fail between any 2 nodes, other nodes on loop to continue to communicate with each other and programmed functions on communicating nodes to continue operating.

.9 Support up to 2 46 RS-232-C I/O ports. CCU output: parallel ASCII with adjustable baud rates to allow interface of any commercially available printer, terminal or PC.

.10 Equipped with software routines to provide Event-Initiated-Programs (EIP); change is status of one or more monitor points, may be programmed to operate any or all of system's control points.

.11 Software and hardware to maintain time of day, day of week, day of month, month and year.

.12 On-board, 20-column, DC strip printer, thermal head with automatic paper take-up, and silent operation; operational while system is operating on standby power. Expanded font available for selected printing conditions.

.13 Printer to record activities on system controlled by EIA RS-232-C link from within CCU.

.14 Software to operate variable sensitivity addressable smoke detectors and annunciate their status and sensitivity settings at control panel.

2.4 POWER SUPPLIES

.1 120 V, 60 Hz as primary source of power for system.

.2 Voltage regulated, current limited distributed system power.

.3 Primary power failure or power loss (less than 102 V) will activate common trouble sequence.

.4 Interface with battery charger and battery to provide uninterruptible transfer of power to standby source during primary power failure or loss.

2.4 POWER SUPPLIES (Cont'd)

.5 During normal operating conditions fault in battery charging circuit, short or open in battery leads to activate common trouble sequence and standby power trouble indicator.

.6 Standby batteries: sealed, maintenance free.

.7 Continuous supervision of wiring for external initiating and alarm circuits to be maintained during power failure.

2.5 INITIATING/INPUT CIRCUITS

.1 Receiving circuits for alarm initiating devices such as manual pull stations, smoke detectors, heat detectors and water flow switches, wired in DCLA configuration to central control unit.

.2 Alarm receiving circuits (active and spare): compatible with smoke detectors and open contact devices.

.3 Actuation of alarm initiating device: cause system to operate as specified in "System Operation".

.4 Receiving circuits for supervisory, N/O devices. Devices: wired in DCLA configuration to central control unit.

.5 Actuation of supervisory initiating device: cause system to operate as specified in "System Operation".

2.6 ALARM OUTPUT CIRCUITS

.1 Alarm output circuit: connected to signals, wired in class A configuration to central control unit.
.1 Signal circuits' operation to follow system programming; capable of sounding bells chimes horns continuously at 20 spm. Each signal circuit: rated at 2 A, 24 VDC; fuse-protected from overloading/overcurrent.
.2 Manual alarm silence, automatic alarm silence and alarm silence inhibit to be provided by system's common control.

2.7 AUXILIARY CIRCUITS

.1 Auxiliary contacts for control functions.

.2 Actual status indication (positive feedback) from controlled device.

.3 Alarm and or supervisory trouble on system to cause operation of programmed auxiliary output circuits.

.4 2 sets of separate contacts for elevator capture to main floor of egress and to alternate floor of egress.

.5 Upon resetting system, auxiliary contacts to return to normal or to operate as pre-programmed.

.6 Fans: stagger-started upon system reset; timing circuit to separate starting of each fan or set of fans connected to auxiliary contact on system.
.1 Timing circuit: controlled by CCU.

.7 Auxiliary circuits: rated at 2 A, 24 Vdc, fuse-protected.

2.8 WIRING

.1 Twisted copper conductors: rated 600 V.

.2 To initiating circuits: 18 AWG minimum, and in accordance with manufacturer's requirements.

.3 To signal circuits: 16 AWG minimum, and in accordance with manufacturer's requirements.

.4 To control circuits: 14 AWG minimum, and in accordance with manufacturer's requirements.

2.9 MANUAL ALARM STATIONS

.1 Addressable manual pull station.
.1 Pull lever, break glass rod, surface semi-flush wall mounted type, single action, single stage, electronics to communicate station's status to addressable module over 2 wires and to supply power to station. Station address to be set on station in field.

2.10 AUTOMATIC ALARM INITIATING DEVICES

.1 Addressable thermal fire detectors, combination fixed temperature and rate of rise, non-restorable fixed temperature element, self-restoring rate of rise, fixed temperature 57 88 degrees C, rate of rise 8.3 degrees C per minute.
.1 Electronics to communicate detector's status to addressable module/transponder.
.2 Detector address to be set on detector base head in field.

.2 Addressable variable-sensitivity smoke detectors.
.1 IonizationPhoto-electric type.
.2 Electronics to communicate detector's status to addressable module/transponder.
.3 Detector address to be set on detector base head in field.
.4 Sensitivity settings: 3 7 settings, determined and operated by control panel. No shifting in detector sensitivity due to atmospheric conditions (dust, dirt) within certain parameters.
.5 Ability to annunciate minimum of 2 levels of detector contamination automatically with trouble condition at control panel.

2.11 AUDIBLE SIGNAL DEVICES

.1 Horns: db, weatherproof mounting, 24 V dc.

.2 Mini-horns: db, surface flush mounting, red beige colour, 24 V dc.

2.12 VISUAL ALARM SIGNAL DEVICES

.1 Strobe type: flashing rotating, red blue, 24 V dc.

.2 Designed for surface mounting on ceiling walls as indicated.

2.13 END-OF-LINE DEVICES

.1 End-of-line devices to control supervisory current in alarm circuits and signalling circuits, sized to ensure correct supervisory current for each circuit. Open , short or ground fault in any circuit will alter supervisory current in that circuit, producing audible and visible alarm at main control panel and remotely as indicated.

2.14 REMOTE ANNUNCIATORS

.1 LEDremote alphanumeric type, with designation cards to indicate zones.

.2 Display:
.1 Alarms and troubles for alarm initiating circuits.
.2 Supervisory alarms and troublescommon supervisory alarm for supervisory initiating circuits.
.3 Common system trouble.

.3 Trouble buzzer:
.1 Acknowledging trouble at main panel to silence trouble buzzers in system.

.4 Supervised, with LED test button and alarm trouble acknowledge button.

.5 Minimum wiring configuration with main panel and other remote annunciators.

2.15 GRAPHIC DISPLAY

.1 Passive type.

2.16 REMOTE PRINTER

.1 System printer: to give a hard copy record of system events c/w following features:
.1 120 V ac, 60 Hz.
.2 80 columns.
.3 120160 cps.
.4 Utilizes fan fold paper.
.5 Connected to RS-232 output at central control panel.

2.17 REMOTE TERMINAL .1 CRT screen: 120 V, 60 Hz, to incorporate 100% solid state circuitry, with 30 cm screen and front mounted controls for brightness, contrast, vertical and horizontal hold and power ON/OFF switch.

2.18 AS-BUILT RISER DIAGRAM .1 Fire alarm system riser diagram: in glazed frame on black lamicoid sheet with bevelled edges, white lettering and designations, minimum size 600 x 600 mm.

2.19 ANCILLARY DEVICES .1 Remote relay unit to initiate fan shutdown.

2.20 PRE-ACTION PANEL .1 Provide double interlock detection interface to pre-action control panel as required with pre-action sprinkler system for the server room. Provide integrations as required with BAS.

PART 3 - EXECUTION

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

3.2 INSTALLATION .1 Install systems in accordance with CAN/ULC-S524 and TB Fire Protection Standard.

3.2 INSTALLATION (Cont'd)

.2 Install central control unit and connect to ac power supply, dc standby power.

.3 Install manual alarm stations and connect to alarm circuit wiring.

.4 Locate and install detectors and connect to alarm circuit wiring. Mount detectors more than 1 m from air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.

.5 Connect alarm circuits to main control panel.

.6 Install signal horns and visual signal devices and connect to signalling circuits.

.7 Connect signalling circuits to main control panel.

.8 Install end-of-line devices at end of signalling circuits.

.9 Install remote annunciator panels and connect to annunciator circuit wiring.

.10 Install door releasing devices.

.11 Install remote relay units to control fan shut down.

.12 Sprinkler system: wire alarm and supervisory switches and connect to control panel.

.13 Room detection system.
.1 Install detectors. Make necessary connections between room detection panel and main fire alarm panel.
.2 Locate and install audible signals visual alarms.
.3 Locate and install detectors under raised floor. Fasten to steel brackets approximately 300 mm above sub-floor level to clear cables and conduits.

.14 Connect fire suppression systems to control panel.

.15 Splices are not permitted.

3.2 INSTALLATION (Cont'd)

.16 Provide necessary raceways, cable and wiring to make interconnections to terminal boxes, annunciator equipment and CCU, as required by equipment manufacturer.

.17 Ensure that wiring is free of opens, shorts or grounds, before system testing and handing over.

.18 Identify circuits and other related wiring at central control unit, annunciators, and terminal boxes.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and CAN/ULC-S537.

.2 Fire alarm system:

.1 Test such device and alarm circuit to ensure manual stations, thermal and smoke detectors sprinkler system transmit alarm to control panel and actuate first stage alarm general alarm ancillary devices.

.2 Check annunciator panels to ensure zones are shown correctly.

.3 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of systems.

.4 Addressable circuits system style DCLA:

.1 Test each conductor on all DCLA addressable links for capability of providing 3 or more subsequent alarm signals on each side of single open-circuit fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.

.2 Test each conductor on all DCLA addressable links for capability of providing 3 or more subsequent alarm signals during ground-fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.

3.3 FIELD QUALITY CONTROL (Cont'd)

.2 (Cont'd)
.4 (Cont'd)

.3 Provide final PROM program re-burn for system Departmental RepresentativeDCC Representative Consultant incorporating program changes made during construction.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal 01 35 21 - LEED Requirements.
.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
.2 Place materials defined as hazardous or toxic waste in designated containers.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by fire alarm system installation.

3.6 CLOSEOUT ACTIVITIES

.1 Provide on-site lectures and demonstration by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.

3.7 MAINTENANCE

.1 Provide individual price on tender form for subsequent PROM re-burns. Price: good for years from date of project completion.

3.7 MAINTENANCE (Cont'd)

.2 Provide individual price on tender form for temporary program changes during construction period, to include zone labels, control functions, system operation.

END OF SECTION

Project No. : 7207528

APPENDICES

DIVISION 26

ANNEX 'A' – Section 26 24 16.01	**Lighting Fixtures**	**3 pages**
ANNEX 'B' – Section 26 50 00	**Panel Schedules**	**8 pages**

TYPE L01

108 mm DIAMETER ROUND TRIM, RECESSED MOUNT WITH HIGH PERFORMANCE, LED DOWNLIGHT AND CLEAR GLASS LENS. 1000 NOMINAL LUMENS, MEDIUM ANGLE DISTRIBUTION AND IP20 RATING SUITABLE FOR DAMP LOCATION. .NON-INSULATED INSTALL TYPE, WHITE POWDER COAT FINISH.
MODEL: LACS-120-L10-35K-CR80-W-RD-WH-DA2 OR APPROVED EQUIVALENT.

VOLTAGE:	120V
DRIVER:	DIMMABLE
LAMP:	10W LED 3500K (80 CRI)

TYPE L02

75 mm DIAMETER ROUND TRIM, RECESSED MOUNTED HIGH PERFORMANCE LED DOWNLIGHT WITH TILT CAPABILITY FOR BEAM ANGLES AND CLEAR GLASS LENS. 1000 NOMINAL LUMENS, MEDIUM ANGLE DISTRIBUTION AND IP54 RATING SUITABLE FOR WET LOCATION. NON-INSULATED INSTALL TYPE, WHITE POWDER COAT FINISH.
MODEL: LACN-120-L10-35K-CR80-W-RD-WH-DA2-RM-NA OR APPROVED EQUIVALENT.

VOLTAGE:	120V
DRIVER:	DIMMABLE 0-10V
LAMP:	13W LED 3500K (80 CRI)

TYPE L03

COMPACT EXIT WAY ARCHITECTURAL DESIGN OUTDOOR WALL SCONCE WITH HIGH PRECISION OVER-OPTIC DESIGN. LED DOWNLIGHT FOR LATERAL AND FORWARD PATTERN PROJECTIONS. DIE-CAST HOUSING AND CLEAR GLASS LENS. 3000 NOMINAL LUMENS AND IP65 RATING SUITABLE FOR OUTDOOR. BRONZE COLOUR, THERMALLY CURED, TRIGLYCIDAL ISOCIANURATE TEXTURED POLYESTER POWDER COAT FINISH.
MODEL: LYTEPRO 16 #LPW16BZ OR APPROVED EQUIVALENT

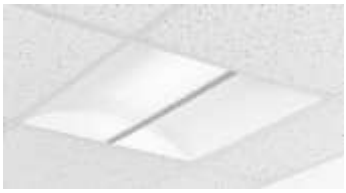
VOLTAGE:	120-277V
DRIVER:	DIMMABLE 0-10V
LAMP:	40W LED 4000K (70 CRI)

TYPE L04-X (X = LENGTH -6, -8, -12)

LINEAR TYPE LED LUMINAIRE, ANIDOLIC OPTICAL STRUCTURE WITH LINEAR LIGHT EXTRACTION ELEMENT AND HIGH TRANSMITTANCE CLEAR ACRYLIC LENSES C/W DIMMING CAPABILITIES. QUICK CONNECTORS FOR CONTINUOUS RUNS OF 50mm WIDE ALUMINUM EXTRUDED HOUSING WITH UP TO 2438mm SECTIONS AND DURABLE POWDER COAT FINISH.

MODEL: PF1-F-A-D-35-W2-W-XX-G-W1-M-03 OR APPROVED EQUIVALENT.

VOLTAGE:	120V
DRIVER:	DIMMABLE, 2700 - 6500°K
LAMP:	NOMINAL 38W/4FT LED (80 CRI)



TYPE L05

RECESSED MOUNT 610 x 610 mm, LED LUMINAIRE SUITABLE FOR T-BAR CEILING, ANIDOLIC OPTICAL STRUCTURE, EXTRUDED HIGH TRANSMITTANCE CLEAR ACRYLIC LENSES, LONG LIFE LED SYSTEM AT 50,000h. DIE FORMED STEEL HOUSING, HIGH REFLECTANCE DIFFUSE WHITE TEXTURED POWDER PAINT FINISH.

MODEL: TR1-22-C-35-F2-M OR APPROVED EQUIVALENT.

VOLTAGE:	120V
DRIVER:	HIGH EFFICIENCY, DIMMABLE 0-10V
LAMP:	38W LED, 3500K (80 CRI)

TYPE L06

ROUND FLOOD FIXTURE, WALL MOUNT WITH HIGH-PERFORMANCE, LED FLOOD / ACCENT LIGHT AND LINEAR SPREAD LENS C/W DIMMING, DMX/RDM CONTROL CAPABILITIES AND BRACKET ARMS AND SELF CONTAINED TYPE, WHITE POWDER COAT FINISH.

MODEL: LUMENBEAM #LBM-120-BLUE-NF-LSL-NO OR APPROVED EQUIVALENT.

VOLTAGE:	120-277V
DRIVER:	DIMMABLE, BLUE COLOUR OUTPUT
LAMP:	28W LED RGB (80 CRI)

TYPE L08

SURFACE/WALL MOUNT 1220 mm LED CUBE LUMINAIRE COMPLETE WITH WRAPAROUND OPAQUE LENS WITH SPRING LOAD ENDS. COLD-ROLLED STEEL AND RIGID SPRING HELD ENDS ASSEMBLY AND HIGH REFLECTANCE WHITE POLYESTER POWDER PAINT FINISH.
MODEL: PACOLIGHTING PUCO-48-LED-40-35-H0-MVOLT OR APPROVED EQUIVALENT

VOLTAGE:	120V
DRIVER:	DIMMABLE 0-10V
LAMP:	23W LED 3500K (80 CRI)

TYPE L10

50mm x 610mm, RECESSED MOUNTED HIGH PERFORMANCE LED WIDE FLOOD OPTICS CAPABILITY AND FROSTED EXTRUDED ACRYLIC LENS. 6W / FT REGULAR OUTPUT NOMINAL LUMENS, FOR DRY LOCATION ONLY. WHITE POWDER COAT FINISH.
MODEL: LLLI2R-120-SU2-dRORGB-WFL-DMX-FG-WH OR APPROVED EQUIVALENT.

VOLTAGE:	120V
DRIVER:	DIMMABLE 0-10V, RGB
LAMP:	12W LED (80 CRI)

Fed from 'ATS2'

Panel Identification: EDP
Location: MAIN ELECTRICAL ROOM 107
Main Bus/Breaker Amps: 400A

Date: June 11, 2018
Main Breaker: 300A
Supply Volts: 347/600V, 3PH, 4W
Installation: SURFACE

DESCRIPTION	WATTS	AMP.	CIR.	A B C	CIR.	AMP.	WATTS	DESCRIPTION
ROOF TOP UNIT 'RTU-1'	6,678	30	1		2	90	28,804	ELECTRICAL PANEL ERP1
	6,678		3		4		28,804	
	6,678		5		6		28,804	
ROOF TOP UNIT 'RTU-3'	6,678	30	7		8	150	19,201	UPS UNIT - RM 110
	6,678		9		10		19,201	
	6,678		11		12		19,201	
5hp AIR COMPRESSOR	1,834	20	13		14			SPARE
	1,834		15		16	20		
	1,834		17		18			
SPACE			19		20	20	4,000	2 FF Heaters - Rms 100, 107
			21		22	20	5,000	5 BASEBOARD HEATERS
			23		24	20		SPARE
SPACE			25		26			SPACE
			27		28			
			29		30			
SPACE			31		32			SPACE
			33		34			
			35		36			
SPACE			37		38			SPACE
			39		40			
			41		42			

Total Phase A	67.19	kW	<GFI> =	Ground fault detector
Total Phase B	68.19	kW	<k> =	Breaker locking device
Total Phase C	63.19	kW	**Total Panel Load :**	198.58 kW

Fed from ATS1/TR1

Panel Identification: LS1 — **Date:** June 11, 2018

Location: MAIN ELECTRICAL ROOM — **Main Breaker:** 100A

Main Bus: 100A — **Supply Volts:** 120/208V, 3PH, 4W

Installation: SURFACE

DESCRIPTION	WATTS	AMP.	CIR.	A B C	CIR.	AMP.	WATTS	DESCRIPTION
EXTERIOR LIGHTS	800	15	1	*	2	20	490	CORRIDOR/TOILET LIGHTS
RM. 103, 104, 119 LIGHTS	458	15	3	*	4	15	274	RM. 118, 119, 121 LIGHTS
RM. 117 LIGHTS	69	15	5	*	6	15 k	100	EXIT LIGHT
SPARE		15	7	*	8	15 k	300	Smoke Dampers - Rm 103
SPARE		15	9	*	10	15		SPARE
SPARE		15	11	*	12	15		SPARE
SPARE		15	13	*	14	15		SPARE
SPARE		15	15	*	16	15 k	200	BATTERY UNIT
SPARE		15	17	*	18	15 k	500	FIRE ALARM CONTROL PANEL
SPACE			19	*	20	100	2,027	LS2 ELECTRICAL PANEL
SPACE			21	*	22		2,027	
SPACE			23	*	24		2,027	

Total Phase A 4 kW

Total Phase B 3 kW

Total Phase C 3 kW

<GFI> = Ground fault detector

<k> = Breaker locking device

Total Panel Load : 9.27 kW

Fed from ATS1/TR1/LS1

Panel Identification: LS2
Location: ELEC/MECH ROOM 129
Main Bus: 100A

Date: June 11, 2018
Main Breaker: 100A
Supply Volts: 120/208V, 3PH, 4W
Installation: SURFACE

DESCRIPTION	WATTS	AMP.	CIR.	A B C	CIR.	AMP.	WATTS	DESCRIPTION
BLUE LIGHT	188	15	1	_.-._ _*__|__|_ _.-._	2	20	150	EXIT SIGNS
BLUE LIGHT	164	15	3	_.-._ _|__*__|_ _.-._	4	15	728	LIGHTING
BLUE LIGHT	70	15	5	_.-._ _|__|__*_ _.-._	6	15	900	LIGHTING
LIGHTING ROOM 121B	320	15	7	_.-._ _*__|__|_ _.-._	8	15	544	LIGHTING
LIGHTING ROOM 121B	420	15	9	_.-._ _|__*__|_ _.-._	10	15	1,008	LIGHTING
SPARE		15	11	_.-._ _|__|__*_ _.-._	12	15	1,008	LIGHTING
SPARE		15	13	_.-._ _*__|__|_ _.-._	14	15	380	LIGHTING
SPARE		15	15	_.-._ _|__*__|_ _.-._	16	15 k	200	FIRE ALARM PANEL - RM 129
SPARE		15	17	_.-._ _|__|__*_ _.-._	18	15		SPARE
SPACE			19	_.-._ _*__|__|_ _.-._	20			SPACE
SPACE			21	_.-._ _|__*__|_ _.-._	22			SPACE
SPACE			23	_.-._ _|__|__*_ _.-._	24			SPACE

Total Phase A 2 kW
Total Phase B 3 kW
Total Phase C 2 kW

<GFI> = Ground fault detector
<k> = Breaker locking device
Total Panel Load : 6.08 kW

Fed from EDP

Panel Identification: ERP1
Location: MAIN ELECTRICAL ROOM
Main Bus: 225A

Date: June 11, 2018
Main Breaker: 200A
Supply Volts: 120/208V, 3PH, 4W
Installation: SURFACE

DESCRIPTION	WATTS	AMP.	CIR.	A B C	CIR.	AMP.	WATTS	DESCRIPTION
Receptacle - Rm 102	400	15	1	*	2	20	500	5 Utility Receptacles
Receptacle - Rm 102	400	15	3	*	4	15	200	Washroom Receptacles (2)
Receptacle - Rm 102	400	15	5	*	6	15	200	2 Receptacles - Room 108
Receptacle - Rm 102	400	15	7	*	8	15	200	2 receptacles - TV
Receptacle - Rm 102	400	15	9	*	10	15	500	Mechanical Power Supply
2 Receptacles - Rms 108, 109	200	15	11	*	12	20	400	2 Receptacles - Rm 107
H2O & Recirc. Pump - Rm 107	500	15	13	*	14	20	400	2 Receptacles - Rm 110
Roof Receptacle	200	20	15	*	16	15	1,000	Dishwasher
Roof Receptacle	200	20	17	*	18	15	700	Microwave
Roof Receptacle	200	20	19	*	20	40	3263	ROOF TOP UNIT RTU-2
Hand Dryer - Rms 104, 105	1,350	20	21	*	22		3263	
	1,350		23	*	24		3263	
Assistance Station - Parking	500	15	25	*	26	25	1404	Roof Top Unit CU-1 + A/C/1
Split Receptacle - Rm 108	200	15	27	*	28		1404	
	200	15	29	*	30	25	1404	Roof Top Unit CU-2 + A/C-2
Split Receptacle - Rm 108	200	15	31	*	32		1404	
	200	15	33	*	34	25	1404	Roof Top Unit CU-3 + A/C-3
Split Receptacle - Rm 108	200	15	35	*	36		1404	
	200	15	37	*	38	15		SPARE
Fridge - room 108		15	39	*	40	15		SPARE
SPARE		15	41	*	42	15		SPARE
SPACE			43	*	44	15		SPARE
SPACE			45	*	46	15		SPARE
SPACE			47	*	48	15		SPARE
SPACE			49	*	50		11,400	
SPACE			51	*	52	100	11,400	ERP2 PANEL - RM 129
SPACE			53	*	54		11,400	
SPACE			55	*	56		7,400	
SPACE			57	*	58	100	7,400	ERP3 PANEL - RM 129
SPACE			59	*	60		7,400	
SPACE			61	*	62			SPACE
SPACE			63	*	64			SPACE
SPACE			65	*	66			SPACE
SPACE			67	*	68			SPACE
SPACE			69	*	70			SPACE
SPACE			71	*	72			SPACE

Total Phase A 28 kW
Total Phase B 29 kW
Total Phase C 29 kW

<GFI> = Ground fault detector
<k> = Breaker locking device
Total Panel Load : 86.41 kW

Fed from EPR1

Panel Identification: ERP2
Location: ELECTRICAL ROOM 129
Main Bus: 100A

Date: September 27, 2016
Main Breaker: 100A
Supply Volts: 120/208V, 3PH, 4W
Installation: SURFACE

DESCRIPTION	WATTS	AMP.	CIR.	A B C	CIR.	AMP.	WATTS	DESCRIPTION
Perimeter Station Recepts	800	15	1	*	2	15	800	Perimeter Station Recepts
Perimeter Station Recepts	800	15	3	*	4	15	800	Perimeter Station Recepts
Perimeter Station Recepts	800	15	5	*	6	15	800	Perimeter Station Recepts
Perimeter Station Recepts	800	15	7	*	8	15	800	Perimeter Station Recepts
Perimeter Station Recepts	800	15	9	*	10	15	800	Perimeter Station Recepts
2 Corner Television Stations	200	15	11	*	12	15	800	Perimeter Station Recepts
Perimeter Station Recepts	800	15	13	*	14	15	800	Perimeter Station Recepts
Perimeter Station Recepts	800	15	15	*	16	15	800	Perimeter Station Recepts
Perimeter Station Recepts	800	15	17	*	18	15	800	Perimeter Station Recepts
Perimeter Station Recepts	800	15	19	*	20	15	800	Perimeter Station Recepts
Perimeter Station Recepts	800	15	21	*	22	15	800	Perimeter Station Recepts
Floor Receptacles	800	20	23	*	24	15	800	Perimeter Station Recepts
Perimeter Station Recepts	800	15	25	*	26	15	800	Perimeter Station Recepts
Perimeter Station Recepts	800	15	27	*	28	20	800	Perimeter Ptr Station Rec.
Perimeter Station Recepts	800	15	29	*	30	15	800	Perimeter Station Recepts
Perimeter Station Recepts	800	15	31	*	32	15	800	Perimeter Station Recepts
Perimeter Station Recepts	800	15	33	*	34	15	800	Perimeter Station Recepts
Perimeter Station Recepts	800	15	35	*	36	15	200	2 Corcer Television Stations
Perimeter Station Recepts	800	15	37	*	38	15	800	Perimeter Station Recepts
Perimeter Station Recepts	800	15	39	*	40	15	800	Perimeter Station Recepts
Perimeter Station Recepts	800	15	41	*	42	15	800	Perimeter Station Recepts
Perimeter Ptr Station Rec.	800	20	43	*	44	15	800	Perimeter Station Recepts
Receptacle room 129	200	20	45	*	46	15		SPARE
SPARE		15	47	*	48	15		SPARE
SPARE		15	49	*	50	15		SPARE
SPARE		15	51	*	52	15		SPARE
SPARE		15	53	*	54	15		SPARE
SPACE			55	*	56			SPACE
SPACE			57	*	58			SPACE
SPACE			59	*	60			SPACE
SPACE			61	*	62			SPACE
SPACE			63	*	64			SPACE
SPACE			65	*	66			SPACE
SPACE			67	*	68			SPACE
SPACE			69	*	70			SPACE
SPACE			71	*	72			SPACE

Total Phase A 12.80 kW
Total Phase B 11.40 kW
Total Phase C 10.00 kW

<GFI> = Ground fault detector
<k> = Breaker locking device
Total Panel Load : 34.20 kW

Fed from ERP1

Panel Identification: ERP3
Location: ELEC/MECH ROOM 129
Main Bus: 100A

Date: June 11, 2018
Main Breaker: 100A
Supply Volts: 120/208V, 3PH, 4W
Installation: SURFACE

DESCRIPTION	WATTS	AMP.	CIR.	A B C	CIR.	AMP.	WATTS	DESCRIPTION
Dedicated Recept. - Rm 127	500	20	1	*	2	15	600	Desk Receptacle - Rm 121B
Dedicated Recept. - Rm 127	500	20	3	*	4	15	600	Desk Receptacle - Rm 121B
Dedicated Recept. - Rm 127	500	20	5	*	6	15	600	Desk Receptacle - Rm 121B
Dedicated Recept. - Rm 127	500	20	7	*	8	15	600	Desk Receptacle - Rm 121B
Dedicated Recept. - Rm 127	500	20	9	*	10	15	600	Desk Receptacle - Rm 121B
Dedicated Recept. - Rm 127	500	20	11	*	12	15	600	Desk Receptacle - Rm 121B
Dedicated Recept. - Rm 127	500	20	13	*	14	15	600	Desk Receptacle - Rm 121B
Dedicated Recept. - Rm 127	500	20	15	*	16	15	600	Desk Receptacle - Rm 121B
Service recept. - Rm 121B	200	20	17	*	18	15	300	Column Recep. - Rm 121B
Podium Receptacle - Rm 121B	300	15	19	*	20	15	600	Desk Receptacle - Rm 121B
Podium Receptacle - Rm 121B	600	15	21	*	22	15	600	Desk Receptacle - Rm 121B
Desk Receptacle - Rm 121B	600	15	23	*	24	15	600	Desk Receptacle - Rm 121B
Desk Receptacle - Rm 121B	600	15	25	*	26	15	600	Desk Receptacle - Rm 121B
Desk Receptacle - Rm 121B	600	15	27	*	28	15	600	Desk Receptacle - Rm 121B
Desk Receptacle - Rm 121B	600	15	29	*	30	15	600	Desk Receptacle - Rm 121B
Desk Receptacle - Rm 121B	600	15	31	*	32	15	600	Desk Receptacle - Rm 121B
Desk Receptacle - Rm 121B	600	15	33	*	34	15	600	Desk Receptacle - Rm 121B
SPARE		15	35	*	36	15	600	Desk Receptacle - Rm 121B
SPARE		15	37	*	38	15		SPARE
SPARE		15	39	*	40	15		SPARE
SPARE		15	41	*	42	15		SPARE
SPARE		15	43	*	44	15		SPARE
SPARE		15	45	*	46	15		SPARE
SPARE		15	47	*	48	15		SPARE
SPARE		15	49	*	50	15		SPARE
SPARE		15	51	*	52	15		SPARE
SPARE		15	53	*	54	15		SPARE
SPACE			55	*	56			SPACE
SPACE			57	*	58			SPACE
SPACE			59	*	60			SPACE
SPACE			61	*	62			SPACE
SPACE			63	*	64			SPACE
SPACE			65	*	66			SPACE
SPACE			67	*	68			SPACE
SPACE			69	*	70	20	1,500	2kW FF Heaters - Rms 140, 141
SPACE			71	*	72		1,500	

Total Phase A 6.60 kW
Total Phase B 8.40 kW
Total Phase C 7.20 kW

<GFI> = Ground fault detector
<k> = Breaker locking device
Total Panel Load : 22.20 kW

Fed from UPS

Panel Identification: UPS1 | **Date:** June 11, 2018

Location: ROOM 110 | **Main Breaker:** 60A

Main Bus: 100A | **Supply Volts:** 120/208V, 3PH, 4W

Installation: SUSFACE

DESCRIPTION	WATTS	AMP.	CIR.	A B C	CIR.	AMP.	WATTS	DESCRIPTION
Dedicated Recept. - Rm 101	500	15	1	*	2	15	750	Dedicated Recept. - Rm 101
Dedicated Recept. - Rm 101	500	15	3	*	4	15	750	Dedicated Recept. - Rm 101
Dedicated Recept. - Rm 101	800	15	5	*	6	20	1,000	Ded. Twist Recept. - Rm 101
Dedicated Recept. - Rm 101	500	15	7	*	8	15		SPARE
Ded. Twist Recept. - Rm 101	1,000	20	9	*	10	15		SPARE
SPARE		15	11	*	12	15		SPARE
SPARE		15	13	*	14	15		SPARE
SPARE		15	15	*	16	15		SPARE
SPARE		15	17	*	18	15		SPARE
SPACE			19	*	20			SPACE
SPACE			21	*	22			SPACE
SPACE			23	*	24			SPACE

Total Phase A	**9.45**	**kW**	**<GFI> = Ground fault detector**
Total Phase B	**8.11**	**kW**	**<k> = Breaker locking device**
Total Phase C	**7.70**	**kW**	**Total Panel Load : 25.26 kW**

Fed from UPS

Panel Identification: UPS2 — **Date:** June 11, 2018

Location: ELECTRICAL ROOM 129 — **Main Breaker:** 60A

Main Bus: 100A — **Supply Volts:** 120/208V, 3PH, 4W

Installation: SUSFACE

DESCRIPTION	WATTS	AMP.	CIR.	A B C	CIR.	AMP.	WATTS	DESCRIPTION
Receptacles - Rm 121C	300	15	1		2	15	300	Receptacles - Rm 121A
Receptacles - Rm 121C	300	15	3		4	15	300	Receptacles - Rm 121A
Receptacles - Rm 121C	300	15	5		6	15	300	Receptacles - Rm 121A
H-Frame Receptacle - Rm 124	800	20	7		8	15	200	Backing Plywd Rec - Rm 124
H-Frame Receptacle - Rm 124	800	20	9		10	20	200	Column Recept. - Rm 124
H-Frame Receptacle - Rm 124	1,000	20	11		12	20	300	Floor receptacles - Rm 124
H-Frame Receptacle - Rm 124	800	20	13		14	30	1,560	RF SHIELD ENCLOSURE - A
H-Frame Receptacle - Rm 124	800	20	15		16		1,560	
SPARE		15	17		18	15		SPARE
SPARE		15	19		20	15		SPARE
SPARE		15	21		22	30	1,560	RF SHIELD ENCLOSURE - B
SPARE		15	23		24		1,500	

Total Phase A	11.66	kW	<GFI> =	Ground fault detector
Total Phase B	11.38	kW	<k> =	Breaker locking device
Total Phase C	9.30	kW	Total Panel Load :	32.34 kW