PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Division 01 – General Requirements.

.2 Section 21 05 01 – Common Work Results for Fire Suppression.

.3 Section 23 05 00 - Common Work Results for HVAC.

.4 Section 25 05 60 - EMCS: Field Installations.

.5 Section 25 30 01 - EMCS: Building Controllers.

.6 Section 25 30 02 - EMCS: Field Control Devices.

.7 Section 25 90 01 - EMCS: Site Requirements, Application and System Sequences of Operation.

1.2 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, in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal materials from landfill to metal facility as approved by Departmental Representative.

.5 Fold up metal banding, flatten and place in designated area for recycling.

1.3 SUMMARY

.1 Section Includes:

.1 General requirements for building Energy Monitoring and Control System (EMCS) that are common to EMCS Sections.

.2 Sustainable requirements for construction and verification.

1.4 REFERENCES

.1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA):

.1 ANSI/ISA 5.5-2009, 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-Z234.1-00(R2006), Canadian Metric Practice Guide.

.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.

1.5 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 OWS - Operator Work Station.
.31 PC - Personal Computer.
.32 PCI - Peripheral Control Interface.
.33 PCMCIA - Personal Computer Micro-Card Interface Adapter.
.34 PID - Proportional, Integral and Derivative.
.35 RAM - Random Access Memory.
.36 SP - Static Pressure.
.37 ROM - Read Only Memory.
.38 TCU - Terminal Control Unit.
.39 USB - Universal Serial Bus.
.40 UPS - Uninterruptible Power Supply.
.41 VAV - Variable Air Volume.

1.6 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 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 shortforms 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 shortform 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 Include additional point identifier expansion fields of equal capacity for each point name.

.4 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 to Division 25.

1.7 SYSTEM DESCRIPTION

.1 Refer to control schematics for system architecture.

.2 Work covered by sections referred to above consists of fully operational EMCS, including, but not limited to, following:

.1 Building Controllers.
.2 Control devices as listed in I/O point summary tables.
.3 Data communications equipment necessary to effect EMCS data transmission system.
.4 Field control devices.
.5 Software/Hardware complete with full documentation.
.6 Complete operating and maintenance manuals.
.7 Training of personnel.
.8 Acceptance tests, technical support during commissioning, full documentation.
.9 Wiring interface co-ordination of equipment supplied by others.
.10 Miscellaneous work as specified in these sections and as indicated.
.11 Provide additional controls as described within this specification.

.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 Representative prior to installation.
.3 Location of controllers as reviewed by Departmental Representative prior to installation.
.4 Provide utility power to EMCS and emergency power to EMCS as indicated.

.5 Metric references: in accordance with CAN/CSA Z234.1.

.4 Language Operating Requirements

.1 Provide English operator selectable access codes.

.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 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.

1.8 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 – Submittal Procedures and Section 25 05 02 – EMCS: Submittals and Review Process.

.2 Co-ordinate submittal requirements and provide submittals as required.

.3 Submit for review:

.1 Equipment list and systems manufacturers within 48 h within ten (10) days after award of contract.

.2 List existing field control devices to be re-used included in bid tender, along with unit price.

.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.

.3 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 01 33 00 – Submittal Procedures and Section 25 05 02 EMCS: Submittals and Review Process. Label or listing of specified organization is acceptable evidence.

.4 In lieu of such evidence, submit certificate from testing organization, approved by Departmental Representative, certifying that item was tested in accordance with their test methods, and that, the item 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 Section 01 10 10 – General Instructions as well as 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 to Departmental Representative.

1.9 QUALITY ASSURANCE

.1 Ensure trained personnel is capable of providing instruction, routine maintenance and emergency service on systems.

.2 Provide record of successful previous installations submitting tender showing experience with similar installations utilizing computer-based systems.

.3 Have access to local supplies of essential parts and provide seven (7) year guarantee of availability of spare parts after obsolescence.

.4 Ensure qualified supervisory personnel continuously direct and monitor work and attend site meetings on a regular basis.

.5 Health and Safety:

.1 Complete construction occupational health and safety in accordance with Division 01.

.2 Sustainable Requirements:

.1 Construction requirements: in accordance as Division 01.

.2 Verification: contractor's verification in accordance with Division 01.

1.10 DELIVERY, STORAGE AND HANDLING

.1 Material Delivery Schedule: provide Departmental Representative with schedule within two (2) weeks after award of Contract.

PART 2 PRODUCTS

2.1 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Division 01.

2.2 EQUIPMENT

.1 Control Network Protocol and Data Communication Protocol: to CEA 709.1 ASHRAE STD 135 “Native BACnet”.

.2 Complete list of equipment and materials to be used on project and forming part of bid tender documents by adding manufacturer's name, model number and details of materials, and submit for approval.

2.3 ADAPTERS

.1 Provide adaptors between metric and imperial components.

PART 3 EXECUTION

3.1 MANUFACTURER’S RECOMMENDATIONS

.1 Installation: to manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

.1 Verification requirements in accordance with Division 01.

- .1 Materials and resources.
- .2 Storage and collection of recyclables.

3.3 COMMISSIONING

.1 Provide labour & material to participate in commissioning activities as indicated in these documents.

END

PART 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Requirements and procedures for identification of devices, sensors, wiring tubing, conduit and equipment, for building Energy Monitoring and Control System (EMCS) Work and nameplates materials, colours and lettering sizes.

1.2 RELATED SECTIONS

.1 Division 01 - General Requirements.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 25 05 01 - EMCS: General Requirements.

1.3 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.

1.4 DEFINITIONS

.1 For acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.5 SYSTEM DESCRIPTION

.1 Language Operating Requirements: provide identification for control items in English.

1.6 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures supplemented and modified by requirements of this Section.

.2 Submit to Departmental Representative for approval samples of nameplates, identification tags and list of proposed wording.

PART 2 PRODUCTS

2.1 NAMEPLATES FOR PANELS

.1 Identify by Plastic laminate, 3 mm thick Melamine, matt white finish, 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 chain 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 Representative.

.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 Representative's.

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 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 Representative 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 EXISTING PANELS

.1 Correct existing nameplates and legends to reflect changes made during Work.

END

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Division 01 – General Requirements.

.2 Section 22 05 00 – Common Work Results for Plumbing.

.3 Section 23 05 00 – Common Work Results for HVAC.

.4 Section 26 05 00 – Common Work Results Electrical.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 21 Construction 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 Divert unused metal materials from landfill to metal facility as approved by Departmental Representative.

.5 Fold up metal banding, flatten and place in designated area for recycling.

1.3 REFERENCES

.1 American National Standards Institute (ANSI)

.1 ANSI/ASME B16.22-2001, Wrought Copper and Copper Alloy Solder Joint Pressures Fittings.
.2 ANSI C2-1990, National Electrical Safety Code.
.3 ANSI/NFPA 70-2008, National Electrical Code.

.2 Canadian Standards Association (CSA)

.1 CSA C22.1-2006, Canadian Electrical Code, Part 1.
.2 CAN/CSA C22.3No.1-M87, Overhead Systems.

1.4 SYSTEM DESCRIPTION

.1 Electrical

.1 Provide power wiring from existing emergency power panels to EMCS field panels. Circuits to be for exclusive use of EMCS equipment. Panel breakers to be identified on panel legends tagged and locks applied to breaker switches.
.2 Hard wiring between field control devices and EMCS field panels.

.2 Mechanical

.1 Pipe Taps Required for EMCS equipment will be supplied and installed by Mechanical Contractor.
.2 Wells and Control Valves Shall Be Supplied by EMCS Contractor and Installed by Mechanical Contractor.
.3 Installation of air flow stations, dampers, and other devices requiring sheet metal trades to be mounted by Mechanical Contractor. Costs to be carried by designated trade.

1.5 PERSONNEL QUALIFICATIONS

.1 Qualified supervisory personnel to:

.1 Continuously direct and monitor all work.
.2 Attend site meetings.

PART 2 PRODUCTS

2.1 WIRING

.1 As per requirements of Division 26.

.2 Division 26 will leave four (4) at 20 V, 20 amp breakers in Power Panels throughout the building. Section 25 05 01 - EMCS: General Requirements will use these as power source and be responsible for providing power to EMCS equipment to standard set out in Division 26.

.3 For 70V and above copper conductor with chemically cross-linked thermosetting polyethylene insulation rated RW90 and 600V. Colour code to CSA 22.1.

.4 Sizes

.1 120V Power supply: to match or exceed breaker, size #12 minimum.
.2 Wiring for safeties/interlocks for starters, motor control centres, to be stranded, #14 minimum.
.3 Field wiring to digital device: #18AWG 20AWG stranded twisted pair.
.4 Analog input and output: shielded #18 minimum solid copper #20 minimum stranded twisted pair. Wiring must be continuous without joints.
.5 More than 4 conductors: #22 minimum solid copper.

.5 Terminations

.1 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

2.2 CONDUIT

.1 As per requirements of Division 26.

.2 Electrical metallic tubing to CSA C22.2 83. Flexible and liquid tight flexible metal conduit to CSA C22.2 56. Rigid steel threaded conduit to CSA C22.2 45.

.3 Junction and Pull Boxes

.1 Welded Steel:
.1 Surface mounting cast FS: screw-on flat covers.
.2 Flush mounting: covers with 25 mm minimum extension all round.

.4 Cabinets

.1 Sheet steel, for surface mounting, with hinged door, latch lock, 2 keys, complete with perforated metal mounting backboard.
.2 Panels to be keyed alike for similar functions and or entire contract as approved.

.5 Outlet Boxes

.1 100 mm minimum, square.

.6 Conduit Boxes, Fittings

.1 Bushings and connectors: with nylon insulated throats.
.2 With push pennies to prevent entry of foreign materials.

.7 Fittings for Rigid Conduit

.1 Couplings and Fittings: threaded type steel.
.2 Double Locknuts and Insulated Bushings: use on sheet metal boxes.
.3 Use factory "ells" where 90° bends required for 25mm and larger conduits.

.8 Fittings for Thin Wall Conduit

.1 Connectors and couplings: steel, set screw type.

2.3 WIRING DEVICES AND COVER PLATES

.1 Starters are generally by Division 26 except where indicated otherwise all VFD’s are to by Section 25 05 01 - EMCS: General Requirements.

.2 Conform to CSA.

.3 Receptacles

.1 Duplex: CSA type 5-15R.
.2 Single: CSA type 5-15R.
.3 Cover plates and blank plates: finish to match other plates in area.

2.4 STARTERS AND CONTROL DEVICES

.1 Across-The-Line Magnetic Starters

.1 Enclosures: CSA Type 1, except where otherwise specified (refer also to Variable Speed Drives).
.2 Size, Type and Rating: to suit motors.

.2 Starter Diagrams

.1 Provide copy of wiring and schematic diagrams - mount one copy in each starter with additional copies for Operation and Maintenance Manual.

.3 Auxiliary Control Devices

.1 Control Transformers: 60 Hz, primary voltage to suit supply, 120 V single phase secondary, VA rating to suit load plus 20% margin.
.2 Auxiliary Contacts: one "Normally Open" and one "Normally Closed" spare auxiliary contact in addition to maintained auxiliary contacts as indicated.
.3 Hand-Off-Automatic Switch: heavy duty type, knob lever operator.
.4 Double Voltage Relays: with barrier to separate relay contacts from operating magnet. Operating coil voltage and contact rating as indicated.

.4 Finish For Starters

.1 Exterior: in accordance with Section 26 05 00 - Common Work Results Electrical.
.2 Interior: white.

2.5 SUPPORTS FOR CONDUIT, FASTENINGS, EQUIPMENT

.1 Solid masonry, tile and plastic surfaces: lead anchors or nylon shields

.1 Hollow masonry walls, suspended drywall ceilings: toggle bolts.

.2 Exposed Conduits or Cables

.1 50 mm Diameter and Smaller: one-hole steel straps.
.2 Larger than 50 mm Diameter: two-hole steel straps.

.3 Suspended Support Systems

.1 Individual cable or conduit runs: support with 6 mm diameter threaded rods and support clips.
.2 Two or more suspended cables or conduits: support channels supported by 6 mm diameter threaded rod hangers.

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.

3.2 ELECTRICAL GENERAL

.1 Do complete installation in accordance with requirements of:

.1 Division 26 and this specification.
.2 CSA 22.1 Canadian Electrical Code.
.3 ANSI/NFPA 70.
.4 ANSI C2.

.2 Fully enclose or properly guard electrical wiring, terminal blocks, high voltage above 70 V contacts and mark to prevent accidental injury.

.3 Do underground installation to CAN/CSA C22.3 No.7, except where otherwise specified.

.4 Conform to manufacturer's recommendations for storage, handling and installation.

.5 Check factory connections and joints. Tighten where necessary to ensure continuity.

.6 Install electrical equipment between 1000 mm and 2000 mm above finished floor wherever possible and adjacent to related equipment.

.7 Protect exposed live equipment such as panel, mains, outlet wiring during construction for personnel safety.

.8 Shield and mark live parts "LIVE 120 VOLTS" or other appropriate voltage.

.9 Install conduits, and sleeves prior to pouring of concrete.

.10 Holes through exterior wall and roofs: flash and make weatherproof.

.11 Make necessary arrangements for cutting of chases, drilling holes and other structural work required to install electrical conduit, cable, pull boxes, outlet boxes.

.12 Install cables, conduits and fittings which are to be embedded or plastered over, neatly and closely to building structure to minimize furring.

3.3 CONDUIT SYSTEM

.1 Communication wiring shall be installed in conduit. Provide complete conduit system to link Building Controllers to BECC. Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems. Maximum conduit fill not to exceed 40%. Design drawings do not show conduit layout.

.2 Install conduits parallel or perpendicular to building lines, to conserve headroom and to minimize interference.

.3 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Obtain approval from Departmental Representative before starting such work. Provide complete conduit system to link field panels and devices with main control centre. Conduit size to match conductors plus future expansion capabilities as specified.

.4 Locate conduits at least 150 mm from parallel steam or hot water pipes and at least 50 mm at crossovers.

.5 Bend conduit so that diameter is reduced by less than 1/10th original diameter.

.6 Field thread on rigid conduit to be of sufficient length to draw conduits up tight.

.7 Limit conduit length between pull boxes to less than 30 m.

.8 Use conduit outlet boxes for conduit up to 32 mm diameter and pull boxes for larger sizes.

.9 Fastenings and supports for conduits, cables, and equipment:

- .1 Provide metal brackets, frames, hangers, clamps and related types of support structures as indicated and as required to support cable and conduit runs.
- .2 Provide adequate support for raceways and cables, sloped vertically to equipment.
- .3 Use supports or equipment installed by other trades for conduit, cable and raceway supports only after written approval from Departmental Representative,

.10 Install polypropylene fish cord in empty conduits for future use.

.11 Where conduits become blocked, remove and replace blocked sections.

.12 Pass conduits through structural members only after receipt of Departmental Representative's written approval.

.13 Conduits may be run in flanged portion of structural steel.

.14 Group conduits wherever possible on suspended or surface channels.

.15 Pull boxes:

.1 Install in inconspicuous but accessible locations.
.2 Support boxes independently of connecting conduits.
.3 Fill boxes with paper or foam to prevent entry of construction material.
.4 Provide correct size of openings. Reducing washers not permitted.
.5 Mark location of pull boxes on record drawings.
.6 Identify AC power junction boxes, by panel and circuit breaker.

.16 Install terminal blocks or strips as specified by Division 26.

.17 Install bonding conductor for 120 volt and above in conduit.

3.4 WIRING

.1 Install multiple wiring in ducts simultaneously.

.2 Do not pull spliced wiring inside conduits or ducts.

.3 Use CSA certified lubricants of type compatible with insulation to reduce pulling tension.

.4 Tests: use only qualified personnel. Demonstrate that:

.1 Circuits are continuous, free from shorts, unspecified grounds.
.2 Resistance to ground of all circuits is greater than 50 Megohms.

.5 Provide Departmental Representative with test results showing locations, circuits, results of tests.

.6 Remove insulation carefully from ends of conductors and install to manufacturer's recommendations. Accommodate all strands in lugs. Where insulation is stripped in excess, neatly tape so that only lug remains exposed.

.7 Wiring in main junction boxes and pull boxes to terminate on terminal blocks only, clearly and permanently identified. Junctions or splices not permitted for sensing or control signal covering wiring.

.8 Do not allow wiring to come into direct physical contact with compression screw.

.9 Install ALL strands of conductor in lugs of components. Strip insulation only to extent necessary for installation.

3.5 WIRING DEVICES AND COVER PLATES

.1 Receptacles:

.1 Install vertically in gang type outlet box when more than one receptacle is required in one location.

.2 Cover plates:

.1 Install suitable common cover plate where wiring devices are grouped.

.2 Use flush type cover plates only on flush type outlet boxes.

3.6 STARTERS AND CONTROL DEVICES

.1 Install and make power and control connections as indicated.

.2 Install correct over-current devices.

.3 Identify each wire, terminal for external connections with permanent number marking identical to diagram.

.4 Performance Verification:

.1 Operate switches and controls to verify functioning.

.2 Perform start and stop sequences of contactors and relays.

.3 Check that interlock sequences, with other separate related starters, equipment and auxiliary control devices, operate as specified.

3.7 GROUNDING

.1 Install complete, permanent, continuous grounding system for equipment, including conductors, connectors and accessories.

.2 Install separate grounding conductors in conduit within building.

.3 Install ground wire in all PVC ducts and in tunnel conduit systems.

.4 Tests: perform ground continuity and resistance tests, using approved method appropriate to site conditions.

3.8 TESTS

.1 General:

.1 Perform following tests in addition to tests specified Section 25 08 20 - EMCS: Warranty and Maintenance.

.2 Give 14 days written notice of intention to test.

.3 Conduct in presence of Departmental Representative and authority having jurisdiction.

.4 Conceal work only after tests satisfactorily completed.

.5 Report results of tests to Departmental Representative in writing.

.6 Preliminary Tests:

.1 Conduct as directed to verify compliance with specified requirements.

.2 Make needed changes, adjustments, replacements.

.3 Insulation resistance tests:

.1 Megger all circuits, feeders, equipment for 120 - 600V with 1000V instrument. Resistance to ground to be more than required by Code before energizing.

.2 Test insulation between conductors and ground, efficiency of grounding system to satisfaction of Departmental Representative and authority having jurisdiction.

END

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Division 01 – General Requirements.

.2 Section 25 05 01 – EMCS: General Requirements.

1.2 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, in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal materials from landfill to metal facility as approved by Departmental Representative.

.5 Fold up metal banding, flatten and place in designated area for recycling.

1.3 SUMMARY

.1 Section Includes
- .1 Materials and installation for building automation controllers including:
- .2 Master Control Unit (MCU).
- .3 Local Control Unit (LCU).
- .4 Equipment Control Unit (ECU).
- .5 Terminal Control Unit (TCU).

1.4 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):
- .3 C22.2 No.205-M1983(R1999), Signal Equipment.
- .4 Institute of Electrical and Electronics Engineers (IEEE):
- .5 IEEE C37.90.1-02, Surge Withstand Capabilities (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.

1.5 DEFINITIONS

.1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.6 SYSTEM DESCRIPTION

.1 General
- .1 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 Representative at time of preliminary design review.

.2 Controllers
- .1 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. Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).
  - .5 Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).

.3 Interface to include provisions for interconnection with remote modem:
- .1 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. Capabilities of adding spare points shall be built into each MCUs and LCUs to avoid having to add additional MCUs and LCUs in future for minor additions to EMCS points.

.3 Field Termination and Interface Devices
- .1 To: CSA C22.2 No.205.
- .2 Electronically interface sensors and control devices to processor unit.
- .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.
.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.

.8 Controllers and associated hardware and software: operate in conditions of 0° C to 44° C and 20 % to 90 % non-condensing RH.

.9 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 Representative for ceiling mounting.

.10 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.

.11 Provide surge and low voltage protection for interconnecting wiring connections.

1.8 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 – Submittal Procedures and Section 25 05 02 - EMCS: Submittals and Review Process.

.2 Submit product data sheets for each product item proposed for this project.

1.9 MAINTENANCE PROCEDURES

.1 Provide manufacturers recommended maintenance procedures for insertion in Section m 25 05 03 EMCS: Project Record Documents in accordance with Section 01 77 00 - Closeout Procedures.

PART 2 PRODUCTS

2.1 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 and 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.
- .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.

.5 Controller to be wall mounted with touch screen display for all new EMCS control operations.

2.2 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.

2.3 SOFTWARE

.1 General
- .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 Representative.

.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.

.2 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 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).

.3 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 allows 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.
.9 Power Fail Restart:
.1 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.
.2 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.

.5 Event and Alarm management:
.1 Use management by exception concept for Alarm Reporting.

.2 This is system wide requirement.
.3 This approach will insure that only principal alarms are reported to OWS.
.4 Events which occur as direct result of primary event to be suppressed by system and only events which fail to occur to be reported.
.5 Such event sequence to be identified in I/O Summary and sequence of operation.
.6 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.
.7 Exception is, when air handler which is supposed to stop or start fails to do so under event condition.

.6 Energy Management Programs:
.1 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.
.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 Representative.

.7 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.

2.4 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 one (1) place of decimals with negative sign as required.
- .2 Update displayed analog values and status when new values received.
- .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.

2.5 POINT NAME SUPPORT

.1 Controllers (MCU, LCU) to support Owner 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 as indicated or as directed by Departmental Representative.

.2 Provide necessary power from local 120 V branch circuit panel for equipment.

.3 Install tamper locks on breakers of circuit breaker panel.

END

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Division 01 – General Requirements.

.2 Section 23 33 15 - Dampers - Operating.

.3 Section 25 05 01 - EMCS: General Requirements.

.4 Section 25 05 02 - EMCS: Submittals and Review Process.

.5 Section 25 90 01 - EMCS: Site Requirements, Application and System Sequence of Operation.

.6 Section 26 05 00 - Electrical General Requirements.

.7 Section 26 27 26 - Wiring Devices.

1.2 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, in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal materials from landfill to metal facility as approved by Departmental Representative.

.5 Fold up metal banding, flatten and place in designated area for recycling.

1.3 SUMMARY

.1 Section Includes

.1 Control devices integral to the Building Energy Monitoring and Control System (EMCS): transmitters, sensors, controls, meters, switches, transducers, dampers, damper operators, valves, valve actuators, and low voltage current transformers.

1.4 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 B148-97(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.

.5 Canadian Standards Association (CSA International):

.1 CSA-C22.1-02, Canadian Electrical Code, Part 1 (19th Edition), Safety Standard for Electrical Installations.

1.5 DEFINITIONS

.1 Acronyms and Definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.6 SUBMITTALS

.1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 01 33 00 – Submittals and 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 Representative, 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.

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°C - 32°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.

.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 and pressure as indicated in Section 25 90 01 - EMCS: Site Requirements, Application and System Sequences of Operation.

.10 Sensors located in public areas shall be stainless steel plate or vandal proof. Sensors located in offices to be complete with temperature setpoint adjustment current temperature indication and pushbutton override.

2.2 TEMPERATURE SENSORS

.1 General

.1 Except for room sensors to be resistance or thermocouple type to following requirements:

.1 Thermocouples: limit to temperature range of 200°C and over.

.2 RTD's: 100 or 1000 ohm at 0°C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored leadwires.

.3 Coefficient of Resistivity: 0.00385 ohms/ohm°C.

.4 Sensing Element: hermetically sealed.

.5 Stem and Tip Construction: copper or Type 304 stainless steel.

.6 Time Constant Response: less than 3 seconds to temperature change of 10 °C.

.7 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 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°.

.5 Accuracy 0.2°C over range of 0°C to 70° C.
.6 Stability 0.02°C drift per year.
.7 Separate mounting base for ease of installation.

.3 Room Temperature Sensors

.1 Wall mounting, in slotted type covers having brushed aluminum brushed stainless steel finish, with guard as indicated.
.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°C.

.4 Duct Temperature Sensors

.1 General Purpose Duct Type: suitable for insertion into ducts at various orientations, insertion length 460 mm or as indicated.
.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.

.5 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 TEMPERATURE TRANSMITTERS

.1 Requirements

.1 Input Circuit: to accept 3-lead, 100 or 1000 ohm at 0°C, platinum resistance detector type sensors.
.2 Power Supply: 24 V DC into load of 575 ohms. Power supply effect less than 0.01° C per volt change.
.3 Output Signal: 4 - 20 mA into 500 ohm maximum load.
.4 Input and output short circuit and open circuit protection.
.5 Output Variation: less than 0.2% of full scale for supply voltage variation of plus or minus 10%.
.6 Combined Non-Linearity, Repeatability, Hysteresis Effects: not to exceed plus or minus 0.5% of full scale output.
.7 Maximum Current to 100 or 1000 ohm RTD Sensor: not to exceed 25 mA.
.8 Integral zero and span adjustments.
.9 Temperature Effects: not to exceed plus or minus 1.0% of full scale 50°C.
.10 Long Term Output Drift: not to exceed 0.25 % of full scale/ 6 months.
.11 Transmitter Ranges: select narrowest range to suit application from following:
.1 Minus 50°C to plus 50°C, plus or minus 0.5°C.
.2 0 to 100°C, plus or minus 0.5°C.
.3 0 to 50°C, plus or minus 0.25°C.
.4 0 to 25°C, plus or minus 0.1°C.
.5 10 to 35°C, plus or minus 0.25°C.

2.4 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°C to 70°C.
.5 Relays to be CSA Certified.
.6 Input/output Isolation Voltage to be 4000 VAC at 25°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.

2.5 CURRENT TRANSDUCERS

.1 Requirements

.1 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.
.2 Frequency insensitive from 10 - 80 hz.
.3 Accuracy to 0.5% full scale.
.4 Zero and span adjustments. Field adjustable range to suit motor applications.
.5 Adjustable mounting bracket to allow for secure/safe mounting inside MCC.

2.6 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.
.8 Coordinate with Division 26, so current sensor relay’s required in motor starter come as a CSA certified assembly.

2.7 CONTROL DAMPERS

.1 Construction

.1 Blades: 152 mm wide, 1219 mm long, maximum.
.2 Modular maximum size: 1219 mm wide x 1219 mm high.
.3 Three or more sections to be operated by jack shafts.

.2 Materials

.1 Frame: 2.03 mm minimum thickness extruded aluminum. For outdoor air and exhaust air applications, frames to be insulated.
.2 Blades: extruded aluminum. For outdoor air/exhaust air applications, blades to be internally insulated.
.3 Bearings: maintenance free, synthetic type of material.
.4 Linkage and shafts: aluminum, zinc and nickel plated steel.
.5 Seals: synthetic type, mechanically locked into blade edges.
.6 Frame Seals: synthetic type, mechanically locked into frame sides.

.3 Performance

.1 Minimum damper leakage meet or exceed AMCA Standard 500-D ratings:
.1 Size/Capacity: refer to damper schedule
.2 25 L/s/m^2 maximum allowable leakage against 1000 Pa static pressure for outdoor air and exhaust air applications.
.3 Temperature range: minus 40°C to plus 100°C.

.4 Arrangements: dampers mixing warm and cold air to be parallel blade, mounted at right angles to each other, with blades opening to mix air stream.

.5 Jack Shafts

.1 25 mm diameter solid shaft, constructed of corrosion resistant metal complete with required number of pillow block bearings to support jack shaft and operate dampers throughout their range.
.2 Include corrosion resistant connecting hardware to accommodate connection to damper actuating device.
.3 Install using manufacturers installation guidelines.
.4 Use same manufacturer as damper sections.

2.8 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 All dampers to have end – switch indication wired to EMCS for positive position indication regardless of whether the requirement for such is included in Sequence of operation.
.4 Operator: size to control dampers against maximum pressure and dynamic closing/opening pressure, whichever is greater.
.5 Power requirements: 5 VA maximum at 24 V AC.
.6 Operating range: 0 - 10 V DC or 4 - 20 mA DC.
.7 For VAV box applications floating control type actuators may be used.

.8 Damper actuator to drive damper from full open to full closed in less than 120 seconds.

2.9 PANELS

.1 Free-standing wall mounted enamelled steel cabinets with hinged and key-locked front door.

.2 Multiple panels as required indicated to handle requirements with additional space to accommodate 25% additional capacity as required by Departmental Representative without adding additional cabinets.

.3 Panels to be lockable with same key.

2.10 WIRING

.1 In accordance with Division 26.

.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 20AWG stranded twisted pair.
.2 Analog input and output: shielded #18 minimum solid copper #20 minimum stranded twisted pair.

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, current-to-pneumatic transducers, solenoid air valves, 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. Maintain fire rating integrity.

.6 Electrical

.1 Complete installation in accordance with Section 26 50 00 – Electrical General Requirements.

.2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.

.3 Refer to electrical control schematics included as part of control design schematics.Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by Departmental Representative before beginning Work.

.4 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

.5 Install communication wiring in conduit.

.1 Provide complete conduit system to link Building Controllers, field panels and OWS(s).

.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.

.6 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Departmental Representative to review before starting work. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.

.7 Fan Powered Terminal Units

.1 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.
.2 Each additional horizontal run to be no more than 300 mm from one above it.
.3 Continue until complete cross sectional area of ductwork is covered.
.4 Use multiple sensors where single sensor does not meet required coverage.
.5 Wire multiple sensors in series for low temperature protection applications.
.6 Wire multiple sensors separately for temperature measurement.
.7 Use software averaging algorithm to derive overall average for control purposes.

.6 Thermowells

.1 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 steam and high temperature hot water service with pigtail syphon between valve and sensor.

.2 Install pressure gauge on output of auxiliary cabinet pneumatic devices.

3.5 TESTING AND COMMISSIONING

.1 Calibrate and test field devices for accuracy and performance.

END

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Division 01 – General Requirements.

.2 Section 25 05 01 - EMCS General Requirements.

1.2 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, in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal materials from landfill to metal facility as approved by Departmental Representative.

.5 Fold up metal banding, flatten and place in designated area for recycling.

1.3 SUMMARY

.1 Section Includes

.1 At minimum, Shop Drawings for EMCS to include a detailed narrative description of Sequence of Operation of each system including ramping periods and reset schedules:

.1 Control Description Logic (CDL) for each system.

.2 Input/Output Point Summary Tables for each system.

.3 System Diagrams consisting of the following; EMCS System architectural diagram, Control Design Schematic for each system (as viewed on OWS), system flow diagram for each system with electrical ladder diagram for MCC starter interface.

PART 2 PRODUCTS

2.1 SEAWATER PUMPHOUSE VENTILATION (EF12-1)

.1 When exhaust fan is off:

.1 Exhaust air dampers is closed.

.2 Fresh air dampers is closed.

.3 Return air damper is open

.2 Start-up:

.1 Fresh air and exhaust air dampers shall open to minimum positions. Setting to be determined by TAB.

.2 Exhaust fan shall start.

.3 Normal Modes:

.1 Fresh air, return air and exhaust air dampers shall modulate to provide cooling as required maintain space setpoint temperature conditions as sensed by space sensor.

.4 On call for heating:

.1 The fresh air and exhaust air dampers shall go to minimum position. On further call EMCS shall activate start of electric unit heaters in sequence to maintain space temp setpoint.

.5 The reverse sequence shall occur in rise of room condition

2.2 SEAWATER PUMPS P-12-1A, B&C

.1 Provide separate operating schedules for each pump to run on a daily basis.

.2 Prior to starting any pump, ensure pumps are primed by status signal from vacuum primer system.

.3 If pump stops or fails to start an alarm is reported.

.4 Provide programming to ensure even run time for all hydronic pumps.

.5 EMCS shall provide Current Sensing Relays for status confirmation of pumps.

.6 Coordinate with Electrical Division 16 to ensure that installation of CSR's is done in accordance with CSA listing of electrical equipment.

.7 In the event the pumps lose their prime, the EMCS shall shut all pumps down and report alarm.

2.3 VACUUM PRIMER SYSTEM:

.1 EMCS shall monitor operating signal from vacuum primer system and issue alarm when low levels exist.

PART 3 EXECUTION

3.1 NOT USED

END