

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes.
 - .1 Methods and procedures for start-up, verification and commissioning, for building Energy Monitoring and Control System (EMCS) and includes:
 - .1 Start-up testing and verification of systems.
 - .2 Check out demonstration or proper operation of components.
 - .3 On-site operational tests.
 - .2 Related Sections.
 - .1 Section 01 33 00 - Shop Drawings and Product Data Samples.
 - .2 Section 01 78 00 - Closeout Submittals.
 - .3 Section 01 91 13 - General Commissioning (Cx) Requirements.
 - .4 Section 01 79 00 - Demonstration and Training.
 - .5 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 fulfill 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 DESIGN REQUIREMENTS

- .1 Confirm with Departmental Representative that Design Criteria and Design Intentions are still applicable.
- .2 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intentions.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Shop Drawings and Product Data Samples.
- .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.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide documentation, O&M Manuals, and training of O&M personnel for review of Departmental Representative before interim acceptance in accordance with Section 01 78 00 - Closeout Submittals.

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 Representative and in presence of Departmental Representative and PWGSC Commissioning Manager.
- .3 Inform, and obtain approval from, Departmental Representative in writing at least 14 days prior to commissioning or 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 and PWGSC Commissioning Manager.

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.

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 as 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 Commissioning Manager Departmental Representative.
- .3 Commission integrated systems using procedures prescribed by Commissioning Manager 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 and to BECC.
- .7 After setting, test zero and span in 10% increments through entire range while both increasing and decreasing pressure.
- .8 Departmental Representative to mark instruments tracking within 0.5% in both directions as "approved for installation".
- .9 Transmitters above 0.5% error will be rejected.
- .10 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 convertor.
 - .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.
 - .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 Representative. 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 Representative and PWGSC Commissioning Manager 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 Representative's 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.
 - .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 Commissioning Manager 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 Commissioning Manager 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 79 00 - Demonstration and Training.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 General requirements for building Energy Monitoring and Control System (EMCS) that are common to NMS EMCS Sections.
 - .2 Sustainable requirements for construction and verification.
- .2 Related Sections:
 - .1 Section 01 33 00 -Shop Drawings and Product Data Samples.
 - .2 Section 01 35 33 - Health and Safety Requirements.
 - .3 Section 01 74 21 - Construction/Demolition Waste Management And Disposal.
 - .4 Section 09 91 23 - Interior Painting.
 - .5 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
 - .6 Section 25 05 54 - EMCS: Identification.
 - .7 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 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.
- .3 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-Z234.1-89(R1995), Canadian Metric Practice Guide.
- .4 Consumer Electronics Association (CEA).
 - .1 CEA-709.1-B-2002, Control Network Protocol Specification.
- .5 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
 - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .6 Electrical and Electronic Manufacturers Association (EEMAC).
 - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .7 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .8 Transport Canada (TC).
 - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.3 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.

1.4 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 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.

1.5 SYSTEM DESCRIPTION

- .1 Refer to control schematics and 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 OWS(s).
 - .4 Data communications equipment necessary to effect EMCS data transmission system.
 - .5 Field control devices.
 - .6 Complete operating and maintenance manuals.
 - .7 Acceptance tests, technical support during commissioning, full documentation.
 - .8 Wiring interface co-ordination of equipment supplied by others.
 - .9 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 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.

1.6 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Shop Drawings and Product Data Samples and 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
- .2 Co-ordinate submittal requirements and provide submittals required by
- .3 Submit for review:
 - .1 Equipment list and systems manufacturers at time of bid tender within 48 h within 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 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 certificate from testing organization, approved by Departmental Representative, certifying that item was tested in accordance with their test methods and that 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 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.

1.7 QUALITY ASSURANCE

- .1 Have local office within 50 km of project staffed by trained personnel 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 7 year guarantee of availability of spare parts after obsolescence.

- .4 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.
- .5 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide Departmental Representative with schedule within 2 weeks after award of Contract.
- .2 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.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
 - .4 Separate for reuse and recycling and place in designated containers Steel Metal Plastic waste in accordance with Waste Management Plan.
 - .5 Place materials defined as hazardous or toxic in designated containers.
 - .6 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal, regulations.
 - .7 Label location of salvaged material's storage areas and provide barriers and security devices.
 - .8 Ensure emptied containers are sealed and stored safely.
 - .9 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
 - .10 Fold up metal and plastic banding, flatten and place in designated area for recycling.

1.9 EXISTING CONDITIONS - CONTROL COMPONENTS

- .1 Utilize existing control wiring and piping as indicated.
- .2 Re-use field control devices that are usable in their original configuration provided that they conform to applicable codes, standards specifications.
 - .1 Do not modify original design of existing devices without written permission from Departmental Representative.
 - .2 Provide for new, properly designed device where re-usability of components is uncertain.
- .3 Inspect and test existing devices intended for re-use within 30 days of award of contract, and prior to installation of new devices.
 - .1 Furnish test report within 40 days of award of contract listing each component to be re-used and indicating whether it is in good order or requires repair by Departmental Representative.
 - .2 Failure to produce test report will constitute acceptance of existing devices by contractor.
- .4 Non-functioning items:
 - .1 Provide with report specification sheets or written functional requirements to support findings.

- .2 Departmental Representative will repair or replace existing items judged defective yet deemed necessary for EMCS.
- .5 Submit written request for permission to disconnect controls and to obtain equipment downtime before proceeding with Work.
- .6 Assume responsibility for controls to be incorporated into EMCS after written receipt of approval from Departmental Representative.
 - .1 Be responsible for items repaired or replaced by Departmental Representative.
 - .2 Be responsible for repair costs due to negligence or abuse of equipment.
 - .3 Responsibility for existing devices terminates upon final acceptance of EMCS applicable portions of EMCS as approved by Departmental Representative.
- .7 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- .1 Control Network Protocol and Data Communication Protocol: to CEA 709.1 ASHRAE STD 135, and compatible with existing RC System.
- .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.

2.2 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 indoors to EEMAC 2Y-1.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes.
 - .1 Methods and procedures for shop drawings submittals, preliminary and detailed review process including review meetings, for building Energy Monitoring and Control System (EMCS).
- .2 Related Sections.
 - .1 Section 01 33 00 - Shop Drawings and Product Data Samples.
 - .2 Section 25 05 01 - EMCS: General Requirements.
 - .3 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.2 DEFINITIONS

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

1.3 DESIGN REQUIREMENTS

- .1 Preliminary Design Review: to contain following contractor and systems information.
 - .1 Location of local office.
 - .2 Description and location of installing and servicing technical staff.
 - .3 Location and qualifications of programming design and programming support staff.
 - .4 List of spare parts.
 - .5 Location of spare parts stock.
 - .6 Names of sub-contractors and site-specific key personnel.
 - .7 Sketch of site-specific system architecture.
 - .8 Specification sheets for each item including memory provided, programming language, speed, type of data transmission.
 - .9 Descriptive brochures.
 - .10 Sample CDL and graphics (systems schematics).
 - .11 Response time for each type of command and report.
 - .12 Item-by-item statement of compliance.
 - .13 Proof of demonstrated ability of system to communicate utilizing Proprietary Communications Protocol to communicate existing PDC control system.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Shop Drawings and Product Data Samples and coordinate with requirements in this Section.
- .2 Submit preliminary design document within 5 working days after tender closing and before contract award, for review by Departmental Representative.
- .3 Shop Drawings to consist of 3 hard copies and 1 soft copy of design documents, shop drawings, product data and software.
- .4 Hard copy to be completely indexed and coordinated package to assure compliance with contract requirements and arranged in same sequence as specification and cross-referenced to specification section and paragraph number.

- .5 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.

1.5 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.
 - .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 Pneumatic schematics and schedules.
 - .5 Complete Point Name Lists.
 - .6 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.
 - .7 Software and programming details associated with each point.
 - .8 Manufacturer's recommended installation instructions and procedures.
 - .9 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.

1.6 QUALITY ASSURANCE

- .1 Preliminary Design Review Meeting: Convene meeting within 45 working days of award of contract to:
 - .1 Undertake functional review of preliminary design documents, resolve inconsistencies.

- .2 Resolve conflicts between contract document requirements and actual items (e.g.: points list inconsistencies).
- .3 Review interface requirements of materials supplied by others.
- .4 Review "Sequence of Operations".
- .2 Contractor's programmer to attend meeting.
- .3 Departmental Representative retains right to revise sequence or subsequent CDL prior to software finalization without cost to Departmental Representative.

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 SUMMARY

- .1 Section Includes.
 - .1 Requirements and procedures for final control diagrams and operation and maintenance (O&M) manual, for building Energy Monitoring and Control System (EMCS) Work.
- .2 Related Sections.
 - .1 Section 01 78 00 - Shop Drawings and Product Data Samples.
 - .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 DEFINITIONS

- .1 BECC - Building Environmental Control Centre.
- .2 OWS - Operator Work Station.
- .3 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 78 00 - Closeout Procedures, supplemented and modified by requirements of this Section.
- .2 Submit As-built drawings and Operation and Maintenance Manual to Departmental Representative in English and French.
- .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.

1.4 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 documentation on system configuration.
- .2 Submit for final review by Departmental Representative.
- .3 Provide before acceptance 4 Hard and 1 soft copy incorporating changes made during final review.

1.5 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.
 - .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 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 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's, plus diagnostics and repair/replacement of system hardware.
- .7 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.
- .8 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.

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 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.
- .2 Related Sections.
 - .1 Section 01 33 00 - Shop Drawings and Product Data Samples.
 - .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 DEFINITIONS

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

1.4 SYSTEM DESCRIPTION

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

1.5 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Shop Drawings and Product Data Samples 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, 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 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.

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 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 OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes.
 - .1 Requirements and procedures for warranty and activities during warranty period and service contracts, for building Energy Monitoring and Control System (EMCS).
- .2 Related Sections.
 - .1 Section 01 33 00 - Shop Drawings and Product Data Samples.
 - .2 Section 01 78 00 - Closeout Submittals.
 - .3 Section 25 05 01 - EMCS: General Requirements.
- .3 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.

1.2 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.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Shop Drawings and Product Data Samples.
- .2 Submit detailed preventative maintenance schedule for system components to Departmental Representative Engineer Consultant.
- .3 Submit detailed inspection reports to Departmental Representative.
- .4 Submit network analysis report showing results with detailed recommendations to correct problems found.
- .5 Records and logs: in accordance with Section 01 78 00 - Closeout Submittals.
 - .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 Representative, after inspection indicating that planned and systematic maintenance have been accomplished.
- .6 Revise and submit to Departmental Representative 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 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.
 - .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 Representative 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.

1.5 SERVICE CONTRACTS

- .1 Provide in-depth technical expertise and assistance to Departmental Representative and Commissioning Manager in preparation and implementation of service contracts and in-house preventive maintenance procedures.
- .2 Service Contracts to include:
 - .1 Annual verification of field points for operation and calibration.
 - .2 2 visits per year.
 - .3 Responses to emergency calls during day, per year.
 - .4 Responses to emergency calls during silent hours per year.
 - .5 Silent hours defined as.
 - .6 Complete inventory of installed system.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not Used.

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 Representative 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 Visually check for mechanical faults, air leaks and proper pressure settings on pneumatic components.
 - .4 Review system performance with Departmental Representative 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 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.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED WORK

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 GENERAL REQUIREMENTS

- .1 Provide all remote sensing points and instrumentation as required for the complete operational capability of the Control System. All sensors shall have the accuracies as stated hereinafter. Hysteresis, relaxation time, span, maximum / minimum limits, etc. shall also be accounted for in all application of sensors and controls.
- .2 All instruments of a particular category shall be of the same type and manufacture.
- .3 All external trim material shall be completely corrosion resistant with all internal parts assembled in watertight, shockproof, vibration proof, heat resistant assembly.
- .4 Use standard conduit box termination with screwdriver connector block unless otherwise specifically stated.
- .5 Operating conditions 0°C to 60°C with 10-90% RH (non-condensing) unless otherwise specifically stated.

PART 2 - PRODUCTS

2.1 CONTROL DAMPERS

- .1 Minimum Requirements:
 - .1 Provide control dampers configured as follows:
 - .1 Modulating; opposed blade dampers.
 - .2 Mixing; parallel blade dampers.
 - .3 Two position; parallel blade dampers.
 - .2 Assemblies - rigid and adequately braced with corner gussets.
 - .3 Galvanized steel or extruded aluminum frames.
 - .4 Maximum frame dimensions - 1220 mm wide and 1220 mm high, unless otherwise indicated. Multiple sections to have stiffening mullions.
 - .5 Maximum blade width - 200 mm.
- .2 Standard control dampers:
 - .1 Minimum performance, based on 610x610 damper size as tested in an independent testing laboratory:
 - .1 Maximum 87 Pa static pressure drop at 15.2 M/s velocity (damper fully open).
 - .2 Maximum 55 L/s / sq m leakage at 747 Pa (Damper fully closed).
 - .3 Maximum blade length of 1219mm suitable for minimum 622 Pa and 7.6 M/s velocity.
 - .2 Minimum 1.6mm single skin galvanized steel blades with longitudinal groove reinforcement.
 - .3 Synthetic sleeve type bearings (no metal to metal contact).
 - .4 Linkage concealed within the damper frame.
 - .5 Square or hexagonal axles locked into blades.
 - .6 Synthetic rubber or PVC coated fabric seals mechanically locked into the blade edge (adhesive or clip-on type seals not acceptable).
 - .7 Flexible metal compression type or extruded synthetic rubber jamb seals.
 - .8 Standard of Acceptance: Ruskin CD36.
- .3 Low leakage control dampers:

- .1 Minimum performance, based on 610x610 damper size as tested in an independent testing laboratory:
 - .1 Maximum 62 Pa static pressure drop at 15.2 M/s (damper fully open).
 - .2 Maximum 55 L/s / sq m leakage at 747 Pa (Damper fully closed).
 - .3 Maximum blade length of 1219mm suitable for minimum 100 Pa and 15.2 M/s velocity.
- .2 Minimum 2.0 mm galvanized steel airfoil type or 2.1mm extruded aluminum airfoil type blades.
- .3 Synthetic sleeve type bearings (no metal to metal contact).
- .4 Linkage concealed within the damper frame.
- .5 Square or hexagonal axles locked into blades.
- .6 Synthetic rubber blade seals mechanically locked into the blade edge (adhesive or clip-on type seals not acceptable).
- .7 Flexible metal compression type or extruded synthetic rubber jamb seals.
- .8 Standard of Acceptance: T A Morrison 1000.
- .4 Note:
 - .1 All control dampers by this Division. Control dampers supplied by the manufactures shall follow the above specifications
 - .2 Instruct the Sheet Metal Trade on damper installation.
 - .3 Indicated size is outside frame dimension. Increase size of damper and oversize ductwork, to include for depth of the frame, for all dampers with a pressure drop greater than 12 Pa. Confirm with the Sheet Metal Sub-Contractor before fabrication.
 - .4 Check that dampers are installed square and true and that blades close tightly against seals and stops.
 - .5 Blades to be horizontal in vertical mounted dampers. Refer to drawings for orientation of dampers.
 - .6 Ensure that damper end-linkages are easily accessible (coordinate with the Sheet Metal Sub-Contractor).
 - .7 Provide an additional drive shaft bearing if the drive shaft is longer than 75 mm.
 - .8 Do not install dampers within the thickness of any wall unless otherwise indicated (coordinate with the Sheet Metal Sub-Contractor).
 - .9 Dampers shall be adequate for the maximum system pressure. Refer to the appropriate Section of the specification.

2.2 CONTROL DAMPERS - ROUND

- .1 Standard of Acceptance:
 - .1 Ruskin CDRS-25
- .2 Minimum Requirements:
 - .1 1.19 mm thick galvanized steel frame with rolled stiffener beads.
 - .2 Damper blade constructed from two layers of galvanized steel with neoprene edge seal sandwiched between layers.
 - .3 Stainless steel bearings.
 - .4 Air leakage shall not exceed 0.28 L/s per 100 mm of blade circumference at 1.0 kPa .

2.3 CONTROL DAMPER ACTUATORS

- .1 General:
 - .1 Valve operators shall allow smooth operation of the valve throughout its entire range and assure tight shut-off against system pressure.
 - .2 Valve actuator shall be easily removed from the valve body for replacement.

- .2 Pneumatic Valve Actuators (VMP & VTP):
 - .1 Provide pneumatic valve actuators with spring return to normal position as indicated.
 - .2 Diaphragm to be molded Buna-N Rubber, nylon reinforced.
 - .3 Where valves are modulated in sequence with other equipment, operators of valves of sizes over 25 mm shall be equipped with pilot positioners suitable to select start point and range of operation.
 - .4 Provide spring range adjustment.
- .3 Electric Two Position Valve Actuators (VTE):
 - .1 Two Position Control Valve Actuators (only to be used where specifically specified):
- .4 Incremental Control Valve Actuators (only to be used where specifically specified) (VMI):
 - .1 The valve actuator shall modulate the control valve between the fully open and closed position based upon a 3-wire control signal (24 VAC). The actuator shall remain in position until the signal is applied.
 - .2 The valve shall maintain its shutoff force even if power is lost.
 - .3 The TUC shall calculate valve position based on the motor speed and duration of control signal. The valve shall be driven to a full position and the calculation reset once every 24 hours.
- .5 Proportional Control Valve Actuators (VME):
 - .1 The valve actuator shall modulate the control valve between the fully open and closed position based upon a 0-10 VDC or 4-20 mA control signal. The actuator shall remain in its position until the applied signal changes. In the event of a control signal loss, the actuator shall move to the zero voltage input position.
 - .2 The valve shall maintain its shutoff force even if power is lost.

2.4 CONTROL PANELS

- .1 General:
 - .1 Fabricate from prime and enamel coated steel suitable for flush mounting, complete with mounting legs.
 - .2 Panel doors shall be hinged and complete with locks.
 - .3 Construct so that instruments and gauges are flush mounted.
 - .4 Provide sub-panel, inside control panel, for mounting control components.
 - .5 Adhere lamicoid nameplates on the control panels to clearly identify the service of each device.
 - .6 Submit shop drawings of control panel for review.

2.5 ROOM THERMOSTATS

- .1 Minimum Requirements
 - .1 Adjustable sensitivity and set point.
 - .2 Standard metal or Lexan covers.
 - .1 Visible thermometer (thermostats only) graduated in deg.C.
 - .2 Concealed set-point adjustment (or removable key adjustment).
 - .3 Lock key covers.
 - .3 Room thermostats sensors for all applications shall be equipped with an "occupied" switch or button to enable room occupants to override the "unoccupied" schedule for "after hours" operation.
- .2 Note:

- .1 Provide a key for each instrument requiring a removable key up to a maximum of six. Obtain two signed receipts from the Owner certifying that the keys have been received. Hand one over to the Consultant.
- .2 Panel to be suitably labelled.
- .3 All sensors, pressure switches, mounting brackets connecting tubing and wiring to be included.

2.6 TEMPERATURE SENSORS

- .1 General: Temperature sensors shall be thermistor, resistance or thermocouple type, however, thermocouples shall be restricted to temperature range +200°C and above.
- .2 The following shall apply to thermistor, resistance or thermocouple temperature sensors as applicable.
 - .1 RTDs shall be 100 ohm or 1,000 ohm at 0°C (+/- .2 ohm) nickel or platinum element with strain minimizing construction and 3 integral anchored leadwires coefficient of resistivity of 0.000385 ohms/ohm/ deg.C. Thermistors shall be 3,000 or 10,000 ohms.
 - .2 Sensing element to be hermetically sealed.
 - .3 Stem and tip construction to be copper or 304 stainless steel as noted.
 - .4 Sensors to have a time constant response of less than 3 seconds to a temperature change of 10°C.
 - .5 Sensors shall operate over the following ranges with the accuracies over the noted range of the sensor.
 - .1 -50°C to +50°C, plus or minus 0.5°C.
 - .2 0°C to +50°C, plus or minus 0.25°C.
 - .3 0°C to 25°C, plus or minus 0.1°C.
 - .4 0°C to 100°C, plus or minus 1°C.
 - .6 Immersion wells shall be of stainless steel materials for steam and domestic hot water and brass for other applications. Heat transfer compound to be compatible with sensor.
- .3 Temperature sensors shall be of the following types:
 - .1 Room type (RTS) - suitable for wall mounting, with or without protective guard. Element length of 10-50 mm with ceramic tube or equivalent mode of mechanical protection.
 - .2 General purpose duct type (DTS) - suitable for insertion into air ducts at any angle, insertion length shall be suitable for application. Copper sheathed construction.
 - .3 Spring-loaded thermowell type (ITS) - spring loaded construction with compression fitting for 20 mm NPT well mounting. Lengths shall be suitable for application. Stainless steel sheathed construction.
 - .4 Averaging duct type (ATS) - continuous filament with immersion length of 6000 mm minimum. Probe to be bent, at field installation time, to a minimum radius of 100 mm at any point along the probe length without degradation in performance. Copper sheathed construction. Or multiple sensors mounted on a cable connected to provide an average temperature reading
 - .5 Outside air type (OTS) - complete with non-corroding shield designed to minimize solar and wind effects, threaded fitting for mating to 12 mm conduit, probe length of 100 - 150 mm.

PART 3 - EXECUTION

3.1 GENERAL

- .1 All equipment shall be installed according to manufacturers' published instructions.
- .2 Temperature, Thermostats:

- .1 All sensors shall be stabilized to such a level as to permit on-the-job installations that will require minimum field adjustments or calibration.
 - .2 Sensor assemblies shall be readily accessible and adaptable to each type of application in such a manner as to allow for quick, easy replacement and servicing without special tools or skills.
 - .3 Outdoor installation shall be weatherproof construction in NEMA 4 enclosures. Install space instruments at a height of 1.5 m above the finished floor, unless otherwise indicated.
 - .4 Install corridor instruments at a height of 2.1 m above the finished floor.
 - .5 Locate instruments in the same vertical centreline as light switches.
 - .6 Where instruments are indicated on an outside wall install on a stand-off wall bracket which provides an air space between the instrument and the wall; or on an insulating base (e.g. a cork pad).
 - .7 Install protective metal guards on instruments in areas where they may be subject to damage (loading areas, gymnasiums, workshops, public corridors and storage areas). Bolt guards, independent of instruments to separate baseplates. Provide backing in wall for securing mounting bases.
 - .8 Sensors in ducts shall be mounted in locations to sense the correct temperature of the air only, and shall not be located in dead air spaces. The location shall be within the vibration and velocity limits of the sensor. Where an extended surface element is required to properly sense the average temperature it shall be securely mounted within the duct to measure the best average temperatures. Elements shall be thermally isolated from brackets and supports to respond to air temperature only. Sensor element to be supported separately and not connected to coils or filter racks.
 - .9 Wells shall be installed in the piping at elbows where piping is smaller than the length of the well to effect proper flow across the entire area of the well. Well shall not restrict flow area to less than 70 percent of line-size-pipe normal flow area.
-
- .3 All field devices to be properly identified.
 - .4 Mount electrical instruments on standard electrical rough-in boxes fastened to structure.
 - .5 Testing:
 - .1 All field devices shall be properly calibrated and tested for performance and accuracy. A report detailing test performed and results to be submitted to the consultant for approval. The consultant will verify results at random. Provide all testing equipment necessary. Provide manpower necessary to assist consultant's verification.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 At minimum 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.

1.2 REFERENCES

- .1 Public Works and Government Services Canada (PWGSC) / Real Property Branch / Architectural and Engineering Services.
- .2 MD13800-September 2000, Energy Management and Control Systems (EMCS) Design Manual. English: <ftp://ftp.pwgsc.gc.ca/rps/doccentre/mechanical/me214-e.pdf>
- .3 "Harry Steven's Building DDC Tune-up 2009" as Appendix F.

1.3 SEQUENCING

- .1 Present sequencing of operations for systems, in accordance with MD13800 - Energy Management and Control Systems (EMCS) Design Manual.
- .2 Refer to the existing DDC control sequence as per attached "Harry Steven's Building DDC Tune-up 2009 as appendix I" and upgrade to meet the sequence of operation in this section.
- .3 Sequencing of operations for systems as follows:

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 - EXECUTION

3.1 HVAC CONTROL OBJECTIVES:

- .1 Program the system to meet the following objectives:
 - .1 Temperature:
 - .1 Control the temperature in each occupied space.
 - .2 Ventilation:

- .1 Control the system's minimum outdoor air intake and the supply to each zone to meet code ventilation requirements under all operating conditions.

- .3 Energy:

- .1 Provide no more heating than is essential (no reheat).
- .2 Shut off the supply air in the large conference rooms and classrooms when they are unoccupied.
- .3 Shut systems down if all the spaces are scheduled to be unoccupied unless the temperature falls below the night setback temperature.

3.2 TERMINAL VAV BOXES AND ELECTRICAL DUCT HEATER

- .1 Thermostat shall modulate electrical duct heater.
- .2 Thermostat shall modulate variable volume damper operator.

3.3 GENERAL EXHAUST FANS

- .1 The following fans shall be operated as per below.
 - .1 EF-1 and EF-3 – exhaust fans in Kitchenette 343, and Business Centre 345. to be controlled by the wall mounted manual switch in each room with time clock and the fans' status to be monitored by the existing DDC system.

3.4 MISCELLANEOUS EXHAUST FANS:

- .1 The following fans shall be operated as per below.
 - .1 EF-2 and EF-4 – general ventilation fans in Small Boardroom 356 and Lan Storage 341. to be controlled by the wall mounted manual switch in each room with time clock and the fans' status to be monitored by the existing DDC system.

3.5 SERVER ROOM AIR CONDITIONING UNITS

- .1 Components:
 - .1 Air Conditioning Units AC-1 and Condensing Units CU-1:
 - .1 Return air filter (100% return air system)
 - .2 DX Refrigerant Cooling Coil (1 stage)
 - .3 Indoor Fan Coil Unit Supply fan
 - .4 Rooftop Condensing Unit (cooling only compressor)
- .2 System Stopped:
 - .1 AC indoor fan coil Supply fan and Rooftop CU Compressor stopped.
 - .2 Normal operation is 24/7 with no unoccupied mode
- .3 Air conditioning Unit "AC" Operation:
 - .1 Provide a BMS System networked Digital Room Thermostat with single speed fan control and one on/off cooling stage to control the AC Units serving the various Communication

rooms and Sub Electrical rooms to maintain the desired room temperature. Verify quantity on the mechanical plans & equipment schedules.

- .2 When enabled the BMS shall start and run the AC unit supply fan continually and cycle the DX Cooling as required to maintain the room temperature set point of 30°C
- .3 In addition to the space temperature the DDC System shall monitor the indoor fan coil unit supply fan status (using a current switch) and the rooftop condensing unit compressor status (using a current switch) as well as the fan coil supply air temperature for trending and remote trouble shooting of the system.
- .4 When enabled the BMS shall start and run the AC unit supply fan continually and cycle the DX Cooling as required to maintain the room temperature set point of 25°C (adjustable).
- .5 Co-ordinate the recommended compressor minimum on and off time requirements with the AC Unit Supplier.
- .6 Provide all required control interlock wiring as required between the AC unit and the rooftop condensing unit.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

- .1 The following points list indicates the input and output points that shall be connected to the existing DDC control system. Any additional points that are noted in Section 25 90 01 to be under DDC control shall also be included as if they were on the points list. All points associated with one mechanical system shall be connected to the same DDC Controller
- .2 Program alarms as specified in the points list and sequences with user adjustable alarm thresholds. Provide descriptors for all programmed alarms which can be accessed via the graphics at the OWS.
- .3 Division 21, 22, 23, and 25 shall coordinate with Division 26 and provide interface between lighting controllers provided by Div 26, in order to provide control and monitoring of low voltage lighting control system via DDC. Allow necessary control points to perform the lighting monitoring and control.
- .4 Contractor refers to the "Harry Steven's Building DDC Tune-up-2009" by ESC for the existing control system and associated point list which attached as mechanical **Appendix-F**

1.2 DEVICE LEGEND

- .1 VDC = 0-10 Output to Device supplied by others.
- .2 RTS = Room Temperature Sensor
- .3 DTS = Duct Temperature Sensor
- .4 ITS = Immersion temperature Sensor
- .5 ATS = Averaging Duct Temperature Sensor
- .6 OTS = Outdoor Temperature Sensor
- .7 HS = Humidity Sensor
- .8 DPT = Differential Pressure Transmitters
- .9 SPT = Static Pressure Transmitter
- .10 VPT = Velocity Pressure Transmitter
- .11 PSW = Pressure Switch
- .12 TSW = Temperature Switch
- .13 CR = Current Relay
- .14 FSW = Flow Switch
- .15 ESW = End Switch
- .16 AUX = Aux Dry Contact supplied with Device

- .17 ER = Electric Relay
- .18 DME = Damper Actuator Modulating Electronic
- .19 DTE = Damper Actuator Two Position Electronic
- .20 DMI = Damper Actuator Modulating Incremental Control
- .21 VME = Valve Actuator Modulating Electronic
- .22 VTE = Valve Actuator Two Position Electronic
- .23 VMI = Valve Actuator Modulating Incremental Control
- .24 MFT = VAV Box Flow Transmitter
- .25 FMS = Electronic Flow Measuring Station
- .26 WFS = Water Flow Measuring Station

1.3 TABLE LEGEND

- .1 DI = DIGITAL INPUT, DO = DIGITAL OUTPUT
- .2 AI = ANALOG INPUT, AO = ANALOG OUTPUT

PART 2 – NEW INPUT/OUTPUT POINTS LIST

Description	DI-Points & Device	DO-Points & Device	AI-Points & Device	AO-Points & Device	Alarms & Indication			
					Hi	Lo	TR	RUN TIME
LAN ROOM SPLIT AIR CONDITIONING UNIT (SEE PLANS & SCHEDULE FOR EXACT QUANTITY)								
Space temperature			RTS		X	X	X	
AC Unit Fan	CR	ER						X
CU Compressor Status	CR							X
AC Unit Cooling Stage		CR						
AC Unit Supply Air Temp			DTS		X	X	X	

Description	DI-Points & Device	DO-Points & Device	AI-Points & Device	AO-Points & Device	Alarms & Indication			
					Hi	Lo	TR	RUN TIME
KITCHENETTE (EF-1)								

DDC fan control	X	X						
BUSINESS CONTRE (EF-3)								
DDC fan control	X	X						
SMALL BOARD ROOM VENT FAN (EF-2)								
Vent Fans Control and Status	X	X						
LAN STORAGE ROOM VENT FAN (EF-4)								
Vent Fans Control and Status	X	X						

END OF SECTION