TABLE DES MATIÈRES

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 Requirements

.1 Section 20 00 10 – Mechanical and electrical general instructions.

.2 Section 01 91 13 – General Commissioning (Cx) Requirements.

.3 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 periods 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 Intents are still applicable.

.2 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intents.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Section 25 05 02 - EMCS – SUBMITTAL AND REVIEW PROCESS.

.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 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 25 05 02 – EMCS – SUBMITTAL AND REVIEW PROCESS, ARTICLE “CLOSOUT DOCUMENTATION”.

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.

.3 Inform, and obtain approval from, Departmental Representative in writing at least 7 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.

1.8 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION

.1 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

1.9 ACCEPTABLE MATERIALS OR PRODUCTS

.1 When materials or products are given by their trademarks, consult the instructions to tenders in order to know the procedure concerning the request for approval of materials or substitutes.

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 Locations to be approved, readily accessible and readable.

.4 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 Debug system software.

.3 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.

3.2 FIELD QUALITY CONTROL

.1 Pre-Installation Testing.

- .1 General: consists of field tests of equipment just prior to installation.
- .2 Configure major components to be tested in same architecture as designed system.
- .3 Additional instruments to include:
  - .1 Terminal unit – Controllers.

.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 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.

.1 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.

.2 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.

.3 Correct defects when they occur and before resuming tests.

3.3 ADJUSTING

.1 Final adjusting: upon completion of commissioning as reviewed by Departmental Representative, set and lock devices in final position and permanently mark settings.

3.4 DEMONSTRATION

.1 Demonstrate to Departmental Representative operation of systems including sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lock-outs in accordance with Section 01 91 13 – General Commissioning (Cx) Requirements.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED SECTIONS

.1 Section 20 00 10 – General mechanical and electrical instructions.

.2 Section 20 91 13 – Start-up – General requirements.

.3 All Division 23 sections.

.4 All Division 26 sections.

1.2 GENERAL CONDITIONS

.1 All mechanical and electrical general requirements of Division 20 apply to Division 25.

.2 All of Division 25 sections complement each other to form a whole.

.3 All mechanical and electrical drawings apply to Division 25.

.4 Division 25 must have knowledge of scope of work of Section 20 91 13 – Start-up – General requirements. Division 25 must supply the services of a qualified technician possessing the required competencies to change and modify the software programs of the control system during commissioning and start-ups periods.

1.3 DESIGNATED SUPPLIER

.1 Hire the services of **Siemens** or its authorized representative to complete the work of all EMCS Sections and division 25.

1.4 ACRONYMS AND ABBREVIATIONS

.1 Acronyms used in this section:

.1 AEL – Average Effectiveness Level.
.2 BACnet - Building Automation and Control Network.
.3 BTL – BACnet Testing Laboratories.
.4 CDL - Control Description Logic.
.5 COSV - Change of State or Value.
.6 CPU - Central Processing Unit.
.7 HVAC - Heating, Ventilation, Air Conditioning.
.8 VFD – Variable Frequency Drive.
.9 DDC – Direct Digital Control.
.10 I/O – Input/Output.
.11 HMI – Human Machine Interface.
.12 LAN - Local Area Network.
.13 NC – Normally Closed.
.14 NO – Normally Open.
.15 O&M - Operation and Maintenance.

.16 OWS - Operator Work Station.

.17 PC - Personal Computer.

.18 MCU(s) – Master Control Unit(s).

.19 LCU(s) – Local Control Unit(s).

.20 TCU(s) – Terminal Control Unit(s).

.21 PID – Proportional, Integral and Derivative.

.22 DP – Differential Pressure.

.23 SP – Static Pressure.

.24 RAM - Random Access Memory.

.25 ROM - Read Only Memory.

.26 EMCS – Energy Management and Control System.

.27 NMC(s) – Network Management Controller(s).

.28 USB - Universal Serial Bus.OS - Operating System.

.29 UPS - Uninterruptible Power Supply.

.30 VAV – Variable Air Volume.

.31 WAN – Wide Area Network.

1.5 REFERENCES

.1 Electronic Industries Alliance (EIA)/Telecommunications Industries Association (TIA):

.1 EIA/TIA-568 – Commercial Building Telecommunications Cabling Standards Set, Part 1 – General Requirements, Part 2 – Balanced Twisted-Pair Cabling Components, Part 3 – Optical Fiber Cabling Components Standard.

.2 EIA/TIA-569 – Commercial Building Standard for Telecommunications Pathways and Spaces.

.2 American Society of Heating, Refrigerating and Air-Conditionning Engineers, Inc. (ASHRAE):

.1 ASHRAE Standard 135, BACnet – Data Communication Protocol for Building Automation and Control Network.

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 to measure physical properties, to provide status conditions of contacts or relays or to provide interaction with related equipment (system start/stop, modulation control, etc.).

.2 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 input.

1.7 SCOPE OF WORK

.1 Work included:

.1 In general, the work covered includes labour, materials, installations, adjustments, calibrations and connections of pneumatic, electric and electronic equipment of all control systems indicated in the plans and specifications.

.2 Division 25 must include, unless specified otherwise, all devices, accessories, piping for pneumatic controls, conduits and wiring for electrical and/or electronic devices pertaining to the control centre and miscellaneous control equipment, the interconnections between two type of controls, the electrical connection to panels and starters for the normal operation of the controlled equipment, supply and install transformer required for the all controllers and field devices.

.3 The work includes, but is not limited to, the following:

.1 All electrical and DDC type controls required for HVAC systems, electrical heating and electro-mechanical equipment, unless specified as part of another section.

.2 Monitoring panels and local cabinets.

.3 Supply and installation of secondary communication required for the BAS compatible with existing Master controllers (MCU) of existing ventilation systems.

.4 Complete electrical installation including conduits, cables, junction boxes, etc. required for control systems, automation and the EMCS, as shown on drawings and described in these specifications, as well as all electrical connections required to motor control centers and starters, interlocks for fans, pumps or other controls (e.g. device, panels).

.5 The power sources at 120V/1/60 and 24 V for the local panels from transformer installed by Division 25 or 120/208 local panels.

.6 The DDC panel electrical power, supplied from emergency power will be provided by Division 26 on circuits dedicated for use by Division 25.

.7 All special connections.

.8 Acoustical and vibrations works required for controls.

.9 All controls required for ventilation – air conditioning.

.10 The support of the VAV manufacturer during testing.

.11 Supply controllers, wiring schematics and support to manufacturer for the construction of the VAVs.

.12 The pre-calibration and control verification of the VAVs at the manufacturer’s factory.

.13 Provide support during on-site calibration of the VAVs.

.14 The decommissioning work and the selective demolition, as described in mechanical drawings.

.15 Provide support during the calibration and balancing of the ventilation systems and the heating and chilled water networks.

.16 Provide engineering, supervision, adjustments and calibrations for the DDC control system, for new and existing controllers.

.17 Programming and complete data base for the DDC and centralized systems, including building all the dynamic graphics for the system, including the system integrations.

.18 Update of existing graphics and any additional graphics for operational and management purposes, as per customer directives.

.19 Provide all floor plan graphics showing location off all space temperature sensors and its value.

.20 Provide documentation for system start-up, initial commissioning, training, operating and maintenance for all systems.

.2 Excluded work:

.1 In general, the work excluded by this section includes:

.1 Elevator controls.

.2 De-stratification equipment requirement and air volumes in ducts.

.3 Balancing equipment in ducts and pipes.

.4 Access doors for controls equipment.

.5 Openings for instrumentations, see section 20 00 10 –General instructions for mechanical and electrical.

.6 Installation of equipment provided by Division 25 but required to be installed by others. Refer to article "Equipment to provide to others" in this section.

1.8 SAMPLES TO SUBMIT

.1 See section 20 00 10 – General instruction for mechanical and electrical.

1.9 DOCUMENT SUBMITTAL

.1 Make submittals in accordance with Section 25 05 02 – EMCS: Document Submittals.

.2 Quality Control:

.1 Unless otherwise noted, provide new equipment and material from manufacturer's regular production, CSA and ULC certified, manufactured to standard quoted plus additional specified requirements.

.2 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 25 05 02 – EMCS: Document Submittals. Label or listing of specified organization is acceptable evidence.

.3 See article "LAWS, REGLEMENTATIONS AND PERMITS" of section 20 00 10 – General instructions for mechanical and electrical.

.4 All wiring must be completed in accordance with manufacturer’s recommendations and the Régie du Bâtiment du Québec (RBQ) for all electrical work.

.5 The system must include all the devices, control and monitoring equipment as well as all the devices, accessories and equipment installed remotely, the software, the interlock wiring required to obtain a fully functional system, as described in this section. The system must meet all newest local and national codes. If a conflict between the two reference codes appears, the most recent and most severe local codes must be applied.

1.10 MISCELLANEOUS WORK

.1 Must comply with article in "MISCELLANEOUS WORK" of section 20 00 10 – General instruction for mechanical and electrical.

.2 Are included in control work:

.1 Supply and installation of field control devices, conduits, wiring and system connections for controls of all sections, unless specified as being part of another section.

.2 Provide instructions, monitor work and retain complete responsibility for all field control devices and equipment (e.g. control valves, thermowells, flow meters, meters, etc.) provided by Division 25, but installed by others.

.3 Air handling:

.1 Provide and install all wiring, equipment and electrical conduits required for controls in this contract.

.2 The interlock between the timer and the rotary filter control panel and the air handler.

.4 Coordinate required signal types between all equipment suppliers for all sections.

1.11 WARRANTY

.1 Regardless of the warranty period stipulated in article "WARRANTY" of section 20 00 10 – General instructions for mechanical and electrical, the complete control system must have a two (2) year warranty period from the final acceptation date.

1.12 FIXED PRICE

.1 Provide in the quote, a global lump sum that includes all the work covered in Division 25.

.2 If the bidder would like to submit an alternate or substitution, he must include in the quote, an alternate lump sum for more or less to the base quote, references to the sections and items and all documentations pertaining to the proposed alternative. See section 20 00 10 – General instruction for mechanical and electrical, article "QUOTES AND EQUIVALENCIES".

Part 2 Product

2.1 MATERIALS

.1 Due to the small scope of work and in order to ensure a complete compatibility, only the company mandated for system maintenance must perform the work. The maintenance of EMCS and existing controls is currently provided by Siemens Canada Limited. Contact the representative Mr Marco Gatti, by phone 514-338-3000 or email: marco.gatti@siemens.com.

2.2 ENERGY MANAGEMENT AND CONTROL SYSTEM (EMCS)

.1 Building controllers and the centralized management system shall be from the same manufacturer and product line.

.2 The BAS shall have the capability of interfacing with third party control systems including pump packages, air-handling units, energy metering systems and other control systems provided they comply with open protocols such as ASHRAE BACnet, Echelon Lonworks or Modbus.

Part 3 Execution

3.1 GENERAL

.1 All controls shall be installed and adjusted by specialized technicians, regularly employed by the EMCS manufacturer. All costs related to adjustments form part of this contract. All controls components must be easily accessible for maintenance and calibration. Install all control devices in unitized cabinets.

.2 Install all capillary tube cleanly and support them in a steady fashion, either inside a copper tubing or onto a galvanized metal support.

.3 Attach the bulb and capillaries with copper hooks inside the air handling ducts. An access door on the ductwork is included by another section to facilitate maintenance.

.4 Any control device installed on an insulated ductwork must be install on an appropriate metal support, supplied by Division 25.

.5 Any piping or tubing going through an obstacle must be protected by a sealed nylon bushing.

.6 Unless specified otherwise, install static pressure sensor 2/3 of the longest duct run.

.7 Install the high limit pressure sensor in the discharge plenum, before the fire dampers.

.8 In finished room, enclose the controls in metal boxes with frames covering the joint between the box and the adjacent construction. The box must be of approved construction.

.9 The location of the thermostats on the drawing is approximate and is given as a reference only.

.10 Under any circumstances, the space thermostat should be affected by the sun or any other heat source, cold source or air draft. When it has to be installed on a hot or cold wall, the thermostat must be installed on an insulated base, supplied by Division 25.

.11 Install the space thermostat at 1.5 m (5’) from the floor covering.

.12 Never install the thermostats above switches, rheostats, dimmers or any other heat generating control equipment.

.13 The control panel cannot have any unprotected openings.

.14 Protect all cables and tubing from abrasion when passing through openings.

3.2 ELECTRICAL WIRING

.1 Division 25 must supply and install the panels, the controls, etc., and others specialized control devices. In addition, it must supply and install conduit, wiring and junction boxes required to connect all the control devices.

.2 Must comply with the requirements of Division 26 for the install of conduits, wiring, junction boxes, etc.

.3 Notwithstanding the conductor gage mentioned in Division 26, the wire gage for conductors being used for control only are as follow:

- .1 120 V: minimum gage 14 AWG.
- .2 24 V: minimum gage 18 AWG.

.4 Unless otherwise noted, all wiring must be installed in EMT type metal conduit.

.5 Using Plenum type wires:

- .1 The use of FT-4 plenum type cables is authorized **only on room ceilings when the cables remain accessible**, for connecting space sensors, for secondary communication and for supplying 24 v power to application specific controllers (TCUs, fan coils, etc.).
- .2 When using FT-4 cables without conduits, the cables must align with the building lines and be **neatly tied every 1.5 m using hooks or velcros** (similar to the ones used by IT installers) made for this purpose.
- .3 In the room walls where the cables are accessible in the ceiling space (for connecting thermostats, sensors or other accessories), the FT-4 cables must be installed in a conduit up to the ceiling space.
- .4 For the plenum cables, provide protection against abrasion at the end of the conduits. When cable is not in conduit, provide “cord-fitting” type of connectors for connection to local control panels.

.6 For secondary communication cables, use twisted or shielded following the instructions of EMCS manufacturer.

.7 Control cables identification must be performed in accordance with section 25 05 54 – EMCS – Identification.

.8 Complete electrical installation including conduits, cables, junction boxes, etc. required for control systems, automation and the BAS, as shown on drawings and described in these specifications, as well as all electrical connections required to motor control centers and starters, interlocks for fans, pumps or other controls (e.g. device, panels).

.9 Division 25 is solely responsible for providing a complete and fully operational Energy Management and Control System (EMCS) utilizing Direct Digital Control (DDC) technology as shown on drawings and described in these specifications. It must verify all electrical control sequences, all electrical safeties, all overloads and all starter diagrams to provide the right number of auxiliary contacts or other, as require din the control drawings.

.10 Grounding systems required for all systems and devices provided under Division 25, in accordance with manufacturer’s instructions and requirements of Division 26.

.11 All electrical connections to 600/347 V are the responsibility of Division 26.

.12 Provide utility power (120V/1/60) and emergency power to EMCS components, local monitoring panels and control cabinets from local 120/208V distribution panels. Dedicated circuits for use by Division 25 will be reserved in local distribution panels.

3.3 ELECTRICAL INSTALLATION

.1 The installation includes: electrical diagrams, factory and on-site wiring, workmanship, surveillance, calibration, start-up and verification for a fully operational system.

.2 Complete electrical installation including conduits, cables, junction boxes, etc. required for control systems, automation and the EMCS, as shown on drawings and described in these specifications, as well as all data transmission “bus”, all electrical connections required to motor control centers and starters, interlocks for fans, pumps or other controls (e.g. device, panels).

.3 All wiring must comply with the requirements of the local authorities as well as article "ELECTRICAL CONNECTION".

3.4 MEASUREMENTS, VERIFICATION, CALIBRATION

.1 Calibration:

.1 Calibrate all control devices, sensors and transmitters.

.2 The controls of each section or contract must be verified and adjusted and proven to be in working condition.

.3 For each system of each section, for each year of the warranty in summer and winter, in order to prove functionality and adequate calibration; perform with the use of a printer.

.1 A trend log of each points every 3 hours for a 24 hour period.

.2 A trend log of each temperature and humidity every 30 minutes for a 24 hour period.

.3 For humidity controlled space and system, a trend log for each temperature and humidity every 3 hours for a period of seven days.

.2 Simulate all freeze condition and verify the controlled action. These same controls must be verified when the exterior temperature is below -18.0°C (0°F).

.3 Simulate all control panel alarms and record results.

.4 Division 25 must provide great support in the testing and commissioning of the equipment and systems of the other contracts.

3.5 START-UPS

.1 Follow the requirements of Section 20 91 13 – Commissioning (CX) – General requirements.

.2 The control Contractor, once installation is completed, must proceed with the start-up of the system. In order to proceed in a safe environment, the start-up is divided in the following phases: verification of the control systems and start-up of the control systems with the electromechanical equipment operational.

.3 During the control system verification, the control Contractor must include, but not limited to, the following activities:

.1 Verify and calibrate all transmitter's signals.

.2 Verify the operation of all actuators.

.3 Verify the operation and feedback of all controlled devices.

.4 Simulate all alarms.

.5 Simulate all control loop and adjust parameters.

.6 Simulate a power fail and ensure proper restauration of the control system.

.4 The final phase of the start-up must be witness by the Owner. During this phase, the systems are functional, under the supervision of the Owner. The control Contractor will make the necessary modifications and adjustments (fine tuning) in order to have a functional and safe system. The control Contractor must perform these changes, at no cost, to optimize the system operation.

.5 Once the start-up is completed, demonstrate the control system operation.

3.6 TRAINING

.1 Provide competent instructors for a period of four hours (4 h) to provide instruction to Owner on operation and maintenance of the EMCS.

.2 The training must be performed in a classroom environment and the content of the training must be approved prior to the training taking place.

.3 Provide 5 copies of all training documentation.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED SECTIONS

.1 Section 20 00 10 – General Mechanical and Electrical Instructions.

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

.3 Section 25 01 11 – EMCS – Start up, Verification and Commissioning.

1.2 SUBMITTALS

.1 Provide all submittals required in accordance with Section 20 00 10 – General mechanical and electrical instructions.

.2 In addition to submittals required in Section 20 00 10, provide all shop drawings and closeout documentation in accordance with the requirements of this section.

.3 Shop Drawings: provide electronic copies (PDF format) of shop drawings.

.4 Closeout documents:

.1 Following the review, make corrections as requested and provide (3) hard copies and (1) "back-up" copy (PDF – multipage format) on DVD of the closeout documents. Closeout documents must also be entered on the facility OWS and laptop.

1.3 SHOP DRAWING REVIEW

.1 Before starting the installation, submit detailed shop drawings and include following:

.1 For each system under control of the EMCS, provide control and wiring schematics showing: all controllers involved in the regulation of local control loops, all field devices, control elements schematic diagrams of system controlled, sequences of operation, etc. Label all control points, control elements, terminals, etc.

.2 List and description of software programs and applications provided. Supply manufacturer’s technical sheets.

.3 Specification sheets for each item. To include manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.

.4 Detailed network architecture showing DDC control units, components of the Centralized Management System, communication interfaces, control networks, communication protocols used and cable types.

.5 Detailed layout of the conduit network dedicated to the Ethernet communication.

.6 Single line diagrams showing the Ethernet TCP/IP network, including all active components, cable types and length and a bill of materials list, etc.

.7 Detailed layouts of each control panel including a bill of materials and system schematics.

.8 Equipment List Summary indicating manufacturer and model number of equipment to be used and the associated equipment ID.

.9 Floor plans showing location of main controllers (NMCs, MCUs), monitoring panels and auxiliary control cabinets.

.10 Wiring schematics for low voltage power supply network showing local distribution panels, transformers and other equipment. Provide load calculations for control transformers and power supplies.

1.4 CLOSEOUT DOCUMENTATION

.1 In addition to the required documents listed in articles "UPDATED DRAWINGS" and "OPERATIONS AND MAINTENANCE" of Section 20 00 10, provide the following documents, once the start-ups and adjustments are completed:

.1 Corrected and updated version of all information requested in the shop drawings reviews, in accordance with the as-built system.

.2 All testing and commissioning reports, in accordance with Section 25 05 01 – EMCS – General requirements.

.3 Copy of all system programs and documentation for their use.

.4 Copy of all software programmed including database, graphics, parameters, etc.

.5 List of alarm limits programed (high and low for each type - critical and cautionary, maintenance).

.6 List of points assigned to schedule and event programs.

.7 A data base list.

.8 Updated floor plans showing location of all main controllers (NMCs, MCUs), EMCS workstations and/or servers, monitoring panels, auxiliary control cabinets and local controllers (TCUs, LCUs).

.9 Training documentation.

Part 2 Product

2.1 NOT USED.

.1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED SECTIONS

.1 Section 25 05 01 – EMCS – General Requirements.

.2 Section 25 05 02 – EMCS – Submittals and Review Process.

.3 Section 25 30 02 – EMCS – Field Control Devices.

1.2 REFRENCES

.1 CSA international:

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

1.3 NAMEPLATES

.1 All devices must have nameplates indicating size, name of the device all other general information such as serial number, voltage, frequency, number of phases, capacity, manufacturer's name, etc.

.2 The lettering stamped, printed or engraved on the nameplate must be legible. Do not paint the nameplates. When the devices are insulated, leave openings in the insulation to keep the nameplate legible. The manufacturer's nameplate must not be modified in any way.

.3 Provide certification nameplate for pressure appliances and laboratories insurance certification and CSA on all supplied equipment, as per regulation requirements.

.4 Submit to Consultant for approval samples of nameplates, identification tags and list of proposed wording.

Part 2 Product

2.1 NAMEPLATES FOR PANELS

.1 Panels include: control panels, controller enclosures, monitoring panel and auxiliary control cabinets.

.2 Identify by white plastic laminate, 3 mm thick black core, glued and screwed to the panel front door.

.3 Sizes: 90 x 40 mm (3½" x 1½") minimum.

.4 Lettering: minimum 25 mm (1") high.

2.2 TCU PANEL – LOCATION INDICATORS

.1 Identify controller with a printed 12mm, black on white self-adhesive "P-touch" ribbon.

.2 Controller access identification:

.1 Identify the location of application-specific control units (TCU) that are installed in the ceiling space with an orange sticker (25mm x 25 mm). Sticker to include the panel's ID number.

.2 Access door: Apply sticker on visible side.

.3 Locate sticker on the T-Bar assembly or on extremity of the access panel.

2.3 NAMEPLATES FOR CONTROL APPLIANCES

.1 Identify control appliances with metallic tags (or plastic token) with rounded edges, with contrasting engraved numbers and letters. Attach the tags with heavy steel wire or glue and screw them to the appliances.

.2 Sizes: 25 x 40 mm (1" x 1½") minimum.

.3 Lettering: minimum 12 mm (½") high.

.4 The indication must be alphanumerical and must correspond to the control diagrams.

2.4 APPLIANCES AND ACCESSORIES INSTALLED IN PANELS

.1 Identify controller with a printed, white on black self-adhesive "P-touch" ribbon. The indication must be alphanumerical and must correspond to the control diagrams.

2.5 NAMEPLATES FOR ROOM SENSORS

.1 Identify each device with pre-printed electronically generated self-adhesive vinyl labels.

.2 Coordinate the characteristics and lettering size with the Owner.

2.6 WIRING

.1 Colour coding complies with CSA C22.1

.2 Power wiring:

.1 Power wiring: identify circuit breaker number and panel ID inside each control panel.

.2 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.

.3 Distribution panels: Identify breaker for controls and EMCS.

.3 Energy Management and Control System (EMCS):

.1 Identify field device and network wiring end-to-end with plastic rings printed with indelible number markings. Alternatively, use pre-printed labels specifically designed for wiring identification.

.2 Inside control panels, label terminals of terminal blocks with the same identification used on wiring schematics.

.3 Use distinctive colour coded wiring for communications cables, matched throughout system. Color to be coordinated with the Owner.

2.7 CONDUIT

.1 Colour code EMCS conduits and boxes using paint or tape strip 25 mm wide, fluorescent orange color.

.2 Conduits must be identified by painting all connectors and anchors. Pre-paint box covers and conduit fittings.

.3 Coding: use fluorescent orange paint.

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.

.2 Install nameplate to be visible.

3.2 ELECTRICAL PANELS

.1 Correct panel schedules to reflect changes made during work.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED SECTIONS

.1 Section 20 00 10 – Mechanical and electrical general instructions.

.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.

.5 Section 25 05 54 – EMCS – Identification.

.6 Section 25 90 01 – EMCS – Site Requirements, Applications and Systems Sequences of Operation.

1.2 REFERENCES

.1 National Electrical Manufacturer's Association (NEMA):

.1 NEMA 250 – Enclosures for Electrical Equipment (1000 V Maximum).

.2 International Electrical Commission (IEC):

.1 IEC 60529 – Classification of Degrees of Protection Provided by Enclosures (IP Code).

1.3 SUBMITTALS

.1 Submit shop drawings, technical sheets and manufacturer's installation instructions in accordance with Section 25 05 02 – EMCS – Submittals and Review Process. The shop drawings and technical sheets must include the following:

.1 All specified information for each device.

.2 Detailed manufacturer’s installation instructions.

.3 Identify each technical sheet submitted for verification with the acronym used in the plans and specifications.

.4 If the technical sheet shows more than one model or options, indicate with an arrow which is selected.

.2 Testing prior to installation:

.1 Provide a random sample from the delivered material, based on the Engineer's requirements, which will be tested prior to installation is to begin. Replace the equipment which performance do not meet the specified requirements.

1.4 INSTALLATION INSTRUCTIONS

.1 Provide manufacturer’s shop drawings, technical sheets and instructions relating to the installation of the devices.

.2 Install devices according to manufacturer’s recommendations.

1.5 EXISTING CONDITIONS

.1 All demolition work, including cutting, fitting, and patching: In accordance with Section 20 00 10 – Mechanical and electrical general instructions.

.2 If necessary, repair any damaged surfaces after performing the work.

.3 Provide the Customer Representative removed materials that cannot be recovered.

1.6 ACCEPTABLE MATERIALS OR PRODUCTS

.1 When materials or products are given by their trademarks, consult the instructions to tenders in order to know the procedure concerning the request for approval of materials or substitutes.

Part 2 Product

2.1 GENERAL

.1 Control devices of each category to be of same type and manufacturer.

.2 Operating conditions: 0 – 40ºC with 10 – 90% RH (non-condensing) unless otherwise specified.

.3 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.

.4 Transmitters and sensors to be unaffected by external transmitters including walkie-talkies.

.5 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

.6 Outdoor installations: use weatherproof construction in NEMA-4 enclosures.

.7 Control devices to satisfy the following requirements:

- .1 Linearity: relationship between control device measurement (temperature, humidity, pressure, etc.) and output signal to be linear type.
- .2 Control limits: control devices to maintain their controlled variable within the following set point limits:
  - .1 Temperature:
    - .1 ± 0.8°C (1.5°F) in spaces.
    - .2 ± 0.3°C (0.5°F) for chilled water, cooling tower water and hot water systems.
    - .3 ± 0.5°C (1.0°F) in all other applications.
  - .2 Humidity:
    - .1 ± 5% in all cases.
- .3 There must be no hysteresis.
- .4 Controls must react to changing conditions.

.8 All control equipment and field devices provided under this section must meet or exceed the level of performance, the operational requirements and the fabrication characteristics of the equipment described in these specifications. Equipment with any variation from these specifications in terms of quality, performance, construction, operating sequences or system features must be reviewed and approved as an equivalent by the Consultant.

.9 The control Contractor is responsible for the supply, installation, submitted drawings and warranty of all accessories included in the plans and specifications, even if it is not manufactured by the control manufacturer.

2.2 ELECTRICAL CONTROL DEVICES

.1 R – Electrical relay:

.1 4PDT or DPDT, with silver or nickel alloy contacts, LED status indicators, and self-maintained test button.

.2 Plug-in type with termination base. In applications where relay is subject to vibration, provide hold-on clip.

.3 Complete with enclosure when installed outside panels.

.4 When used for switching, use appropriate contact rating.

.5 As per Omron model MYxIN or approved equivalent from Magnecraft.

.2 Current sensors:

.1 CT – Current transmitter:

.1 Current transmitter with two (2) wire analog output.

.2 Amperage range: 1 – 120 A as per specific model.

.3 Isolation: 600 V A.C. rms.

.4 Accuracy: ± 2% on all ranges.

.5 Temperature: -15 to 60°C (5 to 140ºF)

.6 Relative humidity ratio: 10 – 90% without condensation

.7 Output signal: 4 to 20 mA

.8 Type H721 or H921 Hawkeye from Veris Industries.

.3 TR – Transformer:

.1 Single phase transformer, enclosed type complete with fuse holder and fuse. Transformer capacity in VA to be at least 20% greater than the rated charge to be connected. Use of transformers with integrated thermal protection or with intrinsic limitation as an alternative to fuses is prohibited.

.2 As per MC series from Marcus or approved equivalent from Hammond.

2.3 ELECTRONIC CONTROL DEVICES

.1 T – Temperature sensor:

.1 Room temperature sensor:

.1 Type: NTC 10k ohms, ± 0.2°C accuracy, standard resistance/ temperature coefficient, for a wall installation.

.2 Separate mounting base with slotted type enclosure and blank cover. Coordinate colour with Architect.

.3 Local setpoint adjustment, day/night override button.

.4 For application specific controller's sensor, include a connection point for quick laptop connection for maintenance and troubleshooting.

.5 Greystone no. TE-200.

.2 Duct temperature sensor:

.1 General purpose duct type: suitable for insertion into ducts at various orientations, probe length 460 mm or half of duct size at insertion point.

.2 Averaging duct type: incorporates numerous sensors inside a soft copper tubing which are averaged to provide one reading. Minimum probe length 6000 mm. Bend probe at field installation time to 100 mm radius at point along probe without degradation of performance.

.3 General: resistance type to following requirements:

.4 RTD's: 1000 ohm or 10k ohm platinum element with strain minimizing construction and standard coefficient of resistivity.

.5 Sensing element: hermetically sealed.

.6 Unless otherwise noted, complete with ABS enclosure.

.7 Accuracy: ± 0.2ºC.

.8 As per TE-200 series from Greystone or approved equivalent.

2.4 ME – ELECTRIC ACTUATORS

.1 General:

.1 ON/OFF operation or modulating, depending on the application. Mounting brackets, crank and rod are supplied and installed by current section. Permanent installation with piercing in shafts using two lock screws. All actuators are with spring return in normal position.

.2 As per Belimo models, NF and AF series, or approved equivalent from Siemens, Johnson Controls or Honeywell.

.3 For terminal units, Belimo model LMB24-SR or approved equivalent from Siemens, Johnson Controls or Honeywell.

2.5 TCU – TERMINAL CONTROL UNIT.

.1 TCU – Terminal Control Unit – Air Terminal Unit, Terminal Equipment:

.1 Architecture:

.1 Microprocessor based, digital controller including a regulated power supply, a communication interface and an input/output module, all mounted on a digital card and protected by a cover.

.2 All programming in the TCU resides on a non-volatile type memory (EEPROM) in the controller to avoid module re-programming after a power failure.

.3 Application-specific controllers **must be fully programmable**. The use of configurable controllers is prohibited.

.1 Each terminal control unit TCU can operate on a standalone basis or in network with a management controller (UGR) and/or master controllers (PCM), thus providing full transparency of data available at application specific controllers.

.2 The use of application specific controllers TCU with i**ntegrated actuators is prohibited, unless the control card allows the dismantlement of the actuator**. Minimum actuator requirements in accordance with these specifications.

.3 Installed directly on unit or in proximity of the unit in the ceiling space in a proper enclosure.

.4 Each TCU, must have the capability to properly execute the operating sequence, as described in Section 25 90 01- Site Requirements Applications and Systems Sequences of Operation.

.2 Minimum Requirements – Local Room Control:

.1 Controller provides DDC type control for local space control applications.

.2 Operating sequence, in accordance with Section 25 90 01- Site Requirements Applications and Systems Sequences of Operation.

.3 Power supply: 20-30 V A.C., 60 Hz, 3.5 to 5 A, 24 V A.C.

.4 Inputs/Outputs:

.1 Provide all analog inputs required for the connection of points shown on drawings and to properly execute the operating sequence, as described in Section 25 90 01- Site Requirements Applications and Systems Sequences of Operation, including the following elements (when applicable):

.2 Analog inputs:

.1 One room thermostat with the characteristics described in these specifications.

.2 One to three room temperature sensors (c/w blank cover).

.3 Auxiliary supply air temperature sensor (when applicable).

.4 One or two airflow sensors (pitot station) with electro-pneumatic transducer (EPT) – if required.

.3 Digital inputs:

.1 One dry contact, for future interlock connection – required for all terminal control unit TCU.

.4 Outputs:

.1 Five digital outputs, 24 V A.C., Triac type, 25 to 500 mA, for on/off or pulsed applications. Used for electric reheat coils (PWM application), start/stop command (unit heaters) or auxiliary heat (electrical convectors).

.2 Two proportional outputs to modulate airflow control dampers. Floating-point control is acceptable if actual position feedback is provided at the controller.

.3 As per model TEC from Siemens, or approved equivalent with BTL Listing as a **B-ASC or BTL-AAC** device.

2.6 LOCAL MONITOR PANELS

.1 General:

.1 "Unitized Cabinet" type, NEMA 1, 610 mm x 815 mm x 205 mm front door mounted on concealed hinges - easy to remove for access, key-operated lock.

.2 Install them on rigid supports, for wall, floor, ceiling or ventilation ducts mounting.

.2 Location:

.1 Location according to on-site conditions, with a space of 1000 mm in front of the panel.

.3 Accessories:

.1 All devices to be mounted inside panels including all relays, switches, fuses and fuse holders, terminals, etc.

.2 Push-buttons, indicator lights, pressure gauges for filter, gauges 70 mm for temperature and humidity, etc., shall be built-in to the panel door.

.4 Identification:

.1 In accordance with Section 25 05 54.

.2 Some monitor panels shall have a separate 120 V emergency power supply connected to a switch, near the panel, by the current section.

.5 Schematic diagram:

.1 A permanently attached schematic diagram showing arrangement of the controls to be installed on the panel door.

.2 This diagram shall be sealed in a transparent, plastic-type material which will not deteriorate.

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 equipment and devices according to manufacturer instructions.

.3 Install transmitters, sensors, relays or any field device inside Nema 1 boxes or equivalent where required. Protect them against electrolytic reaction between continuous dissimilar materials.

.4 Install panels, sensor and local transmitters on suitable “can truss” or profiles.

.5 Ensure to keep enough space for fire protection and maintain the minimal fire ratings.

.6 Electrical wiring:

.1 Comply with electrical requirements as per section 26 05 00 – Electrical – Common work results for electrical.

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

.3 Plug wires to suitable terminals blocks/ lugs depending on wire size.

3.2 IDENTIFICATION

.1 Refer to section 25 05 54 – EMCS – Identification.

3.3 START-UP

.1 Test and calibrate field control equipment and devices according to section 25 01 11 – EMCS – Start-up, Verification and Commissioning.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 PROGRAMMING

.1 The sequences, procedures and programs described in the part "EXECUTION" of this section represent the minimum operation criteria's, excluding the fine details required for tuning of the systems. The supplier of the current section is responsible for system programming and must, as an expert in configuring and commissioning this type of installation, provide all control stratagems, including: delays, ramps, reset functions, interlocks, cascade loops, etc., in order to obtain a system operation that is safe, simple and efficient.

.2 Any modification, addition or refinements to operating sequences, as required or requested by the Consultant, to improve system stability or equipment protection, will be executed without additional costs.

1.2 CONFIGURATION AND CUSTOMIZATION

.1 System configuration and customization must be executed in collaboration with the Owner, in order to allow an easy transfer to operation team.

.2 Messages, descriptors, equipment keywords, etc., must be submitted for approval.

.3 Choice of colors, graphic layouts (displays), system breakdown, tree structure (level of intrusion) and graphic configuration must be done in coordination with the Owner.

.4 Creation of reports, headers, information displayed and its layout, printing frequency and periods, etc., are done in coordination with the Owner.

.5 Further to the dynamic graphic of each systems, a dynamic architectural floorplan for each floor, showing the location of all terminal units, thermostats and lighting statuses. The operator must be able to (by selecting the terminal unit or the thermostat) display all the parameters, statuses, damper positions and all measured variables of the unit with the possibility to modify all the parameters and functions relating to the unit.

.6 The graphics creation must be done to Owner's standards and specifications, as shown in appendix.

Part 2 Product

2.1 NOT USED

.1 Not Used

Part 3 Execution

3.1 GENERAL

.1 Setpoints, parameters and constants:

.1 All setpoints, compensation rates and limits, calendars and schedules are adjustable by the operator, provided he has an authorization level. Similarly, all parameters, constants, programmed delays can be adjusted by an operator with the proper access authorization.

.2 Constants and control modes:

.1 All control loops shall be proportional and integral (PI) type except for flow and pressure control loops which shall be proportional, integral and derivative (PID) type and limit loops, which are proportional only.

.2 On-site, the operator must be able, without making programming modifications, to delete (or add) any type of control mode, modify constants or parameters, etc.

.3 Adjust all control loops in order to obtain a system that will provide a stable operation during extreme conditions, with minimum access time.

.4 Program filters to stabilize analog readings, more specifically on pressure and flow readings used in control loops.

.5 For each start-stop command, provide a minimum “On” and minimum “Off” time to eliminate cycling.

.3 Analytical data transfer:

.1 The data trending and analytical calculation strategy must ensure that the data transfer on the associated network is minimized as much as possible. Therefore, the result of a calculation, instead of the data required for the calculation, will be transmitted directly.

.4 Analog alarms:

.1 For each analog measurement point, program high and low limit alarms.

.2 Allow for the programming of four (4) alarm limits: two low-limits and two high-limits.

.3 Each of these alarm setpoint can be modified or supressed, as required by the operator.

.4 Unless otherwise noted, alarms originating from sensors located in a system duct (or piping) will be interlocked with their corresponding fan (or pump) in order to supress alarms when a system is not running.

.5 Critical alarms:

.1 When the status is available, program critical alarms for the following points:

.1 Unauthorized "on-off" for fans, pumps, etc.

.2 Freeze risk.

.3 High or Low pressure.

.4 Fault (equipment).

.5 Abnormal control state (level, pressure, temperature).

.6 Main electrical phase loss.

.6 Maintenance alarms:

.1 When the status is available, program maintenance alarms for the following points: System stopped, dirty filter, running time.

.2 When a status is available, provide cumulative running time of the equipment.

.7 Analog current transmitter analysis:

.1 For each analog current transmitter, provide real time consumption percentage of the associated motor or equipment by comparing the actual current reading with the full load current consumption.

.2 For all belt driven motor, remove the belts to measure the current with no load, then reinstall the belts. Alarm when the no load value is detected.

.8 Setpoint ramping:

.1 On system start-up or following a set point modification, an ascending (or descending) ramp must be implemented to increase (or decrease) progressively a set point towards its final value, thus preventing risks such as freezing, low-pressure, high-pressure, etc. Ramp rates must be adjustable.

.9 Starting after a power failure:

.1 Once power is restored, every electro-mechanical equipment (i.e. fans, pumps) is started in accordance with a predefine sequence to avoid a power overload and control peak demand. Provide a programmable start-up delay for each equipment controlled.

.10 Starting manually:

.1 Upon detection of a non-start signal or a non-authorized stop (manually commanded at the starter), a maintenance alarm is issued and the system is controlled as per the normal sequence of operation.

.11 Optimized start:

.1 For each system, provide an optimized start algorithm.

3.2 SEQUENCES OF OPERATION

.1 A variable air volume box with single air inlet, variable volume w/wo terminal reheat and hot water baseboard for perimeter heating.

.1 Occupied mode:

.1 The controller modulates the VAV damper, the hot water baseboard valve (if applicable) and the terminal electric reheat (if applicable) according to the principle presented on control drawings.

.2 The VAV box will become operational and will maintain the MIN and MAX air flow settings for occupied mode. While modulating between these two parameters in order to maintain the desired temperature set point.

.2 Unoccupied mode:

.1 The damper in the VAV box is closed.

.2 Reheat coil will be off.

.3 In heating seasons (winter) the temperature set point is lowered by 3°C (adjustable). While in cooling seasons (summer) the set point will be raised by 3°C (adjustable).

.4 When heat is required in the zone, the controller modulates the hot water baseboard valve (if applicable) and the terminal electric reheat (if applicable) like occupied mode in order to maintain the required (S.P.) set point.

.3 Presence detection (Where applicable):

.1 During occupied hours and if there is no presence in the room for at least 30 minutes (adjustable), the controller forces the terminal unit in "unoccupied" mode.

.2 Standalone air conditioning unit:

.1 The air conditioning unit is standalone. Only the room temperature is monitored, the controller sends a low or high room temperature alarm to the EMCS.

END OF SECTION