

Part 1 General**1.01 DEFINITIONS**

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

1.02 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.

1.03 SUBMITTALS

- .1 Submittals in accordance with Division 01 – General Requirements.
- .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 Division 01 – General Requirements.
 - .5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

1.04 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 Division 01 – General Requirements.

1.05 COMMISSIONING

- .1 Do commissioning in accordance with Division 01 – General Requirements.
- .2 Carry out commissioning under direction of Departmental Representative 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 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.

1.06 COMPLETION OF COMMISSIONING

- .1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by Departmental Representative and Commissioning Manager.

1.07 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

2.01 EQUIPMENT

- .1 Provide sufficient instrumentation to verify and commission the installed system.
- .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

3.01 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.
- .3 Commission integrated systems using procedures prescribed by Commissioning Manager.
- .4 Debug system software.
- .5 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.
- .6 Test emergency and life safety procedures including operation and integrity of refuge systems under normal and emergency power conditions as applicable.

3.02 FIELD QUALITY CONTROL

- .1 Pre-Installation Testing.
 - .1 General: consists of field tests of equipment just prior to installation.
 - .2 Equip each Building Controller with sensor and controlled device of each type (AI, AO, DI, DO).
 - .3 Additional instruments to include:
 - .1 DP transmitters.
 - .2 DP switches used for dirty filter indication and fan status.
 - .4 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.
 - .5 After setting, test zero and span in 10 % increments through entire range while both increasing and decreasing pressure.
 - .6 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.
 - .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. This document will be used in final start-up testing.
 - .3 Final Start-up Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of Commissioning Manager and provide:
 - .1 Technical personnel capable of re-calibrating field hardware and modifying software.
 - .2 Detailed daily schedule showing items to be tested and personnel available.

- .3 Commissioning to commence during final start-up testing.
- .4 O&M personnel to assist in commissioning procedures as part of training.
- .5 Commissioning to be supervised by qualified supervisory personnel.
- .6 Operate systems as long as necessary to commission entire project.
- .7 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 20 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 20 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.

3.03 ADJUSTING

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

3.04 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 Division 01 – General Requirements.

END OF SECTION 25 01 11

Part 1 General**1.01 DEFINITIONS**

- .1 CDL - Control Description Logic.
- .2 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.02 SUBMITTALS

- .1 Submittals in accordance with Division 01 – General Requirements, supplemented and modified by requirements of this Section.
- .2 Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to Departmental Representative 30 days prior to anticipated date of beginning of training.
 - .1 List name of trainer, and type of visual and audio aids to be used.
 - .2 Show co-ordinated interface with other EMCS mechanical and electrical training programs.
- .3 Submit reports within one week after completion of training program that training has been satisfactorily completed.

1.03 QUALITY ASSURANCE

- .1 Provide competent instructors thoroughly familiar with aspects of EMCS installed in facility.
- .2 Departmental Representative reserves right to approve instructors.

1.04 INSTRUCTIONS

- .1 Provide instruction to designated personnel in adjustment, operation, maintenance and pertinent safety requirements of EMCS installed.
- .2 Training to be project-specific.

1.05 TIME FOR INSTRUCTION

- .1 Number of days of instruction to be as specified in this section (1 day = 8 hours including two 15 minute breaks and excluding lunch time).

1.06 TRAINING MATERIALS

- .1 Provide equipment, visual and audio aids, and materials for classroom training.
- .2 Supply manual for each trainee, describing in detail data included in each training program.
 - .1 Review contents of manual in detail to explain aspects of operation and maintenance (O&M).

1.07 TRAINING PROGRAM

- .1 To be in 2 phases over 6 month period.
- .2 Phase 1: 1 day program to begin before 20 day test period at time mutually agreeable to Contractor, Departmental Representative and Commissioning Manager.
 - .1 Train O&M personnel in functional operations and procedures to be employed for system operation.
 - .2 Supplement with on-the-job training during 20 day test period.
 - .3 Include overview of system architecture, communications, operation of computer and peripherals, report generation.
 - .4 Include detailed training on operator interface functions for control of mechanical systems, CDL's for each system, and elementary preventive maintenance.
- .3 Phase 2: 1 day program to begin 8 weeks after acceptance for operators, equipment maintenance personnel and programmers.
 - .1 Provide multiple instructors on pre-arranged schedule. Include at least following:
 - .1 Operator training: provide operating personnel, maintenance personnel and programmers with condensed version of Phase 1 training.

1.08 ADDITIONAL TRAINING

- .1 List courses offered by name, duration and approximate cost per person per week. Note courses recommended for training supervisory personnel.

1.09 MONITORING OF TRAINING

- .1 Departmental Representative to monitor training program and may modify schedule and content.

Part 2 Products**2.01 NOT USED**

- .1 Not Used.

Part 3 Execution**3.01 NOT USED**

- .1 Not Used.

END OF SECTION 25 01 12

Part 1 General**1.01 REFERENCES**

- .1 American National Standards Institute (ANSI)
 - .1 ANSI/ISA S5.5, Graphic Symbols for Process Displays.
 - .2 ANSI/IEEE 260.1, Letter Symbols for SI and Certain Other Units of Measurements (SI Units, Customary Inch-Pound Units and Certain Other Units).
- .2 Canadian Standards Association (CSA)
 - .1 CAN/CSA-C22.2 No.0, General Requirements, Canadian Electrical Code, Part II.
 - .2 CAN/CSA-Z234.1, Canadian Metric Practice Guide.

1.02 ACRONYMS, ABBREVIATIONS AND DEFINITIONS

- .1 Acronyms used in EMCS.
 - .1 AI - Analog Input
 - .2 AO - Analog Output
 - .3 BACnet - Building Automation and Control Network
 - .4 CAD - Computer Aided Design
 - .5 CDL - Control Description Logic
 - .6 COSV - Change of State or Value
 - .7 CPU - Central Processing Unit
 - .8 DI - Digital Input
 - .9 DO - Digital Output
 - .10 ECU - Equipment Control Unit
 - .11 EMCS - Energy Monitoring and Control System
 - .12 HVAC - Heating, Ventilation, Air Conditioning
 - .13 IDE - Interface Device Equipment
 - .14 I/O - Input/Output
 - .15 ISA - Industry Standard Architecture
 - .16 LAN - Local Area Network
 - .17 LCU - Local Control Unit
 - .18 LonTalk - Echelon Corporation (proprietary protocol)
 - .19 MCU - Master Control Unit
 - .20 OS - Operating System
 - .21 O&M - Operation and Maintenance
 - .22 OWS - Operator Work Station
 - .23 PC - Personal Computer
 - .24 PCI - Peripheral Control Interface
 - .25 PCMCIA - Personal Computer Micro-Card Interface Adapter
 - .26 RAM - Random Access Memory
 - .27 ROM - Read Only Memory
 - .28 TCU - Terminal Control Unit

- .29 USB - Universal Serial Bus
- .30 UPS - Uninterruptible Power Supply
- .2 Definitions:
 - .1 Point: a point may be logical or physical. Logical points are values calculated by system such as totals, counts, derived corrections i.e. as result of and/or statements in CDL's. Physical points are inputs or outputs which have hardware wired to controllers which are measuring or providing status conditions of contacts or relays providing interaction with related equipment (stop, start) or valve or damper actuators.
- .3 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISAS 5.5.
 - .1 Printouts: to ANSI/IEEE 260.

1.03 PERMITS AND FEES

- .1 In accordance with General Conditions of Contract.

1.04 GENERAL DESCRIPTION

- .1 Refer to control schematics and system descriptions for system architecture.
- .2 The intent of this project is to only replace and supplement existing equipment, not change the sequencing and setpoints of the existing system. The new equipment to be added shall tie into the existing controls system. Work covered by Division 25 includes, but is not limited to, the following:
 - .1 Building Controllers.
 - .2 Control devices as listed in I/O Summaries.
 - .3 Reconnection, or new connections, to existing OWS.
 - .4 Data communications equipment necessary to effect an EMCS data transmission system including gateway and LAN hardware and software for connection to BACnet network.
 - .5 Field control devices.
 - .6 Complete operating and maintenance manuals and field training of operators, programmers and maintenance personnel.
 - .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.

1.05 METRIC REFERENCES

- .1 Conform to CAN/CSA-Z234.1.
- .2 Provide required adapters between Metric and Imperial components.

1.06 STANDARDS COMPLIANCE

- .1 All equipment and material to be 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. Label or listing of specified organization is acceptable evidence.
- .4 For materials whose compliance with organizational standards/codes/specifications is not regulated by an organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.

1.07 EMCS CONTRACTOR QUALIFICATIONS

- .1 EMCS contractor to:
 - .1 Have an office staffed by trained personnel capable of providing instruction, routine maintenance, emergency service on systems,
 - .2 Have access to local supplies of essential parts and provide 7 year guarantee of availability of spare parts after obsolescence.

1.08 SYSTEM DESIGN RESPONSIBILITY

- .1 Design and provide all conduit and wiring linking all elements of system, including future capability.
- .2 Supply sufficient programmable controllers of all types to meet project requirements. Quantity and points contents to be approved by Departmental Representative prior to installation.
- .3 Location of controllers to be approved by Departmental Representative prior to installation.
- .4 Provide utility power to controllers.

1.09 LANGUAGE OPERATING REQUIREMENTS

- .1 Operator to interface to system in English.
- .2 Use non-linguistic symbols for displays on graphic terminals wherever possible. All other information to be in English.
- .3 Operating system executive: primary hardware-to-software interface (specified as part of hardware purchase) with associated documentation to be in English.

1.10 MATERIALS DELIVERY SCHEDULE

- .1 Provide Departmental Representative with "Materials Delivery Schedule" within 2 weeks after award of Contract.

Part 2 Products

2.01 EXISTING SYSTEMS MANUFACTURER

- .1 Johnson Controls

2.02 LOCKABLE PANELS

- .1 Panel to be NEMA rated to suit environmental requirements.
- .2 To have hinged doors equipped with standard keyed-alike cabinet locks, keyed to same key.

Part 3 Execution**3.01 MANUFACTURER'S RECOMMENDATIONS**

- .1 Installation to be to manufacturer's recommendations. Provide printed copies of recommendations with shop drawings or product data.

3.02 PAINTING

- .1 Clean and touch up marred or scratched surfaces of factory finished equipment to match original finish.
- .2 Restore to new condition, finished surfaces which have been damaged too extensively to be primed and touched up to make good.
- .3 Clean and prime exposed hangers, racks, fastenings, and other support components.
- .4 Paint all unfinished equipment installed indoors to CEMA 2Y.1.

3.03 OPERATOR INSTRUCTION

- .1 During and after system commissioning this Trade shall provide on-site operator instruction to the Departmental Representative's operating personnel. Operation instruction during normal working hours shall be performed by competent representatives familiar with the installed system.
- .2 At a time mutually agreed upon with the Departmental Representative the Control Contractor shall give sessions each of eight (8) hours of instructions to up to five (5) of the Departmental Representative's designated personnel on the operation of all equipment in the system and describe its intended use.
- .3 Training to be accomplished as follows:
 - .1 Initial instruction period – 1 day at 8 hours.
 - .2 Followed by one (1) – eight (8) hour instruction periods within the maintenance period at a date requested by the Departmental Representative.
 - .3 Record attendance log for each training period and submit to Departmental Representative.
- .4 An Departmental Representative's Manual, prepared for the project by the Control Contractor shall be used during instruction. Copies of the Departmental Representative's Manual shall be provided to the Departmental Representative with Operation and Maintenance Manuals.

END OF SECTION 25 05 01

Part 1 General**1.01 DEFINITIONS**

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

1.02 DESIGN REQUIREMENTS

- .1 Preliminary Design Review: to contain following contractor and systems information.
 - .1 Names of sub-contractors and site-specific key personnel.
 - .2 Sketch of site-specific system architecture.
 - .3 Specification sheets for each item including memory provided, programming language, speed, type of data transmission.
 - .4 Descriptive brochures.
 - .5 Sample CDL and graphics (systems schematics).
 - .6 Response time for each type of command and report.
 - .7 Item-by-item statement of compliance.

1.03 SUBMITTALS

- .1 Submittals in accordance with Division 01 – General Requirements and coordinate with requirements in this Section.
- .2 Shop Drawings to consist of 10 hard copies and 1 soft copy of design documents, shop drawings, product data and software.
- .3 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.
- .4 Soft copy to be in AutoCad - latest version and Microsoft Word latest version format, structured using menu format for easy loading and retrieval on OWS.

1.04 DETAIL SHOP DRAWING REVIEW

- .1 Submit detailed shop drawings within 60 working days after award of contract and before start of installation and include following:
 - .1 Corrected and updated versions (hard copy only) of submissions made during preliminary review.
 - .2 Wiring diagrams.
 - .3 Piping diagrams and hook-ups.
 - .4 Interface wiring diagrams showing termination connections and signal levels for equipment to be supplied by others.
 - .5 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including:
 - .1 Sensing element type and location.
 - .2 Transmitter type and range.
 - .3 Associated field wiring schematics, schedules and terminations.
 - .4 Complete Point Name Lists.

- .5 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.
- .6 Software and programming details associated with each point.
- .7 Manufacturer's recommended installation instructions and procedures.
- .8 Input and output signal levels or pressures where new system ties into existing control equipment.
- .6 Control schematics, narrative description, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of EMCS.
- .7 Graphic system schematic displays of air and water systems with point identifiers and textual description of system, as specified.
- .8 Listing and example of specified reports.
- .9 Listing of time of day schedules.
- .10 Mark up to-scale construction drawing to detail control room showing location of equipment and operator work space.
- .11 Type and size of memory with statement of spare memory capacity.
- .12 Full description of software programs provided.

Part 2 Products**2.01 NOT USED**

- .1 Not Used.

Part 3 Execution**3.01 NOT USED**

- .1 Not Used.

END OF SECTION 25 05 02

Part 1 General**1.01 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.

1.02 SUBMITTALS

- .1 Submittals in accordance with Division 01 – General Requirements, supplemented and modified by requirements of this Section.
- .2 Submit Operation and Maintenance Manual to Departmental Representative in English.
- .3 Provide soft copies and hard copies in hard-back, 50 mm 3 ring, D-ring binders.
 - .1 Binders to be 2/3 maximum full.
 - .2 Provide index to full volume in each binder.
 - .3 Identify contents of each manual on cover and spine.
 - .4 Provide Table of Contents in each manual.
 - .5 Assemble each manual to conform to Table of Contents with tab sheets placed before instructions covering subject.

1.03 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 5 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 5 hard and 1 soft copy incorporating changes made during final review.

1.04 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 4 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 Explicit description of hardware and software functions, interfaces and requirements for components in functions and operating modes.
 - .6 Description of person-machine interactions required to supplement system description, known or established constraints on system operation, operating procedures currently implemented for implementation in automatic mode.
- .5 System operation to include:
 - .1 Complete step-by-step procedures for operation of system including required actions at each OWS.
 - .2 Operation of computer peripherals, input and output formats.
 - .3 Emergency, alarm and failure recovery.
 - .4 Step-by-step instructions for start-up, back-up equipment operation, execution of systems functions and operating modes, including key strokes for each command so that operator need only refer to these pages for keystroke entries required to call up display or to input command.
- .6 Software to include:
 - .1 Documentation of theory, design, interface requirements, functions, including test and verification procedures.
 - .2 Detailed descriptions of program requirements and capabilities.
 - .3 Data necessary to permit modification, relocation, reprogramming and to permit new and existing software modules to respond to changing system functional requirements without disrupting normal operation.
 - .4 Complete program cross reference plus linking requirements, data exchange requirements, necessary subroutine lists, data file requirements, other information necessary for proper loading, integration, interfacing, program execution.
 - .5 Software for each Controller and single section referencing Controller common parameters and functions.
- .7 Maintenance: document maintenance procedures including inspection, periodic preventive maintenance, fault diagnosis, repair or replacement of defective

components, including calibration, maintenance, repair of sensors, transmitters, transducers, controller and interface firmware's, plus diagnostics and repair/replacement of system hardware.

- .8 System configuration document:
 - .1 Provisions and procedures for planning, implementing and recording hardware and software modifications required during operating lifetime of system.
 - .2 Information to ensure co-ordination of hardware and software changes, data link or message format/content changes, sensor or control changes in event that system modifications are required.
- .9 Programmer control panel documentation: provide where panels are independently interfaced with BECC, including interfacing schematics, signal identification, timing diagrams, fully commented source listing of applicable driver/handler.

Part 2 Products

2.01 NOT USED

- .1 Not Used.

Part 3 Execution

3.01 NOT USED

- .1 Not Used.

END OF SECTION 25 05 03

Part 1 General**1.01 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.

1.02 DEFINITIONS

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

1.03 SYSTEM DESCRIPTION

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

1.04 SUBMITTALS

- .1 Submittals in accordance with Division 01 – General Requirements 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**2.01 NAMEPLATES FOR PANELS**

- .1 Identify by Plastic laminate, black core, square corners, lettering accurately aligned and engraved into core.
- .2 Sizes: 25 x 67 mm minimum.
- .3 Lettering: minimum 7 mm high, white.
- .4 Inscriptions: machine engraved to identify function.

2.02 NAMEPLATES FOR FIELD DEVICES

- .1 Identify by plastic encased cards attached by chain.
- .2 Sizes: 50 x 100 mm minimum.
- .3 Lettering: minimum 5 mm high.
- .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.

2.03 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.

2.04 WARNING SIGNS

- .1 Equipment including motors, starters under remote automatic control: supply and install orange coloured signs warning of automatic starting under control of EMCS.
- .2 Sign to read: "Caution: This equipment is under automatic remote control of EMCS" as reviewed by Departmental Representative's.

2.05 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.

2.06 CONDUIT

- .1 Colour code EMCS conduit.
- .2 Pre-paint box covers and conduit fittings.

Part 3 Execution

3.01 NAMEPLATES AND LABELS

- .1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times.

3.02 EXISTING PANELS

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

END OF SECTION 25 05 54

Part 1 General**1.01 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.

1.02 SUBMITTALS

- .1 Submittals in accordance with Division 01 – General Requirements.
- .2 Submit detailed preventative maintenance schedule for system components to Departmental Representative.
- .3 Submit detailed inspection reports to Departmental Representative.
- .4 Submit dated, maintenance task lists to Departmental Representative and include the following sensor and output point detail, as proof of system verification:
 - .1 Point name and location.
 - .2 Device type and range.
 - .3 Measured value.
 - .4 System displayed value.
 - .5 Calibration detail
 - .6 Indication if adjustment required,
 - .7 Other action taken or recommended.
- .5 Submit network analysis report showing results with detailed recommendations to correct problems found.
- .6 Records and logs: in accordance with Division 01 – General Requirements.
 - .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.
- .7 Revise and submit to Departmental Representative in accordance with Division 01 – General Requirements "As-built drawings" documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period.

1.03 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.
 - .9 Provide system modifications in writing.
 - .10 No system modification, including operating parameters and control settings, to be made without prior written approval of Departmental Representative.

Part 2 Products**2.01 NOT USED**

- .1 Not Used.

Part 3 Execution**3.01 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 25 08 20

Part 1
1.01 **General**
 NOT USED**Part 2**
2.01 **Products**
 GENERAL

- .1 The existing Building Management System is capable of integrating multiple building functions, including equipment supervision and control, alarm management, energy management, and trend data collection. New controls components must tie into the existing system seamlessly.
- .2 The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.
- .3 Acceptable Suppliers: This specification is based upon a "Metasys" system by Johnson Controls Ltd.

2.02 **FIELD EQUIPMENT**

- .1 Temperature Sensors
 - .1 Temperature sensors shall be 1000 OHM nickel RTD type. Analog temperature sensors shall provide an output signal that varies continuously with the sensed temperature, within a specified range. Binary temperature sensors shall provide an output signal that is either on or off depending upon whether the sensed temperature is above or below the setpoint temperature. All sensors of a particular category shall be of the same type and manufacturer. Provide temperature sensors suitable for one or more of the following mounting methods: duct mount, pipe thermowell mount.
 - .2 Insertion Type - Suitable for insertion into air ducts at any angle, and shall have a minimum insertion of 6".
 - .3 Immersion Type - Suitable for immersion into fluids in tanks or pipes with separable well and heat transfer compound. Sensor wells shall be brass and compatible with the sensor.
 - .4 Averaging Type with Extended Element - Suitable for duct mounting to obtain average temperature by sampling along a capillary tube element.
 - .5 Outside Air Sensing Type - Shall have sun shades to minimize solar effects and shall be mounted to minimize building outside air film effects.
 - .6 Space Type – Standard non-secure areas - occupied/unoccupied override switches. Thermostats/ sensors for terminal boxes shall have lockable access to temperature setpoint adjustment. Portable operator terminal shall be able to connect to space thermostat/sensor. Replace existing multi-zone temperature sensors with new in renovated areas.
 - .7 Space Type – Secure Areas – locate sensors as shown on drawings. Sensors shall be moisture resistant, general purpose RTD/thermistor sensing element suitable for mounting concealed on rear side of blank wall plate. Sensing element to be firmly adhered to back of blank plate. Enclosure shall be designed and manufactured for secure installation in poured concrete walls and shall consist of 10 ga steel backplate for cast-in-place concrete or core-

filled block construction, one-piece blank 10 ga steel front plate finished in baked white enamel and fastened with secure screws in each corner.

- .1 Acceptable material: Johnson Controls, Greystone.
- .2 Differential Pressure Switches
 - .1 All pressure sensing elements shall be corrosion resistant.
 - .2 Pressure sensing elements shall be diaphragm type as required by the application.
 - .3 Units shall have adjustable range and differential pressure settings.
 - .4 Pressure sensor switches shall be snap action type.
 - .5 Sensor assembly shall operate automatically and reset automatically when conditions return to normal.
 - .6 Protect complete sensor assembly against vibration at all critical movement pivots and slides.
 - .7 Sensors on all liquid lines shall have an isolation valve installed between each sensor and its pressure source
- .3 Electric Operators (Valve)
 - .1 Provide a 24 vac control operators which are 0-10 VDC input proportional and designed for water or steam service valve bodies. Operator shall be Synchronous motor driven with 50 lb force and force sensor safety stop. Enclosure shall be cast aluminum.
- .4 Electric Operators (Damper)
 - .1 Provide 24 vac damper actuators which are 0-10 vac input proportional and designed to operate position dampers. Operator shall be synchronous motor driven with up to 100 in.lb. force sensor safety stops and spring return as required. Enclosure shall be cast aluminum.
- .5 Static Pressure Transmitters
 - .1 The sensors shall be a variable capacitance type, utilizing a stainless steel diaphragm and insulated electrode for positioning of the diaphragm.
 - .2 The sensor shall produce a linear 4 to 20 mA or 0-5 VDC with accuracy's of 1% full scale in normal ambient temperature environments.
 - .3 Pressure ranges 0 to 0.1 in w.g. through 0 to 25.0 in w.g.
 - .4 The transmitter shall be temperature compensated to account for any thermal error over the entire temperature range of 40°F-100°F, 0-95% RH. Overpressurization 10 in w.g. up to ten times range.
 - .5 The transmitter shall have zero span adjustment capability, but shall be factory calibrated.

3.01 INSTALLATION

- .1 Install the digital panel and other associated hardware as shown on plans.
- .2 Verify location of thermostats and other exposed control sensors with drawings before installation. Locate thermostats at same elevation as light switches.
- .3 Install damper motors on outside of ducts. Do not locate in air stream, except for roof mounted equipment.
- .4 Wire "hand/off/auto" selector switches such that automatic operating controls and not safety controls and electrical over current protection shall be overridden when switch is in the "hand" position.
- .5 Unless specified otherwise, install all outdoor air sensors on the north exposure of the building.
- .6 Install all safety limits at the operator's level.

END OF SECTION 23 30 01

Part 1 General**1.01 SYSTEM DESCRIPTION**

- .1 Electrical:
 - .1 Division 26 to provide power wiring from power panels to EMCS field panels. Circuits to be for exclusive use of EMCS equipment. Panel breakers to be identified on panel legends tagged and locks applied to breaker switches.
- .2 Mechanical:
 - .1 Pipe Taps Required for EMCS equipment will be supplied and installed by Division 23.
 - .2 Wells and Control Valves Shall Be Supplied by EMCS Contractor and Installed by Division 23.
 - .3 Installation of dampers, and other devices requiring sheet metal trades to be mounted by Division 23. Costs for installation to be carried by designated trade.
- .3 Structural:
 - .1 Special steelwork as required for installation of work.

1.02 PERSONNEL QUALIFICATIONS

- .1 Qualified supervisory personnel to:
 - .1 Continuously direct and monitor all work.
 - .2 Attend site meetings.

Part 2 Products**2.01 SPECIAL SUPPORTS**

- .1 Structural grade steel, primed and painted after construction and before installation.

2.02 WIRING

- .1 As per requirements of Division 26.
- .2 For 70V and above copper conductor with chemically cross-linked thermosetting polyethylene insulation rated RW90 and 600V. Color code to CSA 22.1.
- .3 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. All other cases use FT4 wiring.
- .4 Sizes:
 - .1 120V Power supply: to match or exceed breaker, size #12 minimum.
 - .2 Wiring for safeties/interlocks for starters, motor control centres, to be stranded, #14 minimum.
 - .3 Field wiring to digital device: 20AWG stranded twisted pair.

- .4 Analog input and output: shielded #20 minimum stranded twisted pair. Wiring must be continuous without joints.
- .5 More than 4 conductors: #22 minimum solid copper.
- .5 Terminations:
 - .1 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

2.03 CONDUIT

- .1 As per requirements of Division 26.
- .2 Electrical metallic tubing to CSA C22.2 83. Flexible and liquid tight flexible metal conduit to CSA C22.2 56. Rigid steel threaded conduit to CSA C22.2 45.
- .3 Junction and pull boxes: welded steel.
 - .1 Surface mounting cast FS: screw-on flat covers.
 - .2 Flush mounting: covers with 25 mm minimum extension all round.
- .4 Cabinets: sheet steel, for surface mounting, with hinged door, latch lock, 2 keys, complete with perforated metal mounting backboard. Panels to be keyed alike for similar functions and or entire contract as approved.
- .5 Outlet boxes: 100 mm minimum, square.
- .6 Conduit boxes, fittings:
 - .1 Bushings and connectors: with nylon insulated throats.
 - .2 With push pennies to prevent entry of foreign materials.
- .7 Fittings for rigid conduit:
 - .1 Couplings and fittings: threaded type steel.
 - .2 Double locknuts and insulated bushings: use on sheet metal boxes.
 - .3 Use factory "ells" where 90 degree bends required for 25 mm and larger conduits.
- .8 Fittings for thin wall conduit:
 - .1 Connectors and couplings: steel, set screw type.

2.04 WIRING DEVICES, COVER PLATES

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

2.05 STARTERS, CONTROL DEVICES

- .1 Starter diagrams:

- .1 Provide copy of wiring and schematic diagrams - mount one copy in each starter with additional copies for operation and maintenance manual.
- .2 Auxiliary Control Devices:
 - .1 Control transformers: 60 Hz, primary voltage to suit supply, 120 V single phase secondary, VA rating to suit load plus 20% margin.
 - .2 Auxiliary contacts: one "Normally Open" and one "Normally Closed" spare auxiliary contact in addition to maintained auxiliary contacts as indicated.
 - .3 Hand-Off-Automatic switch: heavy duty type, knob lever operator.
 - .4 Double voltage relays: with barrier to separate relay contacts from operating magnet. Operating coil voltage and contact rating as indicated.

2.06 SUPPORTS FOR CONDUIT, FASTENINGS, EQUIPMENT

- .1 Solid masonry, tile and plastic surfaces: lead anchors or nylon shields.
 - .1 Hollow masonry walls, suspended drywall ceilings: toggle bolts.
- .2 Exposed conduits or cables:
 - .1 50 mm diameter and smaller: one-hole steel straps.
 - .2 Larger than 50 mm diameter: two-hole steel straps.
- .3 Suspended support systems:
 - .1 Individual cable or conduit runs: support with 6 mm diameter threaded rods and support clips.
 - .2 Two or more suspended cables or conduits: support channels supported by 6 mm diameter threaded rod hangers.

Part 3 Execution

3.01 INSTALLATION

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

3.02 SUPPORTS

- .1 Install special supports as required and as indicated.

3.03 ELECTRICAL GENERAL

- .1 Do complete installation in accordance with requirements of:
 - .1 Division 26, this specification.
 - .2 CSA 22.1 Canadian Electrical Code.
 - .3 ANSI/NFPA 70.
 - .4 ANSI C2.
- .2 Fully enclose or properly guard electrical wiring, terminal blocks, high voltage above 70 V contacts and mark to prevent accidental injury.
- .3 Do underground installation to CAN/CSA C22.3 No.7, except where otherwise specified.

- .4 Conform to manufacturer's recommendations for storage, handling and installation.
- .5 Check factory connections and joints. Tighten where necessary to ensure continuity.
- .6 Install electrical equipment between 1000 and 2000 mm above finished floor wherever possible and adjacent to related equipment.
- .7 Protect exposed live equipment such as panel, mains, outlet wiring during construction for personnel safety.
- .8 Shield and mark live parts "LIVE 120 VOLTS" or other appropriate voltage.
- .9 Install conduits, and sleeves prior to pouring of concrete.
- .10 Holes through exterior wall and roofs: flash and make weatherproof.
- .11 Make necessary arrangements for cutting of chases, drilling holes and other structural work required to install electrical conduit, cable, pull boxes, outlet boxes.
- .12 Install cables, conduits and fittings which are to be embedded or plastered over, neatly and closely to building structure to minimize furring.

3.04 CONDUIT SYSTEM

- .1 Communication wiring shall be installed in conduit. Provide complete conduit system to link Building Controllers to main control panel. Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems. Maximum conduit fill not to exceed 40%. Design drawings do not show conduit layout.
- .2 Install conduits parallel or perpendicular to building lines, to conserve headroom and to minimize interference. Conduit shall be installed tight to building structure unless authorized by the Departmental Representative.
- .3 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Obtain approval from Departmental Representative before starting such work. Provide complete conduit system to link field panels and devices with main control centre. Conduit size to match conductors plus future expansion capabilities as specified.
- .4 Locate conduits at least 150 mm parallel from hot pipes and at least 50 mm at crossovers.
- .5 Bend conduit so that diameter is reduced by less than 1/10th original diameter.
- .6 Field thread on rigid conduit to be of sufficient length to draw conduits up tight.
- .7 Limit conduit length between pull boxes to less than 30 m.
- .8 Use conduit outlet boxes for conduit up to 32 mm diameter and pull boxes for larger sizes.
- .9 Fastenings and supports for conduits, cables, and equipment:
 - .1 Provide metal brackets, frames, hangers, clamps and related types of support structures as indicated and as required to support cable and conduit runs.

- .2 Provide adequate support for raceways and cables, sloped vertically to equipment.
- .3 Use supports or equipment installed by other trades for conduit, cable and raceway supports only after written approval from Departmental Representative.
- .10 Install polypropylene fish cord in empty conduits for future use.
- .11 Where conduits become blocked, remove and replace blocked sections.
- .12 Pass conduits through structural members only after receipt of Departmental Representative's written approval.
- .13 Conduits may be run in flanged portion of structural steel.
- .14 Group conduits wherever possible on suspended or surface channels.
- .15 Pull boxes:
 - .1 Install in inconspicuous but accessible locations.
 - .2 Support boxes independently of connecting conduits.
 - .3 Fill boxes with paper or foam to prevent entry of construction material.
 - .4 Provide correct size of openings. Reducing washers not permitted.
 - .5 Mark location of pull boxes on record drawings.
 - .6 Identify AC power junction boxes, by panel and circuit breaker.
- .16 Install terminal blocks or strips indicated in cabinets.
- .17 Install bonding conductor for 120 volt and above in conduit.
- .18 No conduit shall be exposed in non-secure areas.

3.05 WIRING

- .1 Install multiple wiring in ducts simultaneously.
- .2 Do not pull spliced wiring inside conduits or ducts.
- .3 Use CSA certified lubricants of type compatible with insulation to reduce pulling tension.
- .4 Tests: use only qualified personnel. Demonstrate that:
 - .1 Circuits are continuous, free from shorts, unspecified grounds.
 - .2 Resistance to ground of all circuits is greater than 50 Megohms.
- .5 Provide Departmental Representative with test results showing locations, circuits, results of tests.
- .6 Remove insulation carefully from ends of conductors and install to manufacturer's recommendations. Accommodate all strands in lugs. Where insulation is stripped in excess, neatly tape so that only lug remains exposed.

- .7 Wiring in main junction boxes and pull boxes to terminate on terminal blocks only, clearly and permanently identified. Junctions or splices not permitted for sensing or control signal covering wiring.
- .8 Do not allow wiring to come into direct physical contact with compression screw.
- .9 Install ALL strands of conductor in lugs of components. Strip insulation only to extent necessary for installation.

3.06 WIRING DEVICES, COVER PLATES

- .1 Receptacles:
 - .1 Install vertically in gang type outlet box when more than one receptacle is required in one location.
- .2 Cover plates:
 - .1 Install suitable common cover plate where wiring devices are grouped.
 - .2 Use flush type cover plates only on flush type outlet boxes.

3.07 STARTERS, CONTROL DEVICES

- .1 Install and make power and control connections as indicated.
- .2 Install correct over-current devices.
- .3 Identify each wire, terminal for external connections with permanent number marking identical to diagram.
- .4 Performance Verification:
 - .1 Operate switches and controls to verify functioning.
 - .2 Perform start and stop sequences of contactors and relays.
 - .3 Check that interlock sequences, with other separate related starters, equipment and auxiliary control devices, operate as specified.

3.08 GROUNDING

- .1 Install complete, permanent, continuous grounding system for equipment, including conductors, connectors and accessories.
- .2 Install separate grounding conductors in conduit within building.
- .3 Install ground wire in all PVC ducts and in tunnel conduit systems.
- .4 Tests: perform ground continuity and resistance tests, using approved method appropriate to site conditions.

3.09 TESTS

- .1 General:
 - .1 Perform following tests.

- .2 Give 14 days written notice of intention to test.
- .3 Conduct in presence of Departmental Representative and authority having jurisdiction. Departmental Representative will have option to forego attendance and allow test to proceed.
- .4 Conceal work only after tests satisfactorily completed.
- .5 Report results of tests to Departmental Representative in writing.
- .6 Preliminary tests:
 - .1 Conduct as directed to verify compliance with specified requirements.
 - .2 Make needed changes, adjustments, replacements.
 - .3 Insulation resistance tests:
 - .1 Megger all circuits, feeders, equipment for 120 - 600V with 1000V instrument. Resistance to ground to be more than required by Code before energizing.
 - .2 Test insulation between conductors and ground, efficiency of grounding system to satisfaction of Departmental Representative and Authority Having Jurisdiction.

END OF SECTION 25 30 02

Part 1 General**1.01 PURPOSE**

- .1 Control sequences are intended to relay the general intent of how mechanical systems are to operate. They are not intended to give direct instruction in the construction or programming of the system.
- .2 Each control sequence to be custom programmed for its intended function. Provide documentation of control sequence logic used herein.

Part 2 Products**2.01 NOT USED**

- .1 Not used.

Part 3 Execution**3.01 GENERAL**

- .1 Contractor shall provide full EMCS control of all mechanical components affected by the replacement and addition of new air handling units to the building, and other areas of renovation as shown on drawings or indicated in the specifications.
- .2 All noted set points to be adjustable through EMCS.
- .3 Sequencing for existing systems shall not be changed from current design. New installations shall allow existing sequencing, operation, scheduling and alarms to remain. Revise BMS as required to satisfy this requirement.

END OF SECTION 25 90 01