Part 1 General

1.1 DEFINITIONS

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

.2 AEL: ratio between total test period less any system downtime accumulated within that period and test period.

.3 Downtime: results whenever EMCS is unable to fulfill required functions due to malfunction of equipment defined under responsibility of EMCS contractor. Downtime is measured by duration, in time, between time that Contractor is notified of failure and time system is restored to proper operating condition. Downtime not to include following:

.1 Outage of main power supply in excess of back-up power sources, provided that:

.1 Automatic initiation of back-up was accomplished.

.2 Automatic shut-down and re-start of components was as specified.

.2 Failure of communications link, provided that:

.1 Controller automatically and correctly operated in stand-alone mode.

.2 Failure was not due to failure of any specified EMCS equipment.

.3 Functional failure resulting from individual sensor inputs or output devices, provided that:

.1 System recorded said fault.

.2 Equipment defaulted to fail-safe mode.

.3 AEL of total of all input sensors and output devices is at least [99]% during test period.

1.2 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.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Final Report: submit report to Departmental Representative.

.1 Include measurements, final settings and certified test results.

.2 Bear signature of commissioning technician and supervisor

.3 Report format to be approved by Departmental Representative before commissioning is started.

.4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit

to Departmental Representative in accordance with Section 01 78 00 - Closeout Submittals.

.5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

1.4 CLOSEOUT SUBMITTALS

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

1.5 COMMISSIONING

.1 Do commissioning in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.

.2 Carry out commissioning under direction of Departmental Representative and in presence of Departmental Representative and PSPC Commissioning Manager.

.3 Inform, and obtain approval from, Departmental Representative in writing at least 14 days prior to commissioning or each test. Indicate:

.1 Location and part of system to be tested or commissioned.

.2 Testing/commissioning procedures, anticipated results.

.3 Names of testing/commissioning personnel.

.4 Correct deficiencies, re-test in presence of Departmental Representative until satisfactory performance is obtained.

.5 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.

.6 Load system with project software.

.7 Perform tests as required.

1.6 COMPLETION OF COMMISSIONING

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

1.7 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION

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

Part 2 Products

2.1 EQUIPMENT

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

.2 Instrumentation accuracy tolerances: higher order of magnitude than equipment or system being tested.

.3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 2 months prior to tests.

.4 Locations to be approved, readily accessible and readable.

.5 Application: to conform to normal industry standards.

Part 3 Execution

3.1 PROCEDURES

.1 Test each system independently and then in unison with other related systems.

.2 Commission each system using procedures prescribed by the Departmental Representative.

.3 Commission integrated systems using procedures prescribed by Departmental Representative.

.4 Debug system software.

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

.6 Test full scale emergency evacuation and life safety procedures including operation and integrity of smoke management systems under normal and emergency power conditions as applicable.

3.2 FIELD QUALITY CONTROL

.1 Pre-Installation Testing.

.1 General: consists of field tests of equipment just prior to installation.

.2 Testing may be on site or at Contractor's premises as approved by Departmental Representative.

.3 Configure major components to be tested in same architecture as designed system. Include BECC equipment and 2 sets of Building Controller's including MCUs, LCUs, and TCUs.

.4 Equip each Building Controller with sensor and controlled device of each type (AI, AO, DI, DO).

.5 Additional instruments to include:

.1 DP transmitters.

.2 VAV supply duct SP transmitters.

.3 DP switches used for dirty filter indication and fan status.

.6 In addition to test equipment, provide inclined manometer, digital micro-manometer, milli-amp meter, to hold steady at any setting and with direct output to milli-amp meter at source.

.7 After setting, test zero and span in 10% increments through entire range while both increasing and decreasing pressure.

.8 Departmental Representative 0.5 to mark instruments tracking within % in both directions as "approved for installation".

.9 Transmitters above 0.5% error will be rejected.

.10 DP switches to open and close within 2% of set point.

.2 Completion Testing.

.1 General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.

.2 Include following activities:

.1 Test and calibrate field hardware including stand-alone capability of each controller.

.2 Verify each A-to-D convertor.

.3 Test and calibrate each AI using calibrated digital instruments.

.4 Test each DI to ensure proper settings and switching contacts.

.5 Test each DO to ensure proper operation and lag time.

.6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.

.7 Test operating software.

.8 Test application software and provide samples of logs and commands.

.9 Verify each CDL including energy optimization programs.

.10 Debug software.

.11 Blow out flow measuring and static pressure stations with high pressure air at 700 kPa.

.12 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space on commissioning technician and Departmental Representative. This document will be used in final start-up testing.

.3 Final Start-up Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of Departmental Representative Commissioning Co-ordinator and provide:

.1 2 technical personnel capable of re-calibrating field hardware and modifying software.

.2 Detailed daily schedule showing items to be tested and personnel available.

.3 Departmental Representative's acceptance signature to be on executive and applications programs.

.4 Commissioning to commence during final start-up testing.

.5 O M personnel to assist in commissioning procedures as part of training.

.6 Commissioning to be supervised by qualified supervisory personnel and Departmental Representative.

.7 Commission systems considered as life safety systems before affected parts of the facility are occupied.

.8 Operate systems as long as necessary to commission entire project.

.9 Monitor progress and keep detailed records of activities and results.

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

.1 Prior to beginning of 30day test demonstrate that operating parameters (set points, alarm limits, operating control software, sequences of operation, trends, graphics and CDLs) 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 30consecutive 24 hour days.

.3 Tests to include:

.1 Demonstration of correct operation of monitored and controlled points.

.2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.

.4 System will be accepted when:

.1 EMCS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.

.2 Requirements of Contract have been met.

.5 In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.

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

.5 Commissioning Co-ordinator and/or Departmental Representative to verify reported results.

3.3 ADJUSTING

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

3.4 COOPERATION WITH COMMISSIONING TEAM

.1 The Mechanical Contractor to complete commissioning activities as per Section 01 91 13. In addition, advise the Commissioning Authority of dates for the commissioning schedule when mechanical systems will be ready for commissioning reviews.

.2 Cooperate with the Commissioning Team as follows:

.1 Inform Commissioning Team in advance of controls start-up.
.2 Coordinate with TAB to establish setpoints and balancing values.
.3 Coordinate site visits during warranty period.

.3 In-Contract Test:

.1 Include functional testing of each system noted within the Summary of work. The Commissioning Team will witness selected in-contract tests. Provide documentation confirming of test and sign-off acceptance of each test.

.4 Allow for work necessary to assist Commissioning Team in completion of the commissioning process. The Controls Contractor shall fill a point to point and start-up check sheets. Format of one checks sheet will be provided by the Commissioning Team.

.5 Demonstrate all equipment and system operation and fail modes for all elements of mechanical work as defined by the project documents, and in accordance with the commissioning authorities' direction.

3.5 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, shutdown interlocks and lockouts in accordance with Section 01 79 00 - Demonstration and Training.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

.1 CDL - Control Description Logic.

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

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to Departmental Representative 30 days prior to anticipated date of beginning of training.

.1 List name of trainer, and type of visual and audio aids to be used.

.2 Show co-ordinated interface with other EMCS mechanical and electrical training programs.

.3 Submit reports within two weeks after completion of Phase 1 and Phase 2 training program that training has been satisfactorily completed.

1.3 QUALITY ASSURANCE

.1 Provide competent instructors thoroughly familiar with aspects of EMCS installed in facility.

.2 Departmental Representative reserves right to approve instructors.

1.4 INSTRUCTIONS

.1 Provide instruction to designated personnel in adjustment, operation, maintenance and pertinent safety requirements of EMCS installed.

.2 Training to be project-specific.

1.5 TIME FOR TRAINING

.1 Number of days of instruction to be as specified in section 01 91 41 COMMISSIONING (CX) TRAINING.

1.6 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).

1.7 TRAINING PROGRAM

.1 Specific System Training shall occur in sequence with overall project schedule and phased turnover as specified in section 01 91 41 Commissioning (Cx) Training.

.2 Overall controls final training shall be in 2 phases over 6-month period.

.3 Phase 1: 1 day program to begin before 30-day test period at time mutually agreeable to Contractor, Departmental Representative and PSPC 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 30-day test period.

.3 Include overview of system architecture, communications, operation of computer and peripherals, report generation.

.4 Include detailed training on operator interface functions for control of mechanical systems, CDLs for each system, and elementary preventive maintenance.

.4 Phase 2: Three-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.

.2 Equipment maintenance training: provide personnel with 1 day training within a 5-day period in maintenance of EMCS equipment, including general equipment layout, trouble shooting and preventive maintenance of EMCS components, maintenance and calibration of sensors and controls.

.3 Programmers: provide personnel with 1 day training within 5-day period in following subjects in approximate percentages of total course shown:

.1 Software and architecture: 5%.

.2 Application programs: 10%.

.3 Display and interpret summaries. 10%.

.4 Controller programming: 40%.

.5 Trouble shooting and debugging:10%.

.6 Define trend logs. 15%.

.7 Schedule and print reports. 10%.

1.8 ADDITIONAL TRAINING

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

1.9 MONITORING OF TRAINING

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

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute (ANSI):

.1 ANSI/ISA 5.5, Graphic Symbols for Process Displays.

.2 American National Standards Institute (ANSI)/ Institute of Electrical and Electronics Engineers (IEEE):

.1 ANSI/IEEE 260.1, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).

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

.1 ASHRAE STD 135, BACNET - Data Communication Protocol for Building Automation and Control Network.

.4 Canadian Standards Association (CSA International):

.1 CAN/CSA-Z234.1, Canadian Metric Practice Guide.

.5 Consumer Electronics Association (CEA):

.1 CEA-709.1-B, Control Network Protocol Specification.

.6 Department of Justice Canada (Jus):

.1 Canadian Environmental Assessment Act (CEAA).

.2 Canadian Environmental Protection Act (CEPA).

.7 Electrical and Electronic Manufacturers Association (EEMAC):

.1 EEMAC 2Y-1, Light Gray Colour for Indoor Switch Gear.

.8 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Material Safety Data Sheets (MSDS).

.9 Transport Canada (TC):

.1 Transportation of Dangerous Goods Act (TDGA).

.10 Public Works and Government Services Canada (PWGSC):

.1 PWGSC MD 250005: Energy Monitoring and Control Systems (EMCS) Design Guidelines.

1.2 ABBREVIATIONS AND ACRONYMS

.1 Acronyms used in EMCS:

.1 AEL - Average Effectiveness Level

.2 AI - Analog Input

.3 AIT - Agreement on International Trade

.4 AO - Analog Output

.5 BACnet - Building Automation and Control Network.

.6 BC(s) - Building Controller(s).

.7 BECC - Building Environmental Control Centre.
.8 CAD - Computer Aided Design.
.9 CDL - Control Description Logic.
.10 CDS - Control Design Schematic.
.11 COSV - Change of State or Value.
.12 CPU - Central Processing Unit.
.13 DI - Digital Input.
.14 DO - Digital Output.
.15 DP - Differential Pressure.
.16 ECU - Equipment Control Unit.
.17 EMCS - Energy Monitoring and Control System.
.18 HVAC - Heating, Ventilation, Air Conditioning.
.19 IDE - Interface Device Equipment.
.20 I/O - Input/Output.
.21 ISA - Industry Standard Architecture.
.22 LAN - Local Area Network.
.23 LCU - Local Control Unit.
.24 MCU - Master Control Unit.
.25 NAFTA - North American Free Trade Agreement.
.26 NC - Normally Closed.
.27 NO - Normally Open.
.28 OS - Operating System.
.29 O&M - Operation and Maintenance.
.30 OWS - Operator Work Station.
.31 PC - Personal Computer.
.32 PCI - Peripheral Control Interface.
.33 PCMCIA - Personal Computer Micro-Card Interface Adapter.
.34 PID - Proportional, Integral and Derivative.
.35 RAM - Random Access Memory.
.36 SP - Static Pressure.
.37 ROM - Read Only Memory.
.38 TCU - Terminal Control Unit.
.39 USB - Universal Serial Bus.
.40 UPS - Uninterruptible Power Supply.
.41 VAV - Variable Air Volume.

1.3 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 CDLs.

.2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties, or providing status conditions of contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.

.2 Point Name: composed of two parts, point identifier and point expansion:

.1 Point identifier: comprised of three descriptors, "area" descriptor, "system" descriptor and "point" descriptor, for which database to provide 25-character field for each point identifier. "System" is system that point is located on:

.1 Area descriptor: building or part of building where point is located.

.2 System descriptor: system that point is located on.

.3 Point descriptor: physical or logical point description. For point identifier "area", "system" and "point" will be shortforms or acronyms. Database must provide 25character field for each point identifier.

.2 Point expansion: comprised of three fields, one for each descriptor. Expanded form of shortform or acronym used in "area", "system" and "point" descriptors is placed into appropriate point expansion field. Database must provide 32-character field for each point expansion.

.3 Bilingual systems to include additional point identifier expansion fields of equal capacity for each point name for second language:

.1 System to support use of numbers and readable characters including blanks, periods or underscores to enhance user readability for each of the above strings.

.3 Point Object Type: points fall into following object types:

.1 AI (analog input).

.2 AO (analog output).

.3 DI (digital input).

.4 DO (digital output).

.5 Pulse inputs.

.4 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISA S5.5.

.1 Printouts: to ANSI/IEEE 260.1.

.2 Refer also to Section 25 05 54 - EMCS: Identification.

1.4 SYSTEM DESCRIPTION

.1 Refer to schematics for general intent.

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

.1 Building Controllers.

.2 Control devices as listed in I/O point summary tables.

.3 OWS(s).

.4 Data communications equipment necessary to effect EMCS data transmission system.

.5 Field control devices.

.6 Software/Hardware complete with full documentation.

.7 Complete operating and maintenance manuals.

.8 Training of personnel.

.9 Acceptance tests, technical support during commissioning, full documentation.

.10 Wiring interface co-ordination of equipment supplied by others.

.11 Miscellaneous work as specified in these sections and as indicated.

.3 Design Requirements:

.1 Design and provide conduit and wiring linking elements of system.

.2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by Departmental Representative prior to installation.

.3 Location of controllers as reviewed by Departmental Representative prior to installation.

.4 Provide utility power and emergency power to EMCS as indicated.

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

.4 Language Operating Requirements:

.1 Provide English operator selectable access codes.

.2 Use non-linguistic symbols for displays on graphic terminals wherever possible. Other information to be in English.

.3 Operating system executive: provide primary hardware-to-software interface specified as part of hardware purchase with associated documentation to be in English.

.4 System manager software: include in English system definition point database, additions, deletions or modifications, control loop statements, use of high level programming languages, report generator utility and other OS utilities used for maintaining optimal operating efficiency.

.5 Include, in English:

.1 Input and output commands and messages from operator-initiated functions and field related changes and alarms as defined in CDL's or assigned limits (i.e. commands relating to day-to-day operating functions and not related to system modifications, additions, or logic re-definements).

.2 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points. To be in English at specified OWS. Point name expansions in English.

.3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

.5 The network design to be a fully distributed network, with each primary system having its own locally mounted dedicated controller. Any failure in the network shall **not** in any way affect the control of these primary systems. Connecting hardware points from one system to more than one controller is not acceptable. Any points associated with a system are to be connected to one dedicated controller. Each dedicated controller to have a locally mounted control and display device to allow the operator to view and adjust any point on the controller.

.6 All wiring associated with the EMCS communication network as well as all control wiring and conduit associated with the EMCS at 50 volts or less. Wire and conduit above 50 volts by Electrical Division.

.7 BACNet compliance: full compliance to the BACNet standard (ANSA/ASHRAE) 135, BACNet – A Data Communication Protocol for Building Automation and Control Networks is mandatory. Down to the field device level, the EMCS system must meet BACNet standards for system architecture and administration, and use open communication protocols and user friendly programming and graphics. Install the EMCS installed to communicate at the supervisory layer to the WAN using the BACNet TCP/IP protocol implemented on Ethernet.

.8 The EMCS system for this facility to be accessible by designated personnel via the WAN for monitoring and programming purposes. The EMCS contractor to provide all the required hardware, software, gateways, etc. needed to permit connection of the EMCS to the WAN. This shall include all hardware, software, programming, start-up and commissioning required. The contractor to supply and install all the required hardware and software on the WAN file server to allow for this remote operation monitoring and programming to take place. The contractor to supply and install all the required hardware and software on the operator workstation(s) located in the facilities management department. In addition, a remote access directly to the system shall be provided.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Make submittals in accordance with Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process and Section 01 33 00 - Submittal Procedures.

.2 Co-ordinate submittal requirements and provide submittals required by Section 01 47 15 - Sustainable Requirements: Construction.

.3 Submit for review:

.1 Equipment list and systems manufacturers within twenty (20) working days after award of contract.

.2 List existing control hardware to be re-used included in pricing, along with unit price for replacement hardware.

.4 Quality Control:

.1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.

.2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.

.3 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process. Label or listing of specified organization is acceptable evidence.

.4 In lieu of such evidence, submit certificate from testing organization, approved by Departmental Representative, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.

.5 For materials whose compliance with organizational standards/ codes/ specifications is not regulated by organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.

.6 Permits and fees: in accordance with general conditions of contract.

.7 Submit certificate of acceptance from authority having jurisdiction to Departmental Representative.

.8 Existing devices intended for re-use: submit test report.

1.6 QUALITY ASSURANCE

.1 Have local office within 50 km of project staffed by trained personnel capable of providing instruction, routine maintenance and emergency service on systems,

.2 Provide record of successful previous installations submitting tender showing a minimum of 7 years experience with similar installations utilizing computer-based systems.

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

.4 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.

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

1.7 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

.1 Store materials off ground in a dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect materials from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and/or recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.8 EXISTING- CONTROL COMPONENTS

.1 Utilize existing control wiring and piping where possible.

.2 Re-use field control devices that are usable in their original configuration provided that they conform to applicable codes, standards specifications:

.1 Do not modify original design of existing devices without written permission from Departmental Representative.

.2 Provide for new, properly designed device where re-usability of components is uncertain.

.3 Inspect and test existing devices intended for re-use within 30 days of award of contract, and prior to installation of new devices:

.1 Furnish test report within 40 days of award of contract listing each component to be re-used and indicating whether it is in good order or requires repair by Departmental Representative.

.2 Failure to produce test report will constitute acceptance of existing devices by contractor.

.4 Non-functioning items:

.1 Provide with report specification sheets or written functional requirements to support findings.

.2 Departmental Representative will repair or replace existing items judged defective yet deemed necessary for EMCS.

.5 Submit written request for permission to disconnect controls and to obtain equipment downtime before proceeding with Work.

.6 Assume responsibility for controls to be incorporated into EMCS after written receipt of approval from Departmental Representative:

.1 Be responsible for items repaired or replaced by Departmental Representative.

.2 Be responsible for repair costs due to negligence or abuse of equipment.

.3 Responsibility for existing devices terminates upon final acceptance of EMCS or applicable portions of EMCS as approved by Departmental Representative.

.7 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

Part 2 Products

2.1 EQUIPMENT

.1 Existing control system is a Johnson Controls Metasys BACNet MSTP.

.2 All new components shall have communication capability utilizing BACNet Protocol and shall be BACNet BTL listed.

.3 Panel to be NEMA rated to suit environmental requirements.

.4 Panels to have hinged doors equipped with standard keyed-alike cabinet locks, keyed to same key.

.5 Wiring within panels to be contained within properly sized rigid PVC slotted wall wire duct. All wiring within the wire duct to be concealed with a non-slip cover.

.6 Terminations for the connection of power wiring, communication wiring and field mounted devices to be at properly identified terminal blocks mounted within the control panel.

.7 All control panels to be provided with an internally mounted 120-volt duplex power receptacle.

.8 All control panels to be identified with permanently mounted Lamacoid tags to identify the control panel and the systems served by the control panel. Submit schedule of labels with shop drawing submission.

.9 Provide low voltage transformers in panels or elsewhere as required.

.10 Provide adaptors between metric and imperial components.

2.2 ADAPTORS

.1 Provide adaptors between metric and imperial components.

Part 3 Execution

3.1 MANUFACTURER'S RECOMMENDATIONS

.1 Installation: to manufacturer's recommendations.

3.2 PAINTING

.1 Painting: in accordance with Section 09 91 23 - Interior Painting, supplemented as follows:

.1 Clean and touch up marred or scratched surfaces of factory finished equipment to match original finish.

.2 Restore to new condition, finished surfaces too extensively damaged to be primed and touched up to make good.

.3 Clean and prime exposed hangers, racks, fastenings, and other support components.

.4 Paint unfinished equipment installed indoors to EEMAC 2Y-1.

3.3 COOPERATION WITH COMMISSIONING TEAM

.1 The Controls Contractor is to complete commissioning activities as per Section 01 91 13 - General Commissioning (Cx) Requirements. In addition, advise the Commissioning Authority of dates for the commissioning schedule when mechanical systems will be ready for commissioning reviews.

.2 Cooperate with the Commissioning Team as follows:

.1 Inform Commissioning Team in advance of degreasing and flushing of heating system, hydrostatic and air tests.

.2 Allow Commissioning Team free access to the site during construction phase.

.3 Coordinate site visits during warranty period.

.3 Allow for work necessary to assist Commissioning Team in completion of the commissioning process. Fill a complete system of check sheets. Format of one checks sheet will be provided by the Commissioning Team.

.4 Demonstrate all equipment and system operation and fail modes for all sequences as defined by the project documents, and in accordance with the commissioning authorities' direction.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Public Works and Government Services Canada (PWGSC)

.1 PWGSC MD 250005-2009: Energy Monitoring and Control Systems (EMCS) Design Guidelines.

1.2 DEFINITIONS

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

1.3 DESIGN REQUIREMENTS

.1 Preliminary Design Review: to contain following contractor and systems information.

.1 Location of local office.

.2 Description and location of installing and servicing technical staff.

.3 Location and qualifications of programming design and programming support staff.

.4 List of spare parts.

.5 Location of spare parts stock.

.6 Names of sub-contractors and site-specific key personnel.

.7 Sketch of site-specific system architecture.

.8 Specification sheets for each item including memory provided, programming language, speed, type of data transmission.

.9 Descriptive brochures.

.10 Sample CDL and graphics (systems schematics).

.11 Response time for each type of command and report.

.12 Item-by-item statement of compliance.

.13 Proof of demonstrated ability of system to communicate utilizing BACNet and existing controls system.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures and coordinate with requirements in this Section.

.2 Submit preliminary design document within 28 working days contract award, for review by Departmental Representative.

.3 Shop Drawings to consist of 1 soft copy of design documents, shop drawings, product data and software.

.4 Hard copy to be completely indexed and coordinated package to assure compliance with contract requirements and arranged in same sequence as specification and cross-referenced to specification section and paragraph number.

.5 Soft copy to be in AutoCAD - latest version and Microsoft Word latest version format, structured using menu format for easy loading and retrieval on OWS.

1.5 PRELIMINARY SHOP DRAWING REVIEW

1.6 PRELIMINARY SHOP DRAWING REVIEW

.1 Submit preliminary shop drawings within 30 working days of award of contract and include following:

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

.2 Detailed system architecture showing all points associated with each (new & existing) controller including, signal levels, pressures where new EMCS ties into existing control equipment.

.3 Spare point capacity of each controller by number and type.

.4 Controller locations.

.5 Auxiliary control cabinet locations.

.6 Single line diagrams showing cable routings, conduit sizes, spare conduit capacity between control centre, field controllers and systems being controlled.

.7 Valves: complete schedule listing including following information: designation, service, manufacturer, model, point ID, design flow rate, design pressure drop, required Cv, Valve size, actual Cv, spring range, pilot range, required torque, actual torque and close off pressure (required and actual).

.8 Dampers: sketches showing module assembly, interconnecting hardware, operator locations, operator spring range, pilot range, required torque, actual torque.

.9 Flow measuring stations: complete schedule listing designation, service, point ID, manufacturer, model, size, velocity at design flow rate, manufacturer, model and range of velocity transmitter.

1.7 DETAILED 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 Provide a tabulated complete hardware and software points list, with description and point type.

.6 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.

.7 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.

.8 Graphic system schematic displays of air water systems with point identifiers and textual description of system, and typical floor plans as specified.

.9 Complete system CDL's including companion English language explanations on same sheet but with different font and italics. CDL's to contain specified energy optimization programs.

.10 Listing and example of specified reports.

.11 Listing of time of day schedules.

.12 Mark up to-scale construction drawing to detail control room showing location of equipment and operator work space.

.13 Type and size of memory with statement of spare memory capacity.

.14 Full description of software programs provided.

.15 Sample of "Operating Instructions Manual" to be used for training purposes.

.16 Outline of proposed start-up and verification procedures. Refer to Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.8 QUALITY ASSURANCE

.1 Preliminary Design Review Meeting: Convene meeting within 45 working days of award of contract to:

.1 Undertake functional review of preliminary design documents, resolve inconsistencies.

.2 Resolve conflicts between contract document requirements and actual items (e.g.: points list inconsistencies).

.3 Review interface requirements of materials supplied by others.

.4 Review "Sequence of Operations".

.2 Contractor's programmer to attend meeting.

.3 Departmental Representative retains right to revise sequence or subsequent CDL prior to software finalization without cost to Departmental Representative.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Public Works and Government Services Canada (PWGSC)

.1 PWGSC MD 250005-2009: Energy Monitoring and Control Systems (EMCS) Design Guidelines.

1.2 DEFINITIONS

.1 BECC - Building Environmental Control Centre.

.2 OWS - Operator Work Station.

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

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Section 01 78 00 - Closeout Procedures, supplemented and modified by requirements of this Section.

.2 Submit Record Documents, As-built drawings and 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.

1.4 AS-BUILTS

.1 Provide 1 copy of detailed shop drawings generated in Section 25 05 02 - EMCS: Submittals and Review Process and include:

.1 Changes to contract documents as well as addenda and contract extras.

.2 Changes to interface wiring.

.3 Routing of conduit, wiring and control air lines associated with EMCS installation.

.4 Locations of obscure devices to be indicated on drawings.

.5 Listing of alarm messages.

.6 Panel/circuit breaker number for sources of normal/emergency power.

.7 Names, addresses, telephone numbers of each sub-contractor having installed equipment, local representative for each item of equipment, each system.

.8 Test procedures and reports: provide records of start-up procedures, test procedures, checkout tests and final commissioning reports as specified in Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

.9 Basic system design and full documentation on system configuration.

.2 Submit for final review by Departmental Representative.

.3 Provide before acceptance 1 soft copy incorporating changes made during final review.

1.5 O M MANUALS

.1 Custom design O M Manuals (both hard and soft copy) to contain material pertinent to this project only, and to provide full and complete coverage of subjects referred to in this Section.

.2 Provide 2 complete sets of hard and soft copies prior to system or equipment tests

.3 Include complete coverage in concise language, readily understood by operating personnel using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics or in-depth control theory.

.4 Functional description to include:

.1 Functional description of theory of operation.

.2 Design philosophy.

.3 Specific functions of design philosophy and system.

.4 Full details of data communications, including data types and formats, data processing and disposition data link components, interfaces and operator tests or self-test of data link integrity.

.5 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 or planned 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 Software modules, fully annotated source code listings, error free object code files ready for loading via peripheral device

.5 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.

.6 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

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International):

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

.2 Public Works and Government Services Canada (PWGSC):

.1 PWGSC MD 250005-2009: Energy Monitoring and Control Systems (EMCS) Design Guidelines.

1.2 DEFINITIONS

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

1.3 SYSTEM DESCRIPTION

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

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures and Section 25 05 02 – EMCS: Submittals and Review Process supplemented and modified by requirements of this Section.

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

Part 2 Products

2.1 NAMEPLATES FOR PANELS

.1 Identify by Plastic laminate, 3 mm thick Melamine, matt white finish, black core, square corners, lettering accurately aligned and engraved into core.

.2 Sizes: 25 x 67 mm minimum.

.3 Lettering: minimum 7 mm high, black.

.4 Inscriptions: machine engraved to identify function.

2.2 NAMEPLATES FOR FIELD DEVICES

.1 Identify by plastic encased cards attached by plastic tie.

.2 Sizes: 50 x 100 mm minimum.

.3 Lettering: minimum 5 mm high produced from laser printer in black.

.4 Data to include: point name and point address, make, model number.

.5 Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.

2.3 NAMEPLATES FOR ROOM SENSORS

.1 Identify by stick-on labels, using point identifier.

.2 Location: as directed by Departmental Representative.

.3 Letter size: to suit, clearly legible.

2.4 WARNING SIGNS

.1 Equipment including motors, starters under remote automatic control: supply and install orange coloured signs warning of automatic starting under control of EMCS.

.2 Sign to read: "Caution: This equipment is under automatic remote control of EMCS", as reviewed by Departmental Representative.

2.5 WIRING

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

.2 Colour coding: to CSA C22.1. Use colour coded wiring in communications cables, matched throughout system.

.3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.

2.6 PNEUMATIC TUBING

.1 Numbered tape markings on tubing to provide uninterrupted tracing capability.

2.7 CONDUIT

.1 Colour code EMCS conduit.

.2 Pre-paint box covers and conduit fittings.

.3 Coding: use fluorescent orange paint and confirm colour with Departmental Representative during "Preliminary Design Review".

Part 3 Execution

3.1 NAMEPLATES AND LABELS

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

3.2 EXISTING PANELS

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

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

1.1 REFERENCES

.1 American National Standards Institute (ANSI)

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

.2 CSA Group

- .1 CSA C22.1, Canadian electrical code
- .2 CSA C22.2 No. 45.1, Electrical Rigid Metal Conduit.
- .3 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- .4 CSA C22.2 No. 83, Electrical Metallic Tubing.
- .5 CAN/CSA-C22.3 No. 1, Overhead Systems.

1.2 SYSTEM DESCRIPTION

.1 Electrical:

- .1 Provide power wiring from existing emergency power panels to EMCS field panels. Circuits to be for exclusive use of EMCS equipment. Panel breakers to be identified on panel legends tagged and locks applied to breaker switches.
- .2 Hard wiring between field control devices and EMCS field panels.
- .3 Communication wiring between EMCS field panels and OWS's including main control centre BECC.
- .4 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
- .5 Trace existing control wiring installation and provide updated wiring schematics including additions and/or deletions to control circuits for approval by Departmental Representative before commencing work.

.2 Pneumatic: Pneumatic tubing, valves and fittings for field control devices.

.3 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 air flow stations, dampers, and other devices requiring sheet metal trades to be mounted by Division 23. Costs to be carried by designated trade.

.4 Air Terminal Units:

.1 Air flow probe for vav boxes to be supplied and installed under Section 23 36 00 - Air Terminal Units. Air flow dp sensor, actuator and associated vav controls to be supplied and installed by EMCS contractor. Tubing from air probe to dp sensor as well as installation and adjustment of air flow sensors and actuators to be the responsibility of EMCS contractor. Coordinate air flow adjustments with balancing trade.

.5 Structural: Special steelwork as required for installation of work.

1.3 PERSONNEL QUALIFICATIONS

.1 Qualified supervisory personnel to:

.1 Continuously direct and monitor all work.

.2 Attend site meetings.

1.4 EXISTING CONDITIONS

.1 Cutting and Patching: refer to Section 01 73 00 - Execution supplemented as specified herein.

.2 Repair all surfaces damaged during execution of work.

.3 Turn over to Departmental Representative existing materials removed from work not identified for re-use.

Part 2 Products

2.1 SPECIAL SUPPORTS

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

2.2 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. Colour 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: #18AWG or 20AWG stranded twisted pair.

.4 Analog input and output: shielded #18 minimum solid copper or #20 minimum stranded twisted pair. Wiring must be continuous without joints.

.5 More than 4 conductors: #22 minimum solid copper.

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

2.3 CONDUIT

.1 As per requirements of Division 26.

.2 Electrical metallic tubing to CSA C22.2 No. 83. Flexible and liquid tight flexible metal conduit to CSA C22.2 No. 56. Rigid steel threaded conduit to CSA C22.2 No. 45.1.

.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.

2.4 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.

2.5 STARTERS, CONTROL DEVICES

.1 Across-the-line magnetic starters:

.1 Enclosures: CSA Type 1, except where otherwise specified.

.2 Size, type and rating: to suit motors.

.2 Starter diagrams:

.1 Provide copy of wiring and schematic diagrams - mount one copy in each starter with additional copies for operation and maintenance manual.

.3 Auxiliary Control Devices:

.1 Control transformers: 60 Hz, primary voltage to suit supply, 120 V single phase secondary, VA rating to suit load plus 20% margin.

.2 Auxiliary contacts: one "Normally Open" and one "Normally Closed" spare auxiliary contact in addition to maintained auxiliary contacts as indicated.

.3 Hand-Off-Automatic switch: heavy duty type, knob lever operator.

.4 Double voltage relays: with barrier to separate relay contacts from operating magnet. Operating coil voltage and contact rating as indicated.

2.6 SUPPORTS FOR CONDUIT, FASTENINGS, EQUIPMENT

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

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

.2 Exposed conduits or cables:

.1 50 mm diameter and smaller: one-hole steel straps.

.2 Larger than 50 mm diameter: two-hole steel straps.

.3 Suspended support systems:

.1 Individual cable or conduit runs: support with 6 mm diameter threaded rods and support clips.

.2 Two or more suspended cables or conduits: support channels supported by 6 mm diameter threaded rod hangers.

Part 3 Execution

3.1 INSTALLATION

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

3.2 DEMOLITION

.1 Remove all abandoned control wiring back to conduit.

.2 Remove all abandoned exposed conduit back to concealed space. Cap and label abandoned conduit.

.3 Remove all accessible abandoned pneumatic tubing.

3.3 MECHANICAL PIPING

.1 Install piping straight, parallel and close to building structure with required grades for drainage and venting.

.2 Ream ends of pipes before assembly.

.3 Copper tubing not to come into contact with dissimilar metal.

.4 Use non-corrosive lubricant or Teflon tape on male screwed threads.

.5 Clean ends of pipes, tubing and recesses of fittings to be brazed or soldered. Assemble joints without binding.

.6 Install di-electric couplings where dissimilar metals joined.

.7 Sleeves:

.1 Installation:

.1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.

.2 Other floors: terminate 25 mm above finished floor.

.3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint.

.2 Caulking:

.1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.

.2 Elsewhere: provide space for fire stopping by Section 07 84 00 - Fire Stopping. Maintain fire rating integrity.

.3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.

.4 Ensure no contact between copper pipe or tube and sleeve.

.8 Pressure tests:

.1 Test all piping systems modified under this contract by means of visual inspection of each connection.

.2 Isolate equipment, components, not designed to withstand test pressure.

.9 Introduce system pressure carefully into new piping.

3.4 SUPPORTS

.1 Install special supports as required and as indicated.

3.5 PNEUMATIC CONTROL SYSTEMS

.1 Demolition:

.1 Existing Pneumatic components shall be removed upon replacement with electronic component.

3.6 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.

3.7 CONDUIT SYSTEM

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

.2 Communication wiring in ceiling spaces shall be supported above ceilings and shall be plenum rated.

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

.4 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.

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

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

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

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

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

.10 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.

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

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

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

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

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

.16 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.

.17 Install terminal blocks or strips indicated in cabinets to Section 26

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

3.8 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.

3.9 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.

3.10 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.

3.11 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.

3.12 TESTS

.1 General:

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

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

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

.4 Conceal work only after tests satisfactorily completed.

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

.6 Preliminary tests:

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

.2 Make needed changes, adjustments, replacements.

.3 Insulation resistance tests:

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

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

3.13 IDENTIFICATION

.1 Refer to Section 25 05 54 - EMCS: Identification.

END OF SECTION

Part 1 General

1.1 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.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.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 Section 01 78 00 - Closeout Submittals.

.1 Maintain records and logs of each maintenance task on site.

.2 Organize cumulative records for each major component and for entire EMCS chronologically.

.3 Submit records to Departmental Representative, after inspection indicating that planned and systematic maintenance have been accomplished.

.7 Revise and submit to Departmental Representative in accordance with Section 01 78 00 - Closeout Submittals "As-built drawings" documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period.

1.3 MAINTENANCE SERVICE DURING WARRANTY PERIOD

.1 Provide services, materials, and equipment to maintain EMCS for specified warranty period. Provide detailed preventative maintenance schedule for system components as described in Submittal article.

.2 Emergency Service Calls:

.1 Initiate service calls when EMCS is not functioning correctly.

.2 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost.

.3 Furnish Departmental Representative with telephone number where service personnel may be reached at any time.

.4 Service personnel to be on site ready to service EMCS within 2 hours after receiving request for service.

.5 Perform Work continuously until EMCS restored to reliable operating condition.

.3 Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.

.4 Work requests: record each service call request, when received separately on approved form and include:

.1 Serial number identifying component involved.

.2 Location, date and time call received.

.3 Nature of trouble.

.4 Names of personnel assigned.

.5 Instructions of work to be done.

.6 Amount and nature of materials used.

.7 Time and date work started.

.8 Time and date of completion.

.5 Provide system modifications in writing.

.1 No system modification, including operating parameters and control settings, to be made without prior written approval of Departmental Representative.

1.4 SERVICE CONTRACTS

.1 Provide in-depth technical expertise and assistance to Departmental Representative and Commissioning Manager in preparation and implementation of service contracts and in-house preventive maintenance procedures.

.2 Service Contracts to include:

.1 Annual verification of field points for operation and calibration.

.2 4 visits per year.

.3 4 responses to emergency calls during day, per year.

.4 2 responses to emergency calls during silent hours per year.

.1 Silent hours defined as 1630 h – 0730 h and on weekends and statutory holidays.

.2 Complete inventory of installed system.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

.1 Perform as minimum (3) three minor inspections and one major inspection (more often if required by manufacturer) per year. Provide detailed written report to Departmental Representative as described in Submittal article.

.2 Perform inspections during regular working hours, 0800 to 1630 h, Monday through Friday, excluding statutory holidays.

.3 Following inspections are minimum requirements and should not be interpreted to mean satisfactory performance:

.1 Perform calibrations using test equipment having traceable, certifiable accuracy at minimum 50% greater than accuracy of system displaying or logging value.

.2 Check and calibrate random sample of 10% field input/output devices in accordance with Canada Labour Code - Part I and CSA Z204.

.3 Provide dated, maintenance task lists, as described in Submittal article, as proof of execution of complete system verification.

.4 Minor inspections to include, but not limited to:

.1 Perform visual, operational checks to BC's, peripheral equipment, interface equipment and other panels.

.2 Check equipment cooling fans as required.

.3 Visually check for mechanical faults, air leaks and proper pressure settings on pneumatic components.

.4 Review system performance with Departmental Representative to discuss suggested or required changes.

.5 Major inspections to include, but not limited to:

.1 Minor inspection.

.2 Clean OWS(s) peripheral equipment, BC(s), interface and other panels, micro-processor interior and exterior surfaces.

.3 Check signal, voltage and system isolation of BC(s), peripherals, interface and other panels.

.4 Verify calibration/accuracy of each input and output device and recalibrate or replace as required.

.5 Provide mechanical adjustments, and necessary maintenance on printers.

.6 Run system software diagnostics as required.

.7 Install software and firmware enhancements to ensure components are operating at most current revision for maximum capability and reliability.

.1 Perform network analysis and provide report as described in Submittal article.

.6 Rectify deficiencies revealed by maintenance inspections and environmental checks.

.7 Continue system debugging and optimization.

.8 Testing/verification of occupancy and seasonal-sensitive systems to take place during four (4) consecutive seasons, after facility has been accepted, taken over and fully occupied.

.1 Test weather-sensitive systems twice: first at near winter design conditions and secondly under near summer design conditions.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA International).

.1 CSA T529, Telecommunications Cabling Systems in Commercial Buildings (Adopted ANSI/TIA/EIA-568-A with modifications.

.2 CSA T530, Commercial Building Standard for Telecommunications Pathways and Spaces (Adopted ANSI/TIA/EIA – 569-A with modifications.

.2 Institute of Electrical and Electronics Engineers (IEEE)/Standard for Information Technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements:

.1 IEEE Std 802.3TM, Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.

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

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

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

.4 Treasury Board Information Technology Standard (TBITS):

.1 TBITS 6.9, Profile for the Telecommunications Wiring System in Government Owned and Leased Buildings-Technical Specifications.

1.2 DEFINITIONS

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

1.3 SYSTEM DESCRIPTION

.1 Data communication network to link Operator Workstations and Master Control Units (MCU) in accordance with CSA T529, TIA/EIA-568, CSA T530 and TIA/EIA-569-A:

.1 Provide reliable and secure connectivity of adequate performance between different sections segments of network.

.2 Allow for future expansion of network, with selection of networking technology and communication protocols.

.2 Data communication network to include, but not limited to:

.1 EMCS-LAN.

.2 Modems.

.3 Network interface cards.

.4 Network management hardware and software.

.5 Network components necessary for complete network.

1.4 DESIGN REQUIREMENTS

.1 EMCS Local Area Network (EMCS-LAN):

.1 High Speed, high performance, local area network over MS/TP with MCUs and OWSs communicate with each other directly on peer to peer basis in accordance with IEEE 802.3/Ethernet Standard.

.2 EMCS-LAN to be: BACnet Protocol.

.3 Each EMCS-LAN to be capable of supporting at least 50 devices.

.4 Support of combination of MCUs and OWSs directly connected to EMCS-LAN.

.5 High speed data transfer rates for alarm reporting, quick report generation from multiple controllers, upload/download information between network devices. Bit rate to be 10 Megabits per second minimum.

.6 Detection and accommodation of single or multiple failures of either OWSs, MCUs or network media. Operational equipment to continue to perform designated functions effectively in event of single or multiple failures.

.7 Commonly available, multiple sourced, networking components and protocols to allow system to co-exist with other networking applications including office automation.

.2 Dynamic Data Access:

.1 LAN to provide capabilities for OWSs, either network resident or connected remotely to access point status and application report data or execute control functions for other devices via LAN.

.2 Access to data to be based upon logical identification of building equipment.

.3 Network Medium:

.1 Network medium: twisted cable, shielded twisted cable, or fibre optic cable compatible with network protocol to be used within buildings. Fibre optic cable to be used between buildings.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

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

.2 Secondary OWS: serves as backup to primary OWS, is storage and retrieval facility of soft copy of as-built contractor supplied data as described in Section 25 05 03 - EMCS: Project Record Documents.

.3 Portable OWS: used as remote dial-up OWS with same capabilities as primary OWS including graphic display.

.4 Remote Auxiliary OWS: performs identical user interface functions as primary OWS.

1.2 OWS SYSTEM DESCRIPTION

.1 Consists of commercially available personal computer in current production, with sufficient memory and processor capacity to perform functions specified.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Make submittals in accordance with Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

1.4 ENVIRONMENTAL CONDITIONS

.1 OWS to operate in conditions of 10 degrees C to 32 degrees C and 20% to 90% non-condensing RH.

1.5 MAINTENANCE

.1 Provide maintenance in accordance with Section 25 05 03 - EMCS: Project Record Documents.

Part 2 Products

2.1 OWS HARDWARE

.1 PC system to include:

.1 Processor to be Intel i5 micro-processor, operating at clock speed of 2.2 gHz minimum, capable of supporting software necessary to perform functions specified in this section. System backplane bus (1066 Megahertz) to support PCI boards.

.2 Internal clock:

.1 Uninterruptible clock having accuracy of plus or minus 5 seconds/ month, capable of deriving year/month/day/ hour/minute/second.

.2 Rechargeable batteries to provide minimum 48 h clock operation in event of power failure.

.3 Asynchronous interfaces for connection to listed peripheral devices including LAN and remote devices.

.2 Power supply unit to accept 120 V 60 Hz source and include line surge and low voltage protection for processor and its peripherals.

.3 Include UPS to provide 30 minutes' minimum operation of PC, CRT and communication and peripheral devices. This shall apply to fixed (non-portable) OWS and peripherals.

2.2 OWS PC COMPONENTS

.1 OWS shall meet the minimum requirements of the upgraded controls systems and software.

.2 Minimum Components:

.1 Processor: Intel™ i5.

.2 Operating System: Genuine Windows 10.

.3 Monitors: 24" Widescreen flat panel.

.4 Memory: 8 GB Dual Channel DDR3 SDRAM – 2 DIMMs.

.5 Hard Drives: 2 X 2 Tb Serial ATA 3 Gb/s Hard Drive (7200 RPM) w/DataBurst Cache™.

.6 CD or DVD Drive: 8x DVD+/-RW Drive.

.7 Video Cards: Integrated.

.8 Sound Cards: Integrated.

.9 Network Card: Integrated Ethernet.

.10 Office Productivity Software (Pre-Installed): Microsoft® Office – Includes MS WORD 2010, MS EXCEL 2010.

.11 Keyboard: USB Keyboard.

.12 Mouse: Optical USB Mouse.

.13 Hardware Support Services: 2 Year Next Business Day Onsite/In Home Service and Tech Support.

.14 Power Protection: 5-Outlet Desktop Surge Protector.

.15 Ports, Slots and Chassis:

.1 Externally Accessible:

.1 Video: HDMI and DVI/Display Port.

.2 USB: 8 Ports (2 Front, 6 Back) + 1 Internal, with minimum of four (4) 3.0 ports.

.3 Audio: Audio – Six back-panel connectors for line-in, line-out, microphone, rear surround, side surround, SPDIF interface in rear, two front-panel connectors for headphones/microphone, integrated 7.1 channel sound.

.4 Additional Jacks: 1 front headphone jack and 1 front / 1 back microphone jack.

.5 Network: Integrated Ethernet.

.6 Integrated 10/100/1000 Gigabit network interface.

.2 Expansion Slots.
  .1 Half-height PCIe x 1.
  .2 Half-height PCIe x 16 (Graphics).
.3 Power Supply
  .1 DC Power Supply sized for specified system.
    .1 Voltage: 200 to 240 V and 100 to 120 V at 50/60 Hz.
    .2 Backup battery: 3-V CR2032 lithium coin cell.
.4 Chassis:
  .1 3.5” Bays: 2 bays (one external; one internal).
  .2 5.25 Bays: 1 Slimline bays.
  .3 Memory DIMM slots: 4 available.
  .4 Dimensions and Weight:
    .1 H: 31.5 cm (12.5”).
    .2 W: 9.4 cm (3.7”).
    .3 D: 36.5 cm (14.5”).
    .4 Weight: 7.7 kg (16.4 lbs).

2.3 OPERATING SYSTEM (OS) OR EXECUTIVE

.1 OS to support complement of hardware terminals and software programs specified.

.2 OS to be true multitasking operating environment.

  .1 MS DOS or PC DOS based software platforms not permitted.

.3 OWS Software to operate in a "Windows” based operating environment. Software to be Windows 10.

2.4 OWS CONTROL SOFTWARE

.1 OWS is not to form part of real-time control functions either directly or indirectly or as part of communication link. Real-time control functions to reside in MCUs, LCUs, and TCUs with peer to peer communication occurring at MCU to MCU device level.

.2 Time Synchronization Module.

  .1 System to provide Time Synchronization of real-time clocks in controllers.

  .2 System to perform this feature on regular scheduled basis and on operator request.

.3 User Display Interface Module.

  .1 OWS software to support "Point Names" as defined in Section 25 05 01 - EMCS: General Requirements.

  .2 Upon operator's request in either text, graphic or table mode, system to present condition of single point, system, area, or connected points on system to OWS. Display analog values digitally to 1 place of decimal with negative sign as required. Update displayed analog values and status when new values received. Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm. For systems supporting

COSV, refresh rate of screen data not to exceed 5 seconds from time of field change and system is to execute supervisory background scan every 20 seconds to verify point data value. For other systems refresh rate not to exceed 5 seconds for points displayed. Initial display of new system graphic display (with up to 30 active points), including presentation of associated dynamic data not to exceed 8 seconds.

.4 General Event Log Module: to record system activities occurring at OWS or elsewhere in system including:

.1 Operator Log-in from user interface device.

.2 Communication messages: errors, failures and recovery.

.3 Event notifications and alarms by category.

.4 Record of operator initiated commands.

.5 General Event Log:

.1 Hold minimum of 6 months information and be readily accessible to operator.

.2 Able to be archived as necessary to prevent loss of information.

.6 Operator Control Software Module: to support entry of information into system from keyboard and mouse, disk, or from another network device. Display of information to user; dynamic displays, textual displays, and graphic displays to display logging and trending of system information and following tasks:

.1 Automatic logging of digital alarms and change of status messages.

.2 Automatic logging of analog alarms.

.3 System changes: alarm limits, set-points, alarm lockouts.

.4 Display specific point values, states as selected.

.5 Provide reports as requested and on scheduled basis when required.

.6 Display graphics as requested, and on alarm receptions (user's option).

.7 Display list of points within system.

.8 Display list of systems within building.

.9 Direct output of information to selected peripheral device.

.10 On-line changes:

.1 Alarm limits.

.2 Setpoints.

.3 Deadbands.

.4 Control and change of state changes.

.5 Time, day, month, year.

.6 Control loop configuration changes for controller-based CDLs.

.7 Control loop tuning changes.

.8 Schedule changes.

.9 Changes, additions, or deletions, of points, graphics, for installed and future systems.

.11 According to assigned user privileges (password definition) following functions are to be supported:

.1 Permit operator to terminate automatic (logic based) control and set value of field point to operator selected value. These values or settings to remain in effect until returned to automatic (logic based) control by operator.

.2 Requests for status, analog values, graphic displays, logs and controls to be through user interface screens.

.12 Software and tools utilized to generate, modify and configure building controllers to be installed and operational on the OWS.

.7 Dial-up host Module for off site OWSs.

.1 Operators at dial-up OWS to be able to perform control functions, report functions, data base generation and modification functions as described for OWS's connected via LAN. Provide routines to automatically answer calls and either file or display information sent from remote panels.

.2 Operator to be able to access remote buildings by selection of facility by its logical name. Dial-up module to maintain user-definable cross-reference of buildings and associated telephone numbers without manual dialing.

.3 Local OWS may serve as dial-up host for remotely connecting OWSs, remote controllers or networks. Alarms and data file transfers handled via dial-up transactions must not interfere with local LAN activity. LAN activity not to prevent work-station from handling incoming calls.

.8 Message Handling Module - and Error Messages: to provide message handling for following conditions:

.1 Message and alarm buffering to prevent loss of information.

.2 Error detection correction and retransmission to guarantee data integrity.

.3 Informative messages to operator for data error occurrences, errors in keyboard entry, failure of equipment to respond to requests or commands and failure of communications between EMCS devices.

.4 Default device definition to be implemented to ensure alarms are reported as quickly as possible in event of faulty designated OWS.

.9 Access Control Module.

.1 Minimum 5 levels of password access protection to limit control, display, or data base manipulation capabilities. Following is preferred format of progression of password levels:

.1 Guest: no password data access and display only.

.2 Operator Level: full operational commands including automatic override.

.3 Technician: data base modifications.

.4 Programmer: data base generation.

.5 Highest Level: system administration - password assignment addition, modification.

.2 User-definable, automatic log-off timers from 1 to 60 min. to prevent operators leaving devices on-line inadvertently. Default setting = 3 minutes.

.10 Trend Data Module: includes historical data collection utility, trend data utility, control loop plot utility. Each utility to permit operator to add trend point, delete trend point, set scan rate.

.1 Historical data collection utility: collect concurrently operator selected real or calculated point values at operator selectable rate 30-480 minutes. Samples to include for each time interval (time-stamped), minimum present value, maximum present value, and average present value for point selected. Rate to be individually selectable for each point. Data collection to be continuous operation, stored in temporary storage until removed from historical data list by operator. Temporary storage to have at least 12-month capacity.

.2 Trend data utility: continuously collect point object data variables for variables from building controllers as selected by operator, including at minimum; present value of following point object types - DI, DO, AI, AO set points value, calculated values. Trend data utility to have capacity to trend concurrently points at operator-selectable rate of 05 seconds to 3600 seconds, individually selectable for selected value, or use of COSV detection. Collected trend data to be stored on minimum 96 hours basis in temporary storage until removed from trend data list by operator. Option to archive data before overwriting to be available.

.3 Control loop plot utility: for AO Points provide for concurrent plotting of Measured value input - present value, present value of output, and AO setpoint. Operator selectable sampling interval to be selectable between 1 second to 20 seconds. Plotting utility to scroll to left as plot reaches right side of display window. Systems not supporting control loop plot as separate function must provide predefined groups of values. Each group to include values for one control loop display.

.4 Trend data Module to include display of historical or trend data to OWS screen in X Y plot presentation. Plot utility to display minimum of 6 historical points or 6 trend points concurrently or 1 Control Loop Plot. For display output of real time trend data, display to automatically index to left when window becomes full. Provide plotting capabilities to display collected data based on range of selected value for (Y) component against time/date stamp of collected data for (X) component.

.5 Provide separate reports for each trend utility. Provide operator feature to specify report type, by point name and for output device. Reports to include time, day, month, year, report title, and operator's initials. Implement reports using report module. Ensure trend data is exportable to third party spreadsheet or database applications for PCs.

.11 Report Module: reports for energy management programs, function totalization, analog/pulse totalization and event totalization features available at MCU level. Refer also to Section 25 30 01- EMCS: Building Controllers.

.1 Reports to include time, day, month, year, report title, operator's initials.

.2 Software to provide capability to:

.1 Generate and format reports for graphical and numerical display from real time and stored data.

.2 Print and store reports as selected by operator.

.3 Select and assign points used in such reports.

.4 Sort output by area, system, as minimum.

.3 Periodic/automatic report:

.1 Generate specified report(s) automatically including options of start time and date, interval between reports (hourly, daily, weekly, monthly), output device. Software to permit modifying periodic/automatic reporting profile at any time.

.2 Reports to include:

.1 Power demand and duty cycle summary: see application program for same.

.2 Disabled "Locked-out" point summary: include point name, whether disabled by system or by operator.

.3 Run time summary: summary of accumulated running time of selected equipment. Include point name, run time to date, alarm limit setting. Run time to accumulate until reset individually by operator.

.4 Summary of run time alarms: include point name, run time to date, alarm limit.

.5 Summary of start/stop schedules: include start/stop times and days, point name.

.6 Motor status summary.

.4 Report types:

.1 Dynamic reports: system to printout or display of point object data value requested by operator. System to indicate status at time of request, when displayed, updated at operator selected time interval. Provide option for operator selection of report type, by point name, and/or output device. Ensure reports are available for following point value combinations:

.2 Points in accessible from this OWS (total connected for this location), multiple "areas".

.3 Area (points and systems in Area).

.4 Area, system (points in system).

.5 System (points by system type).

.6 System point (points by system and point object type).

.7 Area point (points by system and point object type).

.8 Point (points by point object type).

.5 Summary report: printout or display of point object data value selected by operator. Report header to indicate status at time of request. Ensure reports are available on same basis as dynamic reports. Provide option as to report type, point name, output device.

.6 Include preformatted reports as listed in Event/Alarm Module.

.12 Graphics Display Module: graphics software utility to permit user to create, modify, delete, file, and recall graphics required by Section 25 90 01 - EMCS: Site Requirements, Applications and Systems Sequences of Operation.

.1 Provide capacity for 100% expansion of system graphics. Graphic interface to provide user with multiple layered diagrams for site, building in plan view, floor furniture plan view and building systems, overlaid with dynamic data appropriately placed and permitting direct operator interaction. Graphic interface to permit operator to start and stop equipment, change set points, modify alarm limits, override system functions and points from graphic system displays by use of mouse or similar pointing device.

.2 Display specific system graphics: provide for manual and/or automatic activation (on occurrence of an alarm). Include capability to call up and cancel display of graphic picture.

.3 Library of pre-engineered screens and symbols depicting standard air handling components (fans, coils, filters, dampers, VAV), complete mechanical system components (chillers, boilers, pumps), electrical symbols.

.4 Graphic development, creation, modification package to use mouse and drawing utility to permit user to:

.1 Modify portion of graphic picture/schematic background.

.2 Delete graphic picture.

.3 Call up and cancel display of graphic picture.

.4 Define symbols.

.5 Position and size symbols.

.6 Define background screens.

.7 Define connecting lines, curves.

.8 Locate, orient, size descriptive text.

.9 Define, display colours of elements.

.10 Establish co-relation between symbols or text and associated system points or other graphic displays.

.5 User to be able to build graphic displays showing on-line point data from multiple MCU panels. Graphic displays to represent logical grouping of system points or calculated data based upon building function, mechanical system, building layout, other logical grouping of points which aids operator in analysis of facility operation. Data to be refreshed on screen as "changed data" without redrawing of entire screen or row on screen.

.6 Dynamic data (temperature, humidity, flow, status) to be shown in actual schematic locations, to be automatically updated to show current values without operator intervention.

.7 Windowing environment to allow user to view several graphics simultaneously to permit analysis of building operation, system performance, display of graphic associated with alarm to be viewed without interrupting work in progress. If interface is unable to display several different types of display at same time, provide at minimum 2 OWSs.

.8 Utilize graphics package to generate system schematic diagrams as required in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation, and as directed by Departmental Representative. In addition, provide graphics for schematic depicted on mechanical plan flow diagrams, point lists and system graphics. Provide graphic for floor depicting

room sensors and control devices located in their actual location. For floor graphic include secondary diagram to show TCU-VAV box actuator and, flow sensor. Diagram to be single line schematic of ductwork as well as associated heating coil or radiation valve. Departmental Representative to provide CAD floor layouts. Provide display of TCU-VAVs in table form, include following values as minimum; space temp, setpoint, mode, actual flow, min flow setpoint, max flow setpoint, cooling signal value, and heating signal value. Organize table by rooms and floor groupings.

.9 Provide complete directory of system graphics, including other pertinent system information. Utilize mouse or pointing device to "point and click" to activate selected graphic.

.10 Provide unique sequence of operation graphic or pop-up window for each graphic that is depicted on OWS. Provide access to sequence of operation graphic by link button on each system graphic. Provide translation of sequence of operation, a concise explanation of systems operation, from control descriptive logic into plain and/or English language.

.13 Event/Alarm Module: displays in window alarms as received and stored in General Event Log.

.1 Classify alarms as "critical", "cautionary", "maintenance". Alarms and alarm classifications to be designated by personnel requiring password level.

.2 Presentation of alarms to include features identified under applicable report definitions of Report Module paragraph.

.3 Alarm reports.

.1 Summary of points in critical, cautionary or maintenance alarm. Include at least point name, alarm type, current value, limit exceeded.

.2 Analog alarm limit summary: include point name, alarm limits, deviation limits.

.3 Summary of alarm messages: include associated point name, alarm description.

.4 Software to notify operator of each occurrence of alarm conditions. Each point to have its own secondary alarm message.

.5 EMCS to notify operator of occurrence of alarms originating at field device within following time periods of detection:

.1 Critical - 5 seconds.

.2 Cautionary - 10 seconds.

.3 Maintenance - 10 seconds.

.6 Display alarm messages in English.

.7 Primary alarm message to include as minimum: point identifier, alarm classification, time of occurrence, type of alarm. Provide for initial message to be automatically presented to operator whenever associated alarm is reported. Assignment of secondary messages to point to be operator-editable function. Provide secondary messages giving further information (telephone lists, maintenance functions) on per point basis.

.8 System reaction to alarms: provide alarm annunciation by dedicated window (activated to foreground on receipt of new alarm or event) of OWS with visual

and audible hardware indication. Acknowledgement of alarm to change visual indicator from flashing to steady state and to silence audible device. Acknowledgment of alarm to be time, date and operator stamped and stored in General Event Log. Steady state visual indicator to remain until alarm condition is corrected but must not impede reporting of new alarm conditions. Notification of alarm not to impede notification of subsequent alarms or function of Controller's/CDL. Do not allow random occurrence of alarms to cause loss of alarm or over-burden system. Do not allow acknowledgement of one alarm as acknowledgement of other alarms.

.9 Controller network alarms: system supervision of controllers and communications lines to provide following alarms as minimum:

.1 Controller not responding - where possible delineate between controller and communication line failure.

.2 Controller responding - return to normal.

.3 Controller communications bad - high error rate or loss of communication.

.4 Controller communications normal - return to normal.

.10 Digital alarm status to be interrogated every 2 seconds as minimum or be direct interrupting non-polling type (COV). Annunciate each non-expected status with alarm message.

.14 Archiving and Restoration Module.

.1 Primary OWS to include services to store back-up copies of controller databases. Perform complete backup of OWS software and data files at time of system installation and at time of final acceptance. Provide backup copies before and after Controller's revisions or major modifications.

.2 Provide continuous integrity supervision of controller data bases. When controller encounters database integrity problems with its data base, system to notify operator of need to download copy data base to restore proper operation.

.3 Ensure data base back-up and downloading occurs over LAN without specialized operator technical knowledge. Provide operator with ability to manually download entire controller data base, or parts thereof as required.

.15 CDL Generator and Modifier Module.

.1 CDL Generator module to permit generation and modification of CDLs.

.2 Provide standard reference modules for text based systems module that will permit modification to suit site specific applications. Module to include cut, paste, search and compare utilities to permit easy CDL modification and verification.

.3 Provide full library of symbols used by manufacturer for system product installed accessible to operators for systems using graphical environment for creation of CDLs Module to include graphic tools required to generate and create new object code for downloading to building controllers.

.4 Module to permit testing of code before downloading to building controllers.

Part 3 Execution

3.1 INSTALLATION REQUIREMENTS

.1 Provide necessary power as required from local 120V emergency power branch circuit panels for OWSs and peripheral equipment.

.1 Install tamper locks on breakers of circuit panels.

.2 Refer to UPS requirements stated under OWS Hardware in PART 2.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society of Heating, Refrigeration, and Air-Conditioning Engineers, Inc. (ASHRAE):

.1 ASHRAE, Applications Handbook, SI Edition.

.2 ASHRAE Standard 135 – BAC net – A Data Communications Protocol for Building Automation and Control Networks.

.3 ASHRAE Standard 135.1 Method of Test Conformance to BAC net.

.2 Canadian Standards Association (CSA):

.1 C22.2 No.205, Signal Equipment.

.3 Institute of Electrical and Electronics Engineers (IEEE):

.1 IEEE C37.90.1, Surge Withstand Capabilities Test for Protective Relays and Relays Systems.

.4 Public Works and Government Services Canada (PWGSC)/Real Property Branch/Architectural and Engineering Services:

.1 PWGSC MD 250005-2009: Energy Monitoring and Control Systems (EMCS) Design Guidelines.

1.2 DEFINITIONS

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

1.3 DESCRIPTION

.1 General: Network of controllers comprising of MCU(s), LCU(s), ECU(s) or TCU(s) to be provided as indicated in System Architecture Diagram to support building systems and associated sequence(s) of operations as detailed in these specifications.

.1 Provide sufficient controllers to meet intents and requirements of this section.

.2 Controller quantity, and point contents to be approved by Departmental Representative at time of preliminary design review.

.2 Controllers: stand-alone intelligent Control Units.

.1 Incorporate programmable microprocessor, non-volatile program memory, RAM, power supplies, as required to perform specified functions.

.2 Incorporate communication interface ports for communication to LANs to exchange information with other Controllers.

.3 Capable of interfacing with operator interface device.

.4 Execute its logic and control using primary inputs and outputs connected directly to its onboard input/output field terminations or slave devices, and without need to interact with other controller. Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).

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

.3 Interface to include provisions for use of dial-up modem for interconnection with remote modem.

.1 Dial-up communications to use 56 Kbit modems and voice grade telephone lines.

.2 Each stand-alone panel may have its own modem or group of stand-alone panels may share modem.

1.4 DESIGN REQUIREMENTS

.1 To include:

.1 Scanning of AI and DI connected inputs for detection of change of value and processing detection of alarm conditions.

.2 Perform On-Off digital control of connected points, including resulting required states generated through programmable logic output.

.3 Perform Analog control using programmable logic, (including PID) with adjustable dead bands and deviation alarms.

.4 Control of systems as described in sequence of operations.

.5 Execution of optimization routines as listed in this section.

.2 Total spare capacity for MCUs and LCUs: at least 25 % of each point type distributed throughout the MCUs and LCUs.

.3 Field Termination and Interface Devices:

.1 To: CSA C22.2 No.205.

.2 Electronically interface sensors and control devices to processor unit.

.3 Include, but not be limited to, following:

.1 Programmed firmware or logic circuits to meet functional and technical requirements.

.2 Power supplies for operation of logics devices and associated field equipment.

.3 Lockable wall cabinet.

.4 Required communications equipment and wiring (if remote units).

.5 Leave controlled system in "fail-safe" mode in event of loss of communication with, or failure of, processor unit.

.6 Input Output interface to accept as minimum AI, AO, DI, DO functions as specified.

.7 Wiring terminations: use conveniently located screw type or spade lug terminals.

.4 AI interface equipment to:

.1 Convert analog signals to digital format with 10 bit analog-to-digital resolution.

.2 Provide for following input signal types and ranges:

.1 4-20 mA;

.2 0 - 10 V DC; and

.3 100/1000 ohm RTD input.

.3 Meet IEEE C37.90.1 surge withstand capability.

.4 Have common mode signal rejection greater than 60 dB to 60 Hz.

.5 Where required, dropping resistors to be certified precision devices which complement accuracy of sensor and transmitter range specified.

.5 AO interface equipment:

.1 Convert digital data from controller processor to acceptable analog output signals using 8 bit digital-to-analog resolution.

.2 Provide for following output signal types and ranges:

.1 4 - 20 mA.

.2 0 - 10 V DC.

.3 Meet IEEE C37.90.1 surge withstand capability.

.6 DI interface equipment:

.1 Able to reliably detect contact change of sensed field contact and transmit condition to controller.

.2 Meet IEEE C37.90.1 surge withstand capability.

.3 Accept pulsed inputs up to 2 kHz.

.7 DO interface equipment:

.1 Respond to controller processor output, switch respective outputs. Each DO hardware to be capable of switching up to 0.5 amps at 24 V AC.

.2 Switch up to 5 amps at 220 V AC using optional interface relay.

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

.5 Controllers (MCU, LCU): mount in wall mounted cabinet with hinged, keyed-alike locked door:

.1 Provide for conduit entrance from top, bottom or sides of panel.

.2 ECUs and TCUs to be mounted in equipment enclosures or separate enclosures.

.3 Mounting details as approved by Departmental Representative for ceiling mounting.

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

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

1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

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

1.6 MAINTENANCE

.1 Provide manufacturers recommended maintenance procedures for insertion in Section 25 05 03 - EMCS: Project Record Documents.

Part 2 Products

2.1 MASTER CONTROL UNIT (MCU)

.1 General: primary function of MCU is to provide co-ordination and supervision of subordinate devices in execution of optimization routines such as demand limiting or enthalpy control.

.2 Include high speed communication LAN Port for Peer to Peer communications with OWS(s) and other MCU level devices.

.1 MCU must support Proprietary Protocol BACnet.

.3 MCU local I/O capacity as follows:

.1 MCU I/O points as allocated in I/O Summary Table referenced in MD250005.

.2 LCUs may be added to support system functions.

.4 Central Processing Unit (CPU).

.1 Processor to consist of minimum 16-bit microprocessor capable of supporting software to meet specified requirements.

.2 CPU idle time to be more than 30% when system configured to maximum input and output with worst case program use.

.3 Minimum addressable memory to be at manufacturer's discretion but to support at least performance and technical specifications to include but not limited to:

.1 Non-volatile EEPROM to contain operating system, executive, application, sub-routine, other configurations definition software. Tape media not acceptable.

.2 Battery backed (72-hour minimum capacity) RAM (to reduce the need to reload operating data in event of power failure) to contain CDLs, application parameters, operating data or software that is required to be modifiable from operational standpoint such as schedules, setpoints, alarm limits, PID constants and CDL and hence modifiable on-line through operator panel or remote operator's interface. RAM to be downline loadable from OWS.

.4 Include uninterruptible clock accurate to plus or minus 5 secs/month, capable of deriving year/month/day/hour/minute/second, with rechargeable batteries for minimum 72-hour operation in event of power failure.

.5 Local Operator Terminal (OT): Provide OT for each MCU unless otherwise specified in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

.1 Mount access/display panel in MCU or in suitable enclosure beside MCU as approved by Departmental Representative.

.2 Support operator's terminal for local command entry, instantaneous and historical data display, programs, additions and modifications.

.3 Display simultaneously minimum of 16 point identifiers to allow operator to view single screen dynamic displays depicting entire mechanical systems. Point identifiers to be in English French.

.4 Functions to include, but not be limited to, following:

.1 Start and stop points.

.2 Modify setpoints.

.3 Modify PID loop parameters.

.4 Override PID control.

.5 Change time/date.

.6 Add/modify/start/stop weekly scheduling.

.7 Add/modify setpoint weekly scheduling.

.8 Enter temporary override schedules.

.9 Define holiday schedules.

.10 View analog limits.

.11 Enter/modify analog warning limits.

.12 Enter/modify analog alarm limits.

.13 Enter/modify analog differentials.

.5 Provide access to real and calculated points in controller to which it is connected or to other controller in network. This capability not to be restricted to subset of predefined "global points" but to provide totally open exchange of data between OT and other controller in network.

.6 Operator access to OTs: same as OWS user password and password changes to automatically be downloaded to controllers on network.

.7 Provide prompting to eliminate need for user to remember command format or point names. Prompting to be consistent with user's password clearance and types of points displayed to eliminate possibility of operator error.

.8 Identity of real or calculated points to be consistent with network devices. Use same point identifier as at OWS's for access of points at OT to eliminate cross-reference or look-up tables.

2.2 LOCAL CONTROL UNIT (LCU)

.1 Provide multiple control functions for typical built-up and package HVAC systems, hydronic systems and electrical systems.

.2 Minimum of 16 I/O points of which minimum be 4 AOs, 4 AIs, 4 DIs, 4 DOs.

.3 Points integral to one Building System to be resident on only one controller.

.4 Microprocessor capable of supporting necessary software and hardware to meet specified requirements as listed in previous MCU article with following additions:

.1 Include minimum 2 interface ports for connection of local computer terminal.

.2 Design so that shorts, opens or grounds on input or output will not interfere with other input or output signals.

.3 Physically separate line voltage (70V and over) circuits from DC logic circuits to permit maintenance on either circuit with minimum hazards to technician and equipment.

.4 Include power supplies for operation of LCU and associated field equipment.

.5 In event of loss of communications with, or failure of, MCU, LCU to continue to perform control. Controllers that use defaults or fail to open or close positions not acceptable.

.6 Provide conveniently located screw type or spade lug terminals for field wiring.

.7 LCU to have 25 % spare input and 25 % output point capacity without addition of cards, terminals, etc.

2.3 TERMINAL/EQUIPMENT CONTROL UNIT (TCU/ECU)

.1 Microprocessor capable of supporting necessary software and hardware to meet TCU/ECU functional specifications.

.1 TCU/ECU definition to be consistent with those defined in ASHRAE HVAC Applications Handbook Section 45.

.2 Controller to communicate directly with EMCS through EMCS LAN and provide access from EMCS OWS for setting occupied and unoccupied space temperature setpoints, flow setpoints, and associated alarm values, permit reading of sensor values, field control values (% open) and transmit alarm conditions to EMCS OWS.

.3 VAV Terminal Controller.

.1 Microprocessor based controller with integral flow transducer, including software routines to execute PID algorithms, calculate airflow for integral flow transducer and measure temperatures as per I/O Summary required inputs. Sequence of operation to ASHRAE HVAC Applications Handbook.

.2 Controller to support point definition; in accordance with Section 25 05 01 - EMCS: General Requirements.

.3 Controller to operate independent of network in case of communication failure.

.4 Controller to include damper actuator and terminations for input and output sensors and devices.

2.4 SOFTWARE

.1 General.

.1 Include as minimum: operating system executive, communications, application programs, operator interface, and systems sequence of operation - CDL's.

.2 Include "firmware" or instructions which are programmed into ROM, EPROM, EEPROM or other non-volatile memory.

.3 Include initial programming of Controllers, for entire system.

.2 Program and data storage.

.1 Store executive programs and site configuration data in ROM, EEPROM or other non-volatile memory.

.2 Maintain CDL and operating data including setpoints, operating constants, alarm limits in battery-backed RAM or EEPROM for display and modification by operator.

.3 Programming languages.

.1 Program Control Description Logic software (CDL) using English like or graphical, high level, general control language.

.2 Structure software in modular fashion to permit simple restructuring of program modules if future software additions or modifications are required. GO TO constructs not allowed unless approved by Departmental Representative.

.4 Operator Terminal interface.

.1 Operating and control functions include:

.1 Multi-level password access protection to allow user/manager to limit workstation control.

.2 Alarm management: processing and messages.

.3 Operator commands.

.4 Reports.

.5 Displays.

.6 Point identification.

.5 Pseudo or calculated points.

.1 Software to provide access to value or status in controller or other networked controller in order to define and calculate pseudo point. When current pseudo point value is derived, normal alarm checks must be performed or value used to totalize.

.2 Inputs and outputs for process: include data from controllers to permit development of network-wide control strategies. Processes also to permit operator to use results of one process as input to number of other processes (e.g. cascading).

.6 Control Description Logic (CDL):

.1 Capable of generating on-line project-specific CDLs which are software based, programmed into RAM or EEPROM and backed up to OWS. Departmental Representative must have access to these algorithms for modification or to be able to create new ones and to integrate these into CDLs on BC(s) from OWS.

.2 Write CDL in high level language that allows algorithms and interlocking programs to be written simply and clearly. Use parameters entered into system (e.g. setpoints) to determine operation of algorithm. Operator to be able to alter operating parameters on-line from OWS and BC(s) to tune control loops.

.3 Perform changes to CDL on-line.

.4 Control logic to have access to values or status of points available to controller including global or common values, allowing cascading or inter-locking control.

.5 Energy optimization routines including enthalpy control, supply temperature reset, to be LCU or MCU resident functions and form part of CDL.

.6 MCU to be able to perform following pre-tested control algorithms:

.1 Two position control.

.2 Proportional Integral and Derivative (PID) control.

.7 Control software to provide ability to define time between successive starts for each piece of equipment to reduce cycling of motors.

.8 Provide protection against excessive electrical-demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.

.9 Power Fail Restart: upon detection of power failure system to verify availability of Emergency Power as determined by emergency power transfer switches and analyze controlled equipment to determine its appropriate status under Emergency power conditions and start or stop equipment as defined by

I/O Summary. Upon resumption of normal power as determined by emergency power transfer switches, MCU to analyze status of controlled equipment, compare with normal occupancy scheduling, turn equipment on or off as necessary to resume normal operation.

.7 Event and Alarm management: use management by exception concept for Alarm Reporting. This is system wide requirement. This approach will insure that only principal alarms are reported to OWS. Events which occur as direct result of primary event to be suppressed by system and only events which fail to occur to be reported. Such event sequence to be identified in I/O Summary and sequence of operation. Examples of above are, operational temperature alarms limits which are exceeded when main air handler is stopped, or General Fire condition shuts air handlers down, only Fire alarm status shall be reported. Exception is, when air handler which is supposed to stop or start fails to do so under event condition.

.8 Energy management programs: include specific summarizing reports, with date stamp indicating sensor details which activated and or terminated feature.

.1 MCU in coordination with subordinate LCU, TCU, ECU to provide for the following energy management routines:

.1 Time of day scheduling.

.2 Calendar based scheduling.

.3 Holiday scheduling.

.4 Temporary schedule overrides.

.5 Optimal start/stop.

.6 Night setback control.

.7 Enthalpy (economizer) switchover.

.8 Peak demand limiting.

.9 Temperature compensated load rolling.

.10 Fan speed/flow rate control.

.11 Cold deck reset.

.12 Hot deck reset.

.13 Hot water reset.

.14 Chilled water reset.

.15 Condenser water reset.

.16 Chiller sequencing.

.17 Night purge.

.2 Programs to be executed automatically without need for operator intervention and be flexible enough to allow customization.

.3 Apply programs to equipment and systems as specified or requested by the Departmental Representative.

.9 Function/Event Totalization: features to provide predefined reports which show daily, weekly, and monthly accumulating totals and which include high rate (time stamped) and low rate (time stamped) and accumulation to date for month.

.1 MCUs to accumulate and store automatically run-time for binary input and output points.

.2 MCU to automatically sample, calculate and store consumption totals on daily, weekly or monthly basis for user-selected analog or binary pulse input-type points.

.3 MCU to automatically count events (number of times pump is cycled off and on) daily, weekly or monthly basis.

.4 Totalization routine to have sampling resolution of 1 min or less for analog inputs.

.5 Totalization to provide calculations and storage of accumulations up to 99,999.9 units (e.g., kWH, litres, tonnes, etc.).

.6 Store event totalization records with minimum of 9,999,999 events before reset.

.7 User to be able to define warning limit and generate user-specified messages when limit reached.

2.5 LEVELS OF ADDRESS

.1 Upon operator's request, EMCS to present status of any single 'point', 'system' or point group, entire 'area', or entire network on printer or OWS as selected by operator.

.1 Display analog values digitally to 1 place of decimals with negative sign as required.

.2 Update displayed analog values and status when new values received.

.3 Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm.

.4 Updates to be change-of-value (COV) driven or if polled not exceeding 2 second intervals.

2.6 POINT NAME SUPPORT

.1 Controllers (MCU, LCU) to support PSPC point naming convention as defined in Section 25 05 01 - EMCS: General Requirements.

Part 3 Execution

3.1 LOCATION

.1 Location of Controllers to be approved by Departmental Representative.

3.2 INSTALLATION

.1 Install Controllers in secure locking enclosures as indicated or as directed by Departmental Representative.

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

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

.4 Use uninterruptible Power Supply (UPS) and emergency power when equipment must operate in emergency and co-ordinating mode.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI).

.1 ANSI C12.7, Requirements for Watthour Meter Sockets.

.2 ANSI/IEEE C57.13, Standard Requirements for Instrument Transformers.

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

.1 ASTM B148, Standard Specification for Aluminum-Bronze Sand Castings.

.3 National Electrical Manufacturer's Association (NEMA).

.1 NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

.4 Air Movement and Control Association, Inc. (AMCA).

.1 AMCA Standard 500-D, Laboratory Method of Testing Dampers For Rating.

.5 Canadian Standards Association (CSA International).

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

1.2 DEFINITIONS

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

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 25 05 02 - EMCS: Submittals and Review Process.

.2 Pre-Installation Tests.

.1 Submit samples at random from equipment shipped, as requested by Departmental Representative, for testing before installation. Replace devices not meeting specified performance and accuracy.

.3 Manufacturer's Instructions:

.1 Submit manufacturer's installation instructions for specified equipment and devices.

1.4 EXISTING CONDITIONS

.1 Cutting and Patching: in accordance with Section 01 73 00 - Execution Requirements supplemented as specified herein.

.2 Repair surfaces damaged during execution of Work.

.3 Turn over to Departmental Representative existing materials removed from Work not identified for re-use.

Part 2 Products

2.1 GENERAL

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

.2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof, heat resistant assembly.

.3 Operating conditions: 0 - 32ºC with 10% - 90% RH (non-condensing) unless otherwise specified.

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

.5 Transmitters to be unaffected by external transmitters (eg. walkie talkies).

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

.7 Outdoor installations: use weatherproof construction in CSA 4X enclosures.

.8 Devices to be installed in user occupied space must not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.

.9 Range: including temperature, humidity, and pressure, as indicated in I/O summary in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

2.2 TEMPERATURE SENSORS

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

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

.2 Thermisters 10 K ohm, $\pm$ 0.2ºC accuracy, less than 0.1ºC drift over 10-year span. Power supply 5 V dc, 10-35 Vdc, 24 Vac.

.3 RTD's: 1000 ohm at 0ºC (± 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored leadwires. Coefficient of resistivity: 0.00385 ohms/ohmEC.

.4 Immersion wells: NPS 3/4, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length 100 mm as indicated.

.5 Sensing element: hermetically sealed.

.6 Stem and tip construction: copper or type 304 stainless steel.

.7 Time constant response: less than 3 seconds to temperature change of 10°C.

.8 Immersion wells: 20mm, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length as required.

.2 Room temperature sensors and display wall modules.

.1 Temperature sensing and display wall module.

.1 LCD display to show space temperature and temperature setpoint.

.2 Buttons for occupant selection of temperature setpoint and occupied/unoccupied mode.

.3 Onboard passive infrared (PIR) occupancy sensor.

.4 For wired sensors provide jack connection for plugging in laptop personal computer for access to zone bus.

.5 Integral thermistor sensing element 10,000 ohm at 24 degrees.

.6 Accuracy 0.6°C over range of 13 to 29°C.

.7 Stability 0.02°C drift per year.

.8 Separate mounting base for ease of installation.

.2 Room temperature sensors.

.1 Wall mounting, in slotted type covers having brushed stainless steel finish, with guard.

.2 Element 10-50mm long RTD with ceramic tube or equivalent protection or thermistor, 10,000 ohm, accuracy of plus or minus 0.2 degrees C.

.3 Duct temperature sensors:

.1 General purpose duct type: suitable for insertion into ducts at various orientations, insertion length as required.

.2 Averaging duct type: incorporates numerous sensors inside assembly which are averaged to provide one reading. Minimum continuous filament with minimum immersion length 6000 mm. Bend probe at field installation time to 100 mm radius at any point along probe without degradation of performance.

.4 Outdoor air temperature sensors:

.1 Outside air type: complete with probe length 100 - 150 mm long, non-corroding shield to minimize solar and wind effects, threaded fitting for mating to 13 mm conduit, weatherproof construction in CSA 4X enclosure.

2.3 TEMPERATURE TRANSMITTERS

.1 Requirements:

.1 Input circuit: to accept 3-lead, 100 ohm at 0ºC, platinum resistance detector type sensors.

.2 Power supply: 575 ohms at 24 V DC into load of 575 ohms. Power supply effect less than 0.01ºC per volt change.

.3 Output signal: 4 - 20 mA into 500 ohm maximum load.

.4 Input and output short circuit and open circuit protection.

.5 Output variation: less than 0.2% of full scale for supply voltage variation of ± 10%.

.6 Combined non-linearity, repeatability, hysteresis effects: not to exceed ± 0.5% of full scale output.

.7 Maximum current to 100 ohm RTD sensor: not to exceed 22.5 mA.

.8 Integral zero and span adjustments.

.9 Temperature effects: not to exceed ± 1.0% of full scale/ 50°C.

.10 Long term output drift: not to exceed 0.25% of full scale/6 months.

.11 Transmitter ranges: Select narrowest range to suit application from following:

.1 -5°C to +50°C, ± 0.5°C.

.2 0 to 100°C, ± 0.5°C.

.3 0 to 50°C, ± 0.25°C.

.4 0 to 25°C, ± 0.1°C.

.5 10 to 35°C, ± 0.25°C.

2.4 HUMIDITY SENSORS

.1 Room and Duct Requirements:

.1 Range: 5% - 95% RH minimum.

.2 Operating temperature range: 0 - 60°C.

.3 Absolute accuracy:

.1 Duct sensors: ± 5%.

.2 Room sensors: ± 2%.

.4 Sheath: stainless steel with integral shroud for specified operation in air streams of up to 10 m/s.

.5 Maintenance: by simple field method such as washing with solvent or mild detergent solution so as to remove anticipated airborne contaminants.

.6 Maximum sensor non-linearity: ± 0.5% RH with defined curves.

.7 Room sensors: wall mounted as indicated.

.8 Duct mounted sensors: locate so that sensing element is between ⅓ and ⅔ distance across any duct dimension.

.9 Sensors to be unaffected by external transmitters such as walkie-talkies. Demonstrate to Departmental's Representative.

.10 Power supply: 18-35 Vdc, 18-32 Vac with temperature sensor.

.2 Outdoor Humidity Requirements:

.1 Range: 5% - 95% RH minimum.

.2 Operating temperature range: -40ºC to 85ºC.

.3 Absolute accuracy: ± 2%.

.4 Temperature coefficient: ± 0.03%RH/°C over 0 to 50°C.

.5 Must be unaffected by condensation or 100% saturation.

.6 No routine maintenance or calibration is required.

2.5 HUMIDITY TRANSMITTERS

.1 Requirements:

.1 Input signal: from 1000 ohm RTD.

.2 Output signal: 4 - 20 mA into 1000 ohm maximum load, 0-5 Vdc, 0-10 Vdc.

.3 Input and output short circuit and open circuit protection.

.4 Output accuracy: not to exceed 0.1% of full span.

.5 Output linearity error: ± 1.0% maximum of full scale output.

.6 Integral zero and span adjustment.

.7 Temperature range: 0-70ºC, -40ºC to 85ºC for outside air.

.8 Long term output drift: not to exceed 0.25% of full scale output/6 months.

2.6 PRESSURE TRANSDUCERS

.1 Requirements:

.1 Range: as indicated in I/O summaries.

.1 Pressure sensing elements: bourdon tube, bellows or diaphragm type.

.2 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.

.2 Output signal: 4 - 20 mA, 0-5V, 0-10V.

.3 Output variations: $\pm$ 1% full scale for supply voltage variations of ± 10%.

.4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed ± 1% of full scale output over entire range.

.5 Integral zero and span adjustment.

.6 Temperature effects: not to exceed ± 1.5% full scale/50°C.

.7 Over-pressure input protection to at least twice rated input pressure.

.8 Output short circuit and open circuit protection.

.9 Pressure ranges: see I/O Summaries.

.10 Accuracy: ± 1% of full scale.

.11 LCD Display.

2.7 DIFFERENTIAL PRESSURE TRANSMITTERS

.1 Requirements:

.1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.

.2 Output signal: 4 - 20 mA, 0-5V, 0-10V.

.3 Output variations: $\pm$ 1% full scale for supply voltage variations of ± 10%.

.4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed ± 1% of full scale output over entire range.

.5 Integral zero and span adjustment.

.6 Temperature effects: not to exceed ± 1.5% full scale/50°C.

.7 Over-pressure input protection to at least twice rated input pressure.

.8 Output short circuit and open circuit protection.

.9 The unit to have NPT connections. The enclosure shall be an integral part of the unit.

.10 LCD Display.

2.8 STATIC PRESSURE SENSORS

.1 Requirements:

.1 Multipoint element with self-averaging manifold:

.1 Maximum pressure loss: 160 Pa at 10 m/s. (Air stream manifold).

.2 Accuracy: ± 1% of actual duct static pressure.

2.9 STATIC PRESSURE TRANSMITTERS

.1 Requirements:

.1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.

.2 Calibrated span: not to exceed 150% of duct static pressure at maximum flow.

.3 Accuracy: 0.4% of span.

.4 Repeatability: within 0.5% of output.

.5 Linearity: within 1.5% of span.

.6 Deadband or hysteresis: 0.1% of span.

.7 External exposed zero and span adjustment.

.8 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit

2.10 VELOCITY PRESSURE SENSORS

.1 Requirements:

.1 Multipoint static and total pressure sensing element with self-averaging manifold with integral air equalizer and straightener section.

.2 Maximum pressure loss: 37 Pa at 1000 m/s.

.3 Accuracy: ± 1% of actual duct velocity.

2.11 VELOCITY PRESSURE TRANSMITTERS

.1 Requirements:

.1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.

.2 Calibrated span: not to exceed 25% of duct velocity pressure at maximum flow.

.3 Accuracy: 0.4% of span.

.4 Repeatability: within 0.1% of output.

.5 Linearity: within 0.5% of span.

.6 Deadband or hysteresis: 0.1% of span.

.7 External exposed zero and span adjustment.

.8 The unit to have a NPT ½ conduit connection. The enclosure shall be an integral part of the unit.

2.12 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES

.1 Requirements:

.1 Range: as indicated in I/O summaries.

.1 Pressure sensing elements: bourdon tube, bellows or diaphragm type.

.2 Adjustable setpoint and differential.

.3 Switch: snap action type, rated at 120V, 15 amps AC or 24 V DC.

.4 Sensor assembly: to operate automatically and reset automatically when conditions return to normal. Over-pressure input protection to at least twice rated input pressure.

.5 Accuracy: within 2% repetitive switching.

.6 Provide sensor pressure and accuracy ratings:

.1 Hot water: 860 kPa.

.2 High temperature water: 2700 kPa. Range: 0-2700 kPa. Accuracy: ± 25 kPa.

.3 For fan operation: Range: 0 to 3000 Pa. Adjustable differential: 10 to 300 Pa.

.7 Provide sensors with isolation valve and snubber between sensor and pressure source on liquid service.

.8 Sensors on steam and high temperature hot water service: provide pigtail syphon.

2.13 TEMPERATURE SWITCHES

.1 Requirements:

.1 Temperature sensor: liquid, vapour or bimetallic type. Operate automatically. Reset automatically, except as follows:

.1 Freeze protection: manual reset. Optional if software does not auto restart.

.2 Fire detection: manual reset. Optional if software does not auto restart.

.3 Duct Heater: high limit manual reset in addition to automatic reset.

.2 Adjustable setpoint and differential.

.3 Accuracy: ± 1°C.

.4 Snap action rating: 120V, 15 amps or 24V DC as required. Switch to be DPST for hardwire and EMCS connections.

.5 Type as follows:

.1 Room: for wall mounting on standard electrical box with or without protective guard as indicated.

.2 Duct, general purpose: insertion length = 460 mm.

.3 Thermowell: stainless steel, with compression fitting for NPS 3/4 thermowell. Immersion length: 100 mm.

.4 Freeze detection: continuous element with 6000 mm insertion length, duct mounting, to detect coldest temperature in any 300 mm length.

.5 Strap-on: with helical screw stainless steel clamp.

2.14 TANK LEVEL SWITCHES

.1 Requirements:

.1 Indicate high/low water level and to alarm.

.2 For mounting on top of tank.

.3 Maximum operating temperature: 120°C.

.4 Mechanical switch or snap action contacts rated 15 amp at 120 V.

.5 Adjustable setpoint and differential.

2.15 SOLENOID CONTROL AIR VALVES

.1 Coil: 120V AC or 24V DC, as indicated.

.2 Complete with manual over-ride.

.3 Shall have the capacity to pass .07 l/s air at 104 kPa differential.

2.16 AIR PRESSURE GAUGES

.1 Diameter: 38 mm minimum.

.2 Range: zero to two times operating pressure of measured pressure media or nearest standard range.

.3 Requirements:

.1 Double voltage, DPDT, plug-in type with termination base.

.2 Coils: rated for 120V AC or 24V DC. Other voltage: provide transformer.

.3 Contacts: rated at 5 amps at 120 V AC.

.4 Relay to have visual status indication.

2.17 SOLID STATE RELAYS

.1 General:

.1 Relays to be socket or rail mounted.

.2 Relays to have LED Indicator

.3 Input and output Barrier Strips to accept 14 to 28 AWG wire.

.4 Operating temperature range to be -20°C to 70°C.

.5 Relays to be CSA Certified.

.6 Input/Output Isolation Voltage to be 4000 VAC at 25°C for 1 second maximum duration.

.7 Operational frequency range, 45 to 65 HZ.

.2 Input:

.1 Control voltage, 3 to 32 VDC.

.2 Drop out voltage, 1.2 VDC.

.3 Maximum input current to match AO (Analog Output) board.

.3 Output.

.1 AC or DC Output Model to suit application.

2.18 CURRENT TRANSDUCERS

.1 Requirements:

.2 Purpose: combined sensor/transducer, to measure line current and produce proportional signal in one of following ranges:

.1 4-20 mA DC.

.2 0-1 volt DC.

.3 0-10 volts DC.

.4 0-20 volts DC.

.3 Frequency insensitive from 10 - 80 hz.

.4 Accuracy to 0.5% full scale.

.5 Zero and span adjustments. Field adjustable range to suit motor applications.

.6 Adjustable mounting bracket to allow for secure/safe mounting inside MCC.

2.19 CURRENT SENSING RELAYS

.1 Requirements:

.1 Suitable to detect belt loss or motor failure.

.2 Trip point adjustment, output status LED.

.3 Split core for easy mounting.

.4 Induced sensor power.

.5 Relay contacts: capable of handling 0.5 amps at 30 VAC / DC. Output to be NO solid state.

.6 Suitable for single or 3 phase monitoring. For 3-Phase applications: provide for discrimination between phases.

.7 Adjustable latch level.

2.20 CONTROL DAMPERS

.1 Construction: blades, 152 mm wide, 1219 mm long, maximum. Modular maximum size, 1219 mm wide x 2438 mm high. Multiple sections to have stiffening mullions and jack shafts.

.2 Materials

.1 Frame: 2.3 mm minimum thickness galvanized steel.

.2 Blades: galvanized steel with two sheets 0.5 mm thick or otherwise reinforced to ensure specified low leakage when fully closed.

.3 Bearings: oil impregnated sintered bronze. Provide thrust bearings for vertical blades.

.4 Linkage and shafts: zinc plated steel.

.5 Seals: replaceable neoprene or stainless steel spring on sides, top, bottom of frame, along all blade edges and blade ends.

.3 Performance: minimum damper leakage meets or exceed AMCA Standard 500-D ratings.

.1 Size/Capacity: refer to damper schedule

.2 25 L/s/m^2 maximum allowable leakage against 1000 Pa static pressure for outdoor air and exhaust air applications.

.3 Temperature range: -40°C to +100°C.

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

.5 Jack shafts:

.1 25 mm diameter solid shaft, constructed of corrosion resistant metal complete with required number of pillow block bearings to support jack shaft and operate dampers throughout their range.

.2 Include corrosion resistant connecting hardware to accommodate connection to damper actuating device.

.3 Install using manufacturers installation guidelines.

.4 Use same manufacturer as damper sections.

2.21 ELECTRONIC CONTROL DAMPER ACTUATORS

.1 Requirements:

.1 Direct mount proportional type as indicated.

.2 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated.

.3 Operator: size to control dampers against maximum pressure and dynamic closing/opening pressure, whichever is greater.

.4 Power requirements: 5 VA maximum at 24 V AC.

.5 Operating range: 0 - 10 V DC or 4 - 20 mA DC.

.6 For VAV box applications floating control type actuators may be used.

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

2.22 CONTROL VALVES

.1 Body: globe style, characterized ball.

.1 Flow characteristic as indicated on control valve schedule: linear, equal percentage, quick opening.

.2 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.

.3 Normally open, normally closed, as indicated.

.4 Two and three port, as indicated.

.5 Leakage rate ANSI class IV, 0.01% of full open valve capacity.

.6 Packing easily replaceable.

.7 Stem, stainless steel.

.8 Plug and seat, stainless steel, brass, bronze.

.9 Disc, replaceable, material to suit application.

.10 NPS 2 and under:

.1 Screwed National Pipe Thread (NPT) tapered female connections.

.2 Valves to ANSI Class 250, valves to bear ANSI mark.

.3 Range-ability 50:1 minimum.

.11 NPS 2 and larger:

.1 Flanged connections.

.2 Valves to ANSI Class 150 or 250 as indicated, valves to bear ANSI mark.

.3 Range-ability 100:1 minimum.

.2 Butterfly Valves NPS 2 and larger:

.1 Body: for chilled water ANSI Class 150 cast iron installed in locations as indicated. For steam and heating water ANSI Class 150 carbon steel.

.2 End connections to suit flanges that are ANSI Class 150.

.3 Extended stem neck to provide adequate clearance for flanges and insulation.

.4 Pressure limit: bubble tight sealing to 170 kilopascals.

.5 Disc/vane: 316 stainless steel, aluminum bronze to ASTM B148.

.6 Seat: for service on chilled water PTFE (polytetrafluoroethylene), EPDM (ethylene propylene diene monomer). For service on steam and heating water PTFE, RTFE (reinforced PTFE).

.7 Stem: 316 stainless steel.

.8 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.

.9 Flow characteristic linear.

.10 Maximum flow requirement as indicated on control valve schedule.

.11 Maximum pressure drop as indicated on control valve schedule: pressure drop not to exceed one half of inlet pressure.

.12 Normally open; Normally closed, as indicated.

.13 Valves are to be provided complete with mounting plate for installation of actuators.

2.23 ELECTRONIC / ELECTRIC VALVE ACTUATORS

.1 Requirements:

.1 Construction: steel, cast iron, aluminum.

.2 Control voltage: 0-5, 0-10, 2-10V DC, or 4-20 mA.

.3 Positioning time: to suit application, 90 sec maximum.

.4 Fail to normal position as indicated.

.5 Scale or dial indication of actual control valve position.

.6 Size actuator to meet requirements and performance of control valve specifications.

.7 For interior and perimeter terminal heating and cooling applications floating control actuators are acceptable.

.8 Minimum shut-off pressure: refer to control valve schedule.

2.24 WATTHOUR METERS AND CURRENT TRANSFORMERS

.1 Requirements:

.1 Include three phases, test and terminal blocks for watthour meter connections and connections to FID for monitoring of current. Provide three potentiometer transformers for 600 V 4 wire systems for watthour meter use. Accuracy: ± 0.25% of full scale. For chiller applications: To have instantaneous indicator with analog or digital display.

.2 Watthour meter sockets: to ANSI C12.7.

.3 Potential and current transformers: to ANSI/IEEE C57.13.

.4 Potential transformers: provide two primary fuses.

.5 Demand meters: configure to measure demand at 15 minute intervals.

2.25 SURFACE WATER DETECTORS

.1 Requirements:

.1 Provide alarm on presence of water on floor.

.2 Expendable cartridge sensor.

.3 Internal waterproof switch.

.4 One set of dry contacts 2 amps at 24 V.

.5 Unaffected by moisture in air.

.6 Self-powered.

2.26 PANELS

.1 Either free-standing or wall mounted enameled steel cabinets with hinged and key-locked front door.

.2 To be modular multiple panels as required to handle requirements with additional space to accommodate future capacity as required by Department's Representative without adding additional cabinets.

.3 Panels to be lockable with same key.

2.27 WIRING

.1 In accordance with Division 26.

.2 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.

.3 Wiring must be continuous without joints.

.4 Sizes:

.1 Field wiring to digital device: #18AWG or 20AWG stranded twisted pair.

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

Part 3 Execution

3.1 INSTALLATION

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

.2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.

.3 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.

.4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.

.5 Firestopping: provide space for firestopping in accordance with Section 07 84 00 - Firestopping. Maintain fire rating integrity.

.6 Electrical:

.1 Complete installation in accordance with Section 26 05 00 - Common Work Results for Electrical.

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

.3 Refer to electrical control schematics included as part of control design schematics on drawings and in Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation. Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by Departmental Representative before beginning Work.

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

.5 Install communication wiring in conduit.

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

.2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.

.3 Maximum conduit fill not to exceed 40%.

.4 Design drawings do not show conduit layout.

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

.7 VAV Terminal Units: supply, install and adjust as required.

.1 Air probe, actuator and associated vav controls.

.2 Tubing from air probe to dp sensor as well as installation and adjustment of air flow sensors and actuators.

.3 Co-ordinate air flow adjustments with balancing trade.

3.2 TEMPERATURE AND HUMIDITY SENSORS

.1 Stabilize to ensure minimum field adjustments or calibrations.

.2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.

.3 Outdoor installation:

.1 Protect from solar radiation and wind effects by non-corroding shields.

.2 Install in NEMA 4 enclosures.

.4 Duct installations:

.1 Do not mount in dead air space.

.2 Locate within sensor vibration and velocity limits.

.3 Securely mount extended surface sensor used to sense average temperature.

.4 Thermally isolate elements from brackets and supports to respond to air temperature only.

.5 Support sensor element separately from coils, filter racks.

.5 Averaging duct type temperature sensors.

.1 Install averaging element horizontally across the ductwork starting 300 mm from top of ductwork. Each additional horizontal run to be no more than 300 mm from one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.

.2 Wire multiple sensors in series for low temperature protection applications.

.3 Wire multiple sensors separately for temperature measurement.

.4 Use software averaging algorithm to derive overall average for control purposes.

.6 Thermowells: install for piping installations.

.1 Locate well in elbow where pipe diameter is less than well insertion length.

.2 Thermowell to restrict flow by less than 30%.

.3 Use thermal conducting paste inside wells.

.7 Room Temperature Sensors:

.1 Room Temperature sensors for non-inmate areas shall include temperature display and user adjustable set points.

.2 Room Temperature sensors for inmate areas shall be concealed behind a tamper proof plate or enclosure as approved by CSC.

3.3 PANELS

.1 Arrange for conduit and tubing entry from top, bottom or either side.

.2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.

.3 Identify wiring and conduit clearly.

3.4 MAGNEHELIC PRESSURE INDICATORS

.1 Install adjacent to fan system static pressure sensor and duct system velocity pressure sensor as reviewed by Departmental Representative.

.2 Locations: as indicated.

3.5 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES AND SENSORS

.1 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.

.1 Protect sensing elements on steam and high temperature hot water service with pigtail syphon between valve and sensor.

3.6 I/P TRANSDUCERS

.1 Install air pressure gauge on outlet.

3.7 AIR PRESSURE GAUGES

.1 Install pressure gauges on pneumatic devices, I/P, pilot positioners, motor operators, switches, relays, valves, damper operators, valve actuators.

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

3.8 IDENTIFICATION

.1 Identify field devices in accordance with Section 25 05 54 - EMCS: Identification.

3.9 AIR FLOW MEASURING STATIONS

.1 Protect air flow measuring assembly until cleaning of ducts is completed.

3.10 TESTING AND COMMISSIONING

.1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Public Works and Government Services Canada (PWGSC):

.1 MD250005-2009, Energy Monitoring and Control Systems (EMCS) Design Guidelines.

1.2 SEQUENCING

.1 Present sequencing of operations for systems, in accordance with MD250005-2009, Energy Monitoring and Control Systems (EMCS) Design Guidelines.

1.3 ABBREVIATIONS

.1 SA – Supply Air

.2 RA – Return Air

.3 MA – Mixed Air

.4 EA – Exhaust Air

.5 OA – Outdoor Air

.6 SAT - Supply Air Temperature

.7 RAT – Return Air Temperature

.8 MAT – Mixed Air Temperature

.9 OAT – Outdoor Air Temperature

.10 HWS – Heating Water Supply

.11 HWR – Heating Water Return

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 SYSTEM PROTOCOL

.1 The existing controls system is a Metasys MS/TP system.

.2 All new control items shall be on a BACnet MS/TP system parallel to the existing.

.3 Replace existing server with new

3.2 GRAPHICS LIST

.1 Update all equipment tags to reflect tags indicated on the drawing:

.2 Provide updated graphics to reflect the updated system.

3.3 POINT LIST

.1 Existing points noted in bold italics

Description	Type	Alarm	Comments
AH-4E/F, 7G/H, 10ºC/D, 13A/B (Multi-zone) (8 Units one per cell block)			
Return Air Damper Actuators	AO		
Return Air Temperature Sensor	AI		
Return Air Humidity Sensor	AI		
Return Air Filter Pressure Differential Sensor	AI		New
Return Air Coil Valve Actuator	AO		New
Outdoor Air Damper Actuator	AO		
Outdoor Air Temperature Sensor	AI		
Mixed Air Temperature Sensor	AI		
Filter Pressure Differential Sensor	AI		
Supply Fan Start/Stop	DO		
Supply Fan Status	DI		
Mixed air Humidity Sensor	AI		
Hot Deck Coil Valve Actuator	AO		
Hot Deck SAT sensor	AI		
Loop HWS Temp sensor	AI		New
Loop HWR Temp sensor	AI		New
Cold Deck Temperature Sensor	AI		New
AH Heating Coil Pump Start/Stop	DO		
AH Heating Coil Pump Status	DI		New
AH Heating Coil Pump Mixing valve	DO		New
Steam Humidification Valve Actuator	AO		Delete
Low Temperature alarm	DI		Interlocked to stop unit
ZONE Mixing Damper	AO		Type of 4 per unit
ZONE SA Temperature Sensor	AI		Type of 4 per unit
Zone Temperature Sensor	AI		4 existing plus **2 new** in end cells
Cell Block Fire Alarm Status	DI		Zone Alarm/Smoke detection by fire alarm contractor
Upper RA Smoke Damper Status	DI		
Lower RA Smoke Damper Status	DI		
Upper Range Exhaust Fan Status	DI		

Description	Type	Alarm	Comments
Lower Range Exhaust Fan Status	DI		
DELCO "STOP"	DI		
AS-1 (Multi-Zone) Segregation			
Return Fan Status	DI		Delete
Return Air Damper Actuators	AO		New
Return Air Temperature Sensor	AI		Existing
Return Air Humidity Sensor	AI		Existing
Outdoor Air Damper Actuator	AO		Existing
Outdoor Air Temperature Sensor	AI		New
Mixed Air Temperature Sensor	AI		Existing
Filter Pressure Differential Sensor	AI		Existing
Steam Humidification Valve Actuator	AO		Delete
Supply Fan Start/Stop	DO		Existing
Supply Fan Status	DI		Existing
Mixed Air Humidity Sensor	AI		Existing
Heating Coil Valve Actuator	AO		Existing
Heating Coil HWR Temp sensor	AI		New
Heating Coil Pump Start/Stop	DO		Existing
Heating Coil Pump Status	DI		Existing
Hot Deck Temperature Sensor	AI		Existing
Low Temperature alarm	DI		Existing - Interlocked to stop unit
Zone Mixing Damper (Typ 8)	AO		Existing
Zone SA Temperature Sensor (Typ 8)	AI		Existing
Zone Temperature Sensor (Typ 8)	AI		Existing
Cell Block Fire Alarm Status	DI		Existing
Electric Reheat Coil	AO		Control of end cell reheat coils based on cell temperature. Refer to drawing for locations.
AH-1			
Return Air Damper Actuators	AO		New
Return Air Temperature Sensor	AI		New
Return Air Damper End Switch	DI		New
Outdoor Air Damper Actuator	AO		Delete
Outdoor Air Temperature Sensor	AI		Global
Isolation Damper Actuator	AO		New
Filter Pressure Differential Sensor	AI		New

Description	Type	Alarm	Comments
Mixed Air Temperature Sensor	AI		Delete
Bypass Mixing Damper	AO		Delete
Supply Fan Start/Stop	DO		Existing
Supply Fan Status	DI		Existing
Heating Coil Valve Actuator	AO		Existing
Heating Coil Pump Start/Stop	DO		New
Heating Coil Pump Status	DI		New
Heating Coil HWR Temp Sensor	AI		New
Heating Coil Air Temp Sensor	AI		Delete
Supply Temperature Sensor	AI		Existing
Freezing Temperature Stat	DI		Existing
AH-2			
Return Air Damper Actuators	AO		Existing
Return Air Temperature Sensor	AI		Existing
Outdoor Air Damper Actuator	AO		New
Outdoor Air Temperature Sensor	AI		Global
Filter Pressure Differential Sensor	AI		New
Mixed Air Temperature Sensor	AI		Existing
Bypass Mixing Damper	AO		Delete
Supply Fan Start/Stop	DO		Existing
Supply Fan Status	DI		Existing
Heating Coil Valve Actuator	AO		Existing
Heating Coil Pump Start/Stop	DO		Existing
Heating Coil Pump Status	DI		Existing
Heating Coil HWR Temp Sensor	AI		New
Heating Coil Air Temp Sensor	AI		Delete
Supply Temperature Sensor	AI		Existing
Freezing Temperature Stat	DI		Existing
AH-3B, 5, 8, 11, 14, 18, 23, 27, 29, 30, 103 & AS-2			
Return Air Damper Actuators	AO		
Return Air Temperature Sensor	AI		
Return Air Humidity Sensor	AI		
Outdoor Air Damper Actuator	AO		New for 23, 27, 29, 30, 103
Outdoor Air Temperature Sensor	AI		New for 1, 2, 3B, 5, 8, 11, 14, 18, 23, 27, 29, 30, 103, AS-2

Description	Type	Alarm	Comments
Mixed Air Temperature Sensor	AI		
Filter Pressure Differential Sensor	AI		New for 1, 2, 3B
Supply Fan Start/Stop	DO		
Supply Fan Status	DI		
Heating Coil Valve Actuator	AO		
Heating Coil Pump Start/Stop	DO		New for 5, 8, 11, 14
Heating Coil Pump Status	DI		New for 5, 8, 11, 14
Heating Coil Air Temp sensor	AI		Delete from 1, 2, 3B, 5, 8, 11, 14, 18, 23, 29, 30,
Heating Coil HWR Temp	AI		New for 1, 2, 3B, 5, 8, 11, 14, 18, 23, 27, 29, 30, 103 & AS-2
Bypass Mixing Damper	AO		Delete from 1, 2, 3B, 5, 8, 11, 14, 18, 23, 27, 29, 30
Steam Humidification Valve Actuator	AO		Delete from 1, 2, 3B, 5, 8, 11, 14, 18, 23, 27
Supply Temperature Sensor	AI		
Supply Humidity Sensor	AI		Delete from 1, 2, 3B, 5, 8, 11, 14,18, 23, 27
Zone Temperature Sensor	AI		
Supply air Low Temperature alarm	DI		Interlocked to stop unit
AH-6, 9, 12, 15 (Free cooling fan)			
Return Air Damper Actuators	AO		
Outdoor Air Damper Actuator	AO		
Filter Pressure Differential Sensor	AI		
Mixed Air Temperature Sensor	AI		
Supply Fan Start/Stop	DO		
Supply Fan Status	DI		
Supply Temperature Sensor	AI		
Zone Temperature Sensor	AI		
Supply air Low Temperature alarm	DI		Interlocked to stop unit
AH-16 (VAV)			
Return Air Damper Actuators	AO		
Return Air Temperature Sensor	AI		
Return Air Humidity Sensor	AI		
Outdoor Air Damper Actuator	AO		
Outdoor Air Temperature Sensor	AI		Global
Mixed Air Temperature Sensor	AI		
Filter Pressure Differential Sensor	AI		

Description	Type	Alarm	Comments
Supply Fan Start/Stop	DO		
Supply Fan speed	AO		New
Supply Fan Status	DI		
Supply Air Pressure Sensor	AI		Duct mounted sensor located in ceiling space of Administration office.
Supply Air Flow Station	AI		
Heating Coil Valve Actuator	AO		New
Heating Coil Pump Start/Stop	DO		New
Heating Coil Pump Status	DI		New
Heating Coil HWR Temp	AI		New
Cooling Start/Stop	DO		
Cooling Status	DI		
Steam Humidification Valve Actuator	AO		Delete
Supply Temperature Sensor	AI		
Supply Humidity Sensor	AI		Delete
Supply air Low Temperature alarm	DI		
AH-26, 28, 32, 101			
Return Air Damper Actuators	AO		(linked to OA on 101)
Return Air Temperature Sensor	AI		
Return Air Humidity Sensor	AI		Delete from 26
Outdoor Air Damper Actuator	AO		(linked to MA on 26,28)
Outdoor Air Temperature Sensor	AI		New for 28, 32, 101
Mixed Air Temperature Sensor	AI		
Mixed Air Low Temperature Alarm	DI		Delete from 26
Steam Humidification Valve Actuator	AO		Delete from 26
Filter Pressure Differential Sensor	AI		
Supply Fan Start/Stop	DO		
Supply Fan Status	DI		
Heating Coil Valve Actuator	AO		New for 26
Heating Coil Pump Start/Stop	DO		New for 26
Heating Coil Pump Status	DI		New for 26
Heating Coil HWR Temp	AI		New for 26, 28, 32, 101
Cooling Start/Stop	DO		New for 26, 28, 32, 101
Cooling Status	DI		New for 26, 28, 32, 101
Supply Temperature Sensor	AI		
Supply Humidity Sensor	AI		Delete from 26
Zone Temperature Sensor	AI		32 only
Supply air Low Temperature alarm	DI		
AH-3ºC (Gas fired make up air) (all new)			
Outdoor Air Temperature Sensor	AI		Global
Filter Pressure Differential Sensor	AI		
AH Start/Stop	DO		

Description	Type	Alarm	Comments
AH Status	DI		
Supply fan speed	DO		Command to AH for fan speed.
F-13(Hood exhausts)	DI		Fan status.
EF-218 General exhaust (50%)	DO		Hard wired interlock with low speed.
EF-218 Status	DI		Fan Status
Air Handler Common Alar,	DI		From factory controller.
Supply Temperature Sensor	AI		
Supply Set Point	AO		
Supply air Low Temperature alarm	DI		
Supply air damper	DO		Wired interlock with air handler
VAV – Terminal			
Zone Temperature Sensor	AI		
Damper Position	AO		
Air Flow	AI		
Supply air temp	AI	Hi/Low	
Reheat Valve	AO		
· Locations as indicated on drawings			
Heating Water System			
End of Line differential pressure	AI		New (Location in West Mechanical Room) Add to graphic for monitoring
Zone valves	AO		(Cabinet, ceiling radiant, unit heaters, duct reheat coils)
Zone Temperature Sensors	AI		
S & D Boiler System			
Boiler 1 Enable	DO		
Boiler 1 Status	AI		Via BACnet
Pump 1 Control (Speed)	AO		
Pump 1 Status	DI		
Boiler 1 HWS temperature sensor	AI		
Common HWR temperature sensor	AI		
Boiler 1 Enable	DO		
Boiler 2 Status	AI		Via BACnet
Pump 2 Control (Speed)	AO		
Pump 2 Status	DI		
Boiler 2 HWS temperature sensor	AI		
Outdoor air temperature sensor	AI		
Common HWS Set Point	AI		
Terminal Differential Pressure sensor	AI		
Pressure bypass valve actuator	AO		
System Static Pressure	AI		
Boiler system points Via BACnet to Boiler Controller for monitoring. Include: · Boiler status · Firing rate · Common alarm			

Description	Type	Alarm	Comments
Branch Booster Pumps (Serving systems P-214B, 216B, 217A, 218A, 220A, 223, 225B, 227B, 228A, 229A)			
Booster Pump Start/Stop	DO		
Booster Pump 2 Status	DI		
Room Temperature Sensors and Heating Terminals			
Room Temperature Sensor	AI		
Room Temperature Set point	AI		
Occupancy Sensor	DI		
Occupancy Override	DI		
Heating Terminal Valve	AO		
Locations as indicated on drawings			
Server Room Cooling			
Room Temperature Sensor	AI	Hi/Low	
CRAC Status	DI		Via BACNet Connection
CRAC Rack Temperature	AI		Via BACNet Connection
CRAC Rack Temperature Set point	AI		Via BACNet Connection
CRAC Humidity	AI		Via BACNet Connection
CRAC Dirty Filter	DI		Via BACNet Connection
CRAC Common Alarm	DI		Via BACNet Connection
Air Conditioner (AC) On/off	DO		Via BACNet Connection
AC Dirty Filter	DI		Via BACNet Connection
AC Set-point	AI		Via BACNet Connection
AC Alarm	DI		Via BACNet Connection
West Mechanical Room			
Temperature Sensor	AI		
West Mechanical Room intake Louvre 1	DO		
West Mechanical Room intake Louvre 2	DO		
West Mechanical Room intake Louvre 3	DO		
Fan 82 Status	DI		
Fan 82 Enable	DO		
Fan 83 Status	DI		
Fan 83 Enable	DO		

3.4 CONTROL SEQUENCES

.1 Program EMCS software to achieve the following sequences of operation.

.2 Existing sequences on existing controls system shall remain unless noted in the following sections.

3.5 AH-4E/F, 7G/H, 10ºC/D, 13A/B Cell Living Air Handler Units -Multi-zone

.1 General

.1 The 4 existing units serving the 8 cell blocks are being replaced with 8 units, one for each cell block. The Number of zones have not changed. The smoke control system is modified and a reheat coil is being added to the end cell zone along with a concealed room temperature sensor.

.2 This system provides heating and ventilation to the Cell Block living units.

.3 The system includes:

.1 A mixed air constant volume multi-zone air handler as per air handler schematic shown on drawings.

.2 Heating loop pump

.3 Two (upper and lower) end of range exhaust fans for smoke removal with interlocked dampers.

.4 Return Air Smoke control dampers.

.4 The air handler runs continuously all year long in

.1 Normal - Occupied/ Unoccupied mode or

.2 Smoke/Fire Alarm mode.

.2 Stopped mode

.1 When the system is stopped the supply fan is deenergized and the OA damper and RA damper are closed.

.2 Multizone dampers will stay in the last position.

.3 The heating coil circulating pump is off

.4 The mixing valve for the heating coil circuit is deenergized open

.5 The control valves for the heating coils are deenergized open

.3 Start-Up mode

.1 The air handler will be activated via BMS. Upon activation, the R/A damper shall open fully and the supply fan will only start when the R/A damper is fully open in full recirculation mode.

.2 The heating coil circulating pump will be activated when the OA temperature falls below 20ºC (adj.)

.4 Normal Operation

.1 Once the supply fan status indicates operation it will operate continuously.

.2 After 1 minute (adjustable) the unit will go into occupied mode and the RA and OA damper (mixing dampers) will ramp open to minimum OA position over a 5 min period (adjustable). The minimum OA damper position shall be established in coordination with the air balancer. When the operator switched the unit in to unoccupied mode the mixing dampers will go to full recirculation.

.3 The MA is the air to the cold deck. The RA reheat coil will modulate to maintain a cold deck temperature set point of 17.C (Adjustable)

.4 The unit will go into free-cool mode when the cold deck temperature is higher than the cold deck set point for more than 3 mins (adjustable) and when there is no call for heat. Free cool shall be locked out when the OAT is below 14ºC (adj.). In free-cool mode the RA reheat coil will be closed and the mixing dampers will modulate to maintain cold set point. If the OAT is higher than RAT the mixing dampers will go back to minimum position.

.5 The hot deck coil will modulate to maintain a hot deck supply temperature based on an adjustable linear OAT reset of:

OAT	Hot Deck Setpoint
-30ºC	40ºC
22 C	28ºC

.6 The Air handler heating pump will energize upon call for heat from any of the zone temperature sensors and or when the OAT is less than 19ºC (Adjustable)

.7 Zone control: Each multizone damper will modulate to maintain the corresponding zone temperature set point.

.5 Alarm Modes

.1 A freeze stat located up stream of the hot deck coil shall shut down the unit if the temperature falls below 3ºC. A manual reset will be required.

.2 Low Air Temperature Alarm: If the Cold Deck temperature is below 10ºC (Adj) or the hot deck SA temperature is below 10ºC (Adj) then the MA dampers will reduce the OA flow to half of the balanced minimum OA value and initiate a low temperature alarm. When the alarm is cleared, the unit will return to normal operation. If the MA temperature falls below 3ºC then the air handling unit will go into stopped mode.

.3 Filter Alarm: When the pressure differential across the filter exceeds 180 Pa (adj.) an filter alarm signal is sent to the BMS.

.6 DELCO Controls Modes

.1 The DELCO control system will be revised to have the following states per cell block:

.1 Cell Block Ventilation Stop

.2 Upper Range Purge.

.3 Lower Range Purge

.2 The DELCO shall provide contacts/relays for these states for connection by controls contractor.

.3 The STOP status shall be interlocked with both upper and lower RA smoke control dampers and close on STOP status. The STOP status shall prompt the associated Air handler to go in to “Stopped” mode by BMS. When the Stop mode is deactivated, the Smoke Dampers shall open and the air handler will reactivate.

.4 The Range Purge state shall be interlocked with the associated Range Exhaust and Smoke Damper. Upon activation, the range Smoke damper will close and the Range Exhaust shall energize when the exhaust damper is fully open. The air handler will continue to operate normally. The purge fan status will be monitored by the BMS.

.5 Purge mode shall be activated by a signal from the DELCO Alarm system. Once activated the DELCO Alarm mode will end, the air handling unit will be signaled to start operating in normal mode and the end of run exhaust fans shall be energized via direct interlock with the Delco System, while the return fire/smoke dampers in each level of the cell block shall remain closed via a direct interlock

with the DELCO alarm system. A stop purge signal from the DELCO alarm system shall stop the end of run exhaust fans and open the fire/smoke dampers in the return air openings. The air handling unit shall remain in normal operating mode.

.7 Smoke control refer to schematic shown on drawings and the following.

.1 The return air openings from each level of the cell block is equipped with a combination smoke and fire damper with smoke detection. Upon detection of smoke in these ducts the damper shall close and the fire alarm will activate.

.2 A fire alarm for the cell block zone shall shut down the air handler via interlock relay to the starter. The system will reactivate in start-up up mode when the fire alarm is cleared.

3.6 AS-1 Cell Living Air Handler Units

.1 General

.1 This system provides heating and ventilation to the Cell Block living units.

.2 The system includes:

.1 A mixed air constant volume multi-zone air handler as per air handler schematic shown on drawings.

.2 Heating loop pump

.3 Two (upper and lower) end of range exhaust fans for smoke removal with interlocked dampers.

.4 Return Air Smoke control dampers.

.3 The air handler runs continuously all year long in

.1 Normal - Occupied/ Unoccupied mode or

.2 Smoke/Fire Alarm mode.

.2 Stopped mode

.1 When the system is stopped the supply fan is deenergized and the OA damper and RA damper are closed.

.2 Multizone dampers will stay in the last position.

.3 The heating coil circulating pump is off

.4 The mixing valve for the heating coil circuit is deenergized open

.5 The control valves for the heating coils are deenergized open

.3 Start-Up mode

.1 The air handler will be activated via BMS. Upon activation, the R/A damper shall open fully and the supply fan will only start when the R/A damper is fully open in full recirculation mode.

.2 The heating coil circulating pump will be activated when the OA temperature falls below 18ºC (adj.)

.4 Normal Operation

.1 Once the supply fan status indicates operation it will operate continuously.

.2 After 1 minute (adjustable) the unit will go into occupied mode and the RA and OA damper (mixing dampers) will ramp open to minimum OA position over a 5 min period (adjustable). The minimum OA damper position shall be established in coordination with the air balancer. When the operator switched the unit in to unoccupied mode the mixing dampers will go to full recirculation.

.3 The MA is the air to the cold deck. The RA reheat coil will modulate to maintain a cold deck temperature set point of 17.C (Adjustable)

.4 The unit will go into free-cool mode when the cold deck temperature is higher than the cold deck set point for more than 3 mins (adjustable) and when there is no call for heat. Free cool shall be locked out when the OAT is below 14ºC (adj.). In free-cool mode the RA reheat coil will be closed and the mixing dampers will modulate to maintain cold set point. If the OAT is higher than RAT the mixing dampers will go back to minimum position.

.5 The hot deck coil will modulate to maintain a hot deck supply temperature based on an adjustable linear OAT reset of:

OAT	Hot Deck Setpoint
-30ºC	40ºC
22 C	25ºC

.6 The Air handler heating pump will energize upon call for heat from any of the zone temperature sensors and or when the OAT is less than 19ºC (Adjustable)

.7 Zone control: Each multizone damper will modulate to maintain the corresponding zone temperature set point.

.5 Alarm Modes

.1 A freeze stat located up stream of the hot deck coil shall shut down the unit if the temperature falls below 3ºC. A manual reset will be required.

.2 Low Air Temperature Alarm: If the Cold Deck temperature is below 10ºC (Adj) or the hot deck SA temperature is below 10ºC (Adj) then the MA dampers will reduce the OA flow to half of the balanced minimum OA value and initiate a low temperature alarm. When the alarm is cleared, the unit will return to normal operation. If the MA temperature falls below 3ºC then the air handling unit will go into stopped mode.

.3 Filter Alarm: When the pressure differential across the filter exceeds 180 Pa (adj.) an filter alarm signal is sent to the BMS.

.6 Purge Mode

.1 The existing smoke controls system shall be maintained.

.7 Fire Alarm:

.1 Reconnect fire alarm shutdown to supply fan.

3.7 AH-1 (Boiler Room)

.1 General

.1 This system provides tempered combustion air, heating and free cooling ventilation.

.2 The system includes:

.1 Constant volume air handler as per air handler schematic shown on drawings. Heating coil.

.2 Heating coil pump

.3 Relief damper (existing)

.3 The air handler runs all year long in:

.1 Normal – heating / cooling mode or

.2 Smoke/Fire Alarm mode.

.2 Stopped mode

.1 When the system is stopped the supply, fan is deenergized and shut off damper is closed and return damper is opened fully for recirculation.

.2 The heating coil circulating pump is off

.3 The mixing valve for the heating coil circuit is deenergized

.3 Start-Up mode

.1 The air handler will be activated manually via BMS based on combustion equipment status. Upon activation, isolation damper will open and the unit will begin monitoring the room temperature.

.2 The R/A damper shall remain deenergized in the open position.

.3 The heating coil circulating pump will be activated when the OA temperature falls below 18ºC (adj.)

.4 Normal Operation

.1 Once activated the unit will continuously monitor the room temperature to maintain the room cooling and heating set points by cycling the fan and modulating the heating coil or return damper as indicated below.

.2 The RA damper will remain open even when there is no call for heating or cooling to allow combustion air into the space. The room temperature sensor shall be located near the RA intake to sense any cold combustion air coming into the space when the fan is off.

.3 When the room temperature falls below the heating set point 18ºC (adj.) the supply fan will energize and the heating valve will modulate to provide the SA temperature set-point as provided by outdoor reset table. Once the room temperature rises above the heating set point for more than 5 minutes (adj.) the fan will stop.

OAT	SA Set-point
-30ºC	30ºC
15 C	18ºC

.4 When the room temperature rises above the cooling set point 25ºC (adj.) and the outdoor air temperature is less than the cooling set point, the supply fan will operate at full speed and the RA damper will be close to 50% to allow more OA into the space. The RA damper shall energized closed / fail open and it shall have a mechanical end stop that prevents the RA damper from fully closing more than 50%. The additional OA will be relived through the rooms existing relief damper which shall be balanced to minimize any room pressurization. Once the room temperature falls below the cooling set point for more than 1 min (adj.) the RA damper will fully open and after 5 minutes (adj.) the fan will stop.

.5 Alarm Modes

.1 The Low Temp Alarm shall stop the SA fan and close the isolation damper when the SA temp drops below 4ºC or the coil return water temp drops below 5ºC.

.2 A freeze stat located down stream of the heating coil shall shut down the unit and close the isolation damper through interlocks when the supply temperature falls below 3ºC. A manual reset will be required.

.3 The Fire Alarm shall stop the S/A fan, and close the isolation damper through hard wired interlock to the alarm system

.4 Filter Alarm: When the pressure differential across the filter exceeds 180 Pa (adj.) an filter alarm signal is sent to the BMS.

3.8 AH-2 (Laundry Room)

.1 General

.1 This system provides tempered make-up air, heating and free cooling ventilation.

.2 The system includes:

.1 Constant volume air handler as per air handler schematic shown on drawings. Heating coil.

.2 Heating coil pump

.3 Relief damper (existing)

.3 The air handler runs all year long in:

.1 Normal – heating / cooling mode or

.2 Smoke/Fire Alarm mode.

.2 Stopped mode

.1 When the system is stopped the supply, fan is deenergized, the OA damper is closed and return damper is opened fully for recirculation.

.2 The heating coil circulating pump is off

.3 The mixing valve for the heating coil circuit is deenergized

.3 Start-Up mode

.1 The air handler will be activated manually via BMS, upon activation the unit will begin monitoring the room temperature.

.2 The OA damper shall open

.3 The RA damper shall remain deenergized in the open position.

.4 The heating coil circulating pump will be activated when the OA temperature falls below 18ºC (adj.).

.4 Normal Operation

.1 Once activated the unit will maintain the room cooling and heating set points by modulating the heating coil or return damper as indicated below. The OA and RA damper will remain open even when there is no call for heating or cooling to allow make-up air into the space.

.2 When the room temperature falls below the heating set point 20ºC (adj.) the heating valve will modulate to provide the SA temperature set-point based on the outdoor reset table below.

OAT	SA Set-point
-30ºC	35ºC
15ºC	18ºC

.3 When the room temperature rises above the cooling set point 25ºC (adj.) and the outdoor air temperature is less than the cooling set point, the RA damper will modulate to achieve a cooling SA set-point of 18ºC (adj.). The additional OA will be relived through the existing relief damper which shall be balanced to minimize any room pressurization.

.5 Alarm Modes

.1 The Low Temp Alarm shall stop the SA fan and close the isolation damper when the SA temp drops below 4ºC or the coil return water temp drops below 5ºC.

.2 A freeze stat shall shut down the unit and close the isolation damper through interlocks when the supply temperature falls below 3ºC. A manual reset will be required.

.3 The Fire Alarm shall stop the S/A fan, and close the isolation damper through hard wired interlock to the alarm system

.4 Filter Alarm: When the pressure differential across the filter exceeds 180 Pa (adj.) an filter alarm signal is sent to the BMS.

3.9 AH-5, 8, 11, 14

.1 General

.1 This system provides tempered ventilation.

.2 The system includes:

.1 A mixed air constant volume air handler as per air handler schematic shown on drawings.

.2 Heating coil pump

.3 The air handler runs continuously all year long in:

.1 Normal - Occupied/ Unoccupied mode or

.2 Smoke/Fire Alarm mode.

.2 Stopped mode

.1 When the system is stopped the supply fan is deenergized and the OA damper is closed and return damper is opened fully for recirculation.

.2 The heating coil circulating pump is off

.3 The mixing valve for the heating coil circuit is deenergized

.3 Start-Up mode

.1 The air handler will be activated manually via BMS. Upon activation, the supply fan will only start when the R/A damper is fully open in full recirculation mode.

.2 The heating coil circulating pump will be activated when the OA temperature falls below 18ºC (adj.)

.4 Normal Operation

.1 Once the supply fan status indicates operation it will operate continuously.

.2 After 1 minute (adjustable) the unit will go into occupied mode and the RA and OA damper (mixing dampers) will gradually open to minimum OA position over a 1 min period (adjustable). The minimum OA damper position shall be established in coordination with the air balancer. When the operator switched the unit in to unoccupied mode the mixing dampers will go to full recirculation.

.3 The unit will go into free-cool mode when the MA temperature is higher than the SA set point for more than 3 mins (adjustable) and when there is no call for heat. Free cool shall be locked out when the OAT is below 14ºC (adj.). In free-cool mode the mixing dampers will modulate to maintain SA set point. If the OAT is higher than RAT the mixing dampers will go back to minimum position.

.4 The SA heating coil valve will modulate to maintain SA temperature based on an adjustable linear OAT reset of:

OAT	SA Set-point
-30ºC	25ºC
22 C	22ºC

.5 Alarm Modes

.1 The Low Temp Alarm shall stop the SA fan and close the isolation damper when the SA temp drops below 4ºC or the coil return water temp drops below 5ºC.

.2 A freeze stat shall shut down the unit and close the isolation damper through interlocks when the supply temperature falls below 3ºC. A manual reset will be required.

.3 The Fire Alarm shall stop the S/A fan, and close the isolation damper through hard wired interlock to the alarm system

.4 Filter Alarm: When the pressure differential across the filter exceeds 180 Pa (adj.) an filter alarm signal is sent to the BMS.

3.10 AH-2, 3B, 18, 23, 27, 29, 30, 103 & AS-2

.1 General

.1 This system provides tempered ventilation

.2 The system includes:

.1 A mixed air constant volume air handler as per air handler schematic shown on drawings.

.2 Heating coil pump

.3 The air handler runs on an occupancy schedule:

.1 Normal - Occupied/ Unoccupied mode or

.2 Smoke/Fire Alarm mode.

.2 Stopped mode

.1 When the system is stopped the supply fan is deenergized and the OA damper is closed and return damper is opened fully for recirculation.

.2 The heating coil circulating pump is off

.3 The mixing valve for the heating coil circuit is deenergized

.3 Start-Up mode

.1 The air handler will be activated via BMS schedule or manually. Upon activation, the supply fan will only start when the R/A damper is fully open in full recirculation mode.

.2 The heating coil circulating pump will be activated when the OA temperature falls below 18ºC (adj.)

.4 Normal Operation

.1 Once the supply fan status indicates operation it will operate continuously until stopped by BMS schedule or manually.

.2 After 1 minute (adjustable) the unit will go into occupied mode and the RA and OA damper (mixing dampers) will gradually open to minimum OA position over a 1 min period (adjustable). The minimum OA damper position shall be established in coordination with the air balancer. When the operator switches the unit in to unoccupied mode the mixing dampers will go to full recirculation.

.3 The SA heating coil valve will modulate to maintain SA temperature based on an adjustable linear OAT reset of:

OAT	SA Set-point
-30ºC	28ºC
22 C	22ºC

.4 The unit will go into free-cool mode when the MA temperature is higher than the SA set point for more than 3 mins (adjustable) and when there is no call for heat. Free cool shall be locked out when the OAT is below 14ºC (adj.). In free-cool mode the mixing dampers will modulate to maintain SA set point. If the OAT is higher than RAT the mixing dampers will go back to minimum position.

.5 Alarm Modes

.1 The Low Temp Alarm shall stop the SA fan and close the isolation damper when the SA temp drops below 4ºC or the coil return water temp drops below 5ºC.

.2 A freeze stat shall shut down the unit and close the isolation damper through interlocks when the supply temperature falls below 3ºC. A manual reset will be required.

.3 The Fire Alarm shall stop the S/A fan, and close the isolation damper through hard wired interlock to the alarm system

.4 Filter Alarm: When the pressure differential across the filter exceeds 180 Pa (adj.) an filter alarm signal is sent to the BMS.

3.11 AH-28 & 32

.1 General

.1 This system provides tempered ventilation and cooling

.2 The system includes:

.1 A mixed air constant volume air handler as per air handler schematic shown on drawings.

.2 Heating coil pump

.3 DX Cooling coil and condensing unit

.3 The air handler runs continuously all year long in:

.1 Normal - Occupied/ Unoccupied mode or

.2 Smoke/Fire Alarm mode.

.2 Stopped mode

.1 When the system is stopped the supply fan is deenergized and the OA damper is closed and return damper is opened fully for recirculation.

.2 The heating coil circulating pump is off

.3 The mixing valve for the heating coil circuit is deenergized

.4 DX cooling system is deenergized

.3 Start-Up mode

.1 The air handler will be activated via BMS or manually. Upon activation, the supply fan will only start when the R/A damper is fully open in full recirculation mode.

.2 The heating coil circulating pump will be activated when the OA temperature falls below 18ºC (adj.)

.4 Normal Operation

.1 Once the supply fan status indicates operation it will operate continuously.

.2 After 1 minute (adjustable) the unit will go into occupied mode and the RA and OA damper (mixing dampers) will gradually open to minimum OA position over a 1 min period (adjustable). The minimum OA damper position shall be established in coordination with the air balancer. When the operator switches the unit in to unoccupied mode the mixing dampers will go to full recirculation.

.3 The unit will go into free-cool mode when the MAT is higher than the SA set point for more than 3 mins (adjustable) and when there is no call for heat. Free cool shall be locked out when the OAT is below 14ºC (adj.). In free-cool mode the mixing dampers will modulate to maintain SA set point. If the OAT is higher than RAT the mixing dampers will go back to minimum position.

.4 The system will be in cooling mode when the space temperature is above the cooling set point. In cooling mode the heating valve shall close and the DX cooling system shall energize and shall cycle and stage to maintain space temperature set point.

.5 The SA heating coil valve will modulate to maintain SA temperature based on an adjustable linear OAT reset of:

OAT	SA Set-point
-30ºC	25ºC
20 C	22ºC

.5 Alarm Modes

.1 The Low Temp Alarm shall stop the SA fan and close the OA damper when the SA temp drops below 4ºC or the coil water return temp drops below 4ºC.

.2 The Fire Alarm shall stop the S/A fan through hard wired interlock to the alarm system. The BMS shall d-energize DX cooling system, stop the coil circulation pump and close the O/A damper.

.3 Filter Alarm: When the pressure differential across the filter exceeds 180 Pa (adj.) an filter alarm signal is sent to the BMS.

3.12 AH-26 & 101

.1 General

.1 This system provides tempered ventilation with mechanical cooling

.2 The system includes:

.1 A mixed air constant volume air handler as per air handler schematic shown on drawings.

.2 Heating coil pump

.3 DX Cooling coil and condensing unit

.3 The air handler runs on an occupancy schedule:

.1 Normal - Occupied/ Unoccupied mode or

.2 Manual – Override or

.3 Smoke/Fire Alarm mode.

.2 Stopped mode

.1 When the system is stopped the supply fan is deenergized and the OA damper is closed and return damper is opened fully for recirculation.

.2 The heating coil circulating pump is off

.3 The mixing valve for the heating coil circuit is deenergized

.4 DX cooling system is deenergized

.3 Start-Up mode

.1 The air handler will be activated via BMS schedule or manually. Upon activation, the supply fan will only start when the R/A damper is fully open in full recirculation mode.

.2 The heating coil circulating pump will be activated when the OA temperature falls below 18ºC (adj.)

.4 Normal Operation

.1 Once the supply fan status indicates operation it will operate continuously until stopped by BMS schedule or manually.

.2 After 1 minute (adjustable) the unit will go into occupied mode and the RA and OA damper (mixing dampers) will gradually open to minimum OA position over a 1 min period (adjustable). The minimum OA damper position shall be established in coordination with the air balancer. When the operator switches the unit in to unoccupied mode the mixing dampers will go to full recirculation.

.3 The unit will go into free-cool mode when the MAT is higher than the SA set point for more than 3 mins (adjustable) and when there is no call for heat. Free cool shall be locked out when the OAT is below 14ºC (adj.). In free-cool mode the mixing dampers will modulate to maintain SA set point. If the OAT is higher than RAT the mixing dampers will go back to minimum position.

.4 The system will be in cooling mode when the space temperature is above the cooling set point. In cooling mode the heating valve shall close and the DX cooling system shall energize and shall cycle and stage to maintain space temperature set point.

.5 The SA heating coil valve will modulate to maintain SA temperature based on an adjustable linear OAT reset of:

OAT	SA Set-point
-30ºC	25ºC
20 C	22ºC

.5 Alarm Modes

.1 The Low Temp Alarm shall stop the SA fan and close the OA damper when the SA temp drops below 4ºC or the coil water return temp drops below 4ºC.

.2 The Fire Alarm shall stop the S/A fan through hard wired interlock to the alarm system. The BMS shall d-energize DX cooling system, stop the coil circulation pump and close the O/A damper.

.3 Filter Alarm: When the pressure differential across the filter exceeds 180 Pa (adj.) an filter alarm signal is sent to the BMS.

3.13 AH-6, 9, 12 & 15

.1 General

.1 This system provides tempered ventilation and free cooling

.2 The system includes:

.1 A mixed air constant volume air handler as per air handler schematic shown on drawings.

.3 The air handler runs continuously all year long in:

.1 Normal - Occupied/ Unoccupied mode or

.2 Smoke/Fire Alarm mode.

.2 Stopped mode

.1 When the system is stopped the supply fan is deenergized and the OA damper is closed and return damper is opened fully for recirculation.

.3 Start-Up mode

.1 The air handler will be activated manually via BMS. Upon activation, the supply fan will only start when the RA damper is fully open in full recirculation mode.

.4 Normal Operation

.1 Once the supply fan status indicates operation it will operate continuously.

.2 After 1 minute (adjustable) the unit will go into <u>occupied mode</u> and the RA and OA damper (mixing dampers) will gradually open to minimum OA position. The minimum OA damper position shall be established in coordination with the air balancer. When the operator switched the unit in to <u>unoccupied</u> mode the mixing dampers will go to full recirculation.

.3 The RA damper and OA damper shall modulate to maintain a space temperature set point. A minimum supply air limit shall prevent the mixing damper from supplying air less than 10ºC (adj.). If the OAT is higher than the space temperature setpoint the mixing dampers will go back to minimum position.

.5 Alarm Modes

.1 The Low SA Temp Alarm shall close the OA damper and go into full recirculation when the SA temp drops below 4ºC. Once the SAT rises above the SA set point the Low temp alarm shall clear and the unit will go into Normal operation mode.

.2 The Fire Alarm shall stop the S/A fan through hard wired interlock to the alarm system. The BMS shall close the O/A damper.

.3 Filter Alarm: When the pressure differential across the filter exceeds 180 Pa (adj.) an filter alarm signal is sent to the BMS.

3.14 AH-16

.1 General

.1 This system provides ventilation air and variable flow cooling Air

.2 The system includes:

.1 A mixed air variable volume air handler with VFD on the supply fan

.2 as per air handler schematic shown on drawings.

.3 Heating coil pump

.4 DX Cooling coil and condensing unit

.5 Variable Air Volume terminals in each Zone

.3 The air handler runs on an occupancy schedule:

.1 Normal - Occupied/ Unoccupied mode or

.2 Manual – Override or

.3 Smoke/Fire Alarm mode.

.2 Stopped mode

.1 When the system is stopped the supply fan is deenergized and the OA damper is closed and return damper is opened fully for recirculation.

.2 The heating coil circulating pump is off

.3 The mixing valve for the heating coil circuit is deenergized

.4 DX cooling system is deenergized

.3 Start-Up mode

.1 The air handler will be activated via BMS schedule or manually. Upon activation, the supply fan will only start when the R/A damper is fully open in full recirculation mode.

.2 The heating coil circulating pump will be activated when the OA temperature falls below 16ºC (adj.)

.4 Normal Operation

.1 Once the supply fan status indicates operation it will operate continuously until stopped by BMS schedule or manually.

.2 After 1 minute (adjustable) the unit will go into occupied mode with the supply air fan operating at minimum air flow and the RA and OA damper (mixing dampers) will gradually open to minimum OA position over a 1 min period (adjustable). The minimum flow rate and minimum OA damper position shall be established in coordination with the air balancer and set based on minimum flow.

.3 The VAV air terminals will have a minimum air flow set point to provide minimum ventilation to each zone. The VAV terminal shall open when the zone temperature exceeds the zone set point and modulate to maintain the temperature set point.

.4 The supply air fan speed will modulate maintain a minimum supply duct static pressure as established with the air balancers for box max operation. The static set point shall be reset based on VAV flow requirements.

.5 The OA and RA damper shall modulate to maintain OA flow rate set point. The OA flow rate shall be calculated by measuring the OAT RAT MAT and the SA flow rate

.6 The unit will operate the DX cooling system to maintain the SA set point. If there is a call for cooling from any VAV air terminal and the MAT is higher than the SA set point. Once the DX system is operating system will cycle and stage the compressors to maintain the SA set point. The DX system will de-energize if no zones are calling for cooling.

.7 The unit will go into economizer mode when the MAT is higher than the SA set point and the heating valve is closed and when there is a call for cooling. Economizer mode shall be locked out when the OAT is below 6ºC (adj.). In Economizer mode the mixing dampers will modulate to maintain SA set point. If the OAT is higher than RAT the mixing dampers will go back to minimum position.

.8 When in heating mode, MAT<SAT, the heating coil valve will modulate to maintain SAT set point.

.9 The supply air set point shall be based on an outdoor reset:

OAT	SA Set-point
-30ºC	20ºC
0 C	18ºC
28	13ºC

.5 Alarm Modes

.1 The Low SA Temp Alarm shall close the OA damper and go into full recirculation when the SA temp drops below 4ºC. Once the SAT rises above the

SA set point the Low temp alarm shall clear and the unit will go into Normal operation mode.

.2 The Fire Alarm shall stop the S/A fan through hard wired interlock to the alarm system. The BMS shall close the O/A damper.

.3 Filter Alarm: When the pressure differential across the filter exceeds 180 Pa (adj.) an filter alarm signal is sent to the BMS.

3.15 AH-3ºC

.1 General

.1 This system provides tempered ventilation

.2 The system includes:

.1 2 Speed gas indirect fired makeup air unit as per air handler schematic shown on drawings.

.2 A general roof exhaust fan c/w interlocked motorized damper

.3 A fume hood exhaust fan c/w interlocked motorized damper

.4 The air handler low speed setting shall be interlocked with the general exhaust fan EF-218.

.5 The air handler high speed setting shall be interlocked with the fume hood fan F-13.

.3 The air handler runs on an occupancy schedule:

.1 Normal - Occupied/ Unoccupied mode or

.2 Smoke/Fire Alarm mode.

.2 Stopped mode

.1 When the system is stopped the supply fan and burner section is deenergized and the OA damper is closed

.3 Start-Up mode

.1 The air handler will be activated via BMS schedule or manually. Upon activation, the air handler controller and the interlocks with the exhaust fans will engage the fans speed.

.4 Normal Operation

.1 Once the supply fan status indicates operation it will operate continuously until stopped by BMS schedule or manually.

.2 The system will normal run low speed with the general exhaust fan.

.3 Upon activation of the fume hood exhaust, through existing wall switch, the general exhaust fan will de-energize and the fume hood exhaust fan will energize.

.4 The indirect natural gas burner will cycle and modulate to maintain SA temperature based on an adjustable linear OAT reset provided from the BMS.

OAT	SA Set-point

-30ºC	25ºC
18ºC	20ºC

.5 Alarm Modes

.1 The Low Temp Alarm shall stop the S/A fan and close the O/A damper when the S/A temp drops below 4ºC.

.2 The Fire Alarm shall stop the S/A fan and close the O/A damper through hard wired interlock to the alarm system

.3 Filter Alarm: When the pressure differential across the filter exceeds 180 Pa (adj.) an filter alarm signal is sent to the BMS.

3.16 S&D Boiler system

.1 General

.1 This system provides hydronic heating water to existing heating terminals and Air Handlers AS-1 and AS-2. The system is a primary flow condensing system.

.2 The system includes:

.1 Two High mass gas fired hydronic boilers with integral burner controls. Each sized for 100% of the heating load.

.2 Two System circulating pumps with VFD speed control. One for each boiler and each sized for 100% of the heating load.

.3 The boiler and pumps runs on:

.1 Normal – Signal from BMS

.2 Manual – Override or

.3 Smoke/Fire Alarm mode.

.2 Stopped mode

.1 When the system is stopped, the boilers are deenergized as well as the system pumps and branch circulators.

.3 Start-Up mode

.1 The BMS shall provide a start signal to the lead boiler controller.

.2 The BMS shall provide boiler start signal based on supply temperature reset.

.3 All boilers system circulators and branch pumps shall be overridden by the OAT. If the OAT is less than 15ºC (adj) and the lowest zone temp sensor is more than 1ºC below set point the lead boiler shall be enabled. If the OAT is less than 5ºC (adj) the lead boiler and pump shall always be enabled

.4 The BMS shall provide boiler/pump staging control which shall alternate lead and stand-by statues monthly(adj).

.5 Once enabled the boiler controller shall first start the system circulators in minimum speed.

.6 The boiler shall be interlocked with its respective system circulator so that the boiler will not operate without flow.

.7 Once flow Is proven the boiler will go into normal operation

.4 Normal Operation

.1 Once the heating system is enabled the lead boiler and system circulation pump shall modulate and cycle as required to maintain system set-points.

.2 The lead system pump will operate by minimum speed and modulate its speed to maintain a constant pressure differential of [30kPa] (adj) between the supply and return at the terminal of the longest run. This shall be set in coordination with the hydronic balancer.

.3 Minimum speed of the pumps shall be set to ensure the required minimum water flow rates for the boiler are met as coordinated by with the TAB (0.32L/s).

.4 A modulating bypass valve shall provide HWS flow to AS-1 & 2 coil loops as the system zone valves close.

.1 The bypass valve shall close if the pump flow is over 1.1L/s (adj.)

.2 The bypass shall modulate to maintain a minimum return water temperature of no less more than 39ºC (adj.) less than the supply water temperature.

.5 The boilers integral controller will cycle and modulated the gas burner as required to maintain the HWS temperature set point provided be the BMS

.6 The BMS shall provide HWS temperature based on outdoor reset (adj).

OAT	HWS Set-point
-30ºC	93ºC (200ºF)
0ºC	65.5ºC (150ºF)
18ºC	38ºC (100ºF)

.7 The BMS shall further reset the HWS temperature plus or minus 5ºC (adj) per the average space heating demand.

.8 When the lead boilers firing rate rises above 95% (adj) for more than 10min (adj) the standby boiler and pump shall go into Startup mode and run in parallel with the lead boiler at a minimum 48% (adj) flow rate. Once both boilers firing rate falls below 45%(adj) for more than 5min (adj) the standby boiler shall be disabled and after 5min (adj) the circulator shall be disabled.

.5 Alarm Modes

.1 Upon failure of the lead boiler or associated system pump and alarm shall be generated at the BMS graphics and the Standby boiler and system pump shall become the lead.

.2 A pressure sensor shall monitor the heating system pressure. If the pressure increases above 120kPa or decreases below 25kPa and alarm shall be generated at the BMS graphics

.3 Provide general boiler alarm point on the BMS graphics to indicate common alarm from boiler system via BACnet connection to the boiler system.

3.17 Hydronic heating system branch booster pump (P-214B, 216B, 217A, 218A, 220A, 223, 225B, 227B, 228A, 229A)

.1 General

.1 These systems boost the pressure to hydronic heating branches of specific areas on the central hydronic heating system. This provide the adequate heating water to these areas as required.

.2 The system includes:

.1 Constant volume hydronic booster pump

.2 Pressure bypass valve

.3 The boiler and pumps runs on:

.1 Normal – Signal from BMS

.2 Manual – Override or

.3 Alarm mode.

.2 Stopped mode

.1 When the system is stopped, pump is deenergized

.3 Start-Up mode

.1 The BMS shall provide a start signal to the pump

.2 The BMS shall provide pump start signal only if the boiler system is energized and OAT is less than 18ºC (adj) or there is a call for heating from any of the control valves in the area being serviced.

.4 Normal Operation

.1 Once the branch booster pump is enabled it will operate continuously.

.2 A differential pressure bypass valve open when differential pressure reaches the adjustment setting. Differential Pressure bypass valve shall be set in coordination with the TAB.

.5 Alarm Modes

.1 Upon pump failure, an alarm signal will be sent to the BMS

3.18 AH-48, 49, 50, 51

.1 Replace existing Pneumatic valves actuator(s) with new electric actuators and connect back to existing point.

.2 The existing points and sequence remain unchanged.

3.19 West Mechanical Room Ventilation

.1 Replace existing Pneumatic actuator(s) with new electric actuators and connect to BMS.

.2 Added EF-82 and EF-83 to BMS

3.20 Fan -1 (Administration ceiling)

.1 Fan F-1 is being replaced. Existing controls is to remain.

3.21 HEATING WATER SYSTEM

.1 Replace existing Pneumatic actuator(s) with new electric actuators and connect back to existing point.

.2 The existing points and sequence remain unchanged.

3.22 Reheat coils

.1 Reheat coils shall modulate valve or electric heating coil to maintain room temperature set point of associated room temperature sensor.

3.23 RTUs

.1 Reconnect existing points from replacement RTU(s) into EMCS.

.1 Refer to existing controls shop drawings.

.2 The existing points and sequence remain unchanged.

.3 RTU(s), points shall be shown on area graphics.

3.24 SERVER ROOM COOLING

.1 The air conditioning systems provide cooling, humidification and dehumidification for the local space. Provide all the programming, graphics, alarming, etc. for the supervisory functions for these systems from the DDC system via the BACnet interface connection. In the event of a DDC system failure, the air conditioning systems shall continue to operate on their local controls using the last know good values for all setpoints.

.2 The Controls Contractor shall supply and install all wiring, and install all control devices for the Split System Computer Room Air Conditioning Systems (supplied by others). See Mechanical specifications and drawings for locations and details.

.3 All setpoints for temperature, humidity, scheduling, etc. shall be approved through the Shop Drawing process.

.4 Provide a room temperature sensor for monitoring of Server Room temperature.

.1 High Temperature Alarm: 27ºC.

.2 Low Temperature Alarm: 19ºC.

END OF SECTION