Part 1 General

1.1 SUMMARY

.1 Related Requirements

.1 Section 23 08 01 – Performance Verification Mechanical Piping Systems

.2 Section 23 08 02 – Cleaning and Start-up of Mechanical Piping Systems

.3 Section 25 05 01 – EMCS: General Requirements

1.2 DEFINITIONS

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

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

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

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

.1 Automatic initiation of back-up was accomplished.

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

.2 Failure of communications link provided that:

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

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

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

.1 System recorded said fault.

.2 Equipment defaulted to fail-safe mode.

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

1.3 DESIGN REQUIREMENTS

.1 Confirm with Departmental Representative that Design Criteria and Design Intents are still applicable.

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

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Section 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.

1.5 CLOSEOUT SUBMITTALS

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

1.6 COMMISSIONING

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

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

.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 Contractor to plan for fine tuning of all parameters at least five times and follow with a re-test each time.

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

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

.7 Load system with project software.

.8 Perform tests as required.

1.7 COMPLETION OF COMMISSIONING

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

1.8 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION

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

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 1month prior to tests.

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

.5 Application: to conform to normal industry standards.

Part 3 Execution

3.1 PROCEDURES

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

.2 Commission each system using procedures prescribed by the Commissioning Agent.

.3 Commission integrated systems using procedures prescribed by Commissioning Agent.

.4 Debug system software.

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

.6 Contractor to plan for fine tuning of all parameters at least five times and follow with a re-test each time.

3.2 FIELD QUALITY CONTROL

.1 Pre-Installation Testing.

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

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

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

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

.5 Additional instruments to include:

.1 DP transmitters.

.2 VAV supply duct SP transmitters.

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

.6 In addition to test equipment, provide inclined manometer, digital micro-manometer, milli-amp meter, source of air pressure infinitely adjustable between 0 and 1000 Pa, 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 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 setpoint.

.2 Completion Testing.

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

.2 Include following activities:

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

.2 Verify each A-to-D convertor.

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

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

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

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

.7 Test operating software.

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

.9 Verify each CDL including energy optimization programs.

.10 Debug software.

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

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

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

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

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

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

.4 Commissioning to commence during final startup testing.

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

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

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

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

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

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

.1 Prior to beginning of 30 day test demonstrate that operating parameters (setpoints, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.

.1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.

.2 Test to last at least 30 consecutive 24-hour days.

.3 Tests to include:

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

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

.4 System will be accepted when:

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

.2 Requirements of Contract have been met.

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

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

.5 Departmental Representative to verify reported results.

3.3 ADJUSTING

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

3.4 DEMONSTRATION

.1 Demonstrate to Departmental Representative operation of systems including sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lock-outs in accordance with Section 01 79 00 - Demonstration and Training.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Related Requirements

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

1.2 DEFINITIONS

.1 CDL - Control Description Logic.

.2 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 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 one week after completion of training program that training has been satisfactorily completed.

1.4 QUALITY ASSURANCE

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

1.5 INSTRUCTIONS

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

.2 Training to be project-specific.

1.6 TIME FOR TRAINING

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

1.7 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).

1.8 TRAINING PROGRAM

.1 To be in 2 phases over 6-month period.

.2 Phase 1: 2 day program to begin before 30 day test period at time mutually agreeable to Contractor, Departmental Representative.

.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, CDL's for each system, and elementary preventive maintenance.

.3 Phase 2: 2 day program to begin after second commissioning phase.

.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 2 days training within 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 2 days training within 5 day period in following subjects:

Software and architecture:
Application programs:
Controller programming:
Trouble shooting and debugging:
Colour graphic generation:

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)/The Instrumentation, Systems and Automation Society (ISA).

.1 ANSI/ISA 5.5-1985, Graphic Symbols for Process Displays.

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

.1 ANSI/IEEE 260.1-1993, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).

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

.1 ASHRAE STD 135-2012, BACNET - Data Communication Protocol for Building Automation and Control Network.

.4 Canadian Standards Association (CSA International).

.1 CAN/CSA-Z234.1-89(R1995), Canadian Metric Practice Guide.

.5 Consumer Electronics Association (CEA).

.1 CEA-709.1-B-2002, Control Network Protocol Specification.

.6 Department of Justice Canada (Jus).

.1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.

.2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.

.7 Electrical and Electronic Manufacturers Association (EEMAC).

.1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.

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

.1 Material Safety Data Sheets (MSDS).

.9 Transport Canada (TC).

.1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.2 DESIGNATED CONTRACTOR

.1 Hire the services of Régulvar or its authorized representative to complete the work of all EMCS sections.

1.3 ACRONYMS AND ABBREVIATIONS

.1 Acronyms used in EMCS:

.1 AEL - Average Effectiveness Level.

.2 AI - Analog Input.

.3 AIT - Agreement on International Trade.

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

1.4 DEFINITIONS

.1 Point: may be logical or physical.

.1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.

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

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

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

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

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

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

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

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

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

.1 AI (analog input).

.2 AO (analog output).

.3 DI (digital input).

.4 DO (digital output).

.5 Pulse inputs.

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

.1 Printouts: to ANSI/IEEE 260.1.

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

1.5 SYSTEM DESCRIPTION

.1 Refer to control drawings for system architecture.

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

.1 Building Controllers.

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

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

.4 Field control devices.

.5 Software/Hardware complete with full documentation.

.6 Complete operating and maintenance manuals.

.7 Training of personnel.

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

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

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

.3 Design Requirements:

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

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

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

.4 Provide utility power to EMCS 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 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, field related changes, alarms as defined in CDL's or assigned limits (i.e. commands relating to day-to-day operating functions and not related to system modifications, additions, or logic re-definements).

.2 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points. To be in English at specified OWS and to be able to operate one terminal in English and second in French. Point name expansions in both languages.

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

1.6 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit for review:

.1 Equipment list and systems manufacturers within 10 days after award of contract.

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

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

1.7 QUALITY ASSURANCE

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

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

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

.4 Health and Safety:

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

1.8 DELIVERY, STORAGE AND HANDLING

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

.2 Waste Management and Disposal:

.1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.

.4 Separate for recycling and place in designated containers Metal waste in accordance with Waste Management Plan.

.5 Place materials defined as hazardous or toxic in designated containers.

.6 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal, regulations.

.7 Label location of salvaged material's storage areas and provide barriers and security devices.

.8 Ensure emptied containers are sealed and stored safely.

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

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

1.9 EXISTING- CONTROL COMPONENTS

.1 Utilize existing control wiring piping as indicated.

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

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

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

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

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

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

.4 Non-functioning items:

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

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

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

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

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

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

.3 Responsibility for existing devices terminates upon final acceptance of 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 MATERIALS

.1 There is an existing Delta system presently installed in the building. All materials must be selected to ensure compatibility with the existing Delta system.

2.2 EQUIPMENT

.1 Control Network Protocol and Data Communication Protocol: ASHRAE STD 135.

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

2.3 ADAPTORS

.1 Provide adaptors between metric and imperial components.

Part 3 Execution

3.1 MANUFACTURER'S RECOMMENDATIONS

.1 Installation: to manufacturer's recommendations.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

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

1.2 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 Names of sub-contractors and site-specific key personnel.
- .6 Sketch of site-specific system architecture.
- .7 Specification sheets for each item including memory provided, programming language, speed, type of data transmission.
- .8 Descriptive brochures.
- .9 Sample CDL and graphics (systems schematics).
- .10 Response time for each type of command and report.
- .11 Item-by-item statement of compliance.
- .12 Proof of demonstrated ability of system to communicate utilizing BACnet.

1.3 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 5 working days after contract award, for review by Departmental Representative.

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

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

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

1.4 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 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 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.
- .10 11 inch LCD screen.

1.5 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 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including:
  - .1 Sensing element type and location.
  - .2 Transmitter type and range.
  - .3 Associated field wiring schematics, schedules and terminations.
  - .4 Complete Point Name Lists.

.5 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.

.6 Software and programming details associated with each point.

.7 Manufacturer's recommended installation instructions and procedures.

.8 Input and output signal levels or pressures where new system ties into existing control equipment.

.6 Control schematics, narrative description, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of EMCS.

.7 Graphic system schematic displays of air and water systems with point identifiers and textual description of system, as specified.

.8 Graphic system showing clean seawater and waste seawater tank levels.

.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.

1.6 QUALITY ASSURANCE

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

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

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

.3 Review interface requirements of materials supplied by others.

.4 Review "Sequence of Operations".

.2 Contractor's programmer to attend meeting.

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

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Related Requirements

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

1.2 DEFINITIONS

.1 BECC - Building Environmental Control Centre.

.2 OWS - Operator Work Station.

.3 For additional acryonyms 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 Submittals, supplemented and modified by requirements of this Section.

.2 Submit As-built drawings 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 4 Hard and 1 soft copy incorporating changes made during final review.

1.5 O&M MANUALS

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

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

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

.4 Functional description to include:

.1 Functional description of theory of operation.

.2 Design philosophy.

.3 Specific functions of design philosophy and system.

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

.5 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 SUMMARY

.1 Related Requirements

.1 Section 23 05 53.01 – Mechanical Identification.

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

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CSA C22.1-2015, The Canadian Electrical Code, Part I (19th Edition), Safety Standard for Electrical Installations.

1.3 DEFINITIONS

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

1.4 SYSTEM DESCRIPTION

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

1.5 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 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, matt white finish, core, square corners, lettering accurately aligned and engraved into core.

.2 Sizes: 25 x 67 mm minimum.

.3 Lettering: minimum 7 mm high, black.

.4 Inscriptions: machine engraved to identify function.

2.2 NAMEPLATES FOR FIELD DEVICES

.1 Identify by plastic encased cards attached by chain.

.2 Sizes: 50 x 100 mm minimum.

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

.4 Data to include: point name and point address.

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

2.3 NAMEPLATES FOR ROOM SENSORS

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

.2 Location: as directed by Departmental Representative.

.3 Letter size: to suit, clearly legible.

2.4 WARNING SIGNS

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

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

2.5 WIRING

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

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

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

2.6 CONDUIT

.1 Colour code EMCS conduit.

.2 Pre-paint box covers and conduit fittings.

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

Part 3 Execution

3.1 NAMEPLATES AND LABELS

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

.2 Nameplate shall include equipment number as identified on equipment schedules and Environment Canada equipment number as identified on drawing legend.

3.2 EXISTING PANELS

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Related Requirements

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

.2 References.

.1 Canada Labour Code (R.S. 1985, c. L-2)/Part I - Industrial Relations.

.2 Canadian Standards Association (CSA International).

.1 CSA Z204-94(R1999), Guidelines for Managing Indoor Air Quality in Office Buildings.

1.2 DEFINITIONS

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

.2 OWS - Operator Work Station.

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

1.3 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.

1.4 MAINTENANCE SERVICE DURING WARRANTY PERIOD

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

.2 Emergency Service Calls:

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

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

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

.4 Service personnel to be on site ready to service EMCS within 4 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.

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) during the 24 month warranty period. 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 each field input/output device in accordance with Canada Labour Code - Part I.
- .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, and leaks.
- .4 Review system performance with Operations Supervisor 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 SUMMARY

.1 Related Requirements

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

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CSA T529-95(R2000), Telecommunications Cabling Systems in Commercial Buildings (Adopted ANSI/TIA/EIA-568-A with modifications).

.2 CSA T530-99(R2004), 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 802.3™-, 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 6.9-2000, Profile for the Telecommunications Wiring System in Government Owned and Leased Buildings - Technical Specifications.

1.3 DEFINITIONS

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

1.4 SYSTEM DESCRIPTION

.1 Data communication network to link Operator Workstations and Master Control Units (MCU) in accordance with CSA T530.

.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.

1.5 DESIGN REQUIREMENTS

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

.1 High speed, high performance, local area network over which 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: BACnet.

.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, compatible with network protocol to be used within 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 SUMMARY

.1 Related Sections:

.1 Section 23 33 15 - Dampers - Operating.

.2 Section 25 01 11 - EMCS: Start-Up, Verification and Commissioning.

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

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

.5 Section 25 05 54 - EMCS: Identification.

.6 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

.7 Section 26 05 00 - Common Work Results - Electrical.

.8 Section 26 27 26 - Wiring Devices.

1.2 REFERENCES

.1 American National Standards Institute (ANSI).

.1 ANSI C12.7-2005, Requirements for Watthour Meter Sockets.

.2 ANSI/IEEE C57.13-2008, Standard Requirements for Instrument Transformers.

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

.1 ASTM B148-2014, Standard Specification for Aluminum-Bronze Sand Castings.

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

.1 NEMA 250-03, Enclosures for Electrical Equipment (1000 Volts Maximum).

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

.1 AMCA Standard 500-D-2012, Laboratory Method of Testing Dampers For Rating.

.5 Canadian Standards Association (CSA International).

.1 CSA-C22.1-2015, Canadian Electrical Code, Part 1 (19th Edition), Safety Standard for Electrical Installations.

1.3 DEFINITIONS

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

1.4 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.

1.5 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.

1.6 EXTENDED WARRANTY

.1 For the work of this Section 25 30 02 – EMCS: Field Control Devices, the 12 month warranty period is extended to 24 months.

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, heat resistant assembly.

.3 Operating conditions: $-30^0 – 40^0$ C with 10 - 90% RH (non-condensing) unless otherwise specified.

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

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

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

.7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.

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

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

2.2 TOUCH SCREEN

.1 Touch screen with color displays, 457mm diagonal and a resolution of 1080 pixels, connected to the main digital controller.

.2 Installation in the control room. Coordinate the exact location with the Departmental Representative.

2.3 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 degrees C and over.

.2 RTD's: 100 or 1000 ohm at 0 degrees C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3integral anchored lead wires. Coefficient of resistivity: 0.00385 ohms/ohm degrees C.

.3 Sensing element: hermetically sealed.

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

.5 Time constant response: less than 3 seconds to temperature change of 10 degrees C.

.6 Immersion wells: DN 20, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length 150 mm as indicated.

.2 Room temperature sensors and display wall modules.

.1 Temperature sensing and display wall module.

.1 LCD display to show space temperature and temperature set point.

.2 Buttons for occupant selection of temperature set point.

.3 Jack connection for plugging in laptop personal computer for access to zone bus.

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

.5 Accuracy 0.2 degrees C over range of 0 to 70 degrees C.

.6 Stability 0.02 degrees C drift per year.

.7 Separate mounting base for ease of installation.

.2 Room temperature sensors.

.1 Wall mounting, in slotted type covers having brushed aluminum finish.

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

.3 Environment Sensors

.1 Humidity and temperature transmitted with 10 metre remote probes.

.2 Acceptance material: Vaisala HMT-333.

.4 Duct temperature sensors:

.1 General purpose duct type: suitable for insertion into ducts at various orientations, insertion length 460 mm as indicated.

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

.5 Outdoor air temperature sensors:

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

2.4 TEMPERATURE TRANSMITTERS

.1 Requirements:

.1 Input circuit: to accept 3-lead, 100 or 1000 ohm at 0 degrees C, platinum resistance detector type sensors.

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

.3 Output signal: 4 - 20 mA into500 ohm maximum load.

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

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

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

.7 Maximum current to 100 or 1000 ohm RTD sensor: not to exceed 25 mA.

.8 Integral zero and span adjustments.

.9 Temperature effects: not to exceed plus or minus 1.0 % of full scale/ 60degrees C.

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

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

.1 Minus 50 degrees C to plus 50 degrees C, plus or minus 0.5 degrees C.

.2 0 to 100 degrees C, plus or minus 0.5 degrees C.

.3 0 to 50 degrees C, plus or minus 0.25 degrees C.

.4 0 to 25 degrees C, plus or minus 0.1 degrees C.

.5 10 to 35 degrees C, plus or minus 0.25 degrees C.

2.5 SURFACE WATER DETECTOR

.1 Water leak detector with sensing probes that can detect the presence of seawater at 13mm from finished floor and send alarm status to BAS via dry closure contact.

.1 Power supply: 14 - 30 VAC/DC

.2 Operating temperature: -40°C - 85°C (-40°F - 185°F)

.3 Cable Rating: Plenum rated - CL2P (UL)

.4 Enclosure: ABS with hinged lid and gasket, IP65 (NEMA 4X), UL94-5VB

.5 Dimensions: (LxWxH) 145 x 100 x 64 mm

2.6 HUMIDITY SENSORS

.1 Room and Duct Requirements:

.1 Range: 5 - 90 % RH minimum.

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

.3 Absolute accuracy:

.1 Duct sensors: plus or minus 3 %.

.2 Room sensors: plus or minus 2 %.

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

.5 Maximum sensor non-linearity: plus or minus 2% RH with defined curves.

.6 Duct mounted sensors: locate so that sensing element is in air flow in duct.

2.7 HUMIDITY TRANSMITTERS

.1 Requirements:

.1 Input signal: from RH sensor.

.2 Output signal: 4 - 20 mA onto 500 ohm maximum load.

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

.4 Output variations: not to exceed 0.2 % of full scale output for supply voltage variations of plus or minus 10 %.

.5 Output linearity error: plus or minus 1.0% maximum of full scale output.

.6 Integral zero and span adjustment.

.7 Temperature effect: plus or minus 1.0 % full scale/ 6 months.

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

2.8 PRESSURE TRANSDUCERS

.1 Requirements:

.1 Combined sensor and transmitter measuring pressure.

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

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

.3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.

.4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.

.5 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 degrees C.

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

.7 Output short circuit and open circuit protection.

.8 Accuracy: plus or minus 1% of Full Scale.

2.9 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 into 500 ohm maximum load.

.3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.

.4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.

.5 Integral zero and span adjustment.

.6 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 degrees C.

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

.8 Output short circuit and open circuit protection.

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

2.10 STATIC PRESSURE SENSORS

.1 Requirements:

.1 Multipoint element with self-averaging manifold.

.1 Maximum pressure loss: 63 Pa at 10 m/s. (Air stream manifold).

.2 Accuracy: plus or minus 1 % of actual duct static pressure.

2.11 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

2.12 TEMPERATURE SWITCHES

.1 Requirements:

.1 Operate automatically. Reset automatically, except as follows:

.1 Low temperature detection: manual reset.

.2 Adjustable set point and differential.

.3 Accuracy: plus or minus 1degrees 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 Duct, general purpose: insertion length = 460 mm.

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

.3 Low temperature detection: continuous element with 6000 mm insertion length, duct mounting, to detect coldest temperature in any 30 mm length.

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

2.13 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 degrees C to 70 degrees C.

.5 Relays to be CSA Certified.

.6 Input/output Isolation Voltage to be 4000 VAC at 25 degrees 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.

2.14 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.

2.15 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.

2.16 CONTROL DAMPERS

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

.2 Materials:

.1 Frame: 2.03 mm minimum thickness extruded aluminum. For outdoor air and exhaust air applications, frames to be insulated.

.2 Blades: extruded aluminum. For outdoor air/exhaust air applications, blades to be internally insulated.

.3 Bearings: maintenance free, synthetic type of material.

.4 Linkage and shafts: aluminum, zinc and nickel plated steel.

.5 Seals: synthetic type, mechanically locked into blade edges.

.1 Frame seals: synthetic type, mechanically locked into frame sides.

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

.1 Size/Capacity: refer to damper schedule

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

.3 Temperature range: minus 40 degrees C to plus 100 degrees 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.

2.17 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 degrees C.

.4 Snap action contacts rated 15 amp at 120 V.

.5 Adjustable setpoint and differential.

2.18 SUMP LEVEL SWITCHES

.1 Requirements:

.1 Liquid level activated switch sealed in waterproof and shockproof enclosure.

.2 Complete with float, flexible cord, weight. Instrument casing to be suitable for immersion in measured liquid.

.3 N.O./N.C. Contacts rated at 15 amps at 120V AC. CSA approval for up to 250 volt 10 amps AC.

2.19 ELECTRONIC / ELECTRIC VALVE ACTUATORS

.1 Requirements:

.1 Construction: steel, cast iron, aluminum.

.2 Control signal: 0-10V DC or 4-20 mA DC.

.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 For the three way valves on the chilled glycol system, provide feedback signal of valve position to BAS.

.9 Minimum shut-off pressure: refer to control valve schedule.

2.20 PANELS

.1 Wall mounted enamelled steel cabinets with hinged and key-locked front door.

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

.3 Panels to be lockable with same key.

2.21 WIRING

.1 In accordance with Section 26 27 26 - Wiring Devices.

.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 .

.2 Analog input and output: shielded #18 minimum solid copper.

2.22 VARIABLE FREQUENCY SPEED CONTROLLERS

.1 Certifications

.1 Variable speed controllers shall be CSA or cUL approved.

.2 The complete unit including the cabinet, the speed controller, the bypass circuit and other components shall be CSA approved.

.2 Manufacturer’s shop drawings shall include:

.1 Dimensions and weights;

.2 Technical specifications;

.3 Wiring diagrams.

.3 Type of load

.1 The load is made up of variable torque centrifugal fans and centrifugal pumps.

.2 The speed controller shall operate adequately at all speeds. Verify the motor starting torque and running torque at different speeds.

.3 The speed controller shall be capable of starting the system when the system is in forward or reverse rotation, at any speed. Should the controller not be capable of starting the unit when in reverse rotation, install breaking resistors on the D.C. bus to prevent system rotation when not energized.

.4 Cabinet

.1 Speed controller and bypass shall be installed in a NEMA 12 enclosure.

.2 The cabinet shall have ventilation slots with replaceable filters to eliminate internal heat build-up.

.3 The cabinet shall be wall mount.

.4 It shall have hinged door with handle and lock and key.

.5 Equipped with disconnect switch complete with the possibility to lock the lever in the “open” position with padlocks.

.6 2-way selector “AUTO-OFF” which allows operation to be set as automatic control, or off-line for servicing.

.7 The following components shall be shown on LCD display on the outer face of the door:

.1 “CONTROLLER RUNNING”;

.2 “CONTROLLER FAULT”;

.3 “MOTOR FAULT”;

.5 Speed controller

.1 Input characteristics:

.1 Voltage: 600 V a.c. ± 10 %;

.2 Number of phases: 3;

.3 Frequency: 60 Hz ± 2 Hz;

.4 Input power factor minimum at any speed: 0.95;

.5 Efficiency: 0.95.

.2 Output characteristics

.1 Power : HP according to indications;

.2 Voltage : 575 V;

.3 Frequency: 0 to 120 Hz;

.4 Maximum carrier frequency: 2 kHz;

.5 Waveform type: PWM;

.6 Direct current: 100 %;

.7 One minute peak current: 110 %.

.3 The unit to be of the programmable microprocessor type with control panel and alphanumeric display.

.4 The following functions to be programmable:

.1 Starting and running frequencies;

.2 V/Hz ratio;

.3 Acceleration/deceleration;

.4 Overvoltage;

.5 Speed.

.5 The following information to be displayed:

.1 Output voltage;

.2 % load;

.3 % speed;

.4 Ready to start;

.5 Operation in automatic mode or local mode.

.6 Unit protected against the following events which are displayed on the alphanumeric panel:

.1 Loss of phase;

.2 Under voltage;

.3 Over voltage;

.4 Overload;

.5 Short circuit;

.6 Ground fault;

.7 Overheating;

.8 Internal component failure.

.7 Environmental operating conditions:

.1 Ambient temperature: 0 to 40 °C;

.2 Relative humidity (non condensing): 20 to 90 % R.H.;

.3 Altitude: 3300 feed (1000 m).

.6 Inductors

.1 A 3 % smoothing inductor on the d.c. bus and a 5 % input inductance shall be supplied on all variable speed drives. Shunt type filters shall not be accepted. The total current harmonic distortion not to exceed 30 % at the a.c. input of each speed controller.

.2 In order to reduce the wave reflexion between the controller and the motor, a 3 % inductor shall be installed at the output of the speed controller if the motor is installed more than 10 m away from speed controller. Make standing wave tests and supply a written report showing the wave shapes on an oscilloscope with or without the inductor.

.7 Control signals

.1 The following control elements stop the motor when the speed controller drives it. Provide the necessary control circuits:

.1 Signal from the control panel:

.1 Start/stop signal.

.2 Protection elements directly connected to the speed controller:

.1 Motor thermistors (Thermistor trip circuits to be compatible with the motor thermistors);

.2 Fire alarm contact;

.3 Other external protections (frost detection, disconnect auxiliary contact closing).

.3 The speed controller accepts the 0 to 10 V d.c. or 4 to 20 mA speed signal from the control panel and communicates with the control panel according to the BACnet MS/TP protocol.

.4 The following signals shall be transmitted to the control panel:

.1 Speed;

.2 Output frequency;

.3 Unit fault contact;

.4 Proof of operation contact obtained by a current reading on one phase of the motor circuit.

2.23 FULL VOLTAGE MAGNETIC STARTERS

.1 Combination magnetic starters of size, type and rating adapted for the connected load. Enclosure to be NEMA 2 type, with components as follows:

.1 Starters shall be CSA or cUL approved.

.2 Contactor solenoid operated, rapid action type.

.3 Motor overload protective device in each phase, manually reset from outside enclosure.

.4 Wiring and schematic diagram inside starter enclosure in visible location.

.5 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

.2 Combination type starters to include fused disconnect switch with operating lever on outside of enclosure to control disconnect, and provision for:

.1 Locking in "OFF" position with up to 3 padlocks.

.2 Independent locking of enclosure door.

.3 Provision for preventing switching to "ON" position while enclosure door open.

.3 Accessories:

.1 Pushbuttons and selector switches: heavy duty, oil tight, labelled as indicated.

.2 Indicating lights: heavy duty, oil tight type. Green color when load is running, Red color when Off.

.3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

.4 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.24 AIR FLOW MEASUREMENT STATION

.1 System:

.1 Calibrated Range: 0 to 25,4 m/s .

.2 Operating Temperature:

.1 Probe: -28.9°C to 71.1°C;

.2 Transmitter: -28.9°C to 48.9°C.

.3 Operating Humidity Range: 0 to 99% non-condensing.

.4 Power Requirements: 24 VAC at 12-20 VA (based on sensor quantity).

.2 Transmitter and Enclosure:

.1 Transmitter Construction: Heavy duty industrial grade IC’s, rugged aluminum chassis and sliding cover.

.2 Transmitter Dimensions: 234.98 x 169.87 x 63.5 mm (HxWxD).

.3 Transmitter Mounting: Mounting holes located 19 mm from top/bottom, and 10mm from left/right edges on integral mounting plate.

.3 Sensor Probes:

.1 Factory Calibrated Sensor to NIST standards.

.2 Accuracy:

.1 Airflow: ±2% of reading;

.2 Temperature: ± 0.08°C.

.3 Probe Construction: Type 316 stainless steel.

.4 Mounting Brackets: Type 304 SS.

.5 Probe Dimensions: 28.575 mm diameter.

.6 Standard Size Ranges:

.1 Insertion/Standoff:: 203.2 to 3048 mm ;

.2 Internal Mount: 304.8 to 3048 mm.

.7 Maximum Quantity:

.1 Probes / Sensing Nodes: 4 probes per transmitter; 8 sensing nodes per probe; 16 nodes total max.

.8 Probe/Transmitter Cable: 3.05 m plenum rated FEP cable, positive locking connector with gold plated pins.

.4 Output Interfaces:

.1 Analog Output: Isolated analog 0-10 VDC or 4-20 mA, linear airflow/temperature.

.2 Analog Output Resolution: 0.010% of full scale at 0-10 VDC .

.3 Repeatability: 0.25% of reading.

.4 Airflow Output Signal Filter: Field Adjustable 0 to 99% (via pushbutton interface) .

.5 Adjustable user specified airflow low limit cut-off .

.6 Programmable alarm for user defined High or Low Limit.

.7 Unaffected by moisture in air.

.8 Self-powered.

Part 3 Execution

3.1 INSTALLATION

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

.2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.

.3 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.

.4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.

.5 Fire stopping: provide space for fire stopping in accordance with Section 07 84 00 - Fire stopping. Maintain fire rating integrity.

.6 Electrical:

.1 Complete installation in accordance with Section 26 05 00 - Common Work Results - 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. 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.

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 specified.

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 IDENTIFICATION

.1 Identify field devices in accordance with Section 25 05 54 - EMCS: Identification.

3.8 AIR FLOW MEASURING STATIONS

.1 Protect air flow measuring assembly until cleaning of ducts is completed.

3.9 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.

3.10 VARIABLE FREQUENCY DRIVE

.1 Installation

.1 The VFD must be installed according to the manufacturer’s recommendations, as stated in the installation guide;

.2 Electrical cable must be install according to the VFD manufacturer recommendations, as stated in the installation guide;

.3 Install the wall-mounted variable frequency drive on plywood mounted on steel profiles attached to the floor and to the building structure;

.4 Attach the variable frequency drives to the floor with 40 mm steel profiles.

.5 Connect all the required control circuits to the drives;

.6 Connect all interlocks and local protections to ensure that they are functional both under normal operation and on bypass operation;

.7 Program and adjust the drive settings according to the Departmental Representative recommendations;

.8 Provide a means to lock out near the motor if the speed controller's installation safety distance with the motor is exceeded;

.9 Provide AutoCad plans of the connections of the speed controllers to the existing infrastructure. Permanently number all wires which are related to the control diagrams.

.2 Tests

.1 The Contractor will include all necessary costs and make arrangements with the distributor to proceed with the verification and comissioning of the speed controllers for every motor according to the "Variable frequency drive test" table found in the appendix;

.2 Prior to testing, the Departmental Representative must be provided with the calibration certificates of every equipment to be used. Tests will be cancelled and new ones will need to be done to the Contractor's charge if there is a default in providing the certificates;

.3 All tests must be coordinated with the intervener's of divisions 23 and 26;

.4 Execute motor wave reflection tests with an oscilloscope that can produce a paper copy of the waveform. Submit the results to the Departmental Representative;

.5 Measure harmonic distortion of the incoming current to every drive to ensure that the 30 % threshold is not exceeded. Execute this test, one drive at a time, at 30 %, 50 %, 65 %, 80 % and 100 % of the normal motor speed;

.6 Once all tests are completed, a report will need to be prepared and signed. The report must include a conclusion covering the results obtained and the corrections made, and must certify the installations as well as the speed controllers' compliance with the manufacturer's requirements. An electronic copy must be provided to the Departmental Representative.

.3 Product support

.1 Well-trained support personnel and application engineers who are familiar with the VFD must be locally available and be able to offer service in no more than four (4) hours;

.2 A 24 hours a day support line must also be available 365 days a year.

.3 A computerized training on CD must be handed to the Departmental Representative at project completion. This training must include the following elements: installation, programmation and utilization of the VFD, bypass and BACnet communication functions and devices.

END OF SECTION

Part 1 General

1.1 REFERENCES

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

.1 MD13800-September 2000, Energy Management and Control Systems (EMCS) Design Manual. English: ftp://ftp.pwgsc.gc.ca/rps/docentre/mechanical/me214-e.pdf

1.2 GENERAL REQUIREMENTS FOR ALL SYSTEMS

.1 Control mode

.1 In case of lead/lag equipment combination such as pumps, fans, etc., start commands are switched every week. Upon a loss of status of the lead equipment for more than 2 minutes, the lag equipment is started.

.2 When equipment is automatically started, the Master Control Unit (MCU) makes sure that equipment is running for a minimum amount of time to prevent excess start/stops.

.2 Analog alarms

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

.2 Allow 4 levels of alarm for each analog point: two high limits and two low limits. Some alarm levels are stated in the sequence of operation.

.3 Alarms from transmitters located in ventilation duct or piping, unless otherwise stated, are locked out by the fan or the pump status to prevent alarms when the system is stopped.

.3 Critical alarms

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

.1 Unwanted start/stop for fans and pumps;

.2 Freeze protection;

.3 High or low pressure;

.4 Fault (equipment);

.5 Control variable outside limits (level, pressure, temperature).

.2 When an unwanted stop alarm stays on for more than 2 minutes, its start command is removed.

.3 Status alarms of a system, unless otherwise stated, are locked out with the fire alarm system to prevent redundant alarms during a fire alarm.

.4 Some critical alarms are sent to the guard station.

.4 Maintenance alarms

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

.1 Stopped system;

.2 Dirty filter;

.3 Run time.

.5 The set points stated in this Section are given as working assumptions. They shall be fully editable within the EMCS according to actual building operation and experience.

.6 Set point ramping

.1 Upon a start of the system or on any changes of set point, provide a control algorithm to gradually bring the set point from its start value to its desired value.

.2 The ramping progression speed must be adjustable.

.7 Electrical power return

.1 On an electrical power return, the mechanical equipment is started one by one upon a predefined sequence to avoid any overload. Provide a programmable appropriate time interval between each start command. As well, upon an electrical power loss, open start contacts of equipment to stop them and then allow the start sequence.

.8 All sequences of operation and programming standards presently in effect in the building apply, unless otherwise stated in this document.

1.3 SEQUENCING – CONTROL ROOM (194F)

.1 Occupied mode

.1 On a cooling call from the room temperature sensor, the air valve AV1-MOS-000 modulates open between the minimum and maximum setting. The control valve CV1-HGL-000 modulates open in order to prevent room over-cooling at minimum air valve position.

.2 Unoccupied Mode

.1 The air valve AV1-MOS-000 is closed. On a cooling call from the room temperature sensor, the air valve modulates open to provide room cooling.

1.4 SEQUENCING – COLD ROOM (194E)

.1 Present sequencing of operations for systems, in accordance with MD13800 - Energy Management and Control Systems (EMCS) Design Manual.

.2 The EMCS shall control the mechanical systems as detailed below and in all of the Modes of Operation as indicated on the drawings. Refer to drawings for a detailed description of equipment sequencing under these Modes of Operation.

.3 Control panel Mode of Operation selection

.1 Due to the nature of testing activities in the Cold Room, the Mode of Operation and set points will be changed frequently by the operator. The control panel shall be user-friendly and present, at a minimum, the following options that will be selected by the user prior to and after tests. The screens will be presented in logical order as below:

.1 Select Mode of Operation

.1 This screen will ask the operator to select the Mode of Operation.

.1 CONTROL ROOM

MODE 1: UNOCCUPIED

MODE 2: OCCUPIED

.2 COLD ROOM

MODE 1: OFF

MODE 2 PREPARATION

2A: WITHOUT FLUME TANK EXHAUST

2B: WITH FLUME TANK EXHAUST

MODE 3: OPERATING

.2 Select Test Temperature

.1 For every Mode, this screen will ask the operator to select the Room Temperature.

.1 Control Room

.1 21.0°C

.2 23.0°C

.2 Cold Room

.1 -20.0°C

.2 -10°C

.3 0.0°C

.4 10.0°C

.5 15.0°C

.3 For the Mode 3 of the Cold Room, this screen will ask to select the Seawater Temperature

.1 -1.8°C

.2 -1°C

.3 0°C

.4 2°C

.2 After selecting one of the Temperatures above, the following screen will ask the operator whether to adjust the temperature set point.

.1 No

.2 Yes

.3 If Yes is selected, another screen will allow the operator to adjust the temperature upward or downward by 0.5°C increments for air temperature and 0.1°C for seawater temperature.

.1 + 0.5°C (+0.1°C)

.2 – 0.5°C (-0.1°C)

.1 For the control room, the Room Temperature can be set between 18°C and 24°C.

.2 For the cold room:

.1 The Room Temperature during preparation modes can be set between 20°C and 24°C.

.2 The Room Temperature during test can be set between -20°C and 15°C.

.3 The Seawater Temperature can be set between -2°C and 8°C.

.3 Select Relative Humidity

.1 For Control room Mode 2 and Cold room Modes 2A, 2B & 2B, this screen will ask the operator whether to adjust the pre-set relative humidity set point of 50% RH.

.1 No

.2 Yes

.2 If Yes is selected, another screen will allow the operator to adjust the relative humidity upward or downward by 5% increments. The maximum limit of relative humidity is 50%.

.1 + 5%

.2 – 5%

.4 Heat Trace Module

.1 Heat trace module status is to be transmitted to the MCU.

.5 Sequence of operation for systems as follows:

.1 Air Valves AV1-MOS-000 and AV1-MOS-0M1

.1 When one of this air valves require providing airflow to the respective area, the existing make-up air unit MAU-1 is required to be started by the BAS.

.2 Steam humidifier HU1-MOS-002

.1 The electric steam humidifier will modulate based on the control room RH sensor and cold room RH sensor.

.2 The humidifier stops on its humidity high limit switch (IH) or on its flow switch (IDA) in the supply duct.

.3 Filters FB1-MOS-0M1

.1 The pressure differential across the following filters shall be monitored by the BAS and displayed on the system graphics.

.2 An alarm shall be initiated if the filter differential pressure exceeds the following setpoints:

.1 375 Pa (1.5” WC)

.4 Chiller CH1-001-TRR

.1 System shutdown:

.1 Chiller is shutdown when the system is disabled from the EMCS.

.2 Chiller compressors are stopped.

.3 Chilled glycol and heating glycol pumps are stopped.

.4 Air-cooled condenser is stopped.

.2 System start-up:

.1 Chiller startup is enabled from the EMCS. The chiller should be enabled the majority of the time to maintain quick response time for chilled water demand.

.2 Upon confirmation of the run status of the chilled water pumps, the chiller starts when commanded from the MCU.

.3 Normal mode:

.1 When the chiller is enabled, the chiller, chilled water pumps, and condenser shall operate via the MCU to maintain the chilled glycol buffer tank BF1-CGL-0M1 at set point temperature, -2.2°C.

.2 The chilled glycol pump PU1-CGL-0M1 shall operate at a constant volume when chiller CH1-001-0M1 operates.

.4 Local protection:

.1 A fire alarm contact stops the system.

.5 Alarm:

.1 The pump running condition is sent to the MCU.

.2 The start command is turned off when the run status is lost for more than two minutes on the supply or exhaust fans.

.3 Alarms are activated when the following variables exceed their limits:

.1 Buffer tank temperature more than ± 2°C from set point.

.2 Chilled glycol pressure more than ± 15 kPa from set point

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION