Part 1 General

1.1 Definitions

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

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

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

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

.1 Automatic initiation of back-up was accomplished.

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

.2 Failure of communications link, provided that:

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

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

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

.1 System recorded said fault.

.2 Equipment defaulted to fail-safe mode.

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

1.2 Design requirements

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

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

1.3 Action and informational submittals

.1 Submittals in accordance with Section 01330 - Submittal Procedures.

.2 Final Report: submit report to Departmental Representative.

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

.2 Bear signature of commissioning technician and supervisor

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

.4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to Departmental Representative in accordance with Section 01 78 00 - Closeout Submittals.

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

1.4 Closeout submittals

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

1.5 Commissioning

.1 Do commissioning in accordance with Section 01 91 13 - GENERAL COMMISSIONING 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 Correct deficiencies, re-test in presence of Departmental Representative until satisfactory performance is obtained.

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

.6 Load system with project software.

.7 Perform tests as required.

1.6 Completion of commissioning

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

1.7 Issuance of final certificate of completion

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

Part 2 Products

2.1 Equipment

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

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

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

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

.5 Application: to conform to normal industry standards.

Part 3 Execution

3.1 Procedures

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

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

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

.4 Debug system software.

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

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

3.2 Field quality control

.1 Pre-Installation Testing.

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

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

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

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

.2 Completion Testing.

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

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

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

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

.3 Commissioning to commence during final startup testing.

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

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

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

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

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

.3 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.

.4 Departmental Representative to verify reported results.

3.3 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.

Ω End of Section

Part 1 General

1.1 Definitions

.1 CDL - Control Description Logic.

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

1.2 Action and informational submittals

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

1.3 Quality assurance

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

.2 Departmental Representative reserves right to approve instructors.

1.4 Instructions

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

.2 Training to be project-specific.

1.5 Time for training

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

1.6 Training materials

.1 Provide equipment, visual and audio aids, and materials for classroom training.

.2 Supply manual for each trainee, describing in detail data included in each training program.

.1 Review contents of manual in detail to explain aspects of operation and maintenance (O&M).

1.7 Training program

.1 Training program to be approved by Departmental Representative.

1.8 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.

Ω End of Section

Part 1 General

1.1 Reference standards

.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-R2001, BACNET - Data Communication Protocol for Building Automation and Control Network.

.4 Canadian Standards Association (CSA Group).

.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 Electrical and Electronic Manufacturers Association (EEMAC).

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

1.2 Abbreviations and acronyms

.1 Acronyms used in EMCS:

.1 AEL - Average Effectiveness Level

.2 AI - Analog Input

.3 AIT - Agreement on International Trade

.4 AO - Analog Output

.5 BACnet - Building Automation and Control Network.

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

.7 BECC - Building Environmental Control Centre.

.8 CAD - Computer Aided Design.

.9 CDL - Control Description Logic.

.10 CDS - Control Design Schematic.

.11 COSV - Change of State or Value.

.12 CPU - Central Processing Unit.

.13 DI - Digital Input.

.14 DO - Digital Output.

.15 DP - Differential Pressure.

.16 ECU - Equipment Control Unit.

.17 EMCS - Energy Monitoring and Control System.

.18 HVAC - Heating, Ventilation, Air Conditioning.

.19 IDE - Interface Device Equipment.

.20 I/O - Input/Output.

.21 ISA - Industry Standard Architecture.

.22 LAN - Local Area Network.

.23 LCU - Local Control Unit.

.24 MCU - Master Control Unit.

.25 NAFTA - North American Free Trade Agreement.

.26 NC - Normally Closed.

.27 NO - Normally Open.

.28 OS - Operating System.

.29 O&M - Operation and Maintenance.

.30 OWS - Operator Work Station.

.31 PC - Personal Computer.

.32 PCI - Peripheral Control Interface.

.33 PCMCIA - Personal Computer Micro-Card Interface Adapter.

.34 PID - Proportional, Integral and Derivative.

.35 RAM - Random Access Memory.

.36 SP - Static Pressure.

.37 ROM - Read Only Memory.

.38 TCU - Terminal Control Unit.

.39 USB - Universal Serial Bus.

.40 UPS - Uninterruptible Power Supply.

.41 VAV - Variable Air Volume.

1.3 Definitions

.1 Point: may be logical or physical.

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

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

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

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

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

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

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

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

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

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

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

.1 AI (analog input).

.2 AO (analog output).

.3 DI (digital input).

.4 DO (digital output).

.5 Pulse inputs.

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

.1 Printouts: to ANSI/IEEE 260.1.

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

1.4 System description

.1 Refer to control schematics for system architecture.

.2 Existing controls system is in Appendix A.

.3 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.

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

1.5 Action and informational submittals

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

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

1.6 Quality assurance

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

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

.3 Health and Safety:

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

1.7 Delivery, storage and handling

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

1.8 Existing- control components

.1 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.

.2 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.

.3 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.

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

.5 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.

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

Part 2 Products

2.1 Adaptors

.1 Provide adaptors between metric and imperial components.

Part 3 Execution

3.1 Manufacturer's recommendations

.1 Installation: to manufacturer's recommendations.

Ω 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 Description and location of installing and servicing technical staff.
- .2 Location and qualifications of programming design and programming support staff.
- .3 List of spare parts.
- .4 Location of spare parts stock.
- .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 Proprietary Communications Protocol.

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

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

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 Spare point capacity of each controller by number and type.
- .3 Controller locations.
- .4 Auxiliary control cabinet locations.

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

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 Interface wiring diagrams showing termination connections and signal levels for equipment to be supplied by others.

.4 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.

.5 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.

.6 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.

.7 Listing and example of specified reports.

.8 Listing of time of day schedules.

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

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

.11 Full description of software programs provided.

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

.13 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.

Ω End of Section

Part 1 General

1.1 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.

1.2 Action and informational submittals

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

.2 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.

1.3 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 2 Hard and 1 soft copy incorporating changes made during final review.

1.4 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.

Ω End of Section

Part 1 General

1.1 Reference standards

.1 Canadian Standards Association (CSA Group).

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

1.2 Definitions

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

1.3 System description

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

1.4 Action and informational submittals

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

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

Part 2 Products

2.1 Nameplates for panels

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

.2 Sizes: 25 x 67 mm minimum.

.3 Lettering: minimum 7 mm high, black.

.4 Inscriptions: machine engraved to identify function.

2.2 Nameplates for field devices

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

.2 Sizes: 50 x 100 mm minimum.

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

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

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

2.3 Warning signs

.1 Equipment includingmotors, 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.

2.4 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.

2.5 Conduit

.1 Colour code EMCS conduit.

.2 Pre-paint box covers and conduit fittings.

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

Part 3 Execution

3.1 Nameplates and labels

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

3.2 Existing panels

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

Ω End of Section

Part 1 General

1.1 Reference standards

.1 American National Standards Institute (ANSI)

.1 ANSI/ASME B16.22-2013, Wrought Copper and Copper Alloy Solder Joint Pressures Fittings.

.2 ANSI C2-1990, National Electrical Safety Code.

.3 ANSI/NFPA 70-1990, National Electrical Code.

.2 CSA Group (CSA)

.1 CSA C22.1-12,

.2 CAN/CSA-C22.3 No. 7-10, Underground Systems.

.3 CAN/CSA C22.2 No. 45.1-07 (R2012), Electrical Rigid Metal Conduit.

.4 CAN/CSA C22.2 No. 56-13, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.

.5 CAN/CSA C22.2 No. 83-M1985 (R2013), Electrical Metallic Tubing.

.6 CAN/CSA-C22.3 No. 1-10, Overhead Systems.

1.2 System description

.1 Electrical:

.1 Provide power wiring from existing power panels to EMCS field panels. Circuits to be for exclusive use of EMCS equipment. Panel breakers to be identified on panel legends tagged and locks applied to breaker switches.

.2 Hard wiring between field control devices and EMCS field panels.

.3 Communication wiring between EMCS field panels and OWS's including main control centre BECC.

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

.2 Mechanical:

.1 Pipe Taps Required For EMCS equipment will be supplied and installed by Division 23.

.2 Wells and Control Valves Shall Be Supplied by EMCS Contractor and Installed by Division 23.

.3 Structural:

.1 Special steelwork as required for installation of work.

1.3 Personnel qualifications

.1 Qualified supervisory personnel to:

.1 Continuously direct and monitor all work.

.2 Attend site meetings.

1.4 Existing conditions

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

.2 Repair all surfaces damaged during execution of work.

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

Part 2 Products

2.1 Piping

.1 Refrigeration: refer to Division 23.

.2 Hangers and supports: refer to Division 23.

.3 Insulation: refer to Division 23.

2.2 Special supports

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

2.3 Wiring

.1 As per requirements of Division 26.

.2 For 70V and above copper conductor with chemically cross-linked thermosetting polyethylene insulation rated RW90 and 600V. Colour code to CSA 22.1.

.3 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. All other cases use FT4 wiring.

.4 Sizes:

.1 120V Power supply: to match or exceed breaker, size #12 minimum.

.2 Wiring for safeties/interlocks for starters, motor control centres, to be stranded, #14 minimum.

.3 Field wiring to digital device: 20 AWG stranded twisted pair.

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

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

.5 Terminations:

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

2.4 Conduit

.1 As per requirements of Division 26.

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

.3 Junction and pull boxes: welded steel.

.1 Surface mounting cast FS: screw-on flat covers.

.2 Flush mounting: covers with 25 mm minimum extension all round.

.4 Cabinets: sheet steel, for surface mounting, with hinged door, latch lock, 2 keys, complete with perforated metal mounting backboard. Panels to be keyed alike for similar functions and or entire contract as approved.

.5 Outlet boxes: 100 mm minimum, square.

.6 Conduit boxes, fittings:

.1 Bushings and connectors: with nylon insulated throats.

.2 With push pennies to prevent entry of foreign materials.

.7 Fittings for rigid conduit:

.1 Couplings and fittings: threaded type steel.

.2 Double locknuts and insulated bushings: use on sheet metal boxes.

.3 Use factory "ells" where 90 degree bends required for 25 mm and larger conduits.

.8 Fittings for thin wall conduit:

.1 Connectors and couplings: steel, set screw type.

2.5 Wiring devices, cover plates

.1 Conform to CSA.

.2 Receptacles:

.1 Duplex: CSA type 5-15R.

.2 Single: CSA type 5-15R.

.3 Cover plates and blank plates: finish to match other plates in area.

2.6 Starters, control devices

.1 Across-the-line magnetic starters:

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

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

.2 Starter diagrams:

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

.3 Auxiliary Control Devices:

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

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

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

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

.4 Finish for starters:

.1 Interior: white.

2.7 Supports for conduit, fastenings, equipment

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

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

.2 Exposed conduits or cables:

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

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

.3 Suspended support systems:

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

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

Part 3 Execution

3.1 Installation

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

3.2 Piping

.1 Refrigeration: refer to Division 23

.2 Insulation: refer to Section Division 23.

3.3 Mechanical piping

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

.2 Ream ends of pipes before assembly.

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

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

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

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

.7 Sleeves:

.1 Installation:

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

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

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

.8 Introduce system pressure carefully into new piping.

3.4 Supports

.1 Install special supports as required and as indicated.

3.5 Electrical general

.1 Do complete installation in accordance with requirements of:

.1 Division 26, this specification.

.2 CSA 22.1 Canadian Electrical Code.

.3 ANSI/NFPA 70.

.4 ANSI C2.

.2 Fully enclose or properly guard electrical wiring, terminal blocks, high voltage above 70 V contacts and mark to prevent accidental injury.

.3 Do underground installation to CAN/CSA-C22.3 No.7, except where otherwise specified.

.4 Conform to manufacturer's recommendations for storage, handling and installation.

.5 Check factory connections and joints. Tighten where necessary to ensure continuity.

.6 Install electrical equipment between 1000 and 2000 mm above finished floor wherever possible and adjacent to related equipment.

.7 Protect exposed live equipment such as panel, mains, outlet wiring during construction for personnel safety.

.8 Shield and mark live parts "LIVE 120 VOLTS" or other appropriate voltage.

.9 Install conduits, and sleeves prior to pouring of concrete.

.10 Holes through exterior wall and roofs: flash and make weatherproof.

.11 Make necessary arrangements for cutting of chases, drilling holes and other structural work required to install electrical conduit, cable, pull boxes, outlet boxes.

.12 Install cables, conduits and fittings which are to be embedded or plastered over, neatly and closely to building structure to minimize furring.

3.6 Conduit system

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

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

.3 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Obtain approval from Departmental Representative before starting such work. Provide complete conduit system to link field panels and devices with main control centre. Conduit size to match conductors plus future expansion capabilities as specified.

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

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

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

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

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

.9 Fastenings and supports for conduits, cables, and equipment:

.1 Provide metal brackets, frames, hangers, clamps and related types of support structures as indicated and as required to support cable and conduit runs.

.2 Provide adequate support for raceways and cables, sloped vertically to equipment.

.3 Use supports or equipment installed by other trades for conduit, cable and raceway supports only after written approval from Departmental Representative.

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

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

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

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

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

.15 Pull boxes:

.1 Install in inconspicuous but accessible locations.

.2 Support boxes independently of connecting conduits.

.3 Fill boxes with paper or foam to prevent entry of construction material.

.4 Provide correct size of openings. Reducing washers not permitted.

.5 Mark location of pull boxes on record drawings.

.6 Identify AC power junction boxes, by panel and circuit breaker.

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

3.7 Wiring

.1 Install multiple wiring in ducts simultaneously.

.2 Do not pull spliced wiring inside conduits or ducts.

.3 Use CSA certified lubricants of type compatible with insulation to reduce pulling tension.

.4 Tests: use only qualified personnel. Demonstrate that:

.1 Circuits are continuous, free from shorts, unspecified grounds.

.2 Resistance to ground of all circuits is greater than 50 Megohms.

.5 Provide Departmental Representative with test results showing locations, circuits, results of tests.

.6 Remove insulation carefully from ends of conductors and install to manufacturer's recommendations. Accommodate all strands in lugs. Where insulation is stripped in excess, neatly tape so that only lug remains exposed.

.7 Wiring in main junction boxes and pull boxes to terminate on terminal blocks only, clearly and permanently identified. Junctions or splices not permitted for sensing or control signal covering wiring.

.8 Do not allow wiring to come into direct physical contact with compression screw.

.9 Install ALL strands of conductor in lugs of components. Strip insulation only to extent necessary for installation.

3.8 Wiring devices, cover plates

.1 Receptacles:

.1 Install vertically in gang type outlet box when more than one receptacle is required in one location.

.2 Cover plates:

.1 Install suitable common cover plate where wiring devices are grouped.

.2 Use flush type cover plates only on flush type outlet boxes.

3.9 Starters, control devices

.1 Install and make power and control connections as indicated.

.2 Install correct over-current devices.

.3 Identify each wire, terminal for external connections with permanent number marking identical to diagram.

.4 Performance Verification:

.1 Operate switches and controls to verify functioning.

.2 Perform start and stop sequences of contactors and relays.

.3 Check that interlock sequences, with other separate related starters, equipment and auxiliary control devices, operate as specified.

3.10 Grounding

.1 Install complete, permanent, continuous grounding system for equipment, including conductors, connectors and accessories.

.2 Install separate grounding conductors in conduit within building.

.3 Install ground wire in all PVC ducts and in tunnel conduit systems.

.4 Tests: perform ground continuity and resistance tests, using approved method appropriate to site conditions.

3.11 Tests

.1 General:

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

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

.3 Conceal work only after tests satisfactorily completed.

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

.5 Preliminary tests:

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

.2 Make needed changes, adjustments, replacements.

.3 Insulation resistance tests:

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

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

3.12 Identification

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

Ω End of Section

Part 1 General

1.1 Definitions

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

.2 OWS - Operator Work Station.

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

1.2 Action and informational submittals

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

.2 Submit detailed preventative maintenance schedule for system components to Departmental Representative.

.3 Submit detailed inspection reports to Departmental Representative.

.4 Submit dated, maintenance task lists to Departmental Representative and include the following sensor and output point detail, as proof of system verification:

.1 Point name and location.

.2 Device type and range.

.3 Measured value.

.4 System displayed value.

.5 Calibration detail

.6 Indication if adjustment required,

.7 Other action taken or recommended.

.5 Submit network analysis report showing results with detailed recommendations to correct problems found.

.6 Records and logs: in accordance with Section 01 78 00 - Closeout Submittals.

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

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

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

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

1.3 Maintenance service during warranty period

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

.2 Emergency Service Calls:

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

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

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

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

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

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

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

.1 Serial number identifying component involved.

.2 Location, date and time call received.

.3 Nature of trouble.

.4 Names of personnel assigned.

.5 Instructions of work to be done.

.6 Amount and nature of materials used.

.7 Time and date work started.

.8 Time and date of completion.

.5 Provide system modifications in writing.

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

Part 2 Products

2.1 Not used

.1 Not Used.

Part 3 Execution

3.1 Field quality control

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

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

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

.2 Check equipment cooling fans as required.

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

.4 Review system performance with Operations Supervisor to discuss suggested or required changes.

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

.1 Minor inspection.

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

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

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

.5 Run system software diagnostics as required.

.6 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.

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

.5 Continue system debugging and optimization.

.6 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.

Ω End of Section

Part 1 General

1.1 Reference standards

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

.1 ASHRAE 2003, Applications Handbook, SI Edition.

.2 Canadian Standards Association (CSA Group).

.1 C22.2 No.205-M1983 (R1999), Signal Equipment.

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

.1 IEEE C37.90.1-02, Surge Withstand Capabilities (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.

1.2 Definitions

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

1.3 Description

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

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

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

.2 Controllers: stand-alone intelligent Control Units.

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

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

.3 Capable of interfacing with operator interface device.

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

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

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

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

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

1.4 Design requirements

.1 To include:

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

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

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

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

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

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

.3 Field Termination and Interface Devices:

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

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

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

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

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

.3 Lockable wall cabinet.

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

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

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

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

.4 AI interface equipment to:

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

.2 Provide for following input signal types and ranges:

.1 4 - 20 mA;

.2 0 - 10 V DC;

.3 100/1000 ohm RTD input;

.3 Meet IEEE C37.90.1 surge withstand capability.

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

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

.5 AO interface equipment:

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

.2 Provide for following output signal types and ranges:

.1 4 - 20 mA.

.2 0 - 10 V DC.

.3 Meet IEEE C37.90.1 surge withstand capability.

.6 DI interface equipment:

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

.2 Meet IEEE C37.90.1 surge withstand capability.

.3 Accept pulsed inputs up to 2 kHz.

.7 DO interface equipment:

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

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

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

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

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

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

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

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

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

1.5 Action and informational submittals

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

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

1.6 Maintenance

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

Part 2 Products

2.1 Master control unit (mcu)

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

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

.1 MCU must support BACnet.

.3 MCU local I/O capacity as follows:

.1 MCU I/O points as allocated in I/O Summary Table referenced in MD13800.

.2 LCUs may be added to support system functions.

.4 Central Processing Unit (CPU).

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

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

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

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

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

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

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

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

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

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

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

.1 Start and stop points.

.2 Modify setpoints.

.3 Modify PID loop parameters.

.4 Override PID control.

.5 Change time/date.

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

.7 Add/modify setpoint weekly scheduling.

.8 Enter temporary override schedules.

.9 Define holiday schedules.

.10 View analog limits.

.11 Enter/modify analog warning limits.

.12 Enter/modify analog alarm limits.

.13 Enter/modify analog differentials.

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

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

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

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

2.2 Local control unit (lcu)

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

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

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

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

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

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

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

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

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

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

2.3 Terminal/equipment control unit (tcu/ecu)

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

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

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

.3 VAV Terminal Controller.

.1 Microprocessor based controller with integral flow transducer, including software routines to execute PID algorithms, calculate airflow for integral flow transducer

and measure temperatures as per I/O Summary required inputs. Sequence of operation to ASHRAE HVAC Applications Handbook.

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

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

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

2.4 Software

.1 General.

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

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

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

.2 Program and data storage.

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

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

.3 Programming languages.

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

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

.4 Operator Terminal interface.

.1 Operating and control functions include:

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

.2 Alarm management: processing and messages.

.3 Operator commands.

.4 Reports.

.5 Displays.

.6 Point identification.

.5 Pseudo or calculated points.

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

.2 Inputs and outputs for process: include data from controllers to permit development of network-wide control strategies. Processes also to permit

operator to use results of one process as input to number of other processes (e.g. cascading).

.6 Control Description Logic (CDL):

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

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

.3 Perform changes to CDL on-line.

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

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

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

.1 Two position control.

.2 Proportional Integral and Derivative (PID) control.

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

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

.9 Power Fail Restart: upon detection of power failure system to verify availability of Emergency Power as determined by emergency power transfer switches and analyse controlled equipment to determine its appropriate status under Emergency power conditions and start or stop equipment as defined by I/O Summary. Upon resumption of normal power as determined by emergency power transfer switches, MCU to analyse status of controlled equipment, compare with normal occupancy scheduling, turn equipment on or off as necessary to resume normal operation.

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

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

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

.1 Time of day scheduling.

.2 Calendar based scheduling.

.3 Holiday scheduling.

.4 Temporary schedule overrides.

.5 Optimal start stop.

.6 Night setback control.

.7 Enthalpy (economizer) switchover.

.8 Peak demand limiting.

.9 Temperature compensated load rolling.

.10 Fan speed/flow rate control.

.11 Cold deck reset.

.12 Hot deck reset.

.13 Hot water reset.

.14 Chilled water reset.

.15 Condenser water reset.

.16 Chiller sequencing.

.17 Night purge.

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

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

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

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

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

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

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

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

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

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

2.5 Levels of address

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

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

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

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

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

2.6 Point name support

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

Part 3 Execution

3.1 Location

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

3.2 Installation

.1 Install Controllers in secure locking enclosures at location indicated on the sealed planset.

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

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

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

Ω End of Section

Part 1 General

1.1 Reference standards

.1 American National Standards Institute (ANSI).

.1 ANSI C12.7-1993 (R1999), Requirements for Watthour Meter Sockets.

.2 ANSI/IEEE C57.13-1993, Standard Requirements for Instrument Transformers.

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

.1 ASTM B148-97 (03), 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-98, Laboratory Method of Testing Dampers For Rating.

.5 CSA Group CSA Group

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

1.2 Definitions

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

1.3 Action and informational submittals

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

.2 Pre-Installation Tests.

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

.3 Manufacturer's Instructions:

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

1.4 Existing conditions

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

.2 Repair surfaces damaged during execution of Work.

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

Part 2 Products

2.1 General

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

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

.3 Operating conditions: 0 - 32 degrees 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 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, 3 integral anchored leadwires. 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: NPS 3/4, stainless steel spring loaded construction, with heat transfer
compound compatible with sensor.

.2 Room temperature sensors and display wall modules.

.1 Temperature sensing and display wall module.

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

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

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

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

.5 Stability 0.02 degrees C drift per year.

.6 Separate mounting base for ease of installation.

.2 Room temperature sensors.

.1 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 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 6096 mm. Bend probe at field installation time to 100 mm radius at point along probe without degradation of performance.

.4 Outdoor air temperature sensors:

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

2.3 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/50 degrees 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.

2.4 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 5%.

.2 Room sensors: plus or minus 5%.

.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 Outdoor Humidity Requirements:

.1 Range: 0 - 100 % RH minimum.

.2 Operating temperature range: -40 - 50 degrees C.

.3 Absolute accuracy: plus or minus 2 %.

.4 Temperature coefficient: plus or minus 0.03%RH/degrees C over 0 to 50 degrees C.

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

.6 No routine maintenance or calibration is required.

2.5 Humidity transmitters

.1 Requirements:

.1 Input signal: from 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.

2.6 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.

2.7 Differential pressure transmitters

.1 Requirements:

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

.2 Output signal: 4 - 20 mA 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.

2.8 Static pressure sensors

.1 Requirements:

.1 Multipoint element with self-averaging manifold.

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

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

2.9 Static pressure transmitters

.1 Requirements:

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

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

.3 Accuracy: 0.4 % of span.

.4 Repeatability: within 0.5 % of output.

.5 Linearity: within 1.5 % of span.

.6 Deadband or hysteresis: 0.1 % of span.

.7 External exposed zero and span adjustment.

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

2.10 Velocity pressure sensors

.1 Requirements:

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

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

.3 Accuracy: plus or minus 1 % of actual duct velocity.

2.11 Velocity pressure transmitters

.1 Requirements:

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

.2 Calibrated span: not to exceed 125 % of duct velocity pressure at maximum flow.

.3 Accuracy: 0.4 % of span.

.4 Repeatability: within 0.1 % of output.

.5 Linearity: within 0.5 % of span.

.6 Deadband or hysteresis: 0.1 % of span.

.7 External exposed zero and span adjustment.

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

2.12 Liquid and steam flow meters

.1 Requirements:

.1 Pressure rating: as specified in I/O summaries.

.2 Temperature rating: as specified in I/O summaries.

.3 Repeatability: plus or minus 0.2 %.

.4 Accuracy and linearity: plus or minus 1.0 %.

.5 Flow rangability: at least 10:1.

.6 Ends:

.1 NPS 2 and under: screwed.

.2 NPS 2.1/2 and over: flanged.

2.13 Pressure and differential pressure switches

.1 Requirements:

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

.2 Adjustable setpoint and differential.

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

.4 Accuracy: within 2 % repetitive switching.

.5 Provide switches with isolation valve and snubber, where code allows, between sensor and pressure source.

.6 Switches on steam and high temperature hot water service: provide pigtail syphon.

2.14 Temperature switches

.1 Requirements:

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

.1 Low temperature detection: manual reset.

.2 High temperature detection: manual reset.

.2 Adjustable setpoint and differential.

.3 Accuracy: plus or minus 1 degrees C.

.4 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 6096 mm insertion length, duct mounting, to detect coldest temperature in any 30 mm length.

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

2.15 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.

2.16 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.

2.17 Current/pneumatic (i/p) transducers

.1 Requirements:

.1 Input range: 4 to 20 mA.

.2 Output range: proportional 20-104 kPa 20-186 kPa as applicable.

.3 Housing: dustproof or panel mounted.

.4 Internal materials: suitable for continuous contact with industrial standard instrument air.

.5 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 2 % of full scale over entire range.

.6 Integral zero and span adjustment.

.7 Temperature effect: plus or minus 2.0 % of full scale/50 degrees C or less.

.8 Regulated supply pressure: 206 kPa maximum.

.9 Air consumption: 16.5 ml/s maximum.

.10 Integral gauge manifold c/w gauge (0-206 kPa).

2.18 Air pressure gauges

.1 Diameter: 38 mm minimum.

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

2.19 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.

2.20 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.

2.21 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.

2.22 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^2maximum 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.

2.23 Pneumatic control damper actuators

.1 Requirements:

.1 Piston type with spring return for "fail-safe" in Normally Open or Normally Closed position, as indicated.

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

.3 Adjustable spring and stroke external stops to limit strokes in either direction.

.4 For modulating applications provide with full relay type positioner with interconnecting linkage for mechanical feedback. Adjust to operate between range of 20-90 kPa unless otherwise indicated in control sequence of operation or input/output summary sheet.

.5 Positioners not required on single damper sections with less than 1 m^2face area.

2.24 Electronic control damper actuators

.1 Requirements:

.1 Direct mount proportional type as indicated.

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

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

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

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

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

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

2.25 Control valves

.1 Body: globe style, characterized ball.

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

.2 Leakage rate ANSI class IV, 0.01% of full open valve capacity.

.3 Packing easily replaceable.

.4 Stem, stainless steel.

.5 Plug and seat, stainless steel, brass, bronze.

.6 Disc, replaceable, material to suit application.

.7 NPS 2 and under:

.1 Screwed National Pipe Thread (NPT) tapered female connections.

.2 Valves to ANSI Class 250, valves to bear ANSI mark.

.3 Rangeability 50:1 minimum.

.8 NPS 2½ and larger:

.1 Flanged connections.

.2 Valves to ANSI Class 150 or 250 as indicated, valves to bear ANSI mark.

.3 Rangeability 100:1 minimum.

.2 Butterfly Valves NPS 2 and larger:

.1 End connections to suit flanges that are ANSI Class 150.

.2 Extended stem neck to provide adequate clearance for flanges and insulation.

.3 Pressure limit: bubble tight sealing to 170 kilopascals.

.4 Disc/vane: 316 stainless steel, aluminum bronze to ASTM B148.

.5 Seat: for service on chilled water PTFE (polytetrafluoroethylene), EPDM (ethylene propylene diene monomer). For service on steam and heating water PTFE, RTFE (reinforced PTFE).

.6 Stem: 316 stainless steel.

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

.8 Flow characteristic linear.

.9 Maximum flow requirement as indicated on control valve schedule.

.10 Maximum pressure drop as indicated on control valve schedule: pressure drop not to exceed one half of inlet pressure.

.11 Valves are to be provided complete with mounting plate for installation of actuators.

2.26 Pneumatic valve actuators

.1 Requirements:

.1 Construction: steel, cast iron, aluminum.

.2 Diaphragm: moulded Buna-N rubber, nylon reinforced.

.3 Spring return to normal position.

.4 Spring range adjustment and position indicator.

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

2.27 Electronic/electric valve actuators

.1 Requirements:

.1 Construction: steel, cast iron, aluminum.

.2 Positioning time: to suit application. 90 sec maximum.

.3 Fail to normal position as indicated.

.4 Scale or dial indication of actual control valve position.

.5 Size actuator to meet requirements and performance of control valve specifications.

.6 For interior and perimeter terminal heating and cooling applications floating control actuators are acceptable.

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

2.28 Watthour meters and current transformers

.1 Requirements:

.1 Include three phases, test and terminal blocks for watthour metre connections and connections for monitoring of current. Provide two transformers for 600 V 3 wire systems for watthour metre use. Accuracy: plus or minus 0.25 % of full scale. For chiller applications: to have instantaneous indicator with analog or digital display.

.2 Watthour metre sockets: to ANSI C12.7.

.3 Potential and current transformers: to ANSI/IEEE C57.13.

.4 Potential transformers: provide two primary fuses.

.5 Demand meters: configure to measure demand at 15 minute intervals.

2.29 Surface water detectors

.1 Requirements:

.1 Provide alarm on presence of water on floor.

.2 Expendable cartridge sensor.

.3 Internal waterproof switch.

.4 One set of dry contacts 2 amps at 24 V.

.5 Unaffected by moisture in air.

.6 Self-powered.

2.30 Panels

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

.2 Multiple panels as indicated 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.

2.31 Control air compressor stations

.1 Requirements: provide 2 high pressure, base mounted, each complete with belts, guards, intake muffler, replaceable cartridge intake cleaner, starter, pressure switches, alternator.

.2 Capacity: size to maintain air pressure, meet control air requirements on 25 % maximum running time.

.3 Receiver: size to suit running time. Complete with electronic automatic drain with strainer, pressure relief valve, pressure gauge ASME code rated for 1400 kPa.

.4 Vibration isolation: 5 % transmissibility.

.5 Refrigerated air drier:

.1 2 continuous operating type, complete with refrigerant evaporator, mechanical condensate separator, installed with 2 isolating valves. Designed for 1400 kPa maximum operating pressure.

.2 Capacity: sized for full capacity of compressors, to reduce dewpoint to minus 10 degrees C when dehydrating at 700 kPa. Maximum pressure drop 19 kPa at rated capacity.

.3 Provide 2 filter and PRV assemblies, with isolating valves and filter element, having 99% efficiency in removal of 0.5 micron diameter solid particles and oil aerosols and with indication of degree of saturation. Piping: ensure one dryer is always in circuit and active.

2.32 Wiring

.1 In accordance with Section 26 05 00 - Common work results for electrical.

.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.

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 the fire-resistance rating integrity of the fire separation.

.6 Electrical:

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

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

.3 Refer to electrical control schematics included as part of control design schematics on drawings. 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 305 mm from top of ductwork. Each additional horizontal run to be no more than 305 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 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.

3.5 I/p transducers

.1 Install air pressure gauge on outlet.

3.6 Air pressure gauges

.1 Install pressure gauges on pneumatic devices, I/P, pilot positioners, motor operators, switches, relays, valves, damper operators, valve actuators.

.2 Install pressure gauge on output of auxiliary cabinet pneumatic devices.

3.7 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.

Ω End of Section

Part 1 General

1.1 Sequencing

.1 Chiller Manager.

.1 To be provided by chiller manufacturer.

.2 Chilled Water System - Chiller Manager - Run Conditions: The chilled water system shall be enabled to run whenever:

.1 A definable number of chilled water coils need cooling

.2 AND the outside air temperature is greater than 12°C (adj.).

.3 To prevent short cycling, the chiller manager shall run for and be off for minimum adjustable times (both user definable).

.4 Each chiller shall run subject to its own internal safeties and controls.

.5 Chiller Lead/Lag Operation:
The two chiller trains, (each chiller and its associated support equipment), shall operate in a lead/lag fashion. Chiller train shall be referred to as chiller in this sequence.

.6 The following setpoints are recommended values. All setpoints shall be field adjusted during the commissioning period to meet the requirements of actual field conditions.

.7 To prevent short cycling, there shall be a user definable delay (adj.) between staging up or down, unless shutdown on safeties or failure. Each chiller shall run subject to its own internal safeties and controls.

.1 The lead chiller shall run first.

.2 On failure of the lead chiller, the lag chiller shall run and the lead chiller shall turn off.

.3 On increasing main chilled water supply temperature above 11°C (adj.), the lag chiller shall stage on and run in unison with the lead chiller to maintain chilled water temperature setpoint.

.8 The designated lead chiller shall rotate upon one of the following conditions (user selectable):

.1 manually through a software switch

.2 if chiller runtime (adj.) is exceeded

.3 daily

.4 weekly

.5 monthly

.9 Alarms shall be provided as follows:

.1 Chiller 1 Failure: Commanded on, but the status is off.

.2 Chiller 2 Failure: Commanded on, but the status is off.

.3 Lead Chiller Failure: The lead chiller is in failure and the lag chiller is on.

.4 High Main Chilled Water Supply Temp: If the main chilled water supply temperature is greater than 13.5°C (adj.).

.5 Low Main Chilled Water Supply Temp: If the main chilled water supply temperature is less than 3°C (adj.).

.6 High Main Chilled Water Return Temp: If the main chilled water return temperature is greater than 20°C (adj.).

.7 Low Main Chilled Water Return Temp: If the main chilled water return temperature is less than 8.5°C (adj.).

	Hardware Points				Software Points						
Point Name	**AI**	**AO**	**BI**	**BO**	**AV**	**BV**	**Loop**	**Sched**	**Trend**	**Alarm**	**Show On Graphic**
Main Chilled Water Return Temp	x								x		x
Main Chilled Water Supply Temp	x								x		x
Outside Air Temp					x						x
Chiller 1 Failure										x	x
Chiller 2 Failure										x	x
High Main Chilled Water Return Temp										x	
High Main Chilled Water Supply Temp										x	
Lead Chiller Failure										x	x
Low Main Chilled Water Return Temp										x	
Low Main Chilled Water Supply Temp										x	
Totals	**2**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**2**	**7**	**6**

Total Hardware (2) **Total Software (10)**

.2 Single water-cooled chiller. Typical of two.

.1 Chiller - Run Conditions: The chiller shall be enabled to run whenever it is commanded to be enabled by the chiller manager program. The chiller shall run subject to its own internal safeties and controls.

.2 Emergency Shutdown: The chiller shall shut down and an alarm generated upon receiving an emergency shutdown signal status.

.3 Refrigerant Detection: The chiller shall shut down and an alarm generated upon receiving a refrigerant leak detection status.

.4 Chilled Water Isolation Valve:
The chilled water isolation valve shall open anytime the chiller is called to run. The chilled water isolation valve shall also open whenever the chilled water pump runs for freeze protection.

.5 The chilled water isolation valve shall open prior to the chiller being enabled and shall close only after the chiller is disabled. The chilled water isolation valve shall therefore have:

.1 A user adjustable delay on start.

.2 AND a user adjustable delay on stop.

.6 The delay times shall be set appropriately to allow for orderly chilled water system start-up, shutdown and sequencing.

.7 Alarms shall be provided as follows:

.1 Chilled Water Isolation Valve Failure: Valve commanded open but the status indicates closed.

.2 Chilled Water Isolation Valve Open in Hand: Valve commanded closed but the status indicates open.

.3 Chilled Water Isolation Valve Runtime Exceeded: Valve status runtime exceeds a user-definable limit.

.8 Chilled Water Pump - Lead/Standby Operation:
The chilled water pumps shall run anytime the chiller is called to run. The lead chilled water pump shall also run for freeze protection whenever the outside air temperature is less than a user definable setpoint (adj.).

.9 The lead pump shall start prior to the chiller being enabled and shall stop only after the chiller is disabled. The chilled water pumps shall therefore have:

.1 A user adjustable delay on start.

.2 AND a user adjustable delay on stop.

.10 The delay times shall be set appropriately to allow for orderly chilled water system start-up, shutdown and sequencing.

.11 The chilled water pumps shall operate in a lead/standby fashion.

.1 The lead pump shall run first.

.2 On failure of the lead pump, the standby pump shall run and the lead pump shall turn off.

.12 The designated lead pump shall rotate upon one of the following conditions (user selectable):

.1 manually through a software switch

.2 if pump runtime (adj.) is exceeded

.3 daily

.4 weekly

.5 monthly

.13 Alarms shall be provided as follows:

.1 Chilled Water Pump P-3

.1 Failure: Commanded on, but the status is off.

.2 Running in Hand: Commanded off, but the status is on.

.3 Runtime Exceeded: Status runtime exceeds a user definable limit.

.2 Chilled Water Pump P-4

.1 Failure: Commanded on, but the status is off.

.2 Running in Hand: Commanded off, but the status is on.

.3 Runtime Exceeded: Status runtime exceeds a user definable limit.

.14 Condenser Water Pump Lead/Standby Operation: The condenser water pumps shall run anytime the chiller is called to run.

.15 The lead pump shall start prior to the chiller being enabled and shall stop only after the chiller is disabled. The pumps shall therefore have:

.1 A user adjustable delay on start.

.2 AND a user adjustable delay on stop.

.16 The delay times shall be set appropriately to allow for orderly chilled water system start-up, shutdown and sequencing.

.17 The condenser water pumps shall operate in a lead/standby fashion.

.1 The lead pump shall run first.

.2 On failure of the lead pump, the standby pump shall run and the lead pump shall turn off.

.18 The designated lead pump shall rotate upon one of the following conditions (user selectable):

.1 manually through a software switch

.2 if pump runtime (adj.) is exceeded

.3 daily

.4 weekly

.5 monthly

.19 Alarms shall be provided as follows:

.1 Condenser Water Pump P-5

.1 Failure: Commanded on, but the status is off.

.2 Running in Hand: Commanded off, but the status is on.

.3 Runtime Exceeded: Status runtime exceeds a user definable limit.

.2 Condenser Water Pump P-6

.1 Failure: Commanded on, but the status is off.

.2 Running in Hand: Commanded off, but the status is on.

.3 Runtime Exceeded: Status runtime exceeds a user definable limit.

.20 Chiller: The chiller shall be enabled a user adjustable time after pump statuses are proven on. The chiller shall therefore have a user adjustable delay on start.

.21 The delay time shall be set appropriately to allow for orderly chilled water system start-up, shutdown and sequencing.

.22 The chiller shall run subject to its own internal safeties and controls.

.23 Alarms shall be provided as follows:

.1 Chiller Failure: Commanded on, but the status is off.

.2 Chiller Running in Hand: Commanded off, but the status is on.

.3 Chiller Runtime Exceeded: Status runtime exceeds a user definable limit.

.24 Chilled Water Supply Temperature - Setpoint Reset:
The chilled water supply temperature setpoint shall reset using a trim and respond algorithm based on cooling requirements.

.25 The chilled water supply temperature setpoint shall reset to a lower value as the facility's chilled water valves open beyond a user definable threshold (90% open, typ.). Once the chilled water coils are satisfied (valves closing) then the chilled water supply temperature setpoint shall gradually rise over time to reduce cooling energy use.

.26 Chilled Water Temperature Monitoring:
The following temperatures shall be monitored:

.1 Chilled water supply.

.2 Chilled water return.

.27 Alarms shall be provided as follows:

.1 High Chilled Water Supply Temp: If the chilled water supply temperature is greater than 13°C (adj.).

.2 Low Chilled Water Supply Temp: If the chilled water supply temperature is less than 3°C (adj.).

.28 Condenser Water Temperature Monitoring:
The following temperatures shall be monitored:

.1 Condenser water supply temperature.

.2 Condenser water return temperature.

.29 Alarms shall be provided as follows:

.1 High Condenser Water Supply Temp: If the condenser water supply temperature is greater than 30°C (adj.).

.2 Low Condenser Water Supply Temp: If the condenser water supply temperature is less than 18.5°C (adj.).

.3 High Condenser Water Return Temp: If the condenser water return temperature is greater than 38°C (adj.).

.4 Low Condenser Water Return Temp: If the condenser water return temperature is less than 24°C (adj.).

	Hardware Points				Software Points						
Point Name	**AI**	**AO**	**BI**	**BO**	**AV**	**BV**	**Loop**	**Sched**	**Trend**	**Alarm**	**Show On Graphic**
Chilled Water Return Temp	x								x		x
Chilled Water Supply Temp	x								x		x
Condenser Water Return Temp	x								x		x
Condenser Water Supply Temp	x								x		x
Chilled Water Supply Temp Setpoint Reset		x							x		x
Chilled Water Isolation Valve Status			x						x		x
Chilled Water Pump P-3 Status			x						x		x
Chilled Water Pump P-4 Status			x						x		x
Chiller Status			x						x		x
Condenser Water Pump P-5 Status			x						x		x
Condenser Water Pump P-6 Status			x						x		x
Emergency Shutdown			x						x	x	x
Refrigerant Leak Shutdown			x						x	x	x
Chilled Water Isolation Valve				x							x
Chilled Water Pump P-3 Start/Stop				x					x		x
Chilled Water Pump P-4 Start/Stop				x					x		x
Chiller Enable				x					x		x
Condenser Water Pump P-5 Start/Stop				x					x		x
Condenser Water Pump P-6 Start/Stop				x					x		x
Outside Air Temp					x						x
Chilled Water Isolation Valve Failure										x	
Chilled Water Isolation Valve in Hand										x	
Chilled Water Isolation Valve Runtime Exceeded										x	
Chilled Water Pump P-3 Failure										x	
Chilled Water Pump P-3 Running in Hand										x	
Chilled Water Pump P-3 Runtime Exceeded										x	
Chilled Water Pump P-4 Failure										x	
Chilled Water Pump P-4 Running in Hand										x	

	Hardware Points				Software Points						
Point Name	**AI**	**AO**	**BI**	**BO**	**AV**	**BV**	**Loop**	**Sched**	**Trend**	**Alarm**	**Show On Graphic**
Chilled Water Pump P-4 Runtime Exceeded										x	
Chiller Failure										x	
Chiller Running in Hand										x	
Chiller Runtime Exceeded										x	
Condenser Water Pump P-5 Failure										x	
Condenser Water Pump P-5 Running in Hand										x	
Condenser Water Pump P-5 Runtime Exceeded										x	
Condenser Water Pump P-6 Failure										x	
Condenser Water Pump P-6 Running in Hand										x	
Condenser Water Pump P-6 Runtime Exceeded										x	
High Chilled Water Supply Temp										x	
High Condenser Water Return Temp										x	
High Condenser Water Supply Temp										x	
Low Chilled Water Supply Temp										x	
Low Condenser Water Return Temp										x	
Low Condenser Water Supply Temp										x	
Totals	**4**	**1**	**8**	**6**	**1**	**0**	**0**	**0**	**18**	**26**	**20**

Total Hardware (19) **Total Software (45)**

.3 Single Cooling Tower - Open Circuit. Typical of 1

.1 Cooling Tower - Run Conditions:
The cooling tower shall be enabled to run whenever the chiller runs.

.2 Emergency Shutdown:
The cooling tower shall shutdown and an alarm generated upon receiving an emergency shutdown signal status.

.3 Vibration Switch:
The cooling tower shall shut down and an alarm generated upon receiving a vibration switch status.

.4 Condenser Water Isolation Valve:
The condenser water isolation valve shall open anytime the cooling tower is called to run and shall close only after the cooling tower is disabled.
The condenser water isolation valve shall therefore have:

.1 A user adjustable delay on stop.

.5 The delay times shall be set appropriately to allow for orderly condenser water system start-up, shutdown and sequencing.

.6 Alarms shall be provided as follows:

.1 Condenser Water Isolation Valve Failure: Valve commanded open but the status indicates closed.

.2 Condenser Water Isolation Valve Open in Hand: Valve commanded closed but the status indicates open.

.3 Condenser Water Isolation Valve Runtime Exceeded: Valve status runtime exceeds a user-definable limit.

.7 Condenser Water Pump Lead/Standby Operation:
The condenser water pumps shall run anytime the chiller is called to run.

.8 The lead pump shall start prior to the chiller being enabled and shall stop only after the chiller is disabled. The pumps shall therefore have:

.1 A user adjustable delay on start.

.2 AND a user adjustable delay on stop.

.9 The delay times shall be set appropriately to allow for orderly chilled water system start-up, shutdown and sequencing.

.10 The condenser water pumps shall operate in a lead/standby fashion.

.1 The lead pump shall run first.

.2 On failure of the lead pump, the standby pump shall run and the lead pump shall turn off.

.11 The designated lead pump shall rotate upon one of the following conditions (user selectable):

.1 manually through a software switch

.2 if pump runtime (adj.) is exceeded

.3 daily

.4 weekly

.5 monthly

.12 Alarms shall be provided as follows:

.1 Condenser Water Pump P-5

.1 Failure: Commanded on, but the status is off.

.2 Running in Hand: Commanded off, but the status is on.

.2 Runtime Exceeded: Status runtime exceeds a user definable limit.
Condenser Water Pump P-6

.1 Failure: Commanded on, but the status is off.

.2 Running in Hand: Commanded off, but the status is on.

.3 Runtime Exceeded: Status runtime exceeds a user definable limit.

.13 Cooling Tower VFD Fan - Condenser Water Temperature Control:
The controller shall measure the cooling tower condenser water supply (basin) temperature and modulate the bypass valve and fan VFD in sequence to maintain setpoints.

.14 The following setpoints are recommended values. All setpoints shall be field adjusted during the commissioning period to meet the requirements of actual field conditions.

.15 On rising condenser water supply temperature, the controller shall modulate the bypass valve to maintain setpoint of 25.5°C (adj.) and the fan VFD to maintain setpoint of 28°C (adj.).

.16 Alarms shall be provided as follows:

.1 Fan

.1 Failure: Commanded on, but the status is off.

.2 Running in Hand: Commanded off, but the status is on.

.3 Runtime Exceeded: Status runtime exceeds a user definable limit.

.2 VFD Fault.

.1 High Condenser Water Supply (Basin) Temp: If greater than 30°C (adj.).

.2 Low Condenser Water Supply (Basin) Temp: If less than 3°C (adj.).

.17 Cooling Tower - Sump Level Monitor: The controller shall monitor the sump level through a series of water level switches.

.1 If the sump level rises above the high water level switch, turning it on, an alarm shall be generated.

.2 If the sump level drops below the low water makeup switch, turning it on, an alarm shall be generated and the makeup valve shall open.

.3 If the sump level drops below the low water level switch, turning it on, an alarm shall be generated and the cooling tower and chiller shall be shutdown.

.18 Condenser Water Temperature Monitoring: The following temperatures shall be monitored:

.1 Condenser water supply temperature.

.2 Condenser water return temperature.

.19 Alarms shall be provided as follows:

.1 High Condenser Water Supply Temp: If the condenser water supply temperature is greater than 30°C (adj.).

.2 Low Condenser Water Supply Temp: If the condenser water supply temperature is less than 18.5°C (adj.).
High Condenser Water Return Temp: If the condenser water return temperature is greater than 38°C (adj.).

.3 Low Condenser Water Return Temp: If the condenser water return temperature is less than 24°C (adj.).

	Hardware Points				Software Points						
Point Name	**AI**	**AO**	**BI**	**BO**	**AV**	**BV**	**Loop**	**Sched**	**Trend**	**Alarm**	**Show On Graphic**
Condenser Water Return Temp	x								x		x

	Hardware Points				Software Points						
Point Name	**AI**	**AO**	**BI**	**BO**	**AV**	**BV**	**Loop**	**Sched**	**Trend**	**Alarm**	**Show On Graphic**
Condenser Water Supply (Basin) Temp	x								x		x
Condenser Water Supply Temp	x								x		x
Bypass Valve Output		x							x		x
Fan VFD Speed		x							x		x
Condenser Water Isolation Valve Status			x						x		x
Condenser Water Pump 1 Status			x						x		x
Condenser Water Pump 2 Status			x						x		x
Emergency Shutdown			x						x	x	x
Fan Status			x						x		x
Fan VFD Fault			x							x	x
High Water Level Switch			x						x	x	x
Low Water Level Makeup Switch			x						x		x
Low Water Level Switch			x						x	x	x
Vibration Status			x						x	x	x
Condenser Water Isolation Valve				x							x
Condenser Water Pump 1 Start/Stop				x							x
Condenser Water Pump 2 Start/Stop				x							x
Fan Start/Stop				x							x
Makeup Valve				x					x		x
Outside Air Temp					x						x
Condenser Water Isolation Valve Failure										x	
Condenser Water Isolation Valve in Hand										x	
Condenser Water Isolation Valve Runtime Exceeded										x	
Condenser Water Pump 1 Failure										x	
Condenser Water Pump 1 Running in Hand										x	
Condenser Water Pump 1 Runtime Exceeded										x	
Condenser Water Pump 2 Failure										x	
Condenser Water Pump 2 Running in Hand										x	

	Hardware Points				Software Points						
Point Name	**AI**	**AO**	**BI**	**BO**	**AV**	**BV**	**Loop**	**Sched**	**Trend**	**Alarm**	**Show On Graphic**
Condenser Water Pump 2 Runtime Exceeded										x	
Fan Failure										x	
Fan in Hand										x	
Fan Runtime Exceeded										x	
High Condenser Water Return Temp										x	
High Condenser Water Supply (Basin) Temp										x	
High Condenser Water Supply Temp										x	
Low Condenser Water Return Temp										x	
Low Condenser Water Supply (Basin) Temp										x	
Low Condenser Water Supply Temp										x	
Makeup Valve Runtime Exceeded										x	
Totals	**3**	**2**	**10**	**5**	**1**	**0**	**0**	**0**	**15**	**24**	**21**

Total Hardware (20) **Total Software (40)**

.4 Chilled Water Energy (typical of 1)

.1 Chilled Water-Cooling Demand - Energy Meter: The Chiller Manager shall monitor the chilled water supply temperature, chilled water return temperature and chilled water flow to the building and calculate current energy demand on a continual basis. These values shall be made available to the system at all times

.2 Alarm shall be generated as follows:

.1 Invalid Reading: Sensor readings indicate an invalid demand value.

.2 Peak Demand History: The controller shall monitor and record the peak (high and low) demand readings from the chilled water energy meter. Peak readings shall be recorded on a daily, month-to-date, and year-to-date basis.

.3 Usage History: The controller shall monitor and record chilled water energy meter readings so as to provide an energy consumption history. Usage readings shall be recorded on a daily, month-to-date, and year-to-date basis.

	Hardware Points				Software Points						
Point Name	**AI**	**AO**	**BI**	**BO**	**AV**	**BV**	**Loop**	**Sched**	**Trend**	**Alarm**	**Show On Graphic**
Chilled Water Flow	x								x		x
Chilled Water Return Temp	x								x		x
Chilled Water Supply Temp	x								x		x

	Hardware Points				Software Points						
Point Name	**AI**	**AO**	**BI**	**BO**	**AV**	**BV**	**Loop**	**Sched**	**Trend**	**Alarm**	**Show On Graphic**
Demand					x				x		x
Peak Month-to-Date									x		x
Peak Today									x		x
Peak Year-to-Date									x		x
Usage Month-to-Date									x		x
Usage Today									x		x
Usage Year-to-Date									x		x
Totals	**3**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**10**	**0**	**10**

Total Hardware (3) **Total Software (11)**

Part 2 Products

2.1 Not used

.1 Not Used.

Part 3 Execution

3.1 Not used

.1 Not Used.

Ω End of Section