PART 1 – GENERAL

1.1 DESIGN REQUIREMENTS

.1 Provide a self healing, EMCS communication link between the new buildings flow sensors and temperature sensors to the existing EMCS.

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

.3 EMCS bridge to report all information available from the flow sensor and temperature sensor to the existing EMCS system in the Energy Centre including status, alarms, values, diagnostics.

1.2 ACTION AND INFORMATIONAL SUBMITTAL

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

.2 Final Report: submit report to Departmental Representative.
- .1 Include measurements, final settings and certified test results.
- .2 Bear signature of commissioning technician and supervisor
- .3 Report format to be approved by Departmental Representative before commissioning is started.
- .4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to Departmental Representative in accordance with Section 01 78 00 - Closeout Submittals.
- .5 Recommend additional changes and/or modifications deemed advisable in order to improve performance.

1.3 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.

1.4 START-UP, TESTING AND COMMISSIONING

.1 The Contractor to start-up, check, adjust, test and functionally commission the works, including all remotely monitored points availability to the existing EMCS system.

.2 The Contractor is to coordinate and pay all associated fees for manufactures' representative to be on-site to assist the controls system integrator to properly start-up, check, adjust, test and functionally commission of all Contractor provided instrumentation and controls equipment, associated field devices and cabling; hard wired I/O and all required telecommunications cabling, where necessary.

.3 The Contractor is to have adequate personal on-site during construction to complete the work.

.4 Carry out start-up testing, and commissioning activities under direction of Departmental Representative, and in the presence of Departmental Representative.

.5 Inform, and obtain approval from, Departmental Representative in writing at least 14 days prior to commissioning for 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.

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

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

.8 Perform tests as required.

1.5 COMPLETION OF COMMISSIONING

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

1.6 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.

.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 by Departmental Representative, be readily accessible and readable.

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, and as specified herein.

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

3.2 FIELD QUALITY CONTROL

.1 Completion Testing.
- .1 General: test after installation of each part of system and after completion to verify correct installation and functioning.
- .2 Include following activities:
  - .1 Test and calibrate field hardware including stand-alone capability of each controller.
  - .2 Test and calibrate each AI using calibrated digital instruments.
  - .3 Test each DI to ensure proper settings and switching contacts.
  - .4 Test operating software.
  - .5 Test application software and provide samples of logs and commands.
  - .6 Verify each CDL including energy optimization programs.
  - .7 Debug software.
  - .8 Blow out flow measuring and static pressure stations with high pressure air at 700 kPa.
  - .9 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits, and engineering units. Include space on commissioning technician and Departmental Representative. This document will be used in final start-up and testing.
- .3 Final Startup Testing: Upon satisfactory completion of tests, perform point-by-point verification of communication from flow meter to EMCS system.
  - .1 Submit result to Departmental Representative.

3.3 ADJUSTING

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

3.4 DEMONSTRATION

.1 Demonstrate to Departmental Representative operation of integrated systems:
- .1 Communication of flow meter to EMCS system.
- .2 Communication of temperature sensors to EMCS system.

END

PART 1 – GENERAL

1.1 RELATED SECTIONS

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

1.2 DEFINITIONS

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

1.3 QUALITY ASSURANCE

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

1.4 INSTRUCTIONS

.1 Training to be project-specific.

1.5 TIME FOR TRAINING

.1 One – one hour training session.

1.6 TRAINING PROGRAM

.1 Train O&M personnel in functional operations and procedures to be employed for system operation.

.2 Operator training: Train operating personnel, maintenance personnel and programmers with condensed version of training.

.3 Equipment maintenance training: provide personnel with training within (10) day period of substantial completion in maintenance of EMCS equipment, including general equipment layout, trouble shooting and preventive maintenance of EMCS components, maintenance and calibration of sensors and controls.

.4 Training to take place on site.

1.7 SCHEDULE OF TRAINING

.1 Training session not to be shorter than 1 hour.

PART 2 – PRODUCTS

Not applicable.

PART 3 – EXECUTION

Not applicable.

END

PART 1 – GENERAL

1.1 SUMMARY

.1 Section Includes:
- .1 General requirements for building Energy Management Controls System (EMCS).

.2 Related Sections:
- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 25 05 01 - EMCS: General Requirements.
- .3 Section 25 05 02 - EMCS: Submittals and Review Process.
- .4 Section 25 05 54 - EMCS: Identification.

1.2 DESIGNATED CONTRACTOR

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

1.3 REFERENCES

.1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).
- .1 ANSI/ISA 5.5-1985, Graphic Symbols for Process Displays.

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

1.4 SYSTEM DESCRIPTION

.1 Refer to control schematics and other drawings for system architecture.

.2 Provide a communication link from new control points to the existing EMCS system in the Energy Centre.

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

.5 Field Installation Description:
- .1 Line voltage wiring, and low voltage wiring to be terminated in junction boxes with screw type terminals, sized for appropriate wire size.
- .2 All wiring to be run in conduit.
- .3 All cables to be run in conduit.

1.5 SUBMITTALS

.1 Make submittals in accordance with 25 05 02 - EMCS: Submittals and Review Process.

.2 Submit for review:
- .1 Equipment list and systems manufacturers as per Section 01 33 00 – Submittal Procedures.

.3 Quality Control:
- .1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.
- .2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.
- .3 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 25 05 02 - EMCS: Submittals and and Review Process. Label or listing of specified organization is acceptable evidence.
- .4 In lieu of such evidence, submit certificate from testing organization, approved by Departmental Representative, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.
- .5 For materials whose compliance with organizational standards/codes/specifications is not regulated by organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.
- .6 Permits and fees: in accordance with general conditions of contract.
- .7 Submit certificate of acceptance from authority having jurisdiction to Departmental Representative.

1.6 QUALITY ASSURANCE

.1 Have local office in Maritime provinces staffed by trained personnel capable of providing instruction, routine maintenance and emergency service on systems,

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

1.7 DELIVERY, STORAGE AND HANDLING

.1 Material Delivery Schedule: provide Departmental Representative with schedule within 6 weeks after award of Contract.

.2 The Contractor is responsible for removing all waste and recycling material from the site at the end of each day.

1.8 EXISTING- CONTROL COMPONENTS

.1 Assume responsibility for controls to be incorporated into EMCS after written receipt of approval from Departmental Representative.
  .1 Be responsible for items repaired or replaced by Departmental Representative.
  .2 Be responsible for repair costs due to negligence or abuse of equipment.
  .3 Responsibility for existing devices terminates upon final acceptance of EMCS applicable portions of EMCS as approved by Departmental Representative.

PART 2 – PRODUCTS

2.1 MATERIALS

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

PART 3 – EXECUTION

3.1 MANUFACTURER'S RECOMMENDATIONS

.1 Installation: to manufacturers' recommendations

END

PART 1 – GENERAL

1.1 RELATED SECTIONS

.1 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

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

1.2 DEFINITIONS

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

1.3 DESIGN REQUIREMENTS

.1 Preliminary Design Review: to contain following contractor and systems information.
- .1 Location of local office.
- .2 Description and location of installing and servicing technical staff.
- .3 Location and qualifications of programming design and programming support staff.
- .4 List of spare parts.
- .5 Location of spare parts stock.
- .6 Names of sub-contractors and site-specific key personnel.
- .7 Sketch of site-specific system architecture.
- .8 Specification sheets for each item including memory provided, programming language, speed, type of data transmission.
- .9 Descriptive brochures.
- .10 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.

1.4 SUBMITTALS

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

.2 Submit preliminary design document within 10 working days after Tender closing and before Contract award, for review by Departmental Representative.

.3 Shop Drawings to consist of 1 PDF.

1.5 PRELIMINARY SHOP DRAWING REVIEW

.1 Submit preliminary shop drawings within (30) thirty working days of award of Contract and include following:

.1 Specification sheets for each item. To include manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.
.2 Detailed system architecture showing all points signal levels, flow data where new flow meter ties into existing EMCS system, and temperature data where temperature sensors tie into existing EMCS system.
.3 Spare point capacity of each controller by number and type.
.4 Equipment locations.
.5 Single line diagrams showing cable routings, conduit sizes, spare conduit capacity between control centre, field controllers and systems being controlled.
.6 Flow measuring stations: complete schedule listing designation, service, point ID, manufacturer, model, size, velocity at design flow rate, manufacturer, model and range of velocity transmitter.

1.6 DETAILED SHOP DRAWING REVIEW

.1 Submit detailed shop drawings within (60) sixty working days after award of contract and before start of installation and include following:
.1 Corrected and updated versions 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 Associated field wiring schematics, schedules and terminations.
.5 Manufacturer's recommended installation instructions and procedures.
.6 Enclosure with all ancillary equipment/devices; terminal strips, wiring/cabling, etc. showing overall enclosure dimensions, general arrangement of panel, wiring diagrams, interface with existing EMCS system.
.7 Outline of proposed start-up and verification procedures. Refer to Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.7 QUALITY ASSURANCE

.1 Preliminary Design Review Meeting: Convene meeting within 15 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".

PART 2 – PRODUCTS

Not applicable.

PART 3 – EXECUTION

Not applicable.

END

PART 1 – GENERAL

1.1 RELATED SECTIONS

.1 Section 01 78 00 - EMCS: Closeout Submittals.

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

.3 Sections 25 05 02 - EMCS: Submittals and Review Process.

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 Submit Record Documents As-built drawings Operation and Maintenance Manual to Departmental Representative in English.

.3 Provide soft copies and hard copies in hard-back, 50 mm 3 ring, D-ring binders.
- .1 Binders to be 2/3 maximum full.
- .2 Provide index to full volume in each binder.
- .3 Identify contents of each manual on cover and spine.
- .4 Provide Table of Contents in each manual.
- .5 Assemble each manual to conform to Table of Contents with tab sheets placed before instructions covering subject.

1.3 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 devices to be indicated on drawings.
- .5 Panel/circuit breaker number for sources of normal/emergency power.
- .6 Names, addresses, telephone numbers of each sub-contractor having installed equipment, local representative for each item of equipment, each system.
- .7 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.
- .8 Basic system design and full documentation on system configuration.

.2 Submit for final review by Departmental Representative.

.3 Provide before acceptance 1 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 1 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 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 System operation to include:
- .1 Failure recovery.
- .2 Step-by-step instructions for start-up, back-up equipment operation.

.6 Maintenance: document maintenance procedures including inspection, periodic preventive maintenance, fault diagnosis, repair or replacement of defective components, including calibration, maintenance and repair.

PART 2 – PRODUCTS

Not applicable.

PART 3 – EXECUTION

Not applicable.

END

PART 1 – GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

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

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).
  .1 CSA C22.1-15, The Canadian Electrical Code, Part I, Safety Standard for Electrical Installations.

1.3 DEFINITIONS

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

1.4 SYSTEM DESCRIPTION

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

1.5 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 chain printer 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.

.6 Reference Section 25 30 02 – EMCS: Field Control Devices for labeling of control valves.

.7 Where field devices are hidden behind a cover or ceiling tile, place identification tag on the cover or ceiling tile in a location that is visible, as close to the field device as possible.

2.3 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 panel.

2.4 CONDUIT

.1 Colour code EMCS conduit.

.2 Pre-paint box covers and conduit fittings.

.3 Coding: use fluorescent orange.

PART 3 – EXECUTION

3.1 NAMEPLATES AND LABELS

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

3.2 EXISTING PANELS

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

END

PART 1 – GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 78 00 - Closeout Submittals.

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

1.2 SUBMITTALS

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

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

1.3 WARRANTY PERIOD

.1 The 12 month warranty period is extended to 60 months for all system components.

1.4 MAINTENANCE SERVICE DURING WARRANTY PERIOD

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

.2 Emergency Service Calls:
- .1 Qualified control personnel to be available during warranty period to provide service to components whenever required at no extra cost.
- .2 Furnish Departmental Representative with telephone number where service personnel may be reached at any time.
- .3 Service personnel to be on site ready to service EMCS within 8 hours after receiving request for service.
- .4 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

Not applicable.

PART 3 – EXECUTION

3.1 FIELD QUALITY CONTROL

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

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

.3 Minor inspections to include, but not limited to:
.1 Perform visual, operational checks Network interface.

.4 Major inspections to include, but not limited to:
.1 Minor inspection.
.2 Clean interior and exterior surfaces.
.3 Check signal, voltage and Network interface.
.4 Run system software diagnostics as required.
.5 Install software and firmware enhancements to ensure components are operating at most current revision for maximum capability and reliability.
.1 Perform network analysis and provide report as described in Submittal article.

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

.7 Continue system debugging and optimization.

END

PART 1 – GENERAL

1.1 RELATED SECTIONS

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

1.2 REFERENCES

.1 Institute of Electrical and Electronics Engineers (IEEE)/Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements.

.1 IEEE Std 802.3TM -2002, Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.

1.3 DEFINITIONS

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

1.4 SYSTEM DESCRIPTION

.1 Data communication network to link remote I/O to existing system.

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

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

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

.1 Network management hardware and software.

.2 Network components necessary to complete network tie-in

1.5 DESIGN REQUIREMENTS

.1 Dynamic Data Access.

.1 LAN to provide capabilities for the existing EMCS system to connect to new devices and controllers.

.2 Network Medium.

.1 Network medium: twisted cable, shielded twisted cable, from the new control points to the new control panel and from the control panel to the existing EMCS.

.

PART 2 – PRODUCTS

Not applicable.

PART 3 – EXECUTION

Not applicable.

END

PART 1 – GENERAL

1.1 RELATED SECTIONS

.1 Section 25 02 01 – EMCS: General Requirements.

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

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

1.2 SYSTEM DESCRIPTION

.1 General. Provide an adequate number of Building Controllers to achieve the performance specified in the Part 1 Article on Design requirements. Each of these panels shall meet the following requirements.
- .1 Data shall be shared between networked Building Controllers.

1.3 DESIGN REQUIREMENTS

.1 To include:
- .1 Scanning of Analog Input and Binary Output 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: at least 25% of each point type distributed throughout the controllers.

.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 Input Output interface to accept as minimum Analog Input, Analog Output, Digital Input, Digital Output functions as specified.

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

.4 Analog Input 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 Analog Outputs 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 – 10V DC.
- .3 Meet IEEE C37.90.1 surge withstand capability.

.6 Binary Input interface equipment:
- .1 Able to reliably detect contact change of sensed field contact and transmit condition to controller.
- .2 Switch up to 5 amps at 220V AC using optional interface relay.

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

.5 Controllers (MCU, LCU): mount in wall mounted cabinet with hinged, keyed-alike locked door.
- .1 Provide for conduit entrance from top, bottom or sides of panel.
- .2 ECUs and TCUs to be mounted in equipment enclosures or separate.

.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.

1.4 SUBMITTALS

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

PART 2 – PRODUCTS

2.1 APPLICATION SPECIFIC CONTROLLERS

.1 General. Provide an adequate number of Advanced Application Controllers to achieve the performance specified in the Part 1 Article on "System Performance." Each of these panels shall meet the following requirement.

- .1 The Application Specific Controller shall have sufficient memory to support its operating system, database, and programming requirements.
- .2 Application Specific Controllers shall be fully peer to peer.
- .3 The operating system of the Controller shall manage the input and output communication signals to allow distributed controllers to share real and virtual object information, and allow central monitoring and alarms.
- .4 Both firmware and controller database shall be loadable over the network.
- .5 Advanced Application Controllers shall be BTL listed as a B-ASC device.

.2 Communication.

- .1 Each Application Specific Controller shall reside on a BACnet network using the MS/TP or Ethernet Data Link/ Physical layer protocol.
- .2 The controller shall provide a service communication port using BACnet Data Link/ Physical layer protocol for connection to portable operator's workstation and allow access to the entire network.

.3 Environment. Controller hardware shall be suitable for the anticipated ambient conditions.

- .1 Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures, and shall be rated for operation at 0°C to 40°C.
- .2 Controllers used in conditioned space shall be mounted in dust-proof enclosures, and shall be rated for operation at 0°C to 50°C.

.4 Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips — or to a termination card connected by a ribbon cable.

.5 Memory. The Application Specific Controller shall be non-volatile FLASH memory.

.6 Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to120 Hz and from keyed radios up to 5 W at 1 m.

2.2 INPUT/OUTPUT INTERFERENCE

.1 Hardwired inputs and output points/objects may be wired into the system through building, Custom Application.

.2 All input and output points shall be protected such that shorting of the point to itself, to another point, or to ground, will cause no damage to the controller. All input and output points shall be protected from voltage up to 24 volts of any duration, such that contact with this voltage will cause no damage to the controller.

.3 Digital inputs shall allow the monitoring of ON/OFF signals from remote devices. The digital inputs shall provide a current of at least 12 mA to be compatible with commonly available control devices, and shall be protected against the effects of contact bounce and noise. Digital inputs shall sense “dry contact” closure without external power (other than that provided by the controller) being applied.

.4 Analog inputs shall allow the monitoring of 0-5 VDC, 0-10 VDC-voltage, 4-20 mA- current, or thermistors. Analog inputs shall be compatible, and be field configurable to commonly available sensing devices.

.5 Digital outputs shall provide for ON/OFF operation. Digital outputs on Building and Advanced Application Controllers shall have three-position override switches, Hand-Off- Auto with status lights. Outputs shall be selectable for either normally open or normally closed operation.

.6 Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide a 0 to 10 VDC signal as required to provide proper control of the output device. Analog outputs on Building or Advanced Application Controllers shall have status lights and a two-position (AUTO/MANUAL) switch and manually adjustable potentiometer for manual override. Analog outputs shall not exhibit a drift of greater than 0.4% of range per year.

.7 Tri-State Outputs. Provide tri-state outputs (two coordinated binary outputs) for control of three-point floating type electronic actuators without feedback. Use of three-point floating devices shall be limited to zone control and terminal unit control applications (VAC) terminal units, duct mounted heating coils, zone dampers, radiation, etc.)

.8 Input/Output points/objects shall be universal type, i.e., controller input or output may be designated (in software) as either a binary or analog type point/object with appropriate properties. Application Specific Controllers are exempted from this requirement.

.9 System Object Capacity. The system size shall be expandable to at least twice the number of input/output objects required for this project. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity requirement. The Operator Workstations installed for this project

shall not require any hardware additions or software revisions in order to expand the system.

2.3 CONTROL PANELS

.1 Local Control Panels: Unitized NEMA 1 cabinet with suitable brackets for wall or floor mounting, located adjacent to each system under automatic control. Provide common keying for all panels.

.1 Fabricate panels of 0.06-inch thick, furniture-quality steel, or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish.

.2 Interconnections between internal and face-mounted devices pre-wired with color- coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL Listed for 600 volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.

.3 Door-Mounted Equipment: Flush-mount (on hinged door) manual switches, including damper-positioning switches, changeover switches, thermometers, and gages.

.4 Provide ON/OFF power switch with over-current protection for control power sources to each local panel.

2.4 POWER SUPPLIES AND LINE FILTERING

.1 Control transformers shall be UL listed. Furnish Class 2 current-limiting type, or furnish over-current protection in both primary and secondary circuits for Class 2 service per NEC requirements. Limit connected loads to 80% of rated capacity.

.2 DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peakto-peak. Regulation shall be 1.0% line and load combined, with 100 microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection, and shall be able to withstand a 150% current overload for at least 3 seconds without trip-out or failure.

.1 Unit shall operate between 0°C and 50°C. EM/RF shall meet FCC Class B and VDE 0871 for Class B, and MIL-STD 810C for shock and vibration.

.2 Line voltage units shall be UL recognized and CSA approved.

.3 Power line filtering:

.1 Dielectric strength of 1,000 volts minimum.

.2 Response time of 10 nanoseconds or less.

.3 Transverse mode noise attenuation of 65 dB or greater.

.4 Common mode noise attenuation of 150 dB or better at 40 Hz to 100 Hz.

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. Provide 120 V duplex receptacles on outside of each main control cabinet.

.2 Provide necessary power from local 120 E.P.S. 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.

END

PART 1 – GENERAL

1.1 RELATED SECTIONS

.1 Section 25 01 11 - EMCS: Start-UP, Verification and Commissioning.

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

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

.4 Section 25 05 54 - EMCS: Identification.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).
  .1 CSA-C22.1-15, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

1.3 SUBMITTALS

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

.2 Manufacturer's Instructions:
  .1 Submit manufacturer's installation instructions for specified equipment and devices.

1.4 EXISTING CONDITIONS

.1 Repair surfaces damaged during execution of Work.

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

PART 2 – PRODUCTS

2.1 DIFFERENTIAL PRESSURE SENSOR TRANSMITTERS

.1 Construction: Stainless steel construction, 316 stainless diaphragm, 12mm NPT connections, 4-20mA output.

.2 Differential range: Select for midpoint to be near normal reading.

.3 Working pressure: 860 kPa.

.4 Provide isolation to saltwater system through use of PVC gauge isolators: Teflon diaphragm mounted in PVC holder, 316 stainless steel fasteners.

2.2 WIRING

.1 Wiring/cabling must be continuous without joints, except where included on the Drawing(s).

.2 Sizes:
- .1 Serial Cabling CRS 232/RS 485) when included on Drawing(s).

2.3 TEMPERATURE SENSORS

.1 General: to be resistance or thermocouple type to following requirements:

The following sensors shall apply to thermistor and resistance temperature sensors as applicable:

- .1 Sensing element to be hermetically sealed.
- .2 Stem and tip construction to be copper.
- .3 Sensors to have a time constant response of less than 3 seconds to a temperature chance of 10ºC.
- .4 Sensors shall operate over the following ranges with the accuracies over the noted range of the sensor.
  -50ºC to +50ºC, plus or minus 0.5ºC.
  0ºC to +50ºC, plus or minus 0.25ºC.
  0ºC to 25ºC, plus or minus 0.1ºC.
  0ºC to 100ºC, plus or minus 1ºC.
- .5 Immersion wells shall be of 316 stainless steel materials. Heat transfer compound to be compatible with sensor.
- .6 Immersion sensors shall be provided with a separable brass well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed.
- .7 Provide matched temperature sensors for differential temperature measurement.

.2 Temperature sensors shall be of the following types:
- .1 Space Temperature Sensors:
  - .1 (Type 3) – Surface-Mounted Space Temperature Sensor: Acceptable Products – Greystone, ACI, BAPI. Install stainless steel plate. Fill box with polyurethane foam and install foam gasket around cover.

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 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets of stainless steel 316 construction unless otherwise indicated.

.4 Electrical:
- .1 Complete installation in accordance with Section 26 05 00 - Common Work Results - For Electrical.
- .2 Trace existing control wiring schematics including additions, deletions to control circuits for review by Departmental Representative before beginning work.
- .3 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
- .4 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.
- .5 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. Conduit to be stainless steel of 316 grade or epoxy coated steel.

3.2 PANELS

.1 Arrange for conduit or cable entry from bottom or either side.

.2 Wiring and tubing within panels: terminate in terminal strips, as indicted on the Drawings.

.3 Identify wiring and conduit clearly.

3.3 IDENTIFICATION

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

3.4 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.

.2 Provide a record of calibration for each field device and submit with final report as per Section 25 01 11 - EMCS: Start up, Verification and Commissioning.

END

PART 1 - GENERAL

1.1 SEQUENCING

.1 The following sequences supplement the existing control sequences in place for the Energy Centre cooling plant operation. Revise the existing sequence for the operation of single chiller as follows to allow for multiple chiller operation.

.2 The EMCS shall monitor the chilled water supply temperature leaving the heat exchangers in comparison the to chilled water setpoint. If the chilled water temperature rises above the setpoint for a time period exceeding 10 minutes (adjustable) the EMCS will engage the appropriate chiller based load as follows:

- .1 EMCS will compute the initial chiller load based on monitoring of the chilled water flow meter and the difference in the chilled water supply temperature to the chilled water setpoint.
- .2 For any chilled water flow rate with an effective load under 100 kW take no action.
- .3 For a load from 100 kW to 633 kW and chilled water flow rate up to 50 l/s designate the 180T chiller to operate.
- .4 For a load of 634 kW to 1055 kW and chilled water flow rate greater than 50 l/s designate one 300T chiller to operate.
- .5 For load of greater than 1055 kW to 2110 kW and chilled water flow rate greater than 50l/s designate both 300T chillers to operate.
- .6 For load greater than 2110 kW and chilled water flow greater than 100 l/s all three chillers to operate.
- .7 At any time the plant chilled water flow rate exceeds the sum of the operating chillers evaporator pump flow rates the operating chiller setpoints are to be reduced to compensate for the mixed mixed water condition downstream of the chiller injection point. The calculation of chiller setpoint to be computed by the EMCS using the variables as follows;

  Tcws = Chilled Water Supply Temperature Setpoint,
  Fcws = Chiller Water Supply Flow Rate,
  Fevap = Chiller Flow Rate = sum of evaporator nominal flows,
  Tcwr = Chilled Water Return Temperature measured downstream of saltwater heat exchanger,
  Tevap = Chiller Setpoint.
  Then Chiller Setpoint,
  $Tevap = [(Tcws*Fcws - Tcwr*(Fcws-Fevap)] / Fevap$,
  with temperatures expressed in absolute values. Tevap is not to be set below 4.5°C. The nominal evaporator flow rates for each chiller are to be confirmed during TAB.

.8 EMCS signal the chiller to operate through its BACnet module and send it the required water setpoint. Each chiller though its internal controller will be responsible for activating its evaporator and and condenser water circulating pumps and verifying flow.

.9 On a daily basis the 300T designated to operate first will be designated to operate second subsequently.

.10 EMCS to monitor chiller alarm signals. If Chiller sends a critical alarm signal to the EMCS and shuts down on its own safeties the EMCS will start the next chiller in the sequence of operation. If the chiller sends a refrigerant leakage alarm then the chiller plant is to be shut down.

.3 For the Operation of exhaust fan EF-01 the EMCS shall monitor and operate the following:

.1 The EMCS shall monitor the existing R134-A gas controller panel for alarms and warnings

. 2 The EMCS shall monitor exhaust fan EF-01 status

.3 The existing space gas sensor shall monitor the level of R134-A. Upon detection of refrigerant gas levels reaching 250 ppm a warning will be issued to the EMCS. The refrigerant gas controller will open the Intake and outlet dampers and start exhaust fan EF-01, If it is not already operating. An Alarm will be issued to the EMCS system to deactivate the chillers

.4 The local line voltage reverse acting thermostat will override the exhaust fan on if space temperature >32C.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END