PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 78 00 - Closeout Submittals.

.3 Section 01 79 00 - Demonstration and Training.

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

1.2 DEFINITIONS

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

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

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

- .1 Outage of main power supply in excess of back-up power sources, provided that:
  - .1 Automatic initiation of back-up was accomplished.
  - .2 Automatic shut-down and re-start of components was as specified.
- .2 Failure of communications link, provided that:
  - .1 Controller automatically and correctly operated in stand-alone mode.
  - .2 Failure was not due to failure of any specified EMCS equipment.
- .3 Functional failure resulting from individual sensor inputs or output devices, provided that:
  - .1 System recorded said fault.
  - .2 Equipment defaulted to fail-safe mode.
  - .3 AEL of total of all input sensors and output devices is at least 99% during test period.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Final Report: submit report to Departmental Representative.

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

1.4 CLOSEOUT SUBMITTALS

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

1.5 COMMISSIONING

.1 Do commissioning of all control valves, cooling tower and chilled water system sequences.

.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 a qualified commissioning professional and approved by Departmental Representative.

.3 Commission integrated systems using procedures prescribed by by a qualified commissioning professional and approved 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 under normal and emergency power conditions as applicable.

3.2 FIELD QUALITY CONTROL

.1 Completion Testing.
- .1 General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.
- .2 Include following activities:
  - .1 Test and calibrate field hardware including stand-alone capability of each controller.
  - .2 Verify each A-to-D convertor.
  - .3 Test and calibrate each AI using calibrated digital instruments.
  - .4 Test each DI to ensure proper settings and switching contacts.
  - .5 Test each DO to ensure proper operation and lag time.
  - .6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.
  - .7 Test operating software.
  - .8 Test application software and provide samples of logs and commands.
  - .9 Verify each CDL including energy optimization programs.
  - .10 Debug software.
  - .11 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space on commissioning technician and Departmental Representative. This document will be used in final startup testing.
- .3 Final Startup Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of Departmental Representative and provide:
  - .1 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.
- .4 Departmental Representative to verify reported results.

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

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

END

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 35 29.06 - Health and Safety Requirements.

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

1.2 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 Institute of Electrical and Electronics Engineers (IEEE).
- .1 IEEE 260.1-2004, IEEE Standard Letter Symbols for Units of Measurement (SI Customary Inch-Pound Units, and Certain Other Units).

.3 Canadian Standards Association (CSA International).
- .1 CAN/CSA-Z234.1-00-(R2006), Canadian Metric Practice Guide.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
- .1 Material Safety Data Sheets (MSDS).

1.3 ACRONYMS AND ABBREVIATIONS

.1 Acronyms used in EMCS:
- .1 AEL - Average Effectiveness Level.
- .2 AI - Analog Input.
- .3 AIT - Agreement on International Trade.
- .4 AO - Analog Output.
- .5 BACnet - Building Automation and Control Network.
- .6 BC(s) - Building Controller(s).
- .7 BECC - Building Environmental Control Center.
- .8 CAD - Computer Aided Design.
- .9 CDL - Control Description Logic.
- .10 CDS - Control Design Schematic.
- .11 COSV - Change of State or Value.
- .12 CPU - Central Processing Unit.
- .13 DI - Digital Input.
- .14 DO - Digital Output.
- .15 DP - Differential Pressure.
- .16 ECU - Equipment Control Unit.
- .17 EMCS - Energy Monitoring and Control System.
- .18 HVAC - Heating, Ventilation, Air Conditioning.
- .19 IDE - Interface Device Equipment.
- .20 I/O - Input/Output.
- .21 ISA - Industry Standard Architecture.
- .22 LAN - Local Area Network.
- .23 LCU - Local Control Unit.
- .24 MCU - Master Control Unit.
- .25 NAFTA - North American Free Trade Agreement.
- .26 NC - Normally Closed.
- .27 NO - Normally Open.
- .28 OS - Operating System.

1.3 ACRONYMS AND ABBREVIATIONS (Cont'd)

.1 (Cont'd)

.29 O&M - Operation and Maintenance.
.30 OWS - Operator Work Station.
.31 PC - Personal Computer.
.32 PCI - Peripheral Control Interface.
.33 PCMCIA - Personal Computer Micro-Card Interface Adapter.
.34 PID - Proportional, Integral and Derivative.
.35 RAM - Random Access Memory.
.36 SP - Static Pressure.
.37 ROM - Read Only Memory.
.38 TCU - Terminal Control Unit.
.39 USB - Universal Serial Bus.
.40 UPS - Uninterruptible Power Supply.
.41 VAV - Variable Air Volume.

1.4 DEFINITIONS

.1 Point: may be logical or physical.

.1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.
.2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties, or providing status conditions of contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.

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

.1 Point identifier: comprised of three descriptors, "area" descriptor, "system" descriptor and "point" descriptor, for which database to provide 25 character field for each point identifier. "System" is system that point is located on.
.1 Area descriptor: building or part of building where point is located.
.2 System descriptor: system that point is located on.
.3 Point descriptor: physical or logical point description. For point identifier "area", "system" and "point" will be shortforms or acronyms. Database must provide 25character field for each point identifier.
.2 Point expansion : comprised of three fields, one for each descriptor. Expanded form of shortform or acronym used in "area", "system" and "point" descriptors is placed into appropriate point expansion field. Database must provide 32 character field for each point expansion.
.3 Bilingual systems to include additional point identifier expansion fields of equal capacity for each point name for second language.
.1 System to support use of numbers and readable characters including blanks, periods or underscores to enhance user readability for each of the above strings.

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

.1 AI (analog input).
.2 AO (analog output).
.3 DI (digital input).
.4 DO (digital output).
.5 Pulse inputs.

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

.1 Printouts: to IEEE 260.1.

1.5 SYSTEM DESCRIPTION

.1 Refer to Section 25 90 01 - EMCS: Site Requirements, Applications and Systems Sequences of Operation.

.2 Work covered by sections referred to above consists of fully operational EMCS, including, but not limited to, following:
- .1 Building Controllers.
- .2 Control devices as listed in I/O point summary tables.
- .3 OWS(s).
- .4 Data communications equipment necessary to effect EMCS data transmission system.
- .5 Field control devices.
- .6 Software/Hardware complete with full documentation.
- .7 Complete operating and maintenance manuals.
- .8 Training of personnel.
- .9 Acceptance tests, technical support during commissioning, full documentation.
- .10 Wiring interface co-ordination of equipment supplied by others.
- .11 Miscellaneous work as specified in these sections and as indicated.

.3 General Requirements:
- .1 Provide conduit and wiring linking elements of system.
- .2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by Departmental Representative prior to installation.
- .3 Location of controllers as reviewed by Departmental Representative prior to installation.
- .4 Provide utility power to EMCS as indicated.
- .5 Metric references: in accordance with CAN/CSA Z234.1.

.4 Language Operating Requirements:
- .1 Provide English operator selectable access codes.
- .2 Use non-linguistic symbols for displays on graphic terminals wherever possible. Other information to be in English.
- .3 Operating system executive: provide primary hardware-to-software interface specified as part of hardware purchase with associated documentation to be in English.
- .4 System manager software: include in English system definition point database, additions, deletions or modifications, control loop statements, use of high level programming languages, report generator utility and other OS utilities used for maintaining optimal operating efficiency.
- .5 Include, in English:
  - .1 Input and output commands and messages from operator-initiated functions and field related changes and alarms as defined in CDL's or assigned limits (i.e. commands relating to day-to-day operating functions and not related to system modifications, additions, or logic re-definements).
  - .2 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points.
  - .3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit for review:
- .1 Equipment list and systems manufacturers at time of tender within 48 h after award of contract.

1.6 ACTION AND INFORMATIONAL SUBMITTALS (Cont'd)

.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.
- .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.

1.7 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.

1.8 EXISTING-CONTROL COMPONENTS

.1 All new controls to be compatible with existing BAS.

1.9 DESIGNATED CONTRACTOR

.1 Hire the services of R+R Automation Inc. to provide all control equipment and complete the work of all EMCS sections.

PART 2 - PRODUCTS

2.1 EQUIPMENT .1 There is an existing ABB 800XA control system presently installed at this facility. All materials must be selected to ensure full compatability with existing ABB automation control system.

PART 3 - EXECUTION

3.1 MANUFACTURER'S RECOMMENDATIONS .1 Installation: to manufacturer's recommendations.

END

PART 1 - GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Control devices integral to the Building Energy Monitoring and Control System (EMCS): transmitters, sensors,controls, meters, switches, transducers, valves, valve actuators, and low voltage current transformers.

.2 Related Sections:

.1 Section 01 73 00 - Execution Requirements.

.2 Section 23 05 23 - Valves.

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

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

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

.6 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).

1.3 DEFINITIONS

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

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.

PART 2 - PRODUCTS

2.1 GENERAL

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

.2 Internal parts to be assembled in watertight, heat resistant, assembly.

.3 Operating conditions: 0 - 40 degrees C with 10 - 90% RH (non-condensing) for equipment installed indoors, -45 to 50 degrees C weatherproof for equipment installed outdoors, 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 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: to be resistance or thermocouple type to following requirements:
- .1 Thermocouples: to be limited to temperature range of 200°C and over.
- .2 RTD's: 100/1000 ohm at 0°C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored leadwires. Coefficient of resistivity: 0.00385 ohms/ohm°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°C.
- .6 Immersion wells: NPS 3/4, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length 100 or 150 mm as indicated. Strap-on pipe temperature sensors are acceptable only where system shut-down & drainage is not possible.

.2 Sensors:
- .1 Outside water and 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 ohm at 0°C, platinum resistance detectors type sensors.
- .2 Power supply: 575 ohms at 24 V DC into load of 575 ohms. Power supply effect less than 0.01°C per volt change.
- .3 Output signal: 4 - 20 mA into 500 ohm maximum load.
- .4 Input and output short circuit and open circuit protection.
- .5 Output variation: less than 0.2% of full scale for supply voltage variation of 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 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°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°C to plus 50°C, plus or minus 0.5°C.
  - .2 0 to 100°C, plus or minus 0.5°C.
  - .3 0 to 50°C, plus or minus 0.25°C.
  - .4 0 to 25°C, plus or minus 0.1°C.
  - .5 10 to 35°C, plus or minus 0.25°C.

2.4 PRESSURE AND DIFFERENTIAL PRESSURE SENSORS AND SWITCHES

.1 Requirements:
- .1 Range: as indicated in I/O summaries.
  - .1 Pressure sensing elements: bourdon tube, bellows or diaphragm type.
- .2 Adjustable setpoint and differential.
- .3 Switch: snap action type, rated at 120V, 15 amps AC or 24 V DC.
- .4 Sensor assembly: to operate automatically and reset automatically when conditions return to normal. Over-pressure input protection to at least twice rated input pressure.
- .5 Accuracy: within 2% repetitive switching.
- .6 Provide sensor pressure and accuracy ratings:
  - .1 Chilled water range: 0 to 2068 kPa.
- .7 Provide sensors with isolation valve and snubber between sensor and pressure source.

2.5 DIFFERENTIAL PRESSURE TRANSMITTERS

.1 Requirements:
- .1 Internal materials: suitable for continuous contact with process material measured including water, 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 0.5% full scale output over entire range.
- .7 Output short circuit and open circuit protection.
- .8 Differential pressure ranges to suit application.

2.6 ELECTRICAL RELAYS

.1 Requirements:
- .1 Double voltage, DPDT, plug-in type with termination base.
- .2 Coils: rated for 120V AC or 24V DC. Other voltage: provide transformer.
- .3 Contacts: rated at 5 amps at 120 V AC.
- .4 Relay to have visual status indication.

2.7 CONTROL VALVES

.1 Requirements:
- .1 Construction: reference Section 23 05 23 - Valves.
- .2 Two or three port as indicated.
- .3 Flow characteristics: ON/OFF control unless specified otherwise.
- .4 Minimum shut-off pressure: refer to drawings and valve specifications.
- .5 Control valves shall be line size.
- .6 Control valve to be supplied by Div. 25 and installed by Div. 23.

2.8 ELECTRONIC / ELECTRIC VALVE ACTUATORS

.1 Requirements:
- .1 Construction: steel, cast iron, aluminum.
- .2 Control signal: 4-20 mA DC.
- .3 Positioning time: to suit application. 90 sec maximum.
- .4 Scale or dial indication of actual control valve position.
- .5 Size actuator to meet requirements and performance of control valve specifications.
- .6 Actuator shall provide minimum torque required for full valve shut-off position.
- .7 Actuators installed outdoors to be weatherproof.
- .8 Actuators to be mounted on existing valves.

.2 Isolation and Electrical:
- .1 Internal electronic control boards shall have clearly marked and different size connection terminals for Power and Control Signals to prevent incorrect wiring and shall provide CW and CCW push buttons for local manual control. The actuator control electronics shall be electrically isolated to allow multiple actuators to be wired in parallel. Electronic control boards shall be protected on the outward side with insulating overlays providing operating instructions and additional safety. Additionally, electronic control boards shall include a simple user-interface, including slide switches and selection knob for mode selection, calibration and set up. The electronic control boards will also supply a 4-20 mA position feedback signal and include a holding brake feature to prevent back-driving. All internal connections, (motor leads, limit switch leads, option connectors, etc.) shall be coded, using different style connectors for each function, to prevent incorrect

2.8 ELECTRONIC / ELECTRIC VALVE ACTUATORS (Cont'd)

.2 Isolation and Electrical:(Cont'd)

.1 (Cont'd)

wiring. All connections will plug-in to simplify field repairs and upgrades. DC applications will utilize an equally reliable DC to DC regulator. Other than periodic battery replacement; no maintenance will be required.

.3 Motor:

.1 The internal electric motor will be of a brushless DC type, capable of running continuously at full torque at ambient temperature at or below 40°C.

.4 Lubrication:

.1 All rotating power train components will be coated with a multi-purpose grease. Lubricants will be suitable for ambient conditions of -40°C to 54°C. Provide heater and thermostat assembly for valves installed outside.

.5 Gearing:

.1 The powertrain will be comprised of hardened steel, machine cut spur gears. Non-metallic, aluminum, cast or stamped gearing will not be permitted.

.6 Limit Switches:

.1 Actuators will have two standard end-of-travel switches, single pole double throw, rated at 11 amps at 250 VAC. Under normal operation the end of travel limit switches will not be activated; activating the limit switches will interrupt actuator travel. Provide two additional limit switches, adjustable to operate at any position as required by the process application, may be added to the actuator for end of travel indication.

.7 On/Off Control (Open/Close Operation)

.1 Open/Close actuators require separate Power and Control signals. The Power signal must be constantly maintained; immediately upon loss of the Power signal. The Control signal consists of one to three maintained AC contacts and the actuator can be set to operate in Two-wire, Three-wire or Three-position modes. In Two-wire mode a signal is maintained to drive the actuator to the CCW position and removed to drive to the CW position. In Three-wire mode separate Control signals are applied to drive the actuator to the CW and CCW positions and may be removed at any point in mid-stroke to position the valve or damper. In Three-position mode separate Control signals are applied to drive the actuator to the CW, "MID" or CCW positions and may be removed at any point in mid-stroke to position the valve or damper. The Power Loss Position may be either the full CW, the full CCW or "MID" position and is determined by the fail position selection switch. All valves to be ON/OFF control except for condenser water bypass located on the 13th floor.

.8 Proportional Control (Modulating Operation)

.1 Modulating control actuators will accept a variable, proportional 4-20 mA or 0-1OVDC valve position signal and respond by positioning the valve linearly with an accuracy of 1%. Normally, the actuator will drive clockwise in response to a decreasing control signal; however,the actuator will be capable of "reverse acting" operation (driving counter-clockwise in response to a decreasing control signal) without internal wiring changes. The actuator will also provide the ability to adjust the sensitivity to control signal changes. Slide switches will enable the user to set the actuator response to a loss of control signal, select the "fail" position upon loss of Power and select either the single cycle or multi-cycle loss of power mode. Locked rotor, stall protection will detect whenever the actuator is unable to achieve the position commanded by the control signal, and will terminate power to the motor in order to prevent damage due to repeated stall conditions.

2.9 ULTRASONIC FLOW METER

.1 Clamp-on bi-directional ultrasonic measuring sensors complete with transmitter. Sensor holder to be stainless steel.

.2 Output signal: 4-20 mA max., 30 V DC.

.3 Accuracy: within 0.5%.

.4 Power supply: 9-32 V DC for the transmitter. Sensor is powered by the transmitter.

.5 Fluid temperature range: -20°C - 80°C.

.6 Fluid flow range: 0 - 570 L/s.

.7 Acceptable material: E.H. Proline Prosonic 93WA.

2.10 ELECTRO-MAGNETIC FLOW METER

.1 Electromagnetic flow meter system for a bidirectional measurement complete with transmitter, sensor to have flanged connections suitable for water pressure (Class 150 for condenser water and Class 300 for chilled water).

.2 Output signal: 4-20 mA, operating voltage 18-30VDC.

.3 Accuracy: within 0.5%.

.4 Fluid temperature range: -20°C to 50°C.

.5 Operable flow range: 1000 to 1.

.6 Measurement range: 0.01 to 10 m/s.

.7 Acceptable material: E.H. Promag 50 W.

2.11 DAY AND NIGHT CAMERA

.1 General:

.1 IP camera that withstands environmental temperatures ranging from -40 to 75°C without a heater/cooling fan. Industrial-grade, H.264 box-type IP camera that combines HD resolution (1280 x 720), advanced IVA (Intelligent Video Analysis) technology, and de-mist technology to enhance surveillance system efficiency while delivering state-of-the-art video quality. Built-in removable IR-cut filter and automatic color mode switching, suitable for day-and-night use. Designed for any indoor and outdoor applications that require operational reliability. High EMI/surge protection, IP66 housing for rain/dust protection. This camera is powered input supporting 12/24 VDC.

.2 Provide indoor/outdoor housing complete with tempered glass window, dual side/screw-locking latch and wall mount bracket.

.3 Provide 3.1 to 8 mm F1.2 day and night lens.

.4 Provide fanless pan/tilt scanner, 360° continuous rotation. Input voltage 24 VAC, to be controlled via BAS.

.5 Install as per manufacturer's instructions and as indicated on drawings.

.6 Cameras to be connected to BAS interface.

2.12 ELECTRONIC WATER LEVEL CONTROL

.1 Water level to include five water level sensors (high alarm, make-up valve OFF, make-up valve ON, low alarm and ground) with a NEMA 4X enclosure mounted in a cleanable 40 PVC standpipe connected to BAS and make-up water solenoid valve. High and low alarm to be connected to BAS.

.2 Supply voltage: 120V, 60 Hz.

.3 Water level sensor to include status code L.E.D. to indicate status.

.4 Install water level as indicated and as per manufacturer's instructions.

2.13 WIRING

.1 Wiring must be continuous without joints.

.2 All wiring to be in EMT conduits.

.3 Sizes:
- .1 Field wiring to digital device: #18AWG or 20AWG stranded twisted pair.
- .2 Analog input and output: shielded #18 minimum solid copper or #20 minimum stranded twisted pair.

PART 3 - EXECUTION

3.1 INSTALLATION

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

.2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions. Install and wire chiller remote control devices and panel controls as per manufacturer's instructions.

.3 Temperature transmitters, controllers and relays: install in NEMA 1 enclosure for indoors, NEMA 4 for outdoors 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. Maintain fire rating integrity.

.6 Electrical:
- .1 Complete installation in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
- .3 Install all 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.

3.2 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.

3.3 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES AND SENSORS

.1 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.

3.4 TEMPERATURE 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 Thermowells: install for piping installations.
- .1 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.

3.5 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. Provide commissioning service by the manufacturer's authorized representative.

.2 Identify wiring and conduit clearly.

END

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 23 05 33 - Heat Tracing for HVAC Piping and Tanks for the pipe heat race sequence.

1.2 SUMMARY

.1 Section Includes:

.1 At minimum detailed narrative description of Sequence of Operation of each system including ramping periods and reset schedules. Controls to provide the following:

.1 Control Description Logic (CDL) for each system.

.2 Input/Output Point Summary Tables for each system.

.3 System Diagrams consisting of the following; EMCS System architectural diagram, Control Design Schematic for each system (as viewed on OWS), System flow diagram for each system with electrical ladder diagram for MCC starter interface.

1.3 SEQUENCING

.1 Sequencing of operations for Cooling Tower CT-1 & CT-2 system as follows:

.1 When the primary chilled water system is enabled (indicated by a primary chilled water pump "ON"), the associated cooling tower isolation valves opens prior to starting the associated condenser water pump. Cooling towers CT-1 & CT-2 to stage ON and OFF with the associated chiller No. 5 and No. 6. If the condenser water supply temperature increases the cooling tower fans are to start sequentially at minimum speed. The cooling tower fan variable frequency drive is modulated to maintain the condenser water set point of 18°C (65°F) (adjustable). When the condenser water supply temperature decreases, the cooling tower fan is modulated to minimum speed. With the cooling tower fan at minimum speed, a further decrease in condenser water supply temperature causes the fan to cycle "OFF" & 3-way diverting valve to bypass to the sump to maintain minimum condenser water at 13°C (56°F). When OA is below 0°C (32°F) the cooling tower fan speed shall be between 50% min. & 100% max. (adjustable). During startup and in shoulder and winter season operation (condenser sump is below 13°C (56°F)), modulate bypass valve to maintain a minimum of 13°C (56°F) condenser water supply. The condenser water shall be diverted to the sump when flow is being bypassed.

.2 Provide de-ice cycle which will be manually activated. De-ice cycle to reverse cooling tower fans at 50% speed for a maximum duration of 30 minutes. De-ice cycle to only be repeated every 3 hours. Provide a time delay of 1 minute between forward and reverse fan operation.

.3 Provide a temperature sensor in each cooling tower sump pit. When water temperature within the sump is below 3°C, an alarm will be announced on the BAS.

.4 Upon loss of power when OA is below 0°C and for a minimum duration of 5 minutes (adjustable), drain valve shall open to prevent freezing of water in the cooling tower sumps and pipes. Controls for this item to be on emergency power.

.5 Electronic water level control to control make-up water level and provide low and high alarm of condenser sump to BAS. Existing mechanical float connected to existing DCW solenoid valves to remain as a secondary means of make-up water control. During loss of power, make-up water valves to remain closed.

.6 Refer to Section 23 05 33 - Heat Tracing for HVAC Piping and Tanks for the pipe heat trace sequence.

.7 Refer to Section 23 21 14 - Hydronic Specialties for the basin heater sequence.

1.3 SEQUENCING (Cont'd)

.2 Sequence of operation for chiller No. 5 & No. 6 systems as follows:

.1 Chillers shall stage ON based on chilled water supply temperature - if Lead chiller fails, Lag chiller shall start and an alarm announced at the BAS.

.2 Total flow of secondary pumps P5 and P6, shall not exceed the total flow of primary pumps P1 and P2.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END