
Part 1 General

1.1 Responsibility

- .1 The Controls Contractor shall be responsible for this section and all applicable portions of Section 20 05 01 - Common Work Results for Mechanical.
- .2 Contractor shall be responsible for all EMCS requirements shown on all heating, plumbing, ventilation and controls drawings. Refer to all sequences and miscellaneous requirements. Refer to all mechanical equipment specifications.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Indicate on complete control diagrams, positions, model numbers, settings, set point and reset schedules, piping and wiring layouts.
- .3 Provide damper schedules indicating sizes, configuration, capacity and locations. If size varies greater than (10%), obtain approval of Departmental Representative.
- .4 Provide technical literature on system components.
- .5 Provide “system architecture” diagram indicating new system(s).
- .6 Provide sample “points verification” sheet.

1.3 MAINTENANCE AND AS-BUILT DRAWINGS

- .1 Provide maintenance data for incorporation into maintenance manual specified in Section 01 33 00 – Submittal Procedures.
- .2 Provide “As-Built” information in accordance with Section 01 33 00 – Submittal Procedures.

1.4 GUARANTEE

- .1 Provide written guarantee against faulty material and workmanship for a period of one (1) year from the date of acceptance.

1.5 TRAINING & PROGRAMMING

- .1 Provide one (1) day of training on beneficial operation of the systems installed.
- .2 Allow for one (1) day of additional programming on-site as requested by Departmental Representative.
- .3 Allow for one (1) day of system verification. Notify Departmental Representative one (1) week in advance of system verification. System verification shall be performed two (2) weeks in advance of request for interim inspection.
- .4 Allow for three (3) hours to assist in balancing and commissioning.

1.6 SCOPE OF WORK

- .1 The words “controls”, “BMS”, “EMCS”, and “HVAC Controls” shall be considered interchangeable and all refer to the system of controls for HVAC systems. The work covered by this specification and related sections consists of providing shop drawings, equipment, labour, materials, engineering, technical supervision and transportation as required to add to an existing Delta control system, reuse existing software, and add a new sensor to graphics, as shown on plans and as required to provide operation specified in strict accordance with these specifications and subject to the terms and conditions of the contract. The work in general consists of but is not limited to, the following:
 - .1 The preparation of submittals and provisions of all related services.
 - .2 Furnish and install, programmable control units, sensors, control devices and wire in the facilities as require to provide the operation specified.
 - .3 Prepare, design and load all software and provide all “locks” or “keys” required to implement a complete and operational EMCS. EMCS shall be ready for use, including all operating parameters, set points and schedules.
 - .4 Provide system testing of every point, sequence verification and points verifications prior to interim inspection. Submit point and sequence verifications prior to interim inspections.

1.7 LOCAL PROGRAMMING

- .1 Only controls contractors authorized to perform work on Delta control systems will be acceptable. This will help to ensure that the specified project requirements are interpreted, designed and applied successfully for this project.
- .2 Minor changes as requested by the Departmental Representative, such as setpoint adjustment, minor sequences modifications and graphic site shall be performed at no additional charge during system verifications.

1.8 EXISTING CONTROL COMPONENTS

- .1 Utilize existing control wiring piping as indicated.
- .2 Re-use field control devices that are usable in their original configuration provided that they conform to applicable codes, standards specifications.
 - .1 Do not modify original design of existing devices without written permission from Departmental Representative.
 - .2 Provide for new, properly designed device where re-usability of components is uncertain.
- .3 Inspect and test existing devices intended for re-use within thirty (30) days of award of contract, and prior to installation of new devices.
 - .1 Furnish test report within forty (40) days of award of contract listing each component to be re-used and indicating whether it is in good order or requires repair by Departmental Representative.
 - .2 Failure to produce test report will constitute acceptance of existing devices by contractor.
- .4 Non-functioning items:

- .1 Provide with report specification sheets or written functional requirements to support findings.
- .2 Departmental Representative will repair or replace existing items judged defective yet deemed necessary for EMCS.
- .5 Submit written request for permission to disconnect controls and to obtain equipment downtime before proceeding with Work.
- .6 Assume responsibility for controls to be incorporated into EMCS after written receipt of approval from Departmental Representative.
 - .1 Be responsible for items repaired or replaced by Departmental Representative.
 - .2 Be responsible for repair costs due to negligence or abuse of equipment.
 - .3 Responsibility for existing devices terminates upon final acceptance of EMCS applicable portions of EMCS as approved by Departmental Representative.
- .7 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

Part 2 Products

2.1 MATERIALS

- .1 There is an existing Delta Controls system presently installed in the building. Add to graphics to incorporate all points to match the base building construction standards.

2.2 USER INTERFACE COMPUTER

- .1 There is no user interface P.C. required for this project.

2.3 HVAC SYSTEMS GRAPHICS

- .1 Generate, program, install, and confirm application of virtual system visual graphics for each point as specified.
- .2 Floor plan graphics shall clearly identify the system(s) boundaries.
- .3 Indicate on graphics all system(s) parameters.
- .4 Home screen graphic shall display OAT, OA HUM, current weather data, snow day button & occupancy mode indication. Retrieve outside air temperature and humidity data for this location from Environment Canada website.

2.4 NETWORK

- .1 Controls shall be web based and accessible from building management network. This Contractor shall install and operate a new network cable to LAN drop provided by Electrical Division in Mechanical room(s). This contractor will provide all cabling, network or otherwise to bring all HVAC controls points back to the LAN connection at main controller in Mechanical room. All high-level controls architecture shall be based on Ethernet.

2.5 D.D.C. CONTROLLERS

- .1 The DDC controllers shall be native BACNet microprocessor based, stand alone, multi-tasking, multi-user, real time digital control processor; consisting of modular hardware, interface receptacles, communications port, sized to meet the requirements of this specifications, sequence of operation and points list indicated. High level controllers shall be installed that communicate over Ethernet BACNet UDPI/P; Minimum one per mechanical room.
 - .1 Allow for 10% spare points on each DDC controller. Minimum two (2) spare points per controller.
- .2 DDC Controllers shall be capable of monitoring the following type of inputs.
 - .1 Analog Inputs
 - .1 4-20 mAdc
 - .2 0-10 Vdc
 - .3 Thermistors
 - .4 10,000 ohm R.T.D.s
 - .2 Digital Inputs
 - .1 Dry contacts
 - .2 Pulse accumulator
 - .3 Voltage sensing
- .3 DDC controllers shall be capable of providing the following types of controlled outputs.
 - .1 Digital Outputs
 - .1 Contact closure
 - .2 Analog Outputs
 - .3 0-138 kPa (0-20 psi.)
 - .4 4-20 mAdc
 - .5 0-10 Vdc
- .4 Controllers Backup
 - .1 In the event of loss of normal power a battery backup shall be provided to support the real time clock and all volatile memory for a period of one hundred (100) hours.
 - .2 Upon restoration of normal power, the DDC Controller shall automatically resume full operation without manual input.
 - .3 Should DDC Controller memory be lost for any reason, the user shall have the capability of reloading the DDC Controller via the local port.
- .5 Resident Software
 - .1 General
 - .1 All necessary software to form a complete operating system as described in this specification shall be provided.
 - .2 The software programs specified in this section shall be provided as an integral part of DDC Controllers and shall not be dependent upon any higher level computer for execution.

- .3 All custom programs and routines shall be fully programmable on-site without the use of any special software or hardware. The Departmental Representative shall have the capability of adding or deleting points and modify control strategies.
- .2 Control Software Description
 - .1 The DDC Controllers shall have the ability to perform the following pretested control algorithms:
 - .1 Two-position control.
 - .2 Proportional control.
 - .3 Proportional plus integral control.
 - .4 Proportional, integral, plus derivative control.
 - .2 Upon the resumption of normal power, DDC Controller shall analyze the status of all controlled equipment, compare it with normal occupancy scheduling and energize or de-energize equipment as necessary to resume normal operations after power failure.
 - .3 DDC Controllers shall have the ability to perform any or all of the following:
 - .1 Time-of-day scheduling.
 - .2 Time-of-work scheduling.
 - .3 Time-of-year scheduling.
 - .4 Daylight savings switch over.
 - .5 Day/Night setback control.
 - .6 Start-Stop time optimization.
 - .7 Temperature-compensated duty cycling.
 - .8 Temperature reset.
 - .9 Trend logs.
 - .10 Demand limiting.
- .6 FCC Guidelines
 - .1 Equipment shall comply with FCC Part 15, Class "A" device, designed to provide reasonable protection against radio frequency interference.
- .7 All new controllers shall be powered from 120V power source and shall also have a UPS such that no memory losses will occur in a power loss situation. EMCS shall obtain 120V at provided source, and wire to controller.
- .8 All controllers shall be mounted in enclosed, lockable cabinets.
- .9 Departmental Representative shall provide numbering and addressing scheme for controllers.
- .10 Standard of Acceptance:
 - .1 Delta Controls DSC - line.

2.6 FIELD DEVICES

- .1 Temperature Sensors
 - .1 Space Temperature Sensors

- .1 Blank Faceplate (Indicated as “S” on drawings)
 - .1 10k ohm \pm 0.2°C (0.36°F) at 25°C (77°F).
- .2 All space temperature sensors shall be installed in a 100mm x 50mm (4” x 2”) metal backbox, c/w 13mm (1/2”) EMT stubbed to an accessible location in ceiling.

Part 3 Execution

3.1 INSTALLATION ELECTRICAL

- .1 Furnish electrical control wiring and conduit (24 and/or 120 volt) unless indicated otherwise on plans. All controls wiring including 120V and 24V shall be run in metal conduit (EMT). 120V power shall be provided in dedicated EMCS junction boxes where indicated on Electrical Drawing by Electrical Division. This contractor shall obtain power from nearest provided junction box and provide all necessary 120V or low voltage power distribution from that point.
- .2 All conduit shall be run concealed in all finished areas (i.e. all areas except service areas such as mechanical spaces).
- .3 Where conduit is run exposed, it shall be neat in appearance and run parallel to the structural grid of the building. Suitable fittings and covers shall be used. Proper offsets shall be made where conduit enters or leaves fittings and boxes. All conduit shall be securely fastened by approved hangers or malleable iron one-hole straps at the following intervals:

Conduit Size mm	Horizontal Hanging Points m (ft)	Vertical Hanging Points m (ft)
12 and 29	1.5 (5)	2.0 (6.5)
25 and 31	1.8 (6)	2.4 (8)
Over 31	3.0 (10)	3.0 (10)

- .4 All threads shall be set neatly, the ends squared and the inner diameter reamed smooth to remove burrs.
- .5 Conduit boxes for all receptacles, thermostats and switches where conduit is run exposed shall be of the FS type.
- .6 Cover screws for all conduit fittings and boxes shall be carefully cut to avoid damage to conductors.
- .7 During construction all open ends of conduit shall be capped with threaded caps immediately after installation.
- .8 All conduit fittings shall form a continuous metallic path and shall be grounded in accordance with the latest requirements of the Canadian Electrical Code.
- .9 Conduit terminations at equipment whose position is adjustable or which is subject to vibration shall be flexible, galvanized steel for a length not exceeding 500mm (20”). Where moisture conditions are such to require waterproof wiring, the flexible conduit shall have a plastic jacket seal-tight or equal.

- .10 Wire cable and conduit shall be installed to meet or exceed Canadian Electrical Code, latest edition.
- .11 Colour coding of control wiring to be used consistently throughout the facility. Coordinate with other Electrical Contractors to ensure there is no duplication of colours.
- .12 All conductors and branch circuit wiring shall be of sufficient size so that the voltage drop from the services entrance to the device being fed is not greater than 3% with the circuit loaded as shown.

3.2 START-UP AND ADJUSTMENT

- .1 Upon completion of installation, test, adjust and regulate controls or safety equipment provided under this section.
- .2 Adjust and place in operating condition.
- .3 Plasticized control and wiring schematics shall be provided for each fan system mounted inside the cabinet.
- .4 Supply all necessary hardware and software for full on site programming.

3.3 SEQUENCES OF OPERATION

- .1 Unit heater control:
 - .1 On a call for heat, unit heater shall start and run until call for heating is satisfied and then heater shall shut down.

3.4 MISCELLANEOUS REQUIREMENTS

- .1 Refer to 20 05 53 - Mechanical Identification for identification requirements. All controls conduit shall be identified on minimum 3m (10'-0") c/c with one 25mm (1") orange and one 25mm (1") brown stripe.
- .2 Contractor shall install all materials supplied by him in this section.
- .3 Controls contractor shall program alarms for all points in the system with industry standard alarm trigger points. Devices requiring alarms include but not limited to the following sensors, transducers, switches actuators, motors, VFD'S, all pieces of equipment etc.
- .4 Alarm trigger points shall cover all conditions for when a system, component or device as part of a system is: out of comfort range or out of code requirement range, has failed, has lost status, has a general alarm or is not meeting intended level of performance. Contractor shall program typical time delays as per industry standard.
- .5 Program specific alarms as requested by Departmental Representative whether they are implied to these documents or not to the satisfaction of the Departmental Representative.

END OF SECTION