

1 GENERAL

- 1.1 The work of this section includes the provision of all design, labour, materials, equipment and services required to fabricate and install controls and instrumentation as required for a complete project. The work includes, but is not necessarily limited to, the items referenced herein:
 - 1.1.1 Controls and Instrumentation.
- 1.2 Provide a stand alone, direct digital system for control, management, and monitoring. System to function as an Energy Monitoring and Control System (EMCS). Connect to existing EMCS communications trunk at controller panel gateway. Provide gateway where required to complete this work.
- 1.3 Acceptable Materials: *[Johnson Controls; Siemens; VCI Controls; Barber Coleman; Trane]*.
- 1.4 *[Proponent]* shall declare and be asked to demonstrate level of open protocol and compatibility with BACNet or Eschelon standards. Provide references from existing systems.
- 1.5 Documentation:
 - 1.5.1 Provide Control System Documentation as follows.
 - 1.5.1.1 An English language narrative sequence of operation for each controlled system.
 - 1.5.1.2 Control Description Logic (CDL) statements describing in detail the sequence of logic operations for each analog output (AO) and digital output (DO) control loop.
 - 1.5.1.3 Mechanical control schematics:
 - 1.5.1.3.1 Motor starter and equipment control schedule and schematic.
 - 1.5.1.3.2 Control System Electrical Ladder Diagram or Electrical Control Schematics.
 - 1.5.1.3.3 A schedule of all input and output points. Point labeling shall comply with labeling convention in place for existing installations at the site.
 - 1.5.1.3.4 Provide connection to all Energy Meters. Monitor all water levels and provide audible warning devices.
 - 1.5.1.3.5 Provide accurate drawing of trunk and LAN wiring locations on floor plans.

- 1.6 Testing and Commissioning
 - 1.6.1 Test and verify all major subsystems of the complete building control system including all field components.
 - 1.6.2 Conduct an operational test of not less than 30 consecutive days, 24 hours per day, on the complete and total system. If the equipment operates at an average effectiveness level (AEL) of 99% or better during the test period, it will be deemed to have met the required standard of completion. In the event the required AEL is not reached during the initial 30 day period, the final acceptance test period will be extended on a day to day basis until the required AEL is reached for 30 consecutive calendar days.
 - 1.6.3 AEL is defined as the ratio between: the total thirty day test period less any system malfunction down time accumulated within that period, and the thirty day period.
 - 1.6.4 When the *[Design Builder]* has satisfied himself as to proper system operation he shall advise the Owner to establish a date for detailed Final Acceptance. Final Acceptance will involve a point-by-point check of all hardware and software items including graphics and displayed data, as well as performing tasks as directed. As an integral part of this procedure, the *[Design Builder]* shall conduct a 7-day system performance verification test. The system must function to satisfactory performance level with no systemic malfunctions for a minimum of 7 days to pass this test and enable final acceptance. Provide top-level access to all system software and controls at least 30 days after Final Acceptance.
- 1.7 Training
 - 1.7.1 Provide on-site training by competent instructors to designated personnel. Training will address the adjustment, operation, maintenance and safety requirements of the equipment and system provided. Training shall be specific to this installation.
 - 1.7.2 Provide training materials including a training manual in English for each trainee.
 - 1.7.3 Provide training in two phases over a 6-month period.
 - 1.7.3.1 Phase 1 shall be for a four-day period prior to the 30 day test period and will include on the job training during the 30 day acceptance period. This training shall include: system architecture, communications, operation of computer and peripherals and detailed instruction in operator interface for control of HVAC systems, control logic for each system, and elementary preventive maintenance

- 1.7.3.2 Provide Phase 2 training twelve to sixteen weeks after system acceptance. Provide a minimum of four days training. Training will address general equipment layout, trouble shooting of all system components, preventive maintenance of all components, and maintenance and calibration of all sensors and control devices. Training will also address the use of application programs, programming of controllers and trouble shooting and debugging the system. Provide additional information necessary to respond to concerns raised by trainees during the operations period to date.
- 1.7.4 Provide access to operator work station and all graphics 30 days prior to start of the test period.

1.8 Warranty and Service

- 1.8.1 Warrant the complete system to be free from defects in workmanship and materials including system and application software for a period of two years from the date of final acceptance.
- 1.8.2 Provide a complete service contract for a period of 30 months from the date of acceptance. During this period, the controls [*Design Builder's*] supplier shall maintain at his office on-line monitoring of the system through a modem connected to the system. Complete all repair and servicing of the system within 24 hours of detecting a fault.

2 GENERAL

- 2.1 Provide digital controllers, programmable and independently operable (stand alone). Provide a system immune to voltage fluctuations and spikes, RF interference, power failures, and surges.
- 2.2 Provide a high-speed communications network incorporating a standard protocol to link the independent controllers, local terminals and the command and management centre. Ensure that the communications link permits access and information transfer from all points within the network.
- 2.3 Provide a connection point in each mechanical room for lap top computer to permit access to information and system controls linked on the communications network.
- 2.4 The existing campus energy management and control system (EMCS) is [*Siemens System 600*].
- 2.5 The design of this installation shall result in a seamless expansion of the existing campus system.
- 2.6 Graphic display information shall match the existing campus system.
- 2.7 Control of mechanical equipment such as chillers, boilers, pumps, fans as well as control sequences such as optimal start, economizer, occupied/unoccupied schedules, etc. shall match the existing campus system in style and substance.
- 2.8 Provide completed graphics, shop drawings, details of components, and wiring schematics prior to commencement of site work and installation.
- 2.9 Select graphic colours for best visual contrast and hardcopy in black and white/grey tones.
- 2.10 Space temperature control shall be DDC. Spaces with similar thermal loads and use may be serviced by a common zone temperature control to a maximum size of 100 m² for interior zones and 50 m² for perimeter zones or zones requiring supplementary heat.
- 2.11 Monitor electrical consumption for the building overall and for the large, discrete gas services. This sub-system shall be by [*Carma*].
- 2.12 Monitor natural gas and water consumption for the building overall.
- 2.13 Monitor heating and cooling consumption for the discrete areas.

3 MATERIALS

3.1 Components

- 3.1.1 Transmitters, temperature, humidity, pressure, etc.: use industry standard signals. ie. 10VDC, 4-20 mA, dry contact, thermistor, RTD.

- 3.1.2 Motors and relays: electric-electronic type, heavy-duty construction, designed for industrial environment.
- 3.1.3 Computer: Latest and fastest technology. System to be approved by Owner prior to purchase. Provide full system manufacturers Operator Work Station software. Provide interconnection cable.
- 3.1.4 Internal, latest technology, modem and necessary software to transmit data over telephone lines to Central Control Monitoring System. Provide auto-dial / answer capability to report critical alarm or upload trend and historical information for archiving, and allow operator to access the system from a remote location, installed complete with alarm transmission to alpha-numeric pager.
- 3.1.5 Printer: *[HP Laserjet IV, colour]*.
- 3.1.6 Supply software programs that allow for the following:
 - 3.1.6.1 Multi-user operation of system with password protection.
 - 3.1.6.2 Multi-function operation.
 - 3.1.6.3 Dynamic colour graphics of all mechanical systems. Provide graphics for all controlled systems.
 - 3.1.6.4 Historical reviews and point trending/tracking.
 - 3.1.6.5 Dynamic analysis of control loop.
 - 3.1.6.6 Production of reports.
 - 3.1.6.7 Manual override of controlled points.
 - 3.1.6.8 Alarm generation and transmission
- 3.1.7 Provide two complete operator workstations as described above. One station shall be installed in the building and the other in the Physical Plant Office. Provide for means of communication and control from remote workstation.
- 3.2 Controls
 - 3.2.1 Design and provide the control system to monitor the status of and control the following systems:
 - 3.2.1.1 Plumbing pumps, pit levels.
 - 3.2.1.2 All HVAC systems and equipments including CO/NO ventilation, heating and cooling equipment, dampers, valves, fans, VAV boxes, condensers, burners, filters, etc.
 - 3.2.1.3 Lighting (monitoring).

- 3.2.1.4 Energy management and metering.
- 3.2.2 Thermostats: user adjustable within allowed range, wall mounted, equipped with lockable Lexan guards. Use remote, recessed, space temperature sensors in public areas.
- 3.2.3 For areas with automobile access, design and provide a Carbon Monoxide, Nitrogen Dioxide Monitoring System:
 - 3.2.3.1 The system shall consist of one or more control monitoring panels with remotely located CO (carbon monoxide) sensors/transmitters, electrochemical NO (nitrogen dioxide) sensor/transmitter sensing (CO, NO) sensor/transmitter combination.
 - 3.2.3.2 The sensor/transmitter shall receive power from and send signals, corresponding to CO, NO values, to the monitor. All sensor/transmitters shall send signals, in the 4 to 20 mA DC range and shall operate on a 12 to 26 VDC power supply.
 - 3.2.3.3 CO Sensor:
 - 3.2.3.3.1 Able to provide a 4 to 20 mA DC linear signal output corresponding to 0 to 100 ppm CO.
 - 3.2.3.3.2 Able to operate on a 12 to 26 VDC power supply.
 - 3.2.3.3.3 Provide a metal oxide semi-conductor sensor.
 - 3.2.3.4 NO Sensor / Transmitter:
 - 3.2.3.4.1 Able to provide a 4 to 20 mA DC linear signal output corresponding to 0 to 10 ppm NO.
 - 3.2.3.4.2 Able to operate on a 12 to 26 VDC power supply.
 - 3.2.3.4.3 DES 4 enclosure.
 - 3.2.3.4.4 An electrochemical sensor.
 - 3.2.3.4.5 Remotely calibrated with non-interactive zero and span.
 - 3.2.3.4.6 Protected against overvoltage and polarity reversal.
 - 3.2.3.4.7 2-wire hookup.
 - 3.2.3.4.8 Capable of monitoring a range up to 750 square meters.
 - 3.2.3.5 Provide all special calibration and maintenance equipment and instructions.
- 3.3 Control Monitoring Panel:
 - 3.3.1 Provide an enclosed CES 4 cabinet. 3-wire hookup. Capable of monitoring a range up to 750 m².

- 3.3.2 Dual trip points for CO and NO sensing.
- 3.3.3 DPDT relays (minimum 5A) for alarm actuation and ventilation control and/or auxiliary alarms.
- 3.3.4 LED's registering power on, low alarms, high alarms and fail plus audio indicator capable of being silenced by operator.
- 3.3.5 A test sequence activated by single push button.
- 3.3.6 Capability of supporting up to a minimum of 12 remote sensing points.

4 INSTALLATION

- 4.1 Install components as per manufacturer's recommendations
- 4.2 All wiring shall be run in either conduit or EMT.
- 4.3 Pipe and tubing required as part of the control and instrumentation package shall be run parallel to the building structure.
- 4.4 Bundle tubing together and run in ladder trays where applicable

End of Section