

## SECTION 23 09 00 - Building Automation Systems (BAS):

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. The Building Automation System shall be an extension of either the existing TAC - Inet system or the existing Computrols CBAS system currently installed in Collier and adjacent buildings.
- B. Provide a new Ethernet connection (and Net Plus Router if providing TAC) in Collier to segment the control network for data traffic flow. Provide Ethernet based controllers for air handlers and major equipment. Provide application specific controllers for terminal unit control.
- C. Provide a complete system of DDC panels, enclosures, sensors, control devices, controls installation, wiring, data communications, programming, engineered drawings, and system architecture drawings for a total operable system as required to meet the sequences of operation and points lists.
- D. Provide any required software upgrades needed to fulfill the intent of this specification. The owner will not entertain requests for extra funds to cover upgrades or changes to the system that the contractor failed to provide during the bid.
- E. For variable and constant volume terminal boxes with reheat provide a supply air temperature sensor downstream of the reheat coil for troubleshooting purposes. Additionally, where shown on the plans, connect to a axillary contact on the room occupancy sensor provided by the electrical contractor. This contact will serve to switch the VAV controller from occupied to unoccupied setpoints.
- F. Provide graphics pages for each of the major mechanical sub-systems (each AHU, chiller, HW converter, etc.) installed and tested on BAS front end computer.
- G. BAS contractor shall provide all controls installation and incidental controls wiring except for the following:
  - Mechanical contractor shall provide all pipe penetrations and install all temperature wells and control valves.
  - Electrical contractor shall provide 120 VAC power to the BAS control panels.

## 1.2 POINTS LISTS

- A. Refer to the mechanical drawings for BAS points lists.

## PART 2 - PRODUCTS

### 2.1 BAS CONTROL PANELS

- A. BAS shall be as manufactured by Computrols or TAC.
- B. Computrols controllers shall be CBAS version. Specifically 8X, 16X, 32X 64X and VAV-AP as applicable to the application. Provide for connection to the facility Ethernet communications backbone via direct connection to the X-line controllers.
- C. TAC controllers shall be Inet version, specifically 7716, 7718, 7790 MCI and VAV-AX as applicable to the application. Provide for connection to the facility Ethernet communications backbone via new Net Plus Routers (minimum 1 NPR for Collier and 1 NPR for Pharmacy).
- D. Major Equipment (air handlers, chillers, etc.) shall be monitored and controlled by fully programmable stand alone, Ethernet based controllers.
- E. Unitary or Application Specific Controllers (ASC) may be used as intended for terminal unit control.
- F. Enclosures shall be NEMA 1 with a hinged cover. Provide with a key lock. Enclosure to be sized large enough to contain all interface devices, DDC controller, power supply and 20% spare capacity for future use. Enclosures shall be painted black and labeled as BAS panels.
- G. Control enclosure shall have a 120V duplex outlet/service switch. Outlets shall remain hot when switch is off.

### 2.2 TEMPERATURE SENSORS AND TRANSDUCERS

- A. Temperature sensors shall be thermistor of type and duty for required service.
- B. Terminal unit zone space sensors in office, classroom and lab areas shall have LCD display w/programmable setpoint range and programmable display. Sensor shall have an integral jack for laptop or service tool connection, primarily for use by the air balancer to

calibrate the terminal unit air flow sensor. Provide service tool and/or software and cable as required to air balancer.

- C. Restroom, hallway and other common area sensors shall be sensor only, with no setpoint adjustment or temperature indication. If connected to a terminal unit controller, the sensor shall have an integral jack for laptop or service tool connection, primarily for use by the air balancer to calibrate the terminal unit air flow sensor. Provide service tool and/or software and cable as required to air balancer.
- D. Outdoor air sensors shall be mounted on the north facing exterior of the building, shielded from direct sunlight, and insulated from the building face to minimize temperature transmission.
- E. Current switches shall be used for sensing motor status. Size current switch appropriately to match both the conductor size and the full load current of the motor to be monitored. For motors controlled from a VFD, the motor run status output from the VFD may be used for motor status to the BAS.
- F. Pneumatic transducers where required shall be Marsh-Bellofram Type 1000.
- G. Air flow stations shall be Ebtron IAQ Silver or approved equal.

### 2.3 DAMPER ACTUATORS

- A. Damper actuators shall be Belimo electronic rotary actuators with spring return.
- B. Provide sufficient quantities of actuators such that the maximum area driven by each actuator is 16 square feet.

## 2.4 ADJUSTABLE FREQUENCY DRIVES

- A. Adjustable Frequency Drives shall be Toshiba, Cutler Hammer or Square D.
- B. Variable Frequency Drives shall be supplied by the BAS contractor, installed by the mechanical contractor, and wired by the electrical contractor.
- C. See section XXXXX – VARIABLE FREQUENCY DRIVES for VFD specifications.

## 2.5 LIGHTING CONTRTOLS

- A. Lighting controls are provided by the electrical contractor.
- B. Provide a general lighting DDC point to the lighting control system for the practice area to sweep the lights for unoccupied shut-down.

## 2.6 CONTROL WIRE AND CABLE

- A. All control wire to be Windy City "Smart Wire" or equal.
- B. Control wire shall have sequential wire length markers and be clearly labeled as "Temperature Control" wire.
- C. General purpose input/output control wire shall be 18 guage, non-shielded twisted pair with white outer jacket and a purple stripe.
- D. VAV zone space sensor cable shall be 18 guage, 2 - twisted pair with white outer jacket and purple stripe.
- E. 24 VAC power cables to terminal equipment controllers shall be minimum 18 gauge non shielded with purple outer jacket.
- F. Ethernet cables between data closets and BAS panels shall be blue CAT 6 cable, terminated to a standard Ethernet jack inside the panel.
- G. RS-485 ASC controller network cable shall be 18 guage twisted shielded pair with orange outer jacket.

## 2.7 CONTROL VALVES

- A. Terminal equipment and reheat valves shall be Belimo modulating characterized ball valves with bronze body, chrome plated ball and screwed connections

- B. Air handler temperature control valve bodies 2" IPS and smaller shall be single seated bronze valves with screwed end connections.
- C. Temperature control valve bodies 2 ½ " and larger shall be cast iron and shall have flanged end connections.
- D. In general, control valve operators shall be Belimo electronic modulating. Control valves on hot water coils shall be spring return, fail open. Control valves on steam converters shall be spring return, fail closed.
- E. Control valves larger than 3" shall have pneumatic actuators unless there is no control air available in the building.

## 2.8 PRESSURE TRANSMITTERS

- A. Air differential pressure transmitters shall be 4-20mA output, scaled to the range of the system being monitored.
- B. Safe over-pressure rating shall be 5 times the operating range.
- C. Water differential pressure transmitters shall be installed with a 3-way bypass manifold for servicing the transducer without shutting down the system.
- D. In general, accuracy shall be +/- 1% of Full Scale.

## 2.9 HUMIDITY TRANSMITTERS

- A. All space, duct and outdoor air relative humidity transmitters shall be Vaisala.
- B. Transmitter output shall be 4-20mA.
- C. Outdoor mounted sensors shall have appropriate rain shields to protect the sensor from direct precipitation and shall be mounted clear of any building relief or exhaust air stream on the north face of the building.
- D. In general, relative humidity accuracy shall be +/- 3% of full scale.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Provide and install all required sensors, relays, current switches, etc. as needed to meet the project point list and intent of the sequence of operation for a complete and operable system.

- B. Provide for a neat and workmanlike installation. Controls personnel shall be experienced in the regular course of installing and commissioning building automation systems. All work to be installed per applicable codes and standards.
- C. Provide all low voltage class 2 wiring required for the proper installation of this system under the BAS contract.
- D. 120V power to the BAS controller shall be by electrical contractor.
- E. Provide EMT conduit for all power wiring and all exposed class 2 wiring within mechanical rooms. Class 2 wiring in concealed accessible areas may be run utilizing plenum cable as long as it is properly supported with J-hooks and bridal rings, routed along building lines.
- F. Mount non-adjustable, non-indicating space sensors at 60" AFF. Mount adjustable or indicating type space sensors at 48" AFF.
- G. Do not run control signal wiring in the same conduit as line voltage wiring. All 24 volt control wiring shall be 18 gauge minimum. Control signal wiring shall be 22 gauge minimum.
- H. All conduit shall be installed straight and level and at right angles to the building lines.
- I. Any penetrations through walls shall be fire-stopped with fire resistant sealant per the University's requirements. All penetrations of class 2 wiring through walls shall be in a conduit sleeve.
- J. Communication and power wiring to VAV controllers shall be cut to length and terminated in a neat and workmanlike manor. DO NOT COIL EXTRA CABLE AT THE CONTROLLER.

### 3.2 IDENTIFICATION

- A. Each control cable shall be labeled with the point name on each end.
- B. Each control device shall be labeled with its corresponding point address and point name with adhesive labels placed directly on the device if possible.
- C. Space temperature sensors shall be labeled on the bottom or under the cover with the VAV box number for easy identification.
- D. Identify conduits carrying control wiring ever 50' with "TEMP CONTROL" stickers for identification purposes.

### 3.3 SOFTWARE

- A. Develop software control schemes to implement the sequence of operation in easy to understand programming blocks.
- B. When possible, break down complex calculations into multiple steps for ease of troubleshooting.
- C. Software control routines should be as similar as possible amongst like equipment such that troubleshooting is easier for the owner.
- D. Software shall be designed to eliminate as much as possible any overlap between heating and cooling operation and to maximize energy savings in all cases.
- E. All software is to be developed and tested off site to insure proper operation before being installed in the field. Review software with owner's controls consultant prior to installation.
- F. Provide a graphic page for each new system or sub-system that is installed. Graphic shall pictorially depict unit being controlled with live unit performance data.

### 3.4 TESTING

- A. Perform a functional test of the software before turn-over to the owner. Owner's controls consultant shall witness the operation of the system during commissioning.
- B. Start-up of the control system shall be provided to insure proper operation of the system prior to turn-over to the owner.

- C. A functional test will be performed on each system. The owner will spot check this testing. Provide evidence of successful functional testing in the form of test sheets at the completion of the project.

### 3.5 TRAINING

- A. At the completion of the project, the BAS field specialists shall perform an in-service walk-through with owner designated personnel to identify locations of equipment and gain a general understanding of the operation of that equipment.
- B. Provide training at the BAS front end PC for the owner's building DDC operators on the operation of the software and graphics relative to the new system installed.
- C. Review alarms, setpoints, and other operator adjustable software items.
- D. Review the as-built operations and maintenance manual contents and how to use them to troubleshoot the system.

### 3.5 Submittals

- A. Before installation begins, provide a package of schematic drawings detailing the point to point wiring of each control panel to each control device.
- B. Provide as a minimum the following:
  1. Controller network architecture.
  2. Controller wiring diagram with power requirements.
  3. Point to point field wiring diagram.
  4. Detailed sequence of operation for each system.
  5. Bill of material identifying part numbers and manufacturer.
  6. Manufactures cut sheets for each device supplied.
  7. Upon completion provide 3 sets of as-builts and an electronic copy on CD.



### 3.6 Warranty

- A. Provide a two year minimum labor and material warranty on all DDC products supplied and installed. In addition, provide software service and troubleshooting support at no additional cost for the warranty period.
- B. Warranty work to be performed during normal business hours, Monday through Friday at no additional cost to the University.

END OF SECTION