

# Specifications for New Construction and Retrofit Building Automation Systems (BAS)

## 1 GENERAL

### 1.1 SUMMARY

- A. Section Includes:
  - 1. Digital control equipment.
  - 2. Software.
  - 3. Control panels.
  - 4. Control valves.
  - 5. Dampers.
  - 6. Damper operators.
  - 7. Input/output sensors.
  - 8. Thermostats.
  - 9. Time clocks.
  - 10. Sequences of operation.
  - 11. All other items necessary to accomplish the Sequences of Operation.
  
- B. Provide electrical wiring for complete system.

## 2 PRODUCTS

### 2.1 CITY OF YUMA ENTERPRISE LEVEL BAS SERVER

- A. Manufacturers: Trane Model: Tracer Ensemble Only, no other substitutions will be accepted.
  
- B. The City of Yuma has a campus wide enterprise level system and the new Building Automation System (BAS) must integrate to this existing Tracer Ensemble System. All the integration of the BAS BACnet points and creation of graphics for the campus wide system must be supplied, installed and programmed by Trane.
  
- C. All cost associated with this integration shall be included in the successful BAS Manufacturer's bid.

### 2.2 BUILDING AUTOMATION SYSTEM MANUFACTURERS

- A. Each building shall have an individual standalone BAS to allow communications to the City of Yuma's Tracer Ensemble System.

- B. Manufacturers: Trane Model: Tracer SC

## 2.3 DIGITAL CONTROL EQUIPMENT

- A. BAS Support: The BAS must support BACnet to the existing Tracer Ensemble Enterprise Server. The BAS shall allow the enterprise frontend to view all physical and virtual points via BACnet. This BAS shall allow the enterprise server to control all hardware, allow for setpoint changes of all program setpoints and allow for scheduling of all the controls equipment.
- B. The BAS must have the capability to operate in a standalone mode if all communication is lost to the City of Yuma Ethernet network. When operating in standalone mode the BAS shall be capable of being accessed via a local Ethernet port or USB port to allow an operator to control all functions of the BAS including but not limited to setpoints, alarms, overrides and schedules. The BAS shall also have the same graphics installed that are installed in the Tracer Ensemble dashboard to allow the operator to navigate through the BAS in the same fashion as if they were logged on to the Tracer Ensemble Frontend.
- C. Control Units:
  - 1. Units: Modular in design and consisting of processor board with programmable RAM memory, local operator access and display panel, and integral interface equipment.
  - 2. Battery Backup: For minimum of 48 hours for complete system including RAM without interruption, with automatic battery charger.
  - 3. Control Units Functions:
    - a. Monitor or control each input/output point.
    - b. Independent with hardware clock/calendar and software to maintain control independently.
    - c. Acquire, process, and transfer information to operator station or other control units on network.
    - d. Accept, process, and execute commands from other control unit's or devices or operator stations.
    - e. Access both data base and control functions simultaneously.
    - f. Record, evaluate, and report changes of state or value occurring among associated points. Unit continues to perform associated control functions regardless of status of network.
  - 4. Input/output Capability:
    - a. Discrete/digital input (contact status).
    - b. Discrete/digital output.
    - c. Analog input.

- d. Analog output.
  - e. Pulse input (5 pulses/second).
  - f. Pulse output (0-655 seconds in duration with 0.01 second resolution).
5. Furnish control units with minimum 30 percent spare capacity.
  6. Test Mode Operation: Place input/output points in test mode to allow testing and developing of control algorithms on line without disrupting field hardware and controlled environment.
- D. Local Area Networks (LAN):
1. Provide communication between control units over local area network (LAN).
  2. LAN Capacity: Not less than 60 stations or nodes.
  3. Transmission Media: Fiber optic or single pair of solid 24 gauge twisted, shielded copper cable.
  4. Network Support: Time for global point to be received by any station, less than 3 seconds. Furnish automatic reconfiguration when station is added or lost. When transmission cable is cut, reconfigure two sections with no disruption to system's operation, without operator intervention.
- E. Operating System Software:
1. Input/output Capability from enterprise front end: Display current values or status, command equipment, initiate logs and reports, add, delete, or change points or descriptors, develop or modify color graphic displays, automatically archive select data.
  2. Operator System Access: Via software password with minimum 30 access levels at work station and minimum 3 access levels at each control unit.
  3. Data Base Creation and Support: Use standard procedures. Control unit automatically checks workstation data base files upon connection and verify data base match.
  4. Dynamic Color Graphic Displays:
    - a. Uses custom symbols or system supported library of symbols.
    - b. Sixteen (16) colors.
    - c. Sixty (60) outputs of dynamic data for each graphic.
    - d. 1,000 separate graphic pages.
    - e. All Graphics must be loaded on the existing Tracer ES Server
    - f. All graphics must be accessible with Tracer ES without the requirement to open any additional programs or systems.
  5. Alarm Processing:
    - a. Off normal condition: Cause alarm and appropriate message.

- b. Critical alarm or change-of-state: Display message, stored on disk for review and sort, or print.
    - c. Display alarm reports on video.
    - d. Allow unique routing of specific alarms.
    - e. Operator specifies when alarm requires acknowledgment.
  - 6. Automatic Restart: Automatically restart field equipment on restoration of power. Furnish time delay between individual equipment restart and time of day start/stop.
  - 7. Maintenance Management: Run time monitoring and maintenance scheduling targets with scheduling.
- F. Load Control Programs:
- 1. General: Support inch-pounds and S.I. metric units of measurement.
  - 2. Demand Limiting: Monitor total power consumption for each power meter and shed associated loads automatically to reduce power consumption to operator set maximum demand level.
  - 3. Duty Cycling: Periodically stops and starts loads, based on space temperature, and according to various On/Off patterns.
  - 4. Automatic Time Scheduling: Automatic start/stop/scheduling of building loads.
  - 5. Start/Stop Time Optimization: Perform optimized start/stop as function of outside conditions, inside conditions, or both.
  - 6. Night Setback/Setup Program: Reduce heating space temperature setpoint or raise cooling space temperature setpoint during unoccupied hours; in conjunction with scheduled start/stop and optimum start/stop programs.
- G. HVAC Control Programs:
- 1. General: Support inch-pounds and S.I. metric units of measurement.
  - 2. Optimal run time.
  - 3. Supply air reset.
  - 4. Enthalpy switchover.
  - 5. Chiller control programs: Control function of condenser water reset, chilled water reset, and chiller sequencing.

## 2.4 CONTROL PANELS

- A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gages, pilot lights, push buttons and switches flush on cabinet panel face.
- B. NEMA 250 Type 1, general-purpose utility enclosures.

C. Furnish common keying for every panel.

## 2.5 CONTROL VALVES

A. Manufacturers:

1. Belimo
2. Or equal performance.

B. Globe Pattern:

1. Up to 2 inches: Bronze body, bronze trim, rising stem, renewable composition disc, screwed ends.
2. Over 2 inches: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, renewable seat and disc.
3. Rate for service pressure of 125 psig at 250 degrees F.
4. Size for 3 psig maximum pressure drop at design flow rate.

C. Butterfly Pattern:

1. Iron body, bronze disc, resilient replaceable seat for service to 180 degrees F wafer or lug ends, extended neck.
2. Rate for service pressure of 125 psig at 250 degrees F.
3. Size for 1 psig maximum pressure drop at design flow rate.

D. Electronic Operators:

1. Valves spring return to normal position on freeze, fire, or temperature protection.

## 2.6 DAMPERS

A. Frames: Galvanized steel welded or riveted with corner reinforcement.

B. Blades: Galvanized steel 8 inches wide, 48 inches long, attached to minimum 1/2 inch shafts with set screws.

C. Blade Seals: Synthetic elastomeric mechanically attached, field replaceable.

D. Jamb Seals: Stainless steel spring.

E. Shaft Bearings: Oil impregnated sintered bronze.

F. Linkage Bearings: Oil impregnated sintered bronze.

G. Leakage: Less than one percent based on approach velocity of 2000 ft/min and 4 inches wg.

H. Maximum Pressure Differential: 6 inches wg.

## 2.7 DAMPER OPERATORS

- A. General: Furnish proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and to seal against maximum system pressures. Furnish spring return for two-position control and for fail safe operation.
- B. Electric Operators: Adjustable stroke motor with spring return, having oil immersed gear train, with auxiliary end switch and 24 V dc, 24 va transformer.
- C. Inlet Vane Operators: High pressure with pilot positioners and sufficient force to move vanes when fan is started with vanes in closed position. Return vane operator to closed position on fan shutdown.

## 2.8 INPUT/OUTPUT SENSORS

- A. Temperature:
  - 1. Resistance temperature detectors with insertion or averaging elements in ducts and insertion elements for liquids with brass socket.
  - 2. Room sensors: Locking cover plate.
  - 3. Outside air sensors: Watertight inlet fitting shielded from direct rays of sun.
  - 4. Room security sensors: Stainless steel covers plate with insulated back and security screws.
- B. Humidity Sensors:
  - 1. Elements: Accurate within 5 percent full range with linear output.
  - 2. Room Sensors: With locking cover matching pneumatic thermostats.
  - 3. Duct and Outside Air Sensors: With element guard and mounting plate.
- C. Static Pressure Sensors:
  - 1. Unidirectional with ranges not exceeding 150 percent of maximum expected input, temperature compensated with one percent of full-scale accuracy.
- D. Equipment Operation Sensors:
  - 1. Status Inputs for Fans: Differential pressure switch.
  - 2. Status Inputs for Pumps: Differential pressure switch.
  - 3. Status Inputs for Electric Motors: Current sensing relay with current transformers.
- E. Damper Position Indication: Potentiometer mounted in enclosure with adjustable crank arm.

- F. Carbon Monoxide Detectors:
  - 1. Single or multi-channel dual level detectors, using solid state sensors with three year minimum life. Sensor capable of being replaced in maximum of 15 minutes. Suitable over temperature range of 23 to 130 degrees F.

## 2.9 THERMOSTATS

- A. Electric Room Thermostats:
  - 1. Type: NEMA DC 3, 24 volts, with setback/setup temperature control.
  - 2. Covers: Locking with set point adjustment with thermometer.
- B. Line Voltage Thermostats:
  - 1. Integral manual On/Off/Auto selector switch, single or two-pole, rated for motor load.
  - 2. Cover: Locking with set point adjustment, setpoint indication.
- C. Outdoor Reset Thermostat: Remote bulb or bimetal rod and tube type, proportioning action with adjustable throttling range, adjustable setpoint.
- D. Electric Limit Duct Thermostat: Snap acting, single pole, single throw, automatic reset switch tripping when temperature sensed across any 12 inches of bulb length is equal to or below setpoint.
- E. Heating/Cooling Valve Top Thermostats: Proportional acting for proportional flow, molded rubber diaphragm, liquid filled element, direct and reverse acting at differential pressure to 25 psig, cast housing with position indicator and adjusting knob.

## 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify conditioned power supply is available to panels and to operator workstation.
- B. Verify field end devices, wiring, and pneumatic tubing is installed prior to installation proceeding.
- C. Coordinate installation of system components with installation of mechanical systems equipment including air handling units, chiller, heat exchanger, fan coil units, ERV units and air terminal units.

### 3.2 INSTALLATION

- A. After completion of installation, test and adjust control equipment. Submit data showing set points and final adjustments of controls.
- B. Install panels and other hardware in position on permanent walls not subject to excessive vibration.
- C. Install software in panels and in operator workstation. Implement features of programs to specified requirements and appropriate to sequence of operation.
- D. Install thermostats and other exposed control sensors at locations as indicated on Drawings. Coordinate with room components before installation. Install 60 inches above floor. Align with light switches.
- E. Install guards on thermostats in entrances, public areas.
- F. Install mixing dampers of opposed or parallel blade construction arranged to mix streams. Install pilot positioners on mixed air damper motors. Install separate minimum outside air damper section adjacent to return air dampers with separate damper motor.
- G. Install damper motors on outside of duct in warm areas. Do not install motors in locations at outdoor temperatures.
- H. Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position.

END OF SECTION