SECTION 15900

FACILITY MANAGEMENT SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish and install a complete Control System consisting of a Building Automation System (BAS) and an Automatic Temperature Control System. The system shall be complete in all respects including labor, materials, equipment, and services necessary, and shall be installed by personnel regularly employed by the manufacturer.

B. All automation and control components shall be integrated into a distributed network system communicating over a nonproprietary local area network. This system shall consist of field Stand-alone Direct Digital Controllers (DDC), Smart Local DDC's and PC-based operator workstations.

C. Although such work is not specifically indicated, provide all supplementary or miscellaneous items such as software, appurtenances and devices for a sound, secure and complete system.

1.2 WORK BY OTHERS

A. Sheet Metal Subcontractor:

1. Setting of automatic control dampers, smoke control dampers, and necessary blank off plates.

2. Access doors where and as required.

B. Heating Contractor:

1. Installation of immersion wells and pressure tapings.

2. Installation of flow switches.

3. Setting of automatic control valves.

4. Installation of pressure tapings and associated shut-off cocks.

C. Electrical Subcontractor:

1. All power wiring and line voltage interlock wiring such as exhaust fan interlocked to supply fan.

2. All control wiring shown on electric plans such as unit heater room thermostats.

1.3 ELECTICAL WORK FOR CONTROLS

A. Complying with the principle of "unit responsibility" all electrical work for automatic controls, except as otherwise specified, or shown on the electrical drawings shall be included in Division 15.

B Electrical work shall, in general, comply with the following:

1. All low voltage wiring in finished rooms shall be concealed below working heights and exposed above.

2. Electrical work may include both line voltage and low voltage wiring, as required.

3. Conduit network for power systems may be used for running control high voltage wiring.

4. All safety devices shall be wired through both hand and auto positions of motor starting device to insure 100% safety shut-off.

5. All magnetic starters furnished by Electrical Contractor for mechanical equipment shall be furnished with integral 120 volt control transformers, sized to handle the additional VA needed for the controls - pilots, EP valves, etc.

6. The motor starter supplier shall provide auxiliary contacts as required for interlock by FMS Contractor; the supplier shall estimate an allowance of at least one auxiliary contract per starter. All interlock and control wiring shown on the electrical prints is by the electrical subcontractor.

7. Low voltage plenum rated wiring may be run above accessible ceilings. Wiring shall be neatly tied to pipes, EMT or other devices and not laid on ceiling tile. Otherwise, the wiring shall be routed within conduit.

1.4 REFERENCED STANDARDS, CODES AND ORDINANCES

A. It is the responsibility of the FMS contractor to be familiar with all codes, rules, ordinances, and regulations of the authority Having Jurisdiction and their interpretations which are in effect at the site of the work.

B. The latest issue of applicable standards and recommended practices of the following agencies in effect shall form a part of the specification to the extent each agency’s relative standards or recommended practices apply to the systems and its components as specified herein.

1. Federal Communications Commission (FCC)

2. American National Standards Institute (ANSI)

3. American society of Mechanical Engineers 9ASME)

4. Electronic Industries Association (EIA)

5. Institute of Electrical and Electronics Engineers (IEEE)

6. National Electrical Manufacturers Association (NEMA)

7. National Fire Protection Association (NPA)

8. Underwriters Laboratories (UL)

9. Occupational Safety and Health Administration (OSHA)

10. American Society of Heating, Refrigeration and Air Conditioning Engineers

B. This Contractor shall be solely responsible for compliance with all health and safety regulations, performing the work in a safe and competent manner, and the use industry accepted installation procedures required for the work as outlined in these documents.

C. All systems equipment, components, accessories, and installation hardware shall be new and free from defects and shall be UL listed where applicable. All components shall be in current production and shall be a standard product of the system or device manufacturer. Refurbished or reconditioned components are unacceptable. Each component shall bear the make, model number, device tag number (if any), and the UL label as applicable. All system components of a given type shall be the product of the same manufacturer.

1.5 SUBMITTALS

A. Provide eight (8) copies of submittal data.

B. Submittals shall consist of:

1. Data sheets of all products, including software and hardware.

2. Valve schedule, including sizing calculations and actuator information.

3. Damper schedule, including actuator information.

4. Wiring and piping interconnection diagrams including panel and device power, and sources.

5. List of materials of all proposed devices and equipment.

6. Software documentation:

a. Sequence(s) of operation, in text form.

b. Application programs.

c. Statement of compatibility with existing programs.

d. Hardware requirements.

7. Point schedules.

8. Controls schematics and system diagrams.

1.6 CONTROL EQUIPMENT AND DEVICES

A. The control system shall include all necessary and specified control equipment properly installed in accordance with specifications and drawings, and shall include the automatic control of the following:

1. Control Dampers: Dampers required in the temperature and smoke control functions of the automatic control system shall be factory fabricated and shall be manufactured by the FMS Systems Manufacturer. All dampers shall be sized as shown on drawings or as specified. All damper frames shall be constructed of 13 gauge galvanized sheet metal or extruded aluminum of 12 gauge thickness, and shall have a flange or duct mounting. The blades shall be parallel or opposed, as required, and suitable for the air velocities to be encountered in the system. Replaceable Butyl rubber seals are to be provided on damper blades and installed along with the top and bottom of the frame. Stainless steel damper blades and seals shall be installed inside the frame sides. Seals and bearings shall be able to withstand temperatures ranging from minus 40˚F to plus 200˚F. Dampers shall be leak rated for 3 CFM/foot squared at 1" WG and 20 CFM/foot squared at 4" WG or less in full closed position at 4" WG pressure differential across damper. All smoke control dampers must conform to UL555S and be Ruskin SD-60 or Johnson Control SD-1300.

2. Damper blades shall not exceed 6" in width. All blades shall not exceed 6" in width. All blades are to be corrugated type construction, fabricated from two sheets of #22 gauge galvanized sheet steel, spot welded together. Blades are to be suitable for high velocity performance. Damper blades shall be a maximum of 48" long. Longer units shall be fabricated in sections. Dampers shall be Ruskin CD-60 or Johnson Controls D-1300.

3. Control Valves: Valves shall be sized by the control manufacturer to produce the required capacity at a pressure loss not exceeding the allowable pressure drop indicated on the drawing. Nominal body rating shall be not less than 125 PSI. However, the valve body and packing selected shall be sized to withstand the system static head plus the maximum pump head and the maximum temperature of the control medium, chilled water, and/or hot water. Three-way modulating valves shall have close-off ratings exceeding the maximum pressure difference, at any load condition, between the outlet and inlet. Each valve shall be equipped with proper packing to assure there will be no leakage at the valve stem.

4. Operators: A damper or valve operator shall be electronic and be provided for each automatic damper or valve and shall be of sufficient capacity to operate the damper or valve under all conditions and to guarantee tight close-off of valves, as specified, against system pressure encountered. Each shall be provided with spring-return for normally closed or normally open position for fail safe operation to account for fire, low temperatures, or power interruption as indicated. Damper and valve operators are to be made out of die cast metal; no plastic or sheet metal bodies will be allowed.

5. Sensors and Controllers:

   a. Differential Pressure Switch for water shall have a single-pole, single-throw (SPST) contact, adjustable set point, UL rated 6 amperes at 120 volts, 100 psig design, with automatic reset. Each switch shall be provided with isolation and drain valves.

b. Differential Pressure Switch for air shall have a single-pole, single-throw (SPST) contact, adjustable set point, UL rated 9.8 amperes at 120 volts.

c. Low Limit Thermostats (Proprietary) shall be of manual reset type, with set point adjustment. The sensing element shall be 20-foot minimum and shall be installed completely across the coil. When any one-foot of the element senses a temperature as low as the set point, the thermostat contacts shall open. These shall contain double pole switches for simultaneous remote alarms or as desired.

d. Duct Type Temperature Transmitter (Proprietary) shall be a general-purpose RTD sensing element, moisture resistant transmitter for mounting into a duct. The operating range shall be as indicated with an accuracy of ± 1% over the full range. The output shall be compatible with the panel it serves.

e. Duct Averaging Type Temperature Transmitter (Proprietary) shall be a general-purpose RTD sensing element, moisture resistant transmitter for mounting into a duct. The operating range shall be as indicated with an accuracy of ± 1% over the full range. The output shall be compatible with the panel it serves. Transmitter shall be with 17 feet of sensor capillary.

f. Space Temperature Transmitter (Proprietary) shall contain an RTD sensing element to monitor room air temperatures in the range of 30 degrees F to 90 degrees F, unless indicated otherwise. The transmitter shall be factory calibrated to an accuracy of ± 1%. The assembly shall be installed within a metal ventilated enclosure suitable for wall mounting. The output shall be an compatible with the panel it serves. Transmitter shall be factory calibrated to an accuracy of ± 1% over the full range.

g. Pipe Temperature Transmitter (Proprietary) shall contain an RTD sensing element to monitor water temperature. The Contractor shall provide brass wells of sufficient size for the pipe to be installed. The output shall be compatible with the panel it serves. Transmitter shall be factory calibrated to an accuracy of ± 1% over the full range.

h. Outdoor Air Temperature Transmitter (Proprietary) shall contain an RTD sensing element mounting in an enclosure rated for outdoor use. The output shall be compatible with the panel it serves. Transmitter shall be factory calibrated to an accuracy of ± 1% over the full range.

i. Humidity Transmitter Duct shall be capable of providing continuous measurement of percent relative humidity with an accuracy of ± 4% over the range of 10 to 80% RH. The output shall be proportional VDC over a cable pair.

j. Humidity Transmitter Outside Air shall be capable of providing continuous measurement of percent relative humidity with an accuracy of ± 2% over the range 20 to 90% RH. The output shall be a 4 to 20 Ma signal over a shielded cable pair. Transmitter shall have outside weather enclosure.

k. Humidity Transmitter Space shall be capable of providing continuous measurement of percent relative humidity with an accuracy of ± 3% over the range of 20 to 60% RH. The output shall be proportional VDC over a cable pair.

l. Pressure Transducer shall be for steam service and have a stainless steel sensor. The device shall output a 4-20 milliamp signal, which is linear in relation to the sensed pressure. Accuracy shall be ± .05% of the full scale. Power shall be from the controller and range from 22-26 volts DC. The unit shall have temperature compensation so that thermal effects are no more than ± .05% of the full scale from 0-175˚F. The unit shall be suitable for the media and pressure measured.

m. Differential Pressure Transducer shall be for air or water service. The device shall output a 4-20 milliamp signal, which is linear in relation to the sensed pressure. Accuracy shall be ± .01% of full scale. The power shall be from the controller and shall be in the range of 22-26 volts DC. The unit shall have temperature compensation so that thermal effects are no more than ± .05% of the full scale from 32-100˚F. The transducer shall be suitable for the media and pressure measured.

6. Instrument Control Cabinets

a. Furnish and install, for components other than room thermostats cabinets to house control equipment. Cabinets shall consist of extruded aluminum alloy frames with all corners securely riveted and supported by angle brackets. The cabinet is to have removable face and back panels and these panels are to be made of aluminum bonnet on both sides over a plywood core. The cabinet door is to be supported by non-removable piano-type hinge that spans the entire height of the cabinet. A key locking latch is to be provided on all cabinets to insure only authorized access. All temperature and status indications and toggle switches are to be flush mounted on the face of the cabinet.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT DESCRIPTION

A. The Facility Management System (FMS) shall be capable of integrating multiple building functions, including equipment supervision and control, alarm management, energy management, and trend data collection.

B. The FMS shall consist of the following:

- Operator Workstation

- Network Control Panel

- Standalone Application Specific Controllers (ASCs)

C. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, ASCs, and operator devices.

D. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

2.2 NETWORKING / COMMUNICATIONS

A. General: The design of the FMS shall be networked as shown on the attached system configuration drawing. Inherent in the system's design shall be the ability to expand or modify the network either via a local network, auto-dial telephone line modem connections, or a combination of the two networking schemes.

2.3 LOCAL NETWORK

A. Panel Support: The Network Control Panel shall directly oversee a local network such that communications may be executed directly to and between ASCs.

B. Data Access: All operator devices, either network resident or connected via dial-up modems, shall have the ability to access all point status and application data on the network. Access to system data shall not be restricted by the hardware configuration of the facility management system.

C. Global Data Sharing: Global Data Sharing or Global Point Broadcasting shall allow point data to be shared between ASCs when it would be inefficient or impractical to locate multiple sensors.

D. General Network Design: The network minimum baud rate shall be 9600 baud, supporting a minimum of 100 ASCs. The network shall detect single or multiple failures of ASCs or the network media. The network shall be composed of commonly available, multiple-source, networking components operating an industry standard protocol.

2.4 OPERATOR INTERFACE

A. Command Entry/Menu Selection Process: Operator interface software shall minimize operator training through the use of English language prompting and English language point identification. The operator interface shall also have the option of using a mouse or similar pointing device for a "point and click" approach to facilities management.

B. Text-Based Displays: The operator interface shall provide consistent text-based displays of all system point and application data described in this specification. Point identification, engineering units, status indication, and application naming conventions shall be the same at all operator devices.

C. Password Protection: Multiple-level password access protection shall be provided to allow the user/manager to limit control, display, and data base manipulation capabilities as he deems appropriate for each user, based upon an assigned password.

1. Passwords shall be exactly the same for all operator devices.

2. A minimum of four (4) levels of access shall be supported:

3. Operators will be able to perform only those commands available for their respective passwords. Menu selections displayed at any operator device shall be limited to only those items defined for the access level of the password used to log-on.

4. User-definable, automatic log-off timers of from 1 to 60 minutes shall be provided to prevent operators from inadvertently leaving devices logged on.

D. Operator Commands: The operator interface shall allow the operator to perform commands including, but not limited to, the following:

- Start-up or shutdown selected equipment
- Adjust set points
- Add/Modify/Delete time programming
- Enable/Disable process execution
- Lock/Unlock alarm reporting for each point
- Enable/Disable Totalization for each point
- Enable/Disable Trending
- Enter temporary override schedules
- Define Holiday Schedules
- Change time/date
- Enter/Modify analog alarm limits
- Enable/Disable demand limiting
- Enable/Disable duty cycle
- Enable/Disable average/high/low signal select and reset

E. Logs and Summaries: Reports shall be generated manually, and directed to the displays. The printer shall automatically print each alarm, access by an operator and any override of any system or set point.

F. A general listing of all points in the system shall include, but not be limited to, the following:

- Points currently in alarm
- Off-line points
- Points currently in override status
- Points in Weekly Schedules
- Holiday Programming

G. Summaries shall be provided for specific points, for a logical point group, for a user-selected group of groups, or for the entire facility without restriction due to the hardware configuration of the facility management system. Under no conditions shall

the operator need to specify the address of hardware controller to obtain system information.

H. System Configuration and Definition: All temperature and equipment control strategies and energy management routines shall be definable by the operator. System definition and modification procedures shall not interfere with normal system operation and control.

I. The system shall be provided complete with all equipment and documentation necessary to allow an operator to independently perform the following functions:

- Add/Delete/Modify Application Specific Controllers

- Add/Delete/Modify points of any type, and all associated point parameters, and tuning constants

- Add/Delete/Modify alarm reporting definition for each point

- Add/Delete/Modify energy management applications

- Add/Delete/Modify time- and calendar-based programming

- Add/Delete/Modify Totalization for every point

- Add/Delete/Modify Historical Data Trending for every point

- Add/Delete/Modify configured control processes

- Add/Delete/Modify dial-up telecommunication definition

- Add/Delete/Modify all operator passwords

- Add/Delete/Modify Alarm Messages

J. Programming Description: Definition of operator device characteristics, ASCs, individual points, applications and control sequences shall be performed through fill-in-the-blank templates.

K. Network-Wide Strategy Development: Inputs and outputs for any process shall not be restricted to a single ASC, but shall be able to include data from any and all other ASCs to allow the development of network-wide control strategies.

L. System Definition/Control Sequence Documentation: All portions of system definition shall be self-documenting to provide hardcopy printouts of all configuration and application data.

M. Data base Save/Restore/Back-Up: Back-up copies of all ASC and Digital Panel data bases shall be stored in at least one personal computer or laptop. Users shall also have the ability to manually execute downloads of an ASC or Digital Panel database.

2.5 NETWORK CONTROL PANELS

A. General: Network Control Panels shall be microprocessor based, multitasking, multi-user, and digital control processors.

B. Each Network Control Panel shall have sufficient memory to support its own operating system and data bases including:

- Control Processes
- Energy Management Applications
- Alarm Management
- Trend Data
- Maintenance Support Applications
- Operator I/O
- Dial-Up Communications
- Manual Override Monitoring

C. Expandability: The system shall be modular in nature, and shall permit easy expansion through the addition of field controllers, sensors, and actuators.

D. Serial Communication Ports: Network Control Panels shall provide at least two RS-232C serial data communication ports for simultaneous operation of multiple operator I/O devices, such as laptop computers, Personal Computers, and Video Display terminals.

E. Hardware Override Monitoring: Network Control Panels shall monitor the status of all overrides, and include this information in logs and summaries to inform the operator that automatic control has been inhibited.

F. Integrated On-line Diagnostics: Each Network Control Panel shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all subsidiary equipment. Master Digital Panels shall provide both local and remote annunciation of any detected component failures, or repeated failure to establish communication. Indication of the diagnostic results shall be provided at each Network Control Panel.

G. Surge and Transient Protection: Isolation shall be provided at all network termination's, as well as all field point termination's, to suppress induced voltage transients consistent with IEEE Standard 587-1980.

H. Power Fail Restart: In the event of the loss of normal power, there shall be an orderly shutdown of the Network Control Panel to prevent the loss of data base or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data, and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours. Upon restoration of normal power, the Network Control Panel shall automatically resume full operation without manual intervention. Should Network Control Panel memory be lost for any reason, the user shall have the capability of reloading the Network Control Panel via the local RS-232C port.

2.6 APPLICATION SPECIFIC CONTROLLERS

A. Unitary Controllers

1. Each Unitary Controller shall operate as a standalone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each Unitary Controller shall be a microprocessor-based, multi-tasking, real-time digital control processor.

2. Unitary Controllers shall support, but not be limited to, the following types of systems to address specific applications described in the "Execution" portion of this Specification, and to address future expansion:

B. VAV Terminal Unit Controller

1. The VAV controller shall provide both standalone and networked direct digital control of variable air volume terminal units. The VAV box controller, damper actuator, and pressure sensor to be supplied by controls contractor and mounted by VAV box manufacturer. All required relays and transformers are to be provided and installed by the VAV box manufacturer.

2. The VAV controller shall be a configurable digital controller with integral differential pressure transducer and damper actuator. All components shall be connected and mounted as a single assembly that can be removed as one piece.

3. The integral damper actuator shall be a fast response stepper motor capable of stroking 90 degrees in 30 seconds for quick damper positioning to speed commissioning and troubleshooting tasks. The VAV controller shall determine airflow by dynamic pressure measurement using an integral dead-ended differential pressure transducer. The transducer shall be maintenance-free and shall not require air filters

4. Each VAV controller shall continuously, adaptively tune the control algorithms to improve control and controller reliability through reduced actuator duty cycle. In addition, this tuning reduces commissioning costs, and eliminates the maintenance costs of manually re-tuning loops to compensate for seasonal or other load changes.

2.7 OPERATOR WORKSTATION

A. The cpu shall be a minimum Pentium III 800 MHz, with 56K modem, CDR, 3.5" floppy disk, with minimum 10 Gb hard drive, 128 Mb of SRAM, minimum 16 Mb of video Ram on a video card. Power supply shall be a minimum 250 W.

B. Monitor shall be minimum 17", maximum 0.28 dot pitch, non-interlaced.

C. Printer shall be tractor feed type for continuous feed.

D. Provide connecting cables for a fully functional system.

PART 3 - SEQUENCE OF OPERATIONS AND INPUT/OUTPUT SUMMARY

SEE DRAWINGS

END OF SECTION