SECTION 23 09 23 - ENERGY MANAGEMENT SYSTEM (EMS)

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

A. Refer to Section 23 00 00.

1.2 WORK DESCRIPTION

A. Scope: This section contains general requirements for the supply and installation of a microprocessor based Energy Management System (EMS) as an extension to the existing University of Texas at Dallas Campus Siemens Building Technologies System 600 APOGEE™.

B. Siemens shall be responsible for furnishing and installing all equipment and wiring for Building Automation Systems (Temperature and HVAC Equipment Control) for a complete and operable system as specified herein. All wiring shall be done in accordance with all local and national codes.

C. Work Included: It is the intent of this specification for the EMS to be installed as a complete package by Siemens Building Technologies. The system shall include all computer software and hardware, controllers, sensors, transmission equipment, local panels, installation, engineering, supervision, commissioning, acceptance test, training, and warranty service.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Products connect to the EMS but not furnished or installed under this section include air flow stations, automatic dampers, valves, flow switches, flow sensors, thermwells and pressure taps to be installed by the Division 23 and/or 26.

1. Section 23 73 23 AHU Mixing Dampers
2. Section 23 29 23 Variable Frequency Drives
3. Section 23 36 00 Air Terminal Unit Transformers and Switches

B. Coordination with electrical:

1. Installation of all 120V power wiring for the EMS, Refrigerant Monitoring System, Control Valves and Flow Meters is the responsibility of this Section.
2. Each motor starter provided under Division 23 or 26, shall be furnished with individual control power transformer to supply 120 volt control power and auxiliary contacts (one N.O. and one N.C.) for use by this section.

C. Work provided by this Section but listed elsewhere:

1. Section 23 36 00 Air Terminal Units Controls
2. Section 23 09 93 Control Sequence - HVAC on Drawings

1.4 QUALIFICATIONS

A. System components shall be provided by Siemens Building Technologies.

B. The control system shall be furnished, engineered and installed by a Siemens owned branch office having factory trained technicians to provide instruction, routine maintenance, and emergency service within 24 hours upon receipt of request.
C. The control system components shall be new and in conformance with the following applicable standards for products specified:

1. American Society for Testing and Materials, ASTM
2. Institute of Electrical and Electronic Engineers, IEEE
3. National Electrical Manufacturers Association, NEMA
4. Underwriters Laboratory, UL (UL 916 & 864)
5. FCC Regulation, Part 15, Section 156
7. Local Building Codes

1.5 SUBMITTALS

A. The controls contractor shall submit Auto CAD generated schematic drawings for the entire system for review and approval before work shall begin. Included in the submittal drawings shall be a one page diagram depicting the system architecture complete with a communications riser. Drawings shall include point-to-point wiring diagrams and any special connection information required for properly controlling the equipment. The submittal shall include a bill of material reference list as well as equipment sequences of operation.

B. The submittals shall include the manufacturer's catalog data describing, highlighting and specifically indicating each item of equipment or component provided and installed for the project.

1.6 PROTECTION OF SOFTWARE RIGHTS

A. Prior to delivery of software, the Owner and the party providing the software will enter into a software license agreement with provisions for the following:

1. Limiting use of software to equipment provided under these Specifications.
2. Limiting copying.
3. Preserving confidentiality.
4. Prohibiting transfer to a third party.

PART 2 - PRODUCTS

2.1 ACCEPTIBLE BIDDERS

A. The specifications are intended to describe the microprocessor based Energy Management System - System 600 APOGEE™ and Siemens Building Technologies is the acceptable manufacturer/installer.

2.2 NETWORKING

A. The design of the EMS shall network operator workstations and stand-alone DOC Controllers. The network architecture shall consist of 3 levels, a campus-wide Management Level Network (MLN) Ethernet network based on TCP/IP protocol, high performance peer-to-peer Automation Level Network (ALN) and Application Specific Controller Field Level Networks (FLN) with access being totally transparent to the user when accessing data or developing control programs.

B. The owner shall provide a point of connection for each ALN Level controllers to the campus Ethernet Backbone for a campus-wide System 600 Management Level Network.

C. The design of EMS shall allow the co-existence of new DOC Controllers with existing DOC Controllers in the same network without the use of gateways or protocol converters.

D. All operator devices either network resident or connected via dial-up modems shall have the ability to access all point status and application report data or execute control functions for
any and all other devices via the peer-to-peer network. No hardware or software limits shall be imposed on
the number of devices with global access to the network data at any time.

E. A single Workstation shall support a minimum of four (4) Automation Level Networks (ALN). The ALN's
   can be any combination of direct or modem connected Networks. All Networks shall be dynamically
   connected to allow access to points on different ALN's simultaneously.

2.3 DOC CONTROLLERS

A. DOC Controllers shall be stand-alone, multi-tasking, multi-user, real-time digital control
   processors with a minimum word size of 16 bits, minimum 48MHz clock and minimum 12MB memory
   consisting of modular hardware with plug-in enclosed processors, communication controllers, power
   supplies and input/output point modules (universal or discrete). Each major DOC Controller (PXC
   Modular) shall support a minimum of 96 FLN Devices.

B. Each DOC Controller shall support its own operating system and databases, including:
   1. Control processes
   2. Energy management applications
   3. Alarm management applications including custom alarm messages for each level alarm for each point
      in the system.
   4. Historical/trend data for points specified
   5. Maintenance support applications
   6. Custom processes
   7. Operator 1/0
   8. Dial-up communications
   9. Manual override monitoring

C. Each DOC Controller shall support any combination of industry standard inputs and outputs.

D. Provide all processors, power supplies and communication controllers so that the implementation of a point
   only requires the addition of the appropriate point input/output termination module and wiring.

E. DDC Controllers shall be provided with one RS-232C serial data communication port for the portable
   laptop operator's terminal. When a modem is required for remote operation, a second RS-232C serial data
   communication port shall be provided. DDC Controllers shall allow temporary use of portable devices
   without interrupting the normal operation of permanently connected modems, printers or terminals.

F. As indicated in the point 1/0 schedule, the operator shall have the ability to manually override automatic or
   centrally executed commands at the DDC Controller via local, point discrete, on-board hand/off/auto
   operator override switches for digital control type points and gradual switches for analog control type
   points.

   1. Switches shall be mounted within the DDC Controllers key-accessed enclosure.

   2. DDC Controllers shall monitor the status of all overrides and inform the operator that automatic control
      has been inhibited. DDC Controllers shall also collect override activity information for reports.

G. DDC Controllers shall provide local **LED** status indication for each digital input and output for constant,
   up-to-date verification of all point conditions without the need for an operator 1/0 device. Graduated
   intensity LED's for analog indication of value shall also be provided for each analog output. Status
indication shall be visible without opening the panel door (MBC only).

H. Each DDC Controller shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all panel components. The DDC Controller shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication.

I. Isolation shall be provided at all peer-to-peer network terminations, as well as all field point terminations to suppress induced voltage transients consistent with IEEE Standards 587-1980.

J. In the event of loss of all power, there shall be an orderly shutdown of all DDC Controllers to prevent the loss of database 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 100 hours.

1. Upon restoration of normal power, the DDC Controller shall automatically resume full operation without manual intervention.

2. Should DDC Controller memory be lost for any reason, the user shall have the capability of reloading the DDC Controller via the local RS-232C port, via telephone line dial-in or automatically from the network workstation PC.

K. As a minimum, a separate DDC Controller shall be provided for each mechanical room.

2.4 DDC CONTROLLER RESIDENT SOFTWARE

A. General:

1. The software programs specified in this Section shall be provided as an integral part of DOC Controllers and shall not be dependent upon any higher level computer for execution.

B. Control Software Description:

1. The DOC Controllers shall have the ability to perform the following pre-tested control algorithms:
   a. Two-position control
   b. Proportional control
   c. Proportional plus integral control
   d. Proportional, integral, plus derivative control
   e. Automatic tuning of control loops

C. DOC Controllers shall have the ability to perform any or all the following energy management routines:

1. Time-of-day scheduling
2. Calendar-based scheduling
3. Holiday scheduling
4. Temporary schedule overrides
5. Start-Stop Time Optimization
6. Automatic Daylight Savings Time Switchover
7. Night setback control
8. Enthalpy switchover (economizer)
9. Peak demand limiting
10. Temperature-compensated duty cycling

D. DOC Controllers shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.

1. A single process shall be able to incorporate measured or calculated data from any and all other DOC Controllers on the network. In addition, a single process shall be able to issue commands to points in
any and all other DOC Controllers on the network.

2. Processes shall be able to generate operator messages and advisories to operator I/O devices. A process shall be able to directly send a message to a specified device or cause the execution of a dial-up connection to a remote device such as a printer or pager.

E. Alarm management shall be provided to monitor and direct alarm information to operator devices. Each DOC Controller shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic and prevent alarms from being lost. At no time shall the DOC Controllers ability to report alarms be affected by either operator or activity at a PC workstation, local I/O device or communications with other panels on the network.

1. All alarm or point change reports shall include the point's English language description and the time and date of occurrence.

2. The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of six priority levels shall be provided for each point. Point priority levels shall be combined with user definable destination categories (PC, printer, DOC Controller, etc.) to provide full flexibility in defining the handling of system alarms. Each DDC Controller shall automatically inhibit the reporting of selected alarms during system shutdown and start-up. Users shall have the ability to manually inhibit alarm reporting for each point.

3. Alarm reports and messages will be directed to a user-defined list of operator devices or PCs.

4. In addition to the point's descriptor and the time and date, the user shall be able to print, display or store a 200 character alarm message to more fully describe the alarm condition or direct operator response.

5. In dial-up applications, operator-selected alarms shall initiate a call to a remote operator device.

F. A variety of historical data collection utilities shall be provided to manually or automatically sample, store and display system data for points as specified in the I/O summary.

1. Any point, physical or calculated may be designated for trending. Any point, regardless of physical location in the network, may be collected and stored in each DDC Controllers point group. Two methods of collection shall be allowed: either by a pre-defined time interval or upon a pre-defined change of value. Sample intervals of 1 minute to 7 days shall be provided. Each DOC Controller shall have a dedicated RAM-based buffer for trend data. All trend data shall be available for use in 3rd party personal computer applications such as Excel 5.0.

2. DOC Controllers shall also provide high resolution sampling capability for verification of control loop performance. Operator-initiated automatic and manual loop tuning algorithms shall be provided for operator-selected PID control loops as identified in the point I/O summary.

   a. Loop tuning shall be capable of being initiated either locally at the DDC Controller, from a network workstation or remotely using dial-in modems. For all loop-tuning functions, access shall be limited to authorized personnel through password protection.

G. DOC Controllers shall automatically accumulate and store run-time hours for digital input and output points and automatically sample, calculate and store consumption totals for analog and digital pulse input type points, as specified in the point I/O summary.

H. DOC Controllers shall be password protected. The user's Password and Privileges shall be identical to the Password and Privileges used at the EMS Workstation.

2.5 APPLICATION SPECIFIC CONTROLLERS
A. TERMINAL EQUIPMENT CONTROLLERS (TEC)

1. Provide for control of each piece of equipment, including, but not limited to, the following:
   a. VAV with or without heating coils
   b. Fan Coil Units

2. The controllers shall include all inputs and outputs necessary to perform the specified control sequences. Analog outputs shall be 24 volt floating.

3. Each controller performing space temperature control shall be provided with a matching room temperature sensor with a set point adjustment between 55 °F and 95°F.

4. Any piece of equipment with either a hot water and/or chilled water coil shall be provided with a supply air temperature sensor.

5. Each room temperature sensor shall include a terminal jack integral to the sensor assembly. The terminal jack shall be used to connect a portable operator's terminal to control and monitor all hardware and software points associated with the respective controller.

6. Set point adjustment and override function shall have the ability to be locked out, overridden, or limited as to time or temperature through software by an authorized operator at the central workstations, at the DOC Controller, or via the portable operator's terminal.

7. Each controller shall perform its primary control function independent of the DOC Controller. The controller shall receive its real-time data from the DOC Controller time clock. Each controller shall include algorithms incorporating proportional, integral, and derivative (PID) gains for all applications. All PID gains and biases shall be adjustable by the user via terminals as specified herein. This functionality shall allow for tighter control and shall facilitate optimal occupant comfort and energy savings.

8. Provide each terminal equipment controller with sufficient memory to accommodate point databases and operating programs. All databases and programs shall be stored in non-volatile EEPROM, EPROM, and PROM. The controllers shall be able to return to full normal operation without user intervention after a power failure. Operating programs shall be selectable and may be modified to meet the user's exact control strategy requirements, allowing for additional system flexibility.

9. Controllers shall be powered from a 24 VAC source, and shall function normally under an operating range of 18 to 28 VAC (-25% to +17%), allowing for power source fluctuations and voltage drops. The controllers shall also function normally under ambient conditions of 32° F to 122° F and 10-95% RH (non-condensing). Provide each controller with a suitable cover or enclosure to protect the intelligence board assembly.

10. Pressure independent controllers shall include differential pressure transducers that shall connect to the terminal unit manufacturer's standard averaging air velocity sensor to measure the average differential pressure in the duct. The controller shall convert this value to actual airflow. The differential pressure transducer shall have a measurement range of 400 to 4,000 FMP and measurement accuracy of +/-5% at 400 FPM insuring primary air flow condition shall be controlled and maintained to within +/-5% of set point at the specified parameters. Each controller shall include provisions for manual and automatic calibration of the differential pressure transducer in order to maintain stable control and insuring against drift overtime. The controller requiring 24 hours a day operation shall calibrate the airflow sensor every 24 hours with the use of an auto-zero module to eliminate the requirement of closing the supply damper to calibrate the flow sensor. It shall not be necessary to remove the controller to remove the damper actuator.
2.6 VALVES, DAMPERS AND ACTUATORS

A. VALVES:

1. Water valves shall be sized by the control manufacturer to produce the required capacity at a pressure loss of 5 psi. Nominal body rating shall be not less than ANSI Class 125. However, the valve body and packing selected shall be designed to withstand the system static head plus the maximum pump head and the maximum temperature of control medium and hot water. Single-seated valves shall have close-off ratings equal to 125% of the system pressure encountered that is the maximum upstream pressure. The valve body and packing selected shall be designed to withstand the system static head plus the maximum pump head and the maximum temperature of control medium without leakage for hot water.

2. Two-Way and Three-Way Valves:
   a. Valve sizes 2” and smaller shall be screwed and supplied with union fittings. The valves shall be constructed of brass with stainless steel trim with equal percentage flow characteristics and have a rangeability of 50:1 or greater.
   b. Valve sizes 2.5” and larger shall be flanged. The valves shall be constructed of cast iron ASTM A126 Class B. The trim shall be stainless steel with equal percentage flow characteristics. The valve rangeability shall be 100:1 or greater.
   c. Valves shall be of the straight-through type as required by the sequence or indicated on the drawings.

3. Low Pressure Steam Valves: Shall be rated to 338° F at a maximum inlet pressure to the valve of 100 psig. Valves for low-pressure steam shall be sized for 80% pressure drop of inlet pressure. Valves shall be equipped with stainless steel trim and disc with linear flow characteristics. Applications, which require steam valves larger than 2", shall utilize 2 valves in a \( \frac{1}{3} \) - \( \frac{2}{3} \) parallel arrangement.

4. Butterfly Valves: Where butterfly valves are indicated to be used as automatic control valves, they shall be line size and designed for motorized control operation with upper disc steam keyed or machined square for mating with the control operators linkage. All butterfly control valves over 8” shall be equipped with a manual, mechanical control actuator override, gear box operator for emergency manual control of the valve position. Provide required accessories to mechanically disengage automatic control actuator linkage and engage manual gear operator without dismantling the valve stem and stem extensions during changeover. Valves 4-20” and larger shall be tapped, full lug, cast iron body butterfly valves with aluminum bronze discs, stainless steel stem and EPDM seat. Design must incorporate top and bottom bushings between shafts and body of material suitable to provide a bearing surface to eliminate seizing or galling. Valves 4-20” must provide bubble-tight seal at 150 PSIG. Liners are to be resilient material suitable for 250° F temperature.

5. Valve Constant (Cv) Charts: Control drawings shall indicate the valve constant (Cv rating) of all valves used so that the valve pressure drop may be used for balancing and performance tests. Submittal data shall also state calculated shut-off pressure for each valve size.

B. DAMPERS:

1. The Temperature Control Manufacturer shall provide control dampers of the types and sizes indicated on the drawings, including but not limited to outside air, return, relief air dampers, isolation and exhaust system bypass dampers.

2. Damper frames shall be 5” X 1” 6063T5 extruded aluminum hat channel with .125” minimum wall thickness with mounting holes for flange and enclosed duct mounting.
3. Dampers shall be available in two-inch size increments from 8" horizontal and vertical to 48". Requirements over 48" shall be standard modules with interconnecting hardware (e.g., shafting).

4. All damper blades shall be 6" 6063T5 heavy gage extruded aluminum airfoil for high velocity performance. Blades on all dampers must be not over 6" wide. Blade bearing shall be molded synthetic with 1/2" hex plated steel shafts. All blade linkage hardware shall be corrosion-resistant finish and readily accessible for maintenance after installation.

5. Extruded vinyl edging seals for outdoor dampers and flexible metal compressible type side seals for all dampers shall be provided.

6. Dampers and seals shall be suitable for temperature ranges of -50°F to +250°F at specified leakage ratings.

7. Dampers used for proportional control shall have opposed blades.

8. Leakage rates shall not exceed 6.25 CFM/Sq. Ft. at 4" wg. differential rated in accordance with AMCA 500.

9. Acceptable manufacturers are Ruskin, Arrow United Industries, American Warming and Ventilating, Inc. or approved equal.

C. DAMPER AND VALVE ACTUATORS:

1. Electronic actuators shall be of 0-10 VDC type. The minimum actuator impedance shall be 800 ohms even when more than one actuator is connected in parallel. Spring return shall be required for two-position (NO/NC) control sequence or for steam valve control. Non-spring return actuators shall be used for all modulating sequence of control. They shall conform to all requirements of sequence descriptions specified or scheduled. Main mechanical equipment actuators shall have a manual position dial to allow manual positioning of valve in absence of control power.

2. Valve actuators shall be of sufficient size to close valves at system pressure drop across the valve plus 50%.

3. Actuators for Terminal Equipment Controllers shall be 24V floating point, 0-10Vdc or pneumatic depending on Sequence of Operation and required speed of response. Regardless of actuator type, they shall be modulating and their position shall be readable in percentage open at the Workstation.

2.7 FLOW STATIONS

A. FLOW STATION

1. Provide where indicated on the plans airflow traverse probes mounted in the ductwork capable of continuously measuring the air volume of the respective ductwork.

2. The ductwork airflow traverse probes shall contain multiple total and static pressure sensors places at concentric area centers along the exterior surface of the cylindrical probe and internally connected to their respective averaging manifolds. Sensors shall not protrude beyond the surface of the probe, nor be adversely affected by particle contamination normally present in building system airflows.

3. The duct work airflow traverse probes (two per duct) shall have dual end support swivel brackets suitable for mounting in the fan inlet bell and symmetrical averaging signal takeoffs and fittings, and shall be of aluminum construction with hard anodized finish.

4. The airflow traverse probes shall not induce a measurable pressure drop, nor shall the sound level within the system be amplified by its presence in the ductwork.
The probes shall be capable of producing steady, non-pulsating signals of standard total and static pressure, without need for flow corrections or factors, with an accuracy of 2% of actual flow. Traverse probes shall be Air Monitor or equal.

2.8 FIELD SENSORS

A. Temperature Sensors:

1. The sensor shall be one of the following temperature sensor types:
   a. 1000 ohm (±0.2%) platinum resistance temperature detectors having a coefficient of resistivity of 0.00385 ohms/ohm/°C (for animal room locations).
   b. 100 ohm (±0.12%) platinum resistance temperature detectors having a coefficient of resistivity of 0.00385 ohms/ohm/°C. Provide RTD temperature transducers with of 4-20 ma output signal variations of less than 0.2% of full scale output for supply voltage variations +/-10% and integral and accessible zero and span adjustment.
   c. 10,000 ohm thermistor having an accuracy of .5° F at calibration point of 77° F may be used for room temperature only. Where applicable, the Room Temperature Sensor (RTS) shall share the wireless mesh technology FLN.
   d. Immersion temperature sensors shall have 316 Stainless Steel wells and duct mounted sensors shall use averaging bulbs of not less than 24" and when mounted in the preheat or mixed air position the averaging bulb shall be twice the diagonal length of the coil or duct.

B. Dew point Sensors:

1. The sensor shall be a 2-wire loop powered duct mounted relative humidity and temperature sensor having a measuring range 0 to 100% of R.H. with an accuracy no less than ±2.5%. The sensor will calculate dew point temperature between -20° C and 80° C. The output from the sensor shall be 4-20 ma. Dew point sensors shall be Vaisala HMT100 or equal.

C. Carbon Dioxide Sensor

1. The sensor shall be a duct mounted microprocessor-based photo-acoustic CO2 sensor to read CO2 levels in the return air. The sensor shall have a range of 0-2000 ppm with an accuracy of ± 100 ppm. CO2 sensor shall be Siemens QPA63 Series or equal.

D. Pressure Sensors:

1. The sensor shall be an air differential pressure transducers with output of 4-20 ma proportional to pressure. The airflow transmitter will have an accuracy of at least ± 0.5% F.S for velocity pressure applications and ± 1.0% F.S for static pressure applications. Airflow transmitter shall be either Dresser Industries Ashcroft Model XLDp or Setra C264 Lab.

2. The sensor shall be a water or steam differential pressure transducers with output of 4-20 ma proportional to pressure. The transmitter will have an accuracy of at least ±0.25% of the transmitter range. The pressure sensor shall have an LCD display. The transmitter shall be Siemens SITRAN 7MF4433 or equal.

E. Smoke Detectors:

1. Smoke sensors are provided and installed under Division 28 to conform to local codes.

F. Low Limit Temperature Switch
1. The sensor shall be a Low Limit Temperature Switch with minimum 20ft. element for freeze protection as specified hereinafter. Element shall be serpentine across the face of the coil and shall be of sufficient length or number for three passes across the width of the coil it is protecting. Connect Low Limit Temperature Switch in series with other safety devices to de-energize fans serviced when a drop in temperature below set point is detected.

G. Electronic-to-Pneumatic Transducers

1. E/P Transducers shall convert 0-10 Vdc or tri-state control to a 0-20 psig pneumatic output. The device shall have an output accuracy of ± 0.5 psi at 77°F and a repeatability of ± 0.05psig. Bleed rate shall not exceed 80 SCIM. The E/P shall utilize a "pump/dump" technology. The E/P Transducer shall have the ability to build or release a volume of no less than 500 SCIM.

H. Differential Pressure Switches:

1. The sensor shall be a pressure switch to monitor the pressure drops across each piece of equipment specifically a filter banks, fans and pumps.
2. Design and sensitivity shall match application, with SPOT contacts to make/break from a field adjustable differential pressure setting for alarm reporting to the EMS. Switches utilized for filter banks and fans shall be Powers Static Pressure Air Flow Switches Series SW 141 or equal. Switches for pumps shall be Penn P74 differential pressure switch or equal.

I. Current Status Switch (CSS)

1. The sensor shall be a high performance miniature split-core current status switch with adjustable set point. The current status switch shall have an operating range of between 1.25-50 amps and be able to detect belt loss and mechanical failure. CSS shall be Veris Hawkeye H908 or equal.

J. Pressure Electric Switch (PE)

1. The sensor shall be a pressure operated snap switch that can actuate electrical circuits. The contact ratings shall be 8 amps at 240V inductive.

K. Steam and Condensate Flow Meter

1. Steam and Condensate: The flow meter shall measure volumetric, mass and energy flow of gas, liquids and steam. The flow meter shall utilize insertion turbine technology to provide reliable and accurate signal. The flow meter shall have a 25:1 turndown ratio and output a 4-20 ma linear signal corresponding to volumetric flow.
   a. Accuracy: ±1% of Volumetric flow rate.
   b. Maximum operating pressure: - 125 PSIG
   c. Operating Temperature: - 40°F to +400°F

L. Chilled and Hot Water Flow Meter

1. Chilled and Heating Water Flow Meter: The flow meter shall measure the volumetric flow of chilled and/or heating water. The flow meter shall be non-intrusive strap-on type and utilize Wide-Beam Transit-Time or Reflex or mode technology to provide reliable and accurate flow signal. The flow meter shall have a 4-20 ma output for instantaneous flow. The Flow Meter computer shall housed in a NEMA 4X enclosure and display instantaneous and total flow.
   a. Accuracy: ±1% of flow rate between± 40 fVsec
   b. Maximum operating pressure: Not Applicable
   c. Operating Temperature: -40°F to +250°F
d. Acceptable Manufacture: Siemens Industry Inc. SITRANS F Flow Meter Model FUS1010 or equal.

M. Natural Gas Flow Meter

1. Natural Gas Flow Meter: The flow meter shall measure natural gas volume in standard units without need for temperature or pressure compensation. It provides an isolated 4-20 ma linear output for flow rate and an isolated 4-20 ma output for process gas temperature. The flow meter shall be insertion design and utilize a Constant Temperature Differential technology to provide a reliable and accurate signal. The flow meter shall have a 100:1 turndown ratio.

   a. Accuracy: ±1% of reading ± 0.2% of full scale.
   b. Maximum operating pressure: -500 PSIG
   c. Operating Temperature: -40° F to +400° F
   d. Acceptable Manufacture: Fox Thermal Instruments Inc. Model FT2 Gas and Temperature Transmitter or equal.

N. Refrigerant Monitor

1. Refrigerant Monitor: The Refrigerant Monitor shall be a multiple refrigerant gas and multiple area monitoring system for low level continuous monitoring of CFC, HCFC and HFC refrigerant gases used in commercial refrigeration systems. The System design supports compliance to the refrigerant monitoring requirements of ANSI/BSR ASHRAE 15-1994. The Refrigerant Monitor shall utilize Non-Dispersive Infrared technology to provide a reliable and accurate signal.

   a. Sensitivity: 1 PPM on all gases. ii. Range: 0 to 1000 PPM
   b. Accuracy: ± 10 PPM
   c. Output: 4-20 ma isolated
   d. Operating Temperature: 32° F to +122° F
   e. Acceptable Manufacture: Bacharach Inc. Model HGM

0. Break Glass Switch

1. Break Glass Switch: The Break Glass Switch shall be housed in a NEMA 4X enclosure. The operator is held in a depressed position by a glass disc. When the glass disc is broken with the hammer, the button return to normal position. The break glass switch shall be properly labeled as to its function.


P. Strobe Light

1. Strobe Light: The Strobe Light shall be housed in a NEMA 4X enclosure. The compact light features a Xenon flash tube, solid state circuitry, polycarbonate Fresnel dome, zinc die-cast base painted with a corrosion resistant polyurethane. The flash bulb shall have an estimate bulb life of 10,000 hours.

   a. Acceptable Manufacture: Federal Signal Model Fireball

Q. Audible Signal Device

1. Audible Signal Device: The Audible Signal device shall be housed in a NEMA 4X enclosure. The audible signal shall be rated for 100 dB@ 10’.


2.9 LOCAL CONTROL PANELS

A. Provide control panels with suitable brackets for wall mounting, for each miscellaneous control system. Locate panel adjacent to systems served.
B. Fabricate panels of 14-gauge furniture-grade steel, or 6063-T5 extruded aluminum alloy, totally enclosed, with hinged doors and keyed lock, with manufacturer's standard shop-painted finish and color. Provide UL listed cabinets for use with line voltage devices.

C. Panel Mounted Equipment: Include temperature controllers, relays, and other devices excluded in the sequence of operation. Mount devices with adjustments accessible through the fronts of panels.

2.10 WORKSTATION

A. Personal computer operator workstations shall be provided for command entry, information management, network alarm management, and database management functions. All real-time control functions shall be resident in the DDC Controllers to facilitate greater fault tolerance and reliability.

1. Provide a workstation(s) of equal capability, to be located by building owner.

2. Each workstation shall consist of a 23" HD (1920X1080) color monitor, personal computer with minimum 8GB RAM, minimum 1 TB hard drive, Multi-format DVD±RW/CD-RW drive, mouse, and 101-key enhanced keyboard. Personal computer shall be a T3500 Dell or equivalent, and shall include as a minimum a Intel® Core™ i5-650 processor 3.2 GHz processor.

3. Provide one (1) printer at the workstation location with the minimum requirements equal to a HP-Network-Ready Black-and-White Laser Printer Model: P2055DN.

2.11 WORKSTATION SOFTWARE

A. Basic Interface Description

1. Operator workstation interface software shall be installed on the Owner furnished computer and no additional license shall be required. Operator workstation interface software shall be a Dynamic Graphical User Interface utilizing Microsoft "Windows 7™" operating system. The system shall minimize operator training through the use of English language prompting, English language point identification and industry standard PC application software. The software shall provide, as a minimum, the following functionality:

   a. Graphical viewing and control of environment
   b. Scheduling and override of control operations
   c. Collection and analysis of historical data
   d. Definition and construction of dynamic color graphic displays
   e. Editing, programming, storage and downloading of controller databases

2. The software shall provide a multi-tasking type environment that allows the user to run several applications simultaneously. Microsoft Word 2007™ and Excel for Windows 2007™ must be provided with the software package.

   a. Provide functionality such that any of the following may be performed simultaneously, and in any combination, via user-sized windows:

      1) Dynamic color graphics and graphic control
      2) Alarm management coordinated with section 2.04.E.
      3) Time-of-day scheduling
      4) Trend data definition and presentation
      5) Graphic definition
      6) Graphic construction

   b. If the software is unable to display several different types of displays at the same time, the EMS contractor shall provide at least two operator workstations.
3. Universal Access and Privileges shall provide system password protection. The user/manager shall be able to limit a user’s access, by assigned password, to workstations, points, applications, graphics, reports or any other object as defined by the system Software.

   a. There shall be four (4) levels of access to all objects:

      1) None = Prevents user from even viewing an unassigned object
      2) View = View only objects assigned
      3) Command = Command objects assigned
      4) Configure = All privileges for the assigned object

   b. A minimum of 50 unique passwords, including user initials, shall be supported.

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

   d. The system shall automatically generate a report of log-on/log-off time and system activity for each user.

   e. User-definable, automatic log-off timers of from five to 60 minutes shall be provided to prevent operators from inadvertently leaving devices on-line.

4. Software shall allow the operator to perform commands including, but not limited to, the following:

   a. Start-up or shutdown selected equipment
   b. Adjust set points
   c. Add/modify/delete time programming
   d. Enable/disable process execution
   e. Lock/unlock alarm reporting for points
   f. Enable/disable totalization for points
   g. Enable/disable trending for points
   h. Override PID loop set points
   i. Enter temporary override schedules
   j. Define holiday schedules
   k. Change time/date
   l. Automatic daylight savings time adjustments
   m. Enter/modify analog alarm limits
   n. Enter/modify analog warning limit
   o. View limits
   p. Enable/disable demand limiting for each meter
   q. Enable/disable duty cycle for each load
   r. Modify individual fume hood face velocity set point

5. Reports shall be generated and directed to CRT displays, printers or disk. As a minimum, the system shall allow the user to easily obtain the following types of reports:

   a. A general listing of all points in the network
   b. List of all points currently in alarm
   c. List of all points currently in override status
   d. List of all disabled points
   e. List of all points currently locked out
   f. DDC Controller trend overflow warning
   g. List all weekly schedules
   h. List of holiday programming
   i. List of limits and deadbands
1) Summaries shall be provided for specific points, for a logical point group, for a user-selected group or groups or for the entire facility without restriction due to the hardware configuration of the EMS. Under no conditions shall the operator need to specify the address of the hardware controller to obtain system information.

B. Scheduling

1. Provide a graphical spreadsheet-type format for simplification of time-of-day scheduling and overrides of system control operations. Provide the following spreadsheet graphic types as a minimum:
   a. Daily schedules
   b. Weekly schedules
   c. Monthly schedules
   d. Yearly schedules
   e. Monthly calendars

2. Schedules shall be provided for each control zone or piece of equipment with a specific occupancy schedule. Each zone shall be scheduled daily for up to a year in advance. Each zone can have a different schedule for each day of the year. Equipment scheduling shall be accomplished by simply inserting occupancy and vacancy times into appropriate information blocks on the graphic. In addition, temporary overrides and associated times may be inserted into blocks for modified operating schedules. After overrides have been executed, the original schedule will automatically be restored.

3. Monthly calendars for a 24-month period shall be provided which shall allow for simplified scheduling of zones days in advance. The days shall be user-selected with the pointing device.

C. Collection and Analysis of Historical Data

1. Provide trending capabilities that allow the user to easily monitor and preserve records of system activity over an extended period of time. Any system point may be trended automatically at time-based intervals or changes of value, both of which shall be user-definable. Trend data may be stored on hard disk for future diagnostics and reporting.

2. Trend data report graphics shall be provided to allow the user to view all trended point data. Reports may be customized to include individual points or pre-defined groups of at least six points. Provide additional functionality to allow any trended data to be to Microsoft Excel™.

3. Provide additional functionality that allows the user to view trended data on trend graph displays. Displays shall be actual plots of both static and/or real-time dynamic point data. A minimum of ten points may be viewed simultaneously on a single graph with color selection and line type for each point being user-definable. Displays shall include an 'X' axis indicating elapsed time and a 'Y' axis indicating a range scale in engineering units for each point. The 'Y' axis shall have the ability to be manually or automatically scaled at the user's option. Different ranges for each point may be used with minimum and maximum values listed at the bottom and top of the 'Y' axis. All 'Y' axis data shall be color-coded to match the line color for the corresponding point. Points may be added to the graph using a Drag & Drop feature. Graphs shall have a 3-D capability.

D. Dynamic Color Graphic Displays

1. Color graphic floor plan displays and system schematics for each part of the ventilation system, including air handling units, smoke evacuation fans, chillers, boilers, shall be provided by the DDC contractor as indicated in the point 1/0 summary of this specification to optimize system performance analysis and speed alarm recognition.

2. The manager interface shall allow users to access the various system schematics and floor plans via a graphical penetration scheme, menu selection or text-based commands.
3. Dynamic airflow values, temperature values, humidity values and status indication shall be shown in their actual respective locations and shall automatically update to represent current conditions without operator intervention.

4. The windowing environment of the PC operator workstation shall allow the user to simultaneously view several graphics at a time to analyze total control operation or to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.

5. Graphic generation software shall be provided to allow the user to add, modify or delete system graphic displays.

   a. The DDC contractor shall provide libraries of pre-engineered screens and symbols depicting standard air handling unit components (e.g., fans, terminal units, etc.), complete mechanical systems (e.g., constant volume- terminal reheat, VAV, etc.), standard safety icons (e.g. biological, radioactive, emergency eyewash stations, etc.), lab fume hoods, Bio-safety cabinets and electrical and hazard identification symbols.

   b. Graphical displays can be created to represent any logical grouping of system points or calculated data based upon control function, mechanical system, layout or any other logical grouping of points which aids the manager in the analysis of the facility.

   1) To accomplish this, the user shall be able to build graphic displays that include point data from multiple DDC Controllers including Application Specific Controllers used for DDC equipment or VAV terminal unit control.

E. System Configuration and Definition

1. All ventilation and temperature control strategies and safety management routines shall be definable by the operator. System definition and modification procedures shall not interfere with normal system operation and control.

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

   a. Add/delete/modify stand-alone DDC Controller panels
   b. Add/delete/modify operator workstations
   c. Add/delete/modify application specific controllers
   d. Add/delete/modify points of any type and all associated point parameters and tuning constants
   e. Add/delete/modify alarm reporting definition for points
   f. Add/delete/modify control loops
   g. Add/delete/modify energy management applications
   h. Add/delete/modify time and calendar-based programming
   i. Add/delete/modify totalization for points
   j. Add/delete/modify historical data trending for points
   k. Add/delete/modify custom control processes
   l. Add/delete/modify any and all graphic displays, symbols and cross-reference to point data
   m. Add/delete/modify dial-up telecommunication definition
   n. Add/delete/modify all operator passwords
   o. Add/delete/modify alarm messages
   p. Add/delete/modify fume hood face velocity set point

3. Definition of operator device characteristics, DDC Controllers individual points, applications and control sequences shall be performed using instructive prompting software.

   a. Inputs and outputs for any process shall not be restricted to a single DDC Controller but shall be able to include data from any and all other network panels to allow the development of network-
wide control strategies. Processes shall also allow the operator to use the results of one process as the input to any number of other processes (cascading).

b. Provide the capability to backup and store all system databases on the workstation hard disk. In addition, all database changes shall be performed while the workstation is on-line without disrupting other system operations. Changes shall be automatically recorded and downloaded to the appropriate DDC Controller. Similarly, changes made at the DDC Controllers shall be automatically uploaded to the workstation, ensuring system continuity. The user shall also have the option to selectively download changes as desired.

c. Provide context-sensitive help menus to provide instructions appropriate with operations and applications currently being performed.

2.12 PORTABLE SERVICE TOOL

A. No additional interface software shall be required.

PART3 - EXECUTION

3.1 PROJECT MANAGEMENT

A. Provide a project manager who shall, as a part of his duties, be responsible for the following activities:

1. Coordination between this Contractor and all other trades, Owner, local authorities and the design team.

2. Scheduling of manpower, material delivery, equipment installation and checkout.

3. Maintenance of construction records such as project scheduling and manpower planning and Auto CAD for project coordination and as-built drawings.

3.2 INSTALLATION METHODS

A. Electrical Wiring

1. Install systems and materials in accordance with manufacturer's instructions, rough in drawings and equipment details. Install electrical components and use electrical products complying with requirements of applicable Division 26 Sections of these Specifications except where specifically stated in this Section.

2. The term "control wiring" is defined to include providing of wire, conduit, and miscellaneous material as required for mounting and connecting electric or electronic control devices.

3. Install all control wiring in EMT conduit with compression fittings for electric/electronic control systems. Conceal wiring, except in mechanical rooms and areas where other conduit and piping are exposed. UL plenum rated cable shall be allowable above accessible lift out ceiling, in air plenums, and in other areas as approved by local and NEC codes.

4. Wall sensors shall be installed on electrical "J" boxes and conduit stubbed to above lift out ceilings. Plastic bushing shall be installed where the sensor wire exits the conduit to prevent damage.

5. Number-code or color-code conductors, excluding those used for individual zone controls, appropriately for future identification and servicing of control system.

6. This section shall provide all line voltage power wiring required for all equipment supplied by this Section of the specification.
7. This section shall provide all 120V power wiring for the EMS, Refrigerant Monitoring System, Control Valves and Flow Meters.

8. Install all control wiring in galvanized rigid conduit and seal tight flex connectors where run outside the building structure or install in wet areas.

3.3 SYSTEM ACCEPTANCE

A. General: The system installation shall be complete and tested for proper operation prior to acceptance testing for the Owner's authorized representative. A letter shall be submitted to the Architect requesting system acceptance. This letter shall certify all controls are installed and the software programs have been completely exercised for proper equipment operation. Acceptance testing will commence at a mutually agreeable time within ten (10) calendar days of request. When the field test procedures have been demonstrated to the Owner's representative, the system will be accepted. The warranty period will start at this time.

B Field Equipment Test Procedures: DOC control panels shall be demonstrated via a functional end-to-end test. Such that:

1. All output channels shall be commanded (on/off, stop/start, adjust, etc.) and their operation verified.
2. All analog input channels shall be verified for proper operation.
3. Changing the state of the field device and observing the appropriate change of displayed value shall verify all digital input channels.
4. If a point should fail testing, perform necessary repair action and retest failed point and all interlocked points.
5. Introducing an error into the system and observing the proper corrective system response shall verify automatic control operation.
6. Changing the schedule and observing the correct response on the controlled outputs shall verify selected time and set point schedules.
   a. Communication with each DOC control panel shall be demonstrated.
   b. Operator commands will be explained and demonstrated.
   c. Control sequences shall be demonstrated for proper operation.
   d. All available system reports and logs shall be demonstrated at the system workstation.
   e. Correct system start-up and shutdown procedures shall be demonstrated.
   f. All controllers shall be demonstrated to operate in a standalone mode.

C. Workstation Test Procedures: The system workstation test procedures shall be as follows:

D. Record Documentation: After a successful acceptance demonstration, the Contractor shall submit as-built drawings of the completed project for final approval. After receiving final approval, supply 6 copies of complete 11 x 17 as-built drawings sets and one (1) CD of ACAD drawings.

E. Operation and Maintenance Manuals: Submit three copies of operation and maintenance manuals. Include the following:

1. Manufacturer's catalog data and specifications on sensors, transmitters, controllers, control valves, damper actuators, gauges, indicators, terminals and any miscellaneous components used in the system.
2. An operator's manual that will include detailed instructions for all operations of the system.
3. An operator's reference table listing the addresses of all connected input points and output points. Settings shall be shown where applicable.
4. A programmer's manual that will include all information necessary to perform programming functions.

5. A language manual that will include a detailed description of the language used and all routines used by the system.

6. Complete program listing file and parameter listing file for all programs.

7. A copy of the warranty.

8. Operating and maintenance cautions and instructions.

9. Recommended spare parts list.

3.4 TRAINING

A. Contractor shall provide to the engineer a training class outline prior to any scheduled training.

B. Factory trained control engineers and technicians shall provide training sessions for the Owner's personnel.

C. The control contractor shall conduct 5 six-hour training sessions on the DOC System for the designated Owner's personnel in the maintenance and operation of the Systems. The class shall be given upon system acceptance.

D. The course shall include instruction on specific systems and instructions for operating the installed system to include as a minimum:

1. HVAC system overview
2. Operation DOC Systems
3. Function of each Component
4. System Operating Procedures
5. Programming Procedures
6. Maintenance Procedures

3.5 SERVICE AND GUARANTEE

A. This system specified under this Section of the Specifications shall be guaranteed from defects in workmanship and material under normal use and service for a period of twelve (12) months from the date of acceptance. If, during the one year period, any of the factory equipment or materials provided in the system is found to be defective in materials or workmanship, it shall be replaced or repaired by the DOC Manufacturer at no additional cost to the Owner.

B. Upon completion of the installation, the Contractor shall thoroughly inspect, check, adjust, calibrate, and make ready for use all devices/sensors comprising the control system and certify that they are installed in accordance with "Record" Drawings.