Section 15900 - Direct Digital Control System

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplemental Conditions and Division 1 Specifications sections, apply to work of this section.

B. Division 15 basic mechanical materials and methods sections apply to work of this section.

1.2 DESCRIPTION OF WORK

A. Extent of Microprocessor Control systems work required by this section is indicated on drawings and schedules, and by the requirements of this section. Control system consists of sensors, indicators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multitasking, multi-user environment on network and programmed to operate mechanical systems according to sequences of operations indicated or specified.

B. Control sequences are specified in Division 15 section: SEQUENCE OF OPERATION.

C. Refer to other Division 15 sections for installation of water sensor wells, valve bodies, and control dampers in mechanical systems; furnished by the Control Contractor but not work of this section.

D. Refer to Division 16 sections for the following work (not work of this section):

1. Power supply wiring for power source to power connection on controls and/or unit control panels, include starters, disconnects, and required electrical devices, except where specified as furnished or factory installed by the manufacturer.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer specializing in HVAC control system installations.

B. Manufacturer Qualifications: Engage a firm experienced in manufacturing control systems similar to those indicated for this Project and that have a record of successful in-service performance for not less than five (5) years.

C. Startup Personnel Qualifications: Engage specially trained personnel that have been certified in all aspects of the software, hardware, installation, programming, startup and calibration of primary temperature control system.

1.4 CODES AND STANDARDS

A. Electrical Standards: provide electrical products which have been tested, listed, and labeled by Underwriters Laboratory for Open Energy Management Equipment (PAZX) under UL Standard for Safety 916.

B. NEMA Compliance: Comply with NEMA standards pertaining to components and devices for electrical control systems.

C. NFPA Compliance: Comply with NFPA 90A "Standard for the installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequence.

D. FCC Part 15 Subpart J, Class A

E. European Union Standards EN50011 or EN55022 “CE Mark”

1.5 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections

B. Product Data for each type of product specified. Include manufacturer's technical Product Data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, and installation instructions.

C. Shop Drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection. Submit damper leakage and flow characteristics, plus size schedule for controlled dampers.

D. Shop Drawings: Refer to Division 15 "Sequence of Operation" for additional shop drawing reference. Submit detailed point to point wiring diagrams for the Microprocessor Control system to include, but not limited to, control points, controller input/output schedules, and equipment bill of material. In addition, Shop Drawings must contain the following information for each control system:

1. Schematic flow diagram showing fans, pumps, coils, dampers, valves, and control devices.
2. Each control device labeled with setting or adjustable range of control.
3. Diagrams for all required electrical wiring. Clearly differentiate between factory-installed and field-installed wiring.
4. Details of control panel faces, including controls, instruments, and labeling.
5. Written description of sequence of operation.
6. Trunk cable schematic showing programmable control unit locations and trunk data conductors.
7. Listing of connected data points, including connected control unit and input device.
8. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
9. System configuration showing peripheral devices, power supplies, diagrams, modems, and interconnections.
10. Software description and sequence of operation.

E. Wiring diagrams detailing wiring for power, signal, and control systems and differentiating clearly between manufacturer-installed and field-installed wiring.

F. Maintenance data for control systems equipment to include in the operation and maintenance manual specified in Division 1. Include the following:

1. List of set points.

G. Graphic Pictures: Submit detailed layout of each graphic drawing to include but not limited to all Air Handlers, reheat coils, ground loop water data, and misc. data points. Graphic drawings shall include all data points and setpoints associated with the equipment listed.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Provide factory shipping cartons for equipment and control devices. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage and to eliminate dirt and moisture from equipment. Store equipment and materials inside and protected from the weather.

B. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping control devices to unit manufacturer.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
ASI Controls, Installing Contractor: _____. Phone: ___-___-____

B. All listed manufacturers shall meet all of the requirements of this specification.

C. Quality Assurance: The equipment and software proposed by the supplier shall be currently in manufacture. No custom products shall be allowed unless required by the specifications. All products shall be supported by the manufacturer for a minimum of five (5) years, including spare parts, board repairs, and software revisions.

D. Operating Environment: All System Controllers (SC's) and Terminal Controllers (TC's) shall operate in an environment of 32° to 104° Fahrenheit and 10 per cent to 95 per cent relative humidity, non-condensing.

E. Agency Approvals: All controllers shall be UL approved as an Energy Management System (UL 916). SC's and TC's shall also comply with FCC regulations.

2.2 GENERAL

A. Furnish all control components required to accomplish the sequence of operation as per Division 15 section "Sequence of Operation."

B. The Microprocessor based controllers shall monitor the data environment and perform control functions in relation to a programmed strategy and the status of the environment.

C. The system shall use solid state computer based digital and analog technology. The system shall be standard with the manufacturer to insure ongoing parts availability and trained technical support.

D. The Microprocessor controller shall be of the fully user programmable type requiring no special computer education for operation. All end user training shall be by the factory trained reseller.

E. The system shall be capable of stand alone operation without the presence of an operator or an on-site user interface computer.

2.3 MATERIALS AND EQUIPMENT

A General

1. All hardware provided shall include a product warranty for one year from the completion of the project.
2. All materials used above ceilings shall be suitable for use in return air plenums.

B. Networks and Operator Communications

1. General: The communications network architecture shall consist of three levels. The top level shall be a High Speed LAN designed to be able to exchange information with other facilities and the User Interface workstation over Ethernet. The High Speed LAN connects through an EtherLink to the System Interface and Network Computer (SINC). The second level System Bus shall be an RS-485 bus to support communications among the System Interface and Network Computer (SINC) and System Controllers (SC's). The third level Local Bus shall be an RS-485 bus that communicates to a family of Terminal Controllers (TC's) for control of the terminal equipment, and lighting control. Controllers on the Local Bus shall communicate bi-directionally with the high speed LAN through the System Controllers.
2. High Speed LAN: This local area network shall be based on standard Personal Computer (PC) Hardware with 10/100MBps Ethernet LAN connection to provide a communicating node(s) via an OLE for Process Control (OPC) data server

The high speed LAN shall support multi-communications and multi-session activity. That is, all global data sharing shall occur simultaneously with the transmission of alarm data or user activity, via modem or local workstation, and more than one user shall be able to access the same controller. LAN protocol shall be TCP/IP.

3. User Interface Computer: User Interface Computer shall have access to all objects and data in the control network (i.e. Inputs, Outputs, Setpoints, Schedules, etc.) via an OLE for Process Control (OPC) data server. Data requests shall be made of the OPC data server for named parameters. The User Interface Computer is not required for normal operation of the system.
3. System Interface and Network Computer: Access to the network of SC's and TC's shall be through a System Interface and Network Computer (SINC) connected via TCP/IP through an EtherLink device, directly through a serial RS-232 port, or by connection to a standard telephone modem. Dial-up Communications: It shall be possible to access the network remotely through a standard dial-up modem.
4. System Bus: The System Bus supports multiple control units for operation of the building's HVAC systems. This RS-485 bus shall operate at a minimum speed of 9600 baud, with a minimum length of 4000 feet or 32 nodes before requiring a network repeater
5. Local Bus: A minimum of 127 TC's shall be configurable on the local bus. Systems with baud rates of less than 19,200 shall be limited to 64 Terminal Controllers to insure adequate global data and alarm response times. The local bus shall permit simultaneous communications with laptop computers that are connected to a Terminal Controller.

C. System Interface and Network Controllers (SINC's)

1. Description: The System Interface and Network Controller (SINC) is a configurable System Controller with an extended communication capability, but no inputs or outputs. It shall be capable of performing the management functions of a System Controller.
2. The SINC shall have two RS-232 ports to allow simultaneous communication with a directly connected personal computer (PC) and a Dial-In modem, or a PC and an Ethernet Connection.
3. The SINC shall have a System Bus RS-485 port operating at up to 19,200 baud to communicate with other System Controllers.
4. The SINC shall have two Local Buses RS-485 ports operating at up to 19,200 baud to communicate with other Terminal Controllers. The SINC shall be able to initiate polling messages to collect data from the TC's to make it rapidly available to the User Interface, and to make control decisions based on that polled data.
5. The SINC shall be able to pass messages from either RS-232 port through to the System Bus or either of 2 Local Busses.
6. The SINC shall be able to initiate Dial-Out messages to annunciate alarms and events.

D. System Controllers (SC's)

1. Description: System Controllers (SC's) shall be provided capable of fully controlling main plant equipment, supervising Terminal Controllers (TC's), and providing management capabilities. The SC's should comprise a single device, capable of fully performing its specified functions without the need for add-on cards or modules. They shall be fully configurable. The SC's shall be based on multi-layer printed circuit boards in metal enclosures, with 16 bit microcontrollers, battery-backed calendar clock chips, two communications ports, on-board RS-232 and RS-485, a minimum scan time of 1 second and a minimum communication speed of 9600 baud. The SC's shall have optional Ethernet adapters for UDP/IP communication.
2. Firmware: Object oriented firmware shall be embedded in each SC so that linking pre-defined objects can configure specific sequences. No special programming language shall be necessary to fully configure SC's. Objects shall include Inputs, Binary Outputs, Schedule, Control State, Afterhours, Optimum Start, Demand Manager, Clock, Poll List, Alarm, Analog Outputs, Utility (for Setpoints, etc), Poll Manager, PID Loops, Broadcast, Logic, Timers, Calculated Points, Trend, Display Manager/List, Counters, Static Trend, Event Manager, Event Log, Function, Sequence, Monitor, Dial Manager, Encode, Calendar, Notify, and Notify Log. The ability to allocate multiple instances of control objects shall be provided. Each controller shall contain all available objects

that may be used as required limited only by the maximum memory of the controller. All configurations shall be retained indefinitely through power outages in non-volatile memory.

3. Controllers: SC's shall perform Direct Digital Control (DDC) and energy management functions, control peripheral devices, and coordinate communications to other SC and TC's in the network. SC's shall be capable of monitoring and organizing alarm and event information from other SC's and TC's on the local bus.

   Each SC shall have onboard I/O consisting of 16 Universal Inputs, 12 Normally Open Relay Outputs and 8 Analog Outputs, 0-10 Vdc ; or 8 Universal Inputs, 8 Normally Open/Normally Closed Relay Outputs and 4 Analog Outputs, 0-10 Vdc.

   The universal inputs shall have the pre-defined ability to interpret up to 4 contact closures in conjunction with a resistor ladder to any single input. They shall also read 0-5 Vdc and 4-20 ma Inputs as standard and have built-in Look-up tables for 3 kohm and 10 kohm thermistors. Inputs may be used for temperature, pressure, flow, current, frequency, and pulse counting.

   Relay Outputs may be configured for maintaining momentary or pulse width modulated operation, with or without interlocks and with or without verification status of the controller device. Relay Outputs shall be rated at 2 amps at 24Vac.

   Onboard LED's shall indicate the status of each Binary Output and the status of the communication busses. Four additional onboard LED's shall be available on each SC for custom user configuration.

   The SC shall contain control programs in non-volatile memory. Each SC shall have the intelligence to perform all control strategies, without communication to other controllers. Each SC shall be able to share global values, such as electrical demand level between controllers on the same communication bus.

   SC's shall support multi-user communications from the user interface computer and/or locally connected laptop service tools. They shall support modem dial-out and user dial-in. They shall be capable of sending different events and alarms to different locations and types of receiving devices including personal computers, pagers and printers.

4. Communication Ports: SC's shall provide concurrent communication to both the system bus and the local bus. They shall be capable of acting as a Modbus RTU Master controller through their dedicated local bus while maintaining concurrent communication on the system bus. In addition, a minimum of one RS-232 or RS-485 port shall be provided for connection to a user interface computer or a laptop computer. When the port is RS-232, it shall optionally support communication to a modem. The SC's shall have optional Ethernet adapters for direct UDP/IP communication.

5. SC Firmware: The SC's shall contain pre-programmed firmware modules for the creation of standard applications. Modules will include as a minimum PID, schedules, calendar functions (seconds, minutes, hour, day of week, day of month, day of year, month, and year), logic, timers and optimum start. Each controller shall be capable of performing basic mathematical calculations (+, -, X. /). The controllers shall be capable of performing complex logical statements including operators such as >, <, =, and, or, exclusive or, greater than, lesser than, signed and unsigned, etc.

6. SC Trending: Each controller shall be capable of trending any system variable over user defined time intervals ranging from one second to four hours. Any system variable (inputs, outputs, math calculations, flags, etc.) can be trended. A maximum of 256 bytes or 128 words values can be stored in each trend in the SC. Trends can be concatenated. Trends may be manual or rotating. Trends may be uploaded to the user interface computer for display or storage on the hard disk.

7. SC Alarming: For each system point, alarms can be created based on high/low limits, high/low fault limits, change of value, change of state, or fault conditions. An adjustable time delay shall be included to prevent nuisance alarms. All alarms will be tested each scan and can result in the generation of one or more alarm messages. Messages and reports can be sent to the network computer running Alarm Monitor software, or via modem to a remote computing device.

8. Real-Time Clock (RTC): A battery backed uninterruptible Real Time Clock shall provide the following information: time of day, day, month, year, and day of week. In normal operation, the

system clock will be based on the frequency of the AC power. The system shall automatically correct for daylight savings time and leap years.

E. Inputs (SC's)

1. Inputs: The input section of System Controllers shall provide "universal" inputs capable of accepting information on any point in the form of a temperature, voltage, digital, or pulse counter with only a programming command required for differentiation between the input type. No hardware changes shall be required, other than changing pull-up or pull-down resistors.
2. Analog Inputs: The Analog Input (AI) function shall monitor each analog input, perform A/D conversion, and hold the digital value in a buffer for interrogation. The A/D conversion shall have a minimum resolution of 10 bits. Input ranges shall be within the range of 0-5 Vdc or 4 to 20 mA .
3. Digital Inputs: The digital input (DI) function shall accept normally open and normally closed dry contact closures only.
4. Pulse Accumulator Inputs: The pulse accumulator input function shall have the same characteristics as the DI, except that in addition a buffer shall be included to totalize pulses between interrogations. Each input shall accept pulses at up to 10 Hz.
5. Temperature Inputs: Temperature inputs originating from a 3 kohm or 10 kohm type 2 thermistor shall be monitored and buffered as an AI and provide automatic conversion to degrees Fahrenheit or Centigrade without any additional signal conditioning.
6. Input Wiring: All inputs shall be two-wire devices and shall not require additional wiring for unoccupied override pushbuttons.

F. Outputs (SC's)

1. Output types shall include digital, tri-state, pulse width modulation, and analog.
2. Digital Output: The Digital Output (DO) function shall provide contact closure operation of field devices using maintained, verified, duty-cycled, or pulse on/off pairs. Contact rating shall be a minimum of 2 amps at 24 VAC. An on-board LED shall be provided to indicate the state of each digital output.
3. Tri-State Outputs: Tri-state outputs shall consist of two 24 Vac relays for control of bi-directional motors and actuators to a resolution of 1 second. Each tri-state output pair is capable of time base or feedback control.
4. Pulse Width Modulation Outputs: Output pulse width base time shall be selectable between 1 and a minimum of 255 seconds with a minimum output resolution of 0.1 seconds. .
5. Analog Outputs: Analog outputs shall be suitable for up to 20 mA over 0-10 volts DC referenced to ground.
6. Power Supply: SC's will operate from 24 Vac 60/50 Hz power with a tolerance of +/- 15%. The controller shall contain over voltage surge protection and require no special AC power signal conditioning.
7. Automatic Restart after Power Failure: Upon restoration of power, the SC shall automatically and without human intervention: update all monitored functions, resume operation based on current synchronized time and status, and implement special startup strategies as required.
8. Indicator Lamps: System Controllers will have as a minimum LED indication of the system and local bus communications, the status of the outputs, and four amber auxiliary LEDs for status indication.

G. Terminal Controllers (TC's)

1. Description: A TC has its own on board CPU, RAM, and EPROM, laptop communication port, and network connection to the local communication bus. The TC contains its own on board I/O for complete stand-alone operation. Controls manufacturer shall offer application specific TC's for packaged heating and A/C, split systems, water-source heat pumps, air-to air heat pumps, pressure independent VAV, and fan powered VAV, and pressure dependent terminal units, dual duct terminal units and fan coils. TC's shall be based upon multi-layer printed circuit boards with

8 bit microcontrollers, a RS-485 communications port and a minimum communications speed of 9600 baud. All TC's shall be pre-programmed with multiple, application specific terminal control routines (personalities). No batteries shall be required for TC's.

2. Configuration: The TC may be programmed from a laptop service tool.
3. Application Firmware: The custom application firmware shall reside in non-volatile EEPROM or flash memory.
4. Terminal Controllers: TC's shall provide stand-alone control of HVAC and lighting control. Each controller shall have its own control programs and will continue to operate in the event of a failure to communicate with the rest of the system.
5. Control programs shall be stored in non-volatile EEPROM or flash. Each TC shall have the intelligence to perform all control strategies, without communication to other controllers, for control functions not requiring data from other controllers. Each TC shall be able to have its control programs edited and/or modified either locally or remotely.
6. Communication Ports: Terminal Controllers shall provide communication to the local bus. In addition, a RJ-45 port shall be provided for connection to a laptop service tool, through the wall sensor, to support local programming and parameter changes. It shall be possible from this port to access and program any controller on the local bus.
7. TC Firmware: The TC's shall contain pre-programmed firmware modules for standard terminal unit applications for VAV, Fan Coil, Heat Pump, or Packaged AC unit. The specific equipment control shall be selected by personality.
8. TC Trends: Each TC controller shall be capable of trending two variables at time intervals ranging from 15 minutes to 4 hours. A maximum of 96 byte values can be stored in each trend in the TC. Trends may be uploaded to the user interface computer for display or storage on the hard disk.
9. TC Alarms: Each TC controller shall have predefined High and Low alarms for Zone Temperature, and other controller values. The alarm status shall be available for the polling system controller or user interface computer in a standard polling table.

H. Input/Output (TC's)

1. Inputs: The input section of TC's shall provide eight inputs capable of accepting information on any point in the form of a temperature, voltage or contact closure.

   The A/D conversion shall have a minimum resolution of 10 bits. Input ranges shall be 0 to 5 Vdc.
2. Temperature Inputs: Temperature inputs originating from a thermistor shall be monitored and buffered as an AI and provide conversion to degrees Fahrenheit or Centigrade.
3. Wall Sensor: The controls vendor shall provide a standard thermistor wall sensor with optional afterhours pushbutton and variable user adjust that connects to the TC by a factory provided 8 conductor sensor cable.

   An optional digital display wall sensor may be provided for the Packaged AC and VAV controller that is powered from the controller through the standard sensor cable and allows display and change temperature setpoints in half degrees Fahrenheit or Centigrade.
4. Schedules: Each terminal controller shall have its own occupancy state schedule providing for Unoccupied, Occupied, Night Setback and Morning Warm-up/Cool-down periods. Separate Cooling and Heating setpoints shall be provided during Unoccupied, Occupied, and Night Setback periods. The Morning Warm-up/Cool-down period shall use Occupied Setpoints.
5. Relay Outputs: The packaged AC controller shall provide 8 relay output with a minimum contact rating of 2 amps at 24 Vac, normally open and normally closed contacts with isolated common return.
6. Triac Outputs: The VAV and other Terminal unit controls shall provide 8 triac outputs switching to common, with a minimum rating of 1amp at 24 Vac unless it has an integral damper actuator in which case it will have only 5.

I. Outputs (TC's)

1. Output types shall include digital and tri-state.
2. Digital Output: The Digital Output (DO) function shall provide pilot-duty maintained contact closure for operation of field devices. Contact rating shall be a minimum of 1amp at 24 Vac.
3. Tri-State Outputs: Tri-state outputs shall consist of two 24 Vac triacs for control of bi-directional motors and actuators.
4. Lighting Output: Each terminal controller shall have an assignable lighting output that is controlled from an internal lighting schedule. During Occupied periods, the lights may be toggled on and off from the afterhours pushbutton.
5. Networking: Each TC will be able to provide information as requested by SC's during each local bus scan.
6. Power Supply: Each terminal controller shall have a built in power supply operating at 24 Vac, 60/50 Hz power +/-15%.
7. Automatic Restart after Power Failure: Upon restoration of power, the TC shall automatically and without human intervention: update all monitored functions, resume operation based on current synchronized time and status, and implement special startup strategies as required.
8. Indicator Lamps: TC will have LED indication of power and communication on the local bus.
9. Packaging: TC's may be housed in an optional steel enclosure, or in a plastic enclosure with a rating UL-94-5V or UL-94-V-0 suitable for installation in return air plenums, or within the rooftop units provided suitable locations are available.

J. System Software

1. Description: This section describes the software capabilities for the entire system.
2. Configuration Software: The configuration software shall recognize and support SINC's, SC's, and TC's in a single integrated package. The configuration software may be run locally through a laptop service tool or in the network computer. All programming shall be on-line and not require system shutdown.
3. SC Configuration: The Windows-based configuration software for SC's and SINC's shall allow for easy graphical configuration and documentation of control programs and sequences by object linking. No special programming language shall be required to configure all strategies, sequences of operation, control algorithms, parameters, setpoints, schedules, alarms, reports, dial-out, local displays, mathematical calculations and trends. It shall display real-time data values for visually debugging sequences.
4. TC Configuration: The Windows-based configuration software for TC's shall allow for the easy selection of options and personalities for specific control sequences. No special programming language shall be required to configure sequences of operation, parameters, setpoints, schedules, alarms, and trends.
5. Alarm Monitor Software: Optional Alarm Monitor software shall be to collect alarm and event information from individual ASI controllers or control systems. The software shall be Windows-based software which resides on a computer that is connected to the system by any of three different methods: telephone modem, direct RS-232 connection, or TCP/IP Ethernet.

   The software shall capture the incoming alarm or event and display current alarms in an easy to view format. Additionally, alarms shall be filed into project folders allowing one Monitor package to keep track of alarm conditions from many different projects. Once an alarm event is collected it can optionally be logged to a local printer.

   Alarm History shall be investigated at the push of a button. All alarms shall be stored in a standard Microsoft database file format so that additional analysis can be performed using the Microsoft Access program.

   The Alarm Monitor software shall host local or web-based logins via a standard internet browser.

   The Alarm Monitor software shall be able to forward alarm and event notifications to an individual, or a list of recipients via alphanumeric or numeric pager, e-mail, and fax on Windows XP computers.

The software shall be password protected with 4 levels of operator security with an unlimited number of access codes to provide adequate flexibility for any operation. The administrator shall have the ability to assign access permissions for any project folder.

6. Handheld Operator Software: An optional hand held operator tool that runs under the Pocket PC, Windows CE operating system, shall be available for field maintenance of the SINC's, SC's and TC's. It shall be equipped with a Compact Flash RS-485 card, cord for communication with TC's through the Wall Sensor connection, and a cord for communication on the RS-485 bus.
7. Web-based User Interface Software: Optional Web-based software shall: 1) include a drag and drop web page builder for real time display and modification of data values from any OPC data server; 2) include built-in password protected web server for remote and local connectivity via Internet Explorer; 3) include console view for real time monitoring of HTTP and Web user activity; and 4) include historical event manager which enables trending to disk of any OPC value, alarming on any OPC value to the Alarm Monitor software.

K. User Interface Computer

1. Hardware: The following shall be the requirements for the Network Computer.
   a. Gateway, HP, or Dell or equivalent Computer with available serial communication ports for connection to Modems or Controllers. For Connection to the high speed LAN, an Ethernet communications card must be provided.
   b. A minimum of an Intel Pentium family 500 MHz and include a 10 GB Hard Drive, Internal 24 x CD ROM Drive, Internal 512 KB Cache, 256 MB RAM, and a 1024x768 display.
2. User Interface Software: The User Interface (UI) software shall obtain all control system information via OLE for Process Control (OPC). Standard OPC servers shall be available allowing the read/write exchange of information between all DDC devices and a UI and other clients in the Windows-XP environment. No consideration will be given to controls manufacturers who cannot show OPC compatibility. An on-site OPC compatibility demonstration shall be performed, at a location and time determined by the engineer, by any alternative controls manufacturer. This demonstration shall show any and all applicable data contained in alternative controls manufacturers' hardware, successfully retrieved into OPC supported front-end User Interface (UI) Software Package. Supporting documentation showing OPC compatibility shall be provided.

   Approved User Interface software shall be ASI Controls WebLink.

   Control system data should be available across standard computer networks such as Ethernet and protocols such as TCP/IP in real time for multiple remote access over LAN, WAN, or Internet using any Windows computer. Up to 10 simultaneous connections are supported.

   The functions shall include monitoring SINC's, SC's and TC's on the control system network. Monitoring consists of alarming, reporting, graphic displays, long-term data storage, automatic data collection, and operator-initiated control actions such as schedule and setpoint adjustments. The software will be able to communicate to all SINC's, SC's and TC's, and where necessary integrate information that is common to one or more Controllers.
3. In the Editor mode, the User Interface software shall allow easy construction of user screens of the control system using drag and drop editing. The web server shall use java script, for animations, screen navigation, and active buttons for operator interaction. The web server shall allow incorporation of graphic files (bmp, jpg, gif) in the user screens. The ability to combine animation links shall be provided to provide size, color, movement, and position changes. The system shall allow for the creation of user defined, color graphic displays for viewing of mechanical and electrical systems, or building schematics. These graphics shall contain point information from the database including any attributes associated with the point. In addition operators shall be able to command equipment or change setpoint from a graphic through the use of the mouse.
4. In the operator's mode, control system information shall be displayed in a standard web browser, Internet Explorer (IE) 5.5 or later using XML to interact with the Web server. All information will be

available in Graphic or Graphic text displays. Graphic displays will feature animation effects to enhance the presentation of the data, to alert operators of problems and to facilitate location of information throughout the DDC System. Graphics shall be developed by controls contractor for all major HVAC equipment. All operator functions shall be selectable with a mouse.

5. Trending: The software shall display historical data in either a tabular or graphical format. Any field point connected to a Controller will be available for trending.
6. Security: User Interface software must have secure login using a 160-bit Secure Hash Algorithm encryption scheme, SHA-1, encoding protects against unauthorized access. A User Account with login and password and one of 4 security levels for each person to connect to the web server.
7. Alarm Management Software: The alarm management software shall be capable of both accepting alarms directly from SC's, and capable of receiving alarms generated by the web-based user interface software. Any alarm will be integrated into the overall alarm management system and will appear in all standard alarm reports, be available for operator acknowledgment, and be displayed on the Color Graphics.
8. The operating software shall be provided with a 1-year warranty on all updates or enhancements with no additional charge to the owner.
9. Provide software "site license" which will allow the owner to install the software on designated workstations and laptop computers purchased under the terms of this project specification.
10. Updates/Upgrades during the warranty shall be provided at no additional cost to the Owner and a training update on the enhanced features and functionality shall be included.

L. Field Devices

1. Room Temperature Sensors: The room sensor shall be a precision thermistor accurate within 0.36° over the range of the applications. The range shall be 55° to 95°. The sensor shall be securely mounted into a molded plastic cover for wall mount. The sensor shall be supplied with an RJ-45 modular connector at the back suitable for connecting pre-fabricated sensor cables, the other end of the sensor cables to plug into the controller in the associated rooftop A/C unit. Alternately the room sensor shall be wired from screw terminals to the controller. Provide an override and set point adjustment feature integral to the room sensors.
2. Duct Sensors: The duct sensor shall be a precision thermistor accurate to within 0.36° over the 45° to 160° range. The material shall be packaged in 4", 8", 12" or 16" long stainless steel tubes attached to a standard four-inch (4") electrical box.
3. Outside Air Sensor: The outside air sensor shall be a precision thermistor accurate to within 0.36° over the –30 to 180 deg F range. The active temperature sensitive element shall be sealed for moisture resistance. The sun shield shall be mounted on a weatherproof outlet box for installation on an outside surface. The outside assembly shall be located on the north side of the building, away from all devices, such as exhaust fans, that would influence the measured temperature.
4. Humidity Transmitter: The humidity transmitter shall be a two-wire, 0-5 Vdc or 4 to 20 mA output type with an accuracy of +/- 3% RH of a 15% to 95% RH span. Operating temperature shall be 0° to 120° Fahrenheit.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that conditioned power supply is available to control units and operator workstation. Verify that field end devices, and wiring tubing are installed before proceeding with installation.

3.2 INSTALLATION

A. Install equipment as indicated to comply with manufacturer's written instructions.

B. Install software in control units and network computer. Implement all features of programs to specified requirements and appropriate to sequence of operation.

C. Connect and configure equipment and software to achieve the sequence of operation specified.

D. Verify location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. Confirm mounting height and exact location with Owner/Engineer prior to installation. Generally locate approximately 48 inches above floor to comply with ADA.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

3.3 ADJUSTING AND CLEANING

A. Startup of the control system shall be performed by trained personnel in the direct digital control field and shall be a factory trained value added reseller. Demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment. Demonstrate all alarm and message displays as described in the sequence of operation.

B. Control contractor shall furnish a one-year warranty on all components furnished under this section.

C. Maintenance, Extended Service and Support

1. Entire system, including all hardware, software, end devices and support shall be warranted for 1 year from the date of final acceptance.
2. Response to Owner reported concerns can be addressed via dial up modem or network connection first, and reasonable time shall be allowed for the contractor to provide on-site support if required. The Owner shall provide for use of a dedicated telephone line or network connection by the control system.

3.5 ELECTRICAL WIRING AND CONNECTIONS

A. Install raceways, boxes, and cabinets according to Division 16 Section "Raceways, Boxes, and Cabinets."

B. Install building wire and cable according to Division 16 Section "Wires and Cables."

C. Connect HAND-OFF-AUTO selector switches to override automatic interlock controls when switch is in HAND position.

3.6 CLOSEOUT PROCEDURES

A. Control Contractor shall submit the training plan to the Owner and Engineer for approval along with submittal documents. Plan must include course outline, syllabus, documentation utilized and lesson plans.

B. Owner shall designate 2 representatives for factory training. The factory training shall consist of not less than 3 days (24 hours) of general operation and programming at the control manufacturers facility, or an authorized training center. All cost of travel, lodging and tuition, course materials shall be payable by the owners.

C. Manufacturer's Field Services: Provide the services of a factory-authorized service representative to demonstrate and train Owner's maintenance personnel as specified below.

1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
2. Schedule all training with Owner and Engineer with at least 7 days' notice.

END OF SECTION 15900