



ADDENDUM #2

CITY HALL HVAC UPGRADE

BID #14/15-008 – PWP# WA-2015-012

BIDS DUE NO LATER THAN: 1:45 PM ON NOVEMBER 13, 2014 (REVISED)

PUBLIC BID OPENING: 2:00 PM ON NOVEMBER 13, 2014 (REVISED)

This addendum is to notify all potential proposers of clarifications made to the Bid documents as stated below.

1) General Comments and Modifications to the Bid:

- a) **THIS BID SHALL NO LONGER INCLUDE THE DIRECT DIGITAL CONTROL SYSTEM. THE CONTROLS CONTRACTOR WILL BE CONTRACTED DIRECTLY THROUGH THE CITY OF SPARKS FOR THIS PROJECT.**

A revised bid item schedule is provided within this addendum and shall replace the Bid Item Schedule in the original bid document (Pages 4-7). The revised schedule removes references to the DDC Controls in Bid Items 6.0, as well as Alternates 1.1, 2.1, 3.1, and 4.1. Also strike through item 6.0 in the Bid Item Clarifications along with "installation of Direct Digital Control System interlocked to all components" in Alternate Bid Item Clarification #1, #2, #3, and #4.

- b) See the attached coordination items as required between the Mechanical, Electrical, and Control Contractor. All items noted in the attached coordination items that are the Mechanical and/or Electrical Contractor's responsibility shall be included within this bid.
- c) The amount of Bid Item 7 (Force Account) has been reduced from \$75,000 to \$50,000 and is changed in the revised Bid Item Schedule to be used in the submittal of bids.

2) RFI Questions and Answers:

- a) The plan sheets and specifications call for new distribution panel "MSD2" to be a freestanding fused switchboard to replace the existing MCC. If alternate's #1 thru #4 are not taken, then where does that board get installed?

Answer: It is a wall mounted fused panel located on the wall in the mechanical room between the doors leading into the chiller and the boiler, as shown on sheet E2.3

- b) Does new distribution panel "MSD2" need to be a freestanding fused switchboard or can it be wall mounted on a strut rack?

Answer: It is a wall mounted panel.

- c) Why a fused switchboard as opposed to circuit breakers for new distribution panel?

Answer: Fusing is desired for fuse protection on the motor feeds, versus circuit breakers

- d) What do we figure for the existing VFD's mounted to the outside of the existing MCC?

Answer: Two are for existing AHU-1, one is for existing Cooling Tower, and all are to be removed under base bid as the new equipment gets installed

- e) The specifications call out factory NETA testing on the new switchboard. Do we need to include a factory rep? Third party testing? Please clarify what is actually required.

Answer: Testing/inspecting can be a factory authorized rep or a third party testing company.

- f) Specification section 23 31 13-3.9-B, requires "leakage tests". Are these tests required on existing ducts?

Answer: No, the leakage test will not be required for the existing ductwork. Although, the duct leakage tests will be required for individual zones that will have the VAV boxes, ductwork and diffusers removed and replaced. Perform leakage tests on the sections of duct that are associated with the new VAV Box and ductwork arrangements for those areas.

- g) What are the specifications for insulation to Chilled Water system and Heating Water system? Section 23 07 19 only addresses Condensate Drain piping and Refrigerant Suction piping.

Answer: The required insulation for all hot and chilled water piping shall be a 1-1/2" fiberglass piping insulation with a self-sealing all service (ASJ) vapor retarder jacket. The product shall be provided by Johns Manville, Owens Corning or approved equal.

- h) Are Boiler and Hot Water Heater Flue PVC Piping requiring a fire-rated wrap enclosure? Piping shown on page M1.1. No reference to in Specs.

Answer: The currently specified boiler does not allow for the PVC flue to be insulated per the manufacturer's requirements.

3) MMI Project Manual Revisions:

- a) Specification Section 230900, "Instrumentation and Control", shall be replaced with the attached section 230900.
- b) The specification 230519 had included a section that covered "Temperature Control System". This section shall be deleted from specification 230519.
- c) The model number for the boiler listed on the schedule shall be changed to Lochinvar Knight XL model # KBN701 gas fired condensing boiler. The new boilers shall be 94% efficient with Low-NOx emissions. They shall have a 700 MBH natural gas input and a 660 MBH output. The minimum fluid flow rate shall be 65 GPM. The flues and intake air shall be 6" PVC material as shown on the drawings. The contractor shall also be responsible for adjusting the point of

connections for the water, gas, flue and intake air locations as required for the new boiler. The required glycol concentration will remain at 30% for the heating hot water loop.

- d) The attached boiler specification, 235216 for Condensing Boilers, supersedes the specification section 235233 for Water Tube Boilers.

- e) Boiler Pumps, BP-1 and BP-2, shall have the flow rates adjusted to be selected at 65 GPM at 35 feet of head. The model number of the pump shall remain the same.

Please note and adjust your bid according to the revisions, additions, deletions, clarifications or modifications as presented on this Addendum #2, which are made a part of this bid. NOTE: To avoid disqualification, this Addendum 2 (and any other addenda) must be signed by an authorized representative of the bidding firm in the space provided and must be submitted with your firm's sealed proposal. Failure to return this addendum, duly signed, may be cause for rejection of the bid. ALL ADDENDA SHOULD BE SIGNED AND PLACED IN SEQUENTIAL ORDER AND ATTACHED TO THE FRONT OF THE BID PACKAGE, COMPLETE WITH ALL REQUIRED DOCUMENTS.

CONTRACTOR BUSINESS NAME

X _____
Authorized Signature

Printed Name of Person Signing

Dan Marran, C.P.M., CPPO
Contracts and Risk Manager

November 6, 2014

BID ITEM SCHEDULE – REVISED BY ADDNEDUM 2
CITY HALL HVAC UPGRADE PROJECT
BID # 14/15-008
PWP # WA-2015-012

PRICES must be valid for 90 calendar days after the bid opening.

COMPLETION of this project is expected **PURSUANT TO CONTRACT DOCUMENTS.**

BIDDER acknowledges receipt of _____ Addenda.

Bidder Name

(signature)

BID ITEM SCHEDULE:

Item No.	Quantity	Unit	Description	Unit Price	Total Price
1.0	1	LS	Removal of old boiler including pumps and installation of two new boilers with associated piping including primary and secondary loops with pumps and all appurtenant work as stated in the plans and bid specifications	\$ _____ /LS	\$ _____
2.0	1	LS	Removal of the existing chiller and installation of a new chiller, heat exchanger, and associative piping including primary and secondary loops and pumps and all appurtenant work as stated in the plans and bid specifications	\$ _____ /LS	\$ _____
3.0	1	LS	Installation of two new exhaust fans in the chiller room and all appurtenant work as stated in the plans and bid specifications	\$ _____ /LS	\$ _____
4.0	1	LS	Removal and replacement of the existing coils and fan motors on the existing air handler and all appurtenant work as stated in the plans and bid specifications	\$ _____ /LS	\$ _____
5.0	1	LS	Removal and replacement of all VAV boxes in building 100 and 400 including all duct transitions and piping extensions to connect each reheat coil in VAV's and all appurtenant work as stated in the plans and bid specifications	\$ _____ /LS	\$ _____

6.0			REMOVED BY ADDENDUM 2		
7.0	1	LS	Force Account (Revised by Addendum 2)		\$ 50,000
TOTAL BASE BID					\$ _____

ALTERNATE BID #1 (Building 300 west):

Item No.	Quantity	Unit	Description	Unit Price	Total Price
1.1	1	LS	Building 300 west: Removal and replacement of existing VAV boxes, rooftop air handling units, heating and cooling coils, and all appurtenant work as stated in the plans and bid specifications	\$ _____/LS	\$ _____
1.2	1	LS	Force Account		\$ 10,000
TOTAL ALTERNATE BID #1					\$ _____

ALTERNATE BID #2 (Building 300 east):

Item No.	Quantity	Unit	Description	Unit Price	Total Price
2.1	1	LS	Building 300 east: Removal and replacement of existing VAV boxes, rooftop air handling units, heating and cooling coils, dedicated split system for IT Server Room, and all appurtenant work as stated in the plans and bid specifications	\$ _____/LS	\$ _____
2.2	1	LS	Force Account		\$ 10,000
TOTAL ALTERNATE BID #2					\$ _____

ALTERNATE BID #3 (Building 200 west):

Item No.	Quantity	Unit	Description	Unit Price	Total Price
3.1	1	LS	Building 200 west: Removal and replacement of existing VAV boxes, rooftop air handling units, heating and cooling coils, and all appurtenant work as stated in the plans and bid specifications	\$ _____/LS	\$ _____
3.2	1	LS	Force Account		\$ 10,000
TOTAL ALTERNATE BID #3					\$ _____

ALTERNATE BID #4 (Building 200 east):

Item No.	Quantity	Unit	Description	Unit Price	Total Price
4.1	1	LS	Building 200 east: Removal and replacement of existing VAV boxes, rooftop air handling units, heating and cooling coils, and all appurtenant work as stated in the plans and bid specifications	\$ _____/LS	\$ _____
4.2	1	LS	Force Account		\$ 10,000
TOTAL ALTERNATE BID #4					\$ _____

TOTAL BASE BID	\$ _____
TOTAL ALTERNATE BID #1	\$ _____
TOTAL ALTERNATE BID #2	\$ _____
TOTAL ALTERNATE BID #3	\$ _____
TOTAL ALTERNATE BID #4	\$ _____
TOTAL BASE, ALT #1, ALT #2, ALT #3, and ALT #4	\$ _____

(Written amount GRAND TOTAL) \$ _____

PLEASE NOTE: Bid ranking, evaluation and award recommendation will be made using the “Total Base Bid.” Use of any or all of the bid alternates in the awarded contract will only be determined after the apparent low bidder is identified using the “Total Base Bid.”

Once the apparent low bidder is determined using the “Total Base Bid,” “Alternate Bid” totals may be considered for inclusion in the resulting contract, depending on available funding. Alternate Bids may be considered/awarded in no particular order.

DDC CONTROL COORDINATION ITEMS

City Hall HVAC Upgrade Project Bid #14/15-008, PWP #WA-2015-012

VFDs (Pumps, AHUs, and Cooling Tower Fan)

1. VFDs to be provided by control contractor and installed/mounted by electrical contractor.
2. VFD start-up and controls by control contractor.
3. Equipment start-up and testing by mechanical contractor.
4. Power wiring, power conduit, electrical terminations to each VFD and from each VFD to associated motor(s) by electrical contractor.
5. Starters, disconnects, fuses, etc. by electrical contractor.
6. All motors for fans, pumps, etc. by mechanical contractor.

AHUs

1. Fan VFDs to be provided by control contractor and installed and mounted by electrical contractor.
2. Power wiring, power conduit, electrical terminations to equipment, each VFD and from each VFD to is associated motor(s) by electrical contractor.
3. Starters, disconnects, fuses, etc. by electrical contractor.
4. All motors for fans, pumps, and equipment by mechanical contractor, power wiring by electrical contractor.
5. Equipment start-up and testing by mechanical contractor.
6. Control valves to be provided by control contractor and installed by mechanical contractor.
7. Control dampers, damper linkages, jackshafts, etc. to be provided by mechanical contractor. Electronic control damper actuators shall be by control contractor.
8. Duct smoke detectors to be provided by mechanical contractor, and wired by electrical contractor.
9. Fire/smoke dampers to be provided and installed by mechanical contractor and wired by electrical contractor.

Hot Water System

1. Secondary hot water heating pump VFDs (BP#3 & #4) to be provided by control contractor and installed and mounted by electrical contractor.
2. Power wiring, power conduit, electrical terminations to equipment, each VFD and from each VFD to is associated motor/Pump(s) by electrical contractor.
3. Starters, disconnects, fuses, etc. by electrical Contractor.
4. All motors for fans, pumps and equipment by mechanical contractor, power wiring by electrical contractor.
5. Equipment start-up and testing by mechanical contractor.
6. DDC temperature Immersion sensor pipe sensor wells and pressure taps to be provided by mechanical contractor, temperature wells to be provided by control contractor.
7. Boiler BacNet controls, interface devices, programming, and start up to be provided and installed by mechanical Contractor/equipment provider.
8. Thermometers and gauges to be provided and installed by mechanical contractor.

Chilled/Condenser Water System

1. Secondary chilled water Pump VFDs (CHWP#3 & #4) and cooling tower fan VFDs to be provided by control contractor and installed and mounted by electrical contractor.

2. Power wiring, power conduit, electrical terminations to equipment, each VFD and from each VFD to each associated motor/Pump(s) by electrical contractor.
3. Starters, disconnects, fuses, etc. by electrical contractor.
4. All motors for fans, pumps, and equipment by mechanical contractor, power wiring by electrical contractor.
5. Equipment start-up and testing by mechanical contractor.
6. DDC temperature immersion sensor pipe sensor wells and pressure taps to be provided by mechanical contractor, temperature wells to be provided by control contractor.
7. Chiller BacNet controls, interface devices, programming, and start up to be provided and installed by mechanical contractor/equipment provider.
8. Cooling tower vibration switches, level controls, sump heaters, and sump heater controls to be provided and installed by factory equipment manufacture.
9. Thermometers and gauges to be provided and installed by mechanical contractor.

VAV-Terminal Units

1. Terminal units to be provided and installed by the mechanical contractor and to include the following devices: control dampers, inlet air velocity sensing probes, hot water coil, isolation valves, balance valves, PT ports, and control enclosures.
2. Terminal unit control valves with electronic actuators to be provided by control contractor, and installed by mechanical contractor.
3. DDC Controllers, DDC room temperature sensors, DDC supply air temperature sensors, electronic damper actuators, low voltage control wiring, and terminations to be provided and installed by control contractor.
4. Control contractor to provide and install terminal unit 24volt power supply control transformers to be located in each building/area. Electrical contractor to provide 120v power source, disconnect switch to each location as follows: Area #100 (4 locations), Area #200 (2 locations), Area #300 (3 locations), Area#400 (1 location). The final locations shall be coordinated in the field between the electrical contractor and the control contractor.

Server Room/Liebert AC

1. Low voltage equipment thermostats to be provided by equipment manufacture and installed by control contractor.
2. Power wiring, power conduit, electrical terminations to equipment, by electrical contractor.
3. Equipment start-up and testing by mechanical contractor.

Front End System

1. Front end Global controller to be provided and installed by control contractor in IT/Data Room, 120v power wiring to controller/control panel by electrical contractor.
2. Network IT Data Drop connection and addressing to be provided by the City of Sparks IT Dept.

Demolition/Clean Up

1. Each Contractor shall be responsible for their own related demolition and clean up.

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PART 1: GENERAL

1.1 WORK INCLUDED

- A. Furnish a totally native Alerton BAC talk system to connect to the existing City of Sparks Server/PC and network EMS Alerton Control System.
- B. Provide all necessary BAC talk-compliant hardware and software to meet the system's functional specifications.
- C. Prepare individual hardware layouts, interconnection drawings, and software configuration from project design data. Implement the detailed design for all analog and binary objects, system databases, graphic displays, logs, and management reports based on control descriptions, logic drawings, configuration data, and bid documents.
- D. Design, provide, and install all equipment cabinets, panels, data communication network cables needed, and all associated hardware.
- E. Provide and install all interconnecting cables between supplied cabinets, application controllers, and input/output devices. Provide and install all interconnecting cables between all operator's terminals and peripheral devices supplied under this section.
- F. Provide supervisory specialists and technicians at the job site to assist in all phases of system installation, startup, and commissioning.
- G. Provide as-built documentation, operator's terminal software, diagrams, and all other associated project operational documentation (such as technical manuals) on approved media, the sum total of which accurately represents the final system.
- H. Provide new sensors, and install only new electronic actuators. No used components shall be used as any part or piece of installed system.

1.2 SYSTEM DESCRIPTION

- A. The existing Operator's workstations at the City of Sparks Facilities office shall be used for remote access to the facility.
- B. Building controllers shall include complete energy management software, including scheduling building control strategies with optimum start and logging routines. All energy management software and firmware shall be resident in field hardware and shall not be dependent on the operator's terminal. Provide zone-by-zone direct digital logic control of space temperature, and scheduling.
- C. Room sensors shall be provided with afterhours pushbutton over-ride capabilities. All classroom sensors shall use Alerton temperature sensors with set point adjustment.
- D. All application controllers for every terminal unit (VAV) air handler, all central plant equipment, and any other piece of controlled equipment shall be fully programmable. Application controllers shall be mounted next to controlled equipment and communicate with building controller through BAC talk LAN.

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1.3 APPROVED MANUFACTURERS

- A. Acceptable BACnet manufactured system is Alerton BACtalk, NO EXCEPTIONS.

Approved Control Manufacturers

- 1. Alerton Controls, by authorized Alerton Associate Dealers only.

1.4 MANUFACTURER QUALITY ASSURANCE

- A. All application specific controllers submitted for use on this project must be certified as compliant with BACnet through the BACnet Manufacturers' Association (BMA) BACnet Testing Lab and must have a "BTL Mark".
- B. Provide standard components, of regular manufacture for this application for all materials and equipment. All systems and components shall have been thoroughly tested and proven in actual use.
- C. New Operator workstations shall not be included in the project. Existing EMS operator's workstations and portable computers shall have the new graphics and programs installed as associated to the project.
- D. Provide all necessary BACnet-compliant hardware and software to meet the system's functional specifications.
- E. Materials and equipment shall be manufacturer's latest standard design that complies with the specification requirements.
- F. All BAS peer-to-peer network controllers, central system controllers and local user displays shall be UL Listed under Standard UL 916, category PAZX.
- G. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.

1.5 BACNET SYSTEM CONTRACTOR QUALITY ASSURANCE

- A. The Building Automation System (BAS) system shall be installed, started up, and serviced by manufacturer authorized and trained personnel. System provider shall have an in-place support facility within 8 hours response time of the site with technical staff, spare parts inventory, and necessary test and diagnostic equipment.
- B. The Building Automation System (BAS) shall be provided by recognized Authorized Alerton Associate or Dealers.

1.6 REFERENCE STANDARDS

- A. The latest edition of the following standards and codes in effect and amended as of supplier's proposal date, and any applicable subsections thereof, shall govern design and selection of equipment and material supplied:
 - 1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
 - 2. ANSI/ASHRAE Standard 135-2008, BACnet.

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3. Uniform Building Code (UBC), including local amendments.
4. UL 916 Underwriters Laboratories Standard for Energy Management Equipment. Canada and the US.
5. National Electrical Code (NEC).
6. FCC Part 15, Subpart J, Class A.
7. EMC Directive 89/336/EEC (European CE Mark).
8. UL-864 UUKL listing for Smoke Controls for any equipment used in smoke control sequences.

1.7 SUBMITTALS

A. Drawings

1. The system supplier shall submit engineered drawings, control sequence, and bill of materials for approval.
2. Drawings shall be submitted in the following standard sizes: 11" x 17" (ANSI B).
3. Eight complete sets (copies) of submittal drawings shall be provided.

B. System Documentation

Include the following in submittal package:

1. System configuration diagrams in simplified block format.
2. All input/output object listings.
3. Electrical drawings that show all system internal and external connection points, terminal block layouts, and terminal identification.
4. Complete bill of materials, sequence of operations, valve schedule and complete system BACnet controller address list.
5. Manufacturer's instructions and drawings for installation, maintenance, and operation of all purchased items.
9. A list of all functions available and a sample of function block programming that shall be part of delivered system.

C. Project Management

1. The vendor shall provide a detailed project design and installation schedule with time markings and details for hardware items and software development phases. Schedule shall show all the target dates for transmission of project information and documents, and shall indicate timing and dates for system installation, debugging, and commissioning.

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1.8 WARRANTY

- A. Warranty shall cover all costs for parts, labor, associated travel, and expenses for a period of one year from completion of system acceptance.
- B. Hardware and software personnel supporting this warranty agreement shall provide on-site or off-site service in a timely manner after failure notification to the vendor. The maximum acceptable response time to provide this service at the site shall be 24 hours, Monday through Friday and 48 hours on Saturday and Sunday.
- C. This warranty shall apply equally to both hardware and software.

1.9 RELATED WORK IN OTHER SECTIONS

- A. Refer to Division 0 and Division 1 for related contractual requirements.
- B. Refer to Section 23 00 00 for General Mechanical Provisions.
- C. Refer to Section 26 00 00 for General Electrical Provisions.

PART 2: PRODUCTS

2.1 OPERATOR'S WORKSTATION

A. Displays

1. The existing Operator's workstations located at the City of Sparks Facilities Office shall display all data associated with project as called out on drawings and/or object type list supplied. Graphic files shall be created using digital, full color photographs of system installation, AutoCAD or Visio drawing files of field installation drawings and wiring diagrams from as-built drawings. Operator's workstations shall display all data using three-dimensional graphic representations of all mechanical equipment. System shall be capable of displaying graphic file, text, and dynamic object data together on each display and shall include animation. Information shall be labeled with descriptors and shall be shown with the appropriate engineering units. All information on any display shall be dynamically updated without any action by the user. Workstation shall allow user to change all field-resident EMCS functions associated with the project, such as setpoints, weekly schedules, exception schedules, etc., from any screen, no matter if that screen shows all text or a complete graphic display. This shall be done without any reference to object addresses or other numeric/mnemonic indications.
2. All displays and programming shall be generated and customized by the local EMCS supplier and installer. Systems requiring factory development of graphics or programming of DDC logic are specifically prohibited.
3. Binary objects shall be displayed as ACTIVE/INACTIVE/NULL or with customized text such as Hand-Off-Auto. Text shall be justified left, right or center as selected by the user. Also, allow binary objects to be displayed as individual change-of-state graphic objects on the display screen such that they overlay the system graphic. Each binary object displayed in this manner shall be assigned up to three graphic files for display when the point is ON, OFF or in alarm. For binary outputs, toggle the object's commanded status when the graphic item is selected with the system mouse. Similarly, allow the workstation operator to toggle the binary object's status by selecting with the

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mouse, for example, a graphic of a switch or light, which then displays a different graphic (such as an “ON” switch or lighted lamp). Additionally, allow binary objects to be displayed as an animated graphic. Animated graphic objects shall be displayed as a sequence of multiple graphics to simulate motion. For example, when a pump is in the OFF condition, display a stationary graphic of the pump. When the operator selects the pump graphic with the mouse, the represented object’s status is toggled and the graphic of the pump’s impeller rotates in a time-based animation. The operator shall be able to click an animated graphical object or switch it from the OFF position to ON, or ON to OFF. Allow operator to change graphic file assignment and also create new and original graphics online. System shall be supplied with a library of standard graphics, which may be used unaltered or modified by the operator. Systems that do not allow customization or creation of new graphic objects by the operator (or with third-party software) shall not be allowed.

4. Analog objects shall be displayed with operator modifiable units. Analog input objects may also be displayed as individual graphic items on the display screen as an overlay to the system graphic. Each analog input object may be assigned a minimum of five graphic files, each with high/low limits for automatic selection and display of these graphics. As an example, a graphic representation of a thermometer would rise and fall in response to either the room temperature or its deviation from the controlling setpoint. Analog output objects, when selected with the mouse, shall be displayed as a prompted dialog (text only) box. Selection for display type shall be individual for each object. Analog object values may be changed by selecting either the “increase” or “decrease” arrow in the analog object spinner box without using the keypad. Pressing the button on the right side of the analog object spinner box allows direct entry of an analog value and accesses various menus where the analog value may be used, such as trendlogs.
6. A customized menu label (push-button) shall be used for display selection. Menu items on a display shall allow penetration to lower level displays or additional menus. Dynamic point information and menu label pushbuttons may be mixed on the same display to allow sub-displays to exist for each item. A security level may be assigned to each display and system object. The menu label shall not appear on the graphic if the operator does not have the appropriate security level.

B. Password Protection

1. Provide security system that prevents unauthorized use unless operator is logged on. Access shall be limited to operator’s assigned functions when user is logged on. This includes displays as outlined above.
3. System shall include an Auto Logout Feature that shall automatically logout user when there has been no keyboard or mouse activity for a set period of time. Time period shall be adjustable by system administrator. Auto Logout may be enabled and disabled by system administrator. Operator terminal shall display message on screen that user is logged out after Auto Logout occurs.
4. The system shall permit the assignment of an effective date range, as well as an effective time of day, that the User IDs are permitted to authenticate.

C. Operator Activity Log

1. Operator Activity Log that tracks all operator changes and activities shall be included

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with system. System shall track what is changed in the system, who performed this change, date and time of system activity, and value of the change before and after operator activity. Operator shall be able to display all activity, sort the changes by user and also by operation. Operator shall be able to print the Operator Activity log display.

2. Log shall be gathered and archived to hard drive on operator's workstation as needed. Operator shall be able to export data for display and sorting in a spreadsheet.
3. Any displayed data that is changeable by the operator may be selected using the right mouse button and the operator activity log shall then be selectable on the screen. Selection of the operator activity log using this method shall show all operator changes of just that displayed data.

D. Scheduling

1. Operator's workstation shall show all information in easy-to-read daily format including calendar of this month and next. All schedules shall show actual ON/OFF times for day based on scheduling priority. Priority for scheduling shall be events, holidays and daily, with events being the highest.
2. Holiday and special event schedules shall display data in calendar format. Operator shall be able to schedule holidays and special events directly from these calendars.
3. Operator shall be able to change all information for a given weekly or exception schedule if logged on with the appropriate security access.
4. System shall include a Schedule Wizard for set up of schedules. Wizard shall walk user through all steps necessary for schedule generation. Wizard shall have its own pull-down selection for startup or may be started by right-clicking on value displayed on graphic and then selecting Schedule.
5. Scheduling shall include optimum start based on outside air temperature, current heating/cooling setpoints, indoor temperature and history of previous starts. Each and every individual zone shall have optimum start time independently calculated based on all parameters listed. User shall input schedules to set time that occupied setpoint is to be attained. Optimum start feature shall calculate the startup time needed to match zone temperature to setpoint. User shall be able to set a limit for the maximum startup time allowed.
6. Any displayed data that is changeable by the operator may be selected using the right mouse button and the schedule shall then be selectable on the screen. Selection of the schedule using this method shall allow the viewing of the assigned schedule or launch the Schedule Wizard to allow the point to be scheduled.

E. Alarm Indication and Handling.

1. Operator's workstation shall provide audible, visual, printed, and email means of alarm indication. The alarm dialog box shall always become the top dialog box regardless of the application(s) currently running. Printout of alarms shall be sent to the assigned terminal and port. Alarm notification can be filtered based on the User ID's authorization level.
2. System shall provide log of alarm messages. Alarm log shall be archived to the hard

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disk of the system operator's terminal. Each entry shall include a description of the event-initiating object generating the alarm. Description shall be an alarm message of at least 256 characters in length. Entry shall include time and date of alarm occurrence, time and date of object state return to normal, time and date of alarm acknowledgment, and identification of operator acknowledging alarm.

3. Alarm messages shall be in user-definable text (English or other specified language) and shall be delivered either to the operator's terminal, client or through remote communication using email (Authenticated SMTP supported).
4. System shall include an Alarm Wizard for set up of alarms. Wizard shall walk user through all steps necessary for alarm generation. Wizard shall have its own pull-down selection for startup or may be started by right-clicking on value displayed on graphic and then selecting alarm setup.
5. Any displayed data that is changeable by the operator may be selected using the right mouse button and the alarm shall then be selectable on the screen. Selection of the alarm using this method shall allow the viewing of the alarm history or launch the Alarm Wizard to allow the creation of a new alarm.

F. Trendlog Information

1. System shall periodically gather historically recorded data stored in the building controllers and store the information in the system database. Stored records shall be appended with new sample data, allowing records to be accumulated. Systems that write over stored records shall not be allowed unless limited file size is specified. Samples may be viewed at the operator's workstation. Operator shall be able to view all trended records, both stored and archived. All trendlog records shall be displayed in standard engineering units.
2. Software that is capable of graphing the trend logged object data shall be included. Software shall be capable of creating two-axis (X, Y) graphs that display up to 10 object types at the same time in different colors. Graphs shall show object values relative to time. Each trendlog shall support a custom scale setting for the graph view that is to be stored continuously. System shall be capable of trending on an interval determined by a polling rate, or change-of-value.
3. Operator shall be able to change Trendlog setup information. This includes the information to be logged as well as the interval at which it is to be logged. All input, output, and value object types in the system may be logged. All operations shall be password protected. Setup and viewing may be accessed directly from any and all graphics on which object is displayed.
4. System shall include a Trend Wizard for setup of logs. Wizard shall walk user through all necessary steps. Wizard shall have its own pull-down selection for startup, or may be started by right-clicking on value displayed on graphic, and then selecting Trendlogs from the displayed menu.
6. Any displayed data that is changeable by the operator may be selected using the right mouse button and the trendlog shall then be selectable on the screen. Selection of the trendlog using this method shall allow the viewing of the trendlog view or launch the Trendlog wizard to allow the creation of a new trend.

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G. Energy Log Information

1. System server shall be capable of periodically gathering energy log data stored in the field equipment and archive the information. Archive files shall be appended with new data, allowing data to be accumulated. Systems that write over archived data shall not be allowed unless limited file size is specified. Display all energy log information in standard engineering units.
4. System shall display archived data in tabular format form for both consumption and peak values. Data shall be shown in hourly, daily, weekly, monthly and yearly formats. In each format, the user shall be able to select a specific period of data to view.

H. Reports

1. System server shall be capable of periodically producing reports of trendlogs, alarm history, tenant activities, device summary, energy logs, and override points. The frequency, content, and delivery are to be user adjustable.
2. All reports shall be capable of being delivered in multiple formats including text- and comma-separated value (CSV) files. The files can be printed, emailed, or saved to a folder, either on the server hard drive or on any network drive location.

I. Configuration/Setup

1. Provide means for operator to display and change system configuration. This shall include, but not be limited to, system time, day of the week, date of daylight savings set forward/set back, printer termination, port addresses, modem port and speed, etc. Items shall be modified using understandable terminology with simple mouse/cursor key movements.

J. Field Engineering Tools

1. Operator's workstation software shall include all field engineering tools for programming all controllers supplied. All controllers shall be programmed using graphical tools that allow the user to connect function blocks on screen that provide sequencing of all control logic. Function blocks shall be represented by graphical displays that are easily identified and distinct from other types of blocks. Graphical programming that uses simple rectangles and squares is not acceptable.
2. User shall be able to select a graphical function block from menu and place on screen. Provide zoom in and zoom out capabilities. Function blocks shall be downloaded to controller without any reentry of data.
3. Programming tools shall include a real-time operation mode. Function blocks shall display real-time data and be animated to show status of data inputs and outputs when in real-time operation. Animation shall show change of status on logic devices and countdown of timer devices in graphical format.
4. Field engineering tools shall also include a database manager of applications that include logic files for controllers and associated graphics. Operator shall be able to select unit type, input/output configuration and other items that define unit to be controlled. Supply minimum of 250 applications as part of workstation software.

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5. Field engineering tool shall include Device Manager for detection of devices connected anywhere on the BACnet network by scanning of the entire network. This function shall display device instance, network identification, model number, and description of connected devices. It shall record and display software file loaded into each controller. A copy of each file shall be stored on the computer's hard drive. If needed, this file shall be downloaded to the appropriate controller using the mouse.
6. System shall automatically notify the user when a device that is not in the database is added to the network.
7. System shall include backup/restore function that will back up entire system to selected medium and then restore system from that media. The system shall be capable of creating a backup for the purpose of instantiating a new client PC.
8. The system shall provide a means to scan, detect, interrogate, and edit 3rd party BACnet devices and BACnet objects within those devices.

2.2 BUILDING CONTROLLER

A. General Requirements

1. BACnet Conformance
 - a. Building Controller shall be approved by the BTL as meeting the BACnet Building Controller requirements.
 - b. Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
2. Building controller shall be of modular construction such that various modules may be selected to fit the specific requirements of a given project. At a minimum, modules shall consist of a power supply module, a BACnet Ethernet-MS/TP (master slave token passing) module, a BACnet MS/TP-only module, and a modem module for telephone communication. Those projects that require special interfaces may use Modbus modules as needed. However, all Ethernet communications and all controllers—including central plant controllers, advanced application controllers and unitary controllers—supplied by BAS manufacturer shall utilize the BACnet protocol standard.
3. Modules shall be selected to fit the particular project application. Up to seven modules shall be powered by a single power supply module. All modules shall be panel-mounted on DIN rail for ease of addition and shall be interconnected using a simple plug-in cable. A module in the middle shall be replaceable without removing any other modules.
4. All modules shall be capable of providing global control strategies for the system based on information from any objects in the system, regardless if the object is directly monitored by the building controller module or by another controller. The software program implementing these strategies shall be completely flexible and user-definable. All software tools necessary for programming shall be provided as part of project software. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site, using a WAN or downloaded through remote

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communications are not acceptable. Changing global strategies using firmware changes is also unacceptable.

5. Programming shall be object-oriented using control function blocks, and support DDC functions, 1000 Analog Values and 1000 Binary Values. All flowcharts shall be generated and automatically downloaded to controller. Programming tool shall be supplied and be resident on workstation. The same tool shall be used for all controllers.
6. Provide means to graphically view inputs and outputs to each program block in real-time as program is executing. This function may be performed using the operator's workstation or field computer.
7. Controller shall have sufficient memory to ensure high performance and data reliability. Battery shall provide power for orderly shutdown of controller and storage of data in nonvolatile flash memory. Battery backup shall maintain real-time clock functions for a minimum of 20 days.
8. Global control algorithms and automated control functions shall execute using 32-bit processor.
9. Schedules
 - a. Each building controller module shall support a minimum of 80 BACnet Schedule Objects and 80 BACnet Calendar Objects.
 - b. Building controller modules shall provide normal seven-day scheduling, holiday scheduling and event scheduling.
10. Logging Capabilities
 - a. Each building controller shall log as minimum 320 values. Any object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.
 - b. Logs may be viewed both on-site or off-site using WAN or remote communication.
 - c. Building controller shall periodically upload trended data to networked operator's workstation for long-term archiving if desired.
 - d. Archived data stored in database format shall be available for use in third-party spreadsheet or database programs.
11. Alarm Generation
 - a. Alarms may be generated within the system for any object change of value or state (either real or calculated). This includes things such as analog object value changes, binary object state changes, and various controller communication failures.
 - b. Each alarm may be dialed out as noted elsewhere.
 - c. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site using remote communications.
 - d. Controller must be able to handle up to 320 alarm setups stored as BACnet event

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enrollment objects, with system destination and actions individually configurable.

B. Ethernet – MS/TP Module

1. Ethernet – MS/TP Module shall support every function as listed under paragraph A, General Requirements, of this section and the following.
2. All communication with operator's workstation and all application controllers shall be through BACnet. Building controller Ethernet – MS/TP module shall incorporate as a minimum, the functions of a 2-way BACnet router. Controller shall route BACnet messages between the high-speed LAN (Ethernet 10/100MHz) and MS/TP LAN. Ethernet – MS/TP module shall also route messages from all other building controller modules onto the BACnet Ethernet network.
3. BACnet Conformance
 - a. Ethernet – MS/TP module shall, as a minimum, support MS/TP and Ethernet BACnet LAN types. It shall communicate directly using these BACnet LANs as a native BACnet device and shall support simultaneous routing functions between all supported LAN types. Global controller shall be approved by the BACnet Testing Laboratory (BTL) as meeting the BACnet Building Controller requirements.
 - b. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
 - c. The building controller shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. Must support interoperability on WANs and CANs and function as a BACnet Broadcast Management Device (BBMD).

C. MS/TP Module

1. MS/TP Module shall support every function as listed under paragraph A, General Requirements, of this section and the following.
2. Building controller MS/TP module communications shall be through BACnet MS/TP LAN to all advanced application and application-specific controllers. MS/TP module shall also route messages to Ethernet - MS/TP module for communication over WAN.
 - b. Standard BACnet object types supported shall include, as a minimum, Analog Value, Binary Value, Calendar, Device, File, Group, Notification Class, Program, and Schedule object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

D. Power Supply Module

1. Power supply module shall power up to seven building controller modules. Input for power shall accept between 17–30VAC, 47–65Hz.
2. Power supply module shall include rechargeable battery for orderly shutdown of controller modules including storage of all data in flash memory and for requirements at

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intelligent room sensor.

2.3 CAV BOX CONTROLLERS—SINGLE DUCT

- A. Provide one native BACnet application controller for each CAV box that adequately covers all objects listed in object list for unit. All controllers shall interface to building controller through MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include on board CFM flow sensor, inputs, outputs and programmable, self-contained logic program as needed for control of units.
- B. BACnet Conformance
 1. Application controllers shall, at a minimum, support MS/TP BACnet LAN types. They shall communicate directly through this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as a native BACnet device and must be hardwired (wireless communication is not acceptable). Application controllers shall be approved by the BTL as meeting the BACnet Application Specific Controller requirements.
 2. Please refer to Section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
 3. Standard BACnet object types supported shall include, as a minimum, Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File, and Program Object Types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
- C. Application controllers shall include universal inputs with 10-bit resolution that can accept 3K and 10K thermistors, 0–5 VDC, and dry contact signals. Inputs on controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor with digital display. Controller shall also include binary outputs on board. For applications using variable speed parallel fans, provide a single analog output selectable for 0-10 V or 0-20 mA control signals. Application controller shall include microprocessor driven flow sensor for use in pressure independent control logic. All boxes shall be controlled using pressure-independent control algorithms and all flow readings shall be in CFM (LPS if metric).
- D. All program sequences shall be stored on board application controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely using modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using the same programming tool as Building Controller and as described in operator's workstation section. All programming tools shall be provided as part of system.
- E. Application controller shall include support for intelligent room sensor (see Section 2.9.B.) Display on room sensor shall be programmable at application controller and include an operating mode and a field service mode. All button functions and display data shall be

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programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence of operations for specific display requirements for intelligent room sensor.

- F. On board flow sensor shall be microprocessor-driven and pre-calibrated at the factory. Pre-calibration shall be at 16 flow points as a minimum. All factory calibration data shall be stored in non-volatile memory. Calibration data shall be field adjustable to compensate for variations in VAV box type and installation. All calibration parameters shall be adjustable through intelligent room sensor. Operator's workstation, portable computers, and special hand-held field tools shall not be needed for field calibration.
- G. Provide duct temperature sensor at discharge of each VAV box that is connected to controller for reporting back to operator's workstation.
- H. CAV controller shall not require reset and synchronization of actual damper position. An automatically initiated function to reset volume regulator damper to fully closed position is not allowed.

2.4 AUXILIARY CONTROL DEVICES

A. Temperature Sensors

1. All temperature sensors to be solid-state electronic, interchangeable with housing appropriate for application. Wall sensors to be installed as indicated on drawings. Mount 48 inches above finished floor. Duct sensors to be installed such that the sensing element is in the main air stream. Immersion sensors to be installed in wells provided by control contractor, but installed by mechanical contractor. Immersion wells shall be filled with thermal compound before installation of immersion sensors. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake, and in a location that is in the shade most of the day.

B. Intelligent Room Sensor with LCD Readout

1. Sensor shall contain a backlit LCD digital display and user function keys along with temperature sensor and must be hardwired (wireless communication is not acceptable). Controller shall function as room control unit and allow occupant to raise and lower setpoint, and activate terminal unit for override use—all within limits as programmed by building operator. Sensor shall also allow service technician access to hidden functions as described in sequence of operation.
2. The intelligent room sensor shall simultaneously display room setpoint, room temperature, outside temperature at each controller. This unit shall be programmable, allowing site developers the flexibility to configure the display to match their application. The site developer should be able to program the unit to display time-of-day.
3. Override time may be set and viewed in half-hour increments. Override time countdown shall be automatic, but may be reset to zero by occupant from the sensor. Time remaining shall be displayed. Display shall show the word "OFF" in unoccupied mode unless a function button is pressed.
4. See sequence of operation for specific operation of LCD displays and function keys in field service mode and in normal occupant mode. Provide intelligent room sensors as specified in point list.

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5. Field service mode shall be customizable to fit different applications. If intelligent room sensor is connected to VAV controller, VAV box shall be balanced and all air flow parameters shall be viewed and set from the intelligent room sensor with no computer or other field service tool needed.

C. Wall Sensor

1. Standard wall sensor shall use solid-state sensor identical to intelligent room sensor and shall be packaged in aesthetically pleasing enclosure. Sensor shall provide override function, warmer/cooler lever for set point adjustment, port for plug-in of Field Service Tool for field adjustments and must be hardwired (wireless communication is not acceptable). Override time shall be stored in controller and be adjustable on a zone-by-zone basis. Adjustment range for warmer/cooler lever shall also be stored in EEPROM on controller. All programmable variables shall be available to field service tool through wall sensor port.

2.5 MISCELLANEOUS CONTROL DEVICES

A. General:

1. Provide sensors and control devices, as specified, indicated on mechanical plans, control flow diagrams and as required to meet specified performance. Where performance specifications exceed capabilities of hardware specified, performance governs.
2. Equip analog sensors with thermistors or 4 to 20 milliamp transmitters with built-in circuit protection against reverse polarity and supply voltage transients. The thermistors and transmitters shall be compatible with the DDC System.
3. All sensor wiring, analog or digital, input or output shall be capable of sharing single conduit runs without affecting signal performance.
4. The sensor range and type shall be suitable to the application.
5. Minimum contact rating of relays and switches shall be 10 amperes, 110 volts resistive.
6. Devices shall be UL listed for electrical safety where applicable.
7. All components of sensors exposed to process shall be rated to withstand 150 percent of maximum process temperature and pressure.

Thermowells shall have extension for pipe insulation and threaded connection to pipe. Threaded connection shall be a minimum of ½-inch nominal pipe thread. Maximum insertion length shall be 6 inches or 75 percent of the pipe diameter whichever is smaller.

A. Pressure Transmitter Assembly – Air Streams:

1. The assembly shall consist of a pressure sensor and a solid-state, 2-wire, 4- to 20-milliamp transmitter contained in a housing suitable for duct mounting.

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2. The assembly shall be factory calibrated and field installed to an accuracy of plus or minus 0.05 inches water gauge over a range of 0 to 4 inches water gauge.
3. Probe: 6-inch pitot tube, brass.
4. Pressure Transmitter shall have a digital display.
5. Acceptable Manufacturers: Veris Industries.

B. Differential Pressure Transmitter Assembly – Water:

1. Assembly shall consist of a differential pressure sensor and an electronic 2-wire, 4 to 20-milliamp transmitter assembly enclosed in a gasketed, dust and watertight case. All body cavities open to the process fluid shall be provided with drain ports at the cavity bottom and vent ports at the top of the cavity. Both drain and vent ports shall be minimum ¼-inch nominal pipe thread.
2. The transmitter shall be 24-volt DC powered and capable of sustaining up to 50 psig differential pressures in either direction, up to the body rating without damage of the instrument, loss of accuracy, or zero shift. Minimum pressure rating: 200 psig.
3. The transmitter shall be fully compensated for both process and ambient temperature variations. The transmitter shall be furnished complete with input gauges and factory mounted 3-valve manifold.
4. Accuracy: plus or minus 1 percent of full range.
5. Repeatability: 0.5 percent.
6. Pressure Transmitter shall have a digital display.
7. Acceptable Manufacturers: Veris Industries.

C. Demand Control Ventilation Sensor

1. CO₂ Sensors and Transmitters: Provide as indicated on control drawings. Locate the sensors to be as shown on the drawings.

D. Current Sensing Switches:

1. Current switches shall be utilized for monitoring motor operation. Switch set point shall be fixed so that a contact closure is made any time the motor is operating within a range of .15-200 amps. Induced current from the motor power feed shall power current switch. Current switch shall be a self-gripping split-core type with optional mounting bracket; shall be isolated to 600 VAC rms, shall have an adjustable mounting bracket for installation flexibility. Output shall be N.O. Solid State, 1.0A @ 30VAC/DC with a minimum aperture of 0.5"x0.6" for motor power feed.
2. Acceptable Manufacturers: Veris Industries.

E. Differential Pressure Switch – Air:

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1. Provide diaphragm operator to actuate a single-pole double-throw snap-acting switch. Operating point shall be adjustable. Range shall suit application.
 2. High and low sensing ports shall be 1/8-inch nominal pipe thread connected to angle type tips designed to sense pressure.
 3. Switches used for fan shutdown shall be manual reset type.
 4. Acceptable Manufacturers: Cleveland Controls or acceptable equal.
- F. Low Limit Thermostat:
1. Shall have a minimum 12-foot flexible vapor charged element.
 2. When temperature sensed by any 12-inch segment of the element falls below setpoint (usually 35 degrees F), thermostat shall operate double-pole double-throw manual reset contacts.
- G. Automatic Dampers:
1. All control dampers to be provided by Mechanical contractor and installed by Mechanical contractor.
- H. Automatic Valves:
1. Automatic control valves shall be Belimo Characterized Control Valves.
 2. Control valves to be sized for a 4 psi pressure drop.
 3. Refer to EMS Control Drawings for actuator control detail and applications.
 4. Acceptable Manufacturers: Belimo.
- I. Automatic Electric Damper/Valve Actuators
1. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.
 2. Where shown, for power-failure/safety applications, an internal mechanical, spring-return mechanism shall be built into the actuator housing.
 3. All rotary spring-return actuators shall be capable of both clockwise and counter-clockwise spring-return operation. Linear actuators shall spring-return to the retracted position.
 4. Proportional actuators shall accept a 0- to 10-volt DC or 0- to 20-milliamp control signal and provide a 2- to 10-volt DC or 4- to 20-milliamp operating range.
 5. All 24-volt AC/VDC actuators shall operate on NEC Class 2 wiring and shall not require more than 10 volt-amps for AC or more than 8 watts for DC applications. Actuators operating on 120 volts AC or 230 volts AC shall not require more than 11-volt-amps.

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6. All non-spring-return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring-return actuators with more than 60 inch-pounds torque capacities shall have a manual crank for this purpose.
7. All modulating actuators shall have an external, built-in switch to allow the reversing of direction of rotation.
8. Actuators shall be provided with a raceway fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
9. Actuators shall be UL Standard 873 Listed and CSA Class 4813 02 Certified as meeting correct safety requirements and recognized industry standards.
10. Actuators shall be designed for a minimum of 60,000 full-stroke cycles at the actuator's rated torque.
11. Actuators shall have visual mechanical position indication, showing output shaft and valve position. The actuator shall be capable of operating the valve from the fully closed to the fully open position and vice versa in less than 60 seconds.
12. Acceptable Manufacturers: Belimo.

2.6 ENCLOSURES

- A. All controllers, power supplies and relays shall be mounted in enclosures.
- B. Enclosures may be NEMA 1 when located in a clean, dry, indoor environment.
- C. Enclosures shall be NEMA 3R when installed in outdoor locations.
- D. Enclosures shall have hinged doors.
- E. Provide laminated plastic nameplates for all enclosures in any mechanical room or electrical room. Include location and unit served on nameplate. Laminated plastic shall be 0.125 inches thick and appropriately sized to make label easy to read. Identify each item of control equipment with stamped tape firmly attached to equipment and each panel with nameplate of 1/16 inch laminated plastic with black background and white letters 1/4 inch high.

PART 3: EXECUTION

3.1 EXAMINATION

- A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence.
- B. Notify the owner's representative in writing of conditions detrimental to the proper and timely completion of the work.
- C. Do not begin work until all unsatisfactory conditions are resolved.

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3.2 INSTALLATION (GENERAL)

- A. All electric wiring and all installation work including piping of control systems and internal wiring of panels for temperature control and indicating systems shall be done by an authorized representative of the controls manufacturer.
- B. Install in accordance with manufacturer's instructions.
- C. Provide all miscellaneous devices, hardware, software, interconnections, installation, and programming required to ensure a complete operating system in accordance with the sequences of operation and point schedules.

3.3 LOCATION AND INSTALLATION OF COMPONENTS

- A. Locate and install components for easy accessibility; in general, mount 48 inches above floor with minimum 3 feet of clear access space in front of units. Obtain approval on locations from owner's representative prior to installation.
- B. All instruments, switches, transmitters, etc., shall be suitably wired and mounted to protect them from vibration, moisture, and high or low temperatures.
- C. Identify all equipment and panels. Provide permanently mounted tags for all panels.
- D. Provide stainless steel or brass thermowells suitable for respective application and for installation under other sections, and sized to suit pipe diameter without restricting flow.

3.4 INTERLOCKING AND CONTROL WIRING

- A. Provide all interlock and control wiring. All wiring shall be installed neatly and professionally, in accordance with Specification Division 16 and all national, state and local electrical codes.
- B. Provide wiring as required by functions as specified and as recommended by equipment manufacturers, to serve specified control functions. Provide shielded low capacitance wire for all communications trunks.
- C. Control wiring shall not be installed in power circuit raceways. Magnetic starters and disconnect switches shall not be used as junction boxes. Provide auxiliary junction boxes as required. Coordinate location and arrangement of all control equipment with the owner's representative prior to rough-in.
- D. Provide auxiliary pilot duty relays on motor starters as required for control function.
- E. Provide power for all control components from nearest electrical control panel or as indicated on the electrical drawings; coordinate with electrical contractor.
- F. All control wiring in the mechanical, electrical, telephone and boiler rooms to be installed in raceways. All other wiring to be installed neatly and inconspicuously. Control wiring above accessible ceiling spaces may be run with plenum-rated cable (without conduit) including proper cable supports.
- G. Division 26 shall provide all necessary underground signal conduit for DDC Control System communication wiring between buildings.

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3.5 DDC OBJECT TYPE SUMMARY

- A. Provide all database generation.
- B. Displays
 - 1. System displays shall show all analog and binary object types within the system. They shall be logically laid out for easy use by the owner. Provide outside air temperature indication on all system displays associated with economizer cycles.
- C. Run Time Totalization
 - 1. At a minimum, run time totalization shall be incorporated for each monitored supply fan, return fan, exhaust fan, hot water and chilled water pumps. Warning limits for each point shall be entered for alarm and or maintenance purposes.
- D. Trendlog
 - 1. All binary and analog object types (including zones) shall have the capability to be automatically trended.
- E. Alarm
 - 1. All analog inputs (High/Low Limits) and selected binary input alarm points shall be prioritized and routed (locally or remotely) with alarm message per owner's requirements.
- F. Database Save
 - 1. Provide backup database for all standalone application controllers on disk.

3.6 FIELD SERVICES

- A. Prepare and start logic control system under provisions of this section.
- B. Start-up all BACnet DDC Control System components provided under this section. Allow sufficient time for startup and pre-functional testing (if specified) prior to placing control systems in permanent operation.
- C. Provide the capability for off-site monitoring at control contractor's local or main office. At a minimum, off-site facility shall be capable of system diagnostics and software download. Owner shall provide phone line or Remote Desktop connection for this service for one year or as specified.
- D. Provide owner's representative with spare parts list. Identify equipment critical to maintaining the integrity of the operating system.

3.7 AS-BUILT DOCUMENTATION REQUIRED

- A. Provide all as-built documentation specified in this section and the general conditions.

3.8 TRAINING

- A. Initial Training – Provide 8 hours of on-site customer training to familiarize owner personnel with basic log-in and navigation function.

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3.9 DEMONSTRATION

- A. Demonstrate complete operating system to owner's representative.
- B. Provide certificate stating that control system has been tested and adjusted for proper operation.

End of Section

SECTION 23 52 16 - CONDENSING BOILERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes packaged, factory-fabricated and -assembled, gas-fired, condensing boilers, trim, and accessories for generating hot water.

1.2 ACTION SUBMITTALS

- A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: For boilers, boiler trim, and accessories. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Design calculations and vibration isolation base details, signed and sealed by a qualified professional engineer.
 - a. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 - b. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails and equipment mounting frames.
 - 2. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturer Seismic Qualification Certification: Submit certification that boiler, accessories, and components will withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC."
- B. Source quality-control reports.
- C. Field quality-control reports.
- D. Warranty: Special warranty specified in this Section.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

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1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.
- C. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."
- D. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N, "Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers."
- E. UL Compliance: Test boilers for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Water-Tube Condensing Boilers: 1 years from date of Substantial Completion.
 - 2. Warranty Period for Water-Jacketed Condensing Boilers:
 - a. Leakage and Materials: 10 years from date of Substantial Completion.
 - b. Heat Exchanger Damaged by Thermal Stress and Corrosion: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 WATER-TUBE CONDENSING BOILERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Laars Heating Systems Company.
 - 2. Lochinvar Corporation.
 - 3. Or approved equal

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- B. Description: Factory-fabricated, -assembled, and -tested, water-tube condensing boiler with heat exchanger sealed pressure tight, built on a steel base; including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls. Water heating service only.
- C. Heat Exchanger: Finned-copper primary and stainless-steel secondary heat exchangers.
- D. Combustion Chamber: Stainless steel, sealed.
- E. Burner: Natural gas, forced draft drawing from gas premixing valve.
- F. Blower: Centrifugal fan to operate during each burner firing sequence and to prepurge and postpurge the combustion chamber.
 - 1. Motors: Comply with requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- G. Gas Train: Combination gas valve with manual shutoff and pressure regulator.
- H. Ignition: Silicone carbide hot-surface ignition that includes flame safety supervision and 100 percent main-valve shutoff.
- I. Integral Circulator: Cast-iron body and stainless-steel impeller sized for minimum flow required in heat exchanger.
- J. Casing:
 - 1. Jacket: Sheet metal, with snap-in or interlocking closures.
 - 2. Control Compartment Enclosures: NEMA 250, Type 1A.
 - 3. Finish: Textured epoxy.
 - 4. Insulation: Minimum **1-inch-** (25-mm-) thick, mineral-fiber insulation surrounding the heat exchanger.
 - 5. Combustion-Air Connections: Inlet and vent duct collars.
 - 6. Mounting base to secure boiler.
 - a. Seismic Fabrication Requirements: Fabricate mounting base and attachment to boiler pressure vessel, accessories, and components with reinforcement strong enough to withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC" when mounting base is anchored to building structure.
- K. Characteristics and Capacities:

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1. See the equipment schedule

2.2 SOURCE QUALITY CONTROL

- A. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.
- B. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.

PART 3 - EXECUTION

3.1 BOILER INSTALLATION

- A. Equipment Mounting:
 1. Retain one of two subparagraphs below. Retain first for projects in seismic areas; retain second for projects not in seismic areas. Indicate vibration isolation and seismic-control device type and minimum deflection in supported equipment schedule on Drawings.
 2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
 3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- B. Install gas-fired boilers according to NFPA 54.
- C. Assemble and install boiler trim.
- D. Install electrical devices furnished with boiler but not specified to be factory mounted.
- E. Install control wiring to field-mounted electrical devices.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to boiler to allow service and maintenance.

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- C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.
- D. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service. Flexible connectors and their installation are specified in Section 232116 "Hydronic Piping Specialties." Section 15179 "Hydronic Piping Specialties."
- E. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas train connection. Provide a reducer if required.
- F. Connect hot-water piping to supply- and return-boiler tapplings with shutoff valve and union or flange at each connection.
- G. Install piping from safety relief valves to nearest floor drain.
- H. Boiler Venting:
 - 1. Install flue venting kit and combustion-air intake.
 - 2. Connect full size to boiler connections. Comply with requirements in Section 235100 "Breechings, Chimneys, and Stacks."

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Perform installation and startup checks according to manufacturer's written instructions.
 - 2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and water temperature.
 - b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

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- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.
- F. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers.
- B. END OF SECTION 235216