SECTION 251404

BAS EQUIPMENT, SOFTWARE, AND PROGRAMMING

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***NOTE TO SPECIFIER***

*Use this Specification Section for Mail Processing Facilities.*

***This is a Type 3 Specification with primarily required text; therefore, most of the text cannot be edited, but there is editable text which is noted within the Section with a “Note to Specifier.” Do not revise the required paragraphs without an approved Deviation from USPS Headquarters, Facilities Program Management, through the USPS Project Manager.***

*For Design/Build projects, do not delete the Notes to Specifier in this Section so that they may be available to Design/Build entity when preparing the Construction Documents.*

*For the Design/Build entity, this specification is intended as a guide for the Architect/Engineer preparing the Construction Documents.*

*The MPF specifications may also be used for Design/Bid/Build projects. In either case, it is the responsibility of the design professional to edit the Specifications Sections as appropriate for the project.*

*Text shown in brackets must be modified as needed for project specific requirements.* *See the “Using the USPS Guide Specifications” document in Folder C for more information.*

*The last date that USPS revised this standard specification section occurs in two places, at the end of this section and in the Table of Contents. If the date in this section matches the date in the Table of Contents, then you are using the latest version. Do not delete or revise the “last revised” date at the end of the section during the development of the Project Manual.*

*The footer in this section should be edited to replace the text, “USPS MPF SPECIFICATION” with the project name, and the blank date in the center should be replaced with the submission date, for interim design reviews, or the issue date of the completed Project Manual.*

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1. GENERAL
	1. SECTION INCLUDES:
		1. Building Controller (BC).
		2. Advance Application Specific Controller (AAC).
		3. Application Specific Controller (ASC).
		4. Network Integration Devices.
		5. BAS Operator Interfaces.
		6. BAS and Network Software, Programming and Energy Management Applications.
	2. RELATED DOCUMENTS:
		1. Section 270500 – Common Work Results for Communications.
		2. Section 230500 - Common Work Results for HVAC.
		3. Section 250504 - Building Automation System (BAS) General.
		4. Section 251104 – Metering Devices.
		5. Section 250804 – Building Automation System (BAS) Commissioning.
	3. DESCRIPTION OF WORK:
		1. Refer to Section 250504 for general requirements.
		2. Furnish and install DDC Control units and/or Smart Devices required to support specified building automation system functions.
		3. Provide all interface devices and software to provide an integrated system connecting BCs, AACs, ASCs and Gateways [in a stand-alone local area network] [connected to the IT USPS network].
		4. Fully configure systems and furnish and install all software, programming and dynamic color graphics for a complete and fully functioning system as specified.
		5. Refer Section 259004 - Sequence of Operation for specific sequences of operation for controlled equipment.
	4. LICENSING
		1. Include licensing for all software packages at all required controllers and workstations.
		2. All operator interface, programming environment, networking, database management and any other software used by the Contractor to configure or operate the system to its full capabilities shall be licensed and provided to the USPS.
		3. All software should be available on all Operator Workstations or CSSs provided, and on all Portable Operator Terminals. Hardware and software keys to provide all rights shall be installed on all workstations. At least 2 sets of CDs shall be provided with backup software for all software provided, so that the USPS may reinstall any software as necessary. Include all licensing for workstation operating systems, and all required third-party software licenses.
		4. Provide licensing and original software copies for each OWS or CSS.
		5. Upgrade all software packages to the release (version) in effect at the end of the Warranty Period.
2. PRODUCTS

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***NOTE TO SPECIFIER***

*This section includes coordination of USPS network services and multiple contractors. Review with the USPS Project Manager the requirements for integration with the EEMS system. Select the options that apply. Integration requires the selection of the last two paragraphs for IT coordination and security protocols.*

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* 1. network connection
		1. USPS EEMS: Ethernet-based network connecting multiple facilities with a central data warehouse and server, accessible via terminal services within the Postal Routed. This is an existing infrastructure and Contractor is not required to configure any components of this WAN. Contractor is required to provide BACnet Objects and services on the Local Supervisory LAN via BACnet over IP [as part of this project] [in preparation for future integration with the EEMS].
		2. Connect and provide all control variables and network variables for control as described in detail in this and other specifications to the EEMS but generally include:
			1. All Trend Data Objects. The controllers/systems to which these variables are applicable shall be bound and the name of the receiving variable shall be the same for these controllers/systems.
			2. All Alarm Events. The controllers/systems to which these variables are applicable shall be bound and the name of the receiving variable shall be the same for these controllers/systems.
			3. All set point variables. The controllers/systems to which these variables are applicable shall be bound and the name of the receiving variable shall be the same for these controllers/systems.
			4. Zone Occupancy and setpoint adjustment variables. The controllers/systems to which these variables are applicable shall be bound and the name of the receiving variable shall be the same for these controllers/systems.
			5. All system/building mode variables/Objects (Schedules, Occupied, Unoccupied, Warm-up, Cool-down, Optimal Start/stop, etc.). [Inform the EEMS Integrator of all occupancy commands required.] The controllers/systems to which the occupancy commands are applicable shall be bound and the name of the receiving variable shall be the same for these controllers/systems.
		3. BACnet standardized Device Profile (Annex L):
			1. BACnet Building Controller (B-BC).
		4. The following BIBBs must be supported on the Local Supervisory LAN using Ethernet directly by the Building Controller:
			1. BACnet Data Sharing Objects (DS-):
				1. Read Property (RP-A) Initiate.
				2. Read Property (RP-B) Execute.
				3. Read Property Multiple (RPM-A) Initiate.
				4. Read Property Multiple (RPM-B) Execute.
				5. Write Property (WP-A) Initiate.
				6. Write Property (WP-B) Execute.
				7. Write Property Multiple (WPM-A) Initiate.
				8. Write Property Multiple (WPM-B) Execute.
				9. COV (COV-A) Initiate.
				10. COV (COV-B) Execute.
				11. COV Unsolicited (COVU-A) Initiate.
				12. COV Unsolicited (COVU-B) Execute.
			2. BACnet Scheduling (SCHED):
				1. Scheduling-Internal-B (I-B) Execute.
				2. Scheduling-External-B(I-B) Execute.
			3. BACnet Alarm and Event Object (AE-):
				1. Alarm and Event-Notification-A (N-A) Initiate.
				2. Alarm and Event-Notification Internal-B (N-I-B) Execute.
				3. Alarm and Event-ACK-A (ACK-A) Initiate.
				4. Alarm and Event-ACK-B (ACK-B) Execute.
				5. Alarm and Event-Alarm Summary-B (ASUM-B) Execute.
				6. Alarm and Event-Enrollment Summary-A (ESUM-A) Initiate.
				7. Alarm and Event-Enrollment Summary-B (ESUM-B) Execute.
				8. Alarm and Event-Information-A (INFO-A) Initiate.
				9. Alarm and Event-Information-B (INFO-B) Execute.
			4. BACnet Trending Object (T-):
				1. Alarm and Event-Notification-A (N-A) Initiate.
				2. Alarm and Event-Notification Internal-B (N-I-B) Execute.
				3. Trending-Viewing and Modifying Trends-A (VMT-A) Initiate.
				4. Trending-Viewing and Modifying Trends-Internal-B (VMT-I-B) Execute.
				5. Trending-Viewing and Modifying Trends-External-B (VMT-E-B) Execute.
				6. Trending Automated trend Retrieval-B (ATR-B) Execute.
			5. BACnet Network Management (NM-):
				1. Network Management-Connection Establishment-A (CE-A).
			6. BACnet Device Management (DM-):
				1. Device Management-Dynamic Device Binding-A (DBB-A) Initiate.
				2. Device Management-Dynamic Device Binding-B (DBB-B) Execute.
				3. Device Management-Dynamic Object Binding-A (DOB-A) Initiate.
				4. Device Management-Dynamic Object Binding-B (DOB-B) Execute.
				5. Device Management-Dynamic Communication Control-B (DCC-B) Execute.
				6. Device Management-Dynamic Private Transfer-A (PT-A) Initiate.
				7. Device Management-Dynamic Private Transfer-B (PT-B) Execute.
				8. Device Management-Dynamic Text Message-A (TM-A) Initiate.
				9. Device Management-Dynamic Text Message-B (TM-B) Execute.
				10. Device Management-Dynamic Time Synchronization-B (TS-B) Execute.
				11. Device Management-Reinitialize Device-B (RD-B) Execute.
				12. Device Management-Backup and Restore-B (BR-B) Execute.
				13. Device Management-List Manipulation-B (LM-B) Execute.
				14. Device Management-Object Creation and Deletion -B (OCD-B) Execute.
		5. The following BACnet standard object types must be supported on the Local Supervisory LAN using Ethernet directly by the Building Controller:
			1. Calendar – Creatable.
			2. Calendar – Deletable.
			3. Command – Creatable.
			4. Command – Deletable.
			5. Notification Class – Creatable.
			6. Notification Class – Deletable.
			7. Schedule – Creatable.
			8. Schedule – Deletable.
		6. The one of the following BACnet data link layer options must be provided on the Local Supervisory LAN using Ethernet directly by the Building Controller:
			1. BACnet IP, (Annex J)
			2. BACnet IP, (Annex J), Foreign Device
		7. The following BACnet segmentation capability must be supported on the Local Supervisory LAN using Ethernet directly by the Building Controller:
			1. Provide transmission of segmented massages with a window size of 32.
			2. Provide receipt of segmented massages with a window size of 32.
		8. The static BACnet device address binding must be supported by the BACnet device.
		9. Coordinate all network connections, IP addresses and other work related to or involving the USPS IT network with the proper project and IT department personnel. Schedule coordination and gain all required approvals to meet the project schedule.
		10. [Comply with all USPS Security and IT requirements and protocols for systems and personnel before beginning work on network connected systems.]

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***NOTE TO SPECIFIER***

*Select one of the two following paragraphs depending on the installation configuration. If the Contractor is totally responsible for all the Primary Controlling LAN hardware and installation, use the first. If USPS is providing the IT infrastructure, include the second*

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* 1. [primary Controlling LAN Hardware
		1. The infrastructure and hardware for the Primary Controlling LAN shall be provided by [others][the USPS] as part of the facility IT system. Coordinate all equipment connections, device naming and security requirements with the infrastructure provider.
		2. Unless specified elsewhere, provide all hardware, physical media, software and programming for the Secondary controlling LAN.]
	2. [primary Controlling LAN Hardware
		1. Where not provided by the USPS to form a Local Supervisory LAN, provide the following:
			1. Network Switch - Cisco 100/1000 or approved equivalent.
			2. Firewall - Cisco PIX 500 series or approved equivalent.
			3. DSL Modem - Preapproved 2 or 4 wire SHDSL 2.3MBps minimum.
		2. Submit to the USPS, or designated representative, all proposed hardware and software for approval prior to installation.
		3. Unless specified elsewhere, provide all hardware, physical media, software and programming for the Secondary Controlling LAN.]
	3. Stand-Alone Functionality
		1. General: These requirements clarify the requirement for stand-alone functionality relative to packaging I/O devices with a controller. Stand-alone functionality is specified with the controller and for each Application Category specified in Part 3. This item refers to acceptable paradigms for associating the points with the processor.
		2. Functional Boundary: Provide controllers so that all points associated with and common to one unit or other complete system/equipment shall reside within a single control unit. The boundaries of a standalone system shall be as dictated in the contract documents. Generally, systems specified for the Application Category will dictate the boundary of the standalone control functionality. See related restrictions below. When referring to the controller as pertains to the standalone functionality, reference is specifically made to the processor. One processor shall execute all the related I/O control logic via one operating system that uses a common programming and configuration tool.
		3. The following configurations are considered acceptable with reference to a controller’s standalone functionality:
			1. Points packaged as integral to the controller such that the point configuration is listed as an essential piece of information for ordering the controller (having a unique ordering number).
			2. Controllers with processors and modular back planes that allow plug in point modules as an integral part of the controller.
			3. I/O point expander boards plugged directly into the main controller board to expand the point capacity of the controller.
			4. I/O point expansion devices connected to the main controller board via wiring and as such may be remote from the controller but within the same room and that communicate via a sub LAN protocol. These arrangements to be considered standalone shall have a sub LAN that is dedicated to that controller and include no other controller devices (AACs or ASCs). All wiring to interconnect the I/O expander board shall be:
				1. [Contained in the control panel enclosure.] [Run in conduit.]
				2. Wiring shall only be accessible at the terminations.
		4. The following configurations are considered unacceptable with reference to a controller’s standalone functionality:
			1. Multiple controllers enclosed in the same control panel to accomplish the point requirement.
			2. Programming or memory allocation in a separate controller to accommodate sequence of operation programming or trend storage requirements.
	4. Building Controller (BC)
		1. General Requirements:
			1. The BC(s) shall provide fully distributed control independent of the operational status of the OWSs and CSS. All necessary calculations required to achieve control shall be executed within the BC independent of any other device. All control strategies performed by the BC(s) shall be both operator definable and modifiable through the Operator Interfaces.
			2. BCs shall perform overall system coordination, accept control programs, perform automated HVAC functions, control peripheral devices and perform all necessary mathematical and logical functions. BCs shall share information with the entire network of BCs and AACs/ASCs for full global control. Each controller shall permit multi-user operation from multiple workstations and portable operator terminals connected either locally or over the Primary Controller LAN. Each unit shall have its own internal RAM, non-volatile memory, microprocessor, battery backup, regulated power supply, power conditioning equipment, ports for connection of operating interface devices, and control enclosure. BCs shall be programmable from an operator workstation, portable operator’s terminal, or hand held operating device. BC shall contain sufficient memory for all specified global control strategies, user defined reports and trending, communication programs, and central alarming.
			3. BCs shall be connected to a controller network that qualifies as a Primary Controlling LAN.
			4. All BCs shall be protected from any memory loss due to a loss of power by one or a combination of the following:
				1. Volatile RAM shall have a battery backup using a lithium battery with a rated service life of fifty (50) hours, and a rated shelf life of at least five years. Self-diagnostic routine shall report an alarm for a low battery condition.
				2. EEPROM, EPROM, or NOVROM non-volatile memory
			5. In addition, BCs may provide intelligent, standalone control of HVAC functions. Each BC may be capable of standalone direct digital operation utilizing its own processor, non-volatile memory, input/output, wiring terminal strips, A/D converters, real-time clock/calendar and voltage transient and lightning protection devices. Refer to standalone functionality specified above.
			6. The BC may provide for point mix flexibility and expandability. This requirement may be met via either a family of expander boards, modular input/output configuration, or a combination thereof. Refer to stand alone functionality specified above.
			7. All BC point data, algorithms and application software shall be modifiable from the Operator Workstation.
			8. Each BC shall execute application programs, calculations, and commands via a microprocessor resident in the BC. The database and all application programs for each BC shall be stored in non-volatile or battery backed volatile memory within the BC and will be able to upload/download to/from the OWS and/or CSS.
			9. BC shall provide buffer for holding alarms, messages, trends etc.
			10. Each BC shall include self-test diagnostics, which allow the BC to automatically alarm any malfunctions, or alarm conditions that exceed desired parameters as determined by programming input.
			11. Each BC shall contain software to perform full DDC/PID control loops.
			12. For systems requiring end-of-line resistors those resistors shall be located in the BC.
			13. Input-Output Processing
				1. Digital Outputs (DO): Outputs shall be rated for a minimum 24 VAC or VDC, 1 amp maximum current. Each shall be configurable as normally open or normally closed. Each output shall have an LED to indicate the operating mode of the output and [a manual hand off or auto switch to allow for override]. [If these HOA switches are not provided directly on the unit they shall be provided via isolation relays within the control enclosure.] Each DO shall be discrete outputs from the BC’s board (multiplexing to a separate manufacturer’s board is unacceptable). Provide suppression to limit transients to acceptable levels.
				2. Analog Inputs (AI): AI shall be compatible with the field sensors provided. Provide signal conditioning, and zero and span calibration for each input. Each input shall be a discrete input to the BC’s board (multiplexing to a separate manufacturers board is unacceptable unless specifically indicated otherwise). A/D converters shall have a minimum resolution of 12 bits.
				3. Digital Inputs (DI): Monitor dry contact closures. Accept pulsed inputs of at least one per second. Source voltage for sensing shall be supplied by the BC and shall be isolated from the main board. Software multiplexing of an AI and resistors may only be done in non-critical applications and only with prior approval of Architect/Engineer.
				4. Universal Inputs (UI-AI or DI): To serve as either AI or DI as specified above.
				5. Electronic Analog Outputs (AO): Voltage mode: 0-10 Vdc; Current mode: 4-20 mA. Provide zero and span calibration and circuit protection. Pulse Width Modulated (PWM) analog via a DO [and transducer] is acceptable only with USPS approval (Generally these will not be allowed on loops with a short time constant such as discharge temperature loops, economizer loops, pressure control loops and the like. They are generally acceptable for standard room temperature control loops.). Where these are allowed, transducer/actuator shall be programmable for normally open, normally closed, or hold last position and shall allow adjustable timing. Each DO shall be discrete outputs from the BC’s board (multiplexing to a separate manufacturers board is unacceptable). D/A converters shall have a minimum resolution of 10 bits.
				6. Analog Output Pneumatic (AOP), 0-20 psi: Pneumatic outputs via an I/P transducer, [PWM/P transducer], or digital to pneumatic transducer are acceptable. Multiplexed digital to pneumatic transducers are acceptable provided they are supplied as a standard product and part of the BC and provide individual feedback. Multiplexed pneumatic outputs of a separate manufacturer are unacceptable.
				7. Pulsed Inputs: Capable of counting up to 8 pulses per second with buffer to accumulate pulse count. Pulses shall be counted at all times.
			14. A communication port for operator interface through a terminal shall be provided in each BC. It shall be possible to perform all program and database back-up, system monitoring, control functions, and BC diagnostics through this port. Standalone BC panels shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems, printers, or workstations.
			15. Each BC shall be equipped with loop tuning algorithm for precise proportional, integral, derivative (PID) control. Loop tuning tools provided with the Operator Workstation software is acceptable. In any case, tools to support loop tuning must be provided such that P, I, and D gains are automatically calculated.
			16. All analog output points shall have a selectable failure setpoint. The BC shall be capable of maintaining this failure setpoint in the event of a system malfunction, which causes loss of BC control, or loss of output signal, as long as power is available at the BC. The failure setpoint shall be selectable on a per point basis.
			17. Slope intercepts and gain adjustments shall be available on a per-point basis.
			18. BC Power Loss:
				1. Upon a loss of power to any BC, the other units on the primary controlling network shall not in any way be affected.
				2. Upon a loss of power to any BC, the battery backup shall ensure that the energy management control software, the Direct Digital Control software, the database parameters, and all other programs and data stored in the RAM are retained for a minimum of fifty (50) hours. An alarm diagnostic message shall indicate that the BC is under battery power.
				3. Upon restoration of power within the specified battery backup period, the BC shall resume full operation without operator intervention. The BC shall automatically reset its clock such that proper operation of any time dependent function is possible without manual reset of the clock. All monitored functions shall be updated.
				4. Should the duration of a loss of power exceed the specified battery back-up period or BC panel memory be lost for any reason, the panel shall automatically report the condition (upon resumption of power) and be capable of receiving a download via the network, and connected computer. In addition, the USPS shall be able to upload the most current versions of all energy management control programs, Direct Digital Control programs, database parameters, and all other data and programs in the memory of each BC to the CSS via the local area network, or to the laptop PC via the local RS-232C port[, or via the telephone line dial-up modem where applicable].
			19. BC Failure:
				1. Building Controller LAN Data Transmission Failure: BC shall continue to operate in stand-alone mode. BC shall store loss of communication alarm along with the time of the event. All control functions shall continue with the global values programmable to either last value or a specified value. Peer BCs shall recognize the loss, report alarm and reconfigure the LAN.
				2. BC Hardware Failure: BC shall cease operation and terminate communication with other devices. All outputs shall go to their specified fail position.
			20. Each BC shall be equipped with firmware resident self-diagnostics for sensors and be capable of assessing an open or shorted sensor circuit and taking an appropriate control action (close valve, damper, etc.).
			21. BCs may include LAN communications interface functions for Secondary Controlling LANs.
			22. A minimum of four levels of password protection shall be provided at each BC.
			23. BCs shall be mounted on equipment, in packaged equipment enclosures, or locking wall mounted in a NEMA 1 enclosure, as specified elsewhere.
		2. BACnet Building Controller Requirements:
			1. The BC(s) shall support all BIBBs defined in the BACnet Building Controller (B-BC) device profile as defined in the BACnet standard and elsewhere in this specification.
			2. BCs shall communicate over the Primary Controlling LAN.
			3. Each BC shall be connected to the Primary Controlling LAN communicating to/from other BCs.
	5. AdvanceD Application Specific Controller (AAC) and Application Specific Controller (AsC)
		1. General Requirements:
			1. AACs and ASCs shall provide intelligent, standalone control of HVAC equipment. Each unit shall have its own internal RAM, non-volatile memory and will continue to operate all local control functions in the event of a loss of communications on the ASC LAN or sub-LAN. Refer to standalone requirements by application specified in Part 3 of this section. In addition, its control data information should be sharable through a BC with every other BC on the entire network.
			2. Each AAC and ASC shall include self-test diagnostics that allow the AAC /ASC to automatically relay to the BC, LAN Interface Device or workstation, any malfunctions or abnormal conditions within the AAC /ASC or alarm conditions of inputs that exceed desired parameters as determined by programming input.
			3. AACs and ASCs shall include sufficient memory to perform the specific control functions required for its application and to communicate with other devices.
			4. Each AAC and ASC must be capable of stand-alone direct digital operation utilizing its own processor, non-volatile memory, input/output, minimum 8 bit A to D conversion, voltage transient and lightning protection devices. All volatile memory shall have a battery backup of at least fifty- (50) hrs with a battery life of five years.
			5. All point data and algorithms within an AAC /ASC shall be configurable from the Operator Workstation.
			6. AAC and ASC Input-Output Processing
				1. Digital Outputs (DO): Outputs shall be rated for a minimum 24 VAC or VDC, 1 amp maximum current. Each shall be configurable as normally open or normally closed. Each output shall have an LED to indicate the operating mode of the output. Each DO shall be discrete outputs from the AAC/ASC’s board (multiplexing to a separate manufacturer’s board is unacceptable). Provide suppression to limit transients to acceptable levels.
				2. Analog Inputs (AI AI shall be compatible with the field sensors provided. Provide signal conditioning, and zero and span calibration for each input. Each input shall be a discrete input to the BC’s board (multiplexing to a separate manufacturers board is unacceptable unless specifically indicated otherwise). A/D converters shall have a minimum resolution of 8-10 bits depending on application.
				3. Digital Inputs (DI): Monitor dry contact closures. Accept pulsed inputs of at least one per second. Source voltage for sensing shall be supplied by the BC and shall be isolated from the main board. Software multiplexing of an AI and resistors may only be done in non-critical applications and only with prior approval of Architect/Engineer
				4. Universal Inputs (UI-AI or DI): To serve as either AI or DI as specified above.
				5. Electronic Analog Outputs (AO) as required by application: voltage mode, 0-5VDC and 0-10VDC; current mode (4-20 mA). Provide zero and span calibration and circuit protection. Pulse Width Modulated (PWM) analog via a DO [and transducer] is acceptable only with USPS approval (Generally, PWM will not be allowed on loops with a short time constant such as discharge temperature loops, economizer loops, pressure control loops and the like. They are generally acceptable for standard room temperature control loops.). Where PWM is allowed, transducer/actuator shall be programmable for normally open, normally closed, or hold last position and shall allow adjustable timing. Each DO shall be discrete outputs from the BC’s board (multiplexing to a separate manufacturers board is unacceptable). D/A converters shall have a minimum resolution of 8 bits.
				6. Analog Output Pneumatic (AOP), 0-20 psi: Pneumatic outputs via an I/P transducer, PWM/P transducer, or digital to pneumatic transducer are acceptable. Multiplexed digital to pneumatic transducers are acceptable provided they are supplied as a standard product and part of the AAC /ASC and provide individual feedback. Multiplexed pneumatic outputs of a separate manufacturer are unacceptable.
		2. BACnet AAC(s) and ASC(s) Requirements:
			1. The AAC(s) and ASC(s) shall support all BIBBs defined in the BACnet Building Controller (B-AAC and B-ASC) device profile as defined in the BACnet standard.
			2. AAC(s) and ASC(s) may communicate over the Primary Controlling LAN or a Secondary controlling LANs.
		3. Terminal Box Controllers:
			1. Terminal box controllers controlling damper positions to maintain a quantity of supply or exhaust air serving a space shall have an automatically initiated function that resets the volume regulator damper to the fully closed position on a scheduled basis. The controllers shall initially be set up to perform this function once every 24 hours. The purpose of this required function is to reset and synchronize the actual damper position with the calculated damper position and to assure the damper will completely close when commanded. The software shall select scheduled boxes randomly and shall not allow more than 5% of the total quantity of controllers in a building to perform this function at the same time. When possible, the controllers shall perform this function when the supply or exhaust air system is not operating.

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***NOTE TO SPECIFIER***

*Connection of computing equipment to the USPS IT systems is controlled for security purposes. Coordinate with the USPS on whether the Contractor or USPS is to provide computer hardware.*

*Coordinate USPS on the following OWS and CCS. Depending on the size of the system and integration with the EEMS a local OWS may not be required. This choice also impacts sections on graphics and operator interfaces. Edit the following as applicable.*

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* 1. OPERATOR WORKSTATION (OWS)
		1. The OWS shall be located on site at the facility.
		2. [The USPS shall provide the computer hardware for the OWS. Contractor shall provide hardware and operating system requirements to USPS to meet the operating requirements of this specification.]
		3. [Provide personal computer (PC) with current generation multi-core Intel processor operating at 2.4 GHz minimum speed. Include 2 GB RAM and minimum of (1) 160GB/7200 RPM hard disk drives. Provide a x16 PCIe graphics card, Four USB 2.0 ports, 100/1000 Base-T network card and 16X DVD+/-RW Drive. Provide 19 in (1280 x 1024 min resolution, 6ms max refresh) LCD.]
		4. [Provide detachable keyboard with standard typewriter layout, function keys, and separate numeric keypad. Provide a USB mouse and mouse pad with the system. Provide one open serial port after configuration of the workstation to meet the requirements of the rest of these specifications.]
		5. Workstation PC shall have the capability of changing serial port interrupt vectors and IOBASE addresses through software.
		6. [Operating system for operator workstation must be Windows XP Professional or Windows Vista. Provide Microsoft Office 2007 Professional Software. All software shall be at least the latest version available as of the date of contract completion.]
		7. Provide software, graphics and programming as specified in below.
		8. Provide network card approved by BAS manufacturer to support Supervisory LAN communications (100/1000 Mbps Ethernet TCP/IP) for OWSs connected to the Local Supervisory LAN and network card or LANID where connected to the Primary Controller LAN.
		9. Provide additional hardware, video drivers, etc., to facilitate all control functions and software requirements specified for the BAS.

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***NOTE TO SPECIFIER***

*It is important that the CSS and OWSs be positioned on the drawings and or their location clearly defined. Edit the following as applicable.*

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* + 1. Operator Workstations shall be placed as follows and as indicated on the drawings or as directed by the USPS. CSS shall be placed in the [\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_].

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***NOTE TO SPECIFIER***

*Coordinate USPS on the following CSS. Depending on the size of the system and integration with the EEMS a CSS may not be required. Edit the following as applicable.*

*Connection of computing equipment to the USPS IT systems is controlled for security purposes. Coordinate with the USPS on whether the Contractor or USPS is to provide computer hardware.*

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* 1. Control System Server (CSS)
		1. The CSS shall be located on site at the facility.
		2. [The USPS shall provide the computer hardware for the OWS. Contractor shall provide hardware and operating system requirements to USPS to meet the operating requirements of this specification.]
		3. [Provide personal computer (PC), either desktop or blade type server with current generation multi-core Intel processor operating at 2.4 GHz minimum speed. Include 2 GB RAM and minimum of two (2) 160GB/7200 RPM hard disk drives. Provide a minimum of Four USB 2.0 ports, 100/1000 Base-T network card and 16X DVD+/-RW Drive. Provide minimum 17 in (1280 x 1024 min resolution, 6ms max refresh) LCD.]
		4. [Provide detachable keyboard with standard typewriter layout, function keys, and separate numeric keypad. Provide a USB mouse and mouse pad with the system. Provide one open serial port after configuration of the workstation to meet the requirements of the rest of these specifications.]
		5. Provide software, graphics and programming as specified in elsewhere in this section.
		6. Provide network card approved by BAS manufacturer to support Primary Controlling LAN communications (100/1000 Mbps Ethernet TCP/IP).
		7. Provide additional hardware, video drivers, etc., to facilitate all control functions and software requirements specified for the BAS.
		8. For CSSs that provide web services for presentation of data across the Ethernet, all Web components and services shall be installed with required licensing. CSS shall be configured to secure it to the extent practical inside the Primary Controlling LAN. CSS shall always function from behind a firewall provided by [USPS] [the Contractor].

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***NOTE TO SPECIFIER***

*It is important that the CSS and OWS be positioned on the drawings and or their location clearly defined. Edit the following as applicable*

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* + 1. Control System Server shall be placed as follows and as indicated on the drawings or as directed by the USPS. CSS shall be placed in the [\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_].
	1. PRINTER
		1. Provide minimum 600x600 dpi, min 4 sheets per minute laser printer with 8-1/2 x 11 inches paper tray.
		2. Provide this printer at the Operator Workstation
	2. Gateways
		1. A Gateway shall be provided to link non-BACnet control products to the Primary Controlling LAN. The Gateway shall include all necessary hardware, software, etc. necessary to meet the requirements listed. All of the functionality described in this section is to be provided by using the capabilities of BACnet. Each Gateway shall have sufficient RAM initially installed to provide the ability to expand the number of BACnet objects of each type supported by 20% to accommodate future system changes.
		2. The gateway shall contain its own microprocessor, RAM, battery, real-time clock, communication ports, and power supply as specified for a BC in this Section. Each gateway shall be mounted in a lockable enclosure.
		3. Each Gateway shall BTL listed device meeting all BACnet requirements of a BC.
		4. Upon loss of power to a Gateway, the battery shall provide for minimum 100-hour backup of all programs and data in RAM. The battery shall be sealed and self-charging.
		5. The Gateway shall be transparent to control functions and shall not be required for information routing on the Primary LAN
		6. Each Gateway shall provide values for all points on the non-BACnet side of the Gateway to BACnet devices as if the values were originating from BACnet objects. The Gateway shall also provide a way for BACnet devices to modify (write) all points specified by the sequence of operations using standard BACnet services. All non-physical points are required to be writable for each site.
		7. Each Gateway and any devices that the Gateway represents which have time of day information shall respond to workstation requests to synchronize the date and time. Each Gateway and any device that the Gateway represents shall support all BIBBS required of all similar native BACnet objects. Refer to the BIBBs listed above for other minimum requirements of the Gateway.
		8. All points in the non-BACnet system shall be made network-visible through the use of standard BACnet objects. All points shall be writable using standard BACnet services.
		9. All devices have a Device Object instance number that is unique throughout the entire USPS network. All BACnet devices shall be configured with a Device Object instance number that is based on the format specified (shown in decimal notation). This includes all physical devices as well as any logical BACnet devices that are physically represented by gateways.
	3. Controller LOCAL AREA NETWORK Interface Devices (LANID)
		1. The Controller LANID shall be a microprocessor-based communications device which acts as a gateway/router between the Primary LAN, Secondary LAN, an operator interface, or printer. These may be provided within a BC or as a separate device.
		2. The LANID shall perform information translation between the Primary LAN and the Secondary LAN, supervise communications on a polling secondary LAN, and shall be applicable to systems in which the same functionality is not provided in the BC. In systems where the LANID is a separate device, it shall contain its own microprocessor, RAM, battery, real-time clock, communication ports, and power supply as specified for a BC. Each LANID shall be mounted in a lockable enclosure.
		3. Each LANID shall support interrogation, full control, and all utilities associated with all BCs on the Primary LAN, all AACs and ASCs connected to all secondary LANs under the Primary Controller LAN, and all points connected to those PCUs and SCUs.
		4. Upon loss of power to a LANID, the battery shall provide for minimum 100-hour backup of all programs and data in RAM. The battery shall be sealed and self-charging.
		5. The LANID shall be transparent to control functions and shall not be required to control information routing on the Primary LAN
		6. All BACnet Interoperability Building Blocks (BIBBs) are required to be supported for each native BACnet device or Gateway. The Gateway shall support all BIBBs defined in the BACnet Gateway’s device profile as defined in the BACnet standard.
	4. SYSTEM SOFTWARE-GENERAL
		1. Functionality and Completeness: Provide all software and programming necessary to provide a complete and functioning system as specified. Include all software and programming not specifically itemized in these Specifications, which is necessary to implement, maintain, operate, and diagnose the system in compliance with these and referenced Specifications.
		2. Configuration: The software shall support the system as a distributed processing network configuration.
	5. Controller SOFTWARE
		1. BC Software Residency: Each BC as defined below shall be capable of control and monitoring of all points physically connected to it. All software including the following shall reside and execute at the BC:
			1. Real-Time Operating System software
			2. Real-Time Clock/Calendar and network time synchronization
			3. BC diagnostic software
			4. LAN Communication software/firmware
			5. Direct Digital Control software
			6. Alarm Processing and Buffering software
			7. Energy Management software
			8. Data Trending, Accumulation, Reporting, and Buffering software
			9. I/O (physical and virtual) database
			10. Remote Communication software
		2. AAC/ASC Software Residency: Each AAC/ASC as defined below shall be capable of control and monitoring of all points physically connected to it. As a minimum, software including the following shall reside and execute at the AAC/ASC. Other software to support other required functions of the AAC/ASC may reside at the BC or LAN interface device with the restrictions/exceptions noted for per application class
			1. Real-Time Operating System software
			2. AAC/ASC diagnostic software
			3. LAN Communication software
			4. Control software applicable to the unit it serves that will support a single mode of operation
			5. I/O (physical and virtual) database to support one mode of operation
		3. Stand Alone Capability: BC shall continue to perform all functions independent of a failure in other BC/AAC/ASC or other communication links to other BCs/AACs/ASCs. Trends and runtime totalization shall be retained in memory. BC memory shall be sufficient to provide program storage and specified trend buffering and allow 20% spare capacity for future modifications. Runtime totalization shall be available on all digital input and virtual status points. Accumulation/ Totalization shall be available for all analog input and calculated virtual points Refer also to refer to other sections of this specification for other aspects of standalone functionality.
		4. Operating System: Controllers shall include a real-time operating system resident in ROM. This software shall execute independently from any other devices in the system. It shall support all specified functions. It shall provide a command prioritization scheme to allow functional override of control functions. Refer also to other sections of this specification for other aspects of the controller’s operating system.
		5. Network Communications: Each controller shall include software/firmware that supports the networking of CUs on a common communications trunk that forms the respective LAN. Network support shall include the following:
			1. Primary Controlling LAN shall be a high-speed network designed and optimized for control system communication. If a Primary Controlling LAN communications trunk is severed, BCs shall reconfigure into two separate LANs and continue operations without interruption or Operator intervention.
			2. Controller communication software shall include error detection, correction, and re-transmission to ensure data integrity.
			3. Operator/System communication software shall facilitate communications between other BCs, all subordinate AACs/ASCs, Gateways and LAN Interface Devices or Operator Workstations. Software shall allow point interrogation, adjustment, addition/deletion, and programming while the controller is on line and functioning without disruption to unaffected points. The software architecture shall allow networked controllers to share selected physical and virtual point information throughout the entire system.
		6. Diagnostic Software: Controller software shall include diagnostic software that checks memory and communications and reports any malfunctions
		7. Alarm/Messaging Software: Controller software shall support alarm/message processing and buffering software though BACnet objects as more fully specified below.
		8. Application Programs: CUs shall support and execute application programs as more fully specified below:
			1. All Direct Digital Control software, Energy Management Control software, and functional block application programming software templates shall be provided in a ‘ready-to-use’ state, and shall not require (but shall allow) USPS user programming.
			2. Line programs shall supply preprogrammed functions to support these energy management and functional block application algorithms. All functions shall be provided with printed narratives and/or flow diagrams to document algorithms and how to modify and use them.
		9. Security: Controller software shall support multiple level password access restriction as more fully specified below.
		10. Direct Digital Control: Controller shall support application of Direct Digital Control Logic. All logic modules shall be provided pre-programmed with written documentation to support their application. Provide the following logic modules as a minimum:
			1. Proportional-Integral-Derivative (PID) control with analog, PWM and floating output
			2. Two Position control (Hi or Low crossing with deadband)
			3. Single-Pole Double-Throw relay
			4. Delay Timer (delay-on-make, delay-on-break, and interval)
			5. Hi/Low Selection
			6. Reset or Scaling Module
			7. Logical Operators (AND, OR, NOT, XOR)
		11. Psychrometric Parameters: Controller software shall provide preprogrammed functions to calculated and present psychrometric parameters (given temperature and relative humidity) including the following as a minimum: Enthalpy, Wet Bulb Temperature.
		12. Updating/Storing Application Data: Site-specific programming residing in volatile memory shall be uploadable/downloadable from an OWS or CSS using BACnet services connected locally, to the Primary Controlling LAN, to the Secondary Controlling LAN and remotely via the internet and modem and telephone lines as applicable but all must be available. Initiation of an upload or download shall include all of the following methods; Manually, Scheduled, and Automatically upon detection of a loss or change.
		13. Restart: System software shall provide for orderly shutdown upon loss of power and automatic restart upon power restoration. Volatile memory shall be retained; outputs shall go to programmed fail (open, closed, or last) position. Equipment restart shall include a user definable time delay on each piece of equipment to stagger the restart. Loss of power shall be alarmed at operator interface indicating date and time.
		14. Time Synchronization: Operators shall be able to set the time and date in any device on the network that supports time-of-day functionality. The operator shall be able to select to set the time and date for an individual device, devices on a single network, or all devices simultaneously. Automatic time synchronization shall be provided using BACnet services.
		15. Misc. Calculations: System software shall automate calculation of psychometric functions, calendar functions, kWh/kW, and flow determination and totalization from pulsed or analog inputs, curve-fitting, look-up table, input/output scaling, time averaging of inputs and A/D conversion coefficients.
	6. Application PROGRAMMING DESCRIPTION
		1. The application software shall be user programmable.
		2. This specification generally requires a programming convention that is logical, easy to learn, use, and diagnose. General approaches to application programming shall be provided by one, or a combination, of the following conventions:
			1. Point Definition: provide templates customized for point type, to support input of individual point information. Use standard BACnet Objects as applicable.
			2. Graphical Block Programming: Manipulation of graphic icon ‘blocks’, each of which represents a subroutine, in a functional/logical manner forming a control logic diagram. Blocks shall allow entry of adjustable settings and parameters via pop-up windows. Provide a utility that shall allow the graphic logic diagrams to be directly compiled into application programs. Logic diagrams shall be viewable either off-line, or on-line with real-time block output values.
			3. Functional Application Programming: Pre-programmed application specific programs that allow/require limited customization via ‘fill-in-the-blanks’ edit fields. Typical values would be setpoints gains, associated point names, alarm limits, etc.
			4. Line Programming: Textual syntax-based programming in a language similar to BASIC designed specifically for HVAC control. Subroutines or functions for energy management applications, setpoints, and adjustable parameters shall be customizable, but shall be provided preprogrammed and documented.
		3. Provide a means for testing and/or debugging the control programs both off-line and on-line.
	7. ENERGY MANAGEMENT APPLICATIONS
		1. BC shall have the ability to perform all of the following energy management routines via preprogrammed function blocks or template programs. As a minimum provide the following whether or not required in the software:
			1. Time-of-Day Scheduling
			2. Calendar-Based Scheduling
			3. Holiday Scheduling
			4. Temporary Schedule Overrides
			5. Optimal Start/Optimal Stop-based on space temperature offset, outdoor air temperature, and building heating and cooling capacitance factors as a minimum
			6. Night Setback and Morning Recovery Control, with ventilation only during occupancy
			7. Economizer Control (enthalpy or dry-bulb)
			8. Peak Demand Limiting / Load Shedding
			9. Dead Band Control
		2. All programs shall be executed automatically without the need for operator intervention, and shall be flexible enough to allow operator customization. Programs shall be applied to building equipment as described in Section 259004 - Sequence of Operation.
	8. PASSWORD PROTECTION
		1. Multiple-level password access protection shall be provided to allow the USPS’s authorized BAS Administrator to limit workstation control, display and database manipulation capabilities as (s)he deems appropriate for each user, based upon an assigned user name with a unique password.
		2. All passwords for the system shall be provided to the USPS including administrator, dealer, or factory level passwords for the systems provided under this project.
		3. Passwords shall restrict access to all Control Units.
		4. Each user name shall be assigned to a discrete access level. A minimum of five levels of access shall be supported. Alternately, a comprehensive list of accessibility/functionality items shall be provided, to be enabled or disabled for each user.
		5. A minimum of 20 user names shall be supported and programmed per the USPS’s direction.
		6. Operators shall be able to perform only those commands available for the access level assigned to their user name.
		7. User-definable, automatic log-off timers of from 1 to 60 minutes shall be provided to prevent operators from inadvertently leaving interface device software on-line.
	9. ALARM and Event Management REPORTING
		1. Alarm management shall be provided to monitor, buffer, and direct alarms and messages to operator devices and memory files. Each BC shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic, and prevent alarms from being lost. At no time shall a BCs ability to report alarms be affected by either operator activity at an Operator Workstation or local handheld device, or by communications with other panels on the network.
			1. Alarm Descriptor: Each alarm or point change shall include that point’s English language description, and the time and date of occurrence. In addition to the alarm’s descriptor and the time and date, the user shall be able to print, display and store an alarm message to more fully describe the alarm condition or direct operator response.
			2. Alarm Prioritization: The software shall allow users to define the handling and routing of each alarm by their assignment to discrete priority levels. A minimum of five priority levels shall be provided. For each priority level, users shall have the ability to enable or disable an audible tone whenever an alarm is reported and whenever an alarm returns to normal condition. Users shall have the ability to manually inhibit alarm reporting for each individual alarm and for each priority level. Coordinate with the USPS on establishing alarm priority definitions. Alarm Level 1 Life Safety (i.e. smoke detector), Level 2 Critical (i.e. controller failure), Level 3 Abnormal (i.e. out-of-range temperature), Level 4 Energy Waste - where applicable (i.e. fighting valves), Level 5 Maintenance Message (i.e. runtime monitor, filter status).
			3. Alarm Report Routing: Each alarm priority level shall be associated with a unique user-defined list of operator devices including any combination of local or remote workstations, printers and workstation disk files. All alarms associated with a given priority level shall be routed to all operator devices on the user-defined list associated with that priority level. For each priority level, alarms shall be automatically routed to a default operator device in the event that alarms are unable to be routed to any operator device assigned to the priority level.
			4. Auto-Dial Alarm Routing: For alarm priority levels that include a remote workstation (accessed by modem) as one of the listed reporting destinations, the BC shall initiate a call to report the alarm, and shall terminate the call after alarm reporting is complete. System shall be capable of multiple retries and buffer alarms until a connection is made. If no connection is made, system shall attempt connection to an alternate dial-up workstation. System shall also be able to dial multiple pagers upon alarm activation.
			5. Alarm Acknowledgment: For alarm priority levels that are directed to a workstation screen, an indication of alarm receipt shall be displayed immediately regardless of the application in use at the workstation, and shall remain on the screen until acknowledged by a user having a password that allows alarm acknowledgment. Upon acknowledgment, the complete alarm message string (including date, time, and user name of acknowledging operator) shall be stored in a selected file on the workstation hard disk.
		2. It shall be possible for any operator to receive a summary of all alarms regardless of acknowledgement status; for which a particular recipient is enrolled for notification; based on current event state; based on the particular BACnet event algorithm (e.g., change of value, change of state, out of range, and so on); alarm priority; and notification class.
		3. BACnet Alarming Services: All alarms and events shall be implemented using standard BACnet event detection and notification mechanisms. The workstation shall receive BACnet alarm and event notifications from any gateway or BACnet controller in the system and display them to an operator. Either intrinsic reporting or algorithmic change reporting may be used but the intrinsic reporting method is preferred. The workstation shall also log alarms and events, provide a way for an operator with sufficient privilege to acknowledge alarms, and log acknowledgements of alarms. It shall be possible for an operator to receive, at any time, a summary of all alarms that are currently in effect at any site whether or not they have been acknowledged. Operators shall also be able to view and change alarm limits for any alarm at the appropriate password level.
		4. Alarm Historical Database: The database shall store all alarms and events object occurrences in an ODBC or an OLE database-compliant relational database. Provide a commercially available ODBC driver or OLE database data provider, which would allow applications to access the data using standard Microsoft Windows Data Services.
	10. TRENDING
		1. The requirements of BC trending shall include the following:
			1. Provide trends for all physical points, virtual points, and calculated variables. Unless specified elsewhere all analog values shall be trended at 5 minute intervals and discrete point as COV. All trends shall be retained in the BC for a minimum of 14 days.
			2. The BAS shall utilize BACnet Trend Objects.
			3. The sample rate and data selection shall be selectable by the operator.
			4. The trended value range shall be selectable by the operator.
		2. Control Loop Performance Trends: Controllers incorporating PID control loops shall also provide high resolution sampling in less than six second increments for verification of control loop performance.
		3. Data Buffering and Archiving: Trend data shall be buffered at the BC and uploaded to hard disk storage when archival is desired. All archived trends shall be transmitted to the on-site CSS as applicable. Uploads shall occur based upon a user-defined interval, manual command, or automatically when the trend buffers become full.
		4. Time Synchronization: Provide a time master that is installed and configured to synchronize the clocks of all BACnet devices supporting time synchronization. Synchronization shall be done using Coordinated Universal Time (UTC). All trend sample times shall be able to be synchronized. The frequency of time synchronization message transmission shall be selectable by the operator.
	11. TOTALIZATION
		1. The BC shall support totalizing analog, digital, and pulsed inputs and be capable of accumulating, storing, and converting these totals to engineering units used in the documents. These values shall generally be accessible to the Operator Interfaces to support management-reporting functions.
		2. Totalization of electricity, steam and chilled water use/demand shall allow application of totals to different rate periods, which shall be user definable.
		3. When specified to provide electrical or utility Use/Demand from a utility pulse contact, obtain from the local utility all information required to obtain meter data, including k factors, conversion constants, and the like.
	12. Point structuring and naming
		1. General: The intent of this section is to require a consistent means of naming points across all USPS facilities. Configure the systems from the perspective of the Enterprise, not solely the local project. Coordinate with the USPS’s representative and compile and submit a proposed Point Summary Table for review prior to any object programming or project startup.
		2. Point Naming Convention
			1. All point names shall adhere to the format as in Appendix A attached. Naming convention shall apply to all physical I/O points, virtual points, calculated points and all application program parameters. For each BAS object, a specific and unique BACnet object name shall be required.
			2. The USPS shall designate the Building descriptor and facility ID. The System descriptor shall further define the object in terms of air handling, cooling, heating, or other system The Equipment descriptor shall define the equipment category, e.g., Chiller, Air Handler, or other equipment. The Point descriptor shall define the hardware or software type, or function associated with the equipment; e.g., supply temperature, water pressure, alarm, mixed air temperature setpoint, etc. and shall contain any numbering conventions for multiples of equipment. Refer to appendix for further details.
		3. Device Instance Number Convention:
			1. BACnet network numbers and Device Object IDs shall be unique throughout the network.
			2. Refer to Appendix A for instance number ranges.
			3. All assignment of network numbers and Device Object IDs shall be coordinated with the USPS.
			4. Coordinate with a designated USPS representative to ensure that no duplicate Device Object IDs occur.
	13. OPERATOR INTERFACE GRAPHIC SOFTWARE
		1. Graphic software shall facilitate user-friendly interface to all aspects of the System Software specified above. The intent of this specification is to require a graphic package that provides for intuitive operation of the systems without extensive training and experience. It shall facilitate logical and simple system interrogation, modification, configuration, and diagnosis.
		2. Graphic software shall support multiple simultaneous screens to be displayed and resizable in a ‘Windows’-like environment. All functions excepting text entry functions shall be executable with a mouse.
		3. Graphic software shall provide for multitasking such that third-party programs can be used while the OWS software is on line. Software shall provide the ability to alarm graphically even when operator is in another software package.
		4. The software shall allow for the USPS’s creation of user-defined, color graphic displays of geographic maps, building plans, floor plans, and mechanical and electrical system schematics. These graphics shall be capable of displaying all point information from the database including any attributes associated with each point (i.e., engineering units, etc.). In addition, operators shall be able to command equipment or change setpoints from a graphic through the use of the mouse
		5. Screen Penetration: The operator interface shall allow users to access the various system graphic screens via a graphical penetration scheme by using the mouse to select from menus or ‘button’ icons. Each graphic screen shall be capable of having a unique list of other graphic screens that are directly linked through the selection of a menu item or button icon.
		6. Dynamic Data Displays: Dynamic physical point values shall automatically updated at a minimum frequency of 6 updates per minute without operator intervention. Point value fields shall be displayed with a color code depicting normal, abnormal, override and alarm conditions.
		7. Point Override Feature: Each displayed point shall be individually enabled/disabled to allow mouse-driven override of digital points or changing of analog points. Such overrides or changes shall occur in the control unit, not just in the workstation software. The graphic point override feature shall be subject to password level protection. Points that are overridden shall be reported as an alarm, and shall be displayed in a coded color. The alarm message shall include the operator’s user name. A list of points that are currently in an override state shall be available through menu selection.
		8. Dynamic Symbols: Provide a selection of standard symbols that change in appearance based on the value of an associated point.
			1. Analog symbol: Provide a symbol that represents the value of an analog point as the length of a line or linear bar.
			2. Digital symbol: Provide symbols such as switches, pilot lights, rotating fan wheels, etc. to represent the value of digital input and output points.
			3. Point Status Color: Graphic presentations shall indicate different colors for different point statuses. (For instance, green = normal, red = alarm, gray (or ‘???’) for non-response.
		9. Graphics Development Package: Graphic development and generation software shall be provided to allow the user to add, modify, or delete system graphic displays.
			1. Provide libraries of pre-engineered screens and symbols depicting standard air handling unit components (e.g. fans, cooling coils, filters, dampers, etc.), mechanical system components (e.g., pumps, chillers, cooling towers, boilers, etc.), complete mechanical systems (e.g. constant volume-terminal reheat, VAV, etc.) and electrical symbols.
			2. The Graphic Development Package shall use a mouse or similar pointing device to allow the user to perform the following:
				1. Define symbols
				2. Position items on graphic screens
				3. Attach physical or virtual points to a graphic
				4. Define background screens
				5. Define connecting lines and curves
				6. Locate, orient and size descriptive text
				7. Define and display colors for all elements
				8. Establish correlation between symbols or text and associated system points or other displays.
				9. Create hot spots or link triggers to other graphic displays or other functions in the software.
	14. OPerator Workstation EQUIPMENT SCHEDULING
		1. Provide a graphic utility for user-friendly operator interface to adjust equipment-operating schedules.
		2. All schedules shall be implemented using BACnet objects and messages and retained in the BC. All building systems with date and time scheduling requirements shall have schedules represented by the BACnet Schedule object. All operators shall be able to view the entries for a schedule. Operators with sufficient privilege shall be able to modify schedule entries from any BACnet workstation.
		3. Scheduling feature shall include multiple seven-day master schedules, plus holiday schedule, each with start time and stop time. Master schedules shall be individually editable for each day and holiday.
		4. Scheduling feature shall allow for each individual equipment unit to be assigned to one of the master schedules.
		5. Timed override feature shall allow an operator to temporarily change the state of scheduled equipment. An override command shall be selectable to apply to an individual unit, all units assigned to a given master schedule, or to all units in a building. Timed override shall terminate at the end of an operator selectable time, or at the end of the scheduled occupied/unoccupied period, whichever comes first. A password level that does not allow assignment of master schedules shall allow a timed override feature.
		6. A yearly calendar feature shall allow assignment of holidays, and automatic reset of system real time clocks for transitions between daylight savings time and standard time.
	15. OPerator Workstation Dynamic Plotting
		1. The system software shall display data in both a tabular and graphical format. Provide a utility to dynamically plot either historical data or in real-time values on a given 2-dimensional dynamic plot/graph with at least two Y-axes. At least 5 dynamic plots shall be allowed simultaneously.
		2. Graphical trend format shall plot at least 8 different values for a given time period superimposed on the same graph. The 8 values shall be distinguishable by using unique colors. In printed form the 8 lines shall be distinguishable by different line symbology. Displayed trend graphs shall indicate the engineering units for each trended value.
		3. Where trended values on one table/graph are COV, software shall automatically fill the trend samples between COV entries.
	16. OWS/CSS Data acquisition and Storage
		1. All points included in the typical equipment point list must be represented in a common, open or accessible format. All points should be provided as BACnet standard analog, binary, schedule, or trend objects when possible. Naming conventions for these points and network addressing are discussed in the ‘Point Naming Conventions’ paragraph below.
		2. Non-BACnet data from the BAS shall be stored in relational database format. The format and the naming convention used for storing the database files shall remain consistent across the database and across time. The relational structure shall allow for storage of any additional data points, which are added to the BAS in future. The metadata/schema or formal descriptions of the tables, columns, domains, and constraints shall be provided for each database.
		3. The database shall allow applications to access the data while the database is running. The database shall not require shutting down in order to provide read-write access to the data. Data shall be able to be read from the database without interrupting the continuous storage of trend data being carried by the BAS.
		4. The database shall be ODBC or OLE database compliant.
	17. REMOTE PERSONAL COMPUTER WORKSTATION GRAPHIC SOFTWARE
		1. Remote graphic operator software shall provide all the functionality specified for the local graphic software. It shall also provide for dial-up communications using the specified modems via commercial telephone lines to connect to the Local Supervisory or Primary LAN, and using the Internet.
		2. Software shall not require graphic images to be sent across the phone lines or 56Kbps or slower Internet connection. Graphic images shall reside on the remote operator workstation hard drive and all licenses must be provided for the graphic software on the remote machine. Exceptions to this requirement include:
			1. System configuration uses an Internet server and presents web pages that can be pulled up using a standard browser.
			2. System configuration uses an Internet server and presents the standalone application running locally but controlled via a remote browser. Operator Interface Graphical Software application must therefore support multi-instancing to allow multiple simultaneous remote connections and use of the graphic software.
		3. Software shall be capable of initiating communication to the any LAN, upon user command, to perform all specified functions. Software shall be capable of initiating communication to the LANs in accordance with user-programmed time schedules to upload trend and report data. Software shall be capable of communicating from the LAN in accordance with user-programmed time schedules to report alarms, upload trend, and report data. Software shall automatically terminate the communication whenever all applications requiring modem connection are closed.
1. EXECUTION
	1. INSPECTION:
		1. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.
	2. INSTALLATION OF CONTROL SYSTEMS:
		1. General: Install systems and materials in accordance with manufacturer's instructions, specifications roughing-in drawings and details shown on drawings. Install all controllers in accordance with manufacturer’s installation procedures and practices.
		2. Refer to Section 250504 for requirements pertaining to control unit quantity and location.
		3. Configure BAS system software, supplemental software, network communications, CSS, OWS, portable operators’ terminal, printer, and remote communications.
	3. INSTALLATION of Operator interface devices
		1. Set up the workstations and printers as indicated on the drawings. Install all software and verify that the systems are fully operational. Ensure licensing is provided for all software.
		2. No license, software component, key, etc or any piece of information required to install, configure, operate, diagnose and maintain the system shall be withheld from the USPS.
		3. Install electronic control system Operation and Maintenance Manuals, programming guides, network configuration tools, control shop drawings etc on each OWS and CSS. Provide interface or shortcuts to guide user to the appropriate information.
		4. Set up portable operator terminal and configure it as the remote workstation. Install all software and verify that the system is fully operational.
		5. Install systems and materials in accordance with manufacturer’s instructions.
		6. Deliver hand-held devices/ Portable operator’s terminal to the USPS prior to conducting the specified training.
	4. HARDWARE APPLICATION REQUIREMENTS
		1. General: The functional intent of this specification is to allow cost effective application of manufacturers standard products while maintain the integrity and reliability of the control functions. A Building Controller as specified above is generally fully featured and customizable whereas the AAC/ASC refers to a more cost-effective unit designed for lower-end applications. Specific requirements indicated below are required for the respective application. Manufacturer may apply the most cost-effective unit that meets the requirement of that application.
		2. Standalone Capability: Each Control Unit shall be capable of performing the required sequence of operation for the associated equipment. All physical point data and calculated values required to accomplish the sequence of operation shall originate within the associated CU with only the exceptions enumerated below. Refer to Item 2.01 above for physical limitations of standalone functionality. Listed below are functional point data and calculated values that shall be allowed to be obtained from or stored by other CUs or SDs via LAN.
		3. Where associated control functions involve functions from different categories identified below, the requirements for the most restrictive category shall be met.
		4. Application Category 0 (Distributed monitoring)
			1. Applications in this category include the following:
				1. Monitoring of variables that are not used in a control loop, sequence logic, or safety.
			2. Points on BCs, AACs, and ASCs may be used in these applications as well as SDs and/or general-purpose I/O modules.
			3. Where these points are trended, verify and document that the network bandwidth is acceptable for such trends and is still capable of acceptable and timely control function.
		5. Application Category 1 (Application Specific Controller):
			1. Applications in this category include the following:
				1. Fan Coil Units
				2. Airflow Control Boxes (VAV and Constant Volume Terminal Units)
				3. Misc. Heaters
				4. Unitary equipment <15 tons (Package Terminal AC Units, Package Terminal Heat Pumps, Split-System AC Units, Split-System Heat Pumps, Water-Source Heat Pumps)
				5. Induction Units
				6. Variable Speed Drive (VSD) controllers not requiring safety shutdowns of the controlled device.
			2. ASCs may be used in these applications.
			3. Standalone Capability: Provide capability to execute control functions for the application for a given setpoint or mode, which shall generally be occupied mode control. Only the following data (as applicable) may be acquired from other controllers via LANs. In the event of a loss of communications with any other controller, or any fault in any system hardware that interrupts the acquisition of any of these values, the ASC shall use the last value obtained before the fault occurred. If such fault has not been corrected after the specified default delay time, specified default value(s) shall then be substituted until such fault has been corrected.

Physical/Virtual Point Default Value

Scheduling Period Normal

Morning Warm-Up Off (cold discharge air)

Load Shed Off (no shedding)

Summer/Winter Winter

* + - 1. Mounting:
				1. ASCs that control equipment located above accessible ceilings shall be mounted on the equipment in an accessible enclosure and shall be rated for plenum use.
				2. ASCs that control equipment mounted in a mechanical room may either be mounted in, on the equipment, or on the wall of the mechanical room at an adjacent, accessible location.
				3. ASCs that control equipment mounted outside or in occupied spaces shall either be located in the unit or in a proximate mechanical/utility space.
			2. Programmability: Operator shall be able to modify all setpoints (temperature and airflow), scheduling parameters associated with the unit, tuning and set up parameters, interstage timing parameters, and mode settings. Application-specific block control algorithms may be used to meet the sequence of operations. The ability to customize the control algorithm is not required unless specifically indicated otherwise.
			3. LAN Restrictions: Limit the number of nodes on the network to the maximum recommended by the manufacturer.
		1. Application Category 2 (General Purpose Terminal Controller)
			1. Applications in this category include the following:
				1. Unitary Equipment >= 15 tons (Air Conditioners, Heat Pumps, Packaged Heating/Cooling Units, and the like)
				2. Small, Constant Volume Single Zone Air Handling Units
				3. Constant Volume Pump Start/Stop
				4. Misc. Equipment (Exhaust Fan) Start/Stop
				5. Misc. Monitoring (not directly associated with a control sequence and where trending is not critical)
				6. Steam Converter Control
			2. BCs may be used in these applications.
			3. ASC’s may be used in these applications provided the ASC meets all requirements specified below. This category requires a general-purpose ASC to which application-specific control algorithms can be attached.
			4. Standalone Capability: Only the following data (as applicable) may be acquired from other ASCs via LANs. In the event of a loss of communications with any other ASCs, or any fault in any system hardware that interrupts the acquisition of any of these values, the AAC/ASC shall use the last value obtained before the fault occurred. If such fault has not been corrected after the specified default delay time, specified default value(s) shall then be substituted until such fault has been corrected.

Physical/Virtual Point Default Delay Time Default Value

Outside Air Temperature 3 minutes 80°F

Outside Air Humidity 3 minutes 60%RH

Outside Air Enthalpy 3 minutes 30 Btu/lb

 Trend Data N/A

 Cooling/Heating Requests 3 minutes None

* + - 1. Mounting:
				1. ASCs that control equipment located above accessible ceilings shall be mounted on the equipment and shall be rated for plenum use.
				2. ASCs that control equipment located in occupied spaces or outside shall either be mounted within the equipment enclosure or in a nearby mechanical/utility room in which case it shall be enclosed in a NEMA 1, locking enclosure.
			2. Programmability: Operator shall be able to modify all setpoints (temperature and airflow), scheduling parameters associated with the unit, tuning and set up parameters, interstage timing parameters, and mode settings. Operator shall be able to address and configure spare inputs for monitoring. [Operator shall be able to address and configure spare outputs for simple single loop control actions or event initiated actions.] Application-specific block control algorithms shall used to meet the sequence of operations. The ability to customize the control algorithm is not required unless specifically indicated otherwise.
			3. LAN Restrictions: Limit the number of nodes servicing any one of these applications on the AAC/ASC LAN to 32.
		1. Application Category 3 (Advanced Application Controller)
			1. Applications in this category include the following:
				1. Large Constant Volume Air Handlers.
				2. VAV Air Handlers, generally >5,000 and <10,000cfm.
				3. Dual Duct Air Handlers, generally >5000 and < 10,000 cfm.
				4. Multizone Air Handlers.
				5. Self-Contained VAV Units.
			2. BCs may be used in these applications.
			3. AAC’s may be used in these applications provided:
				1. The AAC’s meets all requirements specified below.
				2. All control functions and physical I/O associated with a given unit resides in one AAC.
				3. Input A/D is 10-bit. *Exception*: 8-bit input A/D can be used when matched with high accuracy sensors, the range of which meets the resolution requirements specified for the applicable sensor in Section 230901.
				4. Pulsed inputs required for the application can be monitored and accumulated effectively.
			4. Standalone Capability: Only the following data (as applicable) may be acquired from other AACs via LANs. In the event of a loss of communications with any other AACs, or any fault in any system hardware that interrupts the acquisition of any of these values, the AAC shall use the last value obtained before the fault occurred. If such fault has not been corrected after the specified default delay time, specified default value(s) shall then be substituted until such fault has been corrected.

Physical/Virtual Point Default Delay Time Default Value

Outside Air Temperature 3 minutes 80°F

Outside Air Humidity 3 minutes 60%RH

Outside Air Enthalpy 3 minutes 30 Btu/lb

Enable Local Operation Last Value

Cooling/Heating Requests 3 minutes None

* + - 1. Mounting:
				1. AACs that control equipment located above accessible ceilings shall be mounted on the equipment and shall be rated for plenum use.
				2. AACs that control equipment located in occupied spaces or outside shall either be mounted within the equipment enclosure or in a nearby mechanical/utility room in which case it shall be enclosed in a NEMA 1, locking enclosure.
			2. Programmability: Operator shall be able to modify all setpoints (temperature and airflow), scheduling parameters associated with the unit, tuning and set up parameters, interstage timing parameters, and mode settings. Operator shall be able to address and configure spare inputs for monitoring. Operator shall be able to program custom DDC control algorithms and specify trending parameters, which will be retained in memory in the event of a loss of communications. Application-specific block control algorithms may be used provided they meet the sequence of operations. The control algorithms shall be completely customizable.
			3. LAN Restrictions: Each LAN which participates in the transfer of data between the CU and the local operator workstation shall be subject to the following criteria:
				1. Limit the number of nodes servicing any one of these applications on the AAC/ASC LAN to 16.
				2. The building controller LAN shall be subject only to the manufacturer’s published LAN limitations.
		1. Application Category 4
			1. Applications in this category include the following:
				1. Central Cooling Plant
				2. Central Heating Plant
				3. Cooling Towers
				4. Sequenced or Variable Speed Pump Control
				5. Local Chiller Control (unit specific)
				6. Local Free Cooling Heat Exchanger Control
				7. Air Handlers over 10,000 cfm or serving critical areas
			2. BCs shall be used in these applications.
	1. SITE-SPECIFIC APPLICATION PROGRAMMING
		1. Provide all database creation and site-specific application control programming as required by these Specifications, national and local standards and for a fully functioning system. Provide all initial site-specific application programming and thoroughly document programming. Generally, meet the intent of the written sequences of operation. Request clarification on sequence issues that require such clarification.
		2. All site-specific programming shall be fully documented and submitted for review and approval, both prior to downloading into the panel, at the completion of functional performance testing, and at the end of the warranty period.
		3. All programming, graphics and data files must be maintained in a logical system of directories with file names conforming to the naming standards identified in Appendix B. All files developed for the project will be the property of the USPS and shall remain on the workstation(s)/server(s) at the completion of the project.
	2. Control Unit PASSWORD SETUP
		1. Set up the following password levels to include the specified capabilities:
			1. Level 1: (Programmer)
				1. Level 2 capabilities
				2. View, add, change, and delete user names, passwords, password levels
			2. Level 2: (Operator)
				1. Level 3 capabilities
				2. Override output points
				3. Change setpoints
				4. Change equipment schedules
			3. Level 3: (Basic user)
				1. Read point values
				2. Read trend point data
		2. Provide the initial setup of all USPS’s operators by assigning user names, passwords and password levels. Provide a minimum of setup for 20 USPS users.
		3. Remove all default passwords and backdoor entry methods from all CUs before the completion and commission of the equipment.
	3. Control unit POINT PARAMETERS
		1. Provide the following minimum programming for each analog input:
			1. Name
			2. Address
			3. COV threshold
			4. Engineering units
			5. Offset calibration and scaling factor for engineering units
			6. High and low alarm values and alarm differentials for return to normal condition
			7. High and low value reporting limits (reasonableness values), which shall prevent control logic from using shorted or open circuit values.
			8. Default value to be used when the actual measured value is not reporting. This is required only for points that are transferred across the primary and/or secondary controlling networks and used in control programs residing in control units other than the one in which the point resides. Events causing the default value to be used shall include failure of the control unit in which the point resides, or failure of any network over which the point value is transferred.
		2. Provide the following minimum programming for each analog output:
			1. Name
			2. Address
			3. Engineering units
			4. Offset calibration and scaling factor for engineering units
			5. Output Range
			6. Default value to be used when the normal controlling value is not reporting.
		3. Provide the following minimum programming for each digital input:
			1. Name
			2. Address
			3. Engineering units (on/off, open/closed, freeze/normal, etc.)
			4. Message and alarm reporting as specified
			5. Reporting of each change of state, and memory storage of the time of the last change of state
			6. Totalization of on-time (for all motorized equipment status points), and accumulated number of off-to-on transitions.
		4. Provide the following minimum programming for each digital output:
			1. Name
			2. Address
			3. Engineering units (on/off, open/closed, freeze/normal, etc.)
			4. Totalization of on-time and off time and accumulated number of off-to-on transitions.
			5. Default value to be used when the normal controlling value is not reporting.
		5. Provide the following minimum programming for each virtual and calculated point:
			1. Name
			2. Address if applicable
			3. Engineering units (on/off, open/closed, freeze/normal, etc.)
			4. Status association with a DI and failure alarming (as applicable)
			5. Reporting of each change of state, and memory storage of the time of the last change of state.
			6. Totalization of on-time (for status points), and totalization for calculated values
			7. Default value to be used when the normal controlling value is not reporting.
	4. Control unit Trends
		1. Establish and store trend logs. Trend logs shall be prepared for each physical input and output point, and all dynamic virtual points such as setpoints subject to a reset schedule, intermediate setpoint values for cascaded control loops and the like, as indicated in the points list, and as directed by the USPS.
		2. Sample trends indicated as COV (±) or change-of-value mean that the changed parameter only needs to be recorded after the value changes by the amount listed.
		3. Trending intervals or COV thresholds shall be and indicated in the points list and as directed by the USPS upon system start-up.
		4. Demonstrate functional trends as specified for a period of 30 days after successful system demonstration before Substantial Completion of the system.
		5. All trend data shall be stored in the BC for a minimum of 7 days
	5. Control unit ALARMS
		1. Override Alarms: Any point that is overridden through the override feature of the graphic workstation software shall be reported as a Level 3 alarm.
		2. Analog Input Alarms: For each analog input, program an alarm message for reporting whenever the analog value is outside of the programmed alarm limits. Report a ‘Return-to-Normal’ message after the analog value returns to the normal range, using a programmed alarm differential. The alarm limits shall be individually selected based on the following criteria unless indicated differently in the sequence of operations:
			1. Space temperature, except as otherwise stated in sequence of operation: Level 3
				1. Low alarm: 64°F
				2. Low return-to-normal: 68°F
				3. High alarm: 85°F
				4. High return-to-normal: 80°F
			2. Controlled media temperature other than space temperature (e.g. AHU discharge air temperature, steam converter leaving water temperature, condenser water supply, chilled water supply, etc.): Level 3 (If controlled media temperature setpoint is reset, alarm setpoints shall be programmed to follow setpoint)
				1. Low alarm: 3°F below setpoint
				2. Low return-to-normal: 2°F below setpoint
				3. High alarm: 3°F above setpoint
				4. High return-to-normal: 2°F above setpoint.
			3. AHU mixed air temperature: Level 4
				1. Low alarm: 45°F
				2. Low return-to-normal: 46°F
				3. High alarm: 90°F
				4. High return-to-normal: 89°F
			4. Duct Pressure:
				1. Low alarm: 0.5 inch w.g. below setpoint
				2. Low return-to-normal: 0.25 inch w.g. below setpoint
				3. High alarm: 0.5 inch w.g. above setpoint
				4. High return-to-normal: 0.25 inch w.g. above setpoint
			5. Space humidity:
				1. Low alarm: 35%
				2. Low return-to-normal: 40%
				3. High alarm: 75%
				4. High return-to-normal: 70%
		3. HOA Switch Tampering Alarms: The Sequences of Operation are based on the presumption that motor starter Hand-Off-Auto (HOA) switches are in the ‘Auto’ position. [If a motorized equipment unit starts without a prior start command from the BAS, (as sensed by status sensing device), then BAS shall perform the remaining sequence as specified.] BAS shall also enunciate the following Level 5 alarm message if status indicates a unit is operational when the run command is not present:
			1. DEVICE XXXX FAILURE: Status is indicated on {the device} even though it has been commanded to stop. Check the HOA switch, control relay, status sensing device, contactors, and other components involved in starting the unit. Acknowledge this alarm when the problem has been corrected.
		4. Maintenance Alarms: Enunciate Level 5 alarms when runtime accumulation exceeds a value specified by the operator
			1. DEVICE XXXX REQUIRES MAINTENANCE. Runtime has exceeded specified value since last reset.
	6. oPERATOR wORKSTATION Control unit PASSWORD SETUP
		1. Set up the following password levels to include the specified capabilities:
			1. Level 1: (USPS’s BAS Administrator)
				1. Level 2 capabilities
				2. View, add, change and delete user names, passwords, password levels
				3. All unrestricted system capabilities including all network management functions.
			2. Level 2: (Programmer)
				1. Level 3 capabilities
				2. Configure system software
				3. Modify control unit programs
				4. Modify graphic software
				5. Essentially unrestricted except for viewing or modifying user names, passwords, password levels
			3. Level 3: (Senior HVAC Technician)
				1. Level 4 capabilities
				2. Override output points
				3. Change setpoints
				4. Change equipment schedules
				5. Exit BAS software to use third party programs
			4. Level 4: (Junior HVAC Technician)
				1. Level 5 capabilities
				2. Acknowledge alarms
				3. Temporarily override equipment schedules
			5. Level 5: (HVAC Technician Trainee)
				1. Display all graphic data
				2. Trend point data
		2. Provide the initial setup of all USPS’s operators by assigning user names, passwords and password levels. Provide a minimum of setup for [20][\_\_] USPS users.
		3. Remove all default passwords and backdoor entry methods from all OWS/CCSs before the completion and commission of the equipment.
	7. Operator Workstation TREND Graphs
		1. Prepare workstation software to display graphical format trends. Trended values and intervals shall be the same as those specified in this or related sections.
		2. Lines shall be labeled and shall be distinguishable from each other by using either different line types, or different line colors.
		3. Indicate engineering units of the y-axis values, e.g. degrees F., inches w.g., Btu/lb, percent open, etc.
		4. The y-axis scale shall be chosen so that all trended values are in a readable range. Use a secondary Y-axis to make the unit ranges compatible in the display.
		5. Trend outside air temperature, humidity, and enthalpy during each period in which any other points are trended.
		6. All points trended for one HVAC subsystem (e.g. air handling unit, chilled water system, etc.) shall be trended during the same trend period.
		7. Each graph shall be clearly labeled with HVAC subsystem title, date, and times.

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***NOTE TO SPECIFIER***

*A/E must edit the following to be project specific. Consult with USPS.*

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* + 1. See requirements for additional equipment-specific alarms specified in Section [\_\_\_\_\_\_].
		2. All alarms shall be stored in an SQL database.
	1. oPERATOR wORKSTATION GRAPHIC SCREENS

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***NOTE TO SPECIFIER***

*A/E may provide drawings to the Contractor for developing backgrounds for graphic screens. Edit the following to suit the project.*

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* + 1. Floor Plan Screens:
			1. Provide graphic floor plan screens for each [floor] [wing] [tower] [other] of the building. Indicate the location of all equipment that is not located on the equipment room screens. Indicate the location of temperature sensors associated with each temperature-controlled zone (i.e., VAV terminals, fan-coils, single-zone AHUs, etc.) on the floor plan screens. [Zone background color shall change based on the temperature offset from setpoint]. Display the space temperature point adjacent to each temperature sensor symbol. Use a distinct line symbol to demarcate each terminal unit zone boundary. Use distinct colors to demarcate each air handling unit zone. Indicate room numbers as provided by the USPS. Provide a drawing link from each space temperature sensor symbol and equipment symbol shown on the graphic floor plan screens to each corresponding equipment schematic graphic screen.
			2. Provide graphic floor plan screens for each mechanical equipment room and a plan screen of the roof. Indicate the location of each item of mechanical equipment. Provide a drawing link from each equipment symbol shown on the graphic plan view screen to each corresponding mechanical system schematic graphic screen.
			3. If multiple floor plans are necessary to show all areas, provide a graphic building key plan. Use elevation views and/or plan views as necessary to graphically indicate the location of all of the larger scale floor plans. Link graphic building key plan to larger scale partial floor plans. Provide links from each larger scale graphic floor plan screen to the building key plan and to each of the other graphic floor plan screens.
			4. Provide a graphic site plan with links to and from each building plan.
		2. System Schematic Screens: Provide graphic system schematic screen for each HVAC subsystem controlled with each I/O point in the project appearing on at least one graphic screen. System graphics shall include flow diagrams with status, setpoints, current analog input and output values, operator commands, etc. as applicable. General layout of the system shall be schematically correct. Input/output devices shall be shown in their schematically correct locations. Include appropriate engineering units for each displayed point value. Verbose names (English language descriptors) shall be included for each point on all graphics; this may be accomplished by the use of a pop-up window accessed by selecting the displayed point with the mouse. Indicate all adjustable setpoints on the applicable system schematic graphic screen or, if space does not allow, on a supplemental linked-setpoint screen.
			1. Provide graphic screens for each air handling system. Indicate outside air temperature and enthalpy, and mode of operation as applicable (i.e., occupied, unoccupied, warm-up, cool-down). Link screens for air handlers to the heating system and cooling system graphics. Link screens for supply and exhaust systems if they are not combined onto one screen.
			2. Provide a graphic screen for each zone. Provide links to graphic system schematic screens of air handling units that serve the corresponding zone.
			3. Provide a cooling system graphic screen showing all points associated with the chillers, cooling towers and pumps. Indicate outside air dry-bulb temperature and calculated wet-bulb temperature. Link screens for chilled water and condenser water systems if they cannot fit onto one cooling plant graphic screen.
			4. Link screens for heating and cooling system graphics to utility history reports showing current and monthly electric uses, demands, peak values, and other pertinent values.
		3. Bar Chart Screens: On each graphic Bar Chart Screen, provide drawing links to the graphic air handling unit schematic screens.
			1. Provide a graphic chilled water valve screen showing the analog output signal of all chilled water valves in a bar chart format, with signals expressed as percentage of fully open valve (percentage of full cooling). Indicate the discharge air temperature and setpoint of each air handling unit, cooling system chilled water supply and return temperatures and the outside air temperature and humidity on this graphic. Provide drawing links between the graphic cooling plant screen and this graphic screen.
			2. Provide a graphic heating water valve screen showing the analog output signal of all air handling unit heating water valves in a bar chart format, with signals expressed as percentage of fully open valve (percentage of full heating). Indicate the temperature of the controlled medium (such as AHU discharge air temperature or zone hot water supply temperature) and the associated setpoint and the outside air temperature and humidity.
		4. Alarms: Each programmed alarm shall appear on at least one graphic screen. In general, alarms shall be displayed on the graphic system schematic screen for the system that the alarm is associated with (for example, chiller alarm shall be shown on graphic cooling system schematic screen). For all graphic screens, display analog values that are in a ‘high alarm’ condition in a red color, ‘low alarm’ condition in a blue color. Indicate digital values that are in alarm condition in a red color.

END OF SECTION

USPS MPF Specification Last Revised: 10/1/2022