

SECTION 23 09 22 - CLIMATE MANAGEMENT CONTROL FOR HVAC

PART 1 - GENERAL

1.00 RELATED SECTIONS

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section. The Contractor is bound by the provisions of Division 0 and Division 1.

1.01 CONTROL SYSTEM DESCRIPTION:

- A. The Building Automation System (BAS) shall be as specified in the drawings and this document. The system shall include a network of commercial, Internet-programmable thermostats, accessories, and required networked devices for climate management. Devices shall communicate via a wireless IEEE 802.15.4 mesh network, automatically establishing network addresses and communication routes.
- B. A single Ethernet-connected Gateway shall be capable of connecting the wireless mesh network to the Internet, enabling climate management via a cloud-based web application. The BAS shall remain isolated from the owner's private LAN/WiFi network. The Gateway shall connect via an outbound Ethernet connection over TCP/IP, requiring no inbound firewall port assignments, public IPs, or standard operating systems like Windows or Linux.
- C. BAS access and control shall be via a web-based platform hosted on a cloud server, accessible from local and remote HTML5-supported web browsers. No on-site servers, licensing fees, or future upgrade fees shall be required.
- D. The BAS shall allow unlimited simultaneous users with role-based security managed by owner site Administrators.

1.02 APPROVED BUILDING AUTOMATION SYSTEM MANUFACTURERS

- A. Pelican Wireless Systems

1.03 SUBMITTALS

- A. The Contractor shall provide shop drawings and manufacturer data sheets for all hardware. Work shall not commence until the Engineer and Owner have reviewed submittals for compliance.

- B. Submittals shall be provided in a three-ring binder or digitally on a USB drive, including a table of contents and section tabs. Five (5) copies shall be submitted to the Architect or Engineer.

- C. Shop drawings shall include floor plans indicating equipment locations, wiring details, and necessary power/data connections. The Engineer will review, request corrections, and require resubmission as needed.

1.04 SYSTEM STARTUP & COMMISSIONING

- A. Each BAS component shall be tested for hardware and software functionality. Mechanical and electrical systems under BAS control shall be tested per the specified sequence of operations. The Contractor shall document installation, testing completion, and any unrelated mechanical issues.

- B. The BAS Contractor shall provide manpower and engineering services to assist the HVAC and Balancing Contractors in testing, adjusting, and balancing all systems. A trained technician shall be available as needed during balancing. Three (3) copies of record documents shall be submitted post-installation, including:
 - 1. Testing and Commissioning Reports and Checklists signed complete by trained field commissioning personnel.

 - 2. Name, address and telephone number of Contractor personnel managing and installing equipment, along with service personnel responsible for supporting the ongoing warranty and services of the control system.

 - 3. BAS operation procedures, including, but not limited to:
 - a. Adding Administrators and Users.
 - b. Setting Password Requirements that meet customer's security levels.
 - c. Users Logging On and Off.
 - d. Notification review, resolution, and management.
 - e. Reading real-time and historical reports and graphical trends.
 - f. Modification of setpoints, equipment operations, and other climate related functions.

- g. Normally Occupied/Unoccupied Scheduling, Event Scheduling, and Vacation Calendar.
- h. and other interactive system requirements.

- 4. Provide details on how to receive support from the BAS manufacturer, emphasizing that they are to be a direct support resource on utilizing, evaluating, and assisting with BAS related functions and features. Include contact information for how to reach the manufacturer's technical resources and support departments.

1.05 CODES AND STANDARDS The system shall comply with applicable codes, including:

- A. California 2022 Title 24
- B. California Energy Commission Occupant Control Smart Thermostat (OCST) certification
- C. OpenADR 2.0 certification

1.06 TRAINING The BAS Contractor shall provide training for two (2) owner representatives or maintenance personnel. Training shall be a minimum of one (1) hour and shall cover the following topics:

- A. System Architecture Overview: Including, but not limited to, wireless communication, wireless networking, application network mapping, repeater and gateway locations, and their functions.
- B. System Maintenance: Covering annual testing and evaluation of BAS performance, hardware assessment and diagnostics, electrical output verification between hardware and equipment, availability of technical resources, and the warranty process.
- C. User Access: Instruction on adding or removing users, setting complex passwords and enabling two-factor authentication, signing in and out, and accessing the web application across various web-connected devices.

- D. BAS Web Application Features: Including an overview of main climate control groups, individual device control sections, administrative settings, scheduling dashboards, usage and historical graphs, notifications, advanced controllers, device configurations, and network maps.

- E. Equipment Maintenance Evaluation: Guidance on utilizing the BAS to assess mechanical equipment maintenance needs and determine whether issues originate from the equipment or the BAS.

1.07 OPERATION AND MAINTENANCE MANUALS

- A. The BAS Contractor shall provide manuals covering system operation, maintenance, installation, warranty and replacement. As-built documentation reflecting final installation shall be submitted after project completion.

1.08 WARRANTY

- A. The BAS Contractor shall warrant the system for 12 months following system acceptance and beneficial use by the owner. During this warranty period, the BAS Contractor shall be responsible for all necessary revisions to ensure a complete and functional system in accordance with the letter and intent of the Sequence of Operation outlined in the specifications.

- B. The manufacturer shall provide a five (5) year limited warranty for equipment, covering replacement of defective products.

1.09 WORK BY OTHERS

- A. The BAS Contractor shall coordinate with other contractors prior to performing work on this project and shall cooperate as necessary to ensure a complete and orderly installation. Each contractor shall review the drawings and specifications for all trades to understand the scope and impact of others' work before proceeding with fabrication and installation. If any conflicts arise between trades, the BAS Contractor shall immediately notify the owner's representative before fabrication and installation. Additionally, the BAS Contractor shall provide field supervision to the Mechanical Contractor for the pre-installation of control components.

- B. Low-voltage thermostat wiring between equipment and thermostat locations shall be furnished and installed by others. Unless otherwise specified, all new low-voltage wiring shall consist of multiple-conductor thermostat wiring, with wire counts as indicated in the

Thermostat Manufacturer's Installation Instructions and installed per the owner's specifications. For existing installations, wiring shall meet a minimum standard of three (3) conductor, 18-gauge wires per the BAS manufacturer's specifications, with multiple-conductor, 18-gauge thermostat wiring preferred. Specific conductor counts shall be determined based on the heating and cooling modes of the existing equipment, as outlined in the Installation Instructions.

C. Related Work Provided by Others:

1. Electrical: A 110V outlet shall be provided within five (5) feet of each Gateway or Wireless Repeater location.
2. Networking: One (1) Ethernet data port shall be provided within ten (10) feet of each Gateway location.

D. Mechanical equipment start-up and ongoing servicing shall be performed by others or the Controls Contractor, as agreed upon through contractor-client relations.

1.11 SCOPE OF WORK

- A. Except where otherwise noted, the EMS shall consist of a wireless network of commercial Internet-programmable thermostats, their accessories, and any other wireless networked climate management devices required to fulfill the intent of the specifications and sequence of operations, ensuring a complete and operable system.
- B. The BAS Contractor shall review and assess existing building/site conditions, where applicable, as well as all new construction drawings for the project, including HVAC drawings and the entire project specifications. This review is necessary to familiarize themselves with the equipment and system operation prior to bidding and submitting a price. Any conflicts between the project requirements and the scope of work outlined in this section, including work designated to be completed by others, shall be reported to the owner immediately.
- C. All equipment and the installation of control devices associated with the equipment listed below shall be provided under this BAS Contractor.

- D. Upon full installation and operational readiness of the BAS, the BAS Contractor shall be available to meet with the designated representatives of the owner to review the as-installed condition of the system. At this time, the BAS Contractor shall demonstrate the system's operation and confirm compliance with the intent of the drawings and specifications.

- E. The BAS Contractor shall furnish and install a complete BAS control system, including all necessary hardware and all operating and application software required to execute the specified control sequences of operation.
 - 1. Provide and install BAS controls for all HVAC equipment as indicated in the project drawings.
 - 2. Provide technical support necessary for system commissioning in coordination with the HVAC Contractor, Balancing Contractor, and the owner's team.
 - 3. Conduct training sessions as specified in other sections of this agreement.

- F. All work performed under this section of the specifications shall comply with all applicable codes and regulations as mandated by the authority having jurisdiction.

PART 2 - PRODUCTS

2.00 ACCEPTABLE MANUFACTURERS

- A. Unless otherwise specified, all products shall be sourced from a single manufacturer. The standard for design and quality shall be based on products manufactured by Pelican Wireless Systems.

2.01 COMMUNICATION

- A. The BAS shall consist of a network of devices utilizing an IEEE 802.15.4 self-creating and self-healing wireless mesh communication network to connect to an Ethernet Gateway.

- B. The Gateway shall communicate with cloud servers via a single Ethernet connection within the owner's wide area network (WAN) using a TCP/IP connection. The facility's firewall shall not require any inbound port assignments for the Gateway to establish a connection with the cloud servers. Additionally, the Gateway shall not require a public IP address.

- C. No BACnet, Modbus, LON, or any other wired device-to-device communication protocol shall be used within the communication network.

2.02 OPERATOR INTERFACE

- A. The BAS shall be controlled, managed, and configured using a Web-App on any personal computer, smartphone, and/or tablet that runs a browser with HTML5 or newer.

- B. The Web-App platform shall run on cloud servers which allow for virtual access. The platform shall not run on a local on-site server.

- C. The Web-App shall support, at a minimum, the following functions:

1. Personal user log-on identifications (email addresses) and unique passwords, with the allowance of complex passwords and two-factor authentication, shall be required.
2. Custom HTML programming shall not be required to display any graphics, data, or build the Web-App. There shall be no development cost, commissioning costs, or software upgrade cost required to obtain and use the Web-App.
3. Storage of historical data shall reside on the cloud server and shall not sit within the client's computer, internal network, or other devices. A BAS that requires on-site data storage is not acceptable.
4. System shall allow for administrator and user-defined access privileges.
5. A Push/Pull OpenAPI interface with XML data output shall be available.
6. Servers shall not run a Windows operating system.

- D. Control and Override

1. The BAS shall provide view, override, and edit capabilities for the status of any object and property in the system. The status of the device shall be defined graphically and shall not require any custom programs or programming.
2. The BAS shall be able to provide temporary override functionality (wherever an override is allowed) and automatically revert back to scheduled operation after a specified period of time.
3. Any override and edit of an object, virtually or at the device, if allowable, shall be historically tracked.

- E. Scheduling

1. The BAS shall provide users with scheduling of application devices through a graphical interface. Scheduling shall include, but is not limited to:

- a. Occupied/Unoccupied Schedules: Shall allow 12 scheduled set-time changes in a single day, be configurable for Daily, Weekly, and Weekday/Weekend layouts, and shall be able to be unique to individual devices or easily shared between multiple devices, where applicable.
- b. Event Schedules: Shall allow for advanced one-time or repeating event-type schedules. Event schedules shall override Occupied/Unoccupied Schedules. After the Event schedule ends, the device shall revert back to the Occupied/Unoccupied Schedule automatically.
- c. Vacation Schedules: A 360-day calendar shall provide override of schedules during vacation days. Thermostats shall be able to automatically or be manually switched to follow Vacation Schedules instead of Occupied/Unoccupied Schedules.

F. Alarm Notification

1. Alarm Notification(s) shall be generated if failures are detected by devices that are part of the BAS. These failures shall include, but are not limited to, temperature deviations, temperatures missing targets, temperatures too high or too low, equipment failures, etc. Alarm Notification(s) shall be posted on the BAS and shall be able to be sent either via email or text message to an unlimited number of users.

G. Reports and Logs

- a. Data shall be logged and stored on cloud servers for all devices that are part of the BAS in real time. Every device real-time "state change," when applicable, shall be stored and viewable for at least one (1) week, with the option of up to two (2) years.
- b. Data logging shall include, but not be limited to:
 1. Each space temperature
 2. Each temperature set point(s)
 3. Each current call: heat, cool, number of stages, fan, economizer, etc.
 4. Each damper position
 5. Each valve position
 6. Each CO₂ change
 7. Each CO₂ setting
 8. Each current call for ventilation due to high CO₂

9. Each humidity change
 10. Each humidity set point
 11. Each current call for dehumidification or humidification
 12. Each fan speed adjustment
 13. Supply duct static pressure
 14. Supply, return, and outside air temperatures
- c. Historical data shall be represented on historical graphs that allow for easy viewing of device state changes over time. Excel outputs shall not be required to view data. Historical data shall be viewable through the BAS.

2.03 APPLICATION-SPECIFIC CONTROLLERS

A. Application-Specific Controllers shall not require custom programming and shall control specific equipment through simple configuration settings done through the cloud-based BAS. All configuration changes shall automatically upload into the device once set on the BAS and shall be stored by the device's internal memory.

B. Gateways

1. Gateways are devices that connect to an Ethernet port and act as a bridge between the BAS cloud servers and the wireless mesh network.
2. Shall be capable of providing Internet connection to up to 2,000 devices.
3. Shall be capable of automatically addressing routing tables to all devices within the wireless mesh network and shall not require manual programming or addressing.
4. Shall communicate with cloud servers over a TCP/IP outbound-only connection.
5. Shall not require a Public IP address, custom VPNs, or any on-site servers.
6. Shall communicate with other BAS devices over a dedicated and isolated wireless 802.15.4 IEEE technical standard.
7. Shall be secured using AES (Advanced Encryption Standards).

C. Internet-Enabled Thermostats

1. Internet-Enabled Thermostats are controllers that detect space/zone temperature and operate equipment or dampers that supply heating, cooling, ventilation, or a combination of these functions. Examples include thermostats for VAV, VVT,

- Fan-Powered Boxes, Fan Coils, Blower Coils, Unit Ventilators, Heat Pumps, Water Source Heat Pumps, and Conventional DX and/or Gas heat equipment.
2. Shall be capable of providing 24VAC outputs configurable to control:
 3. Two stages of fan, three stages of cooling, two stages of heating, and one stage of auxiliary heat (heat pumps).
 4. Floating point zone dampers, two-position zone dampers, floating point zone reheat valves, and two-position zone reheat valves.
 5. Shall include a removable wiring terminal module to allow installation in situations where only three wires are available between the equipment and the thermostat location.
 6. Shall be available with the following internal sensors:
 - a. Temperature Only.
 - b. Temperature and Relative Humidity.
 - c. Temperature and Carbon Dioxide (CO₂).
 - d. Temperature, Relative Humidity, and Carbon Dioxide (CO₂)
 7. All sensors required by the specifications shall be internal to the thermostat and shall not require an additional device on the wall.
 8. Shall support expansion accessories to enable advanced control sequences and additional temperature detection, including:
 - a. Economizer controllers, outside air ventilation control, supply air temperature detection, unit ventilator face/bypass control, and modulating control.
 9. All expansion accessories shall be Internet-enabled and accessible through the EMS.
 10. Shall communicate with the wireless mesh network via an internal wireless antenna operating on the 802.15.4 technical standard.
 11. Shall be capable of automatically repeating the wireless mesh network to additional BAS devices.
 12. Shall push all "state changes" in real-time to the BAS, making historical and real-time data available, including:
 13. Equipment operation (heat, cool, fan), number of active stages, space temperatures, damper positions, valve positions, and temperature setpoints.
 14. Shall support heat pump compressor lock-out based on outside air temperature.
 15. Shall allow setpoint (heat & cool) temperature limitations through the BAS.
 16. Shall provide full local keypad lock-out from the BAS.
 17. Shall meet California 2022 Title 24 code standards.
 18. Shall include a 3°F heat/cool dead band temperature range that auto-adjusts to a 5°F as needed to prevent heat and cool fighting.
 19. Shall provide independent heat and cool setpoints with auto-changeover functionality.
 20. Shall incorporate an Optimum Start algorithm that calculates start times based on at least seven (7) days of previous runtime temperature and rate-of-change historical data. The algorithm shall automatically recalculate before each optimized schedule time.

21. Shall allow manual overrides through the BAS.
22. Shall be configured through the BAS.

D. Wired Temperature Inputs

1. Wired Temperature Inputs shall be available for external temperature detection for BAS devices, including supply air temperature, water temperature, refrigeration temperature, and outside air temperature.
2. Shall accept 10K Type II thermistors.
3. Shall push real-time temperature changes to the BAS for historical and real-time viewing.
4. Shall support thermistor connections up to 100 feet from the input terminal.
5. Shall be configured through the BAS.

E. Internet-Enabled Economizer Controller

1. Internet-Enabled Economizer Controllers shall modulate outside air dampers to provide ventilation and economization to a single zone.
2. Shall require only a dry-bulb outside air temperature sensor and a dry-bulb supply air temperature sensor. No additional return or mixing box sensors shall be required to meet California 2022 Title 24 standards.
3. Shall communicate with the thermostat to determine space temperature and setpoint for economization.
4. Shall continue economization as the only source of cooling as long as the outside air temperature maintains the space temperature within 1°F of the cooling setpoint.
5. Shall enable mechanical cooling while economization is active.
6. Shall determine outdoor enthalpy values using Internet-based humidity and barometric pressure data based on installation location ZIP code. No additional outdoor enthalpy sensors shall be required.
7. If connected to a CO₂ thermostat, shall provide demand-controlled ventilation.
8. Shall include minimum and maximum ventilation damper positions.
9. Shall support scheduling to disable ventilation during unoccupied hours.
10. Shall provide up to five (5) variable frequency drive (VFD) fan speed inputs for different operating modes.
11. Shall modulate an outside air damper via a 0-10VDC control signal.
12. Shall accept a 0-10VDC feedback signal from the damper actuator for status confirmation.
13. Shall comply with California 2022 Title 24 Fault Detection and Diagnostics (FDD) requirements and report FDD data to the BAS.
14. Shall accept at least three (3) 10K Type II thermistors.
15. Shall modulate heating and cooling systems via 0-10VDC control signals.
16. Shall support face/bypass damper control.
17. Shall allow manual overrides through the BAS.
18. Shall be configured through the BAS.

19. Shall push real-time and historical "state changes" to the BAS, including:
 - a. Equipment operation (heat, cool, fan, economization, ventilation), active stages, supply/return/outside air temperatures, valve positions, fan speeds, and damper positions.

F. Internet-Enabled Power Relay Module

1. Power Relay Modules shall provide dry-contact relays for starting/stopping electrical equipment such as exhaust fans, lights, pumps, valves, boilers, and chillers.
2. Shall support relays with a maximum rating of 120VAC @ 15A or 240/277VAC @ 10A.
3. Shall include a low-voltage terminal for momentary contact override inputs, with configurable override duration through the BAS.
4. Shall support Lead/Lag sequencing between relays.
5. Shall accept an external dry-contact input for flow verification when controlling pumps. If used in a lead/lag configuration, the module shall alarm the BAS if flow is not detected on Pump A and start Pump B as a backup.
6. Shall communicate with the wireless mesh network via an external antenna operating on the 802.15.4 technical standard.
7. Antenna communication to the Power Relay Module shall be supported over three (3) 18-gauge wires up to 500 feet from device terminals.
8. Shall automatically repeat the wireless mesh network to additional BAS devices.
9. Shall push real-time and historical "state changes" to the BAS, including relay positions (On/Off).
10. Shall allow manual overrides through the BAS.
11. Shall be configured through the BAS.

G. Zoned Air Handler Controllers

1. Zone Air Handler Controllers are controllers that operate equipment supplying heating, cooling, and ventilation, or a combination of these functions, to multiple zones.
2. Shall communicate with the wireless mesh network through a removable wireless antenna that runs on the 802.15.4 technical standard.
3. Remote mountable antenna shall be able to communicate with the Zone Controller over three (3) 18-gauge wires up to 500 feet between device terminal inputs.
4. Communication from the Zone Controller to all zone/space Thermostats shall be over the wireless mesh network.
5. Shall be capable of providing 24VAC outputs configurable for multiple fan stages, cooling stages, and heating stages.
6. Shall be capable of providing 0-10VDC outputs configurable for variable speed fans (VFD), modulating outside air dampers, and modulating heating valves.

7. Shall have integrated outside air damper control logic and not require additional controllers for economization and ventilation control.
8. Shall directly accept a supply duct static pressure probe and incorporate a learning PID loop algorithm for maintaining target supply static configurations.
9. Shall only require dry-bulb outside, return, and supply air temperature sensors.
10. If communicating with CO₂ thermostat(s), shall provide demand-controlled ventilation of outside air dampers.
11. Shall push all “state changes” to the BAS for real-time and historical viewing.
12. Shall be manually overridden through the BAS.
13. Shall be configured through the BAS.

H. Wireless Repeaters

1. Wireless Repeaters are devices that extend the 802.15.4 wireless mesh network across large expanses or where BAS devices cannot repeat the network on their own. Examples include bridging the wireless mesh network between buildings.
2. Shall communicate using two wireless spectrums: 2.4GHz and 900 MHz
3. Shall communicate with the wireless mesh network through internal wireless antennas using the 802.15.4 technical standard.
4. Shall automatically repeat the wireless mesh networks to additional BAS devices.
5. Shall not require an Ethernet or TCP/IP connection.

I. Remote Wireless Sensors

1. Remote Wireless Sensors are thermostat accessories that are used to either average temperatures between the sensor's location and a master thermostat or to relocate the sensing location of the master thermostat without having to run new wire.
2. Shall be able to communicate to a single Internet-Programmable Thermostat over the wireless mesh network.
3. Shall communicate with the wireless mesh network through an internal wireless antenna that runs on the 802.15.4 technical standard.
4. Shall run on two AA batteries and not require any unique type of battery to operate.
5. Shall push all “state changes” to the BAS as to be viewable historically and in real-time from the BAS. Examples are changes in equipment operation (heat, cool, fan), number of stages active, the temperatures in the space, temperature set-points, etc.
6. Shall be configured through the BAS.

J. Wireless Proximity Sensors

1. Wireless Proximity Sensors are thermostat accessories that are able to detect when a door or window is opened or closed or accept a dry-contact input from an occupancy sensor.

2. Shall be able to communicate to a single Internet-Programmable Thermostat over the wireless mesh network.
3. Shall communicate with the wireless mesh network through an internal wireless antenna that runs on the 802.15.4 technical standard.
4. Shall run on two AA batteries and not require any unique type of battery to operate.
5. Shall push all “state changes” to the BAS as to be viewable historically and in real-time from the BAS. Examples include if the door is open, if the space is unoccupied, and if a window is open.
6. Shall be configured through the BAS.

K. Make-up Air Controllers

1. Make-up Air Controllers operate equipment supplying ventilation to the building.
2. Shall communicate with the wireless mesh network through a removable wireless antenna that runs on the 802.15.4 technical standard.
3. Communication from the Controller to zone/space Thermostat(s) shall be over the wireless mesh network.
4. Shall be capable of providing 24VAC outputs configurable for multiple fan stages, cooling stages, and heating stages.
5. Shall be capable of providing 0-10VDC outputs configurable for modulating variable speed fans (VFD), modulating outside air dampers, modulating heating, and modulating cooling.
6. Shall be able to modulate a VFD to maintain a targeted static pressure.
7. Shall be able to modulate a 0-10VDC hot water, steam, or electric SCR for heating and outside air tempering.
8. Shall be able to modulate a 0-10VDC chilled water or modulating DX for cooling and outside air tempering.
9. Shall have integrated outside air damper control.
10. Shall only require dry-bulb outside and supply air temperature sensors.
11. If communicating with CO₂ thermostat(s), shall be able to provide demand-controlled ventilation of the outside air damper.
12. Shall push all “state changes” to the BAS for real-time and historical viewing. Examples include changes in equipment operation (heat, cool, fan, economization, ventilation), number of stages active, supply air temperature, return air temperature, outside air temperature, hot water valve position, supply duct static reading, and variable speed fan setting.
13. Shall be configured through the BAS.

L. Configuration of Devices and System

1. To meet the sequence of operation for each controller, all configuration shall be performed through the BAS by the installing contractor. No custom programming or external service tools shall be required.

2. After configured, each piece of equipment shall operate independently and shall not require a web connection or BAS communication for normal operation.

PART 3 EXECUTION

3.00 EXAMINATION

- A. The Contract Documents shall be thoroughly examined for coordination of control devices, their installation, wiring, and commissioning. Coordinate and review mechanical equipment specifications, locations, and identify any discrepancies, conflicts, or omissions that shall be reported to the Architect/Engineer for resolution before rough-in work is started.
- B. The BAS manufacturer shall be available to provide assistance to the BAS Contractor to verify that control equipment can be installed as required. Any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.

3.01 PROTECTION

- A. The BAS installing contractor shall protect all work and materials from damage by their work or personnel and shall be liable for all damage thus caused.
- B. The BAS installing contractor shall be responsible for their work and equipment until final inspection, testing, and acceptance. The BAS installing contractor shall protect their work against theft or damage and shall carefully store material and equipment received on-site that is not immediately installed. The contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.
- C. Installation of the BAS shall be performed by an approved contractor. An approved contractor is one who either has installed the BAS before or has been approved by the BAS manufacturer. The contractor shall certify all work as proper and complete. Under no circumstance shall the design, scheduling, coordination, programming, training, and warranty requirements for the project be delegated to a subcontractor unless that subcontractor meets the BAS-approved contractor requirements as stated above.**
- D. Demolition
 1. Remove controls that do not remain as part of the BAS. The owner will inform the contractor of any equipment to be removed that will remain the property of the owner. All other removed equipment shall be disposed of by the contractor.

E. Access to Site

1. Unless notified otherwise, entrance to the building is restricted. No one will be permitted to enter the building unless their names have been cleared with the owner or an owner-approved representative.

F. Code Compliance

1. All wiring shall be installed in accordance with all applicable electrical codes and shall comply with equipment manufacturer's recommendations.

G. Clean Up

1. During installation, the contractor shall maintain a clean environment. At the completion of the work, all equipment pertinent to this contract shall be checked and thoroughly cleaned, and all surrounding areas shall be cleaned around equipment provided under this contract.

3.02 TEST AND BALANCE

- A. Testing of controls shall be performed by the installing contractor. All equipment and their components being controlled shall be tested, including, but not limited to: heating enables and a proper supply air temperature from the AHU, RTU, and into the zone (if there is a zone box) is recorded, cooling enables and a proper supply air temperature from the AHU, RTU, and into the zone (if there is a zone box) is recorded, fan enables and the proper fan speed is set when specified (when using a multiple-speed fan, VFD, or ECM motor), and that the outside air damper fully opens and closes when commanded. Any devices that are enabled and disabled shall properly respond to the BAS control signals.
- B. All control configurations shall be set to meet specifications. All temperatures and other sensors shall be determined accurate and configured for the type of temperature being detected.
- C. All mechanical systems controlled by BAS shall be properly balanced to the right CFMs to meet required codes and specifications.

3.03 WIRING, CONDUIT, AND CABLE

- A. All control wires between mechanical equipment and BAS devices are to be furnished and installed by others, unless the BAS contractor is responsible for this part of the installation. The BAS contractor shall not begin work on this contract until all wiring is installed to the satisfaction of the BAS contractor.

- B. It is not an excuse to have not referenced the manufacturer's installation documentation or to have contacted the BAS manufacturer if wire installation is not understood and done incorrectly by the installing contractor.

3.04 HARDWARE INSTALLATION

- A. Installation Practices for Devices. All devices are to be mounted level/plumb and per the manufacturer's installation documentation.

- B. It is not an excuse to have not referenced the manufacturer's installation documentation or to have contacted the BAS manufacturer if hardware installation is not understood and done incorrectly by the installing contractor.

- C. Identification.
 - 1. Identify all control wires with labeling tape or sleeves using either words, letters, or numbers that can be exactly cross-referenced with as-built drawings.
 - 2. All field enclosures, other than controllers, shall be identified with a nameplate. The lettering shall be in white against a black or blue background.
 - 3. Junction box covers will be marked to indicate that they are a part of the BAS.
 - 4. All field devices (except space sensors) that are not mounted within FIP's shall be identified with nameplates.
 - 5. All field devices inside FIP's shall be labeled.

- D. Existing Controls. Existing controls are not to be reused. All BAS devices will be new.'

- E. Control System Switch-Over. The installing contractor shall minimize control system downtime during switch-over. Sufficient installation mechanics will be on-site so that the entire switch-over can be accomplished in a reasonable time frame.

- F. Location.
 - 1. The location of sensors is as indicated in the mechanical and architectural drawings.
 - 2. Space temperature, humidity, and CO² sensors will be mounted away from machinery generating heat, direct light, and/or diffuser air streams.

3. If external temperature sensors are installed, sensors will be mounted away from machinery generating heat, direct light, and/or diffuser air streams.
4. If outdoor air temperature sensors are installed, sensors are to be installed such that the effects of heat radiated from the building or sunlight are minimized.

3.05 SYSTEM CONFIGURATION

- A. General. The installing contractor shall provide all labor necessary to install, initialize, start up, and troubleshoot all system hardware and configurations described in this section. This includes any requirements necessary to access the web application on third-party devices.

- B. The installing contractor shall work with the owner's representative to determine configuration parameters including but not limited to hours of operation, set points, system variables, naming of devices, and site naming. Naming of devices and the site shall be performed by the installing contractor. Naming convention of space thermostats shall be the space served. Naming convention of zone controllers shall be the equipment serial number. All naming shall be provided by or agreed upon with the owner.

3.06 SYSTEM COMMISSIONING AND SYSTEM START-UP

- A. Each BAS component in the system shall be tested for both hardware and software functionality. In addition, each mechanical and electrical system under control of the BAS will be tested against the appropriate sequence of operation specified herein. Documentation shall be provided to the owner that proves installation and testing have been completed and points out any mechanical issues found that are not related to the installation of the BAS. Successful completion of the system tests shall constitute the beginning of the warranty period.

- B. The BAS Contractor shall provide all manpower and engineering services required to assist the HVAC Contractor and Balancing Contractor in testing, adjusting, and balancing all systems in the building. The BAS Contractor shall have a trained technician available on request during the balancing of the systems. The BAS Contractor shall coordinate all requirements to provide a complete air balance with the Balancing Contractor and shall include all labor and materials in his contract to assist with functional testing of the system as it relates to BAS.

- C. Upon completion of installation, submit three (3) copies of record documents. The documents shall be submitted for approval prior to final completion and include:

1. Testing and Commissioning Reports and Checklists signed off by trained field commissioning personnel.
2. Name, address, and telephone number of contractor personnel managing and installing equipment, along with service personnel responsible for supporting the ongoing warranty and services of the control system.
3. Procedures for operating the BAS including logging on/off, alarm management, reading reports, trends, modification of setpoints, scheduling, and other interactive system requirements.
4. Provide information on how to receive support from Pelican Wireless Systems and demonstrate that they are a direct supporting resource. Contact information for Technical Support from Pelican Wireless Systems is to be provided.

END OF SECTION