SECTION 23 09 22 - CLIMATE MANAGEMENT CONTROL FOR HVAC

PART 1 GENERAL

 1.0 RELATED SECTIONS

1. 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 as part of the contract documents. Consult the above for further instructions pertaining to this work. The Contractor is bound by the provisions of Division 0 and Division 1.

 1.01 CONTROL SYSTEM DESCRIPTIONS

1. The Building Automation System (BAS) shall be as indicated on the drawings and described in these specifications. System shall include a network of commercial Internet-programmable thermostats, their accessories, and any other networked devices required for complete climate management. Devices shall communicate across a wireless network using IEEE 802.15.4 technical standards. Wireless communication shall be of an automated mesh communication type, which self-establishes network addresses, communication routes, and all other setup requirements to establish connection across the entire campus. A single Ethernet-connected Gateway shall be able to connect the wireless mesh network to the Internet, allowing for climate management through a cloud based web-application. This network design is to be used to isolate the BAS from the owner’s private Ethernet network (LAN) and/or WiFi networks. IEEE 802.11 or any other wireless standard of communication or a wired network communication protocol between devices is not acceptable by these BAS specifications. The Gateway is to connect to a single outbound Ethernet connection on the owner’s wide area network (WAN) over a TCP/IP connection. The owner’s firewall shall not require any inbound port assignments for the Gateway to connect to the cloud servers. The Gateway shall not require a Public IP and it shall not run any standard available operating systems, such as Windows or Linux.
2. Access and control of BAS shall be through a web-based graphical management platform. The BAS platform shall sit on a cloud server and be accessible on both local personal computers and remotely by use of a web-browser that supports HTML5 or later.
3. No on-site servers are to be installed or used for the BAS. No licensing fees or future licensing fees shall be required as part of the BAS. These specifications and guidelines are to create a cohesive and secure network that provides full management over the facility’s climate through the cloud BAS.
4. The BAS shall accommodate an unlimited simultaneous multiple-user operation. Access to the BAS shall be limiting based on security permissions of each operator’s role managed by owner site Administrators.

1.02 APPROVED BUILDING AUTOMATION SYSTEM MANUFACTURERS

1. Pelican Wireless Systems

 1.03 SUBMITTALS

1. Shop drawings and manufacturer's standard specification data sheets on all hardware shall be provided for this project. No work may begin on any segment of this project until the Engineer and Owner have reviewed submittals for conformity with the plan and specifications.
2. All submittals shall be bound, in a three-ring binder, or provided digitally on a USB stick with a table of contents and related section tabs. Five (5) copies shall be submitted to the Architect or Engineer for distribution and review.
3. Shop drawings shall include basic floor plans depicting locations of all equipment and wiring (installed by others) to be controlled by system and locations of thermostats, gateways, and other equipment provided under this section. Drawings shall also show location of electrical power, low voltage wiring and data ports, provided by others, required for proper installation of systems of this section.
4. Submit five (5) copies of submittal data and shop drawings to the Engineer for review prior to ordering or fabrication of the equipment. The Contractor prior to submitting shall check all documents for accuracy.
5. The Engineer will make corrections, if required, and return to the Contractor. The Contractor will then resubmit with the corrected or additional data. This procedure shall be repeated until all corrections are made to the satisfaction of the Engineer and the submittals are fully approved.

 1.04 SYSTEM STARTUP & COMMISSIONING

1. 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 has been completed and points out any mechanical issues found which are not related to the installation of the BAS. Successful completion of the system tests shall constitute the beginning of the warranty period.
2. 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 system as it relates to the BAS.
3. 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 communicate that they are a direct supporting resource. Contact information for Technical Support from Pelican Wireless Systems is to be provided.

 1.05 CODES AND STANDARDS

1. Codes and Standards. Meet requirements of all applicable standards and codes, except when more detailed or stringent requirements are indicated by the Contract Documents, including requirements of this Section:
	1. California 2016 Title 24 Compliant
	2. California Energy Commission Occupant Control Smart Thermostat (OCST) certified
	3. OpenADR 2.0 certified

 1.06 TRAINING

1. The BAS Contractor shall provide training for two (2) owner representatives and/or maintenance personnel. The BAS Contractor shall provide on-site training to the District’s representative(s) and maintenance personnel per the following description:
2. On-site training shall consist of a minimum of (1) hours, as indicated above of hands-on instruction geared at the operation and maintenance of the systems. The curriculum shall include:
	1. System Overview
	2. System Application and Operation
	3. System Access
	4. Application Features Overview
	5. Changing Set Points and other attributes
	6. Scheduling
	7. Editing configurable variables
	8. Graphics
	9. Viewing Historical Reports
	10. Operational sequences including start-up, shutdown, adjusting and balancing
	11. Equipment maintenance

 1.07 OPERATING AND MAINTENANCE MANUALS

1. The operation and maintenance manuals shall contain all information necessary for the operation, maintenance, replacement, installation, and parts procurement for the entire BAS.
2. Following project completion and testing, the BAS contractor will submit as-built documentation reflecting the exact installation of the system.

1.08 WARRANTY

1. The BAS contractor shall warrant the system for 12 months after system acceptance and beneficial use by the owner. During the warranty period, the BAS contractor shall be responsible for all necessary revisions as required to provide a complete and workable system consistent with the letter and intent of the Sequence of Operation section of the specification. BAS equipment shall include a limited-warranty by the manufacturer for a period of five (5) years from the time of system acceptance.
2. Limited-warranty by manufacturer is limited to replacement of defective products.

1.09 WORK BY OTHERS

1. The BAS Contractor shall coordinate with other contractors prior to performing the work on this project and cooperate as necessary to achieve a complete and neat installation. To that end, each contractor shall consult the drawings and specifications for all trades to determine the nature and extent of others’ work prior to fabrication and installation. The owner's representative shall be immediately notified if an area of conflict occurs between trades prior to fabrication and installation. BAS Contractor shall provide field supervision to the Mechanical Contractor for pre-installation of control components.
2. Low-voltage thermostat wiring between equipment and thermostat locations shall be furnished and installed by others. Unless otherwise noted all new low-voltage wiring shall be multiple conductor thermostat wiring (wire count as indicated in Thermostat Manufacturer's Installation Instructions) installed per owner's specifications. (Wiring in existing installations shall be minimum three (3) conductor/18-gauge wires per BAS manufacturer's standard specifications, multiple conductor/18-gauge thermostat wiring preferred - see Installation Instructions for specific conductor counts depending on heating and cooling modes of existing equipment.)
3. Related work provided by others:
	1. 110V outlets shall be provided within five (5) feet of each Gateway or Wireless Repeater location.
	2. One (1) Ethernet data port shall be provided within ten (10) feet of each Gateway location.
4. Equipment start-up and servicing.

1.11 SCOPE OF WORK

1. Except where otherwise noted, the system shall consist of a network of commercial Internet-programmable thermostats, their accessories, and any other networked climate management device(s) required to fill the intent of the specification, sequence of operations, and provide for a complete and operable system.
2. The BAS contractor shall review and study existing building/site conditions where applicable and all new construction drawings for the project including HVAC drawings and the entire project specifications to familiarize themselves with the equipment and system operation prior to bidding and submittal of a bid/price and notify the owner immediately of any conflicts between the project and the scope of work of this section, including work to be completed by others.
3. All equipment and installation of control devices associated with the equipment listed below shall be provided under this BAS contractor.
4. When the BAS is fully installed and operational, the BAS contractor will make themselves available to meet with the designated representatives of the owner to review the as-installed condition of the system. At that time, the BAS contractor shall demonstrate the operation of the system and prove that it complies with the intent of the drawings and specifications.
5. The BAS contractor shall furnish and install a complete BAS control system, including all necessary hardware and all operating and applications software necessary to perform the control sequences of operation as called for in this specification.
6. Provide and install BAS controls for the HVAC Equipment as noted on the drawings.
7. Provide technical support necessary for commissioning of system in coordination with the HVAC Contractor, Balancing Contractor, and the owner's team.
8. Shall provide one training session in the operation of the system for owner's personnel.
9. All work performed under this section of the specifications will be in compliance with all codes and regulations as mandated by the authority having jurisdiction.

PART 2 PRODUCTS

 2.0 ACCEPTABLE MANUFACTURERS

1. Unless otherwise noted, all product shall be of a single manufacturer. The standard of design and quality shall be products as manufactured by Pelican Wireless Systems.

 2.01 COMMUNICATION

1. This project shall be comprised of a network of devices that use an IEEE 802.15.4 self-creating and self-healing wireless mesh communication network to reach an Ethernet Gateway.
2. The Gateway shall communicate to cloud servers via a single Ethernet connection at the owner’s wide area network (WAN) over a TCP/IP connection. The facility’s firewall shall not require any inbound port assignments for the Gateway to connect to the cloud servers. The Gateway shall not require a Public IP.
3. No BACnet, modBus, LON, or any other device-to-device wired communication protocol shall be used in the communication network.

 2.02 OPERATOR INTERFACE

1. 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.
2. The Web-App platform shall run on cloud servers which allow for virtual access. Platform shall not run on a local on-site server.
3. The Web-App shall support at a minimum, the following functions:
	1. Personal user log-on identifications (email addresses) and unique passwords 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, which 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.
4. Control and Override
	1. The BAS shall provide view, override, and edit of 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. Temporary Overrides. The BAS shall be able to provide temporary override (wherever an override is allowed) and automatically remove the override after a specified period of time.
	3. Any override and edit of a object virtually or at the device, if allowable, shall be historically tracked.
5. Scheduling
	1. The BAS shall provide users with scheduling of application devices through a graphical interface. Scheduling shall include, but is not limited to:
		1. 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.
		2. 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.
		3. 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.
6. Alarm Notification
	1. Alarm Notification(s) shall be generated if there are failures detected by devices part of the BAS. These failures shall be, but are not limited to: temperature deviations, temperatures missing targets, temperatures too high or too low, failures of equipment, 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.
7. Reports and Logs
	1. Data shall be logged and stored on cloud servers for all devices part of BAS in real-time. Every device real-time “state change”, when applicable, shall be stored and viewable for at least one week, with the option of up to two (2) years.
		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, Outside air temperatures
	2. Data shall be represented on historical graphs that allow for easy viewing of device state change at different times.
	3. Excel outputs shall not be required to view data. Historical data shall be viewable through BAS.

 2.03 APPLICATION-SPECIFIC CONTROLLERS

1. 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.
2. Gateways are devices which connected to an Ethernet port and act as a bridge between the BAS cloud servers and the wireless mesh network.
	1. Shall be capable of providing Internet connection to up to 2,000 devices.
	2. Shall be capable of automatically addressing routing tables to all devices part of wireless mesh network and shall not require manual programming or addressing.
	3. Shall communicate to cloud servers over a TCP/IP outbound-only connection.
	4. Shall not require a Public IP address, custom VPNs, or any on-site servers.
	5. Shall communicate to other BAS devices over the dedicated and isolated 802.15.4 IEEE technical standard.
	6. Shall be secured using AES (Advanced Encryption Standards).
3. Internet-Enabled Thermostats are controllers which detect a space/zone temperature and operate equipment or dampers which supply heating, cooling, ventilation, or a combination of the three mechanical states, to their space/zone. Examples are thermostats for VAV, VVT, Fan-Powered Boxes, Fan Coil, Blower Coils, Unit Ventilators, Heat Pumps, Water Source Heat Pumps, and Conventional DX and/or Gas heat equipment.
	1. Shall be capable of providing 24VAC outputs which can be configured to provide control of the following: two stages of fan, three stages of cooling, two stages of heating, one stage of auxiliary heat (heat pumps), floating point zone dampers, two position zone dampers, floating point zone reheat valves, and two position zone reheat valves.
	2. Shall include a removable wiring terminal module that allows for thermostat installation even in situations where there are only three wires between equipment and where the thermostat is to be installed.
	3. Shall be available with the following internal sensors: temperature only, temperature and humidity, temperature, humidity, and CO², and temperature and CO². All sensors required by the specifications are to be internal to the thermostat and not require two devices on the wall.
	4. Shall be able to accept expansion accessories that allow for more advanced control sequences, and additional temperature detection. Examples are economizer controllers, outside air ventilation control, supply air temperature detection, unit ventilator face/bypass control, and modulating control. All expansion accessories shall be Internet enabled and accessible through EMS.
	5. Shall communicate with the wireless mesh network through an internal wireless antenna that runs on the 802.15.4 technical standards.
	6. Shall be able to automatically repeat the wireless mesh network to additional devices part of the BAS.
	7. Shall automatically push, in real-time, to the BAS all “state changes” so as to be viewable historically and in real-time from BAS. Examples are changes in equipment operation (heat, cool, fan), number of stages active, the temperatures in the space, damper position, valve position, temperature set-points, etc.
	8. Shall be able to lock-out heat pump compressor(s) based on outside air temperature.
	9. Shall provide set-point (heat & cool) temperature limitations through BAS.
	10. Shall provide full local keypad lock-out from BAS.
	11. Shall meet California 2016 Title 24 code standards.
	12. Shall have a programmable three (3°F) degree heat/cool temperature range which auto-adjusts to a five (5°F) degree dead band.
	13. Shall have both a heat setpoint, cool setpoint, and auto-changeover.
	14. Shall have Optimum Start algorithms that will calculate start times based on at least seven (7) days of previous run-time temperature and rate-of-change historical data for its space. Optimum Start algorithm shall recalculate each optimized schedule time before each optimized schedule.
	15. Shall be able to be manually overridden through BAS.
	16. Shall be configured through BAS.
4. Wired Temperature Inputs are to be available to provide external temperature detection for specific BAS devices. Examples are to provide supply air temperature, water temperature, refrigeration temperature, outside air temperature, etc. to a thermostat or other device.
	1. Shall accept 10K type II thermistors.
	2. Shall push to the BAS real-time temperature changes so as to be viewable historically and in real-time from the BAS.
	3. Shall accept a thermistor at a maximum of up to 100 feet from input terminal.
	4. Shall be configured through the BAS.
5. Internet-Enabled Economizer Controller are controllers that modulate an outside air damper to provide ventilation and economization to a single zone.
	1. Shall only require a dry-bulb outside air temperature sensor and dry-bulb supply air temperature sensor. No dry-bulb return air temperature sensor or dry-bulb mixing box temperature sensor shall be required to meet full economizer functionality to at a minimum California 2016 Title 24 standards.
	2. Shall communicate with thermostat to determine space temperature and space temperature setpoint in order to decide when economization can be used.
	3. Shall continue to economize as its only source of cooling as long as the outside air temperature is able to keep the space temperature within 1°F of the cool temperature setpoint.
	4. Shall be able to enable mechanical cooling at the same time as economization.
	5. Shall be able to prevent the supply air temperature from dropping below a minimum temperature.
	6. Shall provide enthalpy by use of pulling humidity and barometric pressure information from the Internet based on the zipcode of installation location. Enthalpy shall not require any additional probes other than the dry-bulb probe and shall be free to enable.
	7. If connected to a CO² thermostat, shall be able to provide demand ventilation control of outside air damper.
	8. Shall have a minimum ventilation damper position and a maximum ventilation damper position.
	9. Shall be able to be scheduled to not open the outside air damper for ventilation during unoccupied hours.
	10. Shall be able to control a Variable Frequency Drive (VFD) with up to five (5) fan speed inputs. Example of fan speed changes are during ventilation, stage one cooling, stage two cooling, stage one heating, stage two heating.
	11. Shall modulate an outside air damper by use of a 0-10VDC signal.
	12. Shall accept a 0-10VDC signal feedback input from the outside air damper actuator to confirm outside air damper is working correctly.
	13. Shall meet all California 2016 Title 24 codes, including Fault Detection and Diagnostic requirements.
	14. Shall send Fault Detection and Diagnostic information to the BAS.
	15. Shall accept a minimum of three (3) 10K type II thermistors.
	16. Shall be able to modulate a 0-10VDC hot water, steam, or electric SCR for heating and outside air tempering.
	17. Shall be able to modulate a 0-10VDC chilled water or modulating DX for cooling and outside air tempering.
	18. Shall be able to control a face/bypass damper.
	19. Shall push all “state changes” to the BAS as to be viewable historically and in real-time from BAS. Examples are changes in equipment operation (heat, cool, fan, economization, ventilation), number of stages active, the supply air temperature, the return air temperature, hot water valve position, face/bypass damper position, variable speed fan setting, etc.
	20. Shall be able to be manually overridden through the BAS.
	21. Shall be configured through the BAS.
6. Internet-Enabled Power Relay Module are controllers which have dry-contact relays able to start/stop different electrical equipment. Examples are exhaust fans, lights, pumps, valves, boilers, chillers, etc.
	1. Shall have relays with a max rating of 120 VAC @ 15 AMPs or 240/277 VAC @ 10 AMPs.
	2. Shall have a low-voltage terminal for momentary contact override inputs. Override time shall be configurable for a specific amount of minutes through a configuration from the BAS.
	3. Shall be able to provide Lead/Lag sequencing between relays.
	4. Shall be able to accept an external dry-contact input used to verify flow if being used as a pump controller. If being used as a lead/lag pump controller, shall be able to alarm the BAS if flow is not detected when Pump A is enabled and start Pump B as a stand-by pump.
	5. Shall communicate with the wireless mesh network through an external wireless antenna that runs on the 802.15.4 technical standards. Antenna shall be able to communicate with Power Relay Module over three (3) 18-gauge wires up to 500 feet between device terminal inputs.
	6. Shall be able to automatically repeat the wireless mesh network to additional devices part of the BAS.
	7. Shall push all “state changes” to the BAS as to be viewable historically and in real-time from the BAS. Examples are changes in relay positions On or Off.
	8. Shall be able to be manually overridden through the BAS.
	9. Shall be configured through the BAS.
7. Zone Controllers are controllers which operate equipment which supply heating, cooling and ventilation, or a combination of these mechanical states to multiple zones.
	1. Shall communicate with the wireless mesh network through a removable wireless antenna that runs on the 802.15.4 technical standards.
	2. Remote mountable antenna shall be able to communicate to Zone Controller over three (3) 18-gauge wires up to 500 feet between devices terminal inputs.
	3. Communication from the Zone Controller to all zone/space Thermostats shall be over the wireless mesh network.
	4. Shall be capable of providing 24VAC outputs which can be configured to provide control of the following: multiple stages of fan, multiple stages of cooling, and multiple stages of heating.
	5. Shall be capable of providing 0-10VDC outputs which can be configured to provide control of the following: variable speed fan (VFD), modulating outside air damper, modulating heating valve.
	6. Shall have integrated outside air damper control logic and not require a third-party or additional controllers to provide economization and ventilation control.
	7. Shall directly accept a supply duct static pressure probe. Shall have an integrated short-term and long-term learning PID loop algorithm for maintaining target supply static configurations. PID loop shall not require any type of cost for programming and is to be factory loaded into controller.
	8. Shall only require dry-bulb outside, return, and supply air temperature sensors.
	9. If communicating to CO² thermostat(s), shall be able to provide demand ventilation control of outside air damper.
	10. 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, economization, ventilation), number of stages active, the supply air temperature, the return air temperature, the outside air temperature, hot water valve position, supply duct static reading, variable speed fan setting, etc.
	11. Shall be able to be manually overridden through the BAS.
	12. Shall be configured through the BAS.
8. Make-up Air Controllers which operate equipment supplying ventilation to the building.
	1. Shall communicate with the wireless mesh network through a removable wireless antenna that runs on the 802.15.4 technical standards.
	2. Remote mountable antenna shall be able to communicate to Controller over three (3) 18-gauge wires up to 500 feet between devices terminal inputs.
	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 which can be configured to provide control of the following: multiple stages of fan, multiple stages of cooling, and multiple stages of heating.
	5. Shall be capable of providing 0-10VDC outputs which can be configured to provide control of the following: modulating variable speed fan (VFD), modulating outside air damper, modulating heating, modulating cooling.
	6. Shall be able to modulate a VFD to maintain a targeted building 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 logic.
	10. Shall directly accept a building pressure probe. Shall have an integrated short-term and long-term learning PID loop algorithm for maintaining target building pressure. PID loop shall not require any type of cost for programming, is to be factory loaded into controller, and updatable virtually through EMS.
	11. Shall only require dry-bulb outside and supply air temperature sensors.
	12. If communicating to CO² thermostat(s), shall be able to provide demand ventilation control of outside air damper.
	13. 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, economization, ventilation), number of stages active, the supply air temperature, the return air temperature, the outside air temperature, hot water valve position, supply duct static reading, variable speed fan setting, etc.
	14. Shall be scheduled On or Off through the BAS.
	15. Shall be able to be manually overridden through the BAS.
	16. Shall be configured through the BAS.
9. Wireless Proximity Sensors are thermostat accessories which are able to detect when a door or window is opened or closed, or be able to accept a dry-contact input from an occupancy sensor.
	1. Shall be able to communicate to a single Internet-Programmable Thermostat over wireless mesh network.
	2. Shall communicate with the wireless mesh network through an internal wireless antenna that runs on the 802.15.4 technical standards.
	3. Shall run on two AA batteries and not require any unique type of battery to operate.
	4. Shall push all “state changes” to the BAS as to be viewable historically and in real-time from the BAS. Examples are if the door is open, if the space is unoccupied, if a window is open.
	5. Shall be configured through the BAS.
10. Remote Wireless Sensors are thermostat accessories which are used to either average temperatures between the sensors location and a master thermostat or to relocate the sensing location of the master thermostat without having to run new wire.
	1. Shall be able to communicate to a single Internet-Programmable Thermostat over wireless mesh network.
	2. Shall communicate with the wireless mesh network through an internal wireless antenna that runs on the 802.15.4 technical standards.
	3. Shall run on two AA batteries and not require any unique type of battery to operate.
	4. 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.
	5. Shall be configured through the BAS.
11. Wireless Repeaters are devices which extend the 802.15.4 wireless mesh network across large expanses or where BAS devices are unable to repeat the wireless mesh network on their own. Examples are when bridging the wireless mesh network from one building to another.
	1. Shall communicate with the wireless mesh network through an internal wireless antenna that runs on the 802.15.4 technical standards.
	2. Shall be able to automatically repeat the wireless mesh network to additional devices part of the BAS.
	3. Shall not require an Ethernet connection or any TCP/IP connection.
	4. Shall only require a single 120V outlet for power.
12. Configuration of Devices and System
	1. To meet the sequence of operation for each controller, the controller shall be configured through the BAS by the installing contractor. No custom programming or downloading by use of a service tool shall be required.
	2. Stand-Alone Operation: Each piece of equipment specified shall provide stand-alone operation. BAS devices shall not require web connection or communication to the BAS to run under normal operations.

PART 3 EXECUTION

 3.0 EXAMINATION

1. 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.
2. The BAS manufacturer shall be available to provide assistance to BAS Contractor in order to verify that control equipment can be installed as required, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.

 3.01 PROTECTION

1. The BAS installing contractor shall protect all work and material from damage by their work or personnel, and shall be liable for all damage thus caused.
2. 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.
3. **Installation of BAS shall be performed by an approved Contractor. Approved contractor is one whom 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.**
4. Demolition. Remove controls which do not remain as part of the BAS. The owner will inform the Contractor of any equipment which is to be removed that will remain the property of the owner. All other equipment which is remove will be disposed of by the Contractor.
5. Access to Site. Unless notified otherwise, entrance to 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.
6. Code Compliance. All wiring shall be installed in accordance with all applicable electrical codes and will comply with equipment manufacturer’s recommendations.
7. Clean Up. During installation, 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 other areas shall be cleaned around equipment provided under this contract.

 3.02 TEST AND BALANCE

1. Testing of controls shall be performed by installing contractor. All equipment and their components being controlled shall be tested, including, but not limited too: 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.
2. 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.
3. 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

1. All control wires between mechanical equipment and BAS devices are to be furnished and installed by others, unless 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.
2. 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

1. Installation Practices for Devices. All devices are to be mounted level/plumb and per the manufacturer’s installation documentation.
2. It is not an excuse to have not referenced the manufacturer’s installation documentation or to have contacted the BAS manufacturer if hardware installation not understood and done incorrectly by the installing Contractor.
3. 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 name plates.
	5. All field devices inside FIP's shall be labeled.
4. Existing Controls. Existing controls are not to be reused. All BAS devices will be new.
5. 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.
6. 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 is minimized.

 3.05 SYSTEM CONFIGURATION

1. 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.
2. Installing contractor shall work with 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 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 STARTUP

1. 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 has 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.
2. 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 system as it relates to BAS.
3. 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