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March 15, 2024

TO : All Bidders  
FROM : Bob Lavey  
PROJECT : Nogales High School New Building and Aquatic Center  
Project W2110000AR.41  
DSA : 03-122782 / File 19-92  
SUBJECT : Addendum 4

The following changes, omissions, and/or additions to the Technical Specifications and/or Drawings shall apply to proposals made for and to the execution of the various parts of the work affected thereby, and all other conditions shall remain the same.

Careful note of the Addendum shall be taken by all parties of interest so that the proper allowances may be made in strict accordance with the Addendum, and that all trades shall be fully advised in the performance of the work which will be required of them.

Bidder shall acknowledge receipt of this Addendum in the space provided on the Bid Form. Failure to do so may subject Bidder to disqualification.

In case of conflict between Drawings, Technical Specifications, and this Addendum, this Addendum shall govern.

#### **4. PROJECT MANUAL**

##### 4.1 SECTION 23 09 23 - DIRECT DIGITAL CONTROLS

- A. Replace this specification section in its entirety with the attached Section 23 09 23.

#### **DRAWINGS**

##### Electrical

##### 4.2 DRAWING EA2.2 - ELECTRICAL - 1ST FLR PLAN - AREA B

- A. Replace this drawing in its entirety with the attached Drawing EA2.2.
- B. Revise electrical information in Room A140.
- C. Add Musco lighting feeders requirement.

##### 4.3 DRAWING EB2.1 - ELECTRICAL - POOL FLR PLAN

- A. Replace this drawing in its entirety with the attached Drawing EB2.1.
- B. Add Musco lighting feeders requirement.

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- 4 .4 DRAWING E5.1 - ELECTRICAL SINGLE LINE DIAGRAM
  - A. Replace this drawing in its entirety with the attached Drawing E5.1.
  - B. Revise Single Line Diagram.
- 4 .5 DRAWING E5.2 - ELECTRICAL PANEL SCHEDULES
  - A. Replace this drawing in its entirety with the attached Drawing E5.2.
  - B. Revise panel schedules for Main Type MCB (800A).
- 4 .6 DRAWING E5.3 - ELECTRICAL PANEL SCHEDULES
  - A. Replace this drawing in its entirety with the attached Drawing E5.3.
  - B. Revise panel schedules for INV-1.

**END OF ADDENDUM 4**

Submitted by,



BOB LAVEY  
AIA, LEED AP  
Managing Partner, Architect



RL:PF:hb\P4W2110000ARx4-add

Attachments: Section 23 09 23 - Direct Digital Controls  
Drawings EA2.2, EB2.1, E5.1, E5.2, E5.3

## SECTION 23 09 23

### DIRECT DIGITAL CONTROLS

#### PART 1 - GENERAL

##### 1.1 WORK INCLUDED

- A. Furnish a totally native BACnet-based system, based on a distributed control system in accordance with this specification. All building controllers, application controllers, and all input/output devices shall communicate using the protocols and network standards as defined by ANSI/ASHRAE Standard 135–2001, BACnet. In other words, all controllers, including unitary controllers, shall be native BACnet devices. The control system shall be Alerton to match existing Rowland USD Energy Management System.
- B. The controls system shall be manufactured by Alerton and installed by an authorized Alerton installer to match the Rowland USD standard, no exceptions, or substitutions. Please see authorized Alerton Installers in section 1.4 (a).
- C. Provide all necessary BACnet-compliant hardware and software to meet the system's functional specifications. Provide Protocol Implementation Conformance Statement (PICS) for Windows-based control software and every controller in system, including unitary controllers.
- D. Prepare individual hardware layouts, interconnection drawings, and software configuration from project design data.
- E. Design, provide, and install all equipment cabinets, panels, data communication network cables needed, and all associated hardware.
- F. Provide and install all interconnecting cables between supplied cabinets, application controllers, and input/output devices.
- G. Provide and install all interconnecting cables between all operator's terminals and peripheral devices (such as printers, etc.) supplied under this section.
- H. Provide complete manufacturer's specifications for all items that are supplied. Include vendor name of every item supplied.
- I. Provide supervisory specialists and technicians at the job site to assist in all phases of system installation, startup, and commissioning.
- J. Provide a comprehensive operator and technician training program as described herein.
- K. Provide as-built documentation, software, diagrams, and all other associated project operational documentation (such as technical manuals) on approved media, the sum total of which accurately represents the final system.
- L. Provide new sensors, valves, and install only new electronic actuators. No used components shall be used as any part or piece of installed system.
- M. Provide seamless connection to existing Alerton Control System. The new system shall be an extension of the existing Alerton Control System currently installed at Rowland USD. All new controllers and points shall be set-up, programmed, and downloaded from the existing Alerton Workstation utilizing Alerton Technologies, no exceptions.

## 1.2 SYSTEM DESCRIPTION

- A. A distributed logic control system complete with all software and hardware functions shall be provided and installed. System shall be completely based on ANSI/ASHRAE Standard 135-2010, BACnet. This system is to control all mechanical equipment, including all unitary equipment (VAV boxes, heat pumps, fan-coils, AC units, etc.), lighting control, and all air handlers, boilers, chillers, and any other listed equipment using BACnet-compliant components. Non-BACnet-compliant or proprietary equipment or systems (including gateways) shall not be acceptable and are specifically prohibited.
- B. Building controllers shall include complete energy management software, including scheduling building control strategies with optimum start and logging routines. All energy management software and firmware shall be resident in field hardware and shall not be dependent on the Master Network. Local operator's terminal software is to be used for access to field-based energy management functions only. Provide zone-by-zone direct digital logic control of space temperature, scheduling, runtime accumulation, equipment alarm reporting, and override timers for after-hours usage.
- C. All application controllers for every terminal unit (VAV, HP, UV, etc.) air handler, all central plant equipment, and any other piece of controlled equipment shall be fully programmable and communicate on a peer-to-peer basis. Application controllers shall be mounted next to controlled equipment and communicate with building controller via BACnet.
- D. All controllers shall be programmed with graphical logic programming tools. Line code programmed controllers are not allowed.
- E. Room sensors shall be provided with digital readout that allows the user to view room temperature, view outside air temperature, adjust the room setpoint within preset limits and set desired override time. User shall also be able to start and stop unit from the digital sensor. Include all necessary wiring and firmware such that room sensor includes field service mode. Field service mode shall allow technician to balance VAV zones and access any parameter in zone controller.

## 1.3 APPROVED MANUFACTURERS

- A. Only Alerton products may be installed for this Section of work.
- B. Only BTL approved equipment furnished by the above listed manufacturer will be acceptable. Products not BTL approved will be rejected. Any manufacturer other than the listed above are not acceptable, no exceptions or substitutions.

## 1.4 APPROVED INSTALLERS

- A. The following Alerton Dealer has been pre-qualified by the Rowland USD to execute this Section of work:
  - 1. Climatec Building Technologies Group  
Contact Ryan Cheng at (949-394-1865)
  - 2. District approved equal.
- B. Only pre-qualified contractors approved by the owner will be acceptable. Any installer other than the listed above are not acceptable, no exceptions.
- C. The installing company must have performed building automation work at the Rowland USD prior to this project. Proof of project or work must be provided upon request.
- D. The approved installer must be an authorized Alerton dealer for Southern California. Authorized dealers from other regions are not acceptable.

## 1.5 QUALITY ASSURANCE

- A. Responsibility: The supplier of the FMCS shall be responsible for inspection and Quality Assurance (QA) for all materials and workmanship furnished.

- B. Component Testing: Maximum reliability shall be achieved through extensive use of high-quality, pre-tested components. Each and every controller, sensor, and all other DDC components shall be individually tested by the manufacturer prior to shipment.
- C. Tools, Testing and Calibration Equipment: The EMCS supplier shall provide all tools, testing, and calibration equipment necessary to ensure reliability and accuracy of the system.
- D. The systems control manufacturer shall have been an established manufacturer of BACnet protocol systems for a minimum of fifteen years.
- E. Installing control contractor shall have been in business for over 10 years with completed projects similar in size and scope. Controls contractor shall not be a subsidiary of a mechanical contractor.
- F. Control system shall be engineered, programmed and supported completely by representative's local office that must be within 50 miles of project site. The control contractor shall be independent; and shall not be a subsidiary or affiliated with a Mechanical Contractor.
- G. Prior to receiving approval to proceed on this project the contractor must provide and demonstrate the following:
  - 1. Ten (10) customer references in Los Angeles County with installed native BACnet Alerton systems as specified for this project.
  - 2. Five (5) large project references in the Southwestern United States with installed native BACnet Alerton systems as specified for this project. Projects must have been completed within the last (3) years.
  - 3. Reference Information must include the following:
    - a. Customer name
    - b. Address
    - c. Contact name
    - d. Contact phone number
    - e. System description
    - f. Statement of BACnet compliance

## 1.6 PROJECT MANAGEMENT

- A. Have present at the project site, a project manager who shall, as a part of their duties, be responsible for the following activities:
  - 1. Coordination between the Subcontractor and all other trades, Owner, Local Authorities, and design team.
  - 2. Coordination of all activities between his subcontractors.
  - 3. Attendance at subcontractor/general contractor meetings.
  - 4. Scheduling of work progress, manpower loading, material delivery, equipment installation and checkout.
  - 5. Coordination of all drawings and submittals between consultants, engineers, other sub-trades and his subcontractors.
  - 6. Supervision of field technicians and interface with other trades.

## 1.7 REFERENCE STANDARDS

- A. The latest edition of the following standards and codes in effect and amended as of supplier's proposal date, and any applicable subsections thereof, shall govern design and selection of equipment and material supplied:
  - 1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
  - 2. ANSI/ASHRAE Standard 135-2010, BACnet.
  - 3. Uniform Building Code (UBC), including local amendments.
  - 4. UL 916 Underwriters Laboratories Standard for Energy Management Equipment. Canada and the US.

5. National Electrical Code (NEC).
6. FCC Part 15, Subpart J, Class A.
7. EMC Directive 89/336/EEC (European CE Mark)
8. City, county, state, and federal regulations and codes in effect as of contract date.

- B. Except as otherwise indicated the system supplier shall secure and pay for all permits, inspections, and certifications required for his work and arrange for necessary approvals by the governing authorities.

## 1.8 SUBMITTALS

### A. Drawings:

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

### B. System Documentation: Include the following in submittal package:

1. System configuration diagrams in simplified block format
2. All input/output object listings and an alarm point summary listing.
3. Electrical drawings that show all system internal and external connection points, terminal block layouts, and terminal identification.
4. Complete bill of materials, valve schedule and damper schedule.
5. Manufacturer's instructions and drawings for installation, maintenance, and operation of all purchased items.
6. Overall system operation and maintenance instructions—including preventive maintenance and troubleshooting instructions.
7. For all system elements—building controller(s), application controllers, routers, and repeaters,—provide BACnet Protocol Implementation Conformance Statements (PICS) as per ANSI/ASHRAE Standard 135-2010.
8. A list of all functions available and a sample of function block programming that shall be part of delivered system.

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

## 1.9 WARRANTY

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

## PART 2 - PRODUCTS

### 2.1 OPERATOR'S WORKSTATION

- A. Integrate with existing District Alerton server. Provide programming and software implementation to seamlessly integrate all controls provided in this project into the existing Alerton Envision server software. Integration shall be an expansion of the existing Alerton database.
- B. The Alerton server shall be able to download and upload programming into all field controllers provided in this project over the BMS network.

### 2.2 BUILDING CONTROLLER

- A. General Requirements:
  - 1. BACnet Conformance
    - a. Building Controller shall be approved by the BTL as meeting the BACnet Building Controller requirements.
    - b. Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
  - 2. Building controller shall be of scalable design such that the number of trunks and protocols may be selected to fit the specific requirements of a given project.
  - 3. The controller shall be capable of panel-mounted on DIN rail and/or mounting screws.
  - 4. The controller shall be capable of providing global control strategies for the system based on information from any objects in the system, regardless if the object is directly monitored by the building controller module or by another controller.
  - 5. The controller shall be capable of running up to six (6) independent control strategies simultaneously. The modification of one control strategy does not interrupt the function or runtime others.
  - 6. The software program implementing the DDC strategies shall be completely flexible and user-definable. All software tools necessary for programming shall be provided as part of project software. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site, using a wide area network (WAN) or downloaded through remote communications are not acceptable. Changing global strategies using firmware changes is also unacceptable.
  - 7. Programming shall be object-oriented using control function blocks and support DDC functions. All flowcharts shall be generated and automatically downloaded to controller. Programming tool shall be supplied and be resident on workstation. The same tool shall be used for all controllers.
  - 8. The programming tool shall provide means to graphically view inputs and outputs to each program block in real-time as program is executing. This function may be performed using the operator's workstation or field computer.
  - 9. Controller shall have 6,000 Analog Values and 6,000 Binary Values.
  - 10. Controller IP configuration can be done via a direct USB connect with an operator's workstation or field computer.
  - 11. Controller shall have at a minimum a Quad Core 996Ghz processor to ensure fast processing speeds.

12. Global control algorithms and automated control functions shall execute using a 64-bit processor.
13. Controller shall have a minimum of 1 GB of DDR3 SDRAM on a 533Mhz bus to ensure high speed data recording, large data storage capacity and reliability.
14. Controller shall support two (2) on-board EIA-485 ports capable of supporting various EIA-485 protocols including, but not limited to BACnet MS/TP and Modbus.
  - a. Ports are capable of supporting various EIA-485 protocols including, but not limited to BACnet MS/TP and Modbus.
15. Controller shall support two (2) ports—each of gigabit speed—Ethernet (10/100/1000) ports.
  - a. Ports are capable of supporting various Ethernet protocols including, but not limited to BACnet IP, FOX, and Modbus.
16. All ports shall be capable of having protocol(s) assigned to utilize the port's physical connection.
17. The controller shall have at a minimum four (4) onboard inputs, two (2) universal inputs and two (2) binary inputs.
18. Schedules
  - a. Building controller modules shall provide normal seven-day scheduling, holiday scheduling and event scheduling.
  - b. Each building controller shall support a minimum of 380 BACnet Schedule Objects and 380 BACnet Calendar Objects.
19. Logging Capabilities
  - a. Each building controller shall log as minimum 2,000 objects at 15-minute intervals. Any object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.
  - b. Logs may be viewed both on-site or off-site using WAN or remote communication.
  - c. Building controller shall periodically upload trended data to networked operator's workstation for long-term archiving if desired.
  - d. Archived data stored in database format shall be available for use in third-party spreadsheet or database programs.
20. Alarm Generation
  - a. Alarms may be generated within the system for any object change of value or state (either real or calculated). This includes things such as analog object value changes, binary object state changes, and various controller communication failures.
  - b. Each alarm may be dialed out as noted elsewhere.
  - c. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site using remote communications.
  - d. Controller must be able to handle up to 2,000 alarm setups stored as BACnet event enrollment objects, with system destination and actions individually configurable.
21. Demand Limiting
  - a. Demand limiting of energy shall be a built-in, user-configurable function. Each controller module shall support shedding of up to 1,200 loads using a minimum of two types of shed programs.



- b. Load shedding programs in building controller modules shall operate as defined in section 2.1.J of this specification.

B. BACnet MS/TP

1. BACnet MS/TP LAN must be software-configurable from 9.6 to 115.4Kbps
  - a. Each BACnet MS/TP LAN shall support 64 BACnet devices at a minimum.
  - b. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

C. BACnet IP

1. The building controller shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the local area network (LAN).
2. Must support interoperability on WANs and campus area networks (CANs), and function as a BACnet Broadcast Management Device (BBMD).
3. Each controller shall support at a minimum 128 BBMD entries.
4. BBMD management architecture shall support 3,000 subnets at a minimum.
5. Shall support BACnet Network Address Translation.
5. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

D. Expansion Ports

1. Controller shall support two (2) expansion ports.
  - a. Combining the two on-board EIA-458 ports with fully loaded expansion ports, the controller shall support six (6) EIA-485 trunks simultaneously.
2. Expansion cards that mate to the expansion ports shall include:
  - a. Dual port EIA-485 card.
  - b. LON network card.

E. Power Supply

1. Input for power shall accept between 17 and 30VAC, 47 and 63Hz.
2. Optional rechargeable battery for shutdown of controller including storage of all data in flash memory.
3. On-board capacitor will ensure continuous operation of real-time clocks for minimum of 14 days.

F. Controller shall be in compliance with the following:

1. UL 916 for open energy management
2. FCC Class B
3. ROHS
4. IEC 60703

5. C-Tick Listed

G. Controller shall operate in the following environmental conditions:

1. -4 to 149 °F (-20 to 65 °C) without optional battery, or 32 to 122 °F (0 to 50 °C) with optional battery.
2. 0 to 95% relative humidity (RH), non-condensing.

2.3 CENTRAL PLANT AND AIR HANDLING UNIT CONTROLLERS

A. General:

1. Central plant and Air Handling Unit controllers shall be the Alerton ACM VLX expandable application controller. It shall be capable of providing control strategies for the system based on information from any or all connected inputs. The program that implements these strategies shall be completely flexible and user definable. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site via simple download are not acceptable. Changing global strategies via firmware changes is also unacceptable. Program execution of controller shall be a minimum of once per second.
2. Programming shall be object-oriented using control program blocks. Controller shall support a minimum of 500 Analog Values and 500 Binary Values. Each and every analog and binary value shall support standard BACnet priority arrays. Programming tool shall be provided with system and shall be the same tool that is used to program the Building Controller. All flowcharts shall be generated and automatically downloaded to controller. No re-entry of database information shall be necessary.
3. Provide means to graphically view inputs and outputs to each program block in real-time as program is executing. This function may be performed via the operator's terminal or field computer.
4. Controller shall have adequate data storage to ensure high performance and data reliability. Battery shall retain static RAM memory and real-time clock functions for a minimum of 1.5 years (cumulative). Battery shall be a field-replaceable (non-rechargeable) lithium type. Unused battery life shall be 10 years.
5. The onboard, battery-backed real time clock must support schedule operations and trend logs.
6. Global control algorithms and automated control functions should execute via 32-bit processor.
7. Controller shall include both on-board 10BASE-T/100BASE-TX Ethernet BACnet communication over twisted pair cable (UTP) and shall include BACnet IP communication. In addition, controller shall include BACnet PTP connection port.
8. The base unit of the controller shall host up to 8 expansion modules with various I/O combinations. These inputs and outputs shall include universal 12-bit inputs, binary triac outputs, and 8-bit switch selectable analog outputs (0-10V or 0-20 mA). Inputs shall support 3K and 10K thermistors, 0-5VDC, 0-10VDC, 4-20mA, dry contacts and pulse inputs directly.
9. All outputs must have onboard Hand-Off-Auto switches and a status indicator light. HOA switch position shall be monitored. Each analog output shall include a potentiometer for manually adjusting the output when the HOA switch is in the Hand position.
10. The position of each and every HOA switch shall be available system wide as a BACnet object. Expandable Central Plant Controller shall provide up to 176 discreet inputs/outputs per base unit.

B. BACnet Conformance:

1. Central Plant/AHU Controller shall as a minimum support Point-to-Point (PTP), MS/TP and Ethernet BACnet LAN types. It shall communicate directly via these BACnet LANs as a native BACnet device and shall support simultaneous routing functions between all supported LAN types. Building controller shall be a BACnet conformance class 3 device and support all BACnet services necessary to provide the following BACnet functional groups:
  - a. Clock Functional Group
  - b. Files Functional Group
  - c. Reinitialize Functional Group
  - d. Device Communications Functional Group
  - e. Event Initiation Functional Group

2. Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All necessary tools shall be supplied for working with proprietary information.
3. Standard BACnet object types supported shall include as a minimum: Analog Input, Binary Input, Analog Output, Binary Output, Analog Value, Binary Value, Device, File, Group, Event Enrollment, Notification Class, Program and Schedule object types. All necessary tools shall be supplied for working with proprietary information.
4. The Controller shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. Must support interoperability on wide area networks (WANs) and campus area networks (CANs) and function as a BACnet Broadcast Management Device (BBMD).

C. Schedules: Each Central Plant/AHU controller shall support a minimum of 50 BACnet Schedule Objects.

D. Logging Capabilities:

1. Each controller shall support a minimum of 200 trend logs. Any object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.
2. Controller shall periodically upload trended data to system server for long term archiving if desired.
3. Archived data stored in database format shall be available for use in third-party spreadsheet or database programs

E. Alarm Generation:

1. Alarms may be generated within the system for any object change of value or state either real or calculated. This includes things such as analog object value changes, binary object state changes, and various controller communication failures.
2. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site via remote communications
3. Controller must be able to handle up to 200 alarm setups stored as BACnet event enrollment objects – system destination and actions individually configurable.

#### 2.4 TERMINAL UNIT APPLICATION CONTROLLERS (RTU, Heat Pumps, AC Units, Fan Coils)

A. Provide one native BACnet application controller for each piece of unitary mechanical equipment that adequately covers all objects listed in object list for unit. All controllers shall interface to building controller via MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of unit.

B. BACnet Conformance:

1. Application controllers shall as a minimum support MS/TP BACnet LAN types. They shall communicate directly via this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as a native BACnet device. Application controllers shall be of BACnet conformance class 3 and support all BACnet services necessary to provide the following BACnet functional groups:
  - a. Files Functional Group
  - b. Reinitialize Functional Group
  - c. Device Communications Functional Group
2. Please refer to Section 22.2, BACnet Functional Groups in the BACnet standard for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
3. Standard BACnet object types supported shall include as a minimum—Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File and Program Object Types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

- C. Application controllers shall include universal inputs with 10-bit resolution that can accept 3K and 10K thermistors, 0–5 VDC, 4–20 mA, dry contact signals and a minimum of 3 pulse inputs. Any input on controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor. Controller shall include binary outputs on board with analog outputs as needed.
- D. All program sequences shall be stored on board controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely via modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using same programming tools as building controller and as described in operator workstation section. All programming tools shall be provided and installed as part of system.
- E. Application controller shall include support for intelligent room sensor (see Section 2.9.B.) Display on room sensor shall be programmable at controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.

## 2.5 TERMINAL BOX CONTROLLERS—SINGLE DUCT

- A. Provide one native BACnet application controller for each terminal box that adequately covers all objects listed in object list for unit. All controllers shall interface to building controller via MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include on board CFM flow sensor, inputs, outputs and programmable, self-contained logic program as needed for control of units.
- B. All VAV controllers shall be the Alerton VAV-SD controller.
- C. BACnet Conformance
  - 1. Application controllers shall as a minimum support MS/TP BACnet LAN types. They shall communicate directly via this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as a native BACnet device. Application controllers shall be of BACnet conformance class 3 and support all BACnet services necessary to provide the following BACnet functional groups:
    - a. Files Functional Group
    - b. Reinitialize Functional Group
    - c. Device Communications Functional Group
  - 2. Please refer to Section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
  - 3. Standard BACnet object types supported shall include as a minimum—Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File and Program Object Types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
- D. Application controllers shall include universal inputs with 10-bit resolution that can accept 3K and 10K thermistors, 0–5 VDC, and dry contact signals. Inputs on controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor with digital display. Controller shall also include binary outputs on board. For applications using variable speed parallel fans, provide a single analog output selectable for 0-10 V or 0-20 mA control signals. Application controller shall include microprocessor driven flow sensor for use in pressure independent control logic. All boxes shall be controlled using pressure independent control algorithms and all flow readings shall be in CFM (LPS if metric).

- E. All program sequences shall be stored on board application controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely via modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using the same programming tool as Building Controller and as described in operator workstation section. All programming tools shall be provided as part of system.
- F. Application controller shall include support for intelligent room sensor (see Section 2.9.B.) Display on room sensor shall be programmable at application controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence for specific display requirements for intelligent room sensor.
- G. On board flow sensor shall be microprocessor driven and pre-calibrated at the factory. Pre-calibration shall be at 16 flow points as a minimum. All factory calibration data shall be stored in EEPROM. Calibration data shall be field adjustable to compensate for variations in terminal box type and installation. All calibration parameters shall be adjustable through intelligent room sensor. Operator workstation, portable computers and special hand-held field tools shall not be needed for field calibration.
- H. Provide duct temperature sensor at discharge of each terminal box that is connected to controller for reporting back to operator workstation.

## 2.6 SENSORS and MISCELLANEOUS DEVICES

### A. Temperature Sensors:

- 1. All temperature sensors to be solid state electronic, factory-calibrated to within 0.5°F, totally interchangeable with housing appropriate for application. Wall sensors to be installed as indicated on drawings. Duct sensors to be installed such that the sensing element is in the main air stream. Immersion sensors to be installed in wells provided by control contractor, but installed by mechanical contractor. Immersion wells shall be filled with thermal compound before installation of immersion sensors. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake and in a location that is in the shade most of the day.

### B. Duct Type Temperature Sensors:

- 1. BAPI or Engineer approved equal.
  - a. Operating Temperature: -40 to 240°F
  - b. Sensing Element: NTC 10K (Type II) Thermistor
  - c. Accuracy at Calibration Temperature: +/- 1°F.
- 2. Sensors in ducts shall be mounted in locations to sense the correct temperature of the air only and shall not be located in dead air spaces, in close proximity to coils so as to display inaccurate temperatures, or positions obstructed by ducts, equipment, and so forth. Locations where installed shall be within the vibration and velocity limit of the sensing element.
- 3. Duct mount sensors shall mount in an electronic box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement. A neoprene grommet (Seal-lite fitting and mounting plate) shall be used on the sensor assembly to prevent air leaks.
- 4. Duct sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate. Duct sensors probe shall be constructed of 304/316 stainless steel.
- 5. Duct sensors shall not be mounted within 36 inches of heating and cooling coils.
- 6. For outdoor air duct applications, use a weatherproof mounting box with weatherproof cover and gasket.

### C. Intelligent Room Sensor with Touchscreen:

- 1. Hardware
  - a. Room sensor shall include:

- i. Backlit touchscreen LCD digital display
  - ii. Temperature sensor
  - iii. Humidity sensor
  - iv. Programmable Status Light indicator
- b. Temperature sensor shall be a Uni-Curve Type II thermistor with an accuracy of +/- 0.36 °F (0.3 °C) at calibration point over the range of 32 to 158 °F or better.
  - c. Humidity sensor shall have an accuracy of +/-3% from 10 to 90% relative humidity (RH) or better, non-condensing.
  - d. The intelligent room sensor's Status Light indicator shall have a minimum of four (4) colors (blue, red, amber and green) that will cast a glow onto the wall below the sensor to be used as visual indicator to the occupants of the condition of the system. The color and on/off state of the Status Light indicator shall be fully programmable.
  - e. The user shall interact with the smart sensor using a touchscreen, with no buttons allowed.
  - f. The intelligent room sensor shall have provisions for a tamper proof installation requiring tools to be removed from the wall.
  - g. The touchscreen shall have a surface hardness of Mohs 7 or greater to prevent being easily scratched.
  - h. Controller shall function as room control unit, and allow occupant to raise and lower setpoint, and activate terminal unit for override use—all within limits as programmed by building operator.
2. Display Content
- a. The intelligent room sensor shall simultaneously display room setpoint, room temperature, and outside temperature at each controller.
  - b. The intelligent room sensor shall have the ability to add or remove from the display time-of-day, room humidity, and indoor air temperature to customize the view for the customer.
  - c. The intelligent room sensor must have the capability to show temperatures in degrees Fahrenheit or degrees Celsius.
  - d. A communication loss or improper communications wiring shall be displayed on the LCD screen to aid in trouble shooting.
  - e. Information about the version of firmware shall be displayable on the LCD screen.
  - f. A cleaning mode will be provided to allow for the touchscreen to be cleaned without inadvertently making changes to system parameters.
  - g. The intelligent room sensor shall have the ability to display the status of a lighting zone and control the on/off state of the zone from the touchscreen using a tenant-accessible display page.
  - h. The intelligent room sensor shall have the ability to display the status of a window zone (e.g., blinds) and control the on/off state of the zone from the touchscreen using a tenant-accessible display page.
  - i. After Hours Override shall:
    - i. Override time may be set and viewed in 30-minute increments.

- ii. Override time countdown shall be automatic, but may be reset to zero by occupant from the sensor.
- iii. Time remaining shall be displayed.
- iv. Display shall show the word "OFF" in unoccupied mode unless a function button is pressed.

3. Other Modes

- a. The intelligent room sensor shall also allow service technician access to hidden functions for advanced system configuration. This functionality shall be accessed-protected with a configurable PIN number.
- b. Field Service Mode shall allow access to common parameters as dictated by the application's sequence of operations. The parameters shall be viewed and set from the intelligent room sensor with no computer or other field service tool needed.
- c. If the intelligent room sensor is connected to VAV controller, Balance Mode shall allow a VAV box to be balanced and all air flow parameters viewed. The balancing parameters shall be viewed and set from the intelligent room sensor with no computer or other field service tool needed.

4. Intelligent Room Sensor shall be in compliance of the following:

- a. UL Standard for Safety 916
- b. FCC Part 15.107 & 109, Class B, CFR47-15
- c. EMC Directive 89/336/EEC (European CE Mark)

D. Wall Sensor:

- 1. Standard wall sensor shall use solid-state sensor identical to intelligent room sensor and shall be packaged in aesthetically pleasing enclosure. Sensor shall provide override function, warmer/cooler lever for set point adjustment and port for plug-in of Field Service Tool for field adjustments. Override time shall be stored in controller and be adjustable on a zone-by-zone basis. Adjustment range for warmer/cooler lever shall also be stored in EEPROM on controller. All programmable variables shall be available to Field Service Tool through wall sensor port.

E. Current Transformers

- 1. The current transformers shall be provided to be installed or removed without dismantling the primary bus or cables. The transformer shall be of a split core design.
- 2. The core and windings shall be completely encased in a UL approved thermoplastic rated 94VA. No metal parts shall be exposed other than the terminals.
- 3. The current transformers shall meet the following specifications.
  - a. Frequency Limits: 50 to 400 Hz.
  - b. Insulation: 0.6 KV Class, 10 KV BIL.
  - c. Accuracy:  $\pm 1\%$  at 5.0 to 25.0 VA accuracy class with U.P.F. burden.
  - d. Provide a disconnect switch for each current transformer.

F. Current Switches

- 1. Current sensing switch shall be self-powered with solid-state circuitry and a dry contact output.
- 2. Current sensing switches shall consist of a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over current up to twice its trip into range.

G. Water Differential Pressure Transmitters

1. Water differential pressure sensors shall be Rosemont Model 2051 with three valve manifold or Engineer approved equal.
2. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage and to hold calibrated accuracy when subject to a momentary 40% over-range input.
3. Provide the following:
  - a. NEMA 1 transmitter housing and locate in accessible local control panels wherever possible.
  - b. Brass 3-valve manifold assembly with shut-off and shunt valves.
  - c. Standard Viton/Silicone bleed screw seals.
  - d. Calibration certificate.
4. The pressure transmitter shall be capable of transmitting a linear electronic signal proportional to the differential of the pressure input signals with the following minimum performance specifications:
  - a. Span: Refer to points list.
  - b. Accuracy:  $\pm 0.25\%$  of full scale.
  - c. Non-Repeatability: 0.05%.
  - d. Non-linearity:  $\pm 0.20\%$
  - e. Response: 30 to 50 ms
  - f. Temperature Stability: Less than 0.20% FS/ $^{\circ}$ F.
  - g. Output: 4 to 20 mA.

H. Magnetic Flow Meters

1. Flow meter shall be Rosemont 8705 or Engineer approved equal with remote transmitter with display and keypad.
2. Provide remote transmitter with display and keypad.
3. Power 24VDC power supply as required.
4. BMS system shall monitor flow rates, pressure and temperature values.
5. Provide isolation valve kit to allow removal and servicing of meter while system is operating.
6. Provide flow meter that is pressure and temperature compensated and rated for chilled (40 $^{\circ}$ F) and heating hot (200 $^{\circ}$ F) service conditions.
7. Heating hot water flow meter shall be provided with ceramic lining.

I. BTU Meters

1. BTU meter shall be Onicon System 10.
2. LCD readout on front panel.
3. BACnet MSTP and IP capability.

J. Power Meters

1. Provide and install Accuenergy Acuvim IIW power quality meters where shown on electrical single line drawings indicating sub metering by Building Management System (BMS).
2. Multifunction power quality meter shall provide continuous monitoring of a three phase power system as required. Meter shall measure voltage, current, real and reactive power, real and reactive energy, current and power demand, power factor, frequency, etc. IO ports shall be provided for monitoring and controlling various functions for specific applications. Programmable alarm set-points shall be available for users to set over/under limit alarm parameters. Meter shall be accessible from BMS via Modbus or BACnet communication.
3. Safety Certificate & Testing
  - a. Meter shall be manufactured under an ISO9001 registered program.
  - b. Meter shall be UL and cUL listed, and CE marked.
  - c. Meter shall conform to IEC 61010-1, UL61010-1 and cUL61010-1 safety standards.
  - d. Meter shall conform to emission compliance FCC Part 15 Subpart B, Class A, EN 55011, EN50081-2, IEC 61000-4/ -2-3-4-5-6-8-11 standards.
  - e. Meter shall conform to the IEC 60068-02 environment standard and conform to immunity standard EN 50082-2 for industrial environment.
  - f. Meter shall have an environmental tolerance rating of IP54 (NEMA 3)



- g. Meter shall be able to store in -40°C to 85°C.
- h. Meter (including LCD screen) shall be able to operate from -25°C to 75°C.
- i. Meter shall have a dielectric strength of 2500 Vac for 1 minute to voltage input and shall withstand 1500 Vac continuously.
- j. Meter shall accept input voltage range of 400 Vac L-N and 690 Vac L-L.
- k. Meter shall have an isolation voltage rating of 2500 Vac for mechanical relay output and 2500 Vac for digital output.
- l. Meter shall be able to withstand fault current at 100 Arms for 1 second and shall withstand 20 Arms continuously.
- m. Meter shall accept universal power for control power supply input.
- n. Meter shall provide optional low voltage DC power for control power supply input

4. Metering and Monitoring

- a. Data Logging
  - i. Meter shall have minimum 8MB of onboard memory to log interval data. The data interval shall be user-configurable from 1 minute to 1 day.
  - ii. Meter's onboard memory shall be user-configurable to log complete or partial meter's measurements.
  - iii. The data logging configuration shall allow user to start logging immediately or log at specific start time and stop time.
- b. Meter shall be panel mount design and shall be able to fit into a DIN 43700 (92mm x 92mm square hole) or ANSI C39.1 (4-inch round hole) cutting standard.
- c. Meter front shall not exceed 96mm x 96mm in size when mounted on panel.
- d. Meter shall have the option for standard 35mm DIN rail mount.
- e. Meter shall include integrated display and control keys on the front panel of the meter for programming settings and viewing real-time measurements.
- f. Integrated display shall be a Liquid Crystal Display (LCD) with backlight to clearly display measurement readings.
- g. Meter shall provide indication signal such as flashing LCD backlight upon alarm conditions.
- h. Meter shall be able to display all measured values on demand using the control keys on meters front panel.
- i. Meter shall provide a true RMS measuring of  $V_{AN}$ ,  $V_{BN}$ ,  $V_{CN}$ ,  $V_{AB}$ ,  $V_{BC}$ ,  $V_{CA}$ ,  $I_A$ ,  $I_B$ ,  $I_C$ ,  $I_N$ , voltage/current unbalance, power factor, line frequency, individual harmonics for voltage/current, THD, kW, kvars, kVA, import and export kWh/kvarh, kVAh, and demand readings for current and power. Maximum and minimum values of measured quantities shall also be recorded and date/time stamped.
- j. Meter shall accept input current range of up to 10 Aac.
- k. Meter shall support current input options of 333mV, RCT or mA for use with 333mV output CT's, Rogowski coil CT's and 80/100/200mA output CT's.
- l. Meter shall be able to provide demand metering for current and power. Demand shall be programmable either using Thermal or Sliding Window method with the demand interval from 1 to 30 minutes (increment of 1 min).
- m. Following measurement range, minimum resolution and full scale accuracy for the monitored parameters shall be provided:

Parameters		Accuracy	Resolution	Range
Voltage		0.2%	0.1V	10V~500kV
Current		0.2%	0.1mA	5mA~50000A
Power		0.2%	1W	-
Reactive Power		0.2%	1 Var	-
Apparent Power		0.2%	1 VA	0~9999MVA
Power Demand		0.2%	1W	-
Reactive Power Demand		0.2%	1 Var	-
Apparent Power Demand		0.2%	1 VA	0~9999MVA
Power Factor		0.2%	0.001	-1.000~1.000
Frequency		0.2%	0.01Hz	45.00~65.00Hz 300-500Hz (400Hz standard)
Energy	Primary	0.2S	0.1kWh	0-
	Secondary	0.2S	0.001	0-
Reactive Energy	Primary	0.2S	0.1 kvarh	0-

Parameters		Accuracy	Resolution	Range
	Secondary	0.2S	0.001	0-
Apparent Energy	Primary	0.2S	0.1 kVAh	0-
	Secondary	0.2S	0.001	0-
Harmonics		2.0%	0.1%	0.0%~100.0%
Phase Angle		2.0%	0.1°	0.0°~359.9°
Unbalance Factor		2.0%	0.1%	0.0%~100.0%
Running Time			0.01h	0~9999999.99h

5. Power Quality Analysis
  - a. Power analysis features shall include individual voltage/ current harmonic spectrum display (through the 63<sup>rd</sup> harmonic with odd, even and total harmonic distortion), THFF, voltage/ current unbalance factor, voltage crest factor and current K factor.
  - b. 512 waveform sample per cycle
  - c. Meter shall automatically generate log for max/min measurement parameter value. Events shall be recorded with time stamps and shall be stored in the meter.
  
6. Module Design
  - a. Meter shall have modules option for flexible and easy function expansion
    - i. Ethernet module shall be available for Ethernet communication.
    - ii. IO modules shall be available to support digital input, digital output, pulse output, relay output, analog input, and analog output functions.
    - iii. Wireless RS485 network 900Mhz module must be integral module to meter's base without requiring additional external power supply.
  
7. Alarming
  - a. User shall be able to set over/under limit alarm conditions for all measured quantities. These include frequency, phase voltage, line voltage, current, real/reactive/apparent power, voltage/current unbalance, power factor, power demand, etc...
  - b. Meter shall automatically generate log for over/ under limit alarm events. Events recorded with time stamp shall be stored in meter.
  - c. Alarming time delay tolerance shall be +/-20%.
  
8. Communication
  - a. Meter shall support dual communication (serial communication through Modbus RTU and Ethernet or Wireless RS485 communication) and shall be able to communicate to master devices such as the Building Automation System using the two methods at the same time.
  - b. Modbus RTU: Meter shall be able to communicate using Modbus-RTU protocol over RS485 communication ports at baud rate up to 38400 bps. Through the use of communication, user shall be able to read/ write set-points, read actual values, execute commands and access the meter remotely.
    - i. Maximum of 32 meters shall be able to connect on the same RS485 serial communication network (daisy chain).
    - ii. Meter shall be able to connect to master controller via RF 900-950 Mhz radio frequency.
      1. Frequencies outside of this bandwidth is not acceptable and may interfere with other critical prison radio frequencies.
    - iii. RF communication shall be 128 bit AES encrypted
    - iv. RF communication shall support both point to multipoint and mesh communication topology
    - v. Each meter and its RF module shall be working as transmitter and repeater without additional hardware
    - vi. The wireless mesh network shall be self-healing and self-optimizing
    - vii. RF communication shall support automatic channel hopping
  - c. Modbus TCP:
    - i. Through the use of Ethernet module, meter shall be able to communicate over Local Area Network using TCP/IP. The module shall support both 10M and 100M connections.
    - ii. Ethernet module shall support both Modbus TCP and HTTP protocol.
    - iii. Meter with Ethernet module shall be capable to act as a HTTP server.

K. Thermal Mass Natural Gas Flow Meters

1. The flow meter shall be Onicon F-5500 series inline/ insertion, or equal. Materials of construction for wetted metal components shall be 316ss. Each meter shall be individually wet-calibrated against a primary volumetric standard that is accurate to within 0.1% and traceable to NIST. A certificate of calibration shall be provided with each flow meter. Insertion meters shall support hot tap installation without interrupting gas service. The insertion meter shall also be removable for service without disrupting flow.
2. Accuracy
  - a. +/-1.0% of readings from 500-700 SFPM
  - b. +/-2.0% of readings from 100-500 SFPM
3. Temperature accuracy +/-1.0 degree F over the range of -40 to 250 degrees F
4. Flow Range: 15 to 35,000 SFPM
5. Pipe Size Range:
  - a. Insertion: 1.5" to 24" nominal diameter
  - b. Inline: 0.75" to 6" nominal diameter
6. Input Power: 12-28 VDC, 6W minimum power
7. Fluid Temperature Range: -40 to 250 degrees F
8. Ambient Temperature Range: -40 to 158 degrees F
9. Flow Sensor shall output:
  - a. 4-20 mA proportional signal
  - b. Or pulse, scaled pulse, or alarm (isolated open collector output)
10. Shall support a remote display.
11. Turbine sensors not allowed.

L. Power Supplies and Line Filtering

1. Power Supplies. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.
  - a. DC power supply output shall match output current and voltage requirements. Unit shall be full wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand 150% current overload for at least three seconds without trip-out or failure.
  - b. Unit shall operate between 32°F and 120°F. EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
  - c. Line voltage units shall be UL recognized and CSA listed.
2. Power Line Filtering.
  - a. Provide internal or external transient voltage and surge suppression for workstations and controllers. Surge protection shall have:
  - b. Dielectric strength of 1000 V minimum
  - c. Response time of 10 nanoseconds or less
  - d. Transverse mode noise attenuation of 65 dB or greater
  - e. Common mode noise attenuation of 150 dB or greater at 40-100 Hz

M. Network Connection Tool:

1. Network connection tool shall allow technician to connect a laptop to any MS/TP network or at any MS/TP device and view and modify all information throughout the entire BACnet network. Laptop connection to tool shall be via Ethernet or PTP.
2. Provide quick connect to MS/TP LAN at each controller. Tool shall be able to adjust to all MS/TP baud rates specified in the BACnet standard.

N. Damper Actuators:

1. Outside Air and Exhaust Air Damper Actuators shall be Mechanical Spring Return. Capacitors or other non-mechanical forms of fail-safe are not acceptable. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the damper as required.
2. Economizer Actuators shall utilize Analog control 2-10 VDC, Floating control is not acceptable.
3. Electric damper actuators (including terminal box actuators) shall be direct shaft mounted and use a V-bolt and toothed V-clamp causing a cold weld effect for positive gripping. Single bolt or setscrew type fasteners are not acceptable.
4. One electronic actuator shall be direct shaft mounted per damper section. No connecting rods or jackshafts shall be needed. Small outside air and return air economizer dampers may be mechanically linked together if one actuator has sufficient torque to drive both and damper drive shafts are both horizontal installed.
5. Multi-section dampers with electric actuators shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft mounted per damper section. (See below execution section for more installation details.)

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

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

#### 3.2 INSTALLATION (GENERAL)

- A. Install in accordance with manufacturer's instructions.
- B. Provide all miscellaneous devices, hardware, software, interconnections installation and programming required to ensure a complete operating system in accordance with the sequences of operation and point schedules.

#### 3.3 LOCATION AND INSTALLATION OF COMPONENTS

- A. Locate and install components for easy accessibility; in general, mount 48 inches above floor with minimum 3'-0" clear access space in front of units. Obtain approval on locations from owner's representative prior to installation.
- B. All instruments, switches, transmitters, etc., shall be suitably wired and mounted to protect them from vibration, moisture and high or low temperatures.
- C. Identify all equipment and panels. Provide permanently mounted tags for all panels.
- D. Provide stainless steel or brass thermo wells suitable for respective application and for installation under other sections—sized to suit pipe diameter without restricting flow.

### 3.4 INTERLOCKING AND CONTROL WIRING

- A. Provide all control wiring. All wiring shall be installed neatly and professionally, in accordance with Specification Division 26.
- B. Plenum rated wiring in concealed accessible ceilings is acceptable.
- C. Provide wiring as required by functions as specified and as recommended by equipment manufacturers, to serve specified control functions. Provide shielded low capacitance wire for all communications trunks.
- D. Control wiring shall not be installed in power circuit raceways. Magnetic starters and disconnect switches shall not be used as junction boxes. Provide auxiliary junction boxes as required. Coordinate location and arrangement of all control equipment with the owner's representative prior to rough-in.
- E. Provide auxiliary pilot duty relays on motor starters as required for control function.
- F. Provide power for all control components from nearest electrical control panel or as indicated on the electrical drawings—coordinate with electrical contractor.
- G. All control wiring in the mechanical and electrical rooms to be installed in raceways.

### 3.5 DDC OBJECT TYPE SUMMARY

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

### 3.6 FIELD SERVICES

- A. Prepare and start logic control system under provisions of this section.
- B. Start-up and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.
- C. Provide Owner's Representative with spare parts list. Identify equipment critical to maintaining the integrity of the operating system.

### 3.7 AS BUILT DOCUMENTATION

- A. After completion of the project, insert final approved shop drawings include the following information:
  - 1. An operator's manual including detailed man-machine interface.

2. An operator's reference table listing the addresses of all connected input points and output points. Show settings where applicable.
3. A programmer's manual including all information necessary to perform the programming function.
4. A language manual including a detailed description of the language used and all routines, modules, etc., used by the system.
5. Flow charts of the software programs utilized in the system.
6. Complete program listing file, and parameter listing file for all programs.

### 3.8 TRAINING

- A. Provide application engineer to instruct owner in operation of systems and equipment.
- B. Provide system operator's training to include (but not limited to) such items as the following: modification of data displays, alarm and status descriptors, requesting data, execution of commands and request of logs. Provide this training to a minimum of 3 persons.
- C. Provide on-site training above as required, up to 4 hours as part of this contract.

### 3.9 DEMONSTRATION

- A. Upon completion of the installation, start up the system and perform all necessary testing, debugging and calibration of each component in the entire system. Perform an acceptance test in the presence of the Owner's Representative. When the system performance is deemed satisfactory in whole or in part of the by the Owner's Representative, the part(s) of the system will be accepted.
- B. Provide certificate stating that control system has been tested and adjusted for proper operation.
- C. Final system acceptance shall be contingent upon completion of final review and correction of all deficiencies. Satisfactory completion of the operational tests which shall demonstrate compliance with all performance and requirements of the Contract Documents.

END OF SECTION



















Job: NOGALES HS ADDITION Job No: W2110000AR AIC Rating: 22000

Mounting SURFACE Main Type: MCB (250A) Neutral: 100% Voltage: 208Y/120V-3PH 4W Main Size: 250 AMP/S Ground: Equipment Ground Lug: SINGLE

PANEL L1M		ALL LOADS IN VA																						
Ltg	Recept	Motor	Heat	Cool	Other	Kitchen	S/S	Description	Amp/P	Wire	Cr. No.	Ph.	Cr. No.	Wire	Amp/P	Description	Ltg	Recept	Motor	Heat	Cool	Other	Kitchen	S/S
3510								HP-1 ROOF	352	8	1	A	2	8	352	HP-2 ROOF								0.00
3510								EF-1 ROOF	201	12	8	B	4	8		SP-9 ROOF								0.00
1950								HP-3 ROOF	252	12	7	A	8			SP-8 ROOF								0.00
1950								HP-15 ROOF	202	12	11	C	12			HP-4 ROOF								0.00
1497								HP-15 ROOF	202	12	11	C	12			SPARE								0.00
1497								HP-6 ROOF	202	12	15	B	16	12	202	HP-7 ROOF								0.00
1497								HP-6 ROOF	202	12	15	B	16	12	202	SPARE								0.00
1497								EF-4 ROOF	201	12	19	A	20	12	201	HP-8 ROOF								0.00
1497								HP-10 ROOF	202	12	21	B	22			SPARE								0.00
1497								HP-10 ROOF	202	12	21	B	22			SPARE								0.00
1248								HP-11 ROOF	202	12	25	A	26	12	202	HP-9 ROOF								0.00
1248								HP-11 ROOF	202	12	25	A	26	12	202	SPARE								0.00
1248								HP-13 ROOF	202	12	29	C	30			HP-12 ROOF								0.00
1248								HP-13 ROOF	202	12	29	C	30			SPARE								0.00
1176								EF-7 ROOF	201	12	33	B	34			HP-14 ROOF								0.00
1176								EF-8 ROOF	201	12	35	C	36	12	201	POOL ROOF RECEPT								0.00
1497								SPARE	201						ROOF CONV. REC.									0.00
1497								SPARE	201						SPARE									0.00
1497								SPARE	201						SPARE									0.00
1497								SPARE	201						SPARE									0.00
1497								SPARE	201						SPARE									0.00
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