# **SECTION 23 0923**

# **DDC CONTROLS**

## PART 1 General System Description

1.1 GENERAL REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and other Conditions and other Division 1 – General Requirements sections, apply to the work specified in this Section.

1.2 BASIC SYSTEM

A. Extend or modify the existing Alerton BAS for the VAV boxes in the basement.

B. The control system shall be fully integrated and installed as a complete package of controls and instruments in a manner that provides maximum benefit to the end user.

C. The system shall include all computer software and hardware, control unit hardware and software, operator input/output devices, sensors, control devices, and miscellaneous devices required for complete operation and future modifications. Documentation for all software and hardware devices shall be provided.

D. Provide engineering, installation, calibration, commissioning, acceptance testing assistance, software programming, and checkout for complete and fully operational DDC.

1.3 SCOPE OF SERVICES

A. Work under this section of the specification shall include, but not limited to, the following:

1. Furnish and install a complete sensor, actuator, wiring and piping system for all added equipment. Install all necessary sensors and actuators as required by the plans and specifications and equipment schedules. Coordinate installation of factory mounted controls.

2. Label all sensors, control devices, and control units.

4. All line drivers, signal boosters, and signal conditioners etc. shall be provided as necessary for proper data communication.

5. Coordination as required with other sections of the specification for the proper and complete installation of the wiring and tubing system, control devices, dampers, valve, actuators, etc.

6. Furnish and install Direct Digital Control Equipment (DDC) as required by the point list, plans, and specifications including, control units, software, database development, check-out, and debugging. Provide points necessary for a complete and operable system.

7. Install the sequence of operations specified in the drawings and in this section.

1.4 Quality Assurance

A. The BAS system shall be designed, installed, commissioned, and serviced by qualified contractor.

B. Acceptable Control Manufacturers:

1. Alerton Only

1.5 Related Sections

A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Mechanical Special Conditions, Electrical Special Conditions and Division ‑ 1 Specification.

B. Coordination with Other Trades:

1. This section specifies cooperation of the Control Contractor with other trades and Owner’s balancing firm to assure proper arrangement of control items. Control valves, dampers, wiring, thermostat wells, and other control devices that are to be built into the field assembled ductwork, piping, or wiring systems shall be furnished by the Control Contractor and installed under other sections of the specification as directed by the Control Contractor and indicated in other portions of the specifications and drawings.

2. The interface between the DDC system and other equipment is the responsibility of the Control Contractor. The Control contractor shall insure that the DDC system communicates successfully with other equipment (e.g., air handling units, packaged rooftop units, heat pumps, motors, actuators, etc.). Note: the equipment supplier is responsible for the proper performance of their equipment (assuming the proper signal are sent/received from the BAS). The control contractor is responsible for all system sensors, including those which are factory installed.

3. Electrical Wiring: All wiring required for work under this section of the specification shall be provided under this section of the specification unless otherwise specified.

4. Electrical wiring - power for control panels, control devices, and sensors

a. Power for control units, control devices and sensors shall be coordinated with the air handling manufacturer for the project and/or the Owner.

b. Contact locations in starter control circuits. All contacts controlling motor starters, including overload contacts, shall be located on the hot side of the coil (un­grounded control power leg). Coordinate this requirement with the air handling manufacturer for the project.

c. Extend power to damper actuators.

1) Actuators will be powered at 24 VAC.

2) At each auxiliary panel location, furnish and install a 24 VAC transformer with 20 VA of capacity for each actuator installed and served from the panel.

3) Furnish and install a fused terminal in the +24 VAC lead and a disconnecting terminal in the neutral lead of the power cable to each actuator.

5. Testing, Adjusting and Balancing: If necessary, The Controls Contractor shall operate the BAS to assist the TAB Contractor.

1.6 Quality Control – Codes and Standards

A. All work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of the local, state, and federal authorities. Such codes, when more restrictive, shall take precedence over these plans and specifications, As a minimum, the installation shall comply with the current editions in effect 30 days prior to receipt of bids for the following codes:

1. National Electric Code (NEC)

2. Uniform Building Code (UBC), Oregon Structural Specialty Code

3. Uniform Mechanical Code (UMC), Oregon Mechanical Specialty Code

4. Underwriters Laboratories (UL)

5. National Electric Manufacturers’ Association (NEMA)

6. National Fire Prevention Association (NFPA)

7. American Society Of Heating, Refrigeration, And Air Conditioning Engineers (ASHRAE)

8. Instrument Society Of America (ISA)

9. National Institute of Standards and Technology (NIST).

B. Meet all of the local authorities and State Fire Marshal code requirements for normal operating and smoke mode functions.

1.7 Definitions

A. BAS. Building Automation System is an integrated system that includes automatic temperature controls and energy management control using a DDC system.

B. DDC. Direct Digital Control is a control system that uses electronic signals to control the HVAC systems within a building. Electronic signals are either binary or are converted to analog.

C. Control logic. The control logic or control loop is a strategy used to process inputs and determine an output. The strategy considers all available inputs and considers any limits and conditions that may constrain the output signal.

D. Control logic diagram. The control logic diagram graphically illustrates the control logic.

E. Control unit. Intelligent stand-alone control unit including both primary and secondary units.

F. Primary control unit. A primary control unit is a self-sufficient, totally programmable microprocessor-based device (see Parts 3 and 4 for specific details) based on the Primary LAN.

G. Secondary control unit. Secondary control units are microprocessor-based devices (see Parts 3 and 4 for specific details) designed to control terminal devices or packaged equipment. Typically residing on the Secondary LAN.

H. Application control unit. Application control units are dedicated control units that control only one process or control loop.

I. Operator Interface. A device used by the operator to manage the BAS and includes Operator workstation or host computer, portable laptop.

J. Operator workstation or Host computer. The host computer’s primary purpose is to enhance man-machine interfacing, enhance reporting, centralized monitoring and control, and provide re-programming capabilities.

K. Portable Operator terminal. Laptop computer used for direct connection to the Control Unit and for remote dial up connection.

L. Commissioning Agent shall refer to mechanical design Commissioning Agent, commissioning agent, or representative chosen by owner.

M. “As-built” documentation means as installed (specifically, after system debugging and system acceptance by the Commissioning Agent).

1.8 Submittals

A. Shop drawing submittals are required for the following. The Contractor shall not start the project until the Shop Drawings have been submitted and approved. Alter the shop drawings completed by Apollo Environmental Controls, Kennewick, Washington in 2015. Owner can make these drawings available for other Alerton Installers if necessary. Shop drawings shall include:

1. All submittals should be provided on paper (with legible font type and size).

2. All drawings should be labeled TC (temperature control) rather than being referenced within the mechanical or electrical divisions. Sheets shall be consecutively numbered

3. One drawing per air handler or system (e.g., boiler plant). Drawing should include point descriptors (DI, DO, AI, AO), addressing, and point names. Each point names should be unique (within a system and between systems). For example, the point named for the mixed air temperature for AHU#1, AHU #2, and AHU #3 should not be MAT but could be named AHU #1, AHU #2MAT, and AHU #3MAT. The point names could be logical and consistent between systems and AHUs. The abbreviation or short hand notation (e.g., MAT) should be clearly defined in writing by the Control Contractor. Naming standard will be decided on during meeting between Commissioning Agent, Control Contractor, and Owner (see Section 6).

4. For each drawing, include a schematic flow diagram of each air and water system showing fans, coils, dampers, valves, pumps, heat exchange equipment, control devices, etc. Label each control device with setting or adjustable range of control. Label each input and output with the appropriate range.

5. Electrical wiring diagrams shall include both ladder logic type diagrams for motor start, control, and safety circuits and detailed digital interface panel control point termination diagrams with all wire numbers and terminal block numbers identified. Indicate all required electrical wiring. Provide panel termination drawings on separate drawings. Ladder diagrams shall appear on system schematic. Clearly differentiate between portions of wiring that are existing, factory-installed and portions to be field-installed.

6. Show all electric connections of the controls system to equipment furnished by others complete to terminal points identified with manufacturer’s terminal recommendations.

7. Control Contractor shall provide one complete drawing that shows the equipment (fan unit, boiler, chiller, etc.) manufacturers wiring diagram with the control contractors wiring diagram superimposed on it. Supply hard copy.

8. Complete identification of all control devices (manufacturer’s type, number, and function).

9. Provide sequence of operation in both narrative form and graphic or line code format. Narrative sequence shall be an original document generated by the programmer. Submitting the sequence from those specifications without edits will be rejected.

1.9 Record Documents

A. Provide a complete set of control drawings with as-installed equipment and operating sequences on paper and in electronic format. Drawings shall be an addition/modification of Apollo Environmental Controls documents produced in 2015. Owner will provide drawings to Alerton installing Contractors if necessary. “As-built” (i.e., as-installed and debugged and after system acceptance) documentation shall include the following as minimum:

1. All data specified in the shop drawings section in its final "as-built" form.

2. Schematic outline of the overall control system for quick reference

3. Adequate record of the work as installed, including exact location of control panels and the wiring route (using TC documents, section 1.09).

4. Blue prints shall include sequence of operation.

5. System hardware specification data which provides a functional description of all hardware components.

6. System engineering information which provides all of the information for the system set-up, definition and application.

7. System database information that provides the point names and application data programmed into the system.

8. All of the information, data, procedures and drawings shall be supplied in the form of manuals.

B. Provide as-installed (after system acceptance) control logic diagrams showing all points (real and virtual).

C. The Control Contractor shall document deviations from the shop drawing submittals. Documentation should include what equipment was changed and the reason for the change.

D. Provide copy of final test reports.

1.10 Operating and Maintenance Materials

A. Provide Operation and maintenance data on all new equipment requiring service or adjustment (prior to and after final acceptance).

B. Provide user guides and programming manuals for all hardware and software.

1. A reference manual shall be furnished and shall contain, as a minimum, an overview of the system, its organization, the concepts of networking and central site/field hardware relationships. It shall be a complete guide to operating all aspects of the software system, including activating the system, use of the mouse, description of all menus, establishing setpoints and schedules, downloading or uploading information to or from field hardware, generating or collecting trends, alarms and reports, backing up system software and data files and interface with third party software.

2. Manuals for advanced programming (for each controller type and for all workstations) shall be provided.

C. Provide a Bill of Materials with each schematic drawing. List all new devices/equipment and match to schematic and actual field labeling. Provide quantity, manufacturer, actual product ordering number, description, size, accuracy, operating ranges (voltage, temperature, pressure, etc.), input/output parameters, etc.

D. Alter field copies of wiring for Control Units. (Laminated and permanently affixed in or above controller).

E. For the equipment not manufactured by the Control Vendor, an alphabetical list of new system components with the name, address and 24-hour telephone number of the company responsible for servicing each item during the first two years of operation shall be provided.

F. Operating and maintenance instructions for each new piece of equipment that includes:

1. Emergency procedures for fire or failure.

2. Start-up, operation, maintenance, disassembly and shutdown procedures.

3. Maintenance instructions for each piece of equipment.

4. Proper lubricants and lubricating instructions.

5. Cleaning, replacement and/or adjustment schedule.

6. Product data on each piece of equipment, including damper and valve information noted earlier.

7. Emergency heat operation.

G. Points list shall include all physical input/output and virtual points. Points list shall be provided in hard copy and shall include:

1. Name

2. Address

3. Scanning frequency

4. Engineering units

5. Offset calibration and scaling factor for engineering units

6. High and low alarm values and alarm differentials for return to normal condition

7. Default value to be used when the normal controlling value is not reporting.

8. Message and alarm reporting as specified.

9. Identification of all adjustable points

10. Description of all points

H. Control Logic documentation shall include:

1. Drawings documenting control logic for all aspects of the BAS including control units, controlled devices, sensors, etc.

2. A detailed sequence of operation (see Part 6) should be submitted on separate sheets for each AHU or HVAC system. The text description of the sequence of operation should include:

a) Logic control statement (i.e., describe control loop process)

b) Setpoints and throttling ranges, deadbands, and differentials for temperature and pressure variables, gains, reset schedules, etc.

c) Limits/conditions and interlocks

d) Measured variables (e.g., mixed air temperature)

e) Variables to communicate to/from the network

3. Control diagrams should identify

a) System being controlled (attach abbreviated control logic text)

b) All DO, DI, AO, AI points

c) Virtual points

d) All functions (logic, math, and control) within control loop

e) Legend for graphical icons or symbols

f) Definition of variables or point names (e.g., OAT = outside air temperature)

g) Define values (e.g., 1 = on, 0 = off)

h) Voltage, amperage, or resistance input/output signal for all sensors and controlled devices

1.11 Conformance Certificates

A. Upon substantial completion of the work, supply and turn over all required inspection certificates from governing authorities to certify that the work as installed conforms to the rules and regulations of the governing authorities.

1.12 Warranty Certificates

A. Warrant all new work as follows:

1. Labor and materials for the control system specified shall be warranted free from defects for a period of 24 months after final completion and acceptance. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to the owner.

2. The Control Contractor shall respond to the owner's request for warranty service within 24 hours during normal business hours.

3. The Control Contractor shall respond to the owner's request for Emergency service during the warranty period within 4 hours.

B. Emergency service shall be available 8,760 hours per year.

C. Five (5) non-warranty emergency service calls shall be provided free of charge per year.

D. Emergency service rates for additional assistance shall be provided.

1. The contractor shall provide unlimited phone technical support to the owner during the warranty period. If the technical support location of the contractor is outside of the toll free calling area for the customer, the contractor shall have a toll free number or accept collect calls for the purpose of providing technical support.

2. The contractor shall provide technical support bulletin service (if available) for two years.

3. During the warranty period and if required by the School District, parts for the DDC system shall arrive at the School District within 24 hours of placing an order.

4. At the end of the final startup, testing, and commissioning phase, if equipment and systems are operating satisfactorily to the Commissioning Agent, the Commissioning Agent shall sign certificates certifying that the control system's operation has been tested and accepted in accordance with the terms of the specifications. The date of acceptance shall be the start of the warranty period.

5. All work shall have a single warranty date, even when the owner has received beneficial use due to an early system startup.

6. Operator workstation software, project-specific software, graphic software, database software, and firmware updates which resolve known software deficiencies as identified by the Control Contractor shall be provided at no charge during the warranty period.

7. Any hardware or software discovered to incorrectly process dates starting January 1, 2000 through the year 2040 shall be replaced by the Control Contractor at no cost to the owner.

8. Control contractor shall be available for a final check and adjustment of the DDC system before the warranty period ends. The final check will include input from the maintenance staff as well as the Commissioning Agent.

1.13 Delivery and Storage

A. Provide factory-shipping cartons for each piece of equipment and control device not factory installed. Provide factory applied plastic end caps on each length of pipe and tube. Maintain cartons and end caps through shipping, storage, and handling as required to prevent equipment and pipe-end damage, and to eliminate dirt and moisture from equipment and inside of pipe and tubes. Store equipment and materials inside and protected from weather.

1.14 Discrepancies

A. Any items not included in the specification but referred to in the Appendix and/or Drawings in reference to this project and any other incidentals not referred to but required as a basic element to the overall performance and/or successful completion of the work shall be installed as part of this contract.

## PART 2 PRODUCTS

2.1 Basic Materials, Control Devices, Sensors

A. Installation of some of the equipment in this section may be the responsibility of other contractors (see 1.6).

B. All sensors and equipment related to or connected to the DDC system shall be installed according to manufacturer’s recommendations.

2.2 Wiring, Cable Trays, Conduit, and Hangers

A. To supply, install and connect all conduits, boxes and wires between all the different components related in this section including all line voltage to the equipment.

B. Provide all necessary field wiring and devices from the point of connection indicated on the drawings. Bring to the attention of the Commissioning Agent in writing, all conflicts, incompatibilities, and/or discrepancies prior to bid or as soon as discovered.

C. Field Wiring: It is the intent of these specifications that all systems shall be complete and operable. Refer to all drawings and specifications to determine voltage, phase, circuit ampacity and number of connections provided.

D. All wiring and fiber optic cable in the central plant, tunnels, and plenums to be supported by B-line Bridle rings or equal. All wiring and fiber optic cable in the hallways, rooms, and other public areas shall be in conduit.

E. All wires in Bridle Rings or conduit shall follow building lines (i.e., wires in plenum space shall run within several inches of the wall and shall NOT run in the middle of the space).

F. Wire:

1. Wire and cable of the sizes and types shown on the plans and/or hereinafter specified shall be furnished and installed by the Control Contractor. All wire and cable shall be new soft drawn copper and shall conform to all the latest requirements of the National Electrical Code, IPCEA, and shall meet the specifications of the ASTM.

2. All control wiring to be copper stranded TEW-105, with appropriate gauge in accordance with the Codes. The minimum gauge used to be 16 AWG.

3. Input/Output Wiring: Wiring serving inputs and outputs from the BAS shall be cables consisting of single or multiple twisted individually shielded pairs. Each pair shall have an independent shield with drain wire. Cables installed without conduit shall be plenum rated and comply with NEC article 725. Where automation input/output wiring is run in cable tray furnish and install conductors or multiconductor cable rated for use in cable trays per NEC articles 340 and/or 725. Conductors shall be minimum #18 wire gauge.

4. Power Conductors: All feeder and branch circuit wire shall be 600 V insulated of THHN type unless shown or specified to be otherwise. No wire less than No. 12 gauge shall be used except for control circuits or low voltage wiring. Wire sizes No. 14 to No. 10 shall be solid except where otherwise indicated. Wire sizes No. 8 and larger shall be stranded. All wire sizes shown are American Wire Gauge sizes. Where power conductors are run in cable tray, furnish and install conductors or multiconductor cable rated for use in cable trays per NEC articles 340 and/or 725.

5. All the conductors used for signals from the Controllers and field sensors must be shielded two wire, 18 AWG. with a drain wire. Conductor model 8760 from Belden is to be used or approved alternative by Commissioning Agent.

6. All power wiring to be copper stranded RW 90 type, with appropriate gauge in accordance with the Codes. The following color code must be applied: line voltage to be black and/or white, ground to be green.

7. Acceptable Manufacturers: Cable and wire shall be a standard type as manufactured by General Electric Company, National Electric Company, U. S. Rubber Company, Simplex, General Cable Company, Carol, Anaconda, Rome, Southwire, Belden, Alpha, Houston Wire and Cable, or ITT Royal.

G. Wiring Installation:

1. All wires shall be continuous from outlet to outlet and there shall be no unnecessary slack in the conductors.

2. All wire terminations will be identified using rail terminal strips (see 5.10)

3. All drain wires must be grounded at the source end. The other end must be protected with a dielectric material (tape).

4. All control wiring (24 V and more) must be in a separate conduit from the shielded conductors.

5. Pull-Box and Junction Box:

a. Pull boxes and junction boxes shall be installed where indicated on the drawings or where required to facilitate wire installation. Locate in conjunction with other trades so as to install without conflict with other materials or equipment.

b. A pull-box will be located at every 50'.

c. All switch, pull, junction boxes, etc., shall be hot dipped galvanized or sherardized, concrete tight, with interlocking ring or multiple point locking devices. Connectors shall be three piece. Indentation fittings are not acceptable.

d. In suspended ceilings, all boxes must be installed on the structure.

e. Boxes shall be attached by fasteners designed for the purpose and shall provide adequate mechanical strength for future maintenance.

f. Junction and pull boxes not dimensioned shall be minimum 4 inch square.

6. Care shall be used to avoid proximity to heat ducts and/or steam lines. Where crossings are unavoidable, conduit shall clear covering of line by at least six inches.

7. Motor Interlock Wiring: Interlock circuit wiring shall be No. 14 solid or stranded wire. Stranded wire only shall be used where wiring is used for flexible wiring harnesses. Stranded control wire shall be provided with crimp type spade terminators. Interlock circuit wiring shall be color coded or numbered using an identical number on both ends of the conductor. Wire numbers shall be installed before conductors are pulled. Where motor interlock conductors are run in cable tray, furnish and install conductors or multiconductor cable rated for use in cable trays per NEC articles 340 and/or 725.

8. All splices, taps, and terminations shall be made at outlet, junction, or pull boxes. Wire to No.6 gauge shall be spliced using Scotchlok wire nuts. No Bakelite wirenuts shall be used. Wire No. 6 and larger shall be spliced using solderness connectors as manufactured by Penn Union Company. Splices No. 6 and larger shall be insulated by taping with plastic vinyl tape as manufactured by Minnesota Mining and Manufacturing Company. Splices shall not be permitted in automation input and output wiring without specific written authorization from the Commissioning Agent. If such a splice is approved, the location of the splice shall be clearly documented on the "As Built" drawings. Splices in automation wiring, if necessary, shall be made using Thomas&Betts STA-KON connectors installed per the manufacturer’s directions to maintain NEMA specified voltage drops and wire retention forces.

9. Grounding:

a. The contractor shall extend existing equipment grounding systems. The Contractor shall use only approved grounding clamps and connectors as manufactured by Penn-Union, Burndy or O-Z Mfg. Company.

b. The conduit system of the 480/277 and 208Y/120 volt systems shall be continuous and shall be used as the static grounding conductor, except for circuits installed in flexible conduit. Install a green grounding conductor inside all flexible conduits and extend to the nearest outlet or junction box. Install a green grounding conductor inside all non-metallic conduits or raceways.

H. Conduit:

1. Conduit Material:

a. All wiring to be in E.M.T. type conduits unless as noted below:

1) Conduit shall not be required where conductors are above accessible ceiling and properly supported via bridle rings. See wireway section below.

2) Conductors routed in wall to single device (thermostat connection as an example) need not be routed in conduit.

b. All conduits to be a minimum of 1/2".

c. All flexible conduits will not exceed 6' in length and are to be used only in areas where vibrations and/or expansion joints are present.

d. In damp areas, the conduit and related equipment must be suitable for the application.

e. Electrometalic tubing shall be installed for all exposed work and for all concealed work in applications where conduit is required.

f. Conduit shall be by Allied, Triangle, Republic, Youngstown, Carlon, Rob Roy, or approved equal.

2. Conduit Installation:

a. All wiring in mechanical rooms at heights below 12 feet must be run in conduit. Otherwise, wiring in all other open areas must have conduit (at all heights).

b. All conduits to be installed in a concealed manner where possible and shall be installed parallel to the lines of the building.

c. All exposed conduits shall be installed parallel or at right angles to the building walls or floors.

d. Conduit bends shall be made with standard hickeys of proper size; radius of bends to be at least 6 times the diameter of the conduit. Runs between outlets shall not contain more than the equivalent of three quarter bends. Conduit runs shall be continuous from outlet to outlet, outlet to cabinet, etc.

e. Conduits shall be installed with pitch toward outlet box wherever possible. All heavy wall conduits shall have two locknuts and a bushing at each termination outlet box, junction box, etc., except where terminated in a threaded hub. Fittings on electrometalic tubing shall be compression type.

f. A bushing shall be used where conduit enters a panel box. Bushing for No. 4 AWG or larger shall be insulated type with provisions for grounding as type "BL" made by O-Z Electric Company, or approved equal.

g. Expansion fittings shall be provided at all conduits across the building expansion joints. Fittings shall be Type "AX" or "TX" as made by O-Z Electric Company, or approved equal. Provide copper bonding jumper at each expansion fitting.

h. All ½’’ conduit to be supported every 6', the supports will be located at the connector end of the conduit.

i. Exposed conduit shall be securely fastened in place on maximum 5 ft. intervals for 3/4" through 2-1/2 inch nominal sizes. Supports may be one hole malleable straps or other approved devices. No perforated metal straps will be permitted.

I. Wireway:

1. Furnish and install at all control panel locations a NEMA 1 lay-in wireway system to bring cable into and out of the panel as specified in this section. Furnish 3-way wireways at each panel location: one for Class 1 wiring, 1 for Class 2 and Class 3 wiring. Panels at units to be NEMA 1 or better.

2. Wireway systems at locations where cables are to be run without conduit or in a cable tray shall consist of a connection to the control panel with a vertical extension to 8’-0” or the pipe rack or cable tray level, whichever is higher. The vertical section shall terminate in a 90° fitting with a closure plate. The closure plate shall be provided with a conduit nipple with locknuts and bushings as a wire entry point into the square duct. The conduit nipple shall be one size smaller than the wireway it is associated with.

3. Bridle Rings: Support of wire shall be at least 8’ on center. Erico Caddy Bridle Rings for attachment to structure as required.

4. Wireway systems at locations where cables are to be run in conduit shall consist of a horizontal section of wireway with a length equal to the control panel width and located above the control panel and connected to the control panel with three conduit nipples, locknuts, and bushings; one for tubing, one for Class 1 wiring and one for Class 2 and 3 wiring. Conduits for cable runs shall terminate on the wireway.

5. The intent of the wireway configurations outlined above is to provide a method for adding input and output wiring to the control panel without having to drill directly into the electronics enclosure after the system is on-line and running and to provide sufficient area to land field conduits while maintaining appropriate circuit segregation for wire entry into the controller enclosure. The installation of wireway shall be made with this consideration in mind.

J. Hangers and Anchors:

1. Where control system tubing is run on trapezes and/or hangers used by and or installed by other trades, supports for the trapezes shall be coordinated by all trades using the trapeze to assure that the anchor system is not overloaded and is sufficient for the load imposed including a margin of safety and seismic considerations. Under no circumstances shall a trapeze or hanger system installed by the electrical trades be used to support work by any other trade, nor shall the electrical trades use the trapezes installed by any of the other trades for the support of electrical equipment, all as required by the National Electric Code. Similarly, under no circumstances shall a trapeze or hanger system installed by the sprinkler trades be used to support work by any other trade, nor shall the sprinkler trades use the trapezes installed by any of the other trades for the support of sprinkler systems or equipment, all as required by NFPA 13, Standard For The Installation Of Sprinkler Systems.

2. Anchors to be loaded in tension for use in existing concrete structure and anchors loaded in tension and not cast in place shall be epoxy resin set anchors installed per the manufacturers recommendations for technique, size, loading, embedment, etc. Where anchors are loaded in shear at these locations, suitably sized and installed wedge type anchors may be used.

3. In all cases, anchor loading shall be based on hanger spacing, weight of the pipe to be supported when full and insulated, weight of any additional loads imposed upon the anchor, wind loading, seismic loading, quality of the material that the anchor is being installed in, etc. The Control Contractor shall verify in the field that the anchors used and the materials that they are being installed in are suitable for the load imposed and shall bring any problems to the attention of the Commissioning Agent in writing immediately and not proceed without direction from the Commissioning Agent.

4. Wedge type anchors shall be Hilti Kwik Bolt II. Adhesive anchors shall be Hilti HVA.

2.3 CURRENT SWITCHES

A. The status of all non–VFD fan and pump motors and all VFD fan and pump motors less than 20 HP shall ONLY be detected using current switches.

B. The current switch shall be provided for electrical equipment status applications only.

C. Switch should attach directly to the conductor and have a mounting bracket for installation flexibility.

D. The current switch shall be 100% solid state electronics.

E. The current switch shall be induce powered from the monitored load

2.4 CURRENT SENSORS/TRANSFORMERS

A. The status and amperage of all VFD motors for fan and pumps shall be detected using current sensors ONLY. A local server with switched output is acceptable.

2.5 output devices

A. Control Relays:

1. 20 amp rated contacts at 277 volts.

2. 10 million cycle rated mechanical contacts.

3. -30º F to 140º F operating range.

4. LED status light.

5. Override HOA device.

6. NEMA 1 rated housing.

7. Functional Devices Inc. RIB or equal.

8. For devices located in control panels provide with rail mount socket.

## PART 3 Direct Digital Controls

3.1 software

A.Existing.

3.2 Schedules

A. The existing AHU schedules remains the same which is 24/7 operation. The usages of basement differ from main floors. Coordinate unoccupied/occupied, etc basement schedules with owner.

3.3 Trending

A. Contact Engineer for additional trended points.

## PART 4 System Setup

4.1 Labeling and Identification

A. All devices relating to the work or systems included herein, including controllers, valves, motors, relays, etc., shall be identified with a unique identification number or name on the submitted engineering drawings. This identification number or name, along with the service of the device (discharge air controller, mixed air controller, etc.), shall be permanently affixed to the respective device.

B. All field devices will be supplied with a nameplate indicating its name, number, address, and all other pertinent information.

C. If the field device is too small for the nameplate to be "adhered" to or on another piece of equipment near it (e.g., nameplate on air handling unit at wire penetration for mixed air temperature sensor), then attach the nameplate via nylon ties.

D. Tagging shall be computer generated. For input/output wiring, cabling, or tubing, the panel side of the terminals shall be labeled with the automation panel circuit board and terminal numbers associated with the point. The field side shall be labeled with the point number. Cable, wiring and tubing not specifically associated with an input or output shall be labeled with a number and function.

E. All wiring, tubing, and cabling both inside and outside of control panels shall be labeled at both ends using Thomas and Betts EDP printable wire and cable markers using style WSL self-laminating vinyl. Input and output cables and wiring shall be labeled with the point number and the point description, such as:

CPDPS005Primary Heating WaterPump #1 On/Off Status

F. Cable and wiring not specifically associated with an input or output shall be labeled with a number and a function description such as:

120 VAC

Panel #

4.2 Safety Circuits

A. All safety circuits shall be hard wired circuits with independent manual reset type switches.

END OF SECTION 23 0923