

# ADDENDUM

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**PROJECT:**  
Clear Creek Middle School  
Addition

**CONTRACTOR:**  
Charles Black Construction Co. Inc.  
1955 Highway 120 South  
Cleveland, GA 30528

**ADD NO.:** CCMS.ADD.001

**PROJECT NO.:** 17134

**RE:** Bid Set Dated: July 9,2018

**ARCHITECT:**  
Breux & Associates Architects  
5955 Shiloh Road East, Suite 200  
Alpharetta, GA 30005

**DATE:** September 10, 2018

**TO:** Prospective Bidders

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This addendum forms a part of the Contract Documents and modifies the Bidding Documents by additions, deletions, clarifications or corrections. Where a portion of the Bid Documents is modified or deleted by this Addendum, the unaltered portions of the Bidding Documents shall remain in effect. Acknowledge receipt of this addendum on the Bid Form. Failure to do so may subject the Bidder to disqualification.

This Addendum consists of five (5) items.

## CHANGES TO SPECIFICATIONS:

**Item No. 1** **PRIOR APPROVALS.** *Subject to compliance with specified requirements, include the following manufacturers and/or product lines:*

### Section 105113 – Metal Lockers

1. DeBourgh Mfg. Co.

**Item No. 2** *Section 066116 – Solid Surface Fabrications: REVISE section 2.1.B as shown below:*

- B.** ~~Sills: 3/4 inch~~ **1/2 inch** - thick, solid surface material.

**Item No. 3** *Section 230700 – Insulation: ADD section included with this addendum.*

**Item No. 4** *Section 230900 – HVAC Automatic DDC Controls- REPLACE entire section with attached section 230900R – HVAC Automatic DDC Controls.*

**Item No. 5** *Section 238000 - HVAC Major Equipment: DELETE section 2.03 as shown below:*

### **2.03 ~~ELECTRIC CEILING HEATERS~~**

- A.** ~~Electric ceiling heaters unless noted otherwise shall be recessed mounted with a fan for forced air supply. U.L. Listed unit shall be complete with mounting bracket, electric junction box, totally enclosed and corrosion resistant element, heavy duty permanently lubricated totally enclosed motor, balanced propeller fan, off white radial blade supply/perforated return steel grille for 2' x 2' T bar lay in ceiling installation, and tamper proof built in thermostat or tamper proof wall thermostat with locking guard as specified in Section 23-0900.~~
- B.** ~~Electric unit heater shall be same as above except with louvered enclosure on four sides, suspended on rods and no locking cover.~~
- C.** ~~Basis of Design is Markel; or approved equivalent product by Indeeco, Trane, Redd I, Q Mark, Raywall, or Berke.~~

## ATTACHMENTS:

230700 – Insulation

230900R – HVAC Automatic DDC Controls

**End of ADD.001**

**SECTION 23 0700  
INSULATION**

**PART 1 - GENERAL**

**1.01 MECHANICAL GENERAL**

- A. Section 23 0010 is applicable.

**1.02 HOT SURFACE INSULATION SYSTEM**

- A. Installed to prevent unwanted heat transfer. Installed on hot pipes and equipment.
- B. Insulation need not be installed within wall or floor sleeves.
- C. Pipe hangers may touch pipe if insulation encloses hanger.

**1.03 COLD SURFACE INSULATION SYSTEM**

- A. Installed to prevent unwanted heat transfer, minimize sweating of pipes, ducts, and equipment, and provide a continuous high-quality vapor retarder on the outer surface of the insulation.
- B. Insulation shall be continuous through wall and floor sleeves.
- C. Pipe hangers shall be outside pipe insulation system.
- D. Staples, screws, rivets, or any other securement device that punctures the vapor retarder shall not be used.

**1.04 DUCT INSULATION**

- A. Installed to prevent unwanted heat transfer to or from ducts and to prevent sweating of ducts and equipment.
- B. Insulation shall be continuous through wall sleeves, except at fire dampers. Insulate fire damper flanges on supply air ductwork.
- C. Staples, screws, rivets, or any other securement device that punctures the vapor retarder shall not be used.

**1.05 ITEMS NOT INSULATED**

- A. Insulation is not to be installed on domestic water plated fixtures & fixture supply piping, hot valve bonnets, valve stems, hot flanges, or hot unions; unless noted otherwise.

**1.06 PIPES THAT SHALL BE INSULATED**

- A. Domestic Hot Water and Hot Water circulating lines.
- B. Domestic Cold Water except where concealed within plumbing chases or within pipe riser shafts.

**1.07 DUCTS THAT SHALL BE INSULATED**

- A. All ductwork shall be insulated, unless specifically noted otherwise in this Specification.

**1.08 EQUIPMENT AND TANKS THAT SHALL BE INSULATED**

- A. Air Handling Units, etc. shall be internally factory insulated.

**PART 2 - PRODUCTS**

**2.01 ABBREVIATIONS FOR MANUFACTURER'S NAMES**

- A. O-CF - Owens-Corning Fiberglass Company
- B. JM - Johns Manville
- C. F - Foster Products Corporation
- D. 3M - Minnesota Mining and Manufacturing Company
- E. PC - Pittsburgh Corning
- F. DM - Delta Maid

- G. CT - CertainTeed
- H. K - Knauf
- I. AER - Aeroflex USA, Inc.
- J. C - Childers
- K. ARM - Armacell
- L. K-F - K-Flex
- M. ITW - ITW Insulation Systems

## 2.02 PIPE INSULATION

- A. Domestic hot water: Molded glass fiber 4 to 8 pound density in 36" long sections, split lengthwise, with self-sealing laps and all service jacket; thermal conductance of 0.25 Btu-in/hr-ft<sup>2</sup>-F maximum at 100F mean temperature. Compliant with ASTM C547, Type I, Grade A. O-CF, JM, K.
  - 1. Pipes - 1/2" thru 1-1/4" = 1" thick
  - 2. 1-1/2" thru 2" = 1-1/2" thick
  - 3. Over 2" = 2" thick
- B. Domestic cold water and interior condensate drains: Moulded glass fiber 4 to 8 pound density in 36" long sections split lengthwise, 1/2" thick. Compliant with ASTM C547, Type I, Grade A. O-CF, K, JM.
  - 1. As an alternative, interior condensate drains may be insulated with flexible, closed-cell, elastomeric insulation, compliant with ASTM C547, Type I, Grade A. Basis of design Armacell Armaflex AP, or approved equivalent product by Aeroflex, K-Flex, Aerocell, or Proflex.
    - a. Condensate drains - Up to 2" = 1/2" thick
    - b. Condensate drains - Over 2" = 3/4" thick

## 2.03 INSULATION JACKETS ON PIPING

- A. Protective outer jackets shall be provided for all outdoor applications, where needed for increased resistance to physical abuse, and where needed for aesthetic purposes.
- B. All insulation systems (except refrigerant piping insulation systems) located outdoors shall be covered with aluminum jacketing compliant with ASTM C1729 and secured with stainless steel banding and seals.
  - 1. Aluminum jacketing on straight pipe shall be 0.016" thick and comply with C1729, Type I, Grade 1, Class A, which shall have bare outer surface, 3105 or 3003 alloy, and a 3 mil thick multi-layer polyfilm moisture barrier factory heat laminated to the interior surface.
- C. Hot pipe and domestic cold water fiberglass insulation systems located indoors shall be covered with all-service jacket (ASJ). Fire retardant kraft-foil-glass yarn, white with factory-applied self-sealing longitudinal laps and circumferential joints sealed with ASJ butt strips.

## 2.04 INSULATION FOR FITTINGS, VALVES, PRVS, STRAINERS, STEAM TRAPS, UNIONS, AND FLANGES

- A. Hot Pipes (not including domestic water plated fixtures & fixture supply piping, unions & flanges): Shall be of same material and thickness as 2.02 above, and with insulation jacket as specified above. Finish any insulation terminations with white mastic. PVC fitting covers with low density batt insulation are not acceptable.
- B. Domestic cold water: Shall be of same material and thickness as 2.02 above. Provide 2-piece factory preformed fittings or mitered insulation. Maintain continuous vapor barrier.

## 2.05 DUCT AND PLENUM INSULATION

- A. Insulation:
  - 1. Flexible glass fiber with factory applied foil-skrim-kraft jacket and laps. Insulation on all ductwork shall conform to the following minimum specifications.

2. Glass fiber for ductwork installed in return air plenum: 4.2 minimum R-value, 0.75 lb/ft<sup>3</sup> minimum density, 1-1/2" minimum thickness.
  3. Glass fiber for ductwork installed in the attic (above the plane of the building insulation): 8.5 minimum R-value, 0.75 lb/ft<sup>3</sup> minimum density, 3" minimum thickness.
  4. All insulation (U.N.O.): O-CF, JM, CT, K.
- B. Mechanical fasteners: Weld pins and retainers or pin applied with adhesive.
- C. Tapes : 4" wide foil-skrim-kraft with vapor barrier adhesive.

## **2.06 ADHESIVES - GENERAL**

- A. Adhesives are packaged in cans and require stirring during application to result in firm bond. Adhesives applied to surfaces and to insulation require a time period to achieve a proper dry surface before final positioning in order to obtain a firm bond. Insulation which is not firmly bonded to surfaces, edges or joints shall be removed and replaced.
- B. All adhesives shall be flame retardant U.L. approved.
- C. Adhesive for flexible elastomeric insulation shall be an air drying contact adhesive applied per manufactures recommendations. Adhesive: Armacell Armaflex 520, or approved equivalent product.
- D. All adhesives used shall be recommended by the insulation materials supplier and by the adhesive manufacturer for the intended application.

## **PART 3 - EXECUTION**

### **3.01 GENERAL**

- A. All work shall be installed in strict accordance with applicable building codes, ordinances, and manufacturer's written instructions, except as noted below.
- B. Insulation materials shall not be applied until the following have been completed:
1. Rust, scale, dirt, and moisture removed from surfaces.
  2. Required tests such as pressure and leak-testing.
  3. Heat tracing.
- C. Insulation shall be kept clean and dry. If insulation becomes wet, the insulation shall be removed from the jobsite and replaced with new.
- D. Protect installed products until completion of project.
- E. Seal all vapor retarder joints, breaks, and punctures with vapor retarder tape or vapor retarder coating.

### **3.02 CLEARANCES**

- A. Plan piping and ductwork layouts so that pipes and ducts are far enough apart and from adjacent surfaces to permit installation of insulation and air movement over surfaces.

**END OF SECTION**

**SECTION 23 0900**  
**HVAC AUTOMATIC DDC CONTROLS**

**PART 1: GENERAL**

**1.01 SCOPE OF WORK**

- A. The Building Automation System (BAS) Contractor shall furnish and install all necessary controls and programming to fully integrated new equipment into the existing building automation system, incorporating direct digital control (DDC) for energy management, equipment monitoring and control as herein specified. The system shall include all required computer software and hardware, controllers, sensors, transmission equipment, local panels, conduit, wire, installation, engineering, database setup, supervision, commissioning, acceptance test, training, warranty service, and extended warranty service if so requested by owner.
  - 1. The system software and hardware shall be BACnet listed, use native BACnet as its communication protocol. System components shall be certified by a BACnet Testing Laboratory and display the BTL mark where applicable.
- B. The BAS shall be capable of total integration of the facility infrastructure systems (where required) with user access to all system data either locally over a secure Intranet within the building or by remote access by a standard Web Browser over the Internet.
- C. The BAS shall communicate to third party systems such as chillers, boilers, air handling systems, energy metering systems, access control systems, fire-life safety systems and other building management related devices with open, interoperable communication capabilities.
- D. All materials and equipment used shall be standard components, regularly manufactured for Building Automation Applications.
- E. The installation of the control system shall be performed by an employee of the controls manufacturer authorized representative with the shop drawings, flow diagrams, bill of materials, component designation or identification number and sequence of operation all bearing the name of the authorized representative. This installing controls contractor shall certify, in writing, that the shop drawings have been prepared by their direct employees. In addition, the controls contractor shall certify in writing that all temperature control equipment was installed under their direct supervision by direct employees of their firm. NO SUBCONTRACT LABOR is acceptable.
- F. The Web based system shall seamlessly communicate transferring data to and from the existing BAS system The BAS shall be able to view all information residing on any existing Controllers as well as make adjustments to set-points and scheduling through the same interface that is currently in use. The BAS shall also be able to make programming changes to the control logic residing in the existing BAS system managers and controllers, if so required.
- G. All sites must seamlessly communicate directly to the existing iNTREO server located at the Board Office at the WBBC site. The Web based system shall communicate transferring data to and from the existing BAS system utilized throughout the county. All existing legacy systems throughout the county shall seamlessly integrate to the iNTREO Server. A separate link/icon through a web browser is unacceptable. Currently, Gilmer County Schools utilizes the Board Approved iNTREO BAS system throughout its school district. This project shall utilize this same system. No substitutions will be reviewed and/or accepted.

**1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Drawings and general provisions of the Contract, including General and supplementary Conditions and Division-1 specification sections, apply to work of this section.
- B. Duct smoke detectors shall be installed by Division 23 contractor, furnished and wired into the fire alarm system under another section (Division 26). This Section includes wiring shut down contacts in smoke detectors and fire alarm signal relays to the automatic temperature control system.
- C. Products furnished but not installed under this section:

1. Valves, flow switches, flow sensors, and thermo-wells to be installed under section 23.
  2. Automatic dampers to be installed under section 23.
- D. Coordination with electrical:
1. Installation of all line voltage power wiring by Division 26.
  2. Each motor starter provided under Division 26, shall be furnished with individual control power transformer to supply 120-volt control power and auxiliary contacts (one N.O. and one N.C.) for use by this section.
  3. Division 26 contractor shall be responsible for providing the electrical box rough-in and conduit stub-out for the room sensors/thermostats as shown on the mechanical plans. The Division 26 Contractor shall coordinate with Division 23 Automatic Temperature Control Contractor for exact locations and type electrical box required (i.e. single gang, double gang) and mounting method (vertical/horizontal).
  4. Wiring of any electrical sub-metering devices furnished by BAS Contractor.

### 1.03 QUALITY ASSURANCE

- A. The system shall be furnished, engineered and installed by the manufacturers' locally authorized representative. The controls contractor shall have factory-trained technicians to provide instruction, routine maintenance and emergency services within 24 hours upon receipt of request. Contractor shall have been engaged in the engineering, installation and service automatic HVAC direct digital control systems for at least Ten (10) years and at least Fifteen (15) years of legacy automation system components and service within the Gilmer County School district. Due to this, Control Concepts is the sole source provider of the Gilmer County Schools DDC System. Further, the controls contractor must have at least Five (5) years of extensive experience with the iNTREO product. All installation personnel shall be fully insured. Contractor shall provide proof of insurance prior to beginning work. All installation of control system shall be by direct employees of the manufacturer's representative.
- B. At the time of bid, all BAS Programmable Equipment Controllers shall be listed as follows:
1. American Society for testing and materials, ASTM
  2. Institute of Electrical and Electronic Engineers, IEEE
  3. National Electrical Manufacturers Association, NEMA
  4. Underwriters Laboratory (UL)
  5. FCC Regulation, Part 15, Section 156
  6. National Fire Protection Association (NFPA)
  7. National Electric Code (NEC)
  8. Uniform Mechanical Code (UMC)
  9. ASHRAE 135-2001
  10. Uniform Building Code (UBC)

### 1.04 SUBMITTALS

- A. Submit 10 complete sets of documentation in the following phased delivery schedule:
1. Valve and damper schedules
  2. BACnet Controller PIC Statement
  3. Equipment data cut sheets
  4. System schematics, including:
    - a. Sequence of operations
    - b. Point to point wiring
    - c. Interface wiring diagrams
    - d. Panel layouts
    - e. System riser diagrams
    - f. AutoCAD compatible as-built drawings
- B. Upon project completion, submit operation and maintenance manuals, consisting of the following:
1. Index sheet, listing contents in alphabetical order

2. Manufacturer's equipment parts list of all functional components of the system, disk of system schematics, including wiring diagrams
3. Description of sequence of operations
4. As-Built interconnection wiring diagrams
5. User's documentation containing product, system architectural and programming information.
6. Trunk cable schematic showing remote electronic panel locations, and all trunk data
7. List of connected data points, including panels to which they are connected and input device (ionization detector, sensors, etc.)
8. Copy of the warranty
9. Operating and maintenance cautions and instructions
10. Recommended spare parts list
11. A copy of the "as-built" control diagram for each system shall be mounted and framed under glass/plastic and displayed in the main Mechanical Room. Framed control diagrams shall be hung on the wall adjacent to the main system DDC control panel.

#### 1.05 REFERENCES

- A. ANSI/ASHRAE STANDARD 135-2010 BACnet® -A Data Communication Protocol for Building Automation and Control Networks
- B. Underwriters Laboratories (UL) - Automation and Control Networks UL 916 and 854UDTZ
- C. Uniform Building Code (UBC)
- D. Section 608; Shutoff for Smoke Control
  1. Section 403.3; Smoke Detection Group B Office Buildings and Group R
  2. Section 710.5; Wiring in Plenums
  3. Section 713.10; Smoke Dampers
  4. Section 1106; Refrigeration Machinery Rooms
  5. Section 1107; Refrigeration Machinery Room Ventilation
  6. Section 1108; Refrigeration Machinery Room Equipment & Controls
  7. Section 1120; Detection and Alarm Systems
- E. National Electric Code (NEC)
- F. National Electrical Manufacturers Association, NEMA
- G. Uniform Mechanical Code (UMC)
- H. FCC Regulation, Part 15, Section 156
- I. National Fire Protection Association, NFPA
- J. ISO - International Organization for Standardization (ISO 16484-5)

#### 1.06 DEFINITIONS

- A. BACnet - An open communications protocol for building automation and control networks. It is an ASHRAE, ANSI, and ISO standard protocol.
- B. BAS - Building Automation System, this may also be referred to as BMS "Building Management System" or EMS "Energy Management System"
- C. DDC - Direct Digital Control
- D. IP - Internet Protocol
- E. Native BACnet - A device that uses BACnet as its standard communication language so as not to require the use of gateways for protocol translation.
- F. B-AWS - BACnet Advanced Operator Workstation
- G. B-BC - BACnet Building Controller
- H. B-AC - BACnet Advanced Application Controller
- I. B-ASC - BACnet Application Specific Controller

- J. BTL - BACnet Testing Laboratories
- K. BIBB - BACnet Interoperability Building Blocks
- L. PICS - Protocol Implementation Conformance Statement
- M. BLC -Building Level Controller

## **PART 2: BUILDING LEVEL CONTROLLER & OPERATOR WORKSTATION**

### **2.01 GRAPHICAL USER INTERFACE SOFTWARE**

- A. Operating System:
  - 1. The GUI shall run on current Microsoft Windows versions.
- B. The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimum knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.
- C. The graphical software must reside directly on the iNTREO Server. No third party graphical applications that sit on top of the iNTREO Server are allowed.
- D. All graphical images must be in SVG (Scalable Vector Format) only. JPG, BMP, PNG, etc are NOT allowed.
- E. All graphics must utilize HTML5 or current industry supported formats. Java applets and Flash applets used to display graphics are NOT allowed.
- F. Ductwork must be shown on all floorplans along with room numbers, room temperatures, and unit names. Each of these items must be capable of being independently turned on/off on the graphics. Turning on/off these layer items must be done at the client level, not server level.
- G. A mouse over of the room temperatures on the floorplans should provide a popup displaying additional unit details, including effective setpoints, supply temperature, and unit mode.
- H. Summaries of each scheduled zone should be created that show all temperatures, occupied setpoints, fan/cool/heat status, occupancy status, supply temperature and other unit relevant items to allow a user to quickly assess a zone of control from one screen. Summaries must also indicate if ANY point of an associated unit is overridden, has a note, or has any alarm by way of a hand/alarm/note icon.
- I. The ability to add unlimited notes to any graphic as well as tracking who made the note and the time the note was added. The ability to remove the last added note or clear all notes should be possible and should depend on access rights. Note should also be stored in the central historical database.
- J. Overrides displayed on unit graphics showing user who initiated override, override value and time remaining until override expires. A numerical value displays total number of overrides on a unit.
- K. Alarms shown on unit graphics showing items in alarm as well as how long the item has been in alarm and the total number of alarms.
- L. All setpoints shall have the capability to be either permanently set or temporarily overridden depending on user rights. Overrides must automatically go back to permanent values depending upon user defined override time per point.
- M. A graphic display of the thermostat on each unit with the capability to control the thermostat buttons as if standing in front of the physical thermostat.
- N. Items that can be overridden/set must highlight when moused over to indicate that they can be adjusted.



- O. The global ability to set all occupied/unoccupied cool/heat and other relevant items with one click.

## 2.02 WEB BROWSER CLIENTS

- A. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™ or Mozilla Firefox. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.
- B. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the FMCS, shall not be acceptable.
- C. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.
- D. The Web browser client shall support at a minimum, the following functions:
  - 1. User log-on identification and password shall be required. If an unauthorized user attempts access, an error message will be displayed. After 3 failed attempts, the user will be locked out for a minimum of 1 hour. Security using TLS 1.2 or greater must be used for authentication.
  - 2. Storage of the graphical screens shall be in the iNTREO Server, without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
  - 3. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
  - 4. All scheduling must reside on the iNTREO Server and be performed via the iNTREO Server.
  - 5. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
  - 6. The system shall provide the capability to specify a user's (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.
  - 7. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

## 2.03 SERVER FUNCTIONS, HARDWARE AND MAINTENANCE

- A. A central iNTREO server, currently located in the WBBC Center, shall be maintained by this contractor as well as the legacy servers integrated to the numerous other legacy sites within the county installed since 1998 during the construction of this project. This shall include, but not be limited to:
  - 1. Hard drive/equipment replacement
  - 2. Hard drive backups
  - 3. Restoration of corrupted data
  - 4. Resolution of network issues that arise between legacy and new equipment.
  - 5. Remapping of software points to legacy systems.
  - 6. Maintaining all Gilmer County technician access (new AND legacy sites).
- B. Local connections shall be via a local Ethernet LAN. Remote connections can be via customer existing WAN.

### **PART 3: PRODUCTS, HARDWARE**

#### **3.01 GENERAL**

- A. The Building Automation System (BAS) shall be comprised of a network of interoperable, stand-alone digital controllers. The BAS shall incorporate the native BACnet communication protocol for all unitary, terminal and other device controllers. Each DDC controller must be BTL listed and fully programmable.

#### **3.02 ACCEPTABLE MANUFACTURERS**

- A. iNTREO Control System as installed by Control Concepts, Inc. Please contact Jeff Morrison at 770-527-1732 or 770-888-0181.
- B. No other control systems will be reviewed and/or accepted.

#### **3.03 OBJECT WRITABLE PROPERTIES**

- A. The following objects and properties must be supported in any BACnet communicating hardware.
  - 1. ANALOG INPUT: This object shall have the following minimum writeable properties: Object Name; Description; Present Value; COV Increment; Out of Service; Time Delay; Notification Class; High Limit; Low Limit; and Deadband.
  - 2. ANALOG OUTPUT: This object shall have the following minimum writeable properties: Object Name; Description; Present Value; COV Increment; Out of Service; Time Delay; Notification Class; High Limit; Low Limit; and Deadband.
  - 3. ANALOG VALUE: This object shall have the following minimum writeable properties: Object Name; Description; Present Value; COV Increment; Out of Service; and Units.
  - 4. BINARY INPUT: This object shall have the following minimum writeable properties: Object Name; Present Value; Description; Polarity; Time Delay; Notification Class; Alarm Value; and Out of Service.
  - 5. BINARY OUTPUT: This object shall have the following minimum writeable properties: Object Name; Present Value; Description; Polarity; Relinquish Default; Min on Time; Min off Time; Out of Service; Time Delay; Notification Class; Feedback Value; and Change of State County.
  - 6. BINARY VALUE: This object shall have the following minimum writeable properties: Object Name; Present Value; Description; and Out of Service.
  - 7. CALENDAR: This object shall have the following minimum writeable properties: Object Name; Description; and Date List.
  - 8. DEVICE: This object shall have the following minimum writeable properties: Object Name; Description; Location; Max Master; and Max Info Frames.
  - 9. EVENT ENROLMENT: This object shall have the following minimum writeable properties: Object Name; Description; Notification Class; Object Property Reference; and Event Parameters.
  - 10. FILE: This object shall have the following minimum writeable properties: Object Name; Description; and Archive.
  - 11. LOOP (PID): This object shall have the following minimum writeable properties: Object Name; Object Value; Description; Action; Bias; Controlled Variable Reference; Controlled Variable Units; Controlled Variable Value; COV Increment; Derivative Constant; Derivative Constant Units; Integral Constant; Integral Constant Units; Manipulated Variable Reference; Output Units; Out of Service; Priority for Writing; Proportional Constant; Proportional Constant Units; Setpoint; and Setpoint Reference.
  - 12. NOTIFICATION CLASS: This object shall have the following minimum writeable properties: Object Name; Description; Priority and Recipient List.
  - 13. PROGRAM: This object shall have the following minimum writeable properties: Object Name; Program Change; Out of Service; and Description.
  - 14. SCHEDULE: This object shall have the following minimum writeable properties: Object Name; Description; Effective period; Schedule Default; Out of Service; Weekly Schedule; Priority for Writing; and List of Object Property References.

15. TREND LOG: This object shall have the following minimum writeable properties: Object Name; Description; Log Enable; Start Time; Stop Time; Log Device Object Property; Log Interval; Stop When Full; and Record Count.
16. MULTI-STATE VALUE: This object shall have the following minimum writeable properties: Object Name; Present Value; Description; and Out of Service.
17. NOTIFICATION CLASS; This object shall have the following minimum writeable properties: Object Name; Description; Priority; and Recipient List.

### 3.04 FIELD DEVICES

- A. Provide automatic control valves, automatic control dampers, thermostats, clocks, sensors, controllers, and other components as required for complete installation. Except as otherwise indicated, provide manufacturer's standard control system components as indicated by published product information, designed and constructed as recommended by manufacturer.
- B. Temperature Sensors
  1. Wall Mount Room Sensors: Each room sensor shall provide temperature indication to the Digital Controller; provide the capability for software-limited set point adjustment and operation override capability. An integral LCD shall annunciate current room temperature and set point as well as override status indication; LCD screen shall be fully customizable by being able to change values displayed on screen through controller programming. In addition, the thermostat shall include a port for connection to access DDC system via a laptop computer using Bluetooth and be capable of having optional Humidity, CO2, or occupancy sensing features built in. Thermostat LCD shall be fully programmable and display colors based upon unit mode (red = heat, blue = cool, light green = deadband). In addition, LCD sensors should have ability to enter an ECO mode should the occupant desire or the county require. ECO mode adjusts setpoints to provide additional energy savings and performs other control strategies. The LCD screen will change a deep green when in ECO mode to indicate to occupants that systems are controlling in an ECO mode sequence. Sensors types shall be installed where required.
  2. Duct mounted averaging sensors shall utilize a sensing element incorporated in a copper capillary with a minimum length of 20 feet. The sensor shall be installed according to manufacture recommendation and looped and fastened at a minimum of every 36 inches.
  3. Sunshields shall be provided for outside air sensors.
  4. Thermo-wells for all immersion sensors shall be stainless steel or brass as required for the application.
- C. Humidity Sensors: Humidity sensors shall be of the solid-state type using a capacitance-sensing element. The sensor shall vary the output voltage with a change in relative humidity. Room humidity sensors shall have a minimum range of 10% to 90%  $\pm$ 5%. Supply air humidity sensors shall have a range of 10% to 90%  $\pm$  5%.
- D. Air Velocity Sensors: The sensor shall use differential pressure to determine airflow rate and have repeatability within 1% of reading and an accuracy of  $\pm$  5% of range. The velocity range shall be from 0 to 3250 FPM.
- E. Pressure Sensors: The differential pressure sensor shall be temperature compensated and shall vary the output voltage with a change in differential pressure. Sensing range shall be suitable for the application with linearity of 1.5% of full scale and offset of less than 1% of full scale. Sensor shall be capable of withstanding up to 150% of rated pressure without damage.
- F. Air Quality Sensor: The air quality sensor shall be capable of simultaneously monitoring various types of Volatile Organic Compounds (VOCs). The sensor shall be capable of monitoring from 100% air quality to 0% air quality and shall produce a linear 0-10 VDC or 4-20 VDC signal. The Air Quality Sensor shall be provided in wall or duct mounted models, as shown on the plans.
- G. Occupancy Sensor: Occupancy sensor shall be of the passive infrared or ultrasonic receiver type or other reliable sensor type. As a minimum the occupancy sensor shall provide adjustments for timed-on delay and sensor sensitivity.
- H. Switches and Thermostats

1. The BAS Contractor shall furnish all low voltage relays and coordinate with the supplier of magnetic starters for auxiliary contact requirements. All electric control devices shall be of a type to meet current, voltage, and switching requirement of their particular application. Relays shall be provided with 24 VAC coils and contacts shall be rated at 10 amps minimum.
  2. Duct Smoke Detectors: Duct smoke detectors shall be supplied by others with an integral auxiliary contact to be used by the BAS contractor to provide a digital input to the BAS.
  3. Low Temperature Detection Thermostats: Shall be the manual reset type. The thermostat shall operate in response to the coldest one-foot length of the 20-foot sensing element, regardless of the temperatures at other parts of the element. The element shall be properly supported to cover the entire downstream side of the coil with a minimum of three loops. Separate thermostats shall be provided for each 25 square feet of coil face area or fraction thereof.
  4. Current Sensing Relays: Motor status indications, where shown on the plans, shall be provided via current sensing relays. The switch output contact shall be rated for 30 VDC, .15 amps.
  5. Flow Switches (proof of flow): Motor status indications (if specifically required), where shown on the plans or called out in points list, shall be provided via flow switches. Flow switches shall be of the paddle type equipped with SPDT contacts to establish proof of flow. Flow switches shall be installed by Mechanical Contractor.
  6. Carbon-Dioxide Sensor: Single detectors, using solid-state infrared sensors, suitable over temperature range of 23 to 130 deg F, calibrated for 0 to 2 percent, with continuous or averaged reading, 4 to 20 mA output, and wall or duct mounted.
  7. Firestats: Fire thermostats shall provide manual reset, fixed temperature line voltage type with a bi-metal actuated switch.
- I. Damper Actuators
1. Actuators shall be of the push-pull or rotary type of modulating, 3-point floating, or 2-position control as required by the application. The actuator shall use an overload-proof synchronous motor or an electric motor with end switches to de-energize the motor at the end of the stroke limits. Control voltage shall be 24VAC, 0-20VDC, or 4-20ma as required. Actuators shall be available with spring return to the normal position when required. Actuators shall have a position indicator for external indication of damper position. Actuators shall have manual override capability without disconnecting damper linkage.

#### **PART 4: EXECUTION**

##### **4.01 PROJECT MANAGEMENT**

- A. Provide a project manager who shall, as a part of his duties, be responsible for the following activities:
1. Coordination between this Contractor and all other trades, owner, local authorities and the design team.
  2. Scheduling of manpower, material delivery, equipment installation and checkout.
  3. Maintenance of construction records such as project scheduling and manpower planning and AutoCAD for project co-ordination and as-built drawings.
  4. Coordination/Single point of contact

##### **4.02 INSTALLATION METHODS**

- A. Install systems and materials in accordance with manufacturer's instructions, rough-in drawings and equipment details. Install electrical components and use electrical products complying with requirements of applicable Division-16 sections of these specifications.
- B. The term "control wiring" is defined to include providing of wire, conduit, and miscellaneous materials as required for mounting and connecting low voltage electronic control devices.
- C. All exposed wiring, low and line voltage subject to mechanical damage, shall be run in EMT conduit. Line and low voltage wiring shall be run in separate conduits. Concealed but accessible wiring, except in mechanical rooms and areas where other conduit and piping are

exposed shall run in UL plenum rated cable as approved by local codes unless expressly restricted by requirements in Division 16 specification.

- D. All Controllers, Relays, Transducers, etc., required for stand-alone control shall be housed in a NEMA 1 enclosure with a lockable door.

#### 4.03 CONTROL WIRING

- A. All low voltage wiring and BAS controllers, computers and network components shall be the responsibility of the BAS contractor.
- B. The electrical contractor (Div. 16) shall furnish all power wiring to BAS Controllers, Computers and any networking equipment (routers, hubs, switches, etc.).
- C. All wiring shall be in accordance with the Project Electrical Specifications (Division 16), the National Electrical Code and Applicable local codes. All FMCS wiring shall be installed in the conduit types specified in the Project Electrical Specifications (Division 16) unless otherwise allowed by the National Electrical Code or applicable local codes. Where FMCS plenum rated cable wiring is allowed it shall be run parallel to or at right angles to the structure, properly supported and installed in a neat and workmanlike manner.

#### 4.04 SYSTEM ACCEPTANCE

- A. General: The system installation shall be complete and tested for proper operation prior to acceptance testing for the Owner's authorized representative. A letter shall be submitted to the Engineer requesting system acceptance. This letter shall certify all controls are installed and the software programs have been completely exercised for proper equipment operation. Acceptance testing will commence at a mutually agreeable time within ten (10) calendar days of request. When the field test procedures have been demonstrated to the Owner's representative, the system will be accepted. The warranty period will start at this time.
- B. Field Equipment Test Procedures: DDC control panels shall be demonstrated via a functional end-to-end test. Such that:
  - 1. All output channels shall be commanded (on/off, stop/start, adjust, etc.) and their operation verified.
  - 2. All analog input channels shall be verified for proper operation.
  - 3. All digital input channels shall be verified by changing the state of the field device and observing the appropriate change of displayed value.
  - 4. If a point should fail testing, perform necessary repair action and retest failed point and all interlocked points.
  - 5. Automatic control operation shall be verified by introducing an error into the system and observing the proper corrective system response.
  - 6. Selected time and set-point schedules shall be verified by changing the schedule and observing the correct response on the controlled outputs.
- C. As-Built Documentation: After a successful acceptance demonstration, the Contractor shall submit as-built drawings of the completed project for final approval. After receiving final approval, supply "6" complete 11x17 or 8 ½ x 11 inch as-built drawing sets, together with AutoCAD diskettes to the owner.
- D. Operation and Maintenance Manuals: Submit three copies of operation and maintenance manuals. Include the following
  - 1. Manufacturer's catalog data and specifications on sensors, transmitters, controllers, control valves, damper actuators, gauges, indicators, terminals, and any miscellaneous components used in the system.
  - 2. An operator's manual that will include detailed instructions for all operations of the system.
  - 3. An operator's reference table listing the addresses of all connected input points and output points. Settings shall be shown where applicable.
  - 4. A programmer's manual that will include all information necessary to perform programming functions.

5. Flow charts of the control software programs utilized in the DDC system.
6. Flow charts of the custom software programs utilized in the DDC system as approved.
7. Complete program listing file and parameter listing file for all programs.
8. A copy of the warranty.
9. Operating and maintenance cautions and instructions.

#### **4.05 TRAINING**

- A. Contractor shall provide to the engineer a training class outline prior to any scheduled training.
- B. Factory trained control engineers and technicians shall provide training sessions for the Owner's personnel.
- C. The control contractor shall conduct one (1) two-hour training courses for the designated owner's personnel in the maintenance and operation of the control system.
- D. The course shall include instruction on specific systems and instructions for operating the installed system to include as a minimum:
  1. HVAC system overview.
  2. Operation of Control System
  3. Function of each Component
  4. System Operating Procedures
  5. Programming Procedures
  6. Maintenance Procedures

#### **4.06 4.6 WARRANTY**

- A. The control system shall be warranted to be free from defects in both material and workmanship for a period of two (2) years of normal use and service once the system is on-line and fully operational.

### **PART 5: SEQUENCE OF OPERATION**

#### **5.01 CONTROLS SEQUENCE FOR WALL MOUNT GAS UNITS**

- A. A control module shall be provided for each unit to control the fan, compressor and gas heat in the unit. A wall mounted temperature sensor located in the space shall provide an analog input signal to the control module. A wall mounted humidity sensor (or combo t/h sensor) located adjacent to the temperature sensor shall be provided for units with a dehumidification cycle.
- B. Each unit shall be programmed to start and stop according to the day/night schedule provided by the Owner.
  1. Occupied Mode: When system is enabled by BAS during normal time-scheduled Occupied hours or by user-actuated override, BAS shall open outside air damper to scheduled CFM value position, and operate stages of heating & cooling to maintain separate heating & cooling Occupied space temperature setpoints. Supply air fan shall run continuously during all Occupied modes.
  2. Night Set-up/Set-back Temperature Control: During Unoccupied hours, system shall be controlled to maintain separate Unoccupied heating and cooling setpoints. Supply air fan shall ONLY RUN on a call for heating or cooling. Outside air damper shall be closed.
  3. Cool-down/Warm-up Mode: Prior to Occupied time schedules, system shall be turned ON by control system using time scheduling or "smart recovery" technology, and heating and cooling shall be provided as required to satisfy Occupied temperature setpoints. Supply air fan shall ONLY RUN on a call for heating or cooling. Outside air damper shall be closed.
  4. Each system shall have an ion generator installed, and generator shall be energized only when supply air fan is energized.

**END OF SECTION**