

**230923 - DIRECT DIGITAL CONTROL SYSTEM FOR HVAC****HVAC Control System Specification**

Controls Contractor shall be prequalified by the state of New Jersey Dept of Treasury for HVAC Work, Control Systems, Energy Management Systems for no less than \$15 million in aggregate.

Contractor shall provide evidence that they are a factory authorized representative for Andover Controls Buildings Business Division of Schneider Electric. The Board of Education has standardized on extending the existing Andover Controls/Schneider Electric HVAC control systems. No exceptions.

**Specification for Work:**

Contractor shall propose the following work in conformance with a mandatory site survey and this specification. No deviations from this specification are acceptable.

A new BACnet based control system shall be installed to provide uniformity and consistency throughout the District.

The new control systems shall replace any existing controls (DDC, electronic, pneumatic, stand alone, etc) and will seamlessly integrate to the existing Andover Controls PC and Graphics workstations at the existing sites. A new workstation and (1) new Laptop PC will be provided at the PS #3.

New systems shall include all labor, material, control wiring, line voltage/power wiring and capping and safing off of existing controls.

**1.0 WORK INCLUDED**

- A. This work includes the provision of all labor, components, material, parts, equipment, engineering, programming, and start-up to furnish and install new BMS controls at the site.
- B. New control work shall include the work specified in this document which will include BMS or conventional controls for:

**New Front End PC / Graphics Workstation Access via any Lap Top**

Control contractor shall provide web accessible based front end PC to communicate with and interface with all new control equipment. Provide BCX controllers as appropriate for connection to district network by Owner.

**Boiler Room new Aerco Heating Plant**

DDC controls and wiring for control and monitoring of Boilers, domestic hot water heating systems, pumps and misc equipment as specified.

**Unit Ventilators:**

Hot Water and interlocked fin tube radiation

**Roof top Air Handling Unit**

Direct Expansion Cooling, Gas fired heat, Economizer and Demand Controlled Ventilation

Misc. Cabinet / Unit Heaters, Fin Tube Radiation, Convectors, Exhaust Fans

System shall be comprised of Stand Alone Digital Microprocessor based controllers that monitor and control HVAC Equipment via Electronic Sensors and Transmitters and solid state Transducers, Relays and other components.

**DIRECT DIGITAL CONTROL EQUIPMENT:**

Manufactures:

1. Andover Controls by Schneider Electric
2. Trane controls
3. Alerton

- C. New Router/Controller shall be installed at each site by the Control Contractor. The AS controller and new PC workstations will require I/P addresses which will be coordinated through the District's IT department.

The new PC graphics shall upgrade the Struxureware, remotely accessible via any Web Browser, locally or remotely.

- D. New Plant Controllers, Air Handlers, Unit Ventilator, VAV box and other local terminal controllers shall be fully compliant with BACnet standard 134-2010 and shall have PICS documentation of each component including software, front end OWS and field controllers. SE Continuum B3 series. No substitutions.
- E. The DDC Based portion of the control system shall include all necessary microprocessor-based panels, pre-wired control panels, ep transducers, thermistors and other components necessary to provide a turnkey fully operable DDC/ATC system. The DDC System scope of work shall include all low voltage DDC/ATC wiring from control panels to fire alarm panels, smoke detectors, freezestats and other fan / unitary safety circuits.
- F. Any valve piping work is by Mechanical Contractor:
- Control Contractor shall provide electric control, isolation and butterfly valves, threadolet wells and separable thermowells for DDC System sensors, flanged or insertion style flow meters, pressure sensor taps and other devices required to be installed into the piping

The Sheet Metal Contractor shall furnish labor for:

- New AHU control and isolation dampers, air flow measuring stations, smoke detectors (where applicable by contract) and other devices required to be installed into the ductwork

1.1 QUALITY ASSURANCE

- A. Control Contractor shall have an established local office with factory trained staff and service mechanics within 60 miles of project site.
- B. Controls contractor shall be a direct factory branch office or authorized representative for DDC System manufacturer for at least ten years.
- C. Bids by wholesalers, dealers or any other firm not authorized by the DDC System manufacturer to design, install and service Integrated Direct Digital / Life Safety /Access Control Systems shall not be acceptable.
- D. Controls contractor shall be SDA and NJ Department of Treasury DPMC approved for HVAC, Energy Management Systems, Control Systems and shall have been successfully installing BACnet based integrated control systems for at least 10 years.

## 1.2 DESCRIPTION OF WORK

### A. Scope

1. As part of the Controls renovations at the school, Contractor shall assist with the demolition of existing controls and install new controls in full compliance with this specification.
2. As part of the Controls renovations, the systems will be retrofitted to maximize energy efficiency. All sequences and new software routines will be designed to operate equipment as efficiently as possible. The following energy savings routines will be implemented and developed between the Contractor and Owner:
  - a. Occupancy, holiday, school calendar and event scheduling using 365 day calendar
  - b. Demand controlled ventilation
  - c. Free cooling/economizer control
  - d. Automatic heating/cooling season changeover
  - e. Lead / Lag pump control

### B. Description of Responsibilities

1. All wiring of sensors and control devices including any power wiring of devices and necessary conduit shall be provided under this section of the specifications. All control and power wiring which is provided under this section shall be in strict accordance with wiring requirements in this specification.
2. All 120 volt power circuits to the DDC panel(s) shall be provided by this Contractor.

### C. System Description

1. Control and Monitoring Points: Provide Input/Output points sufficient to meet specified sequence of operation. Contractor to provide BACnet based, stand alone, field controllers with mstp field bus communication. Controllers shall provide digital, analog inputs and outputs of adequate capacity to suit application. Controllers shall have the ability to be custom programmed. No application specific controllers are acceptable.
2. Expansion Capabilities - Spare control points:
  - Provide at least 2 outputs per DDC Controller as spares for future expansion.
  - These points shall be installed in the system and require no additional hardware to activate.
  - These points shall be user selectable for Digital vs. Analog, or twice the number (half digital/half analog) must be supplied.
3. System Expansion:
  - Additional I/O controllers and Access Control panels may expand the System size in modular fashion by simply adding controllers to the Level II network.
  - System shall have ability to be expanded to twice the original size without requirement for additional Level I controller.

#### 4. Front End Requirements & Graphical Workstation

- Ethernet Controller / Routers each capable of handling no less than 127 controllers each. Install minimum of one in each school within 50ft of data closets.
- (1) New PC and web accessible Cyberstation graphics front end workstation at each site
- B Link signal repeaters for MSTP bus in data closets

### 1.3 CONTROL SYSTEM EXECUTION

- A. Installation of DDC System shall be performed by this Contractor. Only factory trained mechanics shall be used for the System installation. They shall be thoroughly experienced in installing Digital Control systems and their related subsystems. System installation shall be performed by a Contractor licensed for electrical work. Permits and inspection costs are responsibility of this Contractor.
- B. All installation work shall be supervised by a factory trained project manager, regularly employed by the Controls Contractor, who has managed projects of this size and scope.
- C. All work shall be installed in strict accordance with all Local and National governing codes.
- D. Where the drawings and job specifications conflict with code requirements, the contractor shall make the necessary adjustments and base his bid on an installation which complies with those codes.
- E. Where plans and specifications exceed code requirements, the plans and specifications shall govern.
- F. Where plans and specifications conflict one another, the Contractor shall base his bid on the greater scope.

### 1.4 CONTROL AND INTERLOCK WIRING

- A. All control wiring shall be provided by this contractor for the installation of the Direct Digital/ Temperature Control (DDC/ATC) System. This wiring shall conform to NEC and local codes, and shall adhere to the following:
  1. All wiring run exposed, in mechanical rooms, classrooms/corridors etc shall be in EMT or wiremold (unless expressly approved by the A/E or Owner). Refer to NEC Regulations for conduit fill capacities. Exceptions may be coordinated between Control Contractor and Owner but in no case shall the Control Contractor install wiring that violates local, National Electrical Code.

All low voltage wiring run concealed shall be plenum rated and shall be supported every six feet with hangers or wire ties. Wiring run in dropped ceiling or plenums/chases shall be securely tied, bundled, and run parallel to the building structure.
  2. Sensor wire runs exposed shall be installed in wiremold. Wiremold box shall also be painted to match. Coordinate all material colors and finishes with Architect. Provide product samples if requested.
  3. All wires (line and low voltage) shall be clearly labeled to correspond to wire identifications shown on system submittal.

## 2.0 DDC SYSTEM INTERFACE COMPONENTS

- A. DDC System components including relays, contactors, transducers, temperature and humidity sensors, transmitters, power supplies and other input and output devices wired to the DDC Panel shall conform to the following specification:
1. Temperature Sensors:
    - Shall be 10,000 Ohm Thermistors suitable and selected for Outdoor, Duct, Space, or Ambient Temperature Sensing. Space Sensors shall be Stainless Steel type STS3S or equal with blank faceplate. Sensors shall have set point adjust.
  2. Air Flow Switches:
    - Air Flow Switches shall be provided for monitoring fan status.
    - For monitoring Fan Status provide connection from intake side of fan section of unit to negative port of airflow switch. Adjust range to approximately .05" w.c. per manufacturers recommendations. Cleveland Controls AFS-262 shall be utilized with a range of .02" to 2" W.C.
  3. Relays and Contactors:
    - Control Relays shall be Idec Model RH 24 VAC Coil, single, double, triple or four pole and double throw suited for the application.
    - Relays shall be track mounted in Pre-wired control panels unless remote installation of relays at starters or motor control centers is required. Contact rating is 10A at 120V.
    - Contactors shall be single, double, triple pole and single throw suited for the application.
    - Contactors shall be mounted in pre-wired control panels unless remote installation of contactor is required.
    - Contact rating shall be 30A at 120V.
  4. Dampers / Actuators (Where dampers and actuators are not being supplied by manufacturer of HVAC equipment )
    - Control dampers shall be provided by the ATC/DDC System contractor and installed by the sheet metal contractor.
    - Dampers utilized for outside, return, exhaust air or other low leakage type applications shall not allow any more than 1% leakage through the damper at 1500/fpm at 2" W.C.
    - Damper blades shall be parallel blade for two position operation and opposed blade for modulating operation.
    - Damper shall be Ruskin RCD 45 or equal.
    - Damper actuators shall be the electric direct coupled type with either 24 or 120 volt motors and sized to meet torque requirements.  
**Manufacturer: Belimo**
  5. Control Valves (Electric two and three way Valves)
    - All existing valves to be replaced with new or as specified.
    - Control valves shall be fully proportioning, unless otherwise specified, quiet in operation and shall be arranged to fail in either a fail-safe 'heat' or normally open or normally closed position.
    - The open or closed position shall be as specified or as required to suit project application.

- Control valves shall be sized such that pressure drop through the valve does not exceed 25 % of the pressure drop through that part of the piping system.
- Valves shall be sized by the ATC/DDC System contractor and guaranteed to meet the flow, cv and pressure drop requirements as specified and indicated on the drawings and equipment schedules.
- The globe valve's plug stems shall be stainless steel and shall be guided to insure perfect seating.
- Characterized ball valves may be used in lieu of globe valves so long as the ATC Contractor guarantees proper flow, cv and linear control performance.
- Characterized ball valves shall carry three year warranty.
- All valves shall be equipped with fully modulating actuator (2-10vdc) with visual valve position indicator.
- All valves shall spring return to fail safe position without the use of battery back-up or capacitor discharge.
- **Manufacturer: Belimo**

6. Other:

- Other monitoring and control components required for the installation of the ATC / DDC System not specifically mentioned or specified above, shall be fully integrated with the DDC System, and shall function in a fully compatible fashion.

### 3.0 LOCAL PRE-WIRED CONTROL PANELS

- A. Lockable Nema 1 rated steel construction pre-wired / tested control panels shall be provided for each controlled mechanical system and shall include terminal blocks, gauges, switches, relays, contactors, transducers, filters, and other components required for the proper interfacing of the DDC panel to the HVAC System components. One required for every two rooms unless application required individual room control.
- B. LOCAL PRE-WIRED CONTROL PANELS  
Submit panel details including wiring and pneumatic pipe routing and component layouts to Architect for approval. Panels shall be pre-tested prior to installation. Plastic troughing shall be utilized for routing all tubing and wiring.

### 4.0 SUBMITTALS

#### 1. PRE-CONSTRUCTION SUBMITTALS

1. A complete submittal package shall be submitted to the Owner or their Agent for approval. Submittals may be partials and work may commence if the products and equipment exactly matches the equipment previously installed under similar projects. Time is of the essence and the contractor may release equipment, at his/her own risk, to expedite the installation process.
2. The submittal shall contain the following:
  - Table of Contents
  - Bill of Materials/Components Index
  - Component Manufacturers Data Sheets
  - Valve Schedules and Valve Data Sheets
  - Damper Schedules and Damper/Actuator Data Sheets
2. AutoCad Generated Wiring Diagrams/Shop Drawings showing new (or existing) networks and locations of tie in points for new network controllers

## B. POST CONSTRUCTION SUBMITTALS

1. A Complete As-Built Submittal package shall be submitted at the completion of the project and shall include all items mentioned above in Section 4.0.A, however add the following:
  - Autocad (Ver. 13) Drawings on Disk of all control schematics, panel details and field details including wire runs, termination box / control panel locations and MER details
  - Fully documented software manual with program copy and Plain English interpretation of functionality
  - Copy of Field Engineer's FUNCTIONAL TEST reporting that each input and output has been field verified for accuracy and integrity
2. Software Manual
  - The software manual shall describe programming and testing, starting with a system overview and proceeding to a detailed description of each software feature.
  - The manual shall instruct the user on programming or reprogramming any portion of the system. This shall include all control programs, variables, set points, time periods, messages, passwords and other information necessary to load, alter, test and execute the system.

## 5.0 UL AND CSA LISTING

- A. DDC Systems shall be UL and CSA listed as an Energy Management System. (UL916)

## 6.0 CUSTOMER TRAINING

- A. Instruction of Owner's Personnel
  1. Provide the services of competent instructors, who will give full instruction to designated personnel in the operation, maintenance and programming of the DDC System.
  2. Orient the training specifically to the system installed rather than a general training course.
  3. Instructors shall be thoroughly familiar with the subject matter they are to teach.
  4. A minimum of twenty-four hours of training shall be provided in a minimum of four sessions.
  5. Provide a training manual for each student, which describes in detail the data included in each training program.
  6. Provide equipment and material required for classroom training.
- B. Training on the functional operation of the system shall include:
  1. Operation of the equipment
  2. Programming
  3. Diagnostics
  4. Failure recovery procedures
  5. Alarm formats (where applicable)
  6. Maintenance and calibration
  7. Troubleshooting and repair instructions

## 7.0 SEQUENCE OF OPERATION

- A. DDC System shall provide control sequences as outlined in this section and on the drawings and shall also incorporate the following Energy Management Routines to optimize HVAC System operation and energy efficiency. Where sequences of operation are not specific, they shall be developed by the Contractor and submitted the Owner/Engineer for review and approval.
1. OPTIMIZED START/UP AND SHUTDOWN
  2. OUTSIDE AIR / FREE COOLING CONTROL
  3. DEMAND CONTROLLED VENTILATION/ECONOMIZER
  4. ALARMING AND RUN-TIME TOTALIZATION ON HVAC EQUIPMENT
  5. TIME OF DAY SCHEDULING AND ZONE OCCUPANCY CONTROL
  6. ENERGY REDUCTION STRATEGIES

## 8.0 WARRANTY

Entire System shall be guaranteed to operate per functional specification and manufacturers recommendations for a period of one year from date of Owner acceptance. Responses to emergency service may include on or off-site troubleshooting. Two seasonal maintenance inspections shall be provided at each site lasting no less than two days. These inspections shall be coordinated with Owner so seasonal checks can be made on existing heating/cooling equipment. Any issues with the new system shall be rectified immediately at no cost to the Owner.

### Sequence of Operation

#### AIREDALE CLASSROOM AC UNIT (HOT WATER HEATING WITH DX COOLING)

The Airedale Unit will be provided with a Time Clock, Spring Wound 6hr Override Timer, DDC Controller, wall mounted space sensor, a low limit discharge sensor, a 2 way hot water coil spring open control valve and a normally closed damper actuator. The units shall be controlled in accordance with the following space temperature control program.

The unit will operate stand alone and the time clock will facilitate occupancy programming. The spring wound override timer will provide a temporary override of the time clock functions.

The unit shall be indexed for occupied/unoccupied cycle from the time clock.  
The unit can be indexed to the occupied mode for up to 6 hours from the spring wound timer.

The room temperature sensor shall have local setpoint adjustments and shall be initially set for 74 Deg F. The setpoint adjustment shall be limited from the internal program to plus or minus 5 Deg F of programmed setpoint.

When the unit is in the unoccupied mode, the supply / exhaust fans are off, the outdoor damper shall be closed and the 2 way heating valve shall modulate to maintain 90deg f supply air temperature. The unoccupied room setpoint shall cycle the unit fan motor to maintain a minimum space temperature of 60 Deg F.

In the occupied mode, the outdoor sensor will determine summer/winter mode. The supply and exhaust air fans shall run continuously and the space sensor (through the low limit discharge air sensor) shall proportionately position the 2 way hot water coil control valve and the outdoor and return air damper in sequence to maintain the desired space temperature. The outdoor intake damper shall be prevented from opening during warm up period. When the hot water valve is fully closed and the space temperature continues to rise, the outdoor intake damper shall open to provide up to 100% outdoor air. If the outdoor damper is full open with the heating valve closed



and there is a continued call for cooling, the damper will reset to minimum and the mechanical cooling cycle will be enabled.

An auto-reset anti-freeze stat located on the leaving air side of the hot water coil is provided and installed by the unit manufacturer. The anti-freeze stat shall stop the unit supply and exhaust fan motors, close the outdoor damper and open the hot water coil control valve. The anti-freeze stat shall be reset when the air leaving the heating coil rises ten degrees. The setpoint of the low limit freeze stat is set at 38 Deg.F.

**END OF SPECIFICATION 230923**