

Addendum 03

DOCUMENT 00 91 00

DATE: February 26, 2026

PROJECT: Put-in-Bay Local Schools
1919 Building Renovations
548 Catawba Avenue
Put-In-Bay, Ohio 43456

PROJECT #: 25019.01

OWNER: Put-in-Bay Local Schools
Contact: Scott Mangas, Superintendent
548 Catawba Avenue
Put-In-Bay, Ohio 43456

ARCHITECT: Garmann Miller
38 South Lincoln Drive
P.O. Box 71
Minster, Ohio 45865

TO: Prospective Bidders

This addendum form is a part of the Contract Documents and modifies the Construction Documents dated February 12, 2026, with amendments and additions noted below.

Acknowledge receipt of this Addendum on the Bid Form. Failure to do so may disqualify the Bidder.

This addendum consists of 2 pages, 6 specification sections, 4 re-issued drawing sheets.

FOR INFORMATION ONLY

1. Pre-bid meeting minutes and the pre-bid meeting sign-in sheet are attached.
2. Questions and Answers Only
 - a. Question: Is the school relocating / storing the desks, chairs, etc.?
 - i. Answer: Please see Demolition Floor Plan General Notes item #3 on A1 Series drawings.



CHANGES TO THE PROJECT MANUAL

1. 23 09 13 - Instruments and Control Elements – Revised entire section.
2. 23 09 93 - Sequence of Operations – Revised entire section.
3. 23 81 26 – Variable Refrigerant Volume System – Added Lennox/Samsung as an approved manufacturer.
4. 23 81 26.13 – Split System Heating and Cooling – Added Lennox/Samsung and Fujitsu as an approved manufacturer.
5. 27 51 23-CENTRAL SOUND AND PAGING SYSTEM – Fixed clerical and formatting errors. See changes in **Bold**.
6. 27 53 13-CLOCK SYSTEM – Fixed clerical and formatting errors. See changes in **Bold**.

CHANGES TO THE DRAWINGS

1. MD1.2 – Added removal of ductwork and diffusers in new technology room location.
2. M2.2 – Rebalanced airflows with removal of ductwork and diffusers in new technology room.
3. M5.1 – Increased the cooling capacity of SSCU-B101a and SSCU-B101b.
4. M5.2 – Updated "FOR REFERENCE ONLY" schedules to accurately reflect units to be provided by owner.

ATTACHMENTS

The following attachments are included and are part of this addendum:

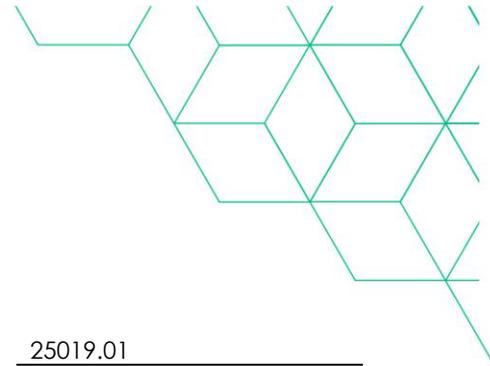
Pre-bid meeting minutes and the pre-bid meeting sign-in sheet.

Specifications Sections: 23 09 13, 23 09 93, 23 81 26, 23 81 26.13, 27 51 23, 27 53 13

Drawing Sheets: MD1.2, M2.2, M5.1, M5.2,

END OF ADDENDUM





Pre-Bid meeting

Project name	Put in Bay Schools 1919 Building Renovations	GM project no.	25019.01
Meeting date	02/24/2026	Meeting location	Put in Bay Schools District Office

Minutes

1. Attendees: Sign in sheet
2. Introductions
3. Project overview – New roofing, interior doors, casework, interior finishes, updated plumbing, fire protection, HVAC, electrical and technology work. New HVAC rooftop units and new electrical switchboard are being pre-purchased by the School District. New technology equipment replacement work is being done under a separate contract and construction work is scheduled to be ongoing at the same time as this project.
4. Bidding
 - a. Date: March 11, 2026, at 1:00pm
 - b. Location: 2011 219 Howard Drive, Sandusky, Ohio, 44870
 - a. Use the bid form provided.
 - b. Plans have been submitted to Ottawa County Building Department for review and permits, costs to be paid by owner.
5. Bid categories
 - a. General construction, non-prevailing wage
6. Alternates- refer to Specification Section 01 23 00 - Alternates
 - a. Alternate #01: Standing Seam Metal Roof over 1919 Original Building
 - b. Alternate #02: Standing Seam Metal Roof over 2001 and Library Additions
 - c. Alternate #03: Shingle Roof over 2001 and Library Additions
 - d. Alternate #04: HVAC Controls by Wadsworth Solutions
7. Contracts will be administered by Garmann/Miller & Associates, Inc.
 - a. All questions and correspondence to go through Garmann Miller
 - b. All RFIs to go through Garmann Miller
 - c. Pay applications to go to Garmann Miller
 - d. Garmann Miller will schedule a preconstruction meeting with the contractor after the notice of award.
8. Schedule
 - a. Tentative award date – March 24, 2026



- b. Start of construction – June 1, 2026
- c. Completion date – August 21, 2026
- d. Further information on this schedule will be issued in a future addendum.

9. General conditions

- a. Waste Removal: by Contractor
- b. General Contractor
 - i. Responsible for construction schedule and general supervision
 - ii. Submit preliminary schedule 10 days after notice to proceed.
 - iii. Responsible for scheduling and administering job meetings; prepare agenda, responsible for meeting minutes and distributing copies.
- c. Responsible for field office
- d. Responsible for telephone service/fax to field office.
- e. Responsible for sanitary facilities
- f. Barriers
- g. Fencing
- h. Exterior and interior enclosures
- i. Project sign

10. Temporary electricity

- a. Electrical contractor to provide service, temporary power, temporary lighting, temporary service to general contractor job trailer, if needed.
 - i. Temporary service to other job trailers is the responsibility of individual requiring.
- b. Cost of electricity by Contractor – if additional temporary electrical service is required. If fed from existing building, cost of electricity is by owner.

11. Temporary heat

- a. Prior to building enclosure: Contractor requiring.
 - b. After building enclosure:
 - i. Method by contractor
 - ii. Cost by Owner
- If systems are not operational at the time of school beginning, the contractor is responsible for providing temporary heating/cooling/ventilation as required.

12. Temporary water

- a. The general contractor shall connect to water utility supply and pay for installation of temporary metered service including tap fees and extend temporary water service to location required.
- b. Cost by Owner

13. Substitution requests are due 10 days prior to bid.

14. Correspondence

- a. Correspondence to run through Garmann Miller
- b. CURT SOUTH – csouth@creategm.com



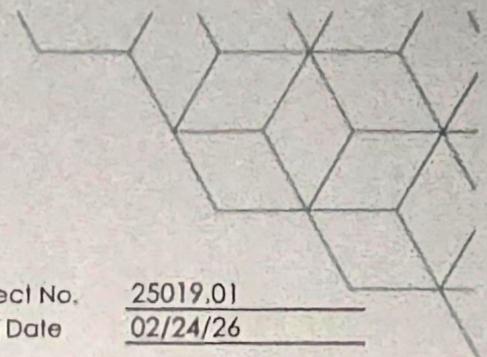
- c. ANDREW HUELSMAN – ahuelsman@creategm.com
- d. KEVIN RINDERLE – krinderle@creategm.com
- e. JASON FLEMING – jfleming@creategm.com

15. Questions and Answers

- a. Question - Is there roofing work to be included in the base bid?
 - i. Answer – yes
- b. Question – Can the schedule be extended, mobilization in May, project completion in October?
 - i. Answer – this question will be reviewed with the school and addressed in a future addendum.
- c. Question – Are there specific areas that can or specific areas that cannot be used for staging/lay down/contractor parking etc.?
 - i. Answer – this question will be reviewed with the school and addressed in a future addendum.
- d. Question - Is there furniture work to be included in the base bid?
 - i. Answer – no, this will be a separate project, with installation scheduled for Summer 2027
- e. Question – can another site visit be scheduled?
 - i. Answer – this question will be reviewed with the school and addressed in a future addendum.
- f. Question – when are the new rooftop units scheduled to be available?
 - i. Answer – July 2026
- g. Question – when is the new electrical switchboard scheduled to be available?
 - i. Answer – July 2026
- h. Question – Who does most of the hired maintenance for the school?
 - i. Answer – Currently, HVAC and controls maintenance are done by Wadsworth Solutions



GARMANN MILLER



Sign-In Sheet

Project Name Put-in-Bay Schools 1919 Building Renovation GM Project No. 25019.01
 Meeting Location Put-in-Bay Schools District Office Meeting Date 02/24/26

Purpose Pre-Bid Meeting

Attendees

Name	<u>MIKE TORLOW</u>	Phone	<u>419 460-7268</u>
Business/Title	<u>SR. ESTIMATOR</u>		
Email	<u>MTORLOW@MOSSERGROUP.COM</u>		
Name	<u>Dave Harper</u>	Phone	<u>419.392.6333</u>
Business/Title	<u>Estimator / PM</u>		
Email	<u>dave.harper@aaboos.com</u>		
Name	<u>John Wilson</u>	Phone	<u>414 691 2329</u>
Business/Title	<u>A.A. BOOS</u>		
Email	<u>JOHN.WILSON@AABOOS.COM</u>		
Name	<u>PAUL SCHROEDER</u>	Phone	<u>419-265-5192</u>
Business/Title	<u>R.J. RUNGS CO. / PROJECT MANAGER</u>		
Email	<u>BIDS@RJRUNGS.COM</u>		
Name	<u>Jason Fleming</u>	Phone	<u>419 733 2658</u>
Business/Title	<u>Garmann Miller / Const. Admin</u>		
Email			
Name	<u>Kevin Rinderle</u>	Phone	
Business/Title	<u>Garmann Miller / Electrical</u>		
Email	<u>krinderle@creategm.com</u>		
Name	<u>Jay Schwartz</u>	Phone	<u>440-477-9592</u>
Business/Title	<u>Fiorilli Construction</u>		
Email	<u>J.SCHARTZ@FIO-CON.COM</u>		
Name	<u>CARMEN FIORILLI</u>	Phone	<u>216-646-5845</u>
Business/Title	<u>Fiorilli Construction - President</u>		
Email	<u>CF@FIO-CON.COM</u>		

@ creategm.com

Minster, OH | Columbus, OH | Indianapolis, IN | Fort Wayne, IN

**SECTION 23 09 13
INSTRUMENTS AND CONTROL ELEMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Transmitters:
 - 1. Building static pressure transmitters.
- B. Control valves.
- C. Control valve operators
- D. Control dampers.
- E. Damper operators.
- F. VAV power Supply Boxes.
- G. Transmitters
- H. Building Automation System
- I. Building Automation Equipment
- J. Temperature Control Wiring
- K. Miscellaneous accessories.

1.02 RELATED REQUIREMENTS

- A. Section 01 3516.01 - Material Documentation Sheet
- B. Section 01 5721 - IAQ Construction and Preoccupancy
- C. Section 01 5721.01 - IAQ Planning Checklist
- D. Section 01 5721.02 - IAQ Inspection Checklist
- E. Section 01 5721.03 - IAQ Log.
- F. Section 01 6116.01 - Accessory Material VOC Content Certification Form.
- G. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- H. Section 01 9000 - Commissioning. Contractor shall make themselves familiar with the commissioning specification and include appropriate time to work with the commissioning agent.
- I. Section 23 0548 - Vibration and Seismic Controls.
- J. Section 23 0519 - Meters and Gages: Thermometer sockets, gage taps.
- K. Section 23 05 19 - Meters and Gages: Thermometer sockets and gauge taps.
- L. Section 23 0553 - HVAC Identification
- M. Section 23 21 13 - Hydronic Piping: Installation of control valves, flow switches, temperature sensor sockets, and gauge taps.
- N. Section 23 33 00 - Air Duct Accessories: Installation of automatic dampers.

1.03 REFERENCE STANDARDS

- A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating; 2012.
- B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.
- C. ASHRAE Standard 135-2008 BACnet Protocol.

- D. ASHRAE Standard 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Control Diagrams
 1. Submit to the Architect/Engineer a complete system diagram, showing control connections and devices and their connection to other equipment, together with a clearly written description of the system and an outline of its function under conditions of operation.
 2. Product Data: Provide description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module.
 3. Submittals shall be prepared on, or folded to, 8-1/2 inch by 11 inch size and bound in brochure form. Electronic form, pdf format, shall also be included.
 4. DDC logic and control diagrams shall be included for all equipment and sequences of control. Include at a minimum all points shown on DDC control drawings. If any additional points are required to complete the sequence of operation, the control equipment needed to provide this information shall be provided.
 5. Upon completion of the Work, provide the complete, accurate, and approved diagrammatic blueprinted layouts on the automatic control system specified herein and as installed. Layouts shall show all control equipment including job installation changes, and the function of each system shall be indicated. Layouts and descriptions shall be included in the project record set and in the operating and maintenance manuals.
- C. Begin no work until submittals have been approved for conformity with design intent. Provide drawings as flash memory. When manufacturer's cutsheets apply to a product series rather than a specific product, clearly indicate applicable data by highlighting or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work. Provide submittals within 12 weeks after contract award.
- D. 100% completed points lists and sequences shall be submitted no later than the point at which system installation is 50% completed.
- E. Product Data: Provide description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module including, but not limited to the following equipment and components indicating arrangements, capabilities, range, voltage, horsepower, and construction.
 1. Valves
 2. Thermostats
 3. Relays
 4. Panels
 5. Gauges
 6. Sensors
 7. Dampers
 8. Switches
 9. Pressure Controllers
 10. DDC microprocessor
 11. Unitary DDC controllers
 12. Actuators
 13. Blade Server (Supervisory Controller)
 14. Laptop Workstation

15. Wiring

- F. Wiring diagrams and layouts for each control panel.
- G. Floor plan schematic diagrams indicating field sensor, controller and power supply locations.
- H. Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Submit schedule of valves indicating size, flow, and pressure drop for each valve. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.
- I. Contractor shall make themselves familiar with the commissioning specification and include appropriate time to work with the commissioning agent.
- J. Provide information noting items utilizing BACnet technology are BTL certified and listed.
- K. Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors. Accurately record actual location of control components, including panels, thermostats, and sensors.
 - 1. Revise shop drawings to reflect actual installation and operating sequences.
 - 2. After drawings are finalized, provide drawings in pdf format. Include a list of all unit default safety and control settings, whether fixed or adjustable, as shipped from the factory. Where field modifications are required to meet the specification, provide all modification labor and materials, and submit a complete, detailed, step-by-step procedure for modifications.
 - 3. Drawings shall also be installed in workstation as web pages.
- L. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.
 - 1. As-built versions of the submittal product data.
 - 2. Names, addresses, and 24-hour telephone numbers of installing contractors and service representatives for equipment and control systems.
 - 3. Operator's manual with procedures for operating control systems: logging on and off, handling alarms, producing point/object reports, trending data, overriding computer control, and changing setpoints and variables.
 - 4. Programming manual or set of manuals with description of the programming language and syntax of statements for algorithms and calculations used of point/object database creation and modification, of program creation and modification, and editor use.
 - 5. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points/objects, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.
 - 6. Documentation of all programs created using custom programming language including setpoints, tuning parameters, and object database.
 - 7. Graphic files, programs and database on magnetic or optical media.
 - 8. List of recommended spare parts with part numbers and suppliers.
 - 9. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware, including computer equipment and sensors.
 - 10. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software.
 - 11. Licenses, guarantee, and warranty documents for equipment and systems.
 - 12. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
 - 13. Operation & Maintenance manuals shall also be installed in workstation as web pages.

- M. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
- N. After the control submittal has been reviewed and marked "No Exceptions Taken" by the design engineer, the controls contractor shall submit all graphics required for the temperature control system. The graphics shall be reviewed by the owner, commissioning agent, and the design engineer. The temperature control contractor shall not install any graphics until they have been reviewed and approved by the owner, commissioning agent and design engineer.

1.05 SUMMARY

- A. General: The control system shall be as indicated on the drawings and described in the specifications.
- B. The intent of this specification and related sections is to provide a fully integrated, open, interoperable, peer-to-peer networked, distributed Direct Digital Control System. The following communication protocols are acceptable:
 1. ANSI/ASHRAE Standard 135 BACnet - A Data Communication Protocol for Building Automation and Control Networks
 2. ANSI/TIA/EIA-568-B Commercial Building Telecommunications Cabling Standard
- C. The Direct Digital Control System (DDC) shall be based on Schneider Electric EcoStruxure framework. Provide an open automation infrastructure that integrates diverse systems and devices (regardless of manufacturer, communication standard or software) into a unified platform that can be easily managed in real time over the internet using a standard web browser.
- D. **ALTERNATE BID #04:** Under alternate bid #04, provide an alternate for controls by Wadsworth Solutions with front end consistent to the existing school. This should be listed as an add/deduct alternate. If Wadsworth Solutions is the base bid controls contractor, this shall be a no-cost alternate.
- E. It is the Owner's expressed goal for the new controls in the renovation to be integrated into the existing web supervisor. The existing controls and web supervisor in the building is a Schneider Electric EcoStruxure framework provided and serviced by Wadsworth Solutions. The contractor shall provide new controls with the appropriate capacity and licensing capable of integrating the existing equipment into the web supervisor and controls. The contractor should field verify the existing controls in the building.
- F. The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s). In addition, the Owner shall receive ownership of all job specific configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and/or configured for use with the EcoStruxure, and any related LAN / WAN / Intranet and Internet connected routers and devices. Any and all required IDs and passwords for access to any component or software program shall be provided to the Owner. The Owner shall determine which organizations to be named in the SI organization ID ("orgid") of all software licenses. Owner shall be free to direct the modification of the "orgid" in any software license, regardless of supplier, by Schneider Electric.
- G. The Network Controller (NWC) shall connect to the Owner's local or wide area network, depending on configuration. Access to the system, either locally in each building, or remotely shall be accomplished through standard Web browsers and/or the EcoStruxure Supervisor, via the Internet and/or local area network.
- H. Each NWC shall communicate to BACnet (B-AAC, B-ASC), devices and/or other open protocol systems/devices as described on the contract drawings and/or in the specifications.

- I. Direct Digital Control (DDC) technology shall be used to provide the functions necessary for control of mechanical systems for Owner.
- J. The control system shall accommodate a minimum 8 simultaneous multiple user operation utilizing standard web-browser clients. Access to the control system data should be limited only by user ID and operator password. Multiple users shall have access to all valid system data. An operator shall be able to log onto any work-station on the school's network and have access to all appropriate data. All users shall have an unique ID and password. Owner shall provide user information and permission levels ninety days prior to scheduled completion.
- K. The control system shall be designed such that each mechanical system will be able to operate under stand-alone control. As such, in the event of a network communication failure, the loss of any other controller, or the school district network, the control system shall continue to independently operate under control.
- L. Communication between the control panels and all work-stations shall be over a high speed 100 Mbps (at minimum) Ethernet network. All nodes on this network shall be peers. The operator shall not have to know the panel identifier or location to view or control an object. Application Specific Controllers shall be constantly scanned by the network controllers to update point information and alarm information.
 - 1. The communication network wiring between control panels, and equipment controls with BACnet communication cards (VFD, VRV) shall be provided and installed by the temperature control contractor. The use of the owner's network for communication between devices shall be prohibited. Provide a single point of communication between the owner's network and the DDC control system network.
- M. Temperature control contractor shall be responsible for the following:
 - 1. The DDC System shall communicate to the owner's communication network thru a single point of data connection. All wiring and communication downstream of that single point of data connection shall be provided with the DDC control system.
 - 2. Providing of a complete DDC electronic automatic temperature control system.
 - 3. Control of rooftop air handling units, VAV terminals, cabinet heaters, exhaust fans, and Variable Refrigerant Volume Systems along with other miscellaneous equipment as denoted on drawings in accordance with requirements herein specified.
 - 4. Providing of control devices, valves, instruments, and the like, as herein specified and as required to comply with required sequences of automatic control.
 - 5. Providing of wiring for secondary control devices, relay switches, safety low limit controls, etc., and such interlock wiring required.
 - 6. Provide all control wiring between all primary network controllers and equipment furnished with Bacnet control panels. Provide a single point connection to owner's LAN.
 - 7. Wire controls for the water pumps including the Variable Frequency Drives.
 - 8. Coordinate communication requirements for the air handling units controls that are provided by the air handling unit manufacturer.
 - 9. The VRF units for this project will be provided with a Bacnet Controller and will be programmed by the unit manufacturer. The controls contractor shall integrate with these controls for seamless operation from the operator interface to the temperature control system.
 - 10. Tag all automatic controls, instruments, safeties, panels, actuators and relays. Key to control schematic. Refer to specification 23 0553 - HVAC Identification
 - 11. Furnish adequate supervision on Work performed for him by others to insure proper operation and the neatest and best possible arrangement.
 - 12. Testing and maintenance of system as herein specified.

- N. The documentation is schematic in nature. The Contractor shall provide hardware and software necessary to implement the functions and sequences shown.
- O. The Temperature control contractor shall provide the following control valves:
 1. Air Handling Unit Heating and Cooling Coils: Pressure Independent Characterized Control and balance valves with P/T ports or Pressure independent characterized control valves with separate P/T ports on both side of valve.
 2. VAR Boxes: Pressure Independent Characterized Control and balance valve with P/T ports or Pressure Independent characterized control valves with separate P/T ports on both sides of valve.

1.06 QUALITY ASSURANCE

- A. The temperature control contractor shall furnish and install a fully integrated building automation system, incorporating direct digital control (DDC) for energy management, equipment monitoring and control, and subsystems as herein specified. The installation of the control system shall be performed by an authorized dealer of the controls manufacturer with the shop drawings, flow diagrams, bill of materials, component designation or identification number, and sequence of operation all bearing the name of the manufacturer.
- B. All materials and equipment used shall be standard components, regularly manufactured for the specified system. All systems and components shall have been thoroughly tested and proven in actual use of at least 2 years.
- C. The temperature control contractor shall read all other Drawings and Specifications, become familiar with requirements and scope of the Project, and include such coordination work as may be required.
- D. Designer Qualifications: Design system under direct supervision of a Control Engineer experienced in design of this work and is certified by control system manufacturer.
- E. Installer Qualifications
 1. Installing contractor shall have an established working relationship with control system manufacturer of not less than 5 years.
 2. Installing contractor and his sub-contractors shall have successfully completed manufacturer's control system training. Provide certification of completed training, including hours of instruction and course outlines, with bid.
 3. Installing contractor shall have an office within 75 miles of the project site and provide 24 hours response in the event of a customer call, 7 days per week, 365 days per year.
- F. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., UL-916 Energy Management Systems, UL-864UUKL Smoke Systems as suitable for the purpose specified and indicated and shall comply with NFPA 70.
- G. Systems utilizing BACnet technology shall be BTL certified and comply with ASNI/ASHRAE Standard 135, BACnet - A Data Communication Protocol for building Automation and control networks.
- H. Systems utilizing Lonworks shall not be permitted.
- I. Damper components shall meet the requirements of AMCA 500.
- J. Control systems shall meet the requirements of ASHRAE Standard 90.1.
- K. Performance Standards. System shall conform to the following minimum standards over network connections:
 1. Graphic Display. A graphic with 20 dynamic points/objects shall display with current data within 10 seconds.
 2. Graphic Refresh. A graphic with 20 dynamic points/objects shall update with current data within 8 seconds.

3. Object Command. Devices shall react to command of a binary object within 2 seconds. Devices shall begin reacting to command of an analog object within 2 seconds.
4. Object Scan. Data used or displayed at a controller or workstation shall have been current within the previous 6 seconds.
5. Alarm Response Time. An object that goes into alarm shall be annunciated at the workstation within 45 seconds
6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 second. Select execution times consistent with the mechanical process under control.
7. Performance. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per second. Select execution times consistent with the mechanical process under control.
8. Multiple Alarm Annunciation. Each workstation on the network shall receive alarms within 5 seconds of other workstations.

1.07 CONTRACTOR RESPONSIBILITIES

- A. The temperature control contractor shall be responsible for final design drawings, installation of all control wiring and control devices in accordance with National Electric Code. The temperature control contractor shall also be responsible for startup and complete checkout, and commissioning of the systems.
- B. This Contractor shall furnish complete drawings, component lists, specification sheets and sequences of operation to the Architect/Engineer for approval before start of installation.
- C. All DDC logic diagrams shall be updated as built and included in the Operation and Maintenance Manuals for the Owner.
- D. The temperature control contractor is responsible to use all room numbers developed and approved by the owner in the development of the temperature control system for this building.
- E. The Temperature Control Contractor shall work hand-in-hand with the commissioning agent during their work on the project. The laptop provided shall be setup for access to the temperature control system for use by the commissioning agent.
- F. The temperature control contractor shall demonstrate system to commissioning agent. As part of commissioning agent check-out, TCC shall create logs for any points as requested by CxA.
- G. The temperature Control Contractor shall provide labeling for all control system sensors, panels, actuators, etc. The label names shall match the point names given on the computer and as shown on the temperature control drawings.
- H. The temperature control contractor shall contact the boiler manufacturer to integrate the control and monitoring points specified in the sequence of operations. The connection to the boiler controller shall be thru BACnet/IP, BACnet over ARCNET, BACnet MS/TP.
- I. The temperature control contractor shall contact the chiller manufacturer to integrate the control and monitoring points specified in the sequence of operations. The connection to the chiller controller shall be thru BACnet/IP, BACnet over ARCNET, BACnet MS/TP.
- J. The temperature control contractor shall contact the Variable Refrigerant Flow (VRF) manufacturer to integrate the control and monitoring points specified in the sequence of operations. The connection to the VRV controller shall be thru BACnet/IP or BACnet MS/TP.
 1. Prior to the submittal of the temperature controls for approval by the engineer, the temperature control contractor shall meet with a representative of the VRF manufacturer for training/coordination (minimum 4 hours) on the integration of the VRF system.
- K. The temperature control contractor shall provide all control valves, balance and control valves, differential pressure controllers balance valves, as indicated on drawings.

- L. Sizing of Valves: Valves shall be furnished to the Division 23- Mechanical Contractor who will mount them as piping is installed. Valves sizes shall be as recommended by the Temperature Control Contractor who shall be responsible for their proper sizing, regardless of indicated valve or line size on the drawings.
- M. The temperature control contractor shall be responsible to provide AC Power Supplies as noted on the temperature control drawings. Temperature Control contractor shall be responsible to provide low voltage wiring from power supplies to VAR reheat box controllers. Submit wiring diagram as part of temperature control submittal.

1.08 SOFTWARE LICENSE AGREEMENT

- A. The owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to the owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software. The owner shall receive a copy or multiple copies licensed to them of any local programming tool required to replace or program local controller.
- B. It is the owner's goal to implement an open system that will allow products from various suppliers to be integrated into an unified system in order to provide flexibility for expansion, maintenance, and service of the system.
- C. The owner shall be named license holder of all software associated with any and all incremental work on the project(s). The owner shall receive a copy or multiple copies licensed to them of any local programming tool required to replace or program local controller.
- D. In addition, the owner shall receive ownership of all job-specific configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job-specific software code and documentation for all configuration and programming that is generated for a given project.
- E. The owner shall be provided with all usernames and passwords required from complete and unlimited access to the system.

1.09 PRE-SUBMITTAL MEETING

- A. The temperature control contractor shall review the sequence of operation and note any exceptions or planned deviations from the specified sequence. Prior to creating the control submittal the control contractor shall contact the design engineer and setup a meeting to discuss the exceptions and planned deviations. The design engineer will not review any submittals until after this meeting has taken place.

1.10 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a one year period following owner acceptance of entire building.
- C. Warranty shall also include any software upgrades available during the one (1) year period.
- D. Temperature control contractor shall provide support for operation of the system and improvements to energy usage to the owner throughout the first two years of operation after the date of substantial completion.

1.11 MAINTENANCE SERVICE

- A. Provide service and maintenance of control system for one year from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. The design intent is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate both the ANSI/ASHRAE Standard 135-2008 BACnet protocol in one open, interoperable system. System shall be capable for future extension by other manufacturer's and shall not be write-protected. The existing system is the Schneider Electric EcoStruxure system.
- B. Control Manufacturers (Certified by BACnet testing laboratory):
 - 1. Tridium Niagara 4 Vykon - JACE 8000
 - 2. Schneider Electric - TAC I/A Series Micronet / MNB Bacnet Controllers
 - 3. Automated Logic - ME series / ZN Series Bacnet Controllers
 - 4. Alerton Controls - VAV and VLC Series Bacnet Controllers
 - 5. Honeywell - Spyder PUB / PVB Series Bacnet Controllers, WEB-8000 Supervisory.
 - 6. Johnson Controls - METASYS FEC / IOM / Series Bacnet Controllers. FX-80 Supervisory
 - 7. Delta Controls, Inc. - DAC / DVC / DFC / DNT Bacnet Controllers
 - 8. Trane Controls - UC210 / UC400 / UC600 Bacnet Controllers.
 - 9. Siemens Building Technologies, Inc. - TC / TEC Bacnet Controllers
 - 10. KMC Controls - Conquest Bacnet Controllers
- C. The following Installing Contractors are prequalified:
 - 1. Wadsworth Solutions, Inc
 - a. **Alternate #04** - Under alternate bid #04, provide an alternate for controls by Wadsworth Solutions with front end consistent to the existing school. This should be listed as an add/deduct alternate. If Wadsworth Solutions is the base bid controls contractor, this shall be a no-cost alternate.
 - 2. Waibel Energy Systems, Building Logix
 - 3. Control Systems of Ohio
 - 4. Smith Boughan, Inc
 - 5. Johnson Controls
 - 6. Point to Point Systems
 - 7. EMCOR Services
 - 8. Building Control Integrators
 - 9. ASA Controls, Inc.
 - 10. Enervise, Inc
 - 11. Gardiner.
- D. Substitutions: See Section 01 60 00 - Product Requirements.
- E. All temperature control systems shall be installed by the factory authorized installer or representative serving the Ohio, OH Area.

2.02 EQUIPMENT - GENERAL

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

2.03 CONTROL PANELS

- A. Control cabinet/enclosure shall be extruded aluminum, galvanized steel or factory-hardened plastic with key locks and hinged doors. Electric panels shall be of code gauge steel construction with UL label. Panels shall be labeled with nameplates and legends as required.
 - 1. The control cabinet/enclosure shall be required to house devices not enclosed as a part of the DDC building automation system panels. Prewire with internal wiring terminated at labeled terminal strips. Thermometers and switches shall be mounted on the cover of the

panel. Relays, transformers, and components shall be mounted inside the panel.

Devices, whether interior or exterior, shall be provided with legend plates of engraved formica or equal. Cabinets shall be located as approved by the Architect/Engineer or as indicated on the Drawings.

2. Local type panels need not contain graphic representations or symbols, unless specified below, but must contain approved nameplates, legends, etc., for each device.
3. Where panels contain any wiring, panels shall be UL approved cubicles.

B. Provide common keying for all panels.

2.04 DAMPERS - ALL RELIEF AIR APPLICATIONS

- A. Extruded aluminum (6063-T5) damper frame shall not be less than 0.080" (2.03 mm) in thickness. Damper frame shall be 4" (101.6 mm) deep x 1" (25.4 mm), with duct mounting flanges on both sides of frame. Frame to be assembled using zinc-plated steel mounting fasteners. Welded frames shall not be acceptable.
- B. Entire frame shall be thermally broken by means of polyurethane resin pockets complete with thermal cuts.
- C. Blades shall be maximum 6" (152.4 mm) deep extruded aluminum (6063-T5) air-foil profiles with a minimum wall thickness of 0.06" (1.52mm). Blades shall be internally insulated with expanded polyurethane foam and shall be thermally broken. Complete blade shall have an insulating factor of R-2.29. All blades shall be symmetrically pivoted.
- D. Blade seals shall be extruded silicone, secured in an integral slot within the aluminum blade extrusions and shall be mechanically fastened to prevent shrinkage and movement over the life of the damper.
- E. Frame seals shall be extruded silicone, secured in an integral slot within the aluminum frame extrusions and shall be mechanically fastened to prevent shrinkage and movement over the life of the damper. Metallic compression type jamb seals will not be approved.
- F. Bearings shall be a dual bearing system composed of a Celcon inner bearing (fixed around a 7/16" (11.11 mm) aluminum hexagon blade pivot pin), rotating within a polycarbonate outer bearing inserted in the frame. Single axle bearing, rotating in an extruded or punched hole shall not be acceptable.
- G. Hexagonal control shaft shall be 7/16" (11.11 mm). It shall have an adjustable length and shall be an integral part of the blade axle. A field-applied control shaft shall not be acceptable. All parts shall be zinc-plated steel.
- H. Linkage hardware shall be aluminum and corrosion-resistant zinc-plated steel, installed in the frame side, out of the airstream, and accessible after installation. Linkage hardware shall be complete with cup-point trunnion screws to prevent linkage slippage and a Celcon bearing between moving parts to reduce wear and increase longevity. Linkage that consists of metal rubbing metal will not be approved.
- I. Dampers shall be designed for operation in temperatures ranging from -40°F (-40°C) to 212°F (100°C).
- J. Dampers shall be AMCA rated for Leakage Class 1A at 1 in w.g. static pressure differential. Standard air leakage data to be certified under the AMCA Certified Ratings Program.
- K. Dampers shall be opposed blade action or parallel blade action, as indicated on the plans.
- L. Dampers shall be Flanged to Duct install type only.
- M. Design based on TAMCO Series 9000 BF Thermally Insulated Damper with Thermally Broken Frame.

2.05 DAMPERS - ALL EXCEPT RELIEF AIR APPLICATIONS

- A. Dampers shall be low leakage type, as required to meet the requirements of ASHRAE Standard 90.1, not less than 22 gauge galvanized steel frames.
- B. Performance: Test in accordance with AMCA 500-D.
- C. Frames: Galvanized steel, welded or riveted with corner reinforcement, minimum 12 gage, 0.1046 inch.
- D. Blades: Galvanized steel, maximum blade size 8 inches wide, 48 inches long, minimum 22 gage, 0.0299 inch, attached to minimum 1/2 inch shafts with set screws.
- E. Blade Seals: Synthetic elastomeric or neoprene mechanically attached, field replaceable.
- F. Jamb Seals: Spring stainless steel.
- G. Shaft Bearings: Oil impregnated sintered bronze or nylon bushings.
- H. Linkage Bearings: Graphite impregnated nylon or oil impregnated sintered iron.
- I. Leakage: Dampers shall be low leakage dampers and shall be designed for tight shut-off such that for a 1500 FPM damper leakage does not exceed 1 percent at 6 inches w.g.
- J. Maximum Pressure Differential: 6 inches wg.
- K. Temperature Limits: Minus 40 to 200 degrees F.
- L. Modulating dampers shall be opposed blade type.
- M. Whenever possible, damper size shall match ductwork size. The Temperature Control Contractor shall verify air velocity and notify the engineer of sizing concerns prior to installation of dampers
- N. Automatic dampers installed in equipment furnished by the manufacturer shall be checked for proper size and design by the Temperature Control Contractor. Should any features of these dampers appear to be unsatisfactory, full details shall be given to the Engineer in writing and suggestions made for any necessary corrections.

2.06 DAMPER OPERATORS

- A. General: Provide smooth proportional control with "continuous control action" and sufficient power for air velocities 20 percent greater than maximum design velocity and to provide tight seal against maximum system pressures. Actuator response shall be linear in response to sensed load and damper stroke shall be smooth and efficient throughout it's entire range. Damper operators shall be electronic, direct coupled type designed for 100,000 full stroke cycles at rated torque, low voltage type. Provide spring return for two position control and for fail safe operation. Damper operators on outside air intakes shall spring return closed.
 - 1. Provide sufficient number of operators to achieve unrestricted movement throughout damper range.
 - 2. Provide one operator for maximum 25 sq ft damper section.
 - 3. Damper operators on outside air intakes and exhaust outlets where required shall be spring return closed.
- B. Size for torque required for damper seal at load conditions with one actuator per damper section. Mechanically paralleled or 'piggybacked' actuators are not permitted.
- C. Coupling: V-bolt dual nut clamp with a V-shaped toothed cradle. Aluminum clamps or set screws are not acceptable.
- D. Overload Protection: Microprocessor or an electronic based motor controller providing burnout protection if stalled before full rotation is reached. The actuator shall be electronically cut off at full open to eliminate noise generation with the holding noise level to be inaudible.

- E. Power Requirements: 0.23A (running) and 0.09A (holding) at 24V-ac or 27 VA (running) and 10 VA (holding) at 120V-ac.
- F. Actuator timing shall be 15 sec.
- G. Temperature Rating: Actuator shall have a UL555S listing by the damper manufacturer for 350°F [250°F].
- H. Proportional Smoke Damper Actuators shall meet all requirements specified above and shall modulate 0-100% open in response to a 2-10vdc or 4-20mA control signal. A 2-10vdc feedback output shall provide a 2-10vdc signal for position indication.
 - 1. Power Requirements (Proportional): Maximum (running) 12 VA at 24-V ac or 8 W at 24-V dc. Maximum (holding) 5VA at 24-V ac or 3 W at 24-V dc.
 - 2. A manual override winder and locking mechanism shall be provided for override operation of the actuator on a loss of power.

2.07 RELAYS

- A. Where required, provide relays for energizing or re-energizing the various branch circuits in response to master control panels. Relays shall be UL labeled and sized for not less than 140 percent of the connected amperage load. Relays shall be rated for the system voltage and have proper throw and poles.

2.08 POWER SUPPLY - VAV

- A. Class 2 UL Listed
- B. Input Power: 115V, single phase, 500 VA
- C. Output Power: Qty 5, 100 VA, 24VAC. Each circuit shall be isolated via on/off switch and breaker.
- D. Over current protection: Circuit breaker
- E. NEMA 1 Metal Enclosure
- F. Unit shall be equal to RIB, model PSH500A.

2.09 TRANSMITTERS

- A. Electronic Temperature Sensors
 - 1. Provide temperature sensors and other temperature indicating sensors of commercial grade quality located at the point of measurement and installed according to the manufacturer's recommendations. Sensors to be vibration and corrosion resistant.
 - 2. Thermistor temperature accuracy shall be +/-0.36 F between the range of 32.0 - 158.0 F.
 - 3. Provide temperature sensors such that the BAS shall be able to convert the resistive input signal available from the element into a digital signal for use by the BAS.
 - 4. Provide outside air temperature sensors with a watertight fitting and adequate protection from the effects of solar radiation.
 - 5. Provide water temperature sensors of the bulb type, mounted within stainless steel wells filled with a heat conductive compound and in direct contact with the water within the pipe.
 - 6. All field mounted sensors shall be labeled as to their function and name used in the control program.
- B. Electronic Room Temperature Sensors
 - 1. Room Temperature Sensors shall be used in classrooms, office spaces, kitchen spaces, student dining, and gymnasiums.
 - 2. Temperature sensors shall be equal to PreCon type-IV thermistors utilizing a 20K ohm thermistor or platinum RTD's of 2000 ohm resistance.
 - 3. Housing: Sensors shall be manufactured in a durable epoxy housing and shall be enclosed for protection from elements when installed in the sensors operating

environment. The sensor cover shall be provided with tamperproof screws. Sensors shall not include a display or keypad.

4. Temperature sensors shall be provided with an override button that will switch the mechanical system into occupied mode of control. Other than the override button the thermostat face shall be blank, with no temperature adjustment, readout panels, etc.
 5. Temperature sensors associated with the Variable Refrigerant Volume units to be provided by the unit manufacturer. The temperature control contractor shall be responsible for the installation of wiring of the sensors. Refer to specification section 23 8126 for additional information. The sensors shall meet the requirements of this section.
 6. Sensor cover shall be color "Pure White".
- C. Electronic Wall Plate Temperature Sensors
1. Wall Plate Temperature Sensors shall be used in corridors, vestibules.
 2. Temperature sensors shall be equal to PreCon type-IV thermistors utilizing a 20K ohm thermistor or platinum RTD's of 2000 ohm resistance.
 3. Housing: Concealed in wall with stainless steel louvered cover plate. 1/4" closed cell foam insulation backin.
- D. Electronic Duct Temperature Sensors
1. All duct sensors shall be true averaging type sensors with capillary lengths not less than 20 feet long. The only exceptions will be return air, and outdoor air sensors, which may be single point temperature sensors.
 2. All duct sensors shall be installed within enclosures that are suitable for the application.
- E. Electric Thermostats
1. Electric thermostats shall be line voltage type of single pole single throw design.
 2. The sensing element shall be liquid-filled.
 3. Covers and base plates shall be of standard design and finish.
 4. Electric thermostats shall be denoted on the Drawings with a sub "E".
 5. Electric thermostats (where noted) for operation of propeller unit heaters and cabinet unit heaters shall be provided and installed by the temperature control contractor.
 6. Sensor cover shall be color "Pure White".
- F. Sensor Guards
1. Provide guard of clear color, mounted with back frame to wall and tamperproof screws on all wall mounted sensors located in gymnasiums, student dining, locker rooms, and corridors where wall plate sensor not utilized. Also, where denoted on the Drawings with a sub "G".
- G. Safety Low Limit Thermostats
1. Automatic reset safety low limit thermostats with flexible sensing elements shall serpentine full length of duct or coil. Instrument to be sensitive to lowest temperature at any 12 inch increment on its 20 foot length. Thermostat shall have a range of 34 degrees F. to 60 degrees F. with a fixed 5 degrees F. differential. Provide one for every 20 square feet of coil.
 - a. Safety low limit thermostats shall be capable of being reset through software at the building energy management computer.
- H. Electronic Pressure Sensors
1. Provide pressure sensors and other pressure indicating sensors of commercial grade quality located at the point of measurement and installed according to the manufacturer's recommendations.
 2. Provide pressure sensors of the direct acting or reverse acting, unidirectional or bidirectional type such that the BAS shall be able to convert input signal into a digital signal for use by the BAS.

3. Provide pressure sensors utilizing the smallest possible operating range which will sufficiently cover the range required for normal operating conditions.
 4. Provide pressure sensors of the ultra precision type with a tolerance at 70 degrees F of no greater than plus/minus .8 percent of full scale and an end-to-end accuracy of plus/minus 2 percent of full scale.
- I. Duct Differential Pressure/Air Velocity Transmitters
1. Differential Pressure/Air Velocity Transmitters shall be provided by the Temperature Control Contractor to monitor the difference between two pressures, duct air velocity and generate a linear output proportional to the difference in pressures.
 2. Design range shall be -5 inches water column to 4 inches water column.
 3. Minimum accuracy shall be +/-1.0 percent of calibrated span. Includes combined effects of linearity, hysteresis and repeatability.
 4. Unit shall be provided with a LCD display.
- J. Humidity Sensors
1. Shall be a "Current Type" humidity transducer. Sensor shall produce a linear 4-20mA current representing the span of the sensor. This signal shall be produced by the sensor itself through a current converter supplied with the sensor.
 2. Space humidity sensor shall be enclosed in a durable enclosure for mounting in interior zones. Sensor shall have a range of 0 to 100 percent relative humidity and shall be accurate with + 2 percent of span.
 3. Duct humidity sensor shall be a probe type with all wiring enclosed in an electrical box. Sensor shall have a range of 0 to 100 percent with an accuracy of + 3 percent of span.
 4. Outdoor humidity sensor shall be enclosed in a weather proof enclosure for mounting outdoors. Sensor shall have a range of 0 to 100 percent with an accuracy of +/- 3 percent of span.
- K. Carbon Dioxide Sensors
1. Sensor type shall be Non-dispersive infrared (NDIR), diffusion sampling with a measurement range from 0-2000 PPM.
 2. Minimum Accuracy: +/- 75 PPM of calibrated span.
 3. Input Voltage: 20 to 30 VAC/DC; 100 mA max.
 4. Analog Output: 0-5 VDC, 0-10 VAC or 4-20 mA user selectable.
 5. Sensor shall have self-calibrating capabilities.
 6. Sensor shall have capability of sensing an alarm to the BAS in the event of a calibration problem or malfunction.
 7. At the time of Project Completion, the TCC shall verify the calibration of all CO2 sensors.
 8. TCC to verify with sensor manufacturer the best signal wiring to be used to prevent signal irregularities and errors.
- L. Current Status Switch
1. Shall be capable of detecting changes in flow of current to motors in determining accurate and reliable equipment status.
 2. Ampere rating for 2.5 - 135 amps continuous.
 3. Sensor supply voltage shall be included from monitor conductor.
 4. Minimum current required is 1 amp.
 5. Trip setpoint shall be adjustable to +/- 1 percent of range.
- M. Building Static Pressure Transmitters:
1. One pipe, direct acting, double bell, scale range 0.01 to 6.0 inch wg positive or negative, and sensitivity of 0.0005 inch wg. Transmit electronic signal to receiver with matching scale range.

2.10 BUILDING AUTOMATION SYSTEM

- A. Furnish a complete Direct Digital Control system.
 - 1. The entire system shall be totally DDC with electric/electronic actuation. No pneumatics shall be utilized except where noted on the associated drawings.
 - 2. The DDC System shall support the ASHRAE Standard 135-1995 BACnet protocol.
 - 3. The DDC System shall communicate to the owner's communication network thru a single point of data connection. All wiring and communication downstream of that single point of data connection shall be provided with the DDC control system.
 - 4. The Local Area Network shall be a 100 Mbps Ethernet network.
 - 5. The system shall be backward compatible. Whenever a system upgrade is provided, the system shall be capable of communicating to existing device level controllers without the requirement to provide any new equipment and controllers.
 - 6. The system shall be capable of operating on the latest version of IE explorer, Firefox, or Google Chrome. System shall be capable of operating without JAVA.
- B. The following HVAC equipment shall be controlled by the Building Automation System including sequences. A graphic shall be provided for each piece of equipment listed below:
 - 1. Rooftop Air Handling Units.
 - 2. Rooftop Air Handling Units with built in Energy Recovery.
 - 3. Variable Air Volume Reheat Terminals.
 - 4. Exhaust Fans
 - 5. Cabinet Heaters
- C. Operator Workstation
 - 1. Data Network Equipment Contractor to furnish a dedicated virtualized server to host web services and storage for temperature control use at minimum (1 TB) partition. Temperature Control Contractor shall be responsible to coordinate with Data Network Equipment Contractor and the owner's representative on requirements for server. Temperature Control Contractor to coordinate with Data Network Equipment Contractor for server resource requirements. Data Network Equipment Contractor to provide Microsoft Operating System only. Temperature Control Contractor to provide all necessary programming, additional licensing, and software required for a fully functional system.
 - 2. A laptop computer shall be provided as part of this project. This contractor shall install network server software on the laptop as part of this project to allow interface with this project. Provide any additional cables necessary to connect to any of the controllers on the system. The laptop shall be made available to the commissioning agent for their use as well.
 - a. Critical alarms shall be reported to the laptop, cell phones, and email accounts of the maintenance department employees. All critical alarms shall be wired so that unit fans, pumps, etc. cannot be turned on in hand mode when safety device is tripped.
 - b. The laptop computer shall include the ability to access the temperature control system via the owners network. User interface shall be seamless and the user shall be capable of performing all functions that can be performed locally.
 - 3. The computer designated shall be used for command entry, information management, network alarm management, and data base management functions. All real-time control functions shall be resident in the standalone DDC panels to facilitate greater fault tolerance and reliability.
 - a. The laptop computer shall have a minimum Intel Core i5 processor with a 500.0 GB hard drive, 8 GB Ram, 24x CD-RW/DVD drive, parallel port, serial port, USB port, wireless 802.11 A/G/N network card, an RJ45 10/100/1000 internal network card, and high capacity Lithium Ion battery. The laptop shall include a minimum 15.4" WXGA

LCD panel. Furnish Nylon laptop carrying case. Acceptable manufacturers shall be IBM/Lenovo, HP, Dell, and Toshiba. Computer platform shall be certified by DDC system manufacturer. Furnish Microsoft Windows 7 operating system as a minimum.

D. Laptop computer Hardware - Communications

1. The new personal computers shall provide a minimum of two communication ports, one EIA-232C for local direct connect communications and one for remote dial-up communications. All communication ports shall be bidirectional data communicators.
2. Storage of software programs and communication logic shall be maintained without battery backed assistance.

E. Server Software

1. Server software shall take advantage of daily energy management report generation capability of the Global Control Panel (GCP) and all remote DDC controllers. The host computer shall automatically poll direct or remotely connected sites, gather the data, archive it and generate daily, weekly, monthly and yearly summaries as needed.
2. The host software shall permit acquisition and long term storage of unlimited independent trend logs. Trends shall be operated by the host directly or automatically uploaded from the GCP or remote DDC controllers at user specified intervals. Trend data shall be graphically represented using a dynamic process graphics report generator in a bar chart or line format including HTML, XML, PlainText, or HTTP formats.
3. Host software will contain alarm and exception processing systems. Events including point alarm, point faults, device diagnostics, maintenance time reminders, actual control programs and log on/off shall be recorded in the system status log. The System Status log shall define automatically generated exception reports based on user selectable criteria such as point type, operator, time and date of occurrence, etc. The program shall prioritize alarms for display with the most critical alarm first. An operator shall also be able to user define individual alarms to interrupt a user and display the system status log.
4. Provide icon selection of users programs such as database programming and monitoring. Provide menus with highlighted active commands, context commands descriptions and help files. A standard mouse interface and normal keyboard operation shall access all programs. Provide continuous display of system status, and text monitoring screens with highlighted alarm conditions and report generation.
5. Any action taken by an operator shall be logged to the systems status log to render an audit trail of operator actions. User access definitions shall be completely definable and modifiable by the system's manager.
6. The Graphical User Interface (GUI) shall run on Microsoft Windows 7 or most recent.
7. The GUI shall employ standard browsers including Windows Explorer and Firefox. 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.
8. Real-Time Displays. The GUI, shall at a minimum, support the following graphical features and functions:
 - a. Minimum Required Graphics:
 - 1) All setpoints shall be shown on the respected graphic page for each piece of equipment. All setpoints shall be adjustable and acceptable range of adjustment shall be noted in as-built sequence of operation.
 - 2) Home Screen with background image of school building or school logo and include following:

- (a) Information on current weather conditions
 - (b) Link to building floor plan
 - (c) Link to each individual air handling unit screen.
 - (d) Link to chilled water plant screen.
 - (e) Link to heating water plant screen.
 - (f) Link to energy dashboard.
 - (g) Link to alarms page
 - (h) Link to schedules page
 - (i) Snow Day Schedule Button.
- 3) Floor Plan: Overall floor plan shall be provided with units broke out in different colors. Link to each individual enlarged unit plan. Enlarged Unit plans shall contain: Unit shall Color graphic floor plan and zone floorplans showing all space temperatures, space CO2 levels and humidity levels where indicated on tempeature control drawings.
- (a) Floor plan showing all spaces with room numbers matching owner's final room number designations.
 - (b) Temperature of each space. Either space or text shall change color based on deviation away from setpoint. Space or text shall change to blue if room below setpoint by 2 F (adj) and change to red if above 2 F (adj) setpoint. Text to be green for space setpoint met.
 - (c) Show space humidity at locations of space humidity sensors.
 - (d) Link back to overall floor plan.
 - (e) Link to equipment page serving the room by clicking on the individual space.
 - (f) Link to alarm page.
- 4) Space Equipment Screen: Screen showing the individual equipment serving the space. Information on screen shall include:
- (a) Graphic of equipment including heating / cooling coils, valves, fans, and dampers. Graphics shall be dynamic.
 - (b) Heating and Cooling Valve Position. If valve is a three-way valve, graphic to represent three way valve.
 - (c) Fan operation including fan speed if variable speed.
 - (d) Damper Positions.
 - (e) Primary airflow value. Also minimum and maximum airflow settings.
 - (f) Discharge air temperature.
 - (g) Current space temperature, space setpoint, and setback temperature setpoints
 - (h) Override button with override temperature
 - (i) Current CO2 level (if specified), high and low level CO2 setpoints
 - (j) Link to associated air handling unit.
 - (k) Link back to overall floor plan screen.
 - (l) Link to alarm screen.
- 5) Air Handling Unit Screen:
- (a) Graphic of equipment including heating / cooling coils, valves, dampers, fans, filters, airflow stations and other sensors. Graphic shall be dynamic
 - (b) Heating and Cooling Valve Position. If valve is a three-way valve, graphic to represent three way valve.
 - (c) Fan operation including fan speed if variable speed.
 - (d) Provide a link to VFD screen. On VFD screen provide in a table format all information from VFD.

- (e) Damper Positions.
 - (f) Energy Recovery wheel status
 - (g) Airflow values and temperature values as shown on temperature control drawing schematics.
 - (h) If air handling unit is set up as a VAV air handling unit, include the following information:
 - (1) Supply air temperature
 - (2) Supply air temperature setpoint
 - (3) Supply air static pressure
 - (4) Supply air fan static pressure setpoint.
 - (i) If air handling unit serves a single zone, include the following information on the equipment screen:
 - (1) Space Temperature
 - (2) Space Temperature setpoint.
 - (3) Unoccupied space temperature and humidity setpoints.
 - (4) Space Humidity level.
 - (5) Space Humidity setpoint.
 - (6) Space CO2 level.
 - (7) Space CO2 setpoint.
 - (j) Filter differential pressure. Include alarm if DP hits high limit.
 - (k) Link to associated chilled water plant.
 - (l) Link to associated heating water plant.
 - (m) Link to sequence of operation page.
 - (n) Link to alarm page.
 - (o) Link back to overall floor plan.
- 6) Miscellaneous Equipment
- (a) Include status, on/off button where noted in the sequence of operation, space temperature, space temperature setpoint for:
 - (1) Exhaust fans
 - (2) cabinet heaters
 - (3) Technology space cooling equipment.
- 7) Alarms Page
- (a) The system will be provided with a dedicated alarm screen. This screen will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm.
 - (b) All critical alarms shall be wired so that unit fans, pumps, etc. cannot be turned on in hand mode when safety device is tripped.
 - (c) All critical alarms as determined by the owner shall be sent to email accounts, cell phones, and pagers via text messaging capabilities.
- 8) Schedules Page
- (a) Provide calendars for all air handling equipment.
- b. The sequence of operations shall be located as a pull down feature at each piece of equipment or provide a link to a pdf document of the sequence of operations.
 - c. Provide As-Built wiring diagrams complete with material part numbers.
 - d. The operator interface shall allow users to access the various system schematics and floor plans via a graphical penetration scheme, menu selection or text-based commands. Dynamic temperature values, flow values and status indication shall be shown in their actual respective locations and shall automatically update to represent current conditions without operator intervention.

- e. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures.
 - f. Graphic screens shall contain objects for text, real-time values, animation, color spectrum objects or "thermo-graphics", logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.
 - g. Graphics shall support layering and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.
 - h. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.
 - 1) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
 - 2) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
 - 3) Snow Day Operation shall be set by clicking on a "Snow Day" button located on screen of graphics.
 - i. 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.
 - j. Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and using a graphical slider to adjust the value. No entry of text shall be required.
9. System Configuration: At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:
- a. Create, delete or modify control strategies.
 - b. Add/delete objects to the system.
 - c. Tune control loops through the adjustment of control loop parameters.
 - d. Enable or disable control strategies.
 - e. Generate hard copy records or control strategies on a printer.
 - f. Select points to be alarmable and define the alarm state.
 - g. Select points to be trended over a period of time and initiate the recording of values automatically.
10. On-Line Help: Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.
11. Security: Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.
12. System Diagnostics. The system shall automatically monitor the operation of all workstations, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.

2.11 BUILDING AUTOMATION EQUIPMENT

A. System Network Controller (SNC)

1. These controllers are designed to manage communications between the programmable equipment controllers (PEC), application specific controllers (ASC) and advanced unitary controllers (AUC) which are connected to its communications trunks, manage communications between itself and other system network controllers (SNC) and with any operator workstations (OWS) that are part of the BAS, and perform control and operating strategies for the system based on information from any controller connected to the BAS.
2. The controllers shall be fully programmable to meet the unique requirements of the facility it shall control.
3. All devices shall meet the requirements of clause 22.1.5 of ASHRAE 135-2012. Use Analog inputs and outputs. If Analog Output objects are used, these must be writeable.
4. The controllers shall be capable of peer-to-peer communications with other SNC's and with any OWS connected to the BAS, whether the OWS is directly connected, connected via cellular modem or connected via the Internet.
5. The communication protocols utilized for peer-to-peer communications between SNC's will be Niagara 4 Fox, BACnet TCP/IP and SNMP. Use of a proprietary communication protocol for peer-to-peer communications between SNC's is not allowed.
6. The SNC shall employ a device count capacity license model that supports expansion capabilities.
7. The SNC shall be enabled to support and shall be licensed with the following Open protocol drivers (client and server) by default:
 - a. BACnet
 - b. SNMP
8. The SNC shall be capable of executing application control programs to provide:
 - a. Calendar functions.
 - b. Scheduling.
 - c. Trending.
 - d. Alarm monitoring and routing.
 - e. Time synchronization.
 - f. Integration of BACnet controller data.
 - g. Network management functions for all SNC, PEC and ASC based devices.
9. The SNC shall provide the following hardware features as a minimum:
 - a. Two 10/100 Mbps Ethernet ports.
 - b. Two Isolated RS-485 ports with biasing switches.
 - c. 1 GB RAM
 - d. 4 GB Flash Total Storage / 2 GB User Storage
 - e. Wi-Fi (Client or WAP)
 - f. USB Flash Drive
 - g. High Speed Field Bus Expansion
 - h. -20-60°C Ambient Operating Temperature
 - i. Integrated 24 VAC/DC Global Power Supply
 - j. MicroSD Memory Card Employing Encrypted Safe Boot Technology
10. The SNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.
11. The SNC shall provide alarm recognition, storage, routing, management and analysis to supplement distributed capabilities of equipment or application specific controllers
12. The SNC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via cellular modem, or wide-area network.

- a. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:
 - 1) Alarm.
 - 2) Return to normal.
 - 3) To default.
 - b. Alarms shall be annunciated in any of the following manners as defined by the user:
 - 1) Screen message text.
 - 2) Email of complete alarm message to multiple recipients.
 - c. The following shall be recorded by the SNC for each alarm (at a minimum):
 - 1) Time and date.
 - 2) Equipment (air handler #, access way, etc.).
 - 3) Acknowledge time, date, and user who issued acknowledgement
 - 13. Programming software and all controller "Setup Wizards" shall be embedded into the SNC.
 - 14. The SNC shall support the following security functions.
 - a. Module code signing to verify the author of programming tool and confirm that the code has not been altered or corrupted.
 - b. Role-Based Access Control (RBAC) for managing user roles and permissions.
 - c. Require users to use strong credentials.
 - d. Data in Motion and Sensitive Data at Rest be encrypted.
 - e. LDAP and Kerberos integration of access management
 - 15. The SNC shall support the following data modeling structures to utilize Search; Hierarchy; Template; and Permission functionality:
 - a. Metadata: Descriptive tags to define the structure of properties.
 - b. Tagging: Process to apply metadata to components
 - c. Tag Dictionary
 - 16. The SNC shall employ template functionality. Templates are a containerized set of configured data tags, graphics, histories, alarms... that are set to be deployed as a unit based upon manufacturer's controller and relationships. All lower level communicating controllers (PEC, AUC, AVAV, VFD...) shall have an associated template file for reuse on future project additions.
 - 17. The SNC shall be provided with a 5 Year Software Maintenance license. Labor to implement not included.
- B. Primary Controllers (Air Handling Units)
- 1. Each primary controller shall be a dedicated, stand-alone, microprocessor-based DDC controller that is BACnet certified (B-BC / B-AAC) with sufficient capacity to handle all points and programming associated with the control sequences as specified. In addition, each controller shall have a minimum 15% spare point capacity. Primary controllers shall be capable of being mounted within the equipment housing and shall have the capability to be programmed on-line and/or off-line (simulation capability) as required to meet unique HVAC application needs as well as the various ASHRAE control cycles. Primary controllers shall be capable of communicating global and critical variables to other primary controllers residing on the same network without the intervention of a higher level controller (Peer to Peer communication).
 - 2. All devices shall meet the requirements of clause 22.1.5 of ASHRAE 135-2012. Use Analog inputs and outputs. If Analog Output objects are used, these must be writeable.
 - 3. All primary controllers shall be application programmable and shall at all times maintain their certification. All control sequences within or programmed into the primary controller shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.

4. Software incorporated into the controller shall include the following:
 - a. Real time operating system software
 - b. Real time clock/calendar and network time synchronization
 - c. Primary control unit diagnostic software
 - d. LAN/WAN communication software
 - e. Alarm processing and buffer software
 - f. Energy management software
 - g. Data trending, reporting, and buffering software
 - h. Input/output database (physical and virtual points)
 5. Primary controller shall have expansion capability to support additional I/O requirements thru remote expansion input/output modules.
 6. The controller shall have a mix of digital inputs (DI), digital Triac outputs (DO), analog outputs (AO), and universal inputs (UI).
 - a. Analog outputs (AO) shall be capable of being configured as digital outputs (DO).
 - b. Input and Output wiring terminal strips shall be removable from the controller without disconnecting wiring.
 - c. Input and Output wiring terminals shall be designated with color coded labels.
 - d. Universal inputs shall be capable of being configured as binary inputs, resistive inputs, voltage inputs (0-10 VDC), or current inputs (4-20 mA).
 7. The controller shall provide "continuous" automated loop tuning with an Adaptive Integral Algorithm Control Loop.
 8. An RJ-11 type connection serial port shall allow a local portable operator terminal to access all program blocks and attributes for complete programmability. The port shall also support complete up/downloading capability.
 9. All input/output and control parameters may be utilized or shared throughout the network. All primary controllers shall be accessible throughout the network.
- C. Secondary Controllers (VAV units, VRV equipment, cabinet heaters, fan coil units, and miscellaneous equipment)
1. Each secondary controller shall be a stand-alone, microprocessor-based DDC controller that is BACnet certified (B-AAC / B-ASC) with sufficient capacity to handle all points associated with the control sequences as specified. Secondary controllers shall be capable of being programmed on-line and/or off-line (simulation capability) as required to meet the specific HVAC application needs as well as the various ASHRAE control cycles. Secondary controllers shall be capable of communicating with other secondary controllers through an interface or higher level controller.
 2. All devices shall meet the requirements of clause 22.1.5 of ASHRAE 135-2012. Use Analog inputs and outputs. If Analog Output objects are used, these must be writeable.
 3. Secondary controllers shall be microprocessor-based, programmable DDC controllers with all operating parameters, setpoints and schedules stored in memory which resides on the controller.
 4. Software incorporated into the controller shall include the following:
 - a. Real time operating system software
 - b. Secondary control unit diagnostic software
 - c. LAN/WAN communication software
 - d. Control software applicable to the unit it serves that will support one mode of operation
 - e. Input/output database (physical and virtual points) to support one mode of operation
 5. The controller shall have digital inputs (DI), digital Triac outputs (DO), three analog outputs (AO), and universal inputs (UI).
 - a. Analog outputs (AO) shall be capable of being configured as digital outputs (DO).

- b. Input and Output wiring terminal strips shall be removable from the controller without disconnecting wiring.
- c. Input and Output wiring terminals shall be designated with color coded labels.
- 6. The controller shall provide "continuous" automated loop tuning with an Adaptive Integral Algorithm Control Loop.
- 7. The controller platform shall have a standard HVAC application program(s) that are modifiable to support both the traditional and specialized "sequence of operations" as outlined in the specification. The controller shall have the capability to communication thru read/write the following:
 - a. Reset room setpoint
 - b. Read/log/trend room temperature
 - c. Override day or night operation
 - d. Change maximum heating and cooling CFM flow rates (VAV terminal units)
 - e. Change minimum heating and cooling CFM flow rates (VAV terminal units)
 - f. Read CFM flow rate at each terminal (VAV terminal units)
 - g. Read the discharge air temperature at each terminal unit
 - h. Room CO2 control.
 - i. Assign daily occupied/unoccupied times
 - j. Read terminal type i.e. fan powered, reheat, etc.
- 8. Should communications to the secondary controller fail in any manner, the controller will have its configuration in non volatile memory and shall maintain room setpoint.

2.12 TEMPERATURE CONTROL WIRING

- A. The DDC System shall communicate to the owner's communication network thru a single point of data connection. All wiring and communication downstream of that single point of data connection shall be provided with the DDC control system.
- B. Control wiring shall meet the requirements of Article 725, Class 1, Class 2, Class 3 Remote-Control, signaling, and power-limited circuits of the NEC.
- C. Control wiring shall be UL listed plenum rated cable or installed in conduit. Wiring shall be routed in conduit where exposed to occupied spaces and in mechanical rooms. Conduit shall be 1/2 inch minimum size and shall be furnished and installed under this section. Exposed wiring in occupied spaces and mechanical rooms will not be accepted.
- D. Concealed wiring and wiring in non-plenum ceiling cavities, which is operating under 100 volts, may be open wired if in compliance with Article 725, NFPA-70 (NEC). Open wiring shall be secured with plastic tie wraps to the permanent building structure as approved by the Architect/Engineer.
- E. Terminations shall be performed by the Temperature Control Contractor.
- F. Wire and conduit not indicated on the Drawings or in the Specifications, but required by the controls supplier, shall be paid for by the Temperature Control Contractor. This includes power supply wiring which is not indicated in the Division 26 drawings but which is necessary for system operation.
- G. Temperature control cable is to be properly supported per industry standards and practices. Cable tray shall not be used for installation of temperature control wiring.
 - 1. Bridle rings shall be used to support wiring in all return air plenums.
- H. All low voltage wiring exposed to the space shall be routed in metallic raceway. Raceway shall be 1 channel and based on Wiremold V700 Series. Coordinate wiremold type with electrical contractor. Submit color samples to architect / engineer for approval. Wiremold must only be used in existing buildings. Wiremold will not be allowed in new construction.

- I. Temperature control wiring Color Identification Guide:
 1. Wiring between AHU equipment, pumps, chillers, and miscellaneous equipment shall be white.
 2. For VRV equipment, wire color shall be:
 - a. Wiring between heat pumps shall be white.
 - b. Wiring between heat pumps and BS boxes shall be Blue.
 - c. Wiring between fan coil units shall be Purple.
 - d. Wiring between BS boxes and fan coils shall be purple
 - e. Wiring between fan coil and controllers shall be gray.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that systems are ready to receive work.
- B. Beginning of installation means installer accepts existing conditions.
- C. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.
- D. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.
- E. Ensure installation of components is complementary to installation of similar components.
- F. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Airflow measurement sensing elements location and sizing of airflow measurement elements shall be confirmed in the field by local factory representative. Velocity calculation and corresponding differential pressure calculations will be calculated accordingly.
- C. Installing contractor shall remote mount the transducer in an acceptable location and provide all pneumatic tubing & wiring required between the transducer and airflow sensors.
- D. Wiring for differential pressure sensors that control heating and chilled water pump operation shall be wired back directly to the chilled water or heating water plant controller. Wiring to nearest controller will not be permitted.
- E. Check and verify location of thermostats with plans and room details before installation. Locate bottom at 44 inches above floor. Align with lighting switches.
- F. Mount outdoor reset thermostats and outdoor sensors indoors, with sensing elements outdoors with sun shield.
- G. Provide separable sockets for liquids and flanges for air bulb elements.
- H. Provide guards on thermostats where indicated.
- I. Provide valves with position indicators and with pilot positioners where sequenced with other controls.
- J. Provide mixing dampers of opposed blade construction arranged to mix streams. Provide pilot positioners on mixed air damper motors. _____ .
- K. Install damper motors on outside of duct in conditioned spaces. Do not install motors in locations at outdoor temperatures.
- L. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same

equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.

- M. Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position.
- N. Temperature control contractor shall make themselves familiar with the commissioning specification and provide all items for the commissioning agents use as noted.

3.03 SEQUENCE OF OPERATION

- A. Refer to Specification Section 23 0993 for all equipment sequences of operation.

3.04 OCCUPIED / UNOCCUPIED ZONES

- A. Manual Overrides:
 - 1. Provide manual, push button overrides as a part of each room temperature sensor. Pressing of override button will place zone on which sensor is located into a programmed override that is adjustable through the software.
 - 2. All zones shall include computer controlled overrides.
- B. Refer to specification section 23 0993 for specified zones.

3.05 GUARANTEE

- A. It is intended that the Temperature Control Contractor include as part of his bid two (2) year full service warranty. All labor and material shall be guaranteed against defects in workmanship for two (2) year period from the date of Substantial Completion and acceptance by the Owner. Any material proving defective shall be repaired or replaced during that period. This shall not, however, apply to material that has been damaged due to willful negligence.
- B. The Contractor will provide hardware and software support during the two year guarantee after the date of acceptance. Hardware support includes replacing of any major or minor components, relays, sensors, etc., that fail to operate properly. Software support includes upgrading of software during warranty period such that system is loaded with latest available revision at end of warranty period.
- C. Software support during the two year warranty shall include any programming changes to correct control operation resulting in alarms. All changes shall be cooresponded with the design engineer and owner.
- D. Support is also defined to include Owner personnel training needed to operate the system effectively as outlined in this Specification. Explicitly included is the training needed to analyze a building's operation with a view to minimizing energy costs.

3.06 TRAINING

- A. The Temperature Control Contractor shall, during the one-year guarantee period, provide no less than (8) 4-hour training sessions to be held at the building site after system is in full operation. A total of two 4 hour training sessions shall be given quarterly during the first 12 months of operation to familiarize maintenance personnel on the operation of the mechanical and control systems through the host computer.
- B. Training shall include a hands on process to get owner involved with making changes, setting schedules, monitoring and acknowledging alarms, setting up trends, and monitoring trends.
- C. All training shall be video-taped by the control Contractor. Two copies shall be turned over to the owner's maintenance staff.

3.07 SERVICE CHECKS

- A. Prior to final inspection, this Contractor shall perform the following service work, including, but not limited to, the following items:

1. Check and oil electric motors furnished under control system.
2. Lubricate damper bearings as required.
3. Check damper travel, adjust and tighten set screws.
4. Lubricate valve stems, as required, check packing; repair as required.
5. Calibration of instruments.
6. Check and verify circuitry.
7. Calibrate and checkout controllers, fusing, etc.
8. Test and debug microprocessor and software.
9. Startup and test operation of variable frequency drive with factory authorized personnel.

3.08 FINAL COMPLETION

- A. When the work is completed, and at a time directed by the Owner or the Architect/Engineer, the Contractor shall carefully adjust all parts of the equipment and systems. This includes adjustment of automatic controls and safety devices, proper setting of adjustable devices, dampers and valves, and other necessary operations so the systems are fully operable and automatic in operation. Upon completion of the Work, notify the Owner, and/or Architect/Engineer that system is ready for final tests and inspection.
- B. At the time of final inspection, this Contractor shall be represented by a person with the proper authority, who shall demonstrate, as directed by the Architect/Engineer, that his Work fully complies with the purpose and intent of the Specifications and Drawings. Labor, services, instruments, and tools necessary for demonstrations and tests shall be provided by the Contractor.
- C. The Contractor shall test and adjust each instrument specialty and equipment furnished by him, prior to final acceptance. The Contractor shall demonstrate, for approval by the Architect/Engineer, that subsystems operate as a coordinated and properly functioning, integrated system.
- D. The Contractor shall furnish labor, provide adjustments and incidentals necessary to obtain the desired and intended results.
- E. The Contractor shall turn over a printed copy and electronic copy of the completed and debugged operating software to the Owner at the conclusion of the first year warranty.
- F. The contractor shall provide a list of all devices and their addresses to the owner. This shall be included in the O&M manual.
- G. The Contractor shall coordinate with the Commissioning Agent to run requested trends for demonstration of the functions.

END OF SECTION

SECTION 23 09 93
SEQUENCE OF OPERATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sequence of operation for:
 - 1. VAV Multi-Zone Packaged Air Handling Unit with Energy Recovery.
 - 2. Single Zone VAV Packaged Air Handling Unit
 - 3. Variable Volume Terminals.
 - 4. Energy Recovery Ventilator Units.
 - 5. Fan coil units.
 - 6. Variable Refrigerant Volume Systems (VRV).
 - 7. Exhaust Fans.
 - 8. Radiant panels and fin tube heaters
 - 9. Domestic water heaters and circulation pumps.
 - 10. Miscellaneous control items.

1.02 RELATED SECTIONS

- A. Section 01 3516 - LEED Submittal Forms
- B. Section 01 3516.01 - Material Documentation Sheet
- C. Section 01 5721 - IAQ Construction and Preoccupancy
- D. Section 01 5721.01 - IAQ Planning Checklist
- E. Section 01 5721.02 - IAQ Inspection Checklist
- F. Section 01 5721.03 - IAQ Log
- G. Section 01 6116.01 - Accessory Material VOC Content Certification Form.
- H. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- I. Section 01 9000 - Commissioning. Contractor shall make themselves familiar with the commissioning specification and include appropriate time to work with the commissioning agent.
- J. Section 23 0913 - Instrumentation and Control Devices for HVAC.

1.03 SYSTEM DESCRIPTION

- A. This section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other sections.
- B. Sequence of operation shall meet the requirements of ASHRAE Standard 90.1-2019.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Temperature Control Contractor shall coordinate a meeting with the Engineer before submitting control sequence to ensure all sequences are understood and to address areas of concern. Sequence of Operation will not be reviewed until this meeting has taken place.
- C. Sequence of Operation Documentation: Submit written sequence of operation for entire HVAC system and each piece of equipment.

- D. Control System Diagrams: Submit graphic schematic of the control system showing each control component and each component controlled, monitored, or enabled.
 - 1. Label with settings, adjustable range of control and limits.
 - 2. Include written description of control sequence.
 - 3. Include flow diagrams for each control system, graphically depicting control logic.
 - 4. Include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.
- E. Points List: Submit list of all control points indicating at least the following for each point. The point names used in the field must match the point names served up by the control system.
 - 1. Name of controlled system.
 - 2. Point abbreviation.
 - 3. Point description; such as dry bulb temperature, airflow, etc.
 - 4. Display unit.
 - 5. Control point or setpoint (Yes / No); i.e. a point that controls equipment and can have its setpoint changed.
 - 6. Monitoring point (Yes / No); i.e. a point that does not control or contribute to the control of equipment but is used for operation, maintenance, or performance verification.
 - 7. Intermediate point (Yes / No); i.e. a point whose value is used to make a calculation which then controls equipment, such as space temperatures that are averaged to a virtual point to control reset.
 - 8. Calculated point (Yes / No); i.e. a "virtual" point generated from calculations of other point values.
- F. Project Record Documents: Record actual locations of components and setpoints of controls, including changes to sequences made after submission of shop drawings.

1.05 QUALITY ASSURANCE

- A. The installing contractor shall be an experienced, licensed dealer for the BAS system specified. Contractor to have a minimum of five years experience in both installation and maintenance of the units required for this project.

1.06 DEFINITIONS

- A. The following are abbreviations used in the sequence of operations below:
 - 1. OA = Outdoor Air
 - 2. RA = Return Air
 - 3. SA = Supply Air
 - 4. DBT = Dry-bulb temperature
 - 5. DBToa = Dry-bulb temperature of the outdoor air
 - 6. DBTra = Dry-bulb temperature of the return air
 - 7. DBTsa = Dry-bulb temperature of the supply air
 - 8. DPToa = Dewpoint temperature of the outdoor air
 - 9. DPTra = Dewpoint temperature of the return air
 - 10. DPTsa = Dewpoint temperature of the supply air
 - 11. hoa = Humidity of the outdoor air
 - 12. hra = Humidity of the return air

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 AIR HANDLING UNITS WITH ENERGY RECOVERY AND EXHAUST: MULTI-ZONE VAV SYSTEMS

- A. The new VAV and RTU controller shall be intergrated into the new Schneider Electric EcoStruxure building automation system for control of system occupid/unoccupied and occupied/unoccupied set points. The graphics shall include all of the points shown on the points list on the drawings.
- B. Building Automation System Interface:
 - 1. The BAS shall also send the discharge air temperature setpoint and the duct static pressure setpoint. If a BAS is not present, or communication is lost with the BAS, the controller shall operate using default modes and setpoints.
- C. System Operating Modes:
 - 1. The Building Automation System (BAS) controller shall include a user-adjustable time-of-day schedule to define when the various areas of the facility are expected to be occupied versus unoccupied. Then based on current zone conditions, the BAS determines the current system operating mode. The BAS controller shall send the following operating modes to the unit level controllers that are a member of the air system: Occupied Heat/Cool, Unoccupied Heat/Cool and Morning Warmup/Pre-cool, Occupied Bypass.
- D. Occupied Heat/Cool
 - 1. During the Occupied Mode, each VAV terminal unit shall be activated to maintain zone temperature at the occupied setpoint (cooling or heating). Meanwhile, the rooftop unit (RTU) modulates the supply fan to deliver the required airflow to the zones, positions the outdoor air damper to bring in required amount of ventilation, and increases/decreases the source of cooling or heating to maintain discharge air at the desired setpoint.
- E. Unoccupied Heat/Cool
 - 1. During the Unoccupied Mode, each VAV terminal unit shall be activated to maintain zone temperature at the unoccupied setpoint (cooling or heating). Meanwhile, the RTU shuts off, unless a zone required unoccupied cooling or heating. If needed to operate, the RTU modulates the supply fan to deliver the required airflow to the zones, coloses the outdoor air damper and increases or decreases the source of cooling or heating to maintain discharge air at the desired setpoint.
- F. Morning Warm-up/Pre-cool
 - 1. During the Morning Warm-up/Pre-cool Mode, each VAV terminal shall be activated to raise or lower the zone temperature to the occupied setpoint (heating or cooling) and then closes. Meanwhile, the RTU modulates the supply fan to deliver the required airflow to the zones, closes the outdoor air damper and increases or decreases the source of cooling or heating to maintain discharge air at the desired setpoint.
- G. Occupied Bypass
 - 1. The BAS shall monitor the status of the "on" and "cancel" buttons of the system's space temperature sensors. When an occupied bypass request is received from a space sensor, the unit shall transition from its currecnt occupancy mode to occupied bypass mode.
- H. Optimized System Level Control Sequences
 - 1. The BAS controller shall perform the following optimized system-level control strategies
 - a. Optimal Start
 - 1) The BAS shall initiate Optimal Start mode such that the RTU is started and VAV boxes are enabled to allow the zone temperature to reach the occupied heating

or cooling setpoint prior to scheduled occupancy. The system shall wait as long as possible before starting, so that the temperature

- b. Optimal Stop
 - 1) The BAS shall initiate Optimal Stop mode such that cooling or heating is disabled so that the zone temperature does not drift beyond the occupied standby setpoint by the end of the scheduled occupancy period. The RTU supply fan shall continue operation.
- c. Unoccupied Economizing (Night Purge)
 - 1) Between 4:00 AM (adj.) and 6:00 AM (adj.), the system controller shall initiate Unoccupied Economizing mode if the current zone temperature is at least 1°F warmer than the occupied cooling setpoint and the outdoor dry-bulb temperature is more than 15°F (adj.) cooler than the current zone temperature. When initiated, the RTU is started (OA damper fully open, cooling source is off) and VAV boxes are enabled to allow the zone temperature to cool to the occupied cooling setpoint.
- d. Optimized Control of Supply Duct Static Pressure (Fan-Pressure Optimization)
 - 1) At a frequency of once every 10 minutes, the system controller shall monitor the damper position of all VAV terminal units. The system controller shall calculate a new supply fan duct static pressure setpoint based on the positions of the furthest-open VAV damper, and send this newly calculated setpoint to the RTU controller. When any VAV damper is more than 75% (adj.) open, the supply fan duct static pressure setpoint shall be reset upward by 5% until no damper is more than 75% (adj.) open or the static pressure setpoint has reset to the maximum setting. When all VAV dampers are less than 65% (adj.) open, the supply fan duct static pressure setpoint shall be reset downward by 5% until at least one damper is more than 65% (adj.) open or the static pressure
- e. Optimized Control of Discharge Air Temperature (DAT Reset)
 - 1) At a frequency of once every 10 minutes, the system controller shall monitor the outdoor dry-bulb temperature, as well as the zone temperature and damper position of all VAV terminal units. The BAS shall calculate a new DAT setpoint based on correct outdoor air (OA) temperature, and send this newly-calculated DAT setpoint to the RTU controller. When the OA temperature is warmer than 65°F (adj.), the DAT setpoint shall be 55°F (adj.). When the OA temperature is colder than 55°F (adj.), the DAT setpoint shall be 60°F (adj.). When the OA temperature is between 55°F (adj.) and 65°F (adj.), the DAT setpoint shall be reset proportionally between 55°F (adj.) and 60°F (adj.). If at least two (adj.) zones have both 1.) a VAV damper that is more than 75% open, and 2.) a current zone temperature that is higher than the current cooling setpoint, then the DAT setpoint shall return to 55°F (adj.). If the outdoor dew point is higher than 60°F (adj.), this DAT Reset sequence shall be suspended and the DAT setpoint shall be reset to 55°F (adj.) until outdoor dew point drops below 57°F (adj.).
- I. Static Pressure High Limit
 - 1. If for any reason the supply air pressure exceeds the supply air pressure high limit, the supply fan shall shut down. The unit shall be allowed to restart three times after a 15 minute off period. If the over pressurization condition occurs on the fourth restart, the unit shall shut down and a manual reset diagnostic is displayed at the remote panel and/or
- J. Relief Air and Building Pressure Control
 - 1. The powered exhaust shall modulate with increased building pressure. As the building pressure increases, the system shall read the space pressure and modulate the powered exhaust relieving air and maintaining a building static pressure set point.

3.02 SINGLE ZONE VARIABLE AIR VOLUME AIR HANDLING UNIT WITH HEATING AND COOLING AND DEMAND CONTROL VENTILATION

- A. The new RTU controller shall be intergrated into the new Schneider Electric EcoStruxure building controller for control of system occupied/unoccupied and occupied/unoccupied set points.
- B. Single Zone VAV
1. Run Conditions - Scheduled: The unit will run according to a user definable time schedule in the following modes: Occupied Mode - The supply fan will run continuously, Unoccupied Mode - The supply fan will remain off, the heating and cooling components will disable, and the outdoor and return air dampers will be closed, except as described below.
 2. Zone Optimal Start: The unit will use an optimal start algorithm for morning start-up. This algorithm will minimize the unoccupied warm-up or cool-down period while still achieving comfort conditions by the start of the scheduled occupied period.
 3. Zone Unoccupied Override: A timed local override control on the zone sensor face will allow an occupant to override the schedule and place the unit into an occupied mode for a pre-determined period of time. At the expiration of this time, control of the unit will automat
 4. Zone Temperature Control: The controller will measure the zone temperature and will modulate the supply fan VFD speed to maintain zone temperature setpoint. The fan speed will increase as the zone temperature rises above cooling setpoint, or as the zone temperature drops below heating setpoint. The supply fan VFD speed will not drop below 50% (adj.) or the speed needed to support minimum outside air ventilation (see below), whichever is greater.
 5. Cooling Coil Valve: The controller will measure the zone temperature and stage DX cooling to maintain the zone temperature setpoint. The cooling will be enabled whenever:
 - a. Outside air temperature is greater than 60°F (adj.).
 - b. AND the economizer is disable or fully open.
 - c. AND the supply fan status is on.
 - d. AND the heating is not active.
 6. Heat Pump Heating: The controller will measure the zone temperature and stage heat pump heating to maintain the zone temperatuer setpoint. The heating will be enable whenever:
 - a. Outside air temperature is less than 65°F (adj.).
 - b. AND the supply fan status is on.
 - c. AND the cooling is not active.
 7. Electric Heat: The controller will measure the zone temperature and modulate the electric heating unit to maintain the zone temperature setpoint. Electric heating will be enabled whenever:
 - a. Outside air temperature is less than 65°F (adj.).
 - b. AND Heat Pump Heating is on.
 - c. AND space temperature is not satisfied after 15 minutes.
 - d. OR Heat Pump signals failure or off due to outdoor air temperature lockout.
 8. Economizer: The economizer will be controlled by the unit. The outside air damper will close and the return air damper will open when the unit is off. During Optimal Sta
 9. Minimum Outside Air Ventilation - Carbon Dioxide (CO2) Control: When in the occupied mode, the controller will measure the zone CO2 levels and modulate the minimum outside air dampers open on rising CO2 concentrations to maintina a CO2
 10. Dehumidification: If the space humidity is above setpoint, DX cooling will be staged on as needed to bring the space humidty back to setpoint. Hot Gas Reheat and Heat Pump Heating will be enabled in order to maintain zone temperature at setpoint.

11. Unit Safeties - Smoke Detector: The unit will shut down, close outside air dampers, disable heating and cooling, and generate an alarm when smoke is detected in the unit.

3.03 FAN COIL UNIT

- A. Provide a microprocessor based direct digital control system that shall provide the following:
 1. Direct Digital Controller interface.
 2. Occupied-unoccupied control.
 3. Necessary operating interlocks.
- B. Occupied Cycle
 1. The supply fan shall run continuously at a constant fan speed.
 2. Space Temperature set points:
 - a. Occupied Heating: 68°F (adj.)
 - b. Occupied Cooling: 74°F (adj.)
 - c. Unoccupied Heating: 65°F (adj.)
 - d. Unoccupied Cooling: 78°F (adj.)
 3. Heating Mode:
 - a. As the space temperature drops below the space temperature set point, the unit shall enter the heating mode. The hot water control valve shall be modulated to maintain the supply air temperature (SAT) set point, 80 degrees F (adj.). As the heating load continues to increase, the SAT set point shall be gradually increased (1 degree F per 10 minutes, adj.) to maintain space temperature at set point. The max SAT set point shall be 95 degrees F (adj.). The sequence shall be reversed for a decreasing heating load.
 4. Cooling Mode:
 - a. As the space temperature rises above the space temperature setpoint, the unit shall enter the cooling mode. The chilled water control valve shall be modulated to maintain the SAT set point, 60 deg F (adj.). As the cooling load increases, the SAT set point shall be gradually decreased (1 deg F per 10 minutes, adj.) to maintain the space temperature at set point. The minimum SAT set point shall be 55 deg F. The sequence shall be reversed for a decreasing cooling load.
 5. Deadband Mode:
 - a. When the space temperature is between the heating and cooling setpoints, the heating or chilled water coil shall modulate in sequence (as above) to maintain the deadband DAT setpoint, 68 degrees F (adj.).
- C. Unoccupied Cycle
 1. The direct digital controller shall automatically program the unit to the unoccupied control mode.
 2. The unit may be manually placed into full occupied cycle during unoccupied time through the DDC controller for a pre-programmed period of time.
 3. The heating water valve shall be spring return open in event of power failure or low limit temperature.
 4. The supply fan shall be off. The cooling valve shall be closed.
 5. Supply fan shall be indexed on and the heating water valve modulated whenever the space requires heating to maintain the space heating unoccupied temperature setpoint of 66 degrees F (adj.).
 6. Supply fan shall be indexed on and the chilled water valve modulated whenever the space requires cooling to maintain the space cooling unoccupied temperature setpoint of 78°F (adj.).

3.04 (ERV) ENERGY RECOVERY VENTILATOR UNIT

- A. Provide a microprocessor based direct digital control system that shall provide the following:

1. Direct Digital Controller interface.
 2. Occupied-unoccupied control.
 3. Necessary operating interlocks.
- B. The BAS shall enable/disable the ERV based on the occupied /unoccupied schedule for the building/zone.
- C. The temperature control contractor (TCC) shall pick up fan status from the unit or provide current sensors for both supply and exhaust fans to display status on BAS graphics.
- D. If at anytime a fan On/Off command does not match its status, the BAS shall generate an alarm.
- E. The BAS shall receive/display any alarms generated by the ERV.
- F. Dehumidification control:
1. If the space relative humidity increases to 65% or above during the occupied time, the BAS shall disable the associated ERV unit. When the relative humidity lowers to 60% or below, the ERV units should be re-enabled. The ERV cannot remain off for more than 90 minutes (adj.) during the occupied cycle. If at 90 minutes the relative humidity has not been reduced to 60%, the ERV shall be enabled for 30 minutes (adj.). After 30 minutes (adj.) expires, the ERV shall be allowed to re-enter the dehumidification mode.
- G. BAS shall integrate all points available from the BACnet interface provided with the ERV unit. Including filter status in order to generate a maintenance alarm.
- H. BAS shall monitor all occupancy of all spaces served (OA & EA) by the ERV. If all associated spaces show vacancy for more than 10 min (adj.), the ERV can shut down. Once one space shows occupied, the ERV will resume normal operation.

3.05 VARIABLE AIR VOLUME TERMINAL REHEAT UNITS (VAR)

- A. VAR Terminal Unit Controllers
1. VAR terminal unit controllers shall consist of microprocessor, enclosure, actuator, differential pressure transducer, terminations, field adjustments, operating system software and application software in a single integrated package.
- B. VAR Reheat Terminal Units
1. A call for cooling and heating shall be generated at the terminal unit space level. When the space temperature is 1°F (adj.) or more above the active space cooling set point, a call for cooling shall be sent to it's RTU. Likewise, if space temperature is 1°F (adj.) or more below the active space heating set point, a call for heating shall be sent to it's RTU.
 2. Space Temperature set points:
 - a. Occupied Heating: 68°F (adj.)
 - b. Occupied Cooling: 74°F (adj.)
 - c. Unoccupied Heating: 66°F (adj.)
 - d. Unoccupied Cooling: 78°F (adj.)
 - e. All occupied space set points shall be capable of being globally set for the entire building or manually overridden individually per space.
 - f. All unoccupied space set points shall be capable of being globally set for the entire building.
 - g. The occupied set points shall be capable of +/- 3°F (adj.) adjustment from the space thermostat.
 3. During occupied cycle, a wall-mount electronic temperature sensor shall modulate the primary air damper to maintain space temperature. When the space temperature is satisfied the box damper shall modulate to maintain the airflow at the min airflow set point. On a drop in space temperature below set point, the primary air damper shall

modulate to its minimum position and the heating coil control valve will modulate open as required to maintain space set point. If the control valve is 100% of box maximum airflow and the space temperature has not been reached over a 10 minute (adj.) interval, the heating water valve shall be maintained at 100% open and the primary air damper shall be modulated to 75% of maximum box airflow. If the space temperature is not met after another 5 minutes (adj.) the primary air damper shall be modulated to 100% open while the heating water valve is maintained at 100% open. After the space temperature is met, the heating sequence shall be reversed. Conversely, on a rise in space temperature, the heating coil control valve shall be closed and the primary air damper shall modulate between its min and max cfm set points as required to maintain space temperature set point.

4. When morning warmup is initiated by the Building Automation System, the VAR controller assumes the occupied mode of operation, reverses the control action of the damper to modulate the air flow between maximum flow and reheat minimum flow values to maintain the zone temperature. The heating valve supplements the warm air available from the air handling unit. When the zone temperature reaches setpoint, the system will automatically index to occupied cycle.
5. The terminal unit manufacturer shall provide a velocity sensor and an enclosure to house the controls provided by the T.C. contractor. The temperature control contractor shall provide the reheat control valve for field installation by the mechanical contractor. The VAR reheat terminal shall be configured for N.O. air damper operation, direct acting temperature sensors and N.O. heating valves. Any relays necessary for this operation shall be furnished and installed by the temperature control Contractor.
6. During unoccupied mode, the VAR box primary air damper shall be modulated to minimum position and the heating valve closed. Upon a rise or fall in space temperature, the VAR box shall operate using the same sequence as described above for occupied mode to maintain the unoccupied space temperature setpoints.
7. The unit may be manually placed into full occupied cycle during unoccupied time through the DDC controller for a pre-scheduled period of time (30 minutes adj.). A manual override button shall be provided on each space thermostat. Activation of the timed override switch shall only reset the space heating and cooling set points to "occupied" values, but shall not affect otherwise scheduled Unoccupied operating mode of the air handling unit.

3.06 VARIABLE REFRIGERANT VOLUME UNITS

- A. Provide a microprocessor based direct digital control system that shall provide the following:
 1. Direct Digital Control Interface
 2. Occupied/Unoccupied control
 3. Setpoint control limits
 4. Night Setback setpoint temperatures
 5. Monitoring and alarming functions
 6. Heating/Cooling/Deadband Operational Mode Control
 7. Local Unoccupied Override Control
 8. Local Occupant Setpoint Adjustment Control
 9. Control for Miscellaneous BACnet Variables
- B. Temperature Control Contractor (TCC) shall provide multiple BacNet communications and control system interfaces to the VRV gateway devices located throughout the building. Coordinate quantity and location of interface points with VRV supplier. The temperature control contractor shall coordinate all intergration limitations of the VRF manufacturers gateway to ensure seamless and reliable integration. These include but is not limited to point read/write intervals.

- C. The sequences require a coordinated system of unitary heat pump controllers and the BAS (Building Automation System) to provide operational control. Various functions will require TCC programming integrating and controlling the heat pump system.
- D. Each grouped system of heat pumps shall be individually controlled and scheduled. The BAS system shall initiate the individual heat pump systems and provide 7-day time clock functions, calendar programming, event programming, and snow-day programming.
- E. Each heat pump module shall provide operation of a heat pump water control valve. The valve shall be provided and wired by the temperature control contractor. Refer to drawings for information on valve location.
- F. The BAS shall provide through the BacNet integration the following temperature control functions (see the sequences below for additional details):
 - 1. Local or BAS control: The BAS shall provide the ability to enable or disable local setpoint control. Under BAS control, the thermostat shall be disabled and allow no temperature adjustment at the thermostat. Under local control, the BAS shall provide a temperature setpoint, and high and low temperature limits of +/- 3 deg F (adj.) from setpoint.
 - 2. Provide a tenant override mode through the space thermostat to allow individual room overrides during unoccupied periods. The DOAS shall remain in the unoccupied mode during a tenant override. The tenant override shall revert to the normal schedule after a time adjustable period (default 60 minutes).
 - 3. Provide night-setback control of heat pump systems during any unoccupied event to reduce temperatures to 66 deg F (adj.) in the heating season, and 79 deg F (adj.) in the cooling season. The BAS shall send "off" command at scheduled time.
- G. The following points list are not intended to be complete controls system points list. The list are limited to the interface of the VRV control system into the BAS. The list is intended to provide the controls contractor with a list of points that are available from the VRV manufacturer's BACnet interface. The TCC is responsible to provide all control points necessary to accomplish all sequences of operation:
- H. The BAS System shall have at a minimum the following objects available for state monitoring thru the BAS graphics:
 - 1. The BAS system shall have at a minimum the following objects available for state monitoring through the BAS graphics:
 - a. On/Off State
 - b. Operational Mode State
 - c. Fan Speed State
 - d. Air Direction State
 - e. Room Temperature State
 - f. Filter Sign State
 - g. Alarm Signal
 - h. Error Code
 - i. Communication State
 - j. Ventilation Mode State
 - k. Accumulated power
 - l. Indoor unit DAT
 - 2. The BAS system shall have at a minimum the following objects available for operational control through the BAS graphics:
 - a. On/Off Control
 - b. Mode Control
 - c. Fan Speed Control
 - d. Air Direction Control

- e. Temperature Set Point Control
 - f. Filter Sign Reset Control
 - g. Prohibit Local On/Off Control
 - h. Prohibit Local Mode Control
 - i. Prohibit Local Filter Sign Reset
 - j. Prohibit Local Temperature Set Point Control
 - k. Ventilation Mode Control
 - l. Forced Off Control
- I. Heating/Cooling/Deadband Operational Mode Control:
1. BAS utilizes the Start/Stop Command, Operational Mode Command, & Set Room Temperature Command to manipulate unit's temperature control functions.
 - a. BAS keeps unit off via Start/Stop Command unless BAS determines space has heating/cooling call
 - b. BAS will have four setpoints available for adjustment for each zone controller: occupied heating, occupied cooling, unoccupied heating, and unoccupied cooling.
 - c. BAS implements the following sequence on call for heating or cooling:
 - 1) Use the Set Room Temperature Command to set the desired heating/cooling setpoint (Occupied Setpoint, Standby Setpoint, or Unoccupied Setpoint).
 - 2) Use the Operational Mode Command to set unit to 'heating' or 'cooling' as required
 - 3) Use the Start/Stop Command to turn the unit 'On'
 - d. BAS implements the following sequence when indoor unit is to go to Deadband:
 - 1) Use the Start/Stop Command to turn the unit 'Off'
 - 2) The unit's Operational Mode Command shall remain at its last commanded value (Heat or Cool).
 - 3) The unit's Set Room Temperature Command shall remain at last commanded value (Occupied Cooling Setpoint or Occupied Heating Setpoint)
 2. IMPORTANT - BAS needs to use the Prohibit Mode command to disable local operator selection of Auto/Heat/Cool operation
 - a. The unit will operate with 0°F heating/cooling differential if BACnet connected to gateway and occupant indexes unit to Auto operation.
 3. IMPORTANT - BAS needs to incorporate minimum five minute (adj.) time delay between Operational Mode Command changes (Guard Timer).
- J. Local Occupant Setpoint Adjustment Control:
1. The Prohibit Local Set Room Temperature Command can be used to enable/disable local occupant setpoint adjustment.
 2. Local occupant is able to adjust setpoint when the Prohibit Local Set Room Temperature command allows. The resulting unit operation is dependent on the current BAS Start/Stop Command and Operational Mode Command. BAS programming needs to be in place to prevent erratic unit operation which can result if the Prohibit Local Set Room Temperature Command is set to enable.
 3. BAS programming is utilized for final setpoint control and to limit occupant setpoint adjustments.
 - a. BAS monitors the Measured Room Temperature to determine the unit's current active setpoint. BAS compares the Measured Room Temperature to the current BAS setpoint command (Set Room Temperature Command). If the values differ by more than 0.2°F, the BAS knows the occupant has changed local setpoint, and shall run the following sequence:
 - 1) BAS compares the Measured Room Temperature to the BAS operator setpoint limits (adj.).

- 2) If the Measured Room Temperature value is within BAS allowable setpoint range, BAS changes its current setpoint to the Measured Room Temperature value, and then writes that value to Set Room Temperature Command.
 - 3) If the Measured Room Temperature value is outside of the BAS allowable setpoint range, BAS changes its current setpoint to the upper or lower (as applicable) limit value, and then writes that value to Set Room Temperature Command.
- K. Local Unoccupied Override Control
1. Prohibit Local On/Off Command can be used to enable/disable local occupant unoccupied override.
 2. BAS sets Prohibit Local On/Off Command to disable during occupied time periods; (occupant will be unable to turn unit off locally)
 3. BAS Prohibit Local On/Off Command to enable during unoccupied. (occupant will be able to use local On/Off button to turn unit On).
 - a. Unit may start heating or cooling based on the last Operational Mode Command, the current space temperature setpoint and current space temperature.
 4. BAS monitors the Start/Stop Status. When the BAS recognizes the Start/Stop Status value of 'On' during scheduled time period=Unoccupied it will know the occupant wants an unoccupied override. The Start/Stop Command would be 'Off', while the Start/Stop Status would be 'On'.
 - a. BAS then sets the Start/Stop Command to 'On' for programmed time period of 30 minutes (adj.); Then the time period expires the BAS sets the Start/Stop Command back to 'Off'.
 - b. Occupant is then able to re-press local On/Off for additional unoccupied override operation if desired.
- L. Control for Miscellaneous BACnet Variables:
- M. The following list gives some guidance on how to incorporate some of the miscellaneous VRF points into the BAS:
1. Fan Speed Command - Send "Nan" (no command), occupant can locally control fan speed or leave fan in auto.
 2. Filter Sign Reset Command - Make available on BAS graphics as a button to allow operator to reset dirty filter alarm timer form front-end instead of at NAV controller
 3. Forced Off Command - Used to force unit into deadband (no heating/cooling occurs). Send "Nan" (no command), BAS should not be forcing unit to deadband.
 4. Fan Speed Status - Only indicates Low/High speed command, not medium. Do not use.
 5. Filter Sign Status - (2, yes) indicates dirty filter, (1, no) clean filter (based on run time).
 6. Error Code - (1) normal, (xx) coded error
 7. Alarm - (1, normal), (2, malfunction)
 8. On/Off Status - (1, off) indicates unit thermostat functions not regulating unit temperature, (2, on) indicates unit is actively performing temperature control.
 9. Forced Off Status - Indicates if unit thermostatic control functions have been forced off.
 10. Accumulated Power - monitor the power consumption and make available for trending

3.07 CABINET HEATERS

- A. Electric Cabinet Heaters: A low-voltage thermostat shall cycle the unit fan and enable electric coil on a call for heating.
- B. Status of cabinet heaters shall be shown on the temperature control system computer. Thermostat and control wiring shall be by the temperature control contractor.

3.08 RADIATION (SUPPLEMENTAL HEAT TO VRF)

- A. The BAS shall receive a signal from the "external contact control module" provided by the VRF manufacturer. Upon receiving the signal for "Second Stage Heat" from the control module, the BAS shall turn on the electric panels to provide supplemental heat. When the signal for "Second Stage Heat" is deactivated by the VRF control system, the electric panels shall be immediately turned off.
- B. When the outdoor air temperature is below 10°F (adj.) The electric panels shall turn on to provide supplemental heat regardless of the signal for "Second Stage Heat" received from the VRF control system.
- C. Each heater shall have an outdoor air supplemental heat lock out temperature set point, 35° F (adj.). When the the outside air is above this set point the electric panels shall remain off.

3.09 EXHAUST FANS

- A. BAS shall provide a graphics showing all exhaust fans and their mode of operation.
- B. Exhaust fans shall be controlled as indicated on temperature control schematics.
- C. CONTROL BY BAS: Exhaust fans shall be controlled by the BAS system. These shall operate based on their own separate schedule. Coordinate initial schedule with owner.
- D. LIGHT SWITCH CONTROL: exhaust fans shall be controlled by Division 26 electrical contractor with light switch/occupancy sensor.
- E. See exhaust fan schedule, control schematics, and keynotes on the drawings.

3.10 DOMESTIC WATER HEATERS

- A. Provide a strap on pipe temperature sensor at the water heater supply pipe. Monitor domestic hot water supply temperature and generate an alarm if the temperature is more than 5°F below the intended setpoint for more than 15 min. (adj.).
- B. BAS shall provide monitoring for the following points at a minimum:
 - 1. Water Heater status.
 - 2. Supply water temperature.
 - 3. Power failure Alarm.
- C. Circulating pumps shall be controlled by a contactor provided by the BAS contractor. BAS contractor shall provide operating schedule for each pump operation and monitor status.

3.11 SPLIT SYSTEM COMPUTER ROOM UNIT (MAIN TECHNOLOGY ROOM)

- A. Temperature control contractor shall mount and wire a thermostat provided by unit manufacturer. Control sequence shall be a part of the unit mounted controls.
- B. Temperature control contractor shall provide a separate thermostat to monitor room temperature through the central BAS panel and alarm if room temperature rises above 80 degrees F (adj). Space temperature shall be viewable thru BAS.
- C. A Bacnet Protocol controller shall be provided with the cooling system. At a minimum, the following points(along with any others necessary to accomplish the control sequences) shall be made available by the temperature control contractor on the BAS:
 - 1. The following input / output points shall be available:
 - a. Fan Speed Setpoint
 - b. High Humidity alarm.
 - c. High Temperature alarm.
 - d. Humidity Setpoint
 - e. Low Humidity Alarm.
 - f. Low Temperature Alarm.

- g. Dual Temperature setpoint
 - h. Set Date/Time.
 - i. Remote Unit Switch on/off
 - j. Compressor sequencing
 - k. Alarms
 - l. Operating Time Scheduling
 - m. Manual control of components.
2. Alarms: The following shall be available:
- a. High / Low temperature threshold exceeded
 - b. High / Low Humidity threshold exceeded
 - c. Supply Air Temperature Threshold Exceeded
 - d. Return Air sensor error Detected alarm
 - e. High / Low Airflow
 - f. Humidifier
 - g. Smoke Detected
 - h. Electronic Expansion Valve Error
 - i. High / Low pressure
 - j. Dual Circuit expansion board error detected
 - k. Air Filter clogged
 - l. Humidity Sensor Error Detected Alarm
 - m. EEPROM Error Detected Alarm

3.12 SPLIT SYSTEM AIR CONDITIONING UNITS

- A. Temperature control contractor shall mount and wire a thermostat provided by unit manufacturer. Control sequence shall be a part of the unit mounted controls.
- B. Temperature control contractor shall provide a separate temperature sensor to monitor room temperature through the central BAS panel and alarm if room temperature rises above 80 degrees F (adj). Space temperature shall be viewable thru BAS.

3.13 SNOW DAY

- A. A "Snow Day" routine shall be provided to return all systems to unoccupied mode upon indication by system operator.

3.14 FIRE ALARM

- A. Coordinate with Division 28 and provide necessary contacts to shut down all mechanical equipment during a fire alarm. The system shall be capable of restarting equipment globally upon a "no alarm signal" from the fire alarm panel.

3.15 CRITICAL ALARMS

- A. Critical alarms shall dial personal cell telephones, pagers, or home telephones and send email messages to selected school district employees.
- B. The following Alarms shall be considered critical alarms:
 - 1. Technology room space temp. above 85°F (adj.)
 - 2. Any space temperature dropping below 50 degrees F (adj.)
 - 3. Any additional alarms deemed critical by the school district and/or the Architect/Engineer.

3.16 DAY/NIGHT ZONES

- A. The following shall be the accepted zone control. Zone control shall include all air handling units, variable-volume terminals, and exhaust fans. All zones to include capabilities through the direct digital controller for override setting to full occupied cycle during unoccupied cycle.
- B. Zones:

1. Each AHU shall be its own zone. Coordinate the naming of each fo the zones with the owner. The owner shall sign-off and approve the naming of the zones.

3.17 EMERGENCY LOSS OF HEAT - FREEZE PROTECTION BUTTON

- A. Provide an emergency button on the graphics to open valves and ramp domestic pumps up in case of RTU and VRV failures and loss of heat. Coordinate exact requirements and settings with the owner.

END OF SECTION

SECTION 23 81 26
VARIABLE REFRIGERANT VOLUME SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Air source heat pumps.
- B. Indoor fan coil units.
- C. Refrigerant Controller Box.
- D. Refrigerant Piping.
- E. Controls.
- F. Refrigerant.

1.02 RELATED REQUIREMENTS

- A. Refer to Section 01 6000 - Product Requirements
- B. Section 23 0519 - Meters and Gages
- C. Section 23 0548 - Vibration and Seismic Controls.
- D. Section 23 0553 - HVAC Identification.
- E. Section 23 0593 - Testing, Adjusting, and Balancing.
- F. Section 23 0719 - HVAC Piping Insulation.
- G. Section 23 0913 - Instrumentation and Control Devices for HVAC: Thermostats, humidistats.
- H. Section 23 0993 - Sequence of Operations.
- I. Section 23 2113 - Hydronic Piping.
- J. Section 26 2717 - Electrical Wiring: Electrical characteristics and wiring connections and installation of wiring of thermostats and other controls components.

1.03 REFERENCE STANDARDS

- A. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2007.
- B. ASHRAE Std 23 - Methods of Testing for Rating Positive Displacement Refrigerant Compressors and Condensing Units; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2005.
- C. ASHRAE Std 90.1 - Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2004.
- D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association; 2002.
- E. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems; National Fire Protection Association; 2006.

1.04 SUMMARY

- A. A variable capacity, heat recovery/ heat pump air conditioning, variable refrigerant volume (VRV) system. The system shall consist of multiple evaporators using DDC PID control, connected to multiple air-cooled condensing units. The condensing units shall be air-cooled heat recovery/ heat pump air-conditioning systems, variable speed driven compressors, multi zone split system, using R32 refrigerant. The condensing unit may connect an indoor

evaporator capacity up to 115 % to that of the condensing unit capacity. All indoor units are each capable of operating separately with individual temperature control.

- B. The condensing units shall be interconnected to indoor units as scheduled in accordance with the manufacturers engineering data detailing each available indoor unit. For the heat recovery system, the indoor units shall be connected to a series of branch controller boxes located as shown on the drawings. In the brach controller box, if one of the zone branch valves fails or requires maintenance, the other zones shall still be able to operate.
- C. The condensing units shall be interconnected to indoor units as scheduled in accordance with the manufacturers engineering data detailing each available indoor unit.
- D. The layout is based on Daikin VRV Emerion. If one of the other approved manufacturers is used, the equipment supplier and mechanical contractor shall submit to the engineer proposed changes to the equipment layout and refrigerant piping layout for approval. The total connected capacity shall not exceed 130% or be more than 10% higher than the scheduled connected capacity. For maintneance reasons, piping configurations with the branch controller boxes installed in series will not be acceptable. Any additional cost for electrical changes, including additional electrical connections for additional branch controller boxes, shall be the responsibility of the mechanical contractor.

1.05 SUBMITTALS

- A. See Section 01 3000 - Submittal Procedures.
- B. Shop Drawings and Product Data: Submit manufacturer's catalog sheets, brochures, performance charts, standard schematic drawings, wiring diagrams, specifications, and installation instructions. Submittal data for all fans shall include fan curves. These curves shall show the relationship of CFM to static pressure and shall contain a family of curves at differing speeds allowing for variation from 30 percent to 120 percent of scheduled flow and shall include scheduled operating point, BHP curves and efficiency curves. Curves shall be correct for air density of operation. Submittals shall include:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material gages and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. Submit drawings indicating components, dimensions, weights and loadings, required clearances, and location and size of field connections.
- C. Certified laboratory measured octave band sound power levels at the design operation point for inlet and outlet of unit and maximum casing radiated power levels. Calculated data is not acceptable.
- D. Operating load at each support and weight of heaviest removable item.
- E. Operation and Maintenance Data: Furnish installation, maintenance, and operating instruction manuals, complete with parts list.
- F. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material gages and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. Submit manufacturer's installation instructions.

- G. Piping Diagrams: Manufacturer to layout and size Refrigerant piping between each component of system. Provide sizing diagrams and revised autocad drawings for review prior to installation by factory-trained refrigerant piping technicians.

1.06 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of mini-split systems and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- B. Units shall be certified for UL 1995 by ETL.
- C. Electrical Components, Devices, and Accessories: ETL Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Fabricate and install refrigeration system according to ASHRAE 15, "Safety Code for Mechanical Refrigeration."
- E. All units must meet or exceed the 2010 Federal minimum efficiency requirements and the proposed ASHRAE 90.1 efficiency requirements for VRF systems. Efficiency shall be published in accordance with the DOE alternative test procedure, which is based on the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standards 340/360, 1230 and ISO Standard 13256-1.
- F. The installing contractor shall be trained and certified by the equipment manufacturer for installation of their equipment. Each person having any role in installing the VRF equipment and piping shall have manufacturer's installation training (minimum one day), and shall have record of the training completion on site and available for review by the engineer.

1.07 COORDINATION

- A. Coordinate location of piping and electrical rough-ins with other disciplines.
- B. A manufacturer's representative shall partake in any required meetings with the successful temperature controls contractor to discuss any questions/issues/concerns with the integration of the VRF system into the BAS.

1.08 WARRANTY

- A. Unit warranty: 1 year from date of substantial completion all parts and labor.
- B. Compressor: 6 year parts only with 1st year of labor included from date of substantial completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - 1. Daikin AC.
 - 2. Trane/Mitsubishi.
 - 3. LG.
 - 4. Fujitsu.
 - 5. Lennox/Samsung
 - 6. Substitutions: Not Permitted.

2.02 FAN COILS

- A. Indoor, direct-expansion, Medium Pressure, Ceiling-Concealed, Ducted Fan Coil Units. The Fan Coil Unit shall be shipped complete with cooling coil, fan, fan motor, piping connectors, electrical controls, DDC control system, filter, and applicable mounting / hanging brackets. The

indoor unit shall be factory assembled, wired and run tested. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

- B. The basic components of the indoor units are a fan, a heat exchanger and an electronic proportional expansion valve which shall be controlled via computerized PID control which constantly, every 20 seconds measures and assesses the status of the return air temperature, refrigerant inlet and outlet temperature. The units shall have a self-diagnostic function, 3 minute time delay.
- C. See attached plans for details of equipment selected.
- D. During the cooling operation the electronic expansion valve shall control the degree of refrigerant superheat at the evaporator outlet. During the heating operation it shall control the degree of refrigerant sub cooling at the condenser outlet.
- E. Provide the indoor unit printed circuit board with power input fusing, address switches for a variety of operation controls, emergency operation switch and fault/operation indication LED's. Fan motors shall be thermally protected.
- F. The unit shall use the temperature at the wall-mounted controller as the room temperature, and not the return air sensor.
- G. The indoor unit fan shall be an assembly with one or two fan(s) direct driven by a single motor.
- H. The indoor fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings.
- I. The fan shall have at least 3 speeds and an Auto-Fan function.
- J. The indoor unit casing shall be fully insulated and sealed to prevent condensation. The insulation shall conform to local regulations.
- K. Unit shall be provided with stainless steel or thermoplastic drain pan, condensate pump, and condensate overflow switch to prevent overflow of drain pan. Condensate pump shall be capable of a minimum of 2 ft head pressure.
 - 1. Manufacturer to provide drain pan level sensor powered by a 20-year life lithium battery. Sensor shall require no external power for operation and shall have an audible indication of low battery condition
 - 2. The drain pan sensor shall provide protection against drain pan overflow by sensing a high condensate level in the drain pan. Should this occur the control shuts down the indoor unit before an overflow can occur. A thermistor error code will be produced should the sensor activate indicating a fault which must be resolved before the unit re-starts.
- L. Coil:
 - 1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
 - 2. The tubing shall have inner grooves for high efficiency heat exchange.
 - 3. All tube joints shall be brazed with phos-copper or silver alloy.
 - 4. The coils shall be pressure tested at the factory.
- M. Filters:
 - 1. Unit shall be provided with accessory filter rack if required for installation with medium efficiency filter.
 - 2. Contractor shall provide a set of filter for unit during construction to protect coil from dust during construction.
 - 3. At completion of project, install a 1" disposable, 90% efficient, MERV 8 filter.

2.03 AIR SOURCE HEAT PUMP UNITS

- A. The heat pump unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the outdoor unit shall consist of a compressor, motors, condensor coil, condensor fan, electronic expansion valve, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shutoff valves, oil separator, service ports, liquid receivers, and accumulators.
- B. General:
 - 1. The air-source unit shall have an accumulator with refrigerant level sensors and controls.
 - 2. The air-source unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.
 - 3. The air-source unit shall have a high pressure safety switch, low pressure safety switch and over-current protection and DC bus protection.
 - 4. Each outdoor unit module shall be furnished with a minimum one direct drive, variable speed propeller type fan.
 - 5. All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
 - 6. The air-source unit shall be configured for a heat recovery application, and capable of continuous operation in heating or cooling mode with an ambient air temperature range between -4°F and 115°F.
 - 7. The Condensing unit shall be a Factory assembled unit with frameless casing structure.
- C. Unit Cabinet:
 - 1. The cabinet(s) shall be fabricated of hot-dip galvanized steel sheet for corrosion resistance. The cabinet shall be painted with factory colors. The cabinet shall be rust proof.
 - 2. The cabinet shall have the option of all field connections (refrigerant, water, line voltage and control wiring) on the top or left side of the unit.
 - 3. The air-source units can be mounted side-by-side. Maintain required clearances around units as noted in manufacturer's installation information.
- D. Heat Exchanger Coil:
 - 1. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing. The coil fins shall have a factory applied corrosion resistant blue-fin finish. The coil shall be protected with an integral metal gaurd.
 - 2. The heat exchanger shall be rated for a maximum of 4.5 MPa.
 - 3. The heat exchanger shall be rated from -148 deg F up to 302 deg F.
- E. Compressor:
 - 1. All air source units shall be equipped with one inverter driven scroll hermetic compressor which is capable of changing the speed to follow the variations in total cooling as determined by the suction gas pressure as measured in the heat pump unit. If a manufacturer requires two compressors the second compressor shall operate whenever the total load on the unit is above 50% capacity while the DV inverter compressor modulates to maintain load.
 - 2. A crankcase heater shall be factory mounted on the compressor.
 - 3. The air-source unit compressor shall have an inverter to modulate capacity. The capacity shall be completely variable down to 23%-7% of rated capacity, depending upon unit size.
 - 4. The inverter driver compressor in each condensing unit shall be of highly efficient reluctance DC, hermetically sealed scroll type with a maximum speed of 6,480 rpm.
 - 5. The compressor shall be equipped with an internal thermal overload.
 - 6. The compressor shall be mounted to avoid the transmission of vibration.

- F. Both liquid and suction lines must be individually insulated between the condensing and indoor units.
- G. The connection ratio of indoor units to condensing unit will be 50% to 130%.
- H. The sound pressure dB(A) at rated conditions shall be a value of 54 decibels at 3 feet from the front of the unit.
- I. The system will automatically restart operation after a power failure and will not cause any settings to be lost, thus eliminating the need for reprogramming.
- J. The condensing unit shall be modular in design and should allow for side-by-side installation with minimum spacing.
- K. The following safety devices shall be included on the condensing unit; high pressure switch, control circuit fuses, crankcase heaters, fusible plug, high pressure switch, overload relay, inverter overload protector, thermal protectors for compressor, over current protection for the inverter and anti-recycling timers. To ensure the liquid refrigerant does not flash when supplying to the various fan coil units, the circuit shall be provided with a sub-cooling feature.
- L. Oil recovery cycle shall be automatic and based on requirements from unit manufacturer.
- M. Defrost cycle shall be automatic to prevent coil freeze up. The unit shall be capable of still providing heat at a reduced capacity during the defrost cycle. The complete loss of heating capacity during defrost mode shall not be acceptable.
- N. Units shall not be set directly on grade. Units shall be supported on structural frames as detailed on drawings.

2.04 CONTROLS

- A. Reference Specification section 23 0993 Sequence of Operations for requirements of the integrated temperature control package. Equipment specified herein shall be capable of all requirements specified within the Sequences of Operation.
- B. Controls shall consist of a DDC control system which shall control space temperature, and determine optimum fan speed. The temperature control range shall be school district standards. Set the space temperature for 70 degrees F heating and 75 degrees F cooling.
- C. Wiring: Control wiring shall be installed in a daisy chain configuration from indoor unit to indoor unit then to the branch selector box and condensing unit. Control wiring shall run from the indoor unit terminal block to the specific controller for that unit.
- D. Wiring Size: The wire shall be a non-shielded, 2-core multi-strand sheathed vinyl cord or cable, size AWG18-2.
- E. The wired remote controller shall be able to control 1 group (maximum of 16 fan coil units) and shall be able to function as follows:
 - 1. The controller shall have a maximum wiring length of 1,640 feet.
 - 2. The controller shall be backlit.
 - 3. The controller shall have a self diagnosis function that constantly monitors the system for malfunctions, and displays error codes in the event of system error.
 - 4. The controller shall be able to immediately display fault location and condition.
 - 5. An LCD digital display will allow the temperature to be set in 1°F units.
 - 6. The controller shall be equipped with a thermostat sensor in the remote thermostat/controller.
 - 7. The thermostat/controller shall monitor room temperature and preset temperature by microcomputer and can select cool/heat operation mode automatically (heat recovery unit only).

8. The controller shall allow the user to change on/off, mode, temperature setting, and fan speed setting and airflow direction.
 9. The controller shall be able to limit the set temperature range. The controller shall be capable of night setback control with upper and lower set temperature settings.
- F. The auto changeover shall be disabled, as the changeover control will be accomplished through the BAS programming.
- G. Necessary gateways and interface for connection of VRV controls to building management system shall be provided by VRV manufacturer and installed by temperature control contractor. Temperature control contractor shall supply all wiring and connections to control interface. Temperature control contractor shall coordinate with unit manufacturer for BACnet protocol.
1. The Bacnet Interface shall have at a minimum the following objects available for state monitoring:
 - a. On/Off State
 - b. Operational Mode State
 - c. Fan Speed State
 - d. Room Temperature State
 - e. Filter Sign State
 - f. Alarm Signal
 - g. Error Code
 - h. Communication State
 - i. Ventilation Mode State
 2. The Bacnet Interface shall have at a minimum the following objects available for operational control:
 - a. On/Off Control
 - b. Mode Control
 - c. Fan Speed Control
 - d. Temperature Set Point Control
 - e. Filter Sign Reset Control
 - f. Prohibit Local Filter Sign Reset Control
 - g. Prohibit Local On/Off Control
 - h. Prohibit Local Mode Control
 - i. Prohibit Local Temperature Set Point Control
 - j. Ventilation Mode Control
 - k. Forced Off Control
- H. Controls system must come with at least two copies of the software.
- I. Controls system must also include any additional service licenses or softwares required to fully service the equipment and control system. The owner shall have access to any and all upgrades to the software at no additional charge.

2.05 REFRIGERANT CONTROLLER BOX

- A. General: The branch selector boxes are designed specifically for use with VRV series heat recovery system components.
1. These selector boxes shall be factory assembled, wired, and piped.
 2. These branch controllers must be run tested at the factory.
 3. These selector boxes must be suitable for mounting indoors, and shall be mounted with access and service clearances provided.
 4. When simultaneously heating and cooling, the units in heating mode shall energize their sub cooling solenoid valve.
 5. The number of connectable indoor units shall be in accordance with the schedule.

6. These units shall have a galvanized steel plate casing.
7. Each cabinet shall house multiple refrigeration control valves and a liquid gas separator.
8. The cabinet shall contain a tube in tube heat exchanger.
9. The unit shall have sound absorption thermal insulation material made of flame and heat resistant foamed polyethylene.
10. Electronic expansion valves shall be used to control the variable refrigerant flow.
11. The refrigerant connections must be of the flare type.
12. The unit electrical power and control wiring terminals shall be in an electrical box attached to the front of the unit. Refer to drawings for unit power.
13. The control voltage between the indoor and condensing unit shall be 16VDC non-shielded 2 conductor cable.
14. Each refrigerant box controller shall be provided with a condensate pump.
15. All refrigerant piping connections on the refrigerant controller box shall include field-installed refrigerant service shut-off valve. This will allow service to any indoor unit without field interruption to overall system operation.
 - a. Each circuit shall have one (54,000 BTU/h or smaller indoor unit section) two-position liquid line valve and a two-position suction line valve.
 - b. The service valves can be provided by the VRF manufacturer or by a third party, but must be approved for use in the VRF manufacturers system and shall not negatively affect any warranty.

2.06 REFRIGERANT

- A. Refrigerant Type: R32.
- B. Mechanical contractor shall provide full charge of refrigerant for system. Refer to drawings for refrigerant quantities.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install fan coil units in accordance with manufacturers recommendations and as shown on drawings. Follow SMACNA and AMCA recommendations for fan installations, belt guards, duct connections, etc.
- B. Install fans and motors with proper support and vibration isolation as specified in Section 23 0548: Vibration and Seismic Control.
- C. Install units with adequate clearances for service and maintenance. Refer to manufacturer's requirements for maintenance and operational clearances.
- D. Make final duct connections with flexible connectors as described in specification Section 23 3100: HVAC Ducts & Casings. Provide sufficient separation of ductwork, plenum panels, or air handling unit casings from fan assembly to prevent metal-to-metal contact due to start-up torque or operating under specified isolator deflections.
- E. Provide sufficient clearances around fans for access and servicing of components. Install fans such that tachometer openings, access doors, motors, belts, lubrication lines, electrical connections, etc. are readily accessible and not obstructed by other installations or structures.
- F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- G. Install units level and plumb, firmly anchored in locations indicated; maintain manufacturer's recommended clearances.
- H. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

3.02 CONNECTIONS

- A. Piping installation requirements are specified in specification section 23 2113. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect refrigerant piping to heat pump units; maintain required access to unit. Install furnished field-mounted accessories. Refrigerant piping and specialties are specified in specification section 23 2300 "Refrigerant Piping."
- D. Connect Power and Controls wiring according to manufacturer's documented instructions and Division 26 specification means and methods.

3.03 STARTUP SERVICE

- A. Equipment Startup Checks:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connection to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Verify lubrication for bearings and other moving parts.
- B. Starting Procedures:
 - 1. Energize motor and adjust fan to indicated rpm.
 - 2. Measure and record motor voltage and amperage.
- C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
- D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Shut unit down and reconnect automatic temperature-control operators.
- F. Refer to Section 23 0593 "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.
- G. Adjust damper linkages for proper damper operation.

3.04 CLEANING

- A. On completion of installation, internally clean system according to manufacturer's written instructions. Remove foreign material and construction debris.
- B. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

3.05 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain Variable Refrigerant Volume systems. A minimum of 3 days of training shall be included. Any routine maintenance recommended shall be demonstrated during this time.
- B. All training shall be video-taped by the Division 23 Mechanical Contractor. Two copies shall be turned over to the owner's maintenance staff.

END OF SECTION

SECTION 23 81 26.13
SPLIT-SYSTEM HEATING AND COOLING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Air cooled condensing units.
- B. Indoor ductless fan & coil units.
- C. Controls.

1.02 RELATED REQUIREMENTS

- A. Section 01 6000 - Product Requirements
- B. Section 26 05 83 - EQUIPMENT WIRING: Electrical characteristics and wiring connections and installation and wiring of thermostats and other controls components.

1.03 REFERENCE STANDARDS

- A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2008.
- B. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; 2004.
- C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems and Designation and Classification of Refrigerants; 2019, with Errata (2020).
- D. ASHRAE Std 23.1 - Methods of Testing for Rating Positive Displacement Refrigerant Compressors and Condensing Units; 2010.
- E. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.
- G. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2015.
- H. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
- C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.
- D. Design Data: Indicate refrigerant pipe sizing.
- E. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.
- F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
- G. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.05 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

- B. Provide 1 year manufacturers warranty on parts from time of start-up.
- C. Provide 5 year manufacturers warranty on compressor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Trane/Mitsubishi.
- B. Daikin.
- C. Lennox/Samsung
- D. Panasonic
- E. Century.
- F. Fujitsu
- G. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 SYSTEM DESIGN

- A. Split-System Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.
 - 1. Cooling: Outdoor electric condensing unit with evaporator coils in multiple ductless indoor units ("mini-split").
 - 2. Provide refrigerant lines internal to units and between indoor and outdoor units, factory cleaned, dried, pressurized and sealed, with insulated suction line.
 - 3. Provide condensate pumps with each indoor fan coil units.
- B. Performance Requirements: See Drawings for additional requirements.
 - 1. Efficiency: Energy Efficiency Rating (EER)/Coefficient of Performance (COP) not less than requirements of ASHRAE Std 90.1; seasonal efficiency to ASHRAE Std 103.
- C. Electrical Characteristics:
 - 1. See drawings for size and electrical requirements.
 - 2. Disconnect Switch: Factory mount disconnect switch on equipment.

2.03 INDOOR UNITS FOR DUCTLESS SYSTEMS

- A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, evaporator coil, and controls; wired for single point power connection with control transformer.
- B. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.
 - 1. Construction and Ratings: In accordance with AHRI 210/240 and UL 207.
 - 2. Condensate Pump for wall mounted fan coil units: Provide condensate pump with unit. Locate pump directly above unit, above the ceiling. Pump to be provided by unit manufacturer.

2.04 OUTDOOR UNITS

- A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.
 - 1. Cabinet: Steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.
 - 2. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23.1 and UL 207.

- B. Compressor: Hermetic, two speed 1800 and 3600 rpm, AHRI 520 resiliently mounted integral with condenser, with positive lubrication, crankcase heater, high pressure control, motor overload protection, service valves and drier. Provide time delay control to prevent short cycling and rapid speed changes.
- C. Air Cooled Condenser: Aluminum fin and copper tube coil, AHRI 520 with direct drive axial propeller fan resiliently mounted, galvanized fan guard.
- D. Accessories: Filter drier, high pressure switch (manual reset), low pressure switch (automatic reset), service valves and gauge ports, thermometer well (in liquid line).
 - 1. Provide thermostatic expansion valves.
- E. Operating Controls:
 - 1. Control by room thermostat to maintain room temperature setting.
 - 2. Low Ambient Kit: Provide refrigerant pressure switch to cycle condenser fan on when condenser refrigerant pressure is above 285 psig and off when pressure drops below 140 psig for operation to 0 degrees F.

2.05 ACCESSORY EQUIPMENT

- A. Room Thermostat: Wall-mounted, electric solid state microcomputer based room thermostat with remote sensor to maintain temperature setting; low-voltage; with following features:
 - 1. Preferential rate control to minimize overshoot and deviation from setpoint.
 - 2. Thermostat Display:
 - a. Actual room temperature.
 - b. System Mode Indication: Heating, Cooling, Fan Auto, Off, and On, Auto or On, Off.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that proper power supply is available and in correct location.
- B. Verify that proper fuel supply is available for connection.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.
- B. Install in accordance with NFPA 90A and NFPA 90B.
- C. Install refrigeration systems in accordance with ASHRAE Std 15.

END OF SECTION

**SECTION 27 51 23
CENTRAL SOUND AND PAGING SYSTEM**

PART 1 GENERAL

1.01 RELATED SECTIONS

- A. The provisions of the General Conditions, Supplementary Conditions, and the Sections included under Division 1, General Requirements, are included as a part of this Section as though bound herein.
- B. Refer to Section 01 2300 for Alternates that may affect the Work of this Section.

1.02 RELATED REQUIREMENTS

1.03 DESCRIPTION OF WORK

- A. The work described in this section includes the furnishing of all materials, equipment, labor, service and the performance of all operations necessary for the installation of a microprocessor controlled classroom paging and central sound system and components, complete and in operating condition as indicated on the Drawings and/or described herein.
- B. The central sound system shall be of modular construction.
- C. The system shall have capacity of two hundred (200) stations and two (2) Administrative Control Consoles (ACC). The system shall be mounted in a floor mounted open technology rack/cabinet provided by the technology cabling contractor.
- D. Modes of communication shall include:
 - 1. Administrative Control Console to Administrative Control Console. (ACC to ACC)
 - 2. Administrative Control Console to speaker station.
 - 3. Loudspeaker or group of loudspeakers from a program source.
 - 4. Administrative Control Console to either all-call or zone paging.
 - 5. IP Phone to **all call or zone paging**.
- E. System shall provide a port to interconnect with the Owner's telephone system. Interconnect Owner's telephone system to the central sound system so that standard telephone stations may access the communications network and perform all communications functions accessed by the ACC.
- F. The system shall provide built-in diagnostics and utilize non-volatile user-programmable memory.
- G. The system shall allow the inclusion of audio sources that can be distributed by the ACC operator to any or all of the thirty two (32) possible zones. Program may be monitored at the ACC.
- H. All programming shall be menu driven for ease of operation.
- I. System shall provide and support a 802.3 Ethernet port for communications with an external computer. It shall be possible to both create, manage and save (backup) system programming from a network connected external computer through a Microsoft Windows graphical user interface (**Windows 11** up to the current release shall be supported).
- J. The system shall include programmable tones for emergency and civil emergency pages.
- K. The system shall provide 2,3, or 4 digit alpha/numeric ~~architectural~~ **final owner determined** room numbering.
- L. The integral system master clock shall have 16 schedules, thirty two (32) zones, and 1536 time events.

1.04 SUBMITTALS

- A. Prior to commencement of work.
 - 1. Shop Drawings - Refer to Section 01 3000 - Administrative Requirements, for submittal procedures. Submit shop Drawings including product data sheets and wiring diagrams and shall include the following:
 - a. A complete bill of materials with model and part numbers and reference to the Specification paragraph number.
 - b. A complete set of detailed manufacturers Specifications describing and illustrating all standard and special components and materials.
 - c. Provide 1/8 inch = 1'-0" Drawings stipulating devices and wiring for review.
- B. Post Construction
 - 1. Provide signed (by attendees & trainer) & dated training syllabus for each completed training session to the Architect/Engineer Technology Designer.
 - 2. Operation & Maintenance Manuals
 - a. Provide complete O & Ms. One hard copy and PDF format.
 - b. Both formats shall be fully indexed by Section Name/System/Device.
 - 3. The Architect/Engineer Technology Designer may require operational demonstration of any products and systems to verify Execution/Installation/Configuration requirements are met.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Technology Kick-Off Meeting: Participate in a technology kick-off meeting at least two (2) weeks prior to the start of the work of this section.
 - 1. Attendance required
 - a. Contractor and contractor's on-site project manager
 - b. Related Subcontractors
 - c. Garmann/Miller Technology Designer
 - d. Construction Manager
 - e. Put-In-Bay Local Schools - Technology Coordinator
- B. Refer to Division 1 Front-End documents for additional requirements.

1.06 QUALITY ASSURANCE

- A. Equipment and components within the equipment shall be approved by UL, and shall meet National, State, and Local Requirements including the 2023 National Electrical Code.
- B. NFPA 70 - National Electric Code.
- C. Underwriter's Laboratory.
- D. ANSI/TIA/EIA-606-B for system records and labeling
- E. ANSI J-STD-607-C Telecommunications Bonding & Grounding.
- F. BICSI 15th Edition TDMM (Telecommunications Distribution Methods Manual)
- G. Americans with Disabilities Act.
- H. Federal Communications Commission Part 15.
- I. Sound System Engineering (Davis & Patronis) - 4th Edition 2013
- J. Audio Systems Design and Installation (Giddings) 1990

1.07 WARRANTY

- A. The system is to be left in first class operating condition and the Contractor is to warrant equipment for a period of three (3) years from date of Substantial Completion against defective materials, design, and workmanship.
- B. Upon receipt of notice from Owner of failure of any part of the new equipment during the warranty period, these parts shall be replaced at no cost to the Owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. The equipment specified herein and shown on the Drawings is based upon the Telecor E Series.
 - 1. Equals by: Bogen Nyquist E7000, Valcom IP6000, CareHawk CH1000

2.02 EQUIPMENT

- A. Administrative Control Console (ACC)
 - 1. The Administrative Control Console shall be desk mounted and contain a matching telephone handset with retractable coiled cord. Housing shall be constructed of high-impact flame retardant black plastic console with volume control keys. Dimensions (including handset) 8" deep, 9" wide, 4" high, and 2lbs, 8ozs in weight. The termination shall be a plug-in locking modular connector. Coordinate the locations of the two Administrative Control Consoles with the owner. Provide cabling to the system as required.
 - 2. Administrative control stations shall be equipped with a large 2-line by 16-Character LCD alpha/numeric readout which shall provide:
 - a. 100% queuing of calling room numbers.
 - b. Sequential displays of calls "waiting".
 - c. Sequential display of priority stations.
 - d. Display of current time in idle state.
 - e. Full menu driven display of programmer prompting.
 - f. Full menu driven display of operator function dialing.
 - g. L.E.D's indicate function key's on/off.
 - h. The LCD display shall indicate that additional calls are pending beyond the one displayed "DISPLAY CALLS" button allows review of calls waiting. Call may be answered in or out of sequence.
 - 3. The Administrative Control Consoles shall provide two modes of communication to classroom speakers. Either voice operated handset or speaker and microphone communication activated by a built-in talk/listen switch for use in high noise areas.
 - 4. All Administrative Control Consoles shall have five (5) dedicated membrane switches labeled "EMERGENCY", "LOCK-DOWN", "EVACUATION", "TORNADO", and "ALL CLEAR". The operation of these switches shall gather all speakers for distribution of the highest priority of voice distribution call.
 - 5. Tone signaling distress or emergency signals.
 - 6. Emergency voice announcements.
 - 7. Distribution of "Civil Emergency" alert tone.
 - 8. All administrative control stations shall have a dedicated membrane button labeled "PAGE". The operation of this control shall allow the distribution of tone signaling, distress signals, and voice announcements to speaker zones. Loudspeakers may be intermixed between zones.
 - 9. Answering calls from classroom locations shall be accomplished by depressing the "PUSH TO TALK" button.

10. The system shall be equipped with a built-in tone generator which provides for both time signal tone and emergency or other signals. It shall be possible to manually activate and sound the time event signal to any of the thirty-two (32) time zones from the ACC.
 11. An ACC shall have the capability to reset the priority level of any remote call-in device through the use of the menu driven display on the ACC control panel. The system shall provide visual feedback of the priority setting of each room station.
 12. Each ACC shall be provided with a wall plate and matching modular connector for the ACC cable. This connector shall be mounted on a standard single gang plate.
 13. Standard of quality shall be Telecor Model MCC-300. Equals: Class Connection VEADP, Bogen MCDS4, Carehawk AP1 Administrative Phone.
- B. System Management Software
1. Provide a graphical interface software or application for system management, programming and messaging.
 2. Manufacturers: Telecor - Telecor eSeries Manager Software , Bogen - Nyquist Application Software, Valcom - Windows Programming Tool - V-MPT, Carehawk Assistant™ software
- C. Central Equipment
1. The central equipment shall be mounted in a floor mounted open equipment rack provided by others. The central equipment shall consist of:
 - a. A power supply to provide operating DC power for the circuitry contained within the central equipment housing and Administrative Control Consoles (ACC's).
 - b. A central microprocessor unit with 60 watt power amplifiers or as required.
 - c. Zone circuit boards as required for remote stations and/or communications linkage.
 - d. The provision for terminating the cabling from up to two hundred (200) stations and two (2) Administrative Control Consoles.
 - e. The unit shall be a Telecor II as basis of design. Equals: Valcom IP6000, Bogen E7000, Carehawk CH1000
 2. The system shall include an integral master clock capable of distributing tone signals for class change purposes to classroom loudspeakers. The display shall be in either (12) or (24) hour format at the Administrative Control Consoles.
 - a. The system shall provide for an editing and review routine to permit the user to change and edit time events, zones, and schedules without having to reprogram the entire sequence.
 - b. The time display shall be protected by a built-in lithium battery which shall automatically correct the ACC time displays upon restoration of power.
 - c. The central sound system clock shall derive its time from the District designated NTP server. Provide the Ethernet ports, accessories and connections necessary to connect to the NTP server. Coordinate this work with the Clock system contractor installing the NTP server.
 3. The system shall include a remote rack located in the office area consisting of an AM/FM Tuner, CD player with Bluetooth, and a desktop microphone. The ACC shall be used to select source input. Coordinate with owner on exact location of the remote paging rack. Provide all cabling required to connect to the PA system.
 - a. The tuner/CD shall provide drift free reception of both standard AM and FM signals. The antenna shall be terminated via a standard RG-59 U connector.
 - b. The system shall include a Compact Disc (CD) media player designed for continuous use as a program source in an institutional or industrial environment. It shall provide the following:
 - 1) The unit shall have a two speed manual search and a repeat and programmed play function.

- 2) Full function infrared remote control.
- 3) Front panel LED display which will provide a visual indication of all player activity.
- 4) The unit shall be rack mounted.
- 5) The unit shall be a Denon DN-500CB CD/USB/Bluetooth Player with Remote.
Equals: Tascam CD-400U Professional CD Player
- c. Desktop rack shall be a Lowell L40 series. Equals: Middle Atlantic 2-10, Raxxess ERS series
- d. The system shall have the capability of being configured through a web browser.
4. Speakers
 - a. The ceiling loudspeaker shall be a 1' x 2' or 2' x 2' lay-in grid type speaker system. 12 watt RMS, 92 dB-SPL - 1W/1M average sensitivity, 25 and 70.7 volt lines, 5 taps at -3 dB levels, and 65Hz - 17kHz frequency response. Speaker shall be white in color. Provide quantities as shown on plans. The standard of quality shall be Quam System 5. Equals: Valcom V-9062, Bogen CSD1x2/U
 - b. The horn type paging speaker for mechanical/storage areas shall be wall mounted type with 16 watt power handling capacity, a sensitivity of 110 dB, 1W/1M, frequency response of 300-15kHz, and built-in 25/70 volt line transformer. Quantity as shown on plans. The standard of quality shall be Quam QH16T. Equals: Clarity S-615, Bogen HS15EZ
 - c. The surface wall mount speakers in the public/academic areas shall be a wall mounted unit equal to Quam System 2. Equals: Valcome V-1961 speaker with VB-A13 angled back box, Bogen MB8TSL with angled back box
 - d. The recessed wall mount speakers in the public/academic areas shall be a square wall mounted unit and installed in the existing recessed back box equal to Quam TBLU-5W-25/70. Equals: Valcome V-1961, Bogen MB8TSL
 - e. In high bay rooms and in open/cloud ceiling rooms, provide pendant mount speakers per drawings equal to a Bogen MPS2B with CK10B hanging kits (Black is the default color unless noted otherwise). Equals by Clarity, Soundtube.
5. Cable
 - a. 22/2 stranded copper conductors shielded with overall jacket plenum rated mic and speaker wire: 7x28 stranding, 0.008" nominal flex plenum PVC insulation material, 100% Aluminum Polyester Foil shield, Stranded Tin Copper drain, 0.015" nominal flex plenum PVC jacket material, -10 to 60 degree C temperature rating, 300V RMS operating voltage rating, 60 pf/ft maximum capacitance @ 1 kHz between conductors, 108 pf/ft capacitance between conductors to shield @ 1kHz, 10.5 ohm/1M' DC resistance @ 20deg C.
 - 1) Approved Manufacturers: West Penn, Belden, Coleman, Windy City.
 - b. All open cabling must be plenum rated.
 - c. Shielded cables shall be bonded to the TGB/TMGB via the rack bonding busbar in the Telecommunication Room of origination.
6. Miscellaneous Equipment
 - a. Two Antennas
 - 1) AM/FM A/S whip type roof mounted.
 - 2) Provide an additional coax cable from the remote rack location to a roof mounted antenna location for future weather radio connections. Weather radio provided by the owner. Coordinate requirements with owner prior to rough-in.
 - b. Microphone: Audio Technica AT808G w/ AT866 (quantity 1). Equals by Shure 522, Bogen MBS1000A
 - c. Microphone wall plates: single gang, stainless steel, single female XLR connector.
 - 1) Approved Manufacturers: Pro Co, Crown, Lowell.

PART 3 INSTALLATION

3.01 WIRING

- A. Circuits: Room speaker locations shall be on separate circuits and new corridor speakers shall be on one circuit.
- B. Room circuits shall be routed through classroom sound reinforcement system for auto mute.
- C. Wiring shall conform to recommendations of the subcontractor and shall be installed in accordance with the Specifications and as indicated on the Drawings.
- D. Interface central sound system with telephone system. Provide necessary transformers or relays to accomplish this.
- E. Interface with the District designated NTP server for clock signal.
- F. Contractor shall ground the AM and FM antennas using a No. 2 AWG and a 5/8" x 10 foot ground rod and the appropriate location on the nearest TGB/TMGB.
- G. Balance the levels of the loudspeaker units in the area to assure adequate coverage and level of sound throughout all areas as detailed hereinafter.
- H. Establish the normal settings for all controls for all systems and record same for future reference. All levels shall be set for optimum signal to noise ratio and signal balance.

3.02 TRAINING

- A. Provide sixteen (16) hours training for District's personnel on the operation, programming and maintenance of the system and four (4) additional training hours each six (6) months post installation until expiration of 3 year warranty.
- B. Provide two (2) video copies of all training.

END OF SECTION

**SECTION 27 53 13
CLOCK SYSTEM**

PART 1 GENERAL

1.01 RELATED SECTIONS

- A. The provisions of the General Conditions, Supplementary Conditions and the Sections included under Division 1, General Requirements are included as a part of this Section as though bound herein.
- B. Refer to Section 01 2300 for Alternates that may affect the Work of this Section.

1.02 SECTION INCLUDES

- A. Wireless Clocks and accessories
- B. Ethernet Sourced Wireless Transmitter
- C. Network Time Server

1.03 QUALITY ASSURANCE

- A. The clock system equipment shall be UL listed.
- B. All equipment and installation practices shall comply with the latest ANSI/NFPA-70 National Electrical Code.
- C. All equipment installation practices shall comply with the 2023 National Electrical Code and local electric code.
- D. All equipment shall comply with the latest ANSI-J-STD-607-C Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications Standard.
- E. All equipment and installation practices shall comply with the latest BICSI 15th Edition TDMM (Telecommunications Distribution Methods Manual).
- F. All equipment shall comply with the latest ANSI TIA/EIA-568, 569, 606, 607 and 862 standards.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Technology Kick-Off Meeting: Participate in a technology kick-off meeting at least two (2) weeks prior to the start of the work of this section.
 - 1. Attendance required
 - a. Contractor and contractor's on-site project manager
 - b. Related Subcontractors
 - c. Garmann/Miller Technology Designer
 - d. Construction Manager
 - e. Put-In-Bay Local Schools - Technology Coordinator
- B. Refer to Division 1 Front-End documents for additional requirements.

1.05 SUBMITTALS

- A. Prior to Commencement of Work
 - 1. Shop Drawings - Refer to Section 01 3000 - Administrative Requirements, for submittal procedures.
 - a. Provide catalog cuts of products for review in the format required by the project front-end Specifications. All products provided must be clearly identified in submittal documents.
 - b. Complete and comprehensive Equipment Catalog Specification Sheets of each component provided.
 - c. Provide a projected coverage map using the default transmitter on the building footprint.

- d. Provide a complete bill of materials with model and part numbers and reference to the Specification paragraph number.
 - e. If a product is manufacturer discontinued, provide the manufacturer recommended direct replacement cut sheet and note as "Replacement for discontinued item".
- B. Post Construction
- 1. Contractor to submit training syllabus to the Architect/Engineer Technology Designer for approval at least 2 weeks prior to commencement of training sessions.
 - 2. Provide signed (by attendees & trainer) & dated training syllabus for each completed training session to the Architect/Engineer Technology Designer.
 - 3. Operation & Maintenance Manuals
 - a. Provide complete O & Ms. One hard copy and PDF format.
 - b. Both formats shall be fully indexed by Section Name/System/Device.
 - 4. Complete record Drawings indicating the interconnection of all equipment.
 - 5. Operating License: Submit evidence of application for FCC Radio Station Authorization prior to installing equipment. Furnish the license or a copy of the application for the license, to the Owner/End User prior to operating the equipment. The original license must be delivered to the Owner/End User.
 - 6. Provide signed (by attendees & trainer) & dated training syllabus for each completed training session to the Architect/Engineer Technology Designer.
 - 7. Operation & Maintenance Manuals
 - a. Provide complete O & Ms. One hard copy and PDF format.
 - b. Both formats shall be fully indexed by Section Name/System/Device.
 - 8. The Architect/Engineer Technology Designer may require operational demonstration of any products and systems to verify Execution/Installation/Configuration requirements are met.

1.06 REGULATORY REQUIREMENTS

- A. Equipment and components furnished shall be of manufacturer's latest model.
- B. The end user will hold a license, known as a "Radio Station Authorization" granted by the FCC or the manufacturer will provide a protected right to use of radio spectrum for the life of the installation.
- C. This license grants the end user protected use for wireless transmission at the designated frequency.
- D. This license will designate a unique "call sign" for each end user, unless it is a manufacturer license.
- E. Transmitter and receiver shall comply with Part 90 of FCC rules as follows:
 - 1. This device may not cause harmful interference, and
 - 2. This device must accept interference received, including interference that may cause undesired operation.
 - 3. Transmitter frequency shall be governed by FCC Part 90.35.
 - 4. Transmitter output power shall be governed by FCC Part 90 257 (b) and Part 74.
 - 5. System shall be installed in compliance with local and state authorities having jurisdiction.

1.07 WARRANTY

- A. Components, parts, and assemblies supplied by the manufacturer shall be warranted against defects in materials and workmanship for a period of three (3) years from date of completion. Warranty services shall be provided during normal working hours. The representative shall be based in a fully staffed branch office and located within a reasonable distance from the job site.

1.08 EXTRA MATERIALS

- A. Provide one(1) additional double faced clock and three (3) additional wall-mount clocks. Turn over to Owner.
- B. Obtain Owner's signature acknowledging receipt of extra stock.

PART 2 PRODUCTS

2.01 GENERAL

- A. Synchronize clock system with the United States Atomic Clock via GPS/NTP receiver with external antenna.
- B. Self-correcting for Daylight Savings Time changes.
- C. Provide new Clocks per Drawings and Specifications.

2.02 WIRELESS CLOCKS

A. DIGITAL CLOCKS

- 1. 6-Digit, 2.5" character height, Wall Mount, Single faced
 - a. 2.5" character height
 - b. Wall Mount kit
 - c. Single Clock
 - d. 120 VAC 50-60 Cycle AC powered with licensed RF signal source
 - 1) If 24 VAC is to be used, the clock contractor is responsible for stepping power down. Division 26 will be providing 120 VAC.
 - 2) UL/cUL listed power supply must be used.
 - e. Approved Manufacturers:
 - 1) Primex - 103-ASP35R
 - 2) Equals by:
 - (a) American Time & Signal
 - (b) Innovation Wireless
 - (c) Paging system manufacture
- 2. 6-Digit, 4" character height, Wall Mount, Single faced (Gymnasuim)
 - a. 4" character height
 - b. Wall Mount kit
 - c. Wire Guard
 - d. **Single Clock**
 - e. **120 VAC 50-60 Cycle AC powered with licensed RF signal source**
 - f. **If 24 VAC is to be used, the clock contractor is responsible for stepping power down. Division 26 will be providing 120 VAC.UL/cUL listed power supply must be used.**
 - g. **Approved Manufacturers:**
 - 1) **Primex - 103-ASP35R**
 - 2) **Equals by:**
 - (a) **American Time & Signal**
 - (b) **Innovation Wireless**
 - (c) **Visiplex**
 - (d) **Paging system manufacture**
 - h. 120 VAC 50-60 Cycle AC powered with licensed RF signal source
 - 1) If 24 VAC is to be used, the clock contractor is responsible for stepping power down. Division 26 will be providing 120 VAC.
 - 2) UL/cUL listed power supply must be used.
 - i. Approved Manufacturers:

- 1) Primex - 103-AS250R
- 2) Equals by:
 - (a) American Time & Signal
 - (b) Innovation Wireless
 - (c) Paging system manufacture
3. 6-Digit, 2.5" character height, Ceiling mount, Dual faced (Corridors)
 - a. 2.5" character height
 - b. Ceiling Mount kit
 - c. Dual Clock
 - d. 120 VAC 50-60 Cycle AC powered with licensed RF signal source
 - 1) If 24 VAC is to be used, the clock contractor is responsible for stepping power down. Division 26 will be providing 120 VAC.
 - 2) UL/cUL listed power supply must be used.
 - e. Ability to synchronize over radio frequency transmission.
 - f. LED dimmer options: 100%, 75%, 50%, or 25%.
 - g. Approved Manufacturers:
 - 1) Primex - 103-ASP35R, Dual clock bracket kit - 198-000007
 - 2) Equals by:
 - (a) American Time & Signal
 - (b) Innovation Wireless
 - (c) Paging system manufacture

2.03 TRANSMITTER WITH NTP (ETHERNET) RECEIVER

- A. Wireless system
- B. Provide central transmitter with dual NTP (Network Time Server) sources to provide complete wireless coverage of entire building. Provide appropriate size antennas, transmitters and/or repeaters required for complete coverage of the building.
 1. It is strongly recommended that this contractor coordinate the transmitter output power with the manufacture to ensure complete coverage of the building.
- C. If transmitter form factor is not compatible with rack mounting (i.e. antenna creates a cabling or equipment pathway obstruction, provide wall-mount shelf for transmitter.
- D. Approved Manufacturers:
 1. Primex XR Series Transmitter
 2. American Time & Signal - SSQRTM-05N6E
 3. InnovationWireless - Part # 101005X

2.04 EXTERNAL ANTENNA & CENTRAL TRANSMITTER

- A. Matched with transmitter.
- B. Match end user licensed band or manufacturer licensed band.
- C. Power Supply: 120V, 60Hz, 0.4 amp.
- D. Provide mounting kit, plenum cabling and any additional pathways required.
- E. Approved Manufacturers : Primex, Visiplex, American Time & Signal, Innovation Wireless

2.05 NTP SERVER - PROVIDE AS THE PRIMARY SOURCE FOR THE TRANSMITTER (THIS FUNCTION CAN BE PROVIDED IN AN INTEGRATED NTP SERVER/TRANSMITTER IF NTP SERVER SPECIFICATIONS ARE MET)

- A. Basis of design - EndRun Technologies GPS Network Time Server
 1. GPS Receiver:
 - a. L1 Band - 1575.42 MHz.

- b. 8 Channels, C/A Code
- 2. Antenna:
 - a. TNC jack on rear panel, $Z_{in} = 50\text{ohm}$.
 - b. Integral +35 dB gain LNA and bandpass filter for out-of-band interference rejection.
 - c. All-weather housing capable of operation over -40° to $+85^{\circ}\text{C}$.
 - d. Mounting via 18" long, 3/4" PVC pipe with clamps.
 - e. RG-59 downlead cable is standard. Provide appropriate length up the 500 feet.
- 3. Holdover Accuracy:
 - a. TCXO (standard): 10 milliseconds/day. Serves Stratum 1 time for 24 hours after signal loss.
- 4. Synchronization Accuracy:
 - a. GPS Receiver Accuracy: < 30 nanoseconds to GPS Time (< 100 ns to UTC*) when locked.
 - b. NTP Timestamp Accuracy: < 10 microseconds @ 200 packets/second (200,000 clients).
- 5. Supported Protocols:
 - a. SNTP, NTP v2, v3, v4, MD5 authentication, and broadcast/multicast mode and autokey.
 - b. SSH server with "secure copy" utility, SCP
 - c. SNMP v1, v2c, v3 with Enterprise MIB
 - d. TIME and DAYTIME server
 - e. TELNET client/server
 - f. FTP and DHCP clients
 - g. SYSLOG
 - h. IPv4 and IPv4/IPv6 Hybrid
- 6. Network I/O:
 - a. 8P8C jack for management/monitoring 10/100Base-T Ethernet.
- 7. Maintenance Console:
 - a. RS-232 serial I/O on rear panel DB9M jack for secure, local terminal access.
- 8. Power 120 VAC
- 9. 19" Rackmount - 1 RU
- B. Contractor to provide NTP clients and configuration information to the Owner and to the Architect/Engineer Technology Designer including installation procedures for each client.
- C. Contractor to provide NTP server data to all other technology contractors to source all technology platform to this server.
- D. Approved Manufacturers:
 - 1. EndRun Technologies Sonoma D12
 - 2. Microsemi - Syncserver S600-GPS
 - 3. Orolia - NetClock Time Server 9489

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install per manufacturer's recommendations.
- B. Mount antennas in order to ensure adequate signal coverage, provide plenum cabling and any antenna specific pathways (including sleeves for external wall penetrations).
- C. Securely mount the clocks flush on the walls in classrooms and office areas.
- D. All clocks shall be capable of synchronization from the host transmitter as installed in rooms.

- E. GPS and transmitter cable shields must be grounded to the Telecommunication Main Ground Busbar in the producer section (furthest to the right-hand end of the busbar). Any deviation from this grounding practice requires approval of the Architect/Engineer Technology Designer.
- F. Cable ties and tape are not permitted for securing cable coils or supporting cabling in any way during installation, be it temporary or permanent, on any indoor cabling.
- G. Cable ties may only be used to secure cabling outdoors. Cable tie ends shall be cleanly cut with flush cutters.
- H. Coordinate with other Technology contractors whose equipment requires a network clock input (i.e. paging/central sound system, telephone system, data network equipment, audio/visual equipment, etc.)

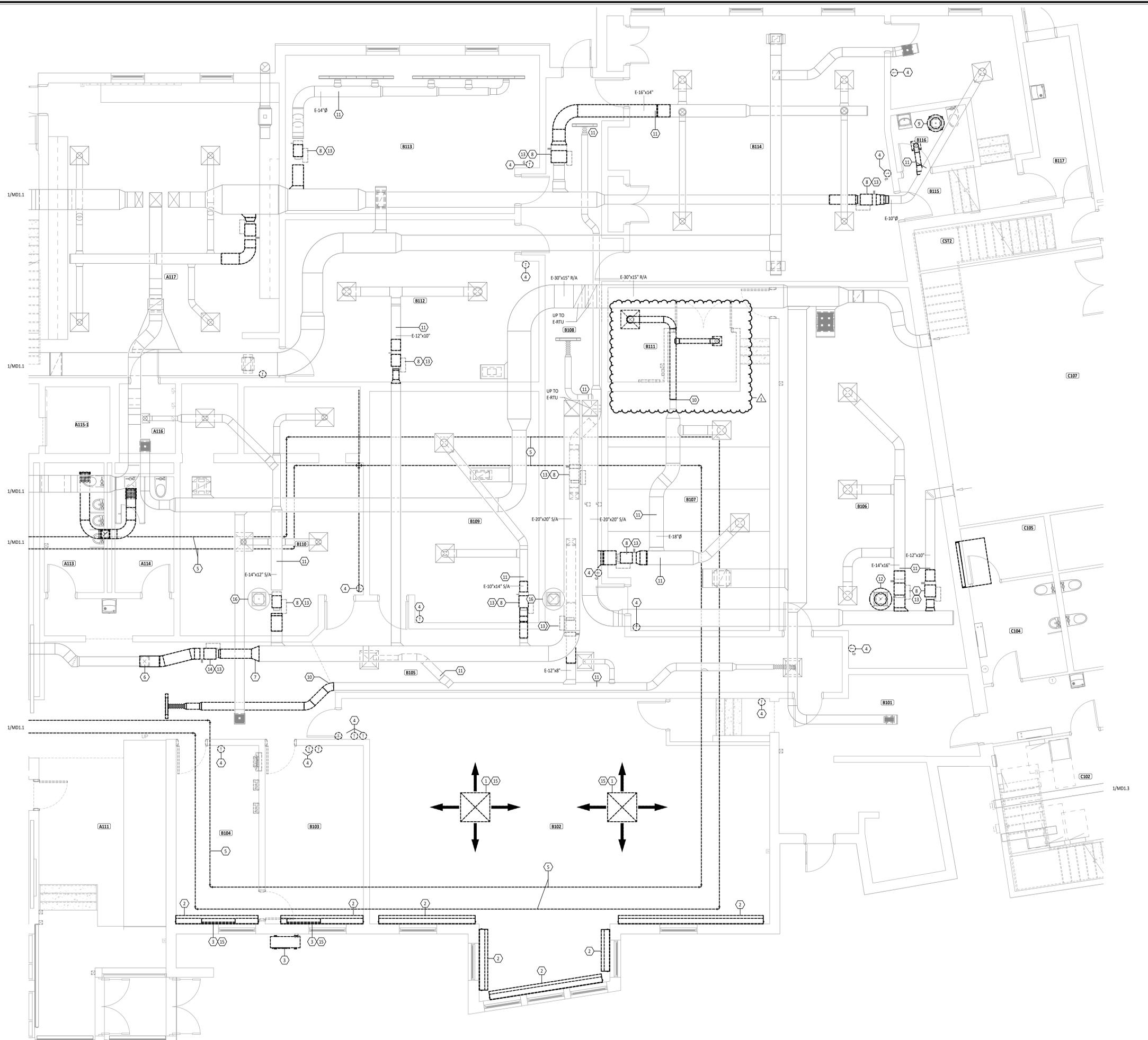
3.02 TRAINING

- A. Provide four (4) hours training for owner's personnel on the operation, programming and maintenance of the system.
- B. Refer to Submittals section of this Specification for training syllabus requirements.
- C. Provide two (2) video copies of all training. Also encode training onto Digital Media Management server and add to system as video asset.

3.03 QUANTITIES

- A. Provide quantities per Specifications and Drawings.
- B. Refer to Extra Materials section of this Specification for additional requirements.

END OF SECTION

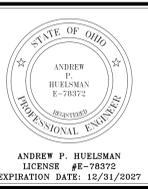


FIRST FLOOR PLAN ROOM INDEX - UNIT B		
ROOM NUMBER	ROOM NAME	AREA
B101	ENTRY	329 SF
B102	LIBRARY	1,099 SF
B103	OFFICE	202 SF
B104	OFFICE	170 SF
B105	CORRIDOR	571 SF
B106	CLASSROOM	666 SF
B107	CLASSROOM	433 SF
B108	CORRIDOR	415 SF
B109	CLASSROOM	437 SF
B110	WORK ROOM	484 SF
B111	TECHNOLOGY ROOM	175 SF
B112	CLASSROOM	463 SF
B113	CLASSROOM	451 SF
B114	MULTI-PURPOSE SPACE	811 SF
B115	KITCHENETTE	224 SF
B116	UNISEX RESTROOM	51 SF
B117	CORRIDOR	95 SF

HVAC DEMOLITION GENERAL NOTES

- ALL EXISTING DUCTWORK AND PIPING SIZES ARE SHOWN BASED ON EXISTING DRAWINGS AND SELECTIVE SITE VERIFICATION. EXACT SIZE, TYPE, AND LOCATION SHALL BE VERIFIED ON SITE PRIOR TO CONSTRUCTION. WHERE CONTRACTOR IS TO CONNECT TO EXISTING, TRANSITIONS SHALL BE PROVIDED AS REQUIRED.
- REMOVAL OF ANY AND ALL MECHANICAL SYSTEMS WITH ELECTRICAL CONNECTIONS SHALL BE COORDINATED WITH DIVISION 26 ELECTRICAL CONTRACTOR UNLESS OTHERWISE NOTED.
- COORDINATE THE REMOVAL AND REPLACEMENT OF ALL EXISTING CEILING, WALLS, ETC. AS REQUIRED FOR MECHANICAL DEMOLITION WITH GENERAL CONTRACTOR.
- ANY MECHANICAL SYSTEMS REMOVED SHALL BE DISPOSED OF OFF-SITE UNLESS OTHERWISE NOTED.

#	KEYNOTE DESCRIPTION
1	EXISTING CEILING CASSETTES TO BE REMOVED AND DISPOSED OF OFF-SITE. REFRIGERANT TO BE DISPOSED OF ACCORDING TO EPA AND ASHRAE GUIDELINES. PREPARE CEILING FOR INSTALLATION OF NEW CASSETTES. REFER TO M2.2 FOR ADDITIONAL INFORMATION. VERIFY EXACT LOCATION ON SITE. COORDINATE CEILING REMOVAL WORK WITH GENERAL CONTRACTOR.
2	EXISTING HYDRONIC PERIMETER HEATING EQUIPMENT, HYDRONIC PIPING, AND ASSOCIATED MOUNTING EQUIPMENT TO BE REMOVED AND DISPOSED OF OFF-SITE. WALL, FLOOR, AND CEILING PATCHING AND REPAIR TO BE COORDINATED WITH GENERAL CONTRACTOR.
3	EXISTING WALL MOUNTED MINI SPLIT AND ASSOCIATED OUTDOOR UNIT TO BE REMOVED AND DISPOSED OF OFF-SITE. REFRIGERANT TO BE DISPOSED OF ACCORDING TO EPA AND ASHRAE GUIDELINES. WALL PATCHING AND REPAIR TO BE COORDINATED WITH GENERAL CONTRACTOR. VERIFY EXACT LOCATION ON SITE.
4	LOW VOLTAGE THERMOSTAT, ASSOCIATED WIRING, AND ASSOCIATED RACEWAYS TO BE DISCONNECTED, REMOVED, AND DISPOSED OF OFF-SITE. VERIFY EXACT TYPE AND LOCATION ON SITE. WALL REPAIR AND PAINTING BY GENERAL CONTRACTOR.
5	EXISTING HYDRONIC HEATING PIPING, ASSOCIATED MOUNTING EQUIPMENT, AND ASSOCIATED PIPING ACCESSORIES TO BE REMOVED AND DISPOSED OF OFF-SITE. WALL, FLOOR, AND CEILING PATCHING AND REPAIR TO BE COORDINATED WITH GENERAL CONTRACTOR.
6	EXISTING DUCT WORK TO BE REMOVED UP TO APPROXIMATE LOCATION SHOWN AND DISPOSED OF OFF-SITE. PREPARE DUCTWORK FOR RECONNECTION TO NEW DUCTWORK FROM NEW ENERGY RECOVERY VENTILATOR. REFER TO M2.1 FOR ADDITIONAL INFORMATION.
7	EXISTING SUPPLY AIR DUCTWORK UP TO APPROXIMATE LOCATION SHOWN TO BE REMOVED AND DISPOSED OF OFF-SITE. REMAINING DUCTWORK TO BE CAPPED AND SEALED.
8	EXISTING ELECTRIC REHEAT BOX TO BE DISCONNECTED, REMOVED, AND DISPOSED OF OFF-SITE. PREPARE DUCTWORK FOR RECONNECTION TO ELECTRIC VAV REHEAT BOX. REFER TO M2.1 AND M5.1 FOR ADDITIONAL INFORMATION.
9	EXISTING EXHAUST FAN AND ASSOCIATED GRILLE TO BE REMOVED AND DISPOSED OF OFF-SITE. PREPARE ROOF CURB FOR INSTALLATION OF NEW EXHAUST FAN. REFER TO M2.2 FOR ADDITIONAL INFORMATION.
10	EXISTING SUPPLY AIR DIFFUSER AND DUCTWORK UP TO APPROXIMATE LOCATION SHOWN TO BE REMOVED AND DISPOSED OF OFF-SITE. REMAINING DUCTWORK TO BE CAPPED AND SEALED.
11	EXISTING SUPPLY AIR DIFFUSERS AND DUCTWORK TO REMAIN. PROTECT DURING CONSTRUCTION. ANY DAMAGE TO DIFFUSER OR DUCTWORK TO BE REPAIRED OR REPLACED AT NO EXPENSE TO THE OWNER.
12	EXISTING ATTIC ROOFTOP VENT TO BE REMOVED, CAPPED, AND SEALED TO ALLOW ROOM FOR INSTALLATION OF NEW ROOFTOP UNIT. REFER TO M2.5 FOR ADDITIONAL INFORMATION. COORDINATE WORK WITH GENERAL CONTRACTOR.
13	REMOVAL AND REINSTALLATION OF REQUIRED CEILING FOR MECHANICAL WORK TO BE COORDINATED WITH GENERAL CONTRACTOR. REFER TO ARCHITECTURAL PLAN FOR ADDITIONAL INFORMATION. VERIFY EXTENT OF CEILING REMOVAL WORK ON SITE.
14	EXISTING ELECTRIC REHEAT BOX TO BE DISCONNECTED, REMOVED, AND DISPOSED OF OFF-SITE.
15	EXISTING CONDENSATION PIPING FROM COOLING UNIT TO BE REMOVED AND DISPOSED OF OFF-SITE. COORDINATE INTERIOR AND EXTERIOR WALL PATCHING AND REPAIR WITH GENERAL CONTRACTOR. VERIFY EXACT SIZE AND LOCATION ON SITE.
16	EXISTING ATTIC ROOFTOP VENT TO REMAIN. PROTECT DURING DEMOLITION. ANY DAMAGE TO VENT TO BE REPAIRED AND/OR REPLACED AT NO EXPENSE TO THE OWNER.



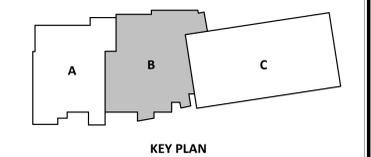
**PUT-IN-BAY LOCAL SCHOOLS
1919 BUILDING RENOVATIONS**

ISSUANCES/REVISIONS	
1	CONSTRUCTION DOCUMENTS - 02/12/2025 CONSTRUCTION DOCUMENTS - 02/26/2025 ADDENDUM 03

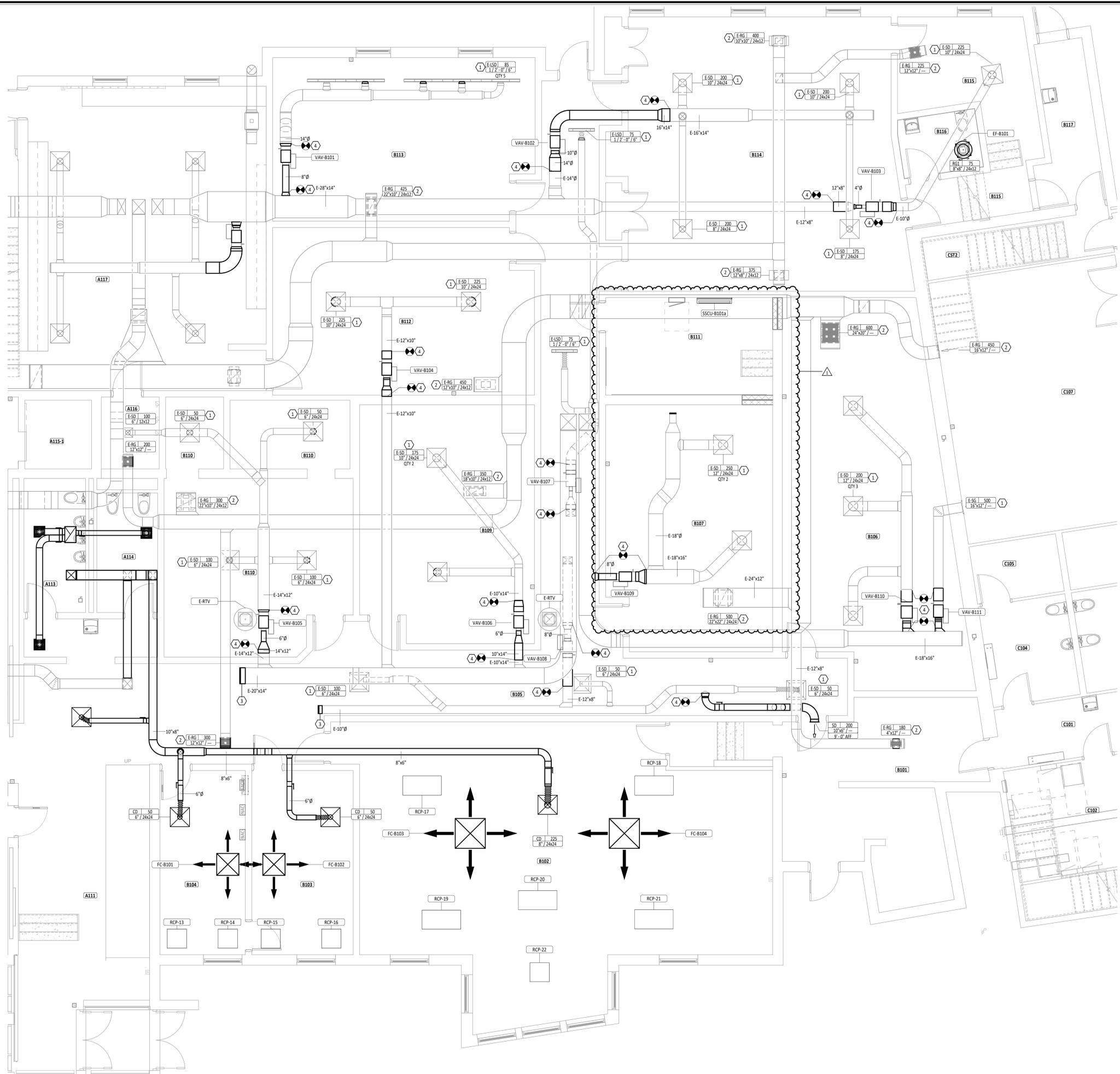
PROJECT NUMBER:	DRAWN BY:	CHECKED BY:
25019.01	KCW	DMB

**FIRST FLOOR MECHANICAL
DEMOLITION PLAN
- UNIT B**

SHEET NUMBER:
MD1.2



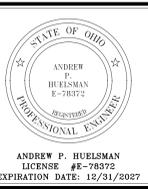
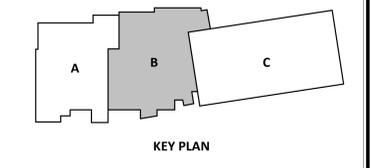
1 FIRST FLOOR MECHANICAL DEMOLITION PLAN - UNIT B
1/4" = 1'-0"



FIRST FLOOR PLAN ROOM INDEX - UNIT B		
ROOM NUMBER	ROOM NAME	AREA
B101	ENTRY	329 SF
B102	LIBRARY	1,099 SF
B103	OFFICE	202 SF
B104	OFFICE	170 SF
B105	CORRIDOR	571 SF
B106	CLASSROOM	666 SF
B107	CLASSROOM	433 SF
B108	CORRIDOR	415 SF
B109	CLASSROOM	437 SF
B110	WORK ROOM	484 SF
B111	TECHNOLOGY ROOM	175 SF
B112	CLASSROOM	463 SF
B113	CLASSROOM	451 SF
B114	MULTI-PURPOSE SPACE	811 SF
B115	KITCHENETTE	224 SF
B116	UNISEX RESTROOM	51 SF
B117	CORRIDOR	95 SF

- HVAC GENERAL NOTES**
- REMOVE ALL UNUSED PIPING, DUCTWORK AND ACCESSORIES. DISPOSE OF THESE ITEMS OFF SITE.
 - THE MECHANICAL CONTRACTOR SHALL BE RESPONSIBLE FOR FIELD VERIFYING, PRIOR TO FINAL BID, ALL EXISTING CONDITIONS FOR PLUMBING AND MECHANICAL SYSTEMS WITHIN SCOPE AREA AND WITHIN CLOSE PROXIMITY OF THE SCOPE AREA.
 - DIVISION 23 MECHANICAL CONTRACTOR IS REQUIRED TO COORDINATE DIFFUSER AND GRILLE LOCATIONS WITH ARCHITECTURAL REFLECTED CEILING PLANS.
 - ALL EQUIPMENT LOCATED ABOVE CEILING REQUIRING MAINTENANCE SHALL BE INSTALLED WITHIN (2) FEET OF THE CEILING FOR MAINTENANCE PURPOSES. DO NOT INSTALL UNITS ABOVE LIGHTS AND CEILING SPEAKERS. COORDINATE LOCATION WITH ARCHITECTURAL REFLECTED CEILING PLAN AND GENERAL CONTRACTOR.
 - COORDINATE THE EXACT LOCATION OF THE VAV BOXES WITH ALL OTHER TRADES. VAV BOXES SHALL BE INSTALLED SUCH THAT THE CONTROL BOXES CAN BE EASILY ACCESSED AND MAINTAINED.
 - ANY BALANCING DAMPERS OR OTHER DEVICES IN DUCTS ABOVE HARD CEILINGS SHALL BE LOCATED ABOVE NEAREST ACCESSIBLE CEILING.
 - THIS CONTRACTOR SHALL BE REQUIRED TO REPLACE FILTERS ON HVAC EQUIPMENT AFTER ALL DUST PRODUCING CONSTRUCTION HAS BEEN COMPLETED AND PRIOR TO THE FINAL PUNCH.
 - ALL ROOF MOUNTED EQUIPMENT SHALL BE A MINIMUM 10'-0" FROM EDGE OF ROOF.
 - LOCATE DUCTWORK AND MECHANICAL EQUIPMENT AWAY FROM THE SPACE ABOVE ELECTRICAL PANELS, TRANSFORMERS AND OTHER ELECTRICAL EQUIPMENT.
 - FIRE SEAL AROUND DUCT PENETRATIONS OF FIRE RATED WALLS. REFER TO SPECIFICATION.
 - PROVIDE SLEEVES AND/OR OPENINGS TO RUN DUCTS THROUGH FOUNDATIONS, FLOORS, WALLS, AND ROOF.
 - CONTRACTOR SHALL LOCATE THERMOSTATS AND TEMPERATURE SENSORS AT 3'-8" AFF, A MINIMUM OF 4" FROM LIGHT SWITCH.
 - CONDENSATE DRAINS SHALL BE SUPPLIED FOR ALL COOLING EQUIPMENT. CONTRACTOR SHALL ENSURE PROPER INSTALLATION AND DRAINAGE AS REQUIRED BY FEDERAL, STATE, AND LOCAL CODES. CONDENSATE PIPING SHALL BE TYPE "L" COPPER.
 - ALL SUPPLY, RETURN, AND EXHAUST DUCTWORK SHALL BE RATED FOR PRESSURE CLASS OF 2" W.G. UNLESS NOTED OTHERWISE.
 - WHERE FLOOR DRAINS OCCUR WITHIN THE LIMITS OF CONSTRUCTION, PREVENT CONSTRUCTION DEBRIS FROM ENTERING DRAIN BODY BY SEALING DRAIN OPENING PRIOR TO START OF WORK. UNSEAL DRAINS AT COMPLETION OF CONSTRUCTION.
 - COORDINATE INSTALLATION OF PIPING, DUCTWORK, CONDUIT, LIGHTS, CABLE TRAY, STRUCTURE, AND EQUIPMENT TO PREVENT CONFLICTS.
 - THE CONTRACTOR SHALL BE FAMILIAR WITH ALL THE CONDITIONS BOTH EXISTING AND THOSE ILLUSTRATED BY THESE DOCUMENTS AS WELL AS THOSE WHICH CAN BE REASONABLY ANTICIPATED INCLUDING, BUT NOT LIMITED TO ARCHITECTURAL, ELECTRICAL, VENTILATION, PLUMBING, AND OTHER SYSTEMS INVOLVED ON THIS PROJECT.
 - FINAL PRODUCT SHALL BE A COMPLETE AND FUNCTIONING SYSTEM, AND SHALL CONFORM TO ALL REQUIREMENTS OF APPLICABLE FEDERAL, STATE, AND LOCAL CODES, INCLUDING BUT NOT LIMITED TO THE INTERNATIONAL BUILDING CODE AND INTERNATIONAL MECHANICAL CODE.
 - ADJUST PIPING AND DUCTWORK SIZES TO PROPERLY CONNECT TO MECHANICAL EQUIPMENT.
 - PIPE SIZES SHOWN SHALL BE CONTINUED IN THE DIRECTION OF FLOW UNTIL ANOTHER SIZE IS SHOWN.
 - INSTALL ALL EQUIPMENT IN ACCORDANCE WITH THE RESPECTIVE MANUFACTURER'S WRITTEN INSTALLATION INSTRUCTIONS, AT A LEVEL OF QUALITY AND WORKMANSHIP CONSISTENT WITH THE SPECIFICATIONS.
 - LOCATIONS OF PIPING, DUCTWORK AND EQUIPMENT AS INDICATED ON THE DRAWING, ARE APPROXIMATE AND SUBJECT TO MINOR ADJUSTMENTS IN THE FIELD. WORK SHALL BE COORDINATED WITH ALL OTHER TRADES TO AVOID INTERFERENCE IN THE FIELD. CONSULT ENGINEER IF MANUFACTURER'S MINIMUM CLEARANCE REQUIRED CAN'T BE MAINTAINED.
 - INSTALL EXPOSED PIPING AND DUCTWORK AS HIGH AS PRACTICAL IN ROOMS WITHOUT CEILINGS, WHERE NOT OTHERWISE NOTED ON DRAWINGS.

#	KEYNOTE DESCRIPTION
1	EXISTING DIFFUSER TO BE REBALANCED TO FLOW RATE SHOWN. VERIFY EXACT LOCATION AND CONDITION OF BALANCING DAMPER ON SITE. COORDINATE CEILING REMOVAL AND REPLACEMENT WORK WITH GENERAL CONTRACTOR.
2	EXISTING RETURN GRILLE TO BE REBALANCED TO FLOW RATE SHOWN. VERIFY EXACT LOCATION AND CONDITION OF BALANCING DAMPER ON SITE. COORDINATE CEILING REMOVAL AND REPLACEMENT WORK WITH GENERAL CONTRACTOR.
3	EXISTING SUPPLY AIR DUCTWORK TO BE CAPPED AND SEALED IN APPROXIMATE LOCATION SHOWN. VERIFY EXACT SIZE AND LOCATION ON SITE. COORDINATE CEILING REMOVAL AND REPAIR WITH GENERAL CONTRACTOR.
4	CONNECT TO EXISTING SUPPLY AIR DUCTWORK IN APPROXIMATE LOCATION SHOWN. MODIFY AND TRANSITION EXISTING DUCTWORK AS NEEDED FOR CONNECTION. VERIFY EXISTING SIZE AND LOCATION ON SITE. COORDINATE CEILING REMOVAL AND REPAIR WORK WITH GENERAL CONTRACTOR.



PUT-IN-BAY LOCAL SCHOOLS 1919 BUILDING RENOVATIONS

ISSUANCES/REVISIONS	
1	CONSTRUCTION DOCUMENTS - 02/22/2026 CONSTRUCTION DOCUMENTS - 02/26/2026 ADDENDUM 03

PROJECT NUMBER: 25019.01	DRAWN BY: ICW	CHECKED BY: DMB
------------------------------------	------------------	--------------------

SHEET TITLE:
**FIRST FLOOR
MECHANICAL
PLAN - UNIT B**

SHEET NUMBER:
M2.2

RADIANT CEILING PANEL SCHEDULE table with columns for ID, MANUFACTURER, MODEL NO., TYPE, HEATING CAPACITY, ELECTRICAL, DIMENSIONS, UNIT WEIGHT, and REMARKS.

VARIABLE AIR VOLUME TERMINAL UNIT SCHEDULE table with columns for ID, MANUFACTURER, MODEL NO., NECK SIZE, TYPE, PRIMARY AIRFLOW, HEATING COIL, HEATING ELEMENT, and REMARKS.

EXHAUST FAN SCHEDULE table with columns for ID, MANUFACTURER, MODEL NO., TYPE, ARRANGEMENT, AIRFLOW, PRESS, RPM, DRIVE, MOTOR, ACCESSORIES, and REMARKS.

VARIABLE REFRIGERANT FLOW FAN COIL UNIT SCHEDULE table with columns for ID, MANUFACTURER, MODEL NO., TYPE, SUPPLY AIRFLOW, BRANCH SELECTOR ID, CAP, AIRSIDE, CONDENSER HEATING COIL, SOUND PRESS LEVEL, and REMARKS.

VARIABLE REFRIGERANT FLOW AIR-SOURCE HEAT PUMP UNIT SCHEDULE table with columns for ID, MANUFACTURER, MODEL NO., TYPE, NOMINAL COOLING CAP, NOMINAL HEATING CAP, AUXILIARY FAN, REFRIGERANT, LOW AMBIENT, PIPE LENGTHS, SUMMER AMBIENT, WINTER AMBIENT, and REMARKS.

VARIABLE REFRIGERANT FLOW BRANCH SELECTOR SCHEDULE table with columns for ID, MANUFACTURER, MODEL NO., TYPE, ARRANGEMENT, R32, R410A, UNIT WEIGHT, MCA, MOC, VOLT, PH, ID, and REMARKS.

WALL MOUNTED HEAT PUMP SCHEDULE table with columns for ID, MANUFACTURER, MODEL NO., TYPE, DESIGN AIRFLOW, NOMINAL CAP, COOLING COIL, AIRSIDE, HEATING COIL, AIRSIDE, UNIT WEIGHT, INTERLOCK, and REMARKS.

SPLIT SYSTEM HEAT PUMP SCHEDULE table with columns for ID, MANUFACTURER, MODEL NO., TYPE, CAP, TYPE, REFRIGERANT, CHARGE, LOW AMBIENT KIT, DESIGN PIPE LENGTH, SUMMER AMBIENT DBT, WINTER AMBIENT DBT, SEER, EER, SOUND PRESS LEVEL, UNIT WEIGHT, MCA, MOC, VOLT, PH, ID, and REMARKS.

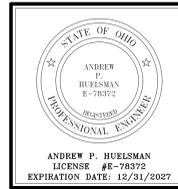
WALL MOUNTED AIR CONDITIONER SCHEDULE table with columns for ID, MANUFACTURER, MODEL NO., TYPE, DESIGN AIRFLOW, COOLING COIL, INTERLOCK, and REMARKS.

SPLIT SYSTEM CONDENSING UNIT SCHEDULE table with columns for ID, DESCRIPTION, MANUFACTURER, MODEL NO., TYPE, CAP, TYPE, REFRIGERANT, LOW AMBIENT KIT, DESIGN PIPE LENGTH, SEER, EER, MCA, MOC, VOLT, PH, ID, and REMARKS.

ASHRAE 62.1 VENTILATION RATE PROCEDURE SUMMARY table with columns for ROOM IDENTITY, LOCATION, Occupancy Category, Area, At, Selected Supply Airflow, Number of People, Outdoor Airflow Rate, Outdoor Airflow Rate Per Unit Area, Zone Air Effectiveness, Breathing Zone Outdoor Airflow, Required Outdoor Air Intake Flow, OA Delivered, and Specified Exhaust Airflow.

GRILLES, REGISTERS AND DIFFUSERS SCHEDULE table with columns for ID, DESCRIPTION, MANUFACTURER, MODEL, QTY, FACE SIZE, NECK, BLADE DESIGN, DEFLECTION ANGLE, ORIENTATION, INSTALLATION, and NOTES.

LINEAR SLOT DIFFUSER SCHEDULE table with columns for ID, DESCRIPTION, MANUFACTURER, MODEL, QTY, MATERIAL, FINISH, SYSTEM, SLOT, PLENUM, NECK, INSTALLATION, and SPECIFICATION.



PUT-IN-BAY LOCAL SCHOOLS 1919 BUILDING RENOVATIONS

ISSUANCES/REVISIONS table with columns for NUMBER, DESCRIPTION, DATE.

PROJECT NUMBER, DRAWN BY, CHECKED BY table with values 25019.01, KW, AIR.

SHEET TITLE: MECHANICAL SCHEDULES, SHEET NUMBER: M5.1

ROOFTOP UNIT WITH ENERGY RECOVERY - HEAT PUMP WITH ELECTRIC HEAT BACKUP SCHEDULE (PART 1 OF 2)																																																								
ID	MANUFACTURER	MODEL NO.	TYPE	ARRANGEMENT	OUTSIDE AIR		SUPPLY FAN				RETURN/EXHAUST FAN				ENERGY RECOVERY WHEEL										COOLING COIL																															
					FLOW	DESIGN	PRESS	DRIVE TYPE	QTY	POWER	RPM	ECM	VOLT	PH	FLA	DESIGN	ESP	DRIVE TYPE	QTY	POWER	RPM	ECM	VOLT	PH	FLA	ERW MOTOR	ERW FLA	ERW VOLTAGE	ERW PHASE	ERW EA (CFM)	ERW OA (CFM)	ERW HAS BYPASSES	ERW EA (DB) SUMMER	ERW EA (WB) SUMMER	ERW OA (DB) SUMMER	ERW OA (WB) SUMMER	ERW MA (DB) SUMMER	ERW MA (WB) SUMMER	ERW TOTAL ENERGY RECOVERED SUMMER	ERW SA (DB) WINTER	ERW SA (WB) WINTER	ERW OA (DB) WINTER	ERW OA (WB) WINTER	ERW MA (DB) WINTER	ERW MA (WB) WINTER	ERW TOTAL ENERGY RECOVERED WINTER	NOMINAL CAP	CAP		AIRSIDE						
																																																TOTAL	SENSIBLE	EAT(DB)	EAT(WB)	LAT(DB)	LAT(WB)	FA	FV	
RTU-1	DAIKIN APPLIED	DPSH16B	MULTIZONE VAV W/ERW	DOWNFLOW	1900 CFM	6400 CFM	1.50 in-wg	DIRECT DRIVE	1	10.00 hp	2245	Yes	460 V	3	25.1 A	6400 CFM	1.00 in-wg	DIRECT DRIVE	1	7.00 hp	2186	Yes	460 V	3	7.0 A	0.17 hp	1.1 A	460 V	3	1900 CFM	1900 CFM	Yes	77.9 °F	64.3 °F	87.8 °F	72.3 °F	75.5 °F	63.0 °F	48727.0 Btu/h	50.8 °F	42.2 °F	1.0 °F	0.0 °F	62.9 °F	49.9 °F	136713.0 Btu/h	17 ton	198301 Btu/h	159100 Btu/h	81622 Btu/h	75.9 °F	63.3 °F	52.2 °F	52.2 °F	19.7 SF	339 FPM
RTU-2	DAIKIN APPLIED	DPSH07B	MULTIZONE VAV W/ERW	DOWNFLOW	1000 CFM	3550 CFM	1.50 in-wg	DIRECT DRIVE	1	4.40 hp	3153	Yes	460 V	3	4.7 A	3550 CFM	1.00 in-wg	DIRECT DRIVE	1	3.00 hp	2639	Yes	460 V	3	3.4 A	0.17 hp	1.1 A	460 V	3	1000 CFM	1000 CFM	Yes	76.8 °F	64.3 °F	87.8 °F	72.3 °F	75.5 °F	63.0 °F	28783.0 Btu/h	57.3 °F	46.3 °F	1.0 °F	0.0 °F	65.0 °F	51.1 °F	80625.0 Btu/h	8 ton	96606 Btu/h	159100 Btu/h	81622 Btu/h	75.5 °F	63.0 °F	53.0 °F	53.0 °F	15.4 SF	224 FPM

ROOFTOP UNIT WITH ENERGY RECOVERY - HEAT PUMP WITH ELECTRIC HEAT BACKUP SCHEDULE (PART 2 OF 2)																																
ID	MANUFACTURER	MODEL NO.	INCLUDE	HEAT PUMP HEATING COIL		HEATING ELEMENT				COMPRESSOR				PRE-FILTER		FILTER		UNIT		REMARKS												
				CAP	EAT(DB)	LAT(DB)	INCLUDE	DESCRIPTION	QTY	POWER	SCR	VOLT	PH	FLA	TYPE	REFRIGERANT	CHARGE	POWER	FLA		LOW AMBIENT KIT	EER	IEER	COP	EFF	EFF	WEIGHT	FLA	MCA	MOCF	VOLT	PH
RTU-1	DAIKIN APPLIED	DPSH16B	Yes	89881 Btu/h	62.9 °F	75.8 °F	Yes	ELECTRIC HEAT	1	20 kW	Yes	460 V	3	25.1 A	INVERTER SCROLL	R32	34 lb	14.50 kW	22.2 A	Yes	10.7	20.2	3.2	2" MERV-8	4" MERV-14	4686 lb	49.8 A	57.9 A	70 A	460 V	3	FACTORY INSTALLED SINGLE DISCONNECT, FIELD PROVIDED DUCT SMOKE DETECTOR BY DIVISION 26. OUTSIDE AIR STATIC PRESSURE SENSOR EQUAL TO DWYER A-306 PROVIDED BY MANUFACTURER.
RTU-2	DAIKIN APPLIED	DPSH07B	Yes	51125 Btu/h	65.0 °F	78.3 °F	Yes	ELECTRIC HEAT	1	18 kW	Yes	460 V	3	21.7 A	INVERTER SCROLL	R32	15 lb	5.62 kW	11.7 A	Yes	13.2	21.1	3.8	2" MERV-8	4" MERV-14	3094 lb	32.5 A	40.6 A	45 A	460 V	3	FACTORY INSTALLED SINGLE DISCONNECT, FIELD PROVIDED DUCT SMOKE DETECTOR BY DIVISION 26. OUTSIDE AIR STATIC PRESSURE SENSOR EQUAL TO DWYER A-306 PROVIDED BY MANUFACTURER.

ROOFTOP UNIT SCHEDULE - HEAT PUMP NO ENERGY RECOVERY (PART 1 OF 2)																													
ID	MANUFACTURER	MODEL NO.	TYPE	ARRANGEMENT	OUTSIDE AIR		FAN				COOLING COIL				ECONOMIZER			HOT GAS REHEAT											
					FLOW	DCV	AIRFLOW	PRESS	DRIVE TYPE	QTY	POWER	RPM	ECM	INCLUDE POWER EXHAUST	NOMINAL CAP	TOTAL	SENSIBLE	EAT(DB)	EAT(WB)	LAT(DB)	LAT(WB)	FA	FV	INCLUDE	CONTROL TYPE	DBT SETPOINT	ENTHALPY SETPOINT	INCLUDE	TOTAL EQUIVALENT HEATING CAP
RTU-3	DAIKIN APPLIED	DPSH30B	SINGLEZONE VAV W/ERW	DOWNFLOW	3150 CFM	Yes	11190 CFM	1.50 in-wg	DIRECT DRIVE	1	15.00 hp	1828	No	No	30 ton	325896 Btu/h	270242 Btu/h	75.6 °F	63.1 °F	52.7 °F	52.7 °F	22.4 SF	499 FPM	Yes	CONTROL TYPE	DBT SETPOINT	ENTHALPY SETPOINT	INCLUDE	210505 Btu/h

ROOFTOP UNIT SCHEDULE - HEAT PUMP NO ENERGY RECOVERY (PART 2 OF 2)																																	
ID	MANUFACTURER	MODEL NO.	CAP	HEAT PUMP HEATING COIL		HEATING ELEMENT				COMPRESSOR				PRE-FILTER		FILTER		UNIT		REMARKS													
				EAT(DB)	LAT(DB)	DESCRIPTION	QTY	POWER	SCR	VOLT	PH	FLA	TYPE	REFRIGERANT	CHARGE	POWER	FLA	LOW AMBIENT KIT	SUMMER AMBIENT DBT		WINTER AMBIENT DBT	EER	IEER	COP	EFF	EFF	WEIGHT	FLA	MCA	MOCF	VOLT	PH	
																																	DESCRIPTION
RTU-3	DAIKIN APPLIED	DPSH30B	132237 Btu/h	49.1 °F	60.0 °F	ELECTRIC HEAT	1	147 kW	Yes	49.1 °F	91.3 °F	460 V	3	184 A	INVERTER	R32	47 lb	2	Yes	95.0 °F	1.0 °F	9.6	16.6	3.3	2" MERV-8	4" MERV-14	4671 lb	211 A	217 A	250 A	460 V	3	MANUFACTURER SUPPLIED VFD FOR VARIABLE SPEED CONTROL, FACTORY INSTALLED SINGLE DISCONNECT, FIELD PROVIDED DUCT SMOKE DETECTOR BY DIVISION 26. SPACE SENSOR WITH ADJUSTABLE HUMIDITY AND CO2 SET POINT PROVIDED BY MANUFACTURER.

ENERGY RECOVERY UNIT SCHEDULE (PART 1 OF 2)																																	
ID	MANUFACTURER	MODEL NO.	TYPE	ARRANGEMENT	SUPPLY AIR		SUPPLY FAN				EXHAUST FAN				SUMMER DESIGN ENERGY RECOVERY																		
					FLOW	OA %	EXHAUST AIRFLOW	TYPE	AIRFLOW	PRESS	TP	RPM	QTY	POWER	ECM	TYPE	AIRFLOW	PRESS	TSP	RPM	QTY	POWER	ECM	COOLING SAVED	OUTSIDE AIR	OA EAT(DB)	OA EAT(WB)	SA LAT(DB)	SA LAT(WB)	RA EAT(DB)	RA EAT(WB)	EA LAT(DB)	EA LAT(WB)
ERV-1	OXYGEN8	8220U	ELECTRIC PREHEAT	DOWNFLOW	900 CFM	100	700 CFM	DIRECT DRIVE	900 CFM	1.00 in-wg	2.08 in-wg	2018	1	3.35 hp	Yes	DIRECT DRIVE	700 CFM	1.00 in-wg	2.33 in-wg	2107	1	3.35 hp	Yes	16374 Btu/h	87.8 °F	72.3 °F	80.3 °F	67.6 °F	75.0 °F	62.5 °F	84.6 °F	69.2 °F	

ENERGY RECOVERY UNIT SCHEDULE (PART 2 OF 2)																																
ID	MANUFACTURER	MODEL NO.	TYPE	WINTER DESIGN ENERGY RECOVERY								PREHEAT ELECTRIC HEATER								FILTER		SECONDARY FILTER		REMARKS								
				HEATING SAVED	RETURN AIR		SUPPLY AIR		RETURN AIR		EXHAUST AIR		QTY	HEATING ELEMENT TYPE	SCR	POWER	MAX POWER	STAGES	VOLT	PH	FLA	TYPE	THICKNESS (IN)		TYPE	THICKNESS (IN)	UNIT WEIGHT	FLA	MCA	MOCF	VOLT	PH
					EAT(DB)	LAT(DB)	LAT(WB)	LAT(WB)	EAT(WB)	LAT(WB)	EAT(DB)	LAT(DB)																				
ERV-1	OXYGEN8	8220U	ELECTRIC PREHEAT	42795 Btu/h	9.0 °F	6.5 °F	43.4 °F	35.8 °F	68.0 °F	52.9 °F	23.7 °F	23.4 °F	1	ELECTRIC HEAT	Yes	3.1 kW	7.0 kW	1	460 V	3	8.8 A	MERV-13	2	MERV-8	2	764 lb	8.2 A	9.0 A	15 A	460 V	3	SEPERATE ELECTRICAL CONNECTION REQUIRED FOR PREHEAT ELECTRIC HEATER.

FOR REFERENCE ONLY

DO NOT EXTENDED LEAD TIMES, THE ROOFTOP UNITS LISTED ON THIS SHEET HAVE BEEN DIRECTLY PURCHASED BY THE OWNER.

- THE ROOFTOP SELECTION AND FULL SUBMITTAL INFORMATION ARE INCLUDED WITH THE DRAWINGS FOR REFERENCE ONLY.
- THE CONTRACTOR SHALL ARRANGE WITH THE SUPPLIER CONTRACTS SHOWN ON THE SUBMITTAL TO RECEIVE THE SHIPMENT OF THE ROOFTOP UNITS. THE CONTRACTOR IS RESPONSIBLE FOR SHIPMENT FROM THE CRANE YARD TO SITE AND ANY OFF RIGGING REQUIRED.
- THE ROOFTOP UNITS ARE CURRENTLY SET TO SHIP IN JUNE/2026. THE SHIP DATE HAS NOT YET BEEN DETERMINED. THE ROOFTOP UNITS WILL BE SHIPPED TO XXXXXXXX.
- AFTER RECEIPT OF DELIVERY, IT IS THE CONTRACTOR'S RESPONSIBILITY TO STORE AND PROTECT THE ROOFTOP UNITS ALL THE WAY THROUGH FINAL INSTALLATION AND THE PROJECT COMPLETION.
- THE CONTRACTOR WILL NOT BE RESPONSIBLE FOR WARRANTY CLAIMS FOR EQUIPMENT DIRECTLY PURCHASED BY THE OWNER. THE ROOFTOP SUPPLIER WILL BE RESPONSIBLE FOR SUCH CLAIMS.
- THE ROOFTOP SUPPLIER IS RESPONSIBLE FOR THE FACTORY REPRESENTATIVE ROOFTOP START-UP AND ASSOCIATED DOCUMENTATION. THE CONTRACTOR IS REQUIRED TO COORDINATE TIMING WITH THE SUPPLIER AND PROVIDE A MINIMUM 1 WEEK NOTICE.
- THE CONTRACTOR IS RESPONSIBLE FOR ALL TRANSPORTATION (AFTER DELIVERY) AND RIGGING OF THE ROOFTOP UNITS.

FOR RECORD PURPOSES ONLY



RENOVATIONS TO
PUT-IN-BAY LOCAL SCHOOLS
1919 BUILDING RENOVATIONS
 SELECTING THE SUPPLIER, CHAIRMAN

ISSUANCES/REVISIONS		
1	CONSTRUCTION DOCUMENTS ADDENDUM 03	02/12/2025 02/26/2025

PROJECT NUMBER: 25019.01	DRAWN BY: KCW	CHECKED BY: APH
------------------------------------	-------------------------	---------------------------

SHEET TITLE:
MECHANICAL SCHEDULES AND DETAILS

SHEET NUMBER:
M5.2