EL MONTE UNION HIGH SCHOOL DISTRICT

Purchasing Department

3537 JOHNSON AVENUE, EL MONTE, CA 91731

Phone: (626) 444-9005

Email: purchasing@emuhsd.org

October 16, 2024

TO	:	All Bidders
FROM	:	El Monte Union High School District
BID #	:	2024-25 (B2)
PROJECT	:	Rosemead Adult Education and Transition Center Addition/Modernization Project
SUBJECT	:	Addendum No. 3

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

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

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

In case of conflict between Drawings, Project Manual, and this Addendum, this Addendum shall govern.

BID DUE DATE CHANGE: *No*

RESPONSE TO BID RFI: *Yes*

See attached DLR Architects Addendum 03 dated October 16, 2024.

REVISIONS TO SPECIFICATIONS: *Yes*

See attached DLR Architects Addendum 03 dated October 16, 2024.

REVISIONS TO DRAWINGS: *Yes*

See attached DLR Architects Addendum 03 dated October 16, 2024.

CLARIFICATIONS: *Yes*

General Conditions Section 11.3 BUILDER'S RISK/ALL RISK INSURANCE – remove this requirement in its entirety. District will obtain this coverage.

See attached DLR Architects Addendum 03 dated October 16, 2024.

END OF ADDENDUM NO. 3

DLR Group inc.
a California corporation

700 South Flower Street, 22nd Floor
Los Angeles, CA 90017

October 16, 2024

ADDENDUM 03

Pre-Bid Revision for Contractors' Incorporation into:

Rosemead Adult Education and Transition Center
El Monte Union High School District
DSA Application No: 03-122743
File No. 19-H10
DLR Group Project No.: 75-20223-02

Prepared By: DLR Group
700 South Flower Street, 22nd Floor
Los Angeles, CA 90017
(213) 800-9400

NOTICE TO BIDDERS:
The following revisions are being made to the Bidding Documents to the above referenced project:

Pre-Bid Requests for Information

The following pre-bid requests for information were received. The responses are incorporated into this Addendum via the answer directly below the RFI.

RFI 130..... Please confirm that the domestic water line and fire line will be existing per addendums 1 & construction notes # 5 -20 - 27 connect to existing water service.

Answer.....The new fire and domestic laterals are shown on the City of Rosemead public improvements plans as issued in Addendum 02.

RFI 131..... Please confirm that the new fire line and backflow device is 6 inch per addendum #1 fire and water service data table?

Answer.....Construction note 23 on sheet C5.0 calls out for an 8-inch DCDA.

RFI 132..... Section 23 09 00 states there is an "existing Siemens Apogee System". Next Level EMS is an Authorized Siemens Dealer. We are authorized to install Desigo CC which is the latest software Siemens has available, which both Siemens Branch and Next Level are authorized to install. Next Level can also integrate into the existing Siemens Apogee. By allowing Next Level to provide Siemens controls this would allow competitive bidding per public contracting code. Please confirm if Next Level EMS is approved to bid this project utilizing Siemens Desigo controls.?

Answer.....District standard is Carrier iVue. No known equal. Existing building system is Honeywell. Refer to updated specification.

RFI 133..... The response to Question 55 in Addendum 2 appears to indicate the Bidder is to provide an additive alternate for flood and earthquake coverage. Will the bid form be revised to include the ability to provide alternate? How will the low bidder be determined? Base Bid + Contingency only or Base Bid + Contingency + Alternate.?

Answer.....No Builders Risk, flood, or earthquake coverage will be required by the contractor for this project. The District will procure this coverage.

A. PROJECT MANUAL - Narrative of Changes

1. SECTION 23 09 00 – BUILDING MANAGEMENT AND CONTROL SYSTEMS

A. ADDED Appendix A: Sequences of Operation.

B. DRAWINGS – Narrative of Changes

1. SHEET A1.4 – OVERALL ROOF PLAN

A. REVISE Reference KeyNote 7.13.
B. ADDED dimensions to existing translucent panel skylight at existing roof.

2. SHEET M0.4 – MECHANICAL CONTROL DIAGRAMS

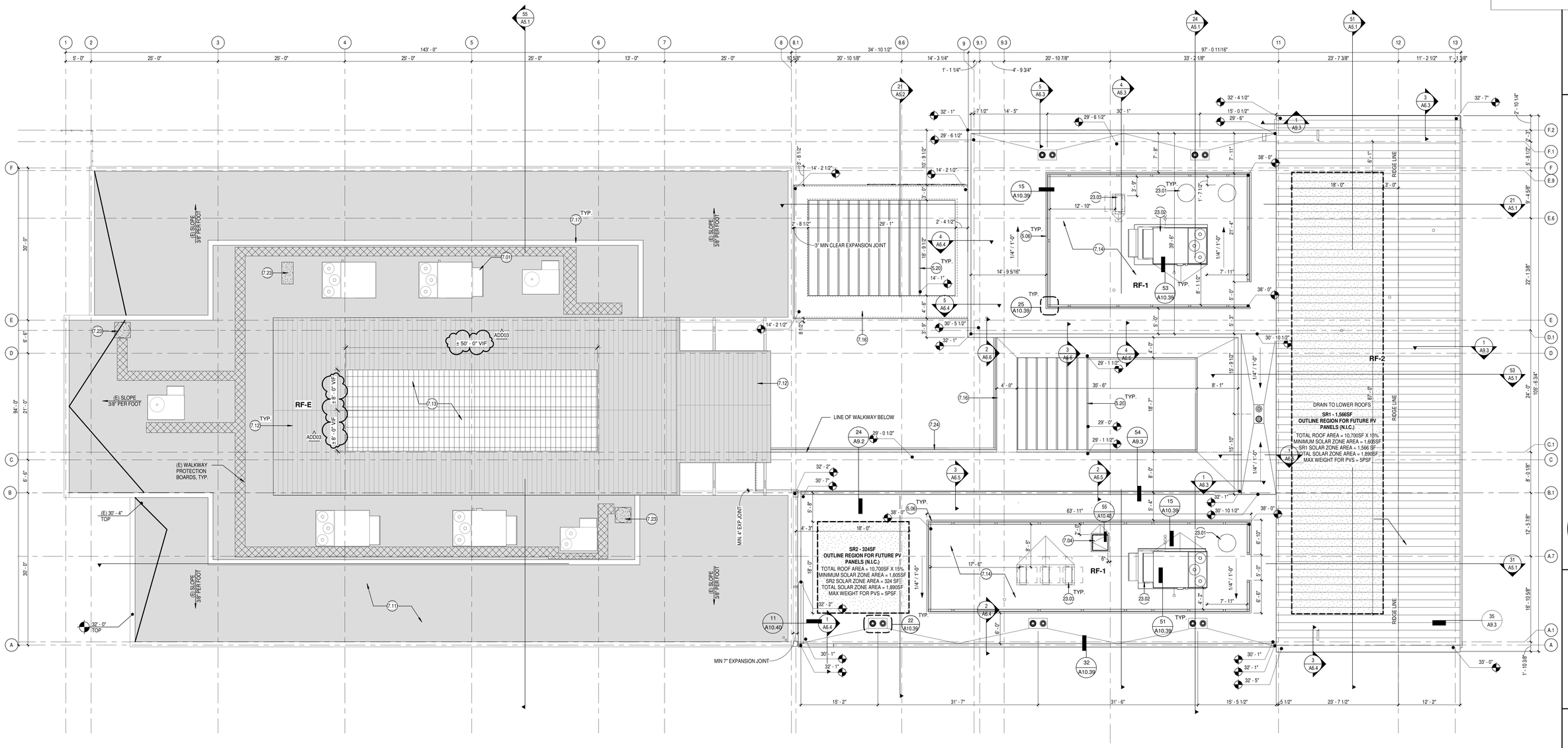
A. NEW Controls Diagram SHEET ADDED in its entirety.

INCLUDED ATTACHMENTS:

Drawings: A1.4, M0.4

Specification Sections: 23 09 00

**** END OF ADDENDUM 03 ****



OVERALL ROOF PLAN

SCALE: 1/8" = 1'-0"

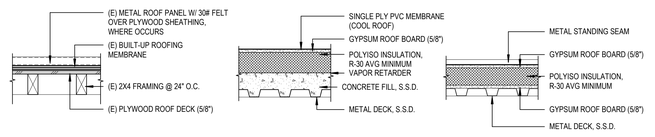
* FUTURE PV PANEL TOTAL NEW ROOF AREA = 10,700 SF X 15%
ROOF AREA = 1,605 SF SOLAR

REFERENCE KEYNOTES

Key Value	Keynote Text
5.06	MTL. MECHANICAL SCREEN WITH STRUCTURAL SUPPORT POST, SEE 51/A10.39 AND REFER TO STRUCTURAL SHEET S2.6.
5.20	AESS CANOPY HSS FRAMING, SEE S2.4 & 05 12 13, PAINT TO MATCH MT-2
7.01	(E) BUILT-UP ROOFING ASSEMBLY TO REMAIN, PATCH AND REPAIR TO MATCH EXISTING AT LOCATION OF MECHANICAL WORK.
7.04	ROOF HATCH, SEE 55/A10.40.
7.11	EXISTING BUILT UP ROOF TO REMAIN
7.12	EXISTING STANDING SEAM ROOF TO REMAIN, CLEAN, PREP AND PAINT COLOR TBD
ADD01 / ADD03 7.13	REMOVE EXISTING TRANSLUCENT PANEL SKYLIGHT SYSTEM. PROVIDE NEW TRANSLUCENT PANEL SKYLIGHT SYSTEM IN EXISTING OPENING. QUADSPAN CLASS A SYSTEM OR EQUAL. SEE 08 45 00.
7.14	ADHERED THERMOPLASTIC PVC FELTBACK MEMBRANE ROOFING
7.16	METAL PANEL CANOPY, SEE 54/A9.3.
7.17	(E) CEMENT PLASTER SCREEN WALL

Key Value	Keynote Text
7.23	REMOVE AND DEMO (E) EXHAUST FAN AND/OR CONDENSING UNIT, PATCH AND REPAIR ROOF TO MATCH EXISTING CONDITION
7.24	METAL PANEL OVERHANG, SEE 54/A9.3.
23.01	ROOF EXHAUST FAN, SEE MECHANICAL M3.1 AND SCHEDULE M0.2
23.02	HVAC UNIT ON CONCRETE MECH. EQUIPMENT PAD, SEE DET. 31/A10.39 AND MECHANICAL M3.1 AND SCHEDULE M0.2
23.03	SPLIT SYSTEM AIR CONDITIONING UNIT, SEE MECHANICAL M3.1 AND SCHEDULE M0.2

ROOF ASSEMBLIES



RF-E: EXISTING ROOF ASSEMBLY
- (E) BUILT-UP ROOFING OVER 5/8" EXT. GRADE PLYWOOD OVER 2X4 FRAMING @ 24" O.C., SLOPE ALL CRICKETS 1/2" PER FT. MIN.
- (E) METAL STANDING SEAM ROOF PANEL OVER 30# FELT OVER PLYWOOD ROOF SHEATHING
- WEIGHT 20 PSF

RF-1: ROOF ASSEMBLY 1
NEW FELTBACK SINGLE PLY MEMBRANE ROOFING OVER CONDITIONED SPACE
- CLASS A PER UL TGFU R8992 SYSTEM 24
- WEIGHT < 20 PSF
- FM ROOF NAV ASSEMBLY NO. 174732-0-0 PER 45/A10.39

RF-2: ROOF ASSEMBLY 2
NEW METAL STANDING SEAM ROOFING OVER CONDITIONED SPACE
- CLASS A PER UL TGFU R8992 SYSTEM 24
- WEIGHT < 20 PSF
- SMOOTH STANDARD PANEL, 22 GA, 12" O.C. SIZE, 'STONE WHITE' COLOR

ROOF PLAN LEGEND

- RF-1 — PROVIDE RF-1 OR RF-2 ROOF ASSEMBLY, U.O.N.
- RF-2 — SEE STRUCTURAL DRAWINGS FOR LOCATIONS WITH CONCRETE FILL
  - 1/4" : 12" MIN. SLOPE (U.N.O.) TO ROOF AND OVERFLOW DRAIN
  - FOR ROOFING DETAILS, SEE SHEET A10.39
- (E) RF-E ROOFING TO REMAIN PROTECT IN PLACE
- (E) ROOF WALKWAY PAD, PROTECT IN PLACE
- (N) ROOF WALKWAY PAD, SEE DET. 14 / A10.39
- PATCH AND REPAIR (E) ROOF TO MATCH EXISTING
- (E) ROOF DRAIN & OVERFLOW DRAIN TO REMAIN
- (N) ROOF DRAIN & OVERFLOW DRAIN, SEE DET. 22 / A10.39
- (E) ROOF HATCH TO REMAIN, PROTECT IN PLACE
- (N)ROOF HATCH, SEE DET.55 / A10.40
- T.O.R. — TOP OF ROOF
- T.O.P. — TOP OF PARAPET

NOTES:
- REFER TO MECHANICAL DRAWINGS FOR ROOF EQUIPMENT INFORMATION AND SCHEDULE
- (N) ROOF CRICKETS TO HAVE 1/2" : 12" MIN. SLOPE, TYP.
- REFER TO ROOF PLAN GENERAL NOTES FOR ADDITIONAL INFORMATION

ROOF PLAN GENERAL NOTES

A. ROOF PLAN GENERAL NOTES APPLY TO ALL ROOF PLAN SHEETS.
B. ROOF SLOPES ARE CREATED BY SLOPING THE ROOF STRUCTURE UNLESS NOTED OTHERWISE. SEE STRUCTURAL DRAWINGS FOR ELEVATIONS OF THE HIGH AND LOW POINTS TO DETERMINE PROPER TAPER IN INSULATION.
C. TAPERED INSULATION SHALL PROVIDE A MINIMUM OF 1/4-INCH PER FOOT OF SLOPE TO ROOF DRAINS, UNLESS NOTED OTHERWISE.
D. AREAS MARKED WITH A HATCHED PATTERN INDICATE TAPERED INSULATION.
E. ALL ROOF CURBS TO BE A MINIMUM OF 8 INCHES ABOVE ROOFING LEVELS. PROVIDE TAPERED INSULATION ROOF SADDLES AT ROOF CURBS TO PROVIDE DRAINAGE AROUND CURB.
F. SEE STRUCTURAL DRAWINGS FOR FRAMING AROUND ROOF PENETRATIONS.
G. COORDINATE THE SIZE AND LOCATION OF ROOF PENETRATIONS FOR MECHANICAL AND ELECTRICAL EQUIPMENT. REFER TO MECHANICAL AND ELECTRICAL DRAWINGS FOR PENETRATIONS NOT SHOWN ON THIS DRAWING.
H. FLASH DRAINS, CURBS, VENTS AND STACKS PER MANUFACTURER'S RECOMMENDATIONS IF DETAIL NOT SHOWN ON DRAWINGS.

LICENSED ARCHITECT — LEIGH MILLER — No. C-23306 — REN. 10-31-25 — STATE OF CALIFORNIA

Rosemead Adult Education and Transition Center Addition/Modernization

El Monte Union High School District
4105 ROSEMEAD BLVD, ROSEMEAD, CA 91770

CONSTRUCTION DOCUMENTS

DLR Group
Architecture Engineering Planning Interiors

DSA APPLICATION NO: 03-122743
DSA FILE NO: 19-H10
DLR PROJECT NO: 75-20223-02
ISSUE DATE: 02/15/2024

SUBMITTAL TITLE

1	ADD01	09/26/2024
3	ADD03	10/16/2024

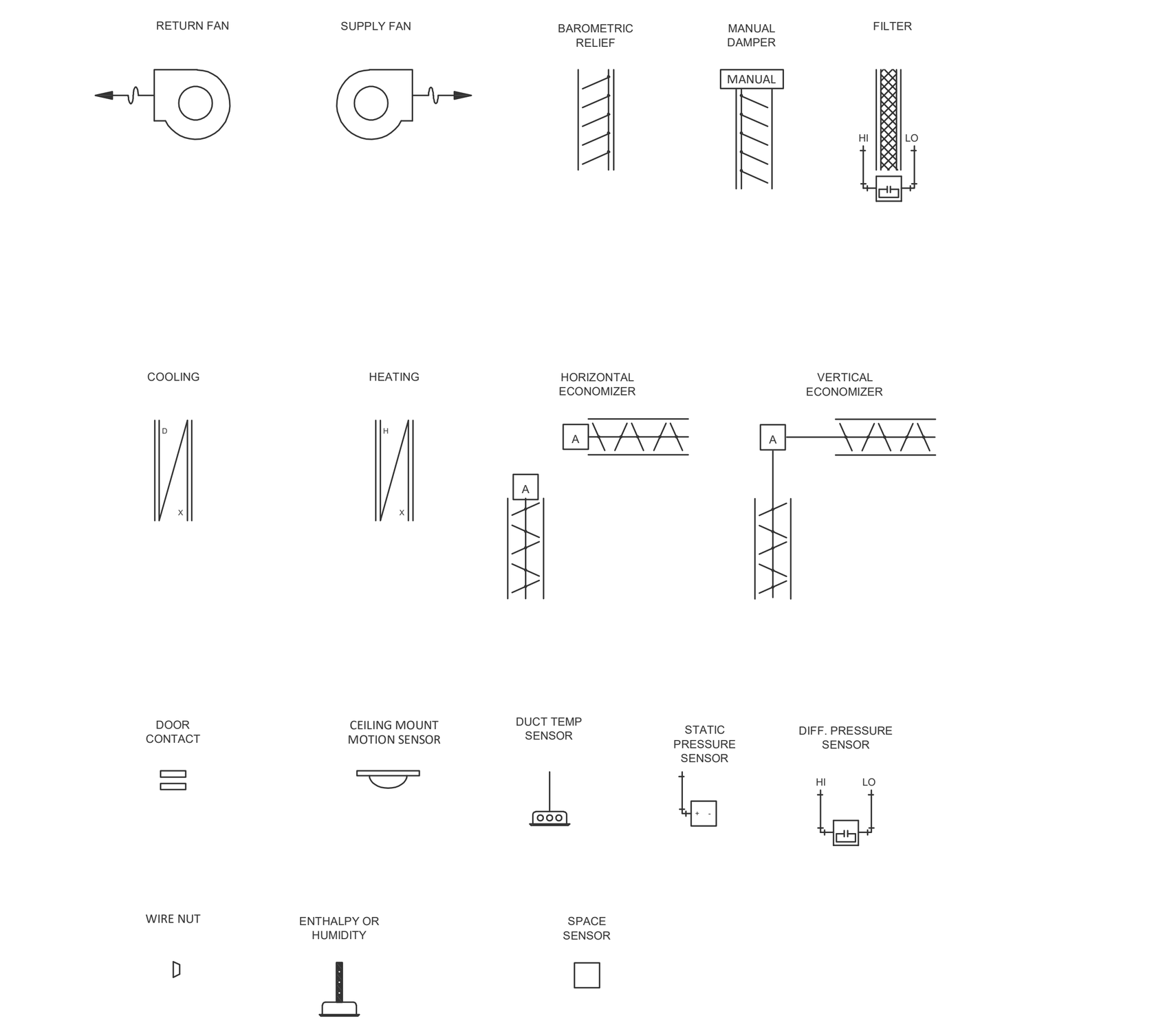
OVERALL ROOF PLAN

A1.4

COMMON ABBREVIATIONS

ABBREVIATION	DESCRIPTION
	AC
AIR CONDITIONING	
ACU	AIR CONDITIONING UNIT
AHU	AIR HANDLING UNIT
AI	ANALOG INPUT
AO	ANALOG OUTPUT
AUTO	AUTOMATIC
AUX	AUXILIARY
BI	BINARY INPUT
BO	BINARY OUTPUT
C	COMMON
DA	DISCHARGE AIR
DI	DIGITAL INPUT
DO	DIGITAL OUTPUT
EA	EXHAUST AIR
EF	EXHAUST FAN
EVAP	EVAPORATOR
F	FAHRENHEIT
FCU	FAN COIL UNIT
HOA	HAND/OFF/AUTO
HP	HEAT PUMP
MAX	MAXIMUM
MIN	MINIMUM
MISC	MISCELLANEOUS
NC	NORMALLY CLOSED
NO	NORMALLY OPEN
OA	OUTDOOR AIR
RA	RETURN AIR
RF	RETURN FAN
RH	RELATIVE HUMIDITY
RTU	ROOFTOP UNIT
SA	SUPPLY AIR
SF	SUPPLY FAN
SP	STATIC PRESSURE
TEMP	TEMPERATURE
UH	UNIT HEATER
UV	UNIT VENTILATOR
VAV	VARIABLE AIR VOLUME
VVT	VARIABLE VOLUME & TEMPERATURE
W/	WITH
W/O	WITHOUT

SYMBOL LEGEND



GENERAL INFORMATION

COMMUNICATION BUS SPECIFICATION

1. A 24 AWG 2-conductor-shielded-stranded cable (plenum rated as required) must be daisy chained from controller to controller. It should be color coded (red, black, white).
2. The communication cable operates at up to 5 VDC. Verify with the local code authority and specs regarding conduit requirements.
3. No "T" tap or "star" type connections are permitted.
4. Terminate the shields on the designated terminal at each device.
5. 30 controller's maximum per communication bus segment. 60 controller's maximum per network router.
6. A repeater is required every 2000 ft. or 30 devices. Maximum of 4 repeaters per bus for a total of 10,000 ft.

POWER TO VVT AND VAV DAMPER ACTUATORS/CONTROLLERS

1. Each zone requires a 24 VAC, 40 VA transformer (more in some cases depending on the valve or electric heater requirements)
.
2. It is recommended that each zone have its own transformer, however zones may be grouped up to 100 VA and still remain in UL Class 2 conformance.
3. Be careful of voltage drop. The damper will operate in a power range of 22 to 26 VAC. The damper will not operate at voltages less than 22 vac.

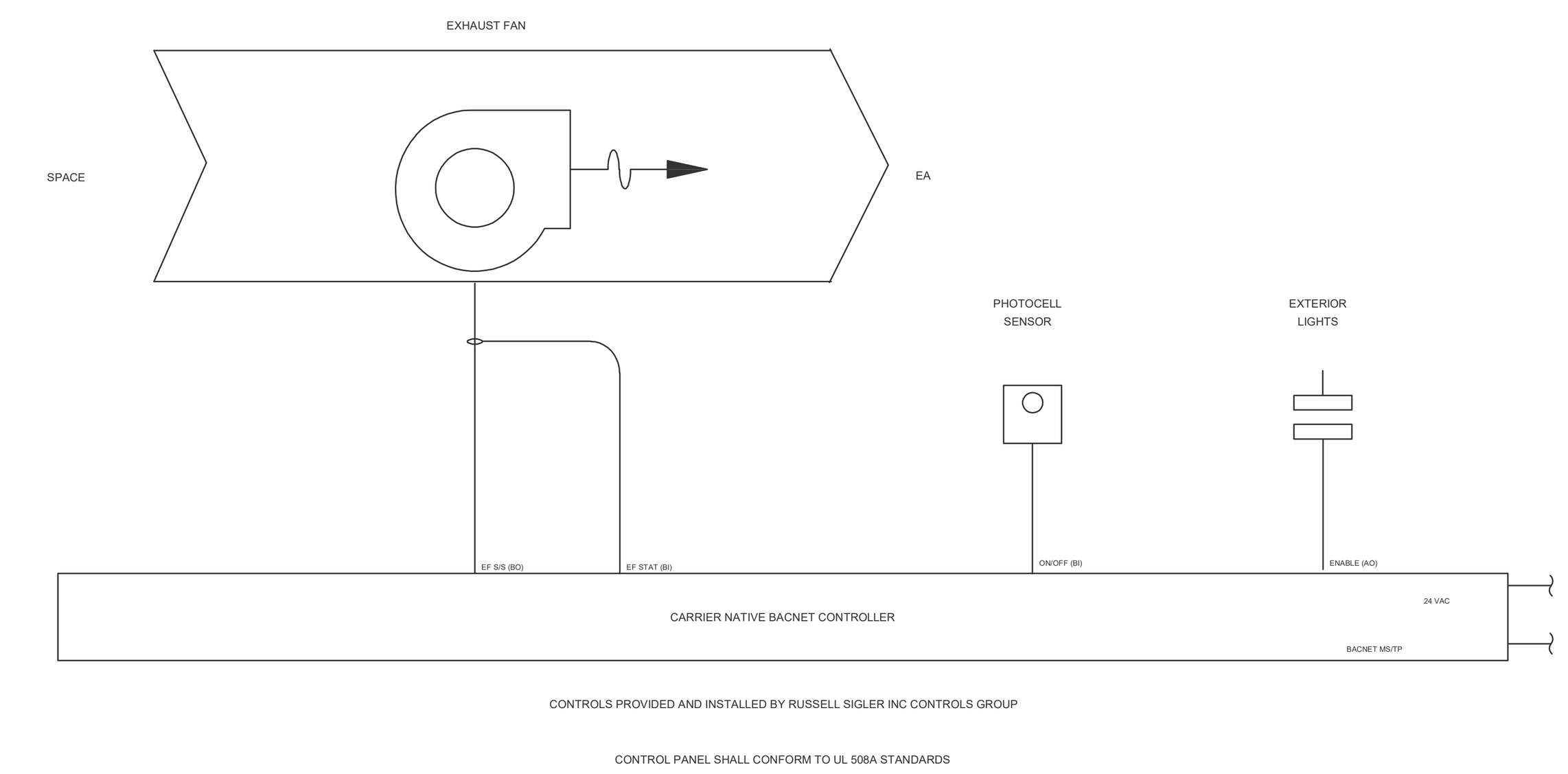
GENERAL NOTES

1. The 2 conductor communication cable and sensor cables must always be in a separate jacket from one another. Never run the
se cables in the same conduit as, or
bundle them with, AC power wiring of any voltage. Do not strap these cables along any conduits that contain AC power wiring of any voltage.
Do not run these cables in rings or conduit with fire, life, safety, security, network, telephone, power, or other wiring. When running communication and sensor wiring parallel to other cabling or conduit maintain a 12 in. distance.
2. Ethernet and/or Internet connection to i-Vu are supplied and maintained by building owner/operator.

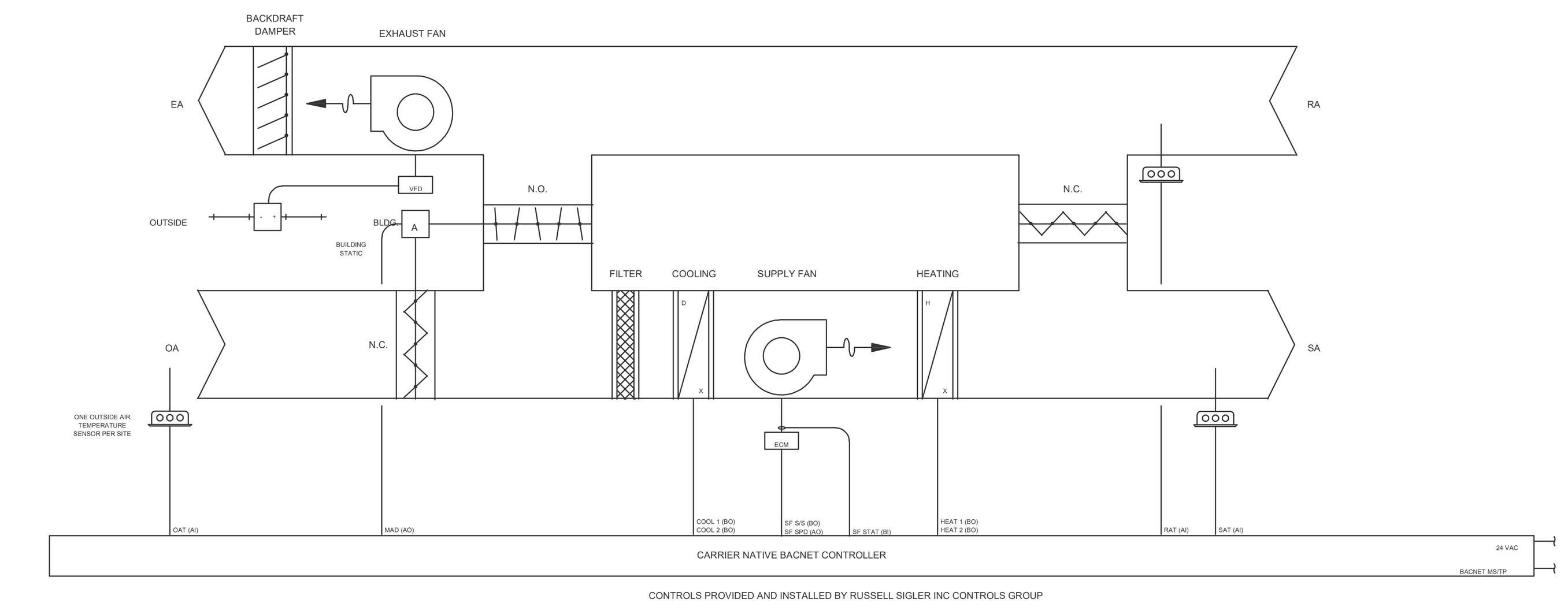
INSTALLATION COORDINATION NOTES

1. Installer shall coordinate all power and data connection requirements with the GC onsite.
2. Install all components in accordance with the specification, applicable codes and manufacturer
's literature

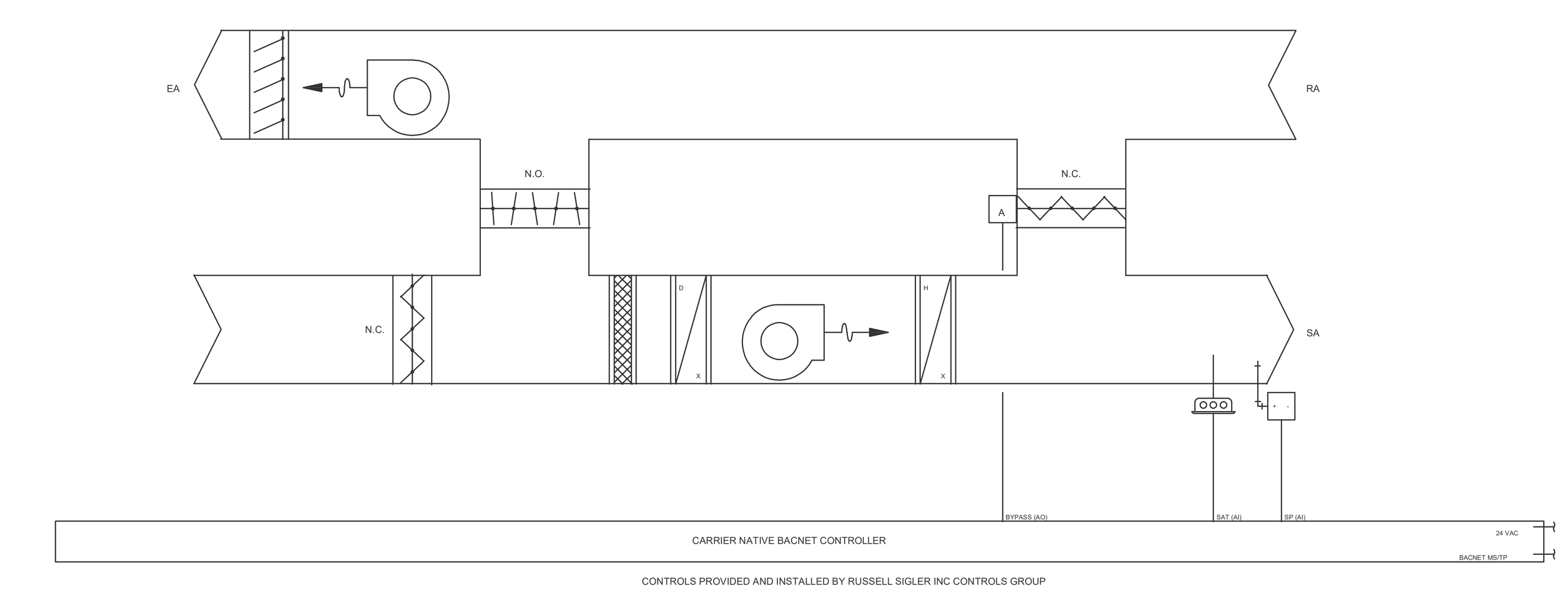
LEGEND



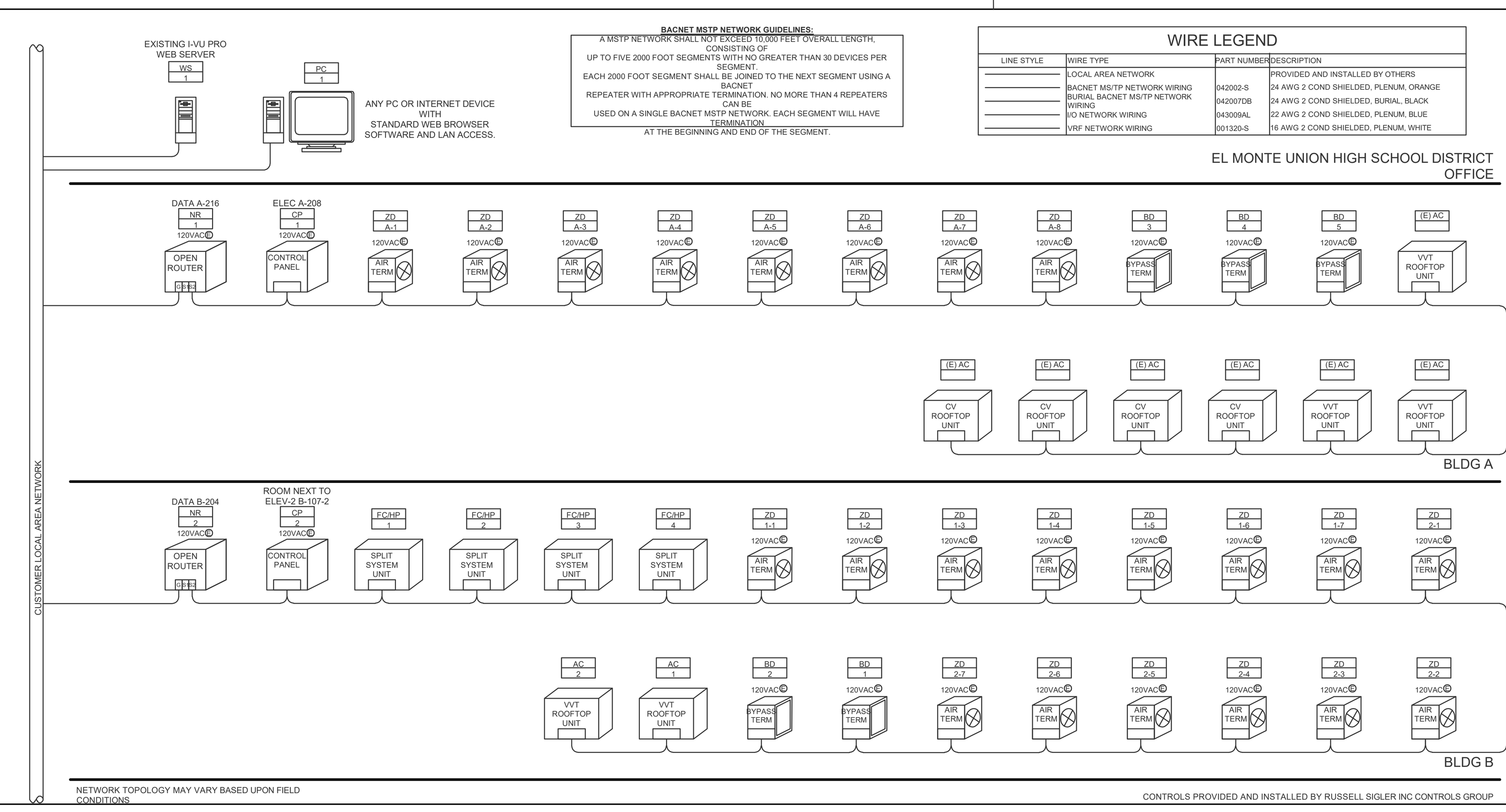
CONTROL PANEL 2 DETAIL (CP-2: EF-1 THRU EF-3)



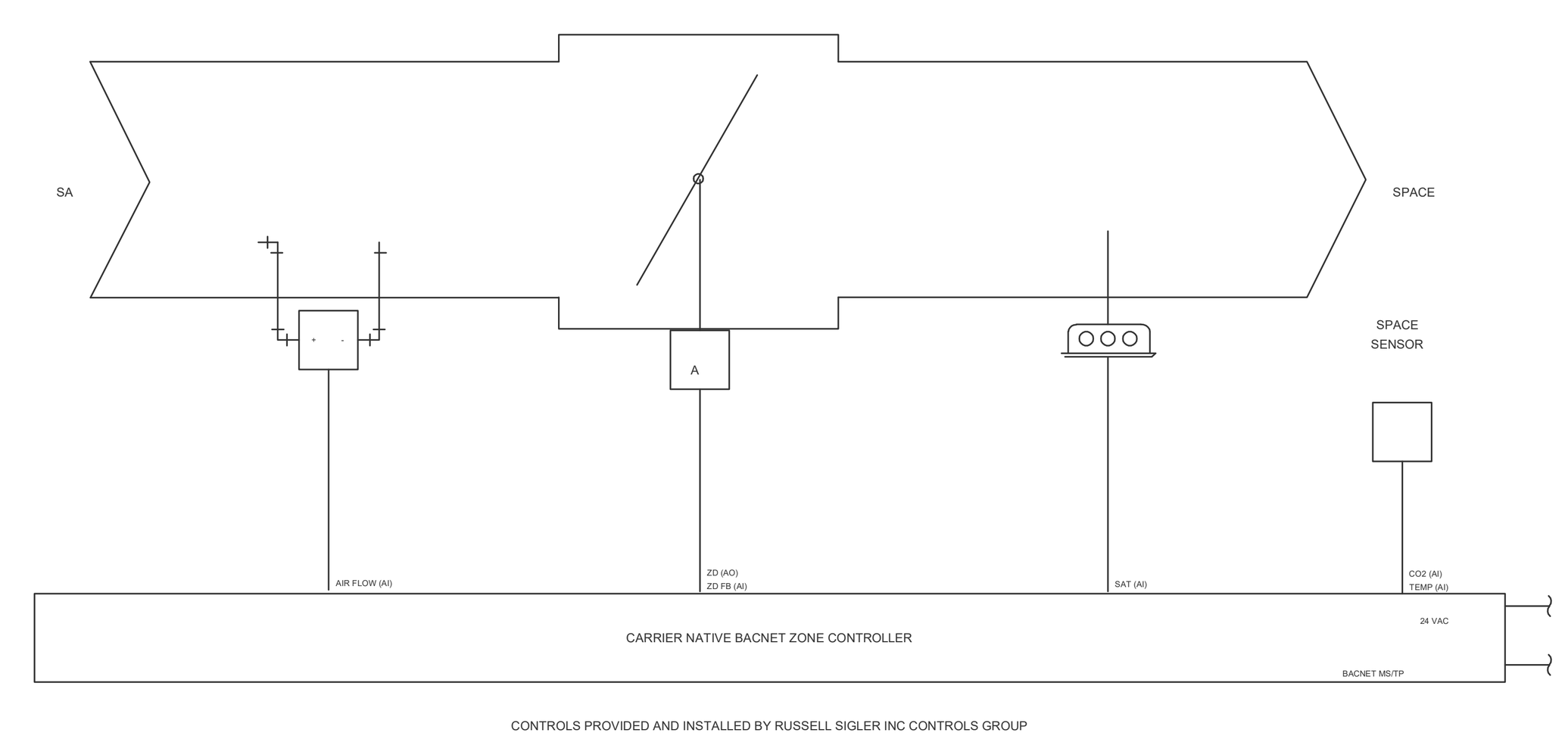
VVT ROOFTOP UNIT DETAIL (AC-1, AC-2, EXISTING QTY. 3)



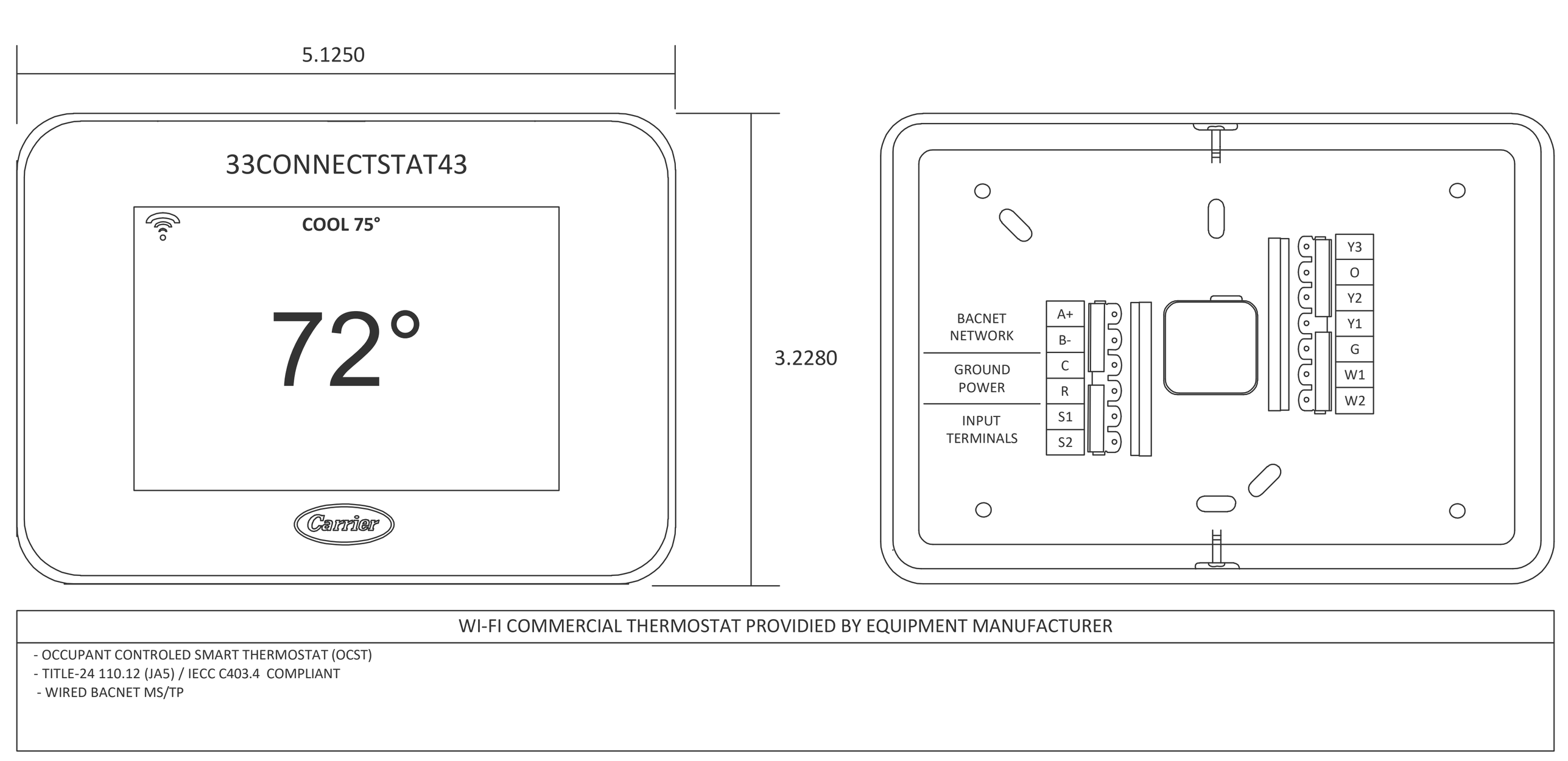
VVT BYPASS DETAIL (BD-1 THRU BD-5)



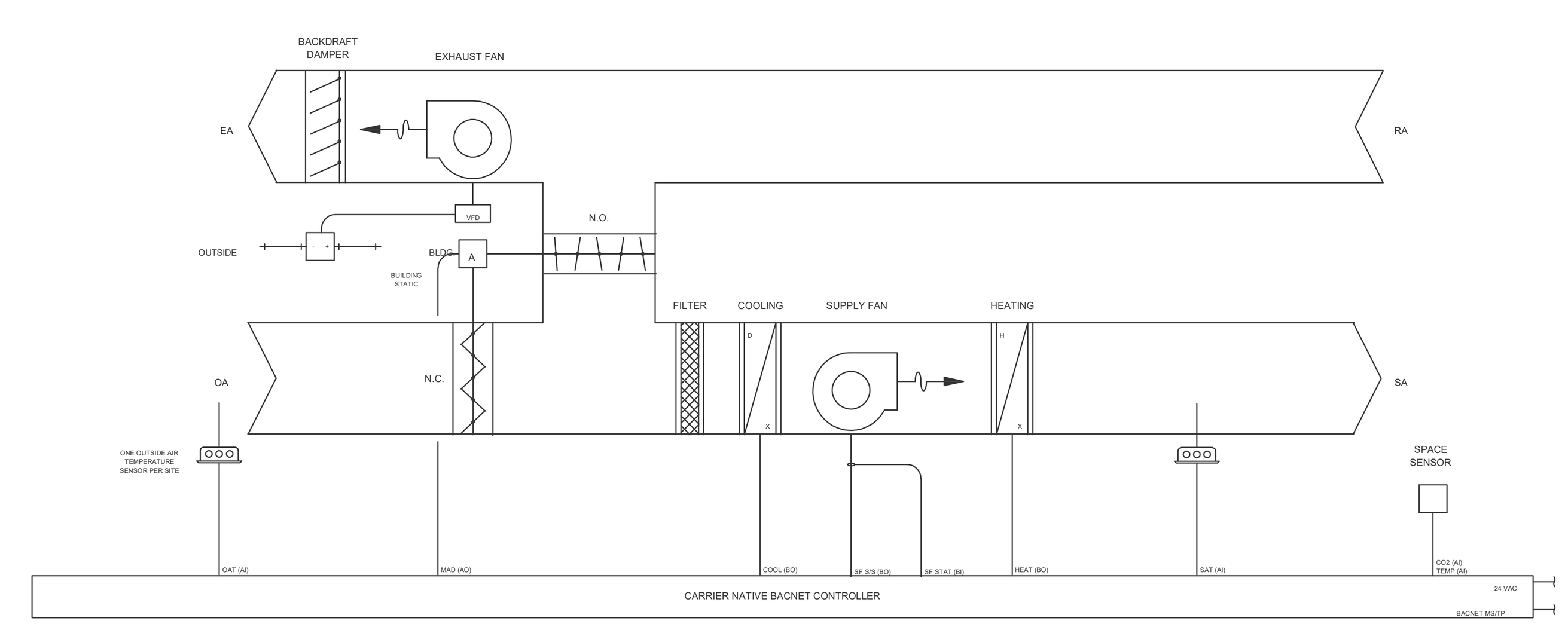
BACS RISER DIAGRAM



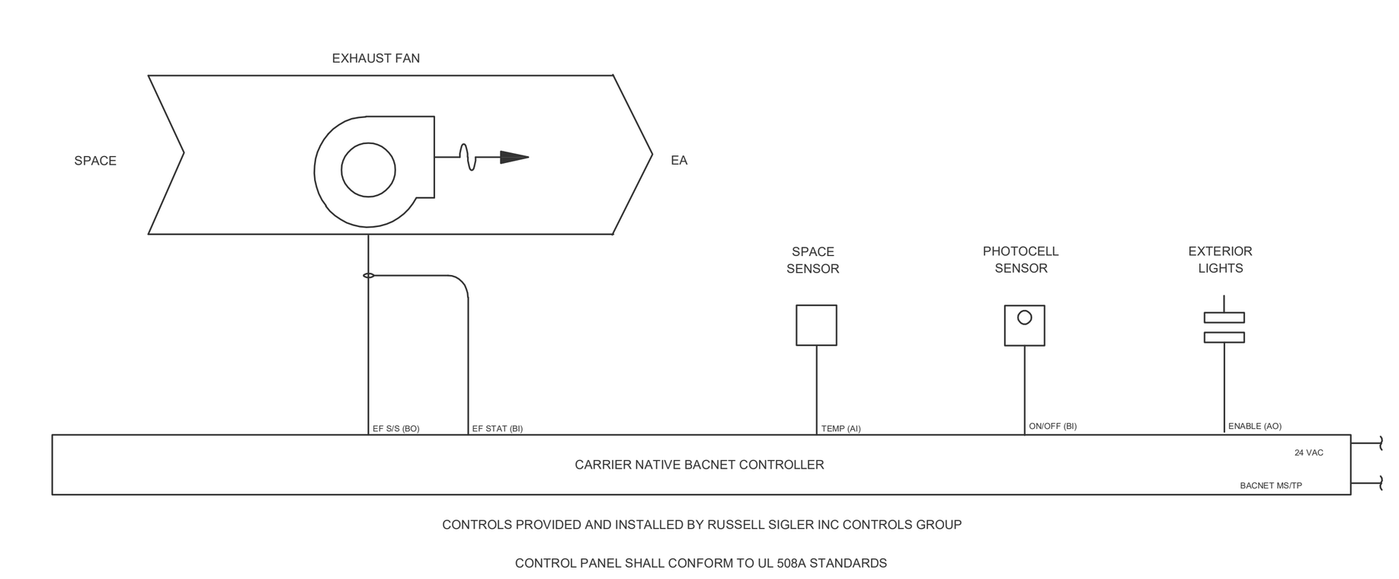
VVT ZONE DETAIL (ZD-1-1 THRU ZD-1-7, ZD-2-1 THRU ZD-2-7, ZD-A-1 THRU ZD-A-8)



SPLIT SYSTEM THERMOSTAT (FC/HP-1 THRU FC/HP-4)



EXISTING SINGLE ZONE ROOFTOP UNITS (QTY. 4)



CONTROL PANEL 1 DETAIL (CP-1: EF-4 & EF-5)

Rosemead Adult Education and Transition Center Addition/Modernization

El Monte Union High School District

4105 ROSEMEAD BLVD, ROSEMEAD, CA 91770

DCGA ENGINEERS
Consulting Mechanical and Electrical Engineers

DSA SUBMITTAL

DLR Group
Architecture Engineering Planning Interiors

DSA APPLICATION NO: 03-122743
DSA FILE NO: 19-H10
DLR PROJECT NO: 75-20223-02
ISSUE DATE: 11/20/2023

SUBMITTAL TITLE

ADD 01	ADD01	10/04/2024
ADD 02	ADD02	10/15/2024
ADD 03	ADD03	10/16/2024

MECHANICAL CONTROL DIAGRAMS

M0.4 ADD03

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DCGA #21092

SECTION 23 09 00 – BUILDING MANAGEMENT AND CONTROL SYSTEMS

PART 1 – GENERAL

1.1 WORK INCLUDED:

A. The Building Automation System (BAS) manufacturer shall furnish and install a fully integrated building automation system as an extension to the existing District Wide Carrier i-Vu System, to match the district's standard 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 under the direct supervision of the controls manufacturer with the shop drawings, 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 this and/or other systems and not custom designed especially for this project. All systems and components shall have been thoroughly tested and proven in actual use for at least two years.

C. BAS manufacturer shall be responsible for all BAS and Temperature Control wiring for a complete and operable system. All wiring shall be done in accordance with all local/national codes and Division 26. All exposed low voltage control wiring throughout the building shall be run in conduit. All low voltage electrical wiring above ceiling may be run in plenum cable. Room sensor cables concealed behind walls shall be run in conduit, with room sensor conduit extending above wall into accessible ceiling. Cable is to be supported off building structure. Support off ductwork, pipe racks, etc. is not acceptable.

1.2 WORK BY OTHER DISCIPLINES

A. Mechanical Contractor provides:

1. All package unit control panels.
2. Furnish & install all smoke fire/smoke, outdoor air, return air, exhaust air, and mixing dampers; with adjacent access doors.

B. Electrical Contractor provides:

1. 120 volt and 20 amp circuits and circuit breakers from normal and/or emergency power panel to direct digital control system panels.
2. Wiring of all power feeds through all disconnects and starters to electrical motor.
3. Wiring of any remote start/stop switches and manual or automatic motor speed control devices not furnished by BAS manufacturer
4. Conduit w/ pull strings between buildings for network communication
5. Other conduits as shown on the plans.
6. Duct smoke detectors & their wiring

1.3 GENERAL PRODUCT DESCRIPTION

A. The building automation system shall be an extension to the existing Honeywell System.

B. Provide Honeywell standard, native protocol for the communications system. The system shall have the capability to interface with standard protocols where specified on the mechanical plans.

C. System shall be capable of high speed Ethernet communication using TCP/IP protocol.

D. The Operator Workstation shall be new, and all new work will communicate with this workstation. Additional workstations are not to be installed.

1. Provide system graphics for each controlled device and/or integrated systems as required by the owner. Origin of information shall be transparent to the operator and shall be controlled, displayed, trended, etc. as if the points were hardwired to the BAS.

E. The building automation system shall consist of the following:

1. Stand-alone Primary DDC Controllers (PXC Product Line)
2. Stand-alone Application Specific Controllers (TECs)
3. Point Modules

F. The system shall be modular in nature and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, DDC Controllers, Application Specific Controllers and operator devices.

G. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. Each DDC Controller shall operate independently by performing its own specified control, alarm management, operator I/O, and data collection. The failure of any single component or network connection shall not interrupt the execution of any control strategy, reporting, alarming and trending function, or any function at any operator interface device.

H. DDC Controllers shall be able to access any data from, or send control commands and alarm reports directly to, any other DDC Controller or combination of controllers on the network without dependence upon a central or intermediate processing device.

I. DDC Controllers shall be able to assign password access and control priorities to each point individually. The logon password (at any PC workstation or portable operator terminal) shall enable the operator to monitor, adjust or control only the points that the operator is authorized for. All other points shall not be displayed at the PC workstation or portable terminal. (e.g., all base building and all tenant points shall be accessible to any base building operators, but only certain base building and tenant points shall be accessible to tenant building operators). Passwords and priority levels for every point shall be fully programmable and adjustable.

1.4 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Not applicable:

1.5 APPROVED CONTROL SYSTEM

A. The contractor shall use the Carrier i-Vu System. No other manufacturer shall be accepted. This item is being sole sourced per Public Contract Code Section 3400, subdivision (b) (2) to match equipment in use at the project either completed or in the course of completion.

B. No substitutions shall be accepted. No known equal.

1.6 QUALITY ASSURANCE

A. The BAS system shall be designed and installed, commissioned and serviced by manufacturer trained personnel. BAS contractor shall have an in-place support facility within 100 miles of the site with technical staff, spare parts inventory and necessary test and diagnostic equipment. The BAS contractor shall provide an experienced project manager for this work, responsible for supervision of the design, installation, start up and commissioning of the BAS. The Bidder shall be regularly engaged in the installation and maintenance of BAS systems and shall have a minimum of ten (10) years of demonstrated technical expertise and experience in the installation and maintenance of BAS systems similar in size and complexity to this project.

B. Materials and equipment shall be the catalogued products of manufacturers regularly engaged in production and installation of automatic temperature control systems and shall be manufacturer's latest standard design that complies with the specification requirements.

C. BAS shall comply with UL 916 PAZX and 864 UDTZ, ULC, and other subsystem listings as applicable, and herein specified, and be so listed at the time of bid.

D. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.

E. This system shall have a documented history of compatibility by design for a minimum of 15 years. Future compatibility shall be supported for no less than 10 years. Compatibility shall be defined as the ability to upgrade existing field panels to current level of technology, and extend new field panels on a previously installed network. Any existing field panel microprocessor must be able to be connected and directly communicate with new field panels without bridges, routers or protocol converters with the exception for Apogee Ethernet Microprocessors.

1.7 SUBMITTALS

A. Product Submittal Requirements. Provide electronic copies of shop drawings and other submittals on hardware and equipment to be installed or furnished. Begin no work until submittals have been approved for conformity with design intent. When manufacturer’s data sheets apply to a product series rather than a specific product, clearly indicate applicable data by highlighting or by other means. Provide submittal as a single, complete set. Valves and long lead time items may be submitted separately for approval to meet construction schedules.

B. Submittal data shall consist of the following:

1. Direct Digital Control System Hardware:

a. Complete bill of materials indicating quantity, manufacturer, and model number of equipment to be used.
b. Manufacturer's description and technical data, such as product specification sheets:
c. Wiring diagrams and layouts for each control panel. Show all termination numbers.

2. Controlled Systems:

a. Riser diagrams showing control network layout, communication protocol, wire types, and DDC Controller locations. Zone riser diagrams showing all zone controllers, network wiring, and power wiring.
b. Schematic diagram of each controlled system. Label control points with point names. Graphically show locations of control elements.
c. Schematic wiring diagram of each controlled system. Label control elements and terminals.
d. Bill of Material
e. Complete description of control system operation including sequences of operation. Sequence of operation shall be provided by the Mechanical Engineer, and modified as necessary by the BAS contractor to match the equipment installed and district standards.
f. Physical point list for each system controller including both inputs and outputs (I/O), point numbers, and controlled device associated with each I/O point.

3. Contractor shall submit documentation in the following phased delivery schedule:

a. Valve schedules and long lead items (if necessary to meet construction schedule)
b. Control Submittal:

1) System Riser Diagrams
2) Sequence of Operations
3) Mechanical Control Schematics
4) Electrical Wiring Diagrams
5) Control Panel Layouts
6) Product Specification Sheets

c. Record drawings

C. Project Record Documents: Submit electronic copy of record documents upon completion of installation. Submittal shall consist of:

1. Project Record Drawings. As-built versions of the submittal package.

1.8 WARRANTY

A. Provide all services, materials and equipment necessary for the successful operation of the entire BAS system for a period of one year after beneficial use.

B. The adjustment, required testing, and repair of the system includes all computer equipment, transmission equipment and all sensors and control devices.

C. If requested by owner, the service modem can be installed. The on-line support services shall allow the local BAS subcontractor to dial out over telephone lines to monitor and control the facility's building automation system. This remote connection to the facility shall be within 2 hours of the time that the problem is reported. This coverage shall be extended to include normal business hours, after business hours, weekends and holidays. Owner shall provide phone lines for this service.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

A. The contractor shall use the Carrier i-Vu System. No other manufacture shall be accepted. This item is being sole sourced per Public Contract Code Section 3400, subdivision (b) (2) to match equipment in use at the project either completed or in the course of completion.

B. No substitutions shall be accepted. No known equal.

2.2 COMMUNICATION

A. The design of the BAS shall support networking of operator workstations and Primary DDC Controllers. The network architecture shall consist of two levels, an Ethernet based primary network for all operator workstations, servers, and primary DDC controllers, and a secondary Floor Level Networks (FLN) for terminal equipment application specific controllers.

B. Primary Network Communication

1. The Primary Ethernet Network shall be installed and maintained by the owner. The BAS shall reside on the campus network. One Ethernet connection point shall be brought to each building by the owner, including the wiring and all necessary hardware. The BAS shall provide any additional wiring and hardware if multiple connections to the Ethernet are required. The BAS contractor is to coordinate with the owner for IP Addressing and gateway information.
2. Any controller residing on the primary network shall connect to Ethernet network without the use of a PC or a gateway with a hard drive.
3. Any PC on the Primary Network shall have transparent communication with controllers on the building level networks connected via Ethernet.
4. Any break in Ethernet communication from the PC to the controllers on the Primary Network shall result in a notification at the PC.
5. The standard client and server workstations on the Primary Network shall reside on industry standard Ethernet utilizing standard TCP/IP, IEEE 802.3.
6. System software applications will run as a service to allow communication with Primary Network Controllers without the need for user log in. Closing the application or logging off shall not prevent the processing of alarms, network status, panel failures, and trend information.

C. Primary Network – DDC Controller Panel to Panel Communication:

1. All Primary DDC Controllers shall directly reside on the primary Ethernet network so that communications may be executed directly between Primary DDC Controllers, directly between server and Primary DDC Controllers on a peer-to-peer basis.
2. Systems that operate via polled response or other types of protocols that rely on a central processor, file server, or similar device to manage panel-to-panel or device-to-device communications shall not be acceptable, except where integration is required.
3. All operator interfaces shall have the ability to access all point status and application report data or execute control functions for any and all other devices. Access to data shall be based upon logical identification of building equipment. No hardware or software limits shall be imposed on the number of devices with global access to the network data.
4. The primary network shall use TCP/IP over Ethernet. All devices must:

    a. Auto-sense 10/100 Mbps networks.
    b. Receive an IP Address from a Dynamic Host Configuration Protocol (DHCP) Server or be configured with a Fixed IP Address.
    c. Allow MMI access to an individual Primary Network Controller using industry standard Telnet software to view and edit entire Primary Network.

5. The primary network shall provide the following minimum performance:

    a. Provide high-speed data transfer rates for alarm reporting, report generation from multiple controllers and upload/download efficiency between network devices.
    b. Message and alarm buffering to prevent information from being lost.
    c. Error detection, correction, and re-transmission to guarantee data integrity.
    d. Synchronization of real-time clocks between Primary DDC Controllers, including automatic daylight savings time corrections.
    e. The primary network shall allow the Primary DDC Controllers to access any data from, or send control commands and alarm reports directly to, any other Primary DDC Controller or combination of controllers on the network without dependence upon a central or intermediate processing device. Primary DDC Controllers shall send alarm reports to multiple operator workstations without dependence upon a central or intermediate processing device. The network shall also allow any Primary DDC Controller to access, edit, modify, add, delete, back up, restore all system point database and all programs.

D. Secondary Network – Application Specific Controller Communication:

1. Communication over the secondary network shall be the Siemens' standard protocol and match district standards.
2. This level communication shall support a family of application specific controllers for terminal equipment.
3. The Application Specific Controllers shall communicate bi-directionally with the primary network through Primary DDC Controllers for transmission of global data.
4. Where appropriate for the equipment being installed, the short board version of the TECshall be used to match campus standards. (p/n 540-110, 540-105)

2.3 OPERATOR INTERFACE:

A. Workstation hardware:

1. Provide new workstation for the district; new workstation shall be compatible with system.

B. Operator Interface Software:

1. Operator interface software is new.

a. Dynamic Color Graphics must match the district's standards seamlessly, including font size, color, state colors, layout, commanding and navigation.

C. Remote Access:

1. Remote access to the workstation shall be provided and maintained by the owner.

2.4 PRIMARY DDC CONTROLLER SOFTWARE

A. General

1. Furnish the following applications software to form a complete operating system for building and energy management as described in this specification. This section describes only the capability of the control system. Not all features will be used on all projects. See the mechanical plans and sequence of operation for requirements.
   The software programs specified in this Section shall be provided as an integral part of Primary DDC Controllers and shall not be dependent upon any higher level computer or another controller for execution.
2. All points, panels and programs shall be identified by up to a 30-character name. All points shall also be identified by up to a 16-character point descriptor. The same names shall be displayed at both Primary DDC Controller and the Operator Interface.
3. All digital points shall have a user defined two-state status indication with up to 8 characters (e.g., Summer, Enabled, Disabled, Abnormal).
4. Primary DDC Controllers shall have the ability to perform energy management routines including but not limited to time of day scheduling, calendar-based scheduling, holiday scheduling, temporary schedule overrides, start stop time optimization, automatic daylight savings time switch over, night setback control, enthalpy switch over, peak demand limiting, temperature-compensated duty cycling, heating/cooling interlock, supply temperature reset, priority load shedding, and power failure restart. Specific routines shall be determined by the mechanical plans and sequence of operation.
5. The Primary DDC Controllers shall have the ability to perform the following pre tested control algorithms:

   a. Two position control
   b. Proportional control
   c. Proportional plus integral control
   d. Proportional, integral, plus derivative control
   e. Automatic tuning of control loops
   f. Model-Free Adaptive Control

B. System Security

1. User access shall be secured using individual security passwords and user names.
2. Passwords shall restrict the user to the objects, applications, and system functions as assigned by the system manager.

3. User Log On/Log Off attempts shall be recorded.

C. User Defined Control Applications

1. Controllers shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.
2. It shall be possible to use any system measured point data or status, any system calculated data, a result from any process, or any user-defined constant in any controller in the system.
3. Any process shall be able to issue commands to points in any and all other controllers in the system.
4. Each controller shall support plain language text comment lines in the operating program to allow for quick troubleshooting, documentation, and historical summaries of program development.

D. Scheduling

1. Scheduling shall be created on the Insight workstation or at the panel.
2. Schedules shall reside in the Primary DDC Controller and shall not rely on external processing or network.
3. The operator shall be able to define the following information:

    a. Time, day
    b. Commands such as on, off, auto, etc.
    c. Time delays between successive commands.
    d. There shall be provisions for manual overriding of each schedule by an authorized operator.

4. It shall be possible to schedule calendar-based events up to one year in advance based on the following:

    a. Weekly Schedule. Provide separate schedules for each day of the week. Each of these schedules should include the capability for start, and stop, optimal start, optimal stop, and night economizer. When a group of objects are scheduled together as an Event, provide the capability to adjust the start and stop times for each member.
    b. Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed, it will be discarded and replaced by the standard schedule for that day of the week.
    c. Holiday Schedules. Provide the capability for the operator to define up to 99 special or holiday schedules. These schedules may be placed on the scheduling calendar and will be repeated each year. The operator shall be able to define the length of each holiday period.

E. Automatic Daylight Savings Time Switchover: The system shall provide automatic time adjustment for switching to/from Daylight Savings Time.

F. Night setback control. The system shall provide the ability to automatically adjust setpoints for night control.

G. Loop Control. A Model-Free Adaptive Control algorithm or alternatively a PID (proportional-integral-derivative) closed-loop control algorithm with direct or reverse action and anti-windup shall be supplied. The algorithm shall calculate a time-varying analog value that is used to position an output or stage a series of outputs. The controlled variable, setpoint, and weighting parameters shall be user-selectable.

H. Sequencing. Provide application software based upon the sequences of operation specified to properly sequence equipment.

I. Totalization

1. Run-Time Totalization. Primary DDC Controllers shall have the ability to automatically accumulate and store run-time hours for all digital input and output points. A high runtime alarm shall be assigned, if required, by the operator.
2. Consumption totalization. Primary DDC Controllers shall have the ability to automatically sample, calculate and store consumption totals on a daily, weekly or monthly basis for all analog and digital pulse input type points.

J. Data Collection

1. A variety of historical data collection utilities shall be provided to manually or automatically sample, store, and display system data for all points.
2. Primary DDC Controllers shall store point history data for selected analog and digital inputs and outputs:

    a. Any point, physical or calculated may be designated for trending. Any point, regardless of physical location in the network, may be collected and stored in each Primary DDC Controllers point group. Trending data to follow district standards.

3. Trend data shall be stored at the Primary DDC Controllers and uploaded to the workstation when retrieval is desired. Uploads shall occur based upon either user-defined interval, manual command or when the trend buffers are full. All trend data shall be available for use in third-party personal computer applications.

2.5 PRIMARY DDC CONTROLLERS

A. Primary DDC Controllers shall be the Siemens Apogee PXC product line. If the PXC product line is being retired, the Primary DDC Controllers shall be of the current Siemens Apogee product line.

B. Primary DDC Controllers shall be 32-bit, multi-tasking, multi-user, real-time 100 MHz digital control processors consisting of modular hardware with plug-in enclosed processors, communication controllers, power supplies and input/output point modules. Controller size shall be sufficient to fully meet the requirements of this specification and the attached point list.

C. Each Primary DDC Controller shall have sufficient memory, a minimum of 24 megabyte, to support its own operating system and databases, including control processes, energy management applications, alarm management applications, historical/trend data for points specified, maintenance support applications, custom processes, operator I/O, and dial-up communications.

D. Provide Universal I/O capability, including software configurable universal inputs and universal outputs.

E. Primary DDC Controller shall have an integral real-time clock.

F. Each Primary DDC Controller shall support firmware upgrades without the need to change hardware.

G. Each Primary DDC Controller shall support:

1. Monitoring of industry standard analog and digital inputs, without the addition of equipment outside the Primary DDC Controller cabinet.
2. Monitoring of industry standard analog and digital outputs, without the addition of equipment outside the Primary DDC Controller cabinet.

H. Manual Override. Where available as a standard option, the operator shall have the ability to manually override automatic or centrally executed commands at the Primary DDC Controller via local, point discrete, integral hand/off/auto operator override switches for all digital control type points and gradual switches for all analog control type points. These override switches shall be operable whether the panel processor is operational or not. Each Primary DDC Controller shall monitor and alarm the hand, off and auto positions of integral HOA switches.

I. Self Diagnostics. Each Primary DDC Controller shall continuously perform self diagnostics, communication diagnosis, and diagnosis of all panel components. The Primary DDC Controller shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication for any system.

J. Power loss. In the event of the loss of power, the database or operating system software shall be saved with a battery backup. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 30 days.

1. Upon restoration of normal power, the HVAC Mechanical Equipment Controller shall automatically resume full operation without manual intervention.
2. Should HVAC Mechanical Equipment Controller memory be lost for any reason, the user shall have the capability of reloading the HVAC Mechanical Equipment Controller via the local RS-232C port, via telephone line dial-in or from a network workstation PC.

K. Immunity to power and noise.

1. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage.

a. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).

L. Panel Layout

1. Each panel with hardwired points shall have a panel layout diagram included in the enclosure showing the point address, point name, and a description.

M. HVAC Mechanical Equipment Controllers shall provide a RS 232C serial data communication port for operation of operator I/O devices such as industry standard printers, operator terminals, modems and portable laptop operator's terminals.

2.6 APPLICATION SPECIFIC CONTROLLERS (ASC) – TERMINAL EQUIPMENT CONTROLLERS (TEC'S)

A. General

1. Where appropriate and specified on the mechanical plans and sequence of operation, TEC's shall be provided for the following:

    a. Variable Air Volume (VAV) boxes
    b. Fan Coil Units (FCU)
    c. Unit Conditioners
    d. Roof Top Units (RTU's)

2. Each Primary DDC Controller shall be able to communicate with application specific controllers (ASCs) over the Secondary Network to control terminal equipment only.
3. Each ASC shall operate as a stand-alone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a microprocessor-based, multi-tasking, digital control processor.
4. Each ASC shall include all point inputs and outputs necessary to perform the specified control sequences. The ASC shall accept input and provide output signals that comply with industry standards. Controllers utilizing proprietary control output signals shall not be acceptable. Outputs utilized either for two-state, modulating floating, or proportional control, allowing for additional system flexibility.
5. Space Temperature Sensors. Each controller performing space temperature control shall be provided with a matching space temperature sensor.

    a. As a standard for occupied spaces such as classrooms and offices, room temperature sensors shall be Siemens Series 2000 with display, temperature adjustment, override button, and auxiliary communication port.
    b. As a standard for hallways, room temperature sensors shall be flush mounted.

6. Communication. Each controller shall perform its primary control function independent of other Secondary Network communication, or if Secondary Network communication is interrupted. Reversion to a fail-safe mode of operation during Secondary Network interruption is not acceptable.
7. The controllers shall be able to return to full normal operation without user intervention after a power failure of unlimited duration.
8. Power Supply. The ASCs shall be powered from a 24 Vac source and shall function normally under an operating range of 18 to 28 Vac, allowing for power source fluctuations and voltage drops. Power supply for the ASC must be rated at a minimum of 125% of ASC power consumption and shall be of the fused or current limiting type.
9. Environment. The controllers shall function normally under ambient conditions of 32 to 122°F (0 to 50°C) and 10% to 95% rh (non-condensing). Provide each controller with a suitable cover or enclosure to protect the circuit board assembly.
10. Immunity to noise. Operation shall be protected against electrical noise of 5-120 Hz and from keyed radios up to 5 W at 1 m (3 ft).

2.7 INPUT/OUTPUT INTERFACE:

A. Hardwired inputs and outputs may tie into the system through Primary DDC Controllers, ASC's or point modules.

B. All input points and output points shall be protected such that shorting of the point to itself, to another point, or to ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage will cause no damage to the controller.

C. Binary inputs shall allow the monitoring of On/Off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against the effects of contact bounce and noise. Binary inputs shall sense "dry contact" closure without external power (other than that provided by the controller) being applied.

D. Pulse accumulation input objects. This type of object shall conform to all the requirements of binary input objects and also accept up to ten (10) pulses per second for pulse accumulation.

E. Analog inputs shall allow the monitoring of low-voltage (0 to 10 Vdc), current (4 to 20 mA), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with—and field configurable to—commonly available sensing devices.

F. 24 Vdc shall be available next to the point signal for powering the output device.

G. Binary outputs shall provide for On/Off operation or a pulsed low-voltage signal for pulse width modulation control. Outputs shall be selectable for either normally open or normally closed operation.

H. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0 to 10 Vdc or 4 to 20 mA signal as required to provide proper control of the output device.

I. Tri-State Outputs. Provide tri-state outputs (two coordinated binary outputs) for control of three-point floating type electronic actuators without feedback. Use of three-point floating devices shall be limited to zone control and terminal unit control applications (VAV terminal units, duct-mounted heating coils, zone dampers, radiation, etc.). Control algorithms shall run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.

2.8 POWER SUPPLIES AND LINE FILTERING

A. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in both primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.

2.9 FIELD DEVICES

A. Provide instrumentation as specified on the mechanical plans and as required to meet the sequence of operation. Provide instrumentation to match district standards.

B. Temperature Sensors

1. Room Temperature Sensors

a. As a standard for occupied spaces such as classrooms and offices, room temperature sensors shall be Siemens Series 2000 with display, temperature adjustment, override button, and auxiliary communication port.
b. As a standard for hallways, room temperature sensors shall be flush mounted, Siemens 540-995, 540-520, 544-973 or 544-374

2. Duct Temperature Sensors

a. Connected to a DDC Controller

1) Single Point for supply air and return air: Siemens Model 544 100 ohm Platinum RTD
2) Averaging for mixed air: Siemens Model 544 100 ohm Platinum RTD

b. Connected to a TEC

1) Single Point, 100,000 ohms , Siemens Model 536-811

3. Outside Air Sensor

a. Temperature Monitoring Range: -58/122 deg F
b. Output Signal: 4 to 10 mA DC
c. Accuracy at Calibration Point: +/- 0.5 deg F

C. Humidity Sensor

1. Room Sensors

a. Siemens Model QFA
b. Accuracy of 5% at room temperature of 73 deg F

2. Duct Sensor

a. Siemens Model QFM
b. Accuracy of 5% at temperature of 73 deg F

D. Air Quality Sensor

1. Room Sensor

a. Siemens Model QPA
b. Less than or equal to +/- 50 ppm +2% of measured value

2. Duct Sensor

a. Siemens Model QPM or equal.
b. Less than or equal to +/- 50 ppm +2% of measured value

E. Line Voltage Thermostats

1. Powers 134-1084

F. Air Differential Pressure Sensor

1. Range shall be appropriate for the application
2. Output signal: 4 to 20 mA
3. Accuracy: +/- 1.0% of FS

G. Door Contacts

1. Sensors shall be by Sentrol.

H. Electric Damper Actuators

1. All actuators shall be manufactured, brand labeled, or distributed by Siemens. Siemens Model GMA, GCA, or GDE as appropriate
2. The actuator shall have mechanical or electronic stall protection to prevent damage to the actuator throughout the rotation of the actuator.
3. All 24 Vac/Vdc actuators shall operate on Class 2 wiring.
4. Upon start up and after power loss, the actuator must immediately respond to control signals. Actuators requiring calibration to determine end stops are not acceptable.
5. All actuators that provide a factory mounted electrical appliance or plenum rated cabling must be marked with numbers on the wires as well as color coded.
6. Provide built-in dual end switches as required for the sequence of operation.
7. Actuators shall be designed for mounting directly to the damper shaft without the need for connecting linkages.
8. All actuators having more than 100 lb-in torque output shall have a self-centering damper shaft clamp that guarantees concentric alignment of the actuator's output coupling with the damper shaft. The self-centering clamp shall have a pair of opposed "v" shaped toothed cradles; each having two rows of teeth to maximize holding strength. A single clamping bolt shall simultaneously drive both cradles into contact with the damper shaft.
9. Butterfly valves shall be Tyco or Bray.

PART 3 – EXECUTION

3.1 COORDINATION

A. Site

1. The project coordination between trades is the responsibility of the prime contractor who is the one tier higher contractual partner such as mechanical contractor, general contractor, construction manager, owner or owner's representative as applicable.

2. The controls contractor shall follow prime contractor's job schedule and coordinate all project related activities through the prime contactor except otherwise agreed or in minor job site issues. Reasonable judgment shall be applied.

B. Project Management

1. Provide a designated project manager who will be responsible for the following:

a. Coordinate with all applicable trades and subcontractors
b. Authorized to accept and execute orders or instructions from owner/architect
c. Attend project meetings as necessary to avoid conflicts and delays
d. Make necessary field decisions relating to this scope of work
e. Coordination/Single point of contact

C. Life Safety

1. Duct smoke detectors required for air handler shutdown are supplied under Division 26 of this specification. Wiring for fan shut down by Division 26.

2. Fire/smoke dampers and actuators required for fire rated walls are provided under another Section of Division 23. Control of these dampers shall be by Division 28.

D. Coordination with controls specified in other sections or divisions.

1. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the contractor as follows:

a. Each supplier of controls product is responsible for the configuration, programming, startup, and testing of that product to meet the sequences of operation described in this section.

3.2 GENERAL WORKMANSHIP

A. Install equipment, piping, and wiring/raceway parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.

B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

C. Install all equipment in readily accessible locations

D. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.3 WIRING

A. All control and interlock wiring shall comply with national and local electrical codes and Division 26 of this specification.

B. All low-voltage wiring shall meet NEC Class 2 requirements. (Low-voltage power circuits shall be sub fused when required to meet Class 2 current limit.)

C. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables may be run not in conduit provided that cables are UL Listed for the intended application. For example, cables used in ceiling plenums shall be UL Listed specifically for that purpose.

D. All wiring in mechanical, electrical, or service rooms shall be installed in conduit.

E. Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).

F. All plenum rated wiring shall be installed as continuous lengths, with no splices permitted between termination points

G. All wiring in conduit shall be installed as continuous lengths, with no splices permitted between termination points or between junction boxes.

H. Size and type of conduit and size and type of wire shall be the responsibility of the contractor, in keeping with the manufacturer’s recommendations and NEC requirements, except as noted elsewhere.

3.4 COMMUNICATION WIRING

A. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer’s installation recommendations for all communication cabling.

B. Do not install communication wiring in raceway and enclosures containing Class 1 wiring.

C. Contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.

D. All communication wiring shall be labeled to indicate origination and destination data.

3.5 PROGRAMMING

A. Provide sufficient internal memory for the specified sequences of operation and trend logging. There shall be a minimum of 25% of available memory free within the primary controller for future use.

B. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index. Point Naming standard shall be agreed upon between owner and BAS contractor.

C. Software Programming shall be complete to provide a fully functional system that matches district standards and the sequence of operation.

D. Operator Interface

1. Standard graphics—Provide graphics for all mechanical systems and floor plans of the building. This includes each chilled water system, hot water system, chiller, boiler, air handler, and all terminal equipment. Point information on the graphic displays shall dynamically update. Show on each graphic all input and output points for the system. Also show relevant calculated points such as setpoints.
2. All graphics shall match existing district standards.
3. The contractor shall provide all the labor necessary to install, initialize, start up, and troubleshoot all operator interface software and its functions as described in this section. This includes any operating system software, the operator interface database, and any third-party software installation and integration required for successful operation of the operator interface.

3.6 CONTROL SYSTEM CHECKOUT AND TESTING

A. The controls contractor shall verify the installation and perfomance of the control system and verify that it meets the design intent. Contractor shall follow their company standard practices.

B. District representative shall be invited to observe the startup process. Construction schedule and activities shall not be modified to accommodate the district representative.

3.7 TRAINING

A. The Contractor shall provide competent instructors to give full instruction to designated personnel in the adjustment, operation and maintenance of the system installed. Factory employed/certified instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach. All training shall be held during normal work hours of 8:00 a.m. to 4:30 p.m. weekdays.

B. Provide 16 hours of site specific training for Owner's operating personnel.

C. Training shall include demonstration of the system at the workstation and an on-site tour of panel, sensor, and equipment locations.

3.8 SEQUENCE OF OPERATION

A. Provide fully implemented application and custom software and controls necessary to accomplish the control sequences required for operation of each unit as follows:

1. Package Unit Control
2. VAV Terminal Units
3. Exhaust Fans
4. Split Systems
5. Utilities Metering
6. Lighting

B. This is a general sequence of operation. Controls contractor to modify the sequence of operation to match equipment being installed and maintain district standards.

C. Units shall be enabled by the DDC System via occupancy schedule.

D. Momentary "After Hours Call" switches, located on each space temperature sensor shall allow occupants to operate the system during unscheduled periods. Each activation of this switch shall provide operation for the next 2 hours.

E. Roof Top Unit Control

1. Where appropriate, the short board form the TEC shall be utilized to match district standards.
2. When reasonable, the TEC's shall be mounted above the room temperature sensor in the ceiling space.
3. Terminal Equipment Controllers shall monitor and control the temperature in the rooms. The Tenant will be able to adjust the space temperature setpoint via the space sensor; the district can enable or disable the setpoint dial at the workstation. If the temperature exceeds a preset reference temperature an alarm will be generated back to the OWS.
4. One hour prior to tenant occupancy, the unit shall go into occupied mode; outside air shall be utilized if it is within a reasonable temperature range.
5. During unoccupied modes, the unit shall control to the unoccupied set points, 58 deg for heating and 84 degrees for cooling. The fan shall cycle on and off.
6. Filter differential pressure shall not be monitored/or alarmed. Filter replacement shall follow the district maintenance schedule.
7. Door switches shall be placed on exterior classroom and roll-up doors. When the door switch is in the "closed" position, the package unit shall be enabled to perform temperature control. When the door is not closed, the unit shall be disabled.
8. The fan status and supply air temperature shall be monitored.
9. Indoor Air Quality and Demand Ventilation (when available on the mechanical unit and specified on the mechanical plans)

    a. Units with controllable outside air, return air, and exhaust air dampers are preferred.
    b. Pre-heat and pre-cool functions may be required to implement demand control ventilation.
    c. When available on the mechanical equipment being installed, the BAS shall control the dampers when possible. This will not apply to RTU's that come with manufacturer controlled economizer and power exhaust options.
    d. The room CO_2 shall be monitored where shown on plans. If the room CO_2 rises above 800ppm, the BAS shall modulate the dampers to provide additional ventilation (when possible).

10. Dry Bulb Temperature Economizer Control (when applicable on the mechanical unit and specified on the mechanical plans and sequence of operation)

F. VAV Terminal Units

1. The variable volume (VAV) terminal unit is controlled independent of system pressure fluctuations by a DDC Actuating Terminal Equipment Controller. The space served by the VAV terminal unit is controlled in Occupied and Unoccupied modes as follows:
2. Occupied

    a. The VAV terminal unit is controlled within user defined maximum and minimum supply air volume settings. The controller monitors the room temperature sensor and air velocity sensor and modulates the supply air damper and reheat coil valve (where applicable) in sequence to maintain the room temperature at set point.

3. Unoccupied

    a. The terminal unit is controlled using the night set point. The controller may reset to the Occupied mode for a predetermined time period upon a signal from the control system or manually at the room sensor.

G. Typical Exhaust Fan Control

1. The toilet exhaust fans shall be interlocked with the local light switch by Div 16.
2. General exhaust fans shall be software interlocked by the BAS to the associated units.
3. Electric room and mechanical room exhaust fans shall have a line voltage thermostat furnished by the controls contractor, installed by div.16.

H. Split Systems

1. Where possible, a TEC shall be used to control the split system unit.
2. Where control is not possible, the room temperature shall be monitored by the BAS.

I. Utilities Metering

1. The main power circuit coming into the campus shall be monitored by a Siemens Digital Energy Monitor.
2. DEM to be provided by Carrier, installed by Division 26.

J. Lighting Control

1. The exterior lights shall be controlled by the BAS.

    a. A digital photocell shall be connected to the BAS. When the exterior lighting is scheduled to be on and the photocell is “off”, the BAS shall enable the exterior lighting.
    b. An override switch shall be located at the main entrance to the building. When activated, the exterior lighting shall be enabled regardless of scheduling or photocell activity
    c. Exterior lighting shall be controlled by contactors furnished and installed by Division 26.

2. When a lighting control panel is used for interior lighting, the control panel shall be provided with BACnet IP communication protocol (by others).

END OF SECTION 23 09 00

APPENDIX A: ADD03

Sequences of Operation

Sequence of Operation for EMUHSD Rosemead Adult School

1.1 SPLIT SYSTEM UNIT CONTROLLER (FC/HP-1 THRU FC/HP-4)

Indoor Fan
During Occupied periods, fan shall operate continuously. During Unoccupied periods, fan shall operate when the space temperature exceeds the unoccupied heating or cooling setpoints. The fan operates at one speed only and provides on/off operation.

Heating Mode
When space temperature is below the occupied heating setpoint, unit shall operate in the heating mode. Unit shall stage available heat stages to satisfy demand in the occupied space.

Cooling Mode
When space temperature is above occupied cooling setpoint, unit shall operate in the cooling mode. Unit shall enable available cooling stages to satisfy demand in the occupied space.

1.2 EXISTING GAS/ELECTRIC VVT ROOFTOP UNIT CONTROLLER (EXISTNG QTY. 4)

Indoor Fan
During Occupied periods, fan shall operate continuously. During Unoccupied periods, fan shall operate when the space temperature exceeds the unoccupied heating or cooling setpoints. The fan operates at one speed only and provides on/off operation.

Heating Mode
When space temperature is below the occupied heating setpoint, unit shall operate in the heating mode. Unit shall stage available heat stages to satisfy demand in the occupied space.

Cooling Mode
When space temperature is above occupied cooling setpoint, unit shall operate in the cooling mode. Unit shall enable available cooling stages to satisfy demand in the occupied space.

Economizer (if applicable)
Economizer shall close when fan is off or during a loss of power. During occupied hours when fan is energized, the economizer shall open to adjustable minimum position. When outside air temperature is below 71° and occupied space requires cooling, economizer shall open. If economizer air is not sufficient to meet the demand in the occupied space, unit shall enable available mechanical cooling stages to satisfy demand in the occupied space.

CO2 Control (if applicable)
Unit shall monitor space CO2 when the supply fan is energized. When CO2 is above setpoint of 1000 PPM, economizer shall modulate open toward an adjustable maximum CO2 position. As the CO2 level in the space increases above the setpoint, the minimum positions of the dampers will be increased proportionally, until the maximum ventilation setting is reached. As the space CO2 level decreases

because of the increase in fresh air, the outdoor-damper will follow the higher demand condition from the DCV mode or from the free-cooling mode.

Power Exhaust (if applicable)
The exhaust fan shall modulate to maintain the room pressure setpoint (as determined by air balancer). **Not controlled through EMS.**

1.3 GAS/ELECTRIC VVT ROOFTOP UNIT CONTROLLER (AC-1, AC-2 AND EXISTNG QTY. 3)

Indoor Fan
During Occupied periods, the fan shall operate continuously. During Unoccupied periods, the fan shall operate when the space temperature exceeds the unoccupied heating or cooling setpoints. The fan operates at a variable speed to meet the load conditions and SAT safety requirements to provide maximum energy savings by minimizing fan horsepower consumption. Fan speed is NOT controlled by static pressure.

Heating Mode
When space temperature is below the occupied heating setpoint, unit shall operate in the heating mode. Unit shall stage available heat stages to satisfy demand in the occupied space.

Cooling Mode
When space temperature is above occupied cooling setpoint, unit shall operate in the cooling mode. Unit shall enable available cooling stages to satisfy demand in the occupied space.

Economizer
Economizer shall close when fan is off or during a loss of power. During occupied hours when fan is energized, the economizer shall open to adjustable minimum position. When outside air temperature is below 71° and occupied space requires cooling, economizer shall open. If economizer air is not sufficient to meet the demand in the occupied space, unit shall enable available mechanical cooling stages to satisfy demand in the occupied space.

CO2 Control
Unit shall monitor space CO2 when the supply fan is energized. When CO2 is above setpoint of 1000 PPM, economizer shall modulate open toward an adjustable maximum CO2 position. As the CO2 level in the space increases above the setpoint, the minimum positions of the dampers will be increased proportionally, until the maximum ventilation setting is reached. As the space CO2 level decreases because of the increase in fresh air, the outdoor-damper will follow the higher demand condition from the DCV mode or from the free-cooling mode.

Power Exhaust
The exhaust fan shall modulate to maintain the room pressure setpoint (as determined by air balancer). **Not controlled through EMS.**

1.4 BYPASS DAMPER CONTROLLER (BD-1 THRU bd-5)

VVT Bypass Damper
While the indoor fan runs, the bypass shall modulate to maintain duct pressure at a configurable setpoint. If the static pressure is below the static pressure setpoint the bypass damper will modulate close to build duct static pressure until the static pressure is at setpoint. If the static pressure is above the static pressure setpoint the bypass damper will modulate open to relieve duct static pressure until the static

pressure is at setpoint.

1.5 ZONE CONTROLLER (ZD-1-1 THRU ZD-1-7, ZD-2-1 THRU ZD-2-7, ZD-A-1 THRU ZD-A-8)

Pressure Independent VVT Zone Controller
Provides pressure-independent zone temperature control by modulating its built-in damper actuator to control the flow of primary air into the zone. The damper modulates the airflow setpoint between the mode's configurable minimum and maximum airflow based on the occupancy status of the zone. This minimum insures sufficient minimum airflow at the air source and sufficient ventilation to the zone during occupied periods.

Demand Controlled Ventilation
The zone controller monitors the CO2 sensor and can override the temperature control to respond to increasing CO2 levels when the zone is occupied. If the sensor's value exceeds the CO2 setpoint the controller increases airflow to the zone at a base rate, and then proportionally increases ventilation if the CO2 level continues to increase.

Linkage
The control system uses linkage to exchange data between the zone terminals and their air source to form a coordinated HVAC system. The system's air source controller, zone controllers, and bypass controller are linked so that their data exchange can be managed by one zone controller configured as the VVT master. The VVT master gathers the following information from the slave zone controllers: occupancy status, setpoints, zone temperature, relative humidity, CO2 level, damper position, and optimal start data (all if applicable).

1.6 EXHUAST FAN DETAIL (CP-1)

Exhaust Fans
EF-4 shall run based on an occupied time schedule (configurable)

EF-5 shall be interlocked with associated existing AC unit. The exhaust fan shall run when the supply fan is on.

Exhaust fan status will be monitored through a current sensing switch. If the current switch does not detect fan status after a start command has been sent to the associated exhaust fan, an alarm will be generated to the i-Vu web server.

Exterior Lighting
The lighting output will turn on and off based upon photocell input.

Space Temperature Monitoring
Existing Split air conditioners (Qty. 2) shall be controlled by the unit manufacturer's thermostat and monitored only by the EMS space temperature sensor. A high temperature limit alarm shall be generated by the i-Vu web server.

1.7 EXHUAST FAN DETAIL (CP-2)

Exhaust Fans
EF-1 & EF-3 shall be interlocked with AC-1. The exhaust fan shall run when the supply fan is on.

EF-2 shall be interlocked with AC-2. The exhaust fan shall run when the supply fan is on.

Exhaust fan status will be monitored through a current sensing switch. If the current switch does not detect fan status after a start command has been sent to the associated exhaust fan, an alarm will be generated to the i-Vu web server.

Exterior Lighting
The lighting output will turn on and off based upon photocell input.