08/26/2025

ADDENDUM NO. 5

August 26, 2025

Project: Galena Park ISD - Havard Elementary School HVAC Modifications

Prepared by: Salas O'Brien Engineers
10930 W. Sam Houston Parkway N., Suite 900
Houston, Texas 77064

Prepared For: Prospective Proposers

PART A: NOTICE TO PROPOSERS

1. Receipt of this Addendum shall be acknowledged on the Proposal Form. Failure to do so may subject Proposers to disqualification. Each Proposer shall make necessary adjustments and submit his proposal with full knowledge of all modifications, clarifications, and supplemental data included therein.

2. This Addendum forms part of the Contract Documents and shall be incorporated integrally therewith. Where provisions of the following supplemental data differ from those of previously issued documents, this Addendum shall govern.

3. The following Contract Documents have been issued to date delineating the Work (Project). Contract Documents dated: August 11, 2025

4. This Addendum consists of 2 typewritten pages and 51 pages of attachments for a total of 53 pages.

PART B CHANGES TO PRIOR ADDENDUM

1. None

PART C CHANGES TO THE PROJECT MANUAL

1. Section 23 09 33 - Building Control System Management, issue this section in its entirety.

PART D CHANGES TO THE DRAWINGS

1. E1.00 - ELECTRICAL COMPOSITE PLAN
   a. Refer to revised sheet.
2. E2.04 - ELECTRICAL ENLARGED PLANS-LEVEL 1
   a. Refer to revised sheet.
3. E4.04 - ELECTRICAL PANEL SCHEDULES2550-00861-00 Woodlands Methodist Church - School
   a. Refer to revised sheet.
4. M3.01 – MECHANICAL BMCS PLAN
   a. Refer to revised sheet.
5. M6.01 – MECHANICAL SCHEDULES AND LEGENDS
   a. Refer to revised sheet.
6. M6.02 – MECHANICAL SCHEDULES
   a. Refer to revised sheet.

PART E RE-ISSUED DRAWING SHEET (30"X42")

1. E1.00 - ELECTRICAL COMPOSITE PLAN
2. E2.04 - ELECTRICAL ENLARGED PLANS-LEVEL 1
3. E4.04 - ELECTRICAL PANEL SCHEDULES
4. M3.01 – MECHANICAL BMCS PLAN
5. M6.01 – MECHANICAL SCHEDULES AND LEGENDS

6. M6.02 – MECHANICAL SCHEDULES

PART F **NEW DRAWINGS SHEETS** (30”X42”)

1. None

PART G **QUESTIONS/CLARIFICATIONS**

1. None

PART H. **ATTACHMENTS**

1. Section 23 09 33 - Building Control System Management

END OF ADDENDUM 5

SECTION 23 09 33

BUILDING MANAGEMENT AND CONTROL SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. The existing Building Management and Control System at Havard Elementary School shall be removed and replaced in its entirety including the implementation of all new sequences here within. Provide and install a complete high speed, peer to peer network Building Management and Control System (BMCS), including web-based operator interface, industrial instrumentation necessary to obtain functions and results specified. A complete system includes items such as sensors, valves, dampers, valve and damper operators, DDC panels, relays, terminal equipment controllers, mounting brackets and thermowell, etc. Integrate all components to provide a complete and functioning system.

B. Temperature Control System components:
   1. Electronic instruments as specified
   2. Electric instruments as specified
   3. Microcomputer instruments as specified

C. All control devices of the same type product shall be of a single manufacturer.

D. Control, power and interlock wiring necessary to accomplish sequences specified in this Section shall be provided and installed by the Control Subcontractor. Materials and methods of execution as specified in Division 26, Electrical.
   1. Coordinate current characteristics of all electrical instruments and equipment with Division 26 of the specifications and related electrical drawings.

E. The entire Building Management and Control System (BMCS) shall be installed by the Automation System Manufacturer or Authorized Distributor.
   1. All components and elements
   2. The testing and acceptance procedure

F. The manufacturer of the building automation system shall provide documentation supporting compliance with ISO-9002 (Model for Quality Assurance in Production, Installation, and Servicing). The intent of this specification requirement is to ensure that the products from the manufacturer are delivered through a Quality System and Framework that will assure consistency in the products delivered for this project.

G. The entire Building Management and Control System (BMCS) shall be installed, Commissioned, and tested; all performed by the Automation System Manufacturer or Authorized Distributor if approved by engineer.
   1. All components and elements.
   2. Start-up and point verification.
   3. The testing and acceptance procedure.

1.2 RELATED WORK

A. Division 23, Mechanical

B. Division 26, Electrical

1.3 SUBMITTALS

A. Submit items of the Building Management and Control System (BMCS).
   1. Temperature control equipment & Field devices.
   2. Wiring & Flow diagrams.
   3. Sequence of operation.
   4. Complete, detailed, control and interlock-wiring diagram.
   5. Indicate mechanical and electrical equipment furnished and electrical interlocks, indicating terminal designation of equipment. Respective equipment manufacturers shall furnish through the Mechanical Contractor, approved drawings of equipment to be incorporated in this diagram.
   6. Submit Input / Output summary of all points.
   7. Submit an outline of testing procedures from section Testing and Acceptance.
   8. Mark up a copy of the specifications for the product. Indicate in the margin of each paragraph the following: “Comply, “Do Not Comply”, or “Not Applicable”. Explain all “Do Not Comply” statements.
   9. Submit sample of space temperature sensor and guards for review prior to purchase or installation.

1.4 COOPERATION WITH OTHER TRADES

A. Furnish control valves, temperature sensing element wells, flow and pressure sensing devices, dampers and other similar devices to the Mechanical Contractor in a timely manner for installation under the Building Management and Control System (BMCS), Subcontractor's supervision.

1.5 METERING AND VERIFICATION REQUIREMENTS

A. Granular data, derived from the BMCS and inherent to this specification, is to be handled in such a way as to support extraction of data by owner for their use. Granular data is defined as temperatures, set points, run times and utility monitoring. All data is to be monitored on a fifteen-minute interval basis and stored in the BAS database. The BAS must have the inherent capability to trend, single point and multipoint, and display all information as described below.

B. Monitoring software must include outside environmental condition data which affect building performance. Heating degree days and cooling degree days must be logged and formatted in such a way that the data may be used for comparative analysis of multiple facilities, this facility and any district facility on a historical basis over time. This data must be imported from a reliable, certified, third party source. On site instrumentation is not acceptable.

C. Metering and Verification requirements must be inherent to the BMCS. It cannot be a “bolt on” product. It shall be of no extra cost to the project. It shall be easily accessible from the graphical interface on the main screens. It shall also be accessible from the BMCS navigation tree. Data must be retrieved and stored in the BMCS module until it is archived on the BMCS server. Data acquisition and storage must continue even if communication to the facility is lost. Data for utility consumption and environmental indexing must be stored on the server for a minimum of two years.

D. All data described in this section shall be easily extractable, without external software or programming, for use by the owner.

E. All data obtained by the BMCS shall be stored within the system and contain no less than 24 months of data that is easily accessible through the BMCS user interface.

1.6 WARRANTY

A. Provide with a manufacturer’s parts and labor warranty for a period of two years from substantial completion. Warranty shall also include unlimited telephone technical support, sequence and graphical modifications. Through warranty period and at the end of warranty period firmware, software and front end shall be updated to be the most current version available.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Automated Logic Controls by Automated Logic Branch Office

B. Reliable by Unify Energy Solutions

C. Trane by Hunton Trane

2.2 SYSTEM ARCHITECTURE

A. The Building Management and Control System (BMCS) shall consist of an information-sharing network of stand-alone Direct Digital Control Panels (DDCP) to monitor and control equipment as specified of the control sequence and input/output summary.

B. "Information sharing" shall be defined as: The function of each DDCP to exchange data on the network trunk with other DDCP's without the need for additional devices such as network managers, gateways or central computers.

C. "Stand-alone" shall be defined as: The function of each DDCP to independently monitor and control connected equipment through its own microcomputer.

2.3 COMMUNICATIONS PROCESSING

A. The BMCS shall operate as a true token-pass peer-to-peer communication network. Resident processors in each DDCP shall provide for full exchange of system data between other DDCP's on the network trunk. Systems that limit data exchange to a defined number of system points are not acceptable.

B. Systems that operate via polled response or other types of protocols that rely on a central processor or similar device to manage DDCP to DDCP communications may be considered only if a similar device is provided as a stand-by. Upon a failure of malfunction of the primary device, the stand-by shall automatically, without any operator intervention, assume all BMCS network management activities.

C. The failure of any DDCP on the network shall not affect the operation of other DDCP's. All DDCP failure shall be annunciated.

D. Network shall support a minimum communications speed of 115.2 Kbps.

E. The network shall support a minimum of 100 DDC controllers and PC workstations.

F. Each PC workstation shall support a minimum of 4 peer-to-peer networks, by hardwired connection.

G. The system shall support integration of third party systems (fire alarm, security, lighting, PCL, chiller, boiler) via panel mounted open protocol processor. This processor shall exchange data between the two systems for inter-process control. All exchange points shall have full system functionality as specified herein for hardwired points. Provide

examples of 5 reference projects utilizing gateways required for this project.

H. The system shall report values with a minimum end to end accuracy as listed in the following reporting accuracy table.

REPORTING ACCURACY	
Measured Variable	Reported Accuracy
Space Temperature	±0.5ºC (±1ºF)
Ducted Air	±0.5ºC (±1ºF)
Outside Air	±1.0ºC (±2ºF)
Dew Point	±1.5ºC (±3ºF)
Water Temperature	±0.5ºC (±1ºF)
Delta-T	±0.15ºC (±0.25ºF)
Relative Humidity	±3% RH
Water Flow	±2% of full scale
Airflow (terminal)	±10% of full scale (see Note 1)
Airflow (measuring stations)	±5% of full scale
Airflow (pressurized spaces)	±3% of full scale
Air Pressure (ducts)	±25 Pa (±0.1 in. w.g.)
Air Pressure (space)	±3 Pa (±0.01 in. w.g.)
Water Pressure	±2% of full scale (see Note 2)
Electrical (A, V, W, Power Factor)	±1% of reading (see Note 3)
Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO 2)	±50 ppm

Note 1: 10% - 100% of scale
Note 2: For both absolute and differential pressure
Note 3: Not including utility-supplied meters

I. The system shall facilitate controls loops to maintain measured variables at a set point within the tolerances listed in the following control stability and accuracy table.

CONTROL STABILITY AND ACCURANCY		
Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±50 Pa (±0.2 in. w.g.) ±3 Pa (±0.01 in. w.g.)	0-1.5 kPa (0-6 in. w.g.) -25 to 25 Pa (-0.1 to 0.1 in. w.g.)
Airflow	±10% of full scale	
Space Temperature	±1.0ºC (±2.0ºF)	
Duct Temperature	±1.5ºC (±3ºF)	
Humidity	±5% RH	
Fluid Pressure	±10 kPa (±1.5 psi) ±250 Pa (±1.0 in. w.g.)	MPa (1-150 psi) 0-12.5 kPa (0-50 in. w.g.) differential

2.4 DDCP HARDWARE

A. Each DDCP shall consist of a 32-bit microprocessor and controller, power supply, input / output boards and communication board. All program and point databases shall be

stored in battery-backed RAM. Provide a minimum of 1.2 MEG RAM in each DDCP to allow for point expansion and trend data storage.

B. Each DDCP shall incorporate a real-time clock.

C. Each DDCP shall be provided with two RS232 communications port. Connecting an operator terminal, whether portable or stationery, shall allow the user to communicate with the entire network.

D. Each DDCP shall provide for input / output connections to field equipment. The following point types shall be supported:
   1. Analog inputs - for measuring sensed variables. Inputs shall be capable of accepting voltage, resistance, current or pressure signals.
   2. Analog outputs - for controlling end devices. Outputs shall be capable of producing voltage, resistance, current or pressure signals. Outputs shall be provided with a manual override for adjusting outputs in the event of a power loss at the DDCP.
   3. Digital inputs - for monitoring dry contacts such as relays, switches, pulses, etc.
   4. Digital outputs - to control two position devices such as starters, actuators, relays, etc.

E. Each DDCP shall be listed under UL916 (Energy Management Systems), and shall be tested to comply with sub-part J of Part 15 FCC rules for Class A computing equipment.

F. Each DDC Controller shall have sufficient memory to support its own operating system and databases, including:
   1. Control processes
   2. Energy management applications
   3. Alarm management applications including custom alarm messages for each level alarm for each point in the system.
   4. Historical/trend data for points specified
   5. Maintenance support applications
   6. Custom processes
   7. Operator I/O
   8. Dial-up communications
   9. Manual override monitoring

G. Operator shall have the ability to manually override automatic or centrally executed commands at the DDC Controller via local, point discrete, on-board hand/off/auto operator override switches for digital control type points and gradual switches for analog control type points.
   1. Switches shall be mounted either within the DDC Controllers key-accessed enclosure, or externally mounted with each switch keyed to prevent unauthorized overrides.
   2. DDC Controllers shall monitor the status of all overrides and inform the operator that automatic control has been inhibited. DDC Controllers shall also collect override activity information for reports.
   3. All BMCS control modules shall have Hand Off Auto (HOA) switches on all outputs for HVAC and electrical, including digital outputs.

H. DDC Controllers shall provide local LED status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device. Graduated intensity LEDs or analog indication of value shall also be provided for each analog output. Status indication shall be visible without opening the panel door.

I. In the event of the loss of normal power, there shall be an orderly shutdown of all DDC

Controllers to prevent the loss of database or operating system software. 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 72 hours.

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

J. Each controller shall provide a service communication port for connection to a Portable Operator's Terminal. Connection shall be extended to space temperature sensor ports.

K. Each piece of equipment shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network.

L. Each Building Controller and Advanced Applications Controller shall retain BIOS and application programming for at least 72 hours in the event of power loss.

M. Each Application Specific Controller shall use nonvolatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.

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

O. Controller Environment

1. Controller hardware shall be suitable for anticipated ambient conditions.
2. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at - 29°C to 60°C (-20°F to 140°F).
3. Controllers used in conditioned space shall be mounted in dust- protective enclosures and shall be rated for operation at 0°C to 50°C (32°F to 120°F).

2.5 PROGRAMMING FUNCTIONS

A. Resident software in each DDCP shall provide custom programming of control strategies.

1. Point database
2. Operator interface
3. Network communications
4. Facilities and energy management functions

B. Programming of control and energy management strategies shall be accomplished via a high-level computer language such as BASIC, JC BASIC, C, or Powers Process Control Language. A standard math processor shall be part of the programming language. All analog loops shall be capable of proportional, integral and derivative control.

C. Each DDCP shall incorporate an operator interface program (OIP) that provides an English language user interface. The OIP shall allow the user to program, interrogate, command and edit the BMCS via a self-prompting method. Operator terminals, whether textual or graphical, shall be able to access the entire network from any DDCP. Access

shall be accomplished in a transparent fashion; that is, the operator shall not be required to address specific DDCP's in order to display or command system points.

2.6 FACILITY MANAGEMENT SOFTWARE

A. The BMCS shall be provided with standard and custom report generation functions that include:
   1. Alarm summaries
   2. Motor status summaries
   3. Point displays by type, system, status, overrides, failures, location, equipment and enabled/disabled.
   4. Program listings

B. All reports shall be either displayed or printed by:
   1. Operator request.
   2. Time of day.
   3. Event conditions (such as in response to an alarm, interlock, etc.).

C. All reports shall be time and date stamped.

D. An alarm-processing program shall be provided to annunciate those points designated as alarmable. Alarm points shall, upon alarm occurrence, be displayed and annunciated. An object that goes into alarm shall be annunciated at the workstation within 15 sec. Each workstation on the network shall receive alarms within 5 seconds of other workstations.

E. Historical trend data shall be collected and stored at each DDCP for later retrieval. Retrieval shall be manual or automatic. Any point, physical or calculated, may be designated for trending. The system shall allow for two methods of trend collection: Either by a pre-defined time interval sample or upon a pre-defined change of value. Trend data shall be presented in a columnar format. Each sample shall be timed stamped. Trend reports may be a single point or may be a group of points, up to a maximum of (8) points in any single group. Any point, regardless of physical location in the system may become part of a multiple point group.

F. Each BMCS network shall provide a point-monitoring function that can display single or multiple points in a continuous updated fashion for dynamic displays of point values.

G. A database and configuration report program shall be provided that allows the user to interrogate BMCS status. As a minimum, the user shall be able to: Verify available RAM at each DDCP, verify DDCP status (on-line, off-line, and failed) and set the system clock.

H. Any invalid operator entry shall result in an error message.

I. DDCP's shall contain a password access routine that will assign an operator to one of three level of access. Level 1 shall permit display function only, level 2 shall additionally permit commanding of system points and level 3 shall additionally permit full program and database editing.

J. DDCP's shall provide for the accumulation of totalized values for the purposes of run-time or energy totalization. Totalized values may be displayed or printed automatically or by operator request.

2.7 ENERGY MANAGEMENT SOFTWARE

A. The BMCS shall be provided with an optimal start program such that the building may be divided into ten zones for optimum start. Warm-up and cool-down shall occur in

sequence with succeeding zones starting only after the preceding zone has completed its warm-up or cool-down.

1. The optimum start-up time of assigned equipment shall be determined based on a software calculation that takes into consideration outdoor air conditions, space conditions, and building thermal characteristics ("U" factor).
2. The optimum start program shall control start-up of the cooling and heating equipment to achieve the target occupancy space temperature at the precise time of building occupancy.
3. A built-In "learning" technique shall cause the BMCS to automatically adjust itself to the most affective time to start equipment based on historical data.

B. The BMCS shall be provided with an operator interactive time of day (TOD) program. TOD programming and modifying shall be accomplished in a calendar-like format that prompts the user in English language to specify month, year, day and time and associated point commands. It shall be possible to assign single points or groups of points to any on or off time. Appropriate time delays shall be provided to "stagger" on times.

1. TOD shall incorporate a holiday and special day schedule capability, which will automatically bring up a pre-defined holiday or special day schedule of operation. Holidays or special days can be scheduled up to one year in advance.
2. In addition to the time dependent two-state control, TOD also provides time dependent setpoint control. This control provides the capability to output assignable, proportional setpoint values in accordance with the time of day and day of week. This program shall be used to accomplish night setback, morning warm-up and normal daily operating setpoints of all control system loops controlled by the BMCS. As with the two-state control, time dependent setpoint control shall be subject to the holiday schedule. The setpoints desired shall be user definable at any operator terminal.
3. The operator shall be capable of reading and/or altering all sorted data pertaining to time of day, day of week, on/off times, setpoint values, and holiday designation.
4. The TOD program shall also provide an override function that allows the user to conveniently change a start or stop time for any point up to one week in advance. The override command shall be temporary. Once executed the TOD program shall revert to its original schedule.
5. The TOD program shall interface with the optimal start program (OSP) such that stop times may be assigned by OSP.

C. Additional Program functions required are to be installed and programmed as requested by end user at no additional cost:

1. Enthalpy optimization.
2. Supply air reset.
3. Hot water reset.
4. Chilled water reset.
5. Volumetric control.
6. Dead band control. Install dual set points as requested by user.
7. All specified energy management programs, whether or not applicable to this project shall be provided such that the owner may enable the program at a future date without the need to purchase additional software or modify existing software.

2.8 WEB SERVER ACCESSIBILITY

A. Industry leading encryption technology to provide accessibility through a web browser.

B. Building Manager’s ability to access, view and command critical building information in

real time over the intranet or internet.

1. Alarm Display
2. Point Commanding
3. Graphic Display
4. Scheduling
5. Running Reports
6. Point Details

C. Operators shall be able to perform all normal operator functions through the web browser interface. If individual software seat licenses or keys are required provide a minimum of 4 additional licenses to accommodate multiple owner operators.

D. Manufacturer shall provide a web-based BAS platform; the installing contractor shall provide the new web-based software and software updates required for this project. Additionally, the installing contractor shall provide all computer related components (BAS web server – reference specifications for hardware requirements) for the new software platform to function in a peer-to- peer environment.

2.9 REMOTE NOTIFICATION

A. Remote notification sends Alarm and System Event information to various notification devices as indicated below but not limited to. Operators can receive their building automation system alarms without restricting them to dedicated workstations.

1. Alphanumeric pagers
2. Numeric pagers
3. Email
4. Phones via voice or short message service (SMS)

2.10 POINT EXPANSION MODULES

A. Capable of extending its input/output capabilities via special purpose modules.

1. Modules may be mounted remote from the DDCP.
2. Shall communicate with the DDCP over a pair of twisted cables.
3. Operator shall have the ability to manually override automatic or centrally executed commands at the DDC Controller via local, point discrete, on-board hand/off/auto operator override switches for digital control type points and gradual switches for analog control type points.
4. **All BMCS control modules shall have Hand Off Auto (HOA) switches on all outputs for HVAC and electrical, including digital outputs.**

2.11 TERMINAL EQUIPMENT CONTROLLERS

A. Provide for control of each piece of equipment, including, but not limited to, the following:

1. Variable Air Volume (VAV) boxes
2. Constant Air Volume (CAV) boxes
3. Dual Duct Terminal Boxes
4. Unit Conditioners
5. Heat Pumps
6. Unit Ventilators
7. Room Pressurization
8. Fan Coil Units

B. Terminal unit controllers and damper actuators shall be separate and individually replaceable.

C. Include the following items:

1. All input and outputs necessary to perform the specified control sequences.
    a. Analog outputs shall be industry standard signals such as 24V floating control.
2. Sufficient memory to accommodate point database, operating programs, local alarming and local trending.
3. All databases and programs shall be stored in non-volatile EEPROM, EPROM and PROM, or minimum of 100-hour battery backup shall be provided.
4. Return to full normal operation without user intervention after a power outage of unlimited duration.
5. Operation programs shall be field selectable for specific applications.
6. Specific control strategy requirements, allowing for additional system flexibility.
7. Controllers that require factory changes of all applications are not acceptable.
8. The failure of any terminal equipment controllers on the network shall not affect the operation of other terminal equipment controllers and be capable of standalone operation. All terminal equipment controller failures shall be annunciated at the specified alarm pages.

2.12 ELECTRONIC DAMPER ACTUATORS

A. Two position damper operators:
    1. Spring return to full travel position.
    2. Built in auxiliary switches (motor end switches)
        a. Switch shall be fully adjustable so that cut-in/cut-out points may be preset at any point within angular travel of the motor.
    3. Minimum torque 60-in-lb

B. Modulating damper operators:
    1. Sized with sufficient reserve power to provide smooth modulating action and tight close off against the system pressure
    2. Select the operator with available torque to exceed the maximum required operating torque by not less than 100%
    3. Minimum torque 100 in-lb

C. Outside air damper actuators shall be interlocked such that damper operates in hand or auto via the starter. The damper end switch shall energize the unit to run only with end switch for fully open is signaled.

D. Outside air damper actuators to be spring return closed and end switches interlocked for start/stops.

E. Damper actuators shall not have integral controllers.

F. Dampers shall be provided with mechanical or electronic stall protection to prevent actuator damage throughout the actuators rotation.

G. Damper actuators shall be able to manually position each actuator when the actuator is not powered. Non-spring-return actuators shall have an external manual gear release. Spring-return actuators with more than 60 in.-lb torque capacity shall have a manual crank.

2.13 CONTROL CABINETS

A. Fully enclosed NEMA 1 for indoors, NEMA 4 for outdoors.
    1. Powder coat painted on all sides
    2. Cabinet with continuously piano type hinged door
    3. Locking latch
    4. All locks shall use a common key

5. Panels or termination panels must be identified with engraved nameplates.
6. Provide enamel finish and extruded aluminum alloy frame UL 50 certified.
7. Provide only 100VA Transformers with integral manual overload reset. ASC power supply shall be fused or current limiting and shall be rated at a minimum of 125% of ASC power consumption.

B. Above each control cabinet provide a wire gutter that matches the width of the control cabinet. All control wiring shall pass through this wiring gutter. Provide each wire with a 3 foot long service loop located in wiring gutter.

C. Each control panel that are directly connected to the districts network and/or are master controllers shall be provided with a two (2) hour UPS. The UPS provided shall contain a Hot swappable battery. UPS shall be installed on the wall in a cabinet and not placed on the floor. The connection between the UPS and the line power shall include a manual disconnecting means for disconnecting the power to the UPS and power to the panel to allow replacement of the UPS without turning off the incoming power.

D. Each plant controller shall be provided with an IP network controller and a dedicated network drop.

E. Each control panel shall have control power source power source (on-off) with overcurrent protection.

F. Each Air Handling unit shall be provided with a dedicated control transformer. Ensure all safeties related to each air handler are associated with the dedicated control transformer.

2.14 AUTOMATIC CONTROL VALVES

A. Pressure ratings: Minimum 125 psig or 1.25 times maximum system operating pressure.

B. Construction:
1. 2" and smaller:
   a. Screwed.
   b. Bodies and internal parts: Bronze, stainless steel or other approved corrosion-resistant metal.
2. 2-1/2" and larger:
   a. Flanged.
   b. Bodies: Cast iron or cast steel.
   c. Seats and parts exposed to fluid: Bronze, stainless steel or other approved corrosion-resistant metal.
3. Characterized port ball valves are acceptable for VAV terminal units only.

C. Modulating straight through water valves: Equal percentage contoured throttling plugs.

D. Three Way Mixing Valves: Linear throttling plugs allowing total flow through valve to remain constant regardless of position.

E. Sizes: By Automatic Control System Manufacturer for fully modulating operation.
1. Minimum pressure drop: Equal to pressure drop of coil or exchanger.
2. Maximum pressure drop: 5.5 psi.
3. Relief and bypass valves: Sized according to pressure available.
4. 2-position valves: Line size.
5. Manual by-pass operator.

F. Electronic Actuator:
1. Direct coupled installation

2. Visual and electronic stroke indicator
3. Die-cast aluminum housing
4. Manual override
5. Self-lubricating bearing and gear train
6. Automatic calibration
7. Automatic duty cycle protection
8. Overload and stall protection
9. Non-spring return
10. Floating /0-10 VAC / 4-20mA operation
11. UL approved
12. Provide smooth modulating action and tight close off against the system pressure.
13. Torque to exceed the maximum required operating torque by not less than 150%.
14. Actuator input signal shall be compatible with output DDC controller.
15. Provide weatherproof enclosure (exterior use).
16. Damper actuators not acceptable for valves.

2.15 FLOW DETECTION SWITCHES

A. Remote Flow Solid-State Flow Detection:
1. Extended length flow probe
2. Cabinet-mounted control monitor
3. Wetted parts, 316 stainless steel probe
4. Optional temperature and wire-break outputs
5. Flow and temperature switch points
6. LED bar graph display for status indication

B. Approved Manufacturer:
1. IFM Effector

2.16 DIFFERENTIAL PRESSURE SWITCHES

A. Wet/wet differential pressure switch
1. Integral Mounting Frame
2. Watertight, dust-tight, and corrosion resistant enclosure.
3. Wetted materials of brass and flouroelastomer.
4. Externally adjustable set point

B. Approved manufacturer:
1. Square D #9012GGW4
2. Dwyer #DXW-11-153-1
3. Carrier #HK06ZC033

2.17 TEMPERATURE LOW LIMIT SWITCH

A. Responsive to the coldest 1' section of its length.
1. Double pole single throw switch
2. 20' capillary
3. Line voltage with bellows actuated switch
4. Auto reset for outdoor installation
5. Manual reset for indoor installation
5. Refer to manufacturer’s installation instructions for installation locations with limited duct access. Support material shall be rigid copper pipe.

2.18 TEMPERATURE AND HUMIDITY SENSORS

A. Space Temperature Sensors
   1. Thermister with resistance of 10,000 ohms at 77°F.
   2. Accuracy shall be +/-1/2°F.
   3. Range of 55° to 95° F.
   4. Surface Mounted (Cafeteria, Multipurpose and Library Only)
      a. Digital temperature display
      b. Setpoint slide adjustment
      c. Override button
      d. Communication port
      e. Color to be approved by Architect / Owner, submit sample for review
   5. Flush mounted (Remainder of building)
      a. Stainless steel flush mount sensor, submit sample for review.
   6. Location and height to be approved by Architect/Engineer prior to installation.
   7. Provide guards impact resistant Polycarbonate equal to BAPI-Guard in the following locations:
      a. Cafeteria
      b. Multipurpose
      c. Library
   8. Provide an insulated sensor wall plate to fully cover wall opening. Back cover plate shall match sensor color.
   9. Where indicated on drawings to provide both space temperature and space humidity, a combination temperature sensor shall be used but device shall still comply with characteristics described in each section of specification.

B. Space / Duct Humidity Sensor
   1. Capacitance element in the space or duct as required and output a 4 to 20 MA signal proportional to 0 to 100% RH to the DDC.
   2. Capacitance element shall be field replaceable and not require calibration.
   3. Accuracy shall be +/-2% in the range from 20 to 95% RH.
   4. Relative humidity sensors shall have the sensing element of inorganic resistance media.
   5. Provide impact resistant Polycarbonate equal to BAPI-Guard covers suitable for institutional use. Submit sample for review.
   6. Provide manufacturers calibration certificate.
   7. Provide impact resistant Polycarbonate equal to BAPI-Guard guards in the following locations:
      a. Cafeteria
      b. Multipurpose
      c. Library
   8. Provide an insulated sensor wall plate to fully cover wall opening. Back cover plate shall match sensor color.
   9. Where indicated on drawings to provide both space temperature and space humidity, a combination temperature sensor shall be used but device shall still comply with characteristics described in each section of specification.

C. Duct Temperature Sensors
   1. Range of 20° to 120°F.
   2. Multi point sensing of temperature.
   3. Averaging elements of sufficient length to sense temperature across the full face of the coil or 2/3 duct width, provide accurate, representative indication and control and prevent variances in temperature or stratification.
   4. Probes with lengths greater than 3’ shall be externally supported to adjacent structures to prevent unwanted movement.
   5. BAPI Rigid Averaging Temperature Sensor with steel junction box. (Note provided sensor shall satisfy the requirement to extend 2/3 across the entire airflow being measured.)

6. In general, and wherever possible, coil discharge temperatures shall be installed far enough downstream of the coil to avoid radiation effects to/from the coil as well as achieve mixing of air stream after it leaves the coil.
7. Zone reheat coil sensors shall be installed at least four feet downstream of the zone reheat coil. Cases where this is not possible or would result in sensor access issues shall be discussed with and approved by the Owner and Engineer.

D. Liquid Immersion Temperature Sensors
1. Platinum type resistance temperature detector (RTD).
2. Match sensor range to medium being monitored.
   a. Hot water range 30° to 250°F.
   b. Chilled Water 20° to 70°F.
3. Furnish stainless steel wells for installation by Mechanical Contractor.
4. Locate all sensors in field with Owner/Engineer present.
5. System accuracy for liquid temperature sensing shall be +/-1/2°.
6. Sensors must be removable from wells.

E. Outside Air Temperature and Humidity Sensor
1. Temperature
   a. Range of –40° to 140°F.
   b. Accuracy shall be +/-0.9°F
   c. Encapsulated into Type 304 stainless steel tubes with low conductivity moisture proofing material and lag extension for thickness of insulation.
2. Humidity
   a. Capacitance element in the space or duct as required and output a 4 to 20 MA signal proportional to 0 to 100% RH to the DDC.
   b. Accuracy shall be +/-2%
   c. Range from 20 to 95% RH.
   d. Relative humidity sensors shall have the sensing element of inorganic resistance media.
3. Weatherproof sun shield consisting of multiple white plastic plates to reduce the thermal effects of the sun and increasing air flow between the plates.
4. Sensor shall be mounted a minimum of 6” from all building structures.
5. Minimum of 8' long leads.
6. Provide manufacturers calibration certificate.
7. Provide with a 5-year warranty
8. Manufactured by ACI Model # A/-RH2-AN-O-SUN---NIST

F. Freezer / Cooler Sensors
1. Thermistor with resistance of 10,000 ohms at 77°F.
2. Accuracy shall be +/-1/2°F.
3. Range of -40°F to 210°F.
4. Provide manufacturers calibration certificate.
2. Die cast aluminum construction
3. Liquid tight wire connector to isolate sensor chamber from exterior temperature influence.
4. 1/2” NPT threaded hub
5. Mamac Systems Model #TE-205-F-12
6. Reuse existing wiring penetrations through cooler or freezer where possible. If existing penetrations through cooler or freezers cannot be reused, seal existing holes with silicone such that opening is airtight.
7. All new penetrations into the cooler or freezer body shall be sealed airtight using silicone. This shall include screw holes and wiring penetrations.

2.19 CURRENT SENSITIVE RELAYS

A. Ensure compatibility with VFD applications for variable speed motor status.
   1. Provide with adjustable set point.
   2. Relays must be mounted and not hung by power wires thru CT.
   3. Provide fixed core current sensors for new wiring and split-core type current sensors for existing wiring.
   4. Loop powered.
   5. LED Status.
   6. Acceptable Manufacturer: Veris Industries / Hawkeye
   7. Relays shall close status contacts in response to current flow in power leads to the equipment being monitored.

2.20 DIFFERENTIAL PRESSURE TRANSDUCER

A. Transducers to convert differential pressures to 4-20 MA analog outputs.
   1. Solid state pressure sensor with accuracy of +/- 1% of calibration range.
   2. Factory calibrated and have zero and span trimmers for field calibration.
   3. Range shall be selected to match the medium being monitored.
   4. Pressure snubbers to protect from pressure pulses and a 3-way bypass / valve assembly to protect the transducer from overpressure damage during start-up.
   5. LCD Display
   5. NEMA 1 Enclosure
   6. Acceptable Manufacturer: Rosemount 1151 or 3051 Pressure Transmitter

2.21 ELECTRIC REMOTE BULB THERMOSTAT

A. Two position remote bulb thermostat:
   1. Bimetal controlled.
   2. Sealed mercury switches.
   3. Provide specified control action.
   4. Adjustment can be made by removing unit cover.
   5. Element with capillary length as required for the location.

2.22 ELECTRIC SPACE THERMOSTAT

A. Two position space thermostat.
   1. Single Pole switch actuated by bi-metal sensing element.
   2. Range shall be 60°F to 90°F.
   3. Removable external knob adjustment means.

2.23 HIGH STATIC PRESSURE SWITCH

A. With manual reset switch
   1. Approved manufacturer: Cleveland AFS-460.

2.24 INSERTION FLOW SENSORS

A. Electromagnetic Flow Meter
   1. Retractable hot tap flow sensor
   2. Accuracy: +/- 1% of full scale
   3. Electromagnetic
   4. Custom thread-o-let 400 psi / 250 degree F rated.
   5. Line size from 1-1/4 to 72 inch
   6. Metering range from 0.3 to 15 f/sec.
   7. Remote NEMA 4 wall mounted LCD display
   8. Field Pro Software & Communicator

9. Warranty two years
10. Approved Manufacturer Onicon Flow Meter F3500 or FT3500

2.25 CONTROL DAMPERS

A. Opposed blade dampers.
1. Frames of 13-gauge galvanized sheet metal.
2. Provisions for duct mounting.
3. Damper blades not exceeding 8" in width.
4. Blades of two sheets of 16-gauge galvanized sheet metal.
5. Blades suitable for high velocity performance.
6. Bearings of nylon or oil-impregnated, sinthered bronze.
7. Shafts of 1/2" zinc-plated steel
8. Leakage does not exceed 1/2% based on 2000 fpm and 4" static pressure.
9. Replaceable resilient seals along top, bottom and sides of frame and blade edge.
10. Submit leakage and flow characteristics data with shop drawings.
11. Linkage shall be exposed and out of the air stream.
12. Acceptable Model is Ruskin Model CD60.

2.26 PHOTO-CELL CONTROL

A. Light Sensitive Resistor.
1. 4-20 output or switch.
2. On = 3.0 / fc. Off 10.0 / fc.
3. UL Approved.

2.27 DRAIN PAN FLOAT SWITCH

A. Rated at 10 Amps.
1. Shuts off equipment if water level becomes too high.
2. DPDT Contacts.

2.28 BY-PASS AUTOMATIC SHUT-OFF TIMERS

A. Rated at 10 Amps, 125 VAC
1. Shuts off equipment with timed switch
2. White decorated timer
3. Without hold feature
4. Time Cycle 60 minutes

2.29 CO_2 SENSOR

A. Telaire Model T5100 CO_2/Temperature Sensor or approved equal
1. Local visual indication of CO_2 levels in enclosed spaces.
2. Pre-calibrated with factory default settings of 1000 ppm and 1500 ppm CO_2 levels
3. Bright LED indicator transitions between green, yellow, and red as the CO_2 threshold is exceeded.
a. Accuracy: +/- 30 ppm @ 72°F
b. Output: 0-10 V (100Ω output impedance) and NTC 20k Thermister

2.30 ENERGY EFFCIENCY EDUCATIONAL DASHBOARD

A. Wall mounted, large screen 42” diagonal LCD touch screen monitor.
B. Steel enclosure for durability in high traffic applications.
C. Infrared sensor technology with Infrared grid.

D. High performance and optic definition with HDMI input.
E. Integrated computer module which must fit behind screen and work with wall mount.
    1. Minimum performance characteristics:
        a. 3.7 GHz Intel I5 Processor.
        b. 4.0 GB RAM.
        c. 256 GB Solid State Drive
        d. Windows 10 Pro or Windows 10 Enterprise or latest version of Windows consistent with Touchscreen display.
        e. Ethernet LAN, wireless not acceptable.
        f. Hardware provided must be capable of operating most recent version and future versions of Windows.
F. Touch screen shall be ELO E222369 and computer module shall be ELO E991988.

2.31 HVAC SHUTDOWN STATION

A. Shutdown Switch:
    1. White Mushroom Button within a clear plastic cover
    2. Latches when depressed
    3. Twist reset
    4. Labeled “HVAC SHUTDOWN”
    5. Manufactured by STI Model # SS2371HV-EN (Coordinate color with Owner)

2.32 EXTERIOR LIGHTING OVERIDE STATION

A. Override Button:
    1. Yellow Mushroom Button within a clear plastic cover
    2. Momentary contact configuration
    3. Labeled “EXTERIOR LIGHTING OVERIDE”
    4. Manufactured by STI Model # SS2234ZA-EN (Coordinate color with Owner)

2.33 INTERIOR LIGHTING OVERIDE STATION

A. Override Button:
    1. Yellow Mushroom Button within a clear plastic cover
    2. Momentary contact configuration
    3. Labeled “INTERIOR LIGHTING OVERIDE”
    4. Manufactured by STI Model # SS2234ZA-EN (Coordinate color with Owner)

2.34 AFTER HOURS A/C STATION (ADMINISTRATION AREA ONLY)

A. After Hours A/C Switch:
    1. Blue Mushroom Button within a clear plastic cover
    2. Momentary contact configuration
    3. Labeled “AFTER HOURS A/C”
    4. Manufactured by STI Model # SS2434ZA-EN (Coordinate color with Owner)

PART 3 - EXECUTION

3.1 REPLACEMENT OF EXISTING BMCS SYSTEMS

A. Complete replacement of the existing Building Management and Control Systems shall include the following:
    1. Remove all existing control devices and replace with new.
    2. Remove all existing wiring and replace with new.
    3. Remove and replace all existing damper actuators.
    4. Remove and replace all terminal unit controllers.

5. Remove and replace all existing BMCS control cabinets.
6. Existing control conduits may be reused where not damaged or aged. Existing conduit shall be extended to new end device locations. All existing control conduit being abandoned shall be removed.
7. New control wiring shall not be routed in the same conduit or pathway as any line voltage wiring.
8. The owner shall be given first right of refusal on all existing control devices.
9. Existing motorized dampers associated with all exhaust fans, outside air intakes, and relief vents shall be replaced with new unless otherwise noted in the project documents. It is the intent that all exhaust, relief, and intakes include a motorized damper. If a device is found not to have an existing damper or the damper is not functioning, notify the engineer/owner immediately.
10. Line voltage wiring shall not be installed within controls cabinet. If line voltage is required a relay should be mounted in a separate enclosure or on the exterior of the controls cabinet.

B. The new BMCS system shall maintain control of all equipment and devices currently on the existing BMCS system. Contractor shall field verify all existing equipment and devices prior to bid.

C. It is the responsibility of the contractor to ensure all equipment is under control of a BMCS system prior to the building system being started and building becoming occupied. In instances where this is not possible, it is the responsibility of the contractor to monitor and maintain, within District standards, the operation of the equipment manually until the equipment is under automatic control. The Contractor shall field all hot and cold calls during construction.

D. Verify operation of all existing equipment prior to adding existing equipment to new control system. Notify engineer/owner of inoperable equipment.

E. Contractor is to maintain safety interlocks during all phases of the BMCS installation. This includes providing temporary rough-ins of high static limits to VFD shut downs, freeze stat interlocks to starters/VFDs, etc. The wiring for these rough-ins may be run in a temporary fashion overhead, exposed and unsupported as long as the wiring is not in the path of the normal construction movement in the space. Wires laying on the floor and/or in the path of other workers in not acceptable at any time. These safeties are to be maintained until the AHUs controls are downloaded, commissioned, and operating in automatic mode per sequence of operations.

F. The new system shall be fully integrated with the existing Building Automation System Host server. BMCS shall provide and install any new hardware and provide additional licenses for new system.

3.2 INSTALLATION

A. The control system shall be installed and final adjustments made by full-time employees of the factory-approved BMCS Building Management Control Subcontractor.

B. The contractor shall collaborate through Architect / Engineer and Owner to determine the Owner's preference for naming conventions, etc. before entering the data in to the system.

C. Due to actual operational or space conditions, it may be necessary for the Contractor to make sequence of operation modifications and/or controller adjustments, change the location or type of sensor to obtain proper operation and coverage of the system in each

room or space. These change, if requested by the Owner or Engineer, shall be performed at no additional cost to the Owner. Therefore labor allowances should be made for such changes and adjustments if requested.

D. Points listed within this section are to be connected to the BMCS system as hard-wired points to cards and not connected through BacNet integration. The BacNet interface is for read only points not included within sequences of this specification.

3.3 INTERLOCK AND SAFETY CIRCUITS

A. Close the outdoor air dampers when the related HVAC unit supply or exhaust fan is de-energized:
   1. The damper and actuators are specified in this section.
   2. Outdoor air damper shall be fully opened before related air handling unit fan is energized for 100% outside air use.
   3. Provide motorized outside air dampers for the following:
      a. Supply fans
      b. AHUs
      c. Exhaust fans (except kitchen exhaust)

B. Close the chilled and hot water valves to the coil when the related unit is de-energized.

C. Interlock each chiller to start its dedicated chilled and condenser water pumps.
   1. On shutdown provide a circuit to permit the chilled water pumps and condenser water pumps to run while the chillers pump down as required by the manufacturer.
   2. As per manufacturer's recommendations

D. Primary chilled water control:
   1. Operating and safety controls are furnished as an integral part of the water-chilling unit and not specified in this section.
   2. Provide a high limit temperature sensor in each primary chilled water pump loop.

E. Exhaust/Supply Fans:
   1. Interlock the related exhaust and supply fans and the related outside air damper.
   2. Interlock the exhaust fans with the related air-handling unit through software.
   3. Interlock related exhaust fan for dishwasher with time delay off relay.
   4. Interlock related exhaust fan for kiln with time delay off relay
   5. Interlock kitchen hood related supply and exhaust fans.
   6. Provide additional interlocks as indicated on fan schedule and on drawings.
   7. Interlock electrical and mechanical room exhaust fans with thermostat.
   8. Interlock refrigerant monitor with mechanical room purge system.
   9. Interlock science room related supply and exhaust fans.
   10. Interlock outside air supply fans for VAV air-handling unit with air-handling unit status point.

F. Freeze Protection:
   1. Provide a freeze protection sequence to ensure proper operation of equipment during a freeze condition not limited to the following:
      a. Outside Air Handling Units & Supply Fans with heating and cooling coils: If unit is in occupied or unoccupied mode, upon the triggering of software point indicating a freeze condition or the low temperature sensor (freeze stat) indicates a freeze condition, the system will be disabled, close the outside air damper, open both heating and cooling valves to enable full flow condition. If heating coil discharge air sensor indicates a failure to control and is below setpoint then enable software point indicating a

freeze condition, disable unit, close outside air damper, and open both heating and cooling valves to enable full flow condition. Ensure HW & CHW pumps are operational.

b. Boilers - Enable during a freeze condition.

c. Chillers – Open isolation valves then command by-pass valve to dump water into basin or by-pass tower. Enable condenser water pumps during a freeze condition.

d. Air Cooled Chillers – Open isolation valves, then enable pumps, run cycle for 15 minutes per hour, open all chilled water valves.

e. Protect coils downstream of DX cooling coil with freeze protection. If unit is in occupied or unoccupied mode, upon the triggering of software point indicating a freeze condition or the low temperature sensor (freeze stat) indicates a freeze condition, the system will be disabled, close the outside air damper, disable the DX cooling coil. If coil discharge air sensor indicates a failure to control and is below setpoint then enable software point indicating a freeze condition.

2. Temperature low limit switch wired with double pole single throw switch with one switch leg hard-wired to de-energize fan and one switch leg to signal BMCS.

G. Drain Pan Float Protection:
1. Interlock to shut down unit and close valves.
2. Cooling Coils mounted above ceiling and in roof mounted units.
3. Provide for each cooling coil location.
4. Signal BMCS alarm point

H. Domestic Water System:
1. Interlock in-line circulating pumps at water heaters with return water pipe mounted thermostat to cycle pump with return water temperature.
2. Interlock high temperature entering water solenoid valve with thermostat on discharge side of tempered water mixing valves.
3. BMCS shall provide contactors/relays to allow scheduling of domestic water heaters and circulation pumps.

I. Copper Tube Boiler:
1. Interlock each boiler to start its dedicated primary circulating pump. Interlock flow switch and pump to boiler safety terminal strip.
2. On startup enable boiler and primary pump prior to starting secondary system pump until primary loop temperature reaches 105 degrees as per manufacturer’s recommendations.
3. Disable secondary pump if boiler goes into alarm or fails to produce heating water within 30 minutes.

J. Hydronic Heating Boiler:
1. Interlock each boiler to start its dedicated pump.
2. On startup enable boiler prior to starting primary pump. Boiler should reach operating temperature prior to starting system pump as per manufacturer’s recommendations.
3. Disable system pump if boiler goes into alarm or fails to produce heating water within 30 minutes.
4. Install communication cable between each boiler and master controller specified by boiler manufacturer.

K. HVAC Shutdown Station:
1. Provide an emergency mushroom style push / pull station shutdown switch in the Administration Area or as directed by Owner / Architect.
2. Signal the building automation system to de-energize the HVAC equipment.

3. This is to stop exhaust fans and outside air units immediately.
4. Other air handling units, chillers and equipment shall be shut down in an orderly manner so as to not damage the equipment.
5. Once stopped, the system may only be restarted with a key operated switch located adjacent to the shutdown switch.

L. After Hours A/C Station:
1. Provide an momentary style push switch in the Principal's Office or as directed by Owner / Architect.
2. Signal the building automation system to energize the separate DX after hours unit serving the administration and associated sequence of operation. This sequence shall only be active when central plant operation is disabled

3.4 GRAPHICS

A. Furnish as-built drawings indicating finally corrected "as installed" diagram(s) of the complete Building Management Control System.
1. Modification of existing control systems shall be included.
2. These must be as-built and any changes during the warranty period drawings must be revised and updated.
3. Provide final sequence of operation in written format.

B. Provide a set of the "as installed" diagram(s) of the complete control system laminated in plastic and hung in the main mechanical room or as directed by Owner.

C. Provide a color-coded floor plan of the building showing the location of each system, and the area served by each AHU or related zone. These must be of professional quality. Floor plan is to hang in main mechanical room near central control panel.

D. Provide computer graphics for each system.

E. Provide final graphic room numbers as selected by Owner / Architect.. Obtain a graphic submittal package for review. Construction Drawing room numbers are not to be used unless approved in writing.

F. Provide a global temperature override function in which every thermostat in the building can be lowered or raised a few degrees, adjustable. This function shall reside on central plant cooling page.

G. Values and Overrides in Graphics
1. All analog values, unless the value is always an integer value {for example # of cooling requests}, shall be displayed to the tenths place, with corresponding units (for example: 55.3 ºF, 75.3 %, etc.). Additionally, all values for display and override capability **shall conform to the following standard**: 0.0 % for fully closed or off, and 100.0 % for fully open or at full speed, as well as directly proportional for all values in between (any and all calculations, or conversions to account for direct acting vs. reversing acting, 2.0 volt to 10.0 volt, or any other variations shall be accounted for in the background such that the displayed value follows the above defined standard;
Example #1: a VFD set with a local minimum and maximum of 20.0 Hz and 60.0 Hz, respectively, shall display values of 0.0 % only for off, 33.3 % for 20.0 Hz, 66.7 % for 40.0 Hz, % for 60.0 Hz, etc.; conversely when an operator override is entered for 75.0 % speed, it shall take the VFD speed to 45.0 Hz {75.0 % x 60.0 Hz max};
Example #2: a reverse acting valve in which 10.0 volts is fully closed and 2.0 volts is fully open, shall display 0.0 % for 10.0 volts, 50.0 % for 6.0 volts, 0.0 %

for 2.0 volts or less, etc.; conversely when an operator override is entered for 75.0 % it shall take the output to 4.0 volts {10.0 – 75.0 % x (10.0–2.0)}) .

4. An overridden value, whether done graphically or at the controller level via HOAs, shall display a visible indicator (color change, arrow, hand, etc.) on the impacted point in the corresponding equipment graphic. Furthermore, the indicator shall remain until the value returns to its auto or calculated value Example #1: if a chiller rotation sequence is temporarily overridden, then this override shall be displayed on the chiller graphic as long as it is in effect; Example #2: if a hot water valve is commanded to 60.0 % open, it shall display as currently overridden at that value on the corresponding airside equipment.

H. Timed Overrides

1. Timed overrides (i.e. the ability to override a point until the selected amount of time expires, at which time the point will return to normal programmed operation) will be required on the following (note: it is acceptable if additional points also have timed override capability in the system; however, at a minimum the following must be equipped with this feature):

Chill Water System
- Plant state
- Chiller lead/lag order number

Hot Water System
- System enable

All Air Handler Unit Types
- Occupancy mode / Request to run

General (All Setpoints)
- Space temperature setpoint
- Discharge air temp setpoint, Etc.

All variables must have a value entered. If no value, enter “N/A” or “—” to indicate no value is available or needed.

I. Provide configuration and tuning screens to be used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 sec.

3.5 IDENTIFICATION

A. **Control Panels Labels:** Provide a laminated engraved nameplate on all control panels shown on the "as installed" control diagrams. Coordinate engraving with nomenclature used on the diagrams. Identifying nameplates shall be secured to each main cabinet, and each control panels. Identifying nameplates shall have minimum of ½ inch high, engraved letters.

B. **Controller labels:** Provide a label affixed to the controller on all controllers with the name of the major equipment or system it serves and the Device Identification Number.

C. **Ceiling Labels:** Provide a label affixed to the ceiling grid below all terminal units, exhaust fans, fan coil unit, hot water coil, and duct static pressure sensors and labeled with the unit tag with those used on the "as installed" control diagrams. Label material shall utilize a black background with white typed lettering and 36 font on 3/4" label material. Coordinate labeling with nomenclature used on the diagrams.

D. **Sensor Labels:** Provide each space temperature and humidity sensors with label located on

the inside of sensor cover. The label shall indicate which device sensor is controlling. If multiple sensors control a single device the sensors shall be labeled with an “A” or “B” etc. Label material shall utilize a white background with black typed lettering. Coordinate labeling with nomenclature used on the diagrams. For example, Multizone (AHU-X, Zone X), VAV (AHU-X, CVB-X), HWC (AHU-X, HWC-X). Provide sample to district prior to the start of labeling.

E. **Electrical Labels:** Provide an identification label on each transformer and relay. The label shall indicate which device they serve and their function. Handwritten labels are not acceptable. Label material shall utilize a white background with black typed lettering. Coordinate labeling with nomenclature used on the diagrams.

F. **Wire Labels:** Provide an identification label on each wire used for this system. Labels shall be affixed to both ends of the wire. Handwritten labels or handwriting on wiring is not acceptable.
   a. Wiring labels at VAV boxes shall include all wiring entering and exiting the VAV box control box with a description of where it is coming from and where it is going. This shall include all communication wiring and all field device wiring.
   b. Wiring labels at AHUs and FCUs shall include all wires entering and exiting the field controller with a description of where it is coming from and where it is going. This shall include all communication wiring and all field device wiring.

G. **Lighting Contactor Labels:** Provide an identification labels on each lighting contactor. Labels shall include panel and circuit number serving contactor and the type and location of lights being served by contactor. (i.e. Bus Drop off Canopy). Handwritten labels are not acceptable. Coordinate labeling with nomenclature used on the diagrams.

H. **End Devices Labels:** Provide an identification label on each end device and sensor. Labels shall include the function of the sensor (i.e. Leaving Air Temperature Sensor). Handwritten labels are not acceptable. Coordinate labeling with nomenclature used on the diagrams.

I. All labeling as described above shall be completed prior to point checkout and startup. Label description shall be part of point checkout process.

3.6 WIRING FOR BUILDING MANAGEMENT AND CONTROL SYSTEMS

A. Prior to the start of any work, controls contractor and wiring subcontractor shall schedule a meeting with the owner and engineer to walk the site to discuss wiring system. Contractor shall provide a 7 day advanced notice of the requested meeting date.

B. Furnish and install all wire, conduit, raceways and cable systems required for the complete operation of the Building Management and Control System.

C. All wiring for the Building Management and Control System is specified in this section and includes, but is not limited to:
   1. Wiring of interlock system.
   2. Wiring of control instruments.
   3. Wiring of control panels.
   4. Wiring of related power supplies, i.e. transformers.
   5. Wiring of 120 VAC power circuits for control panels and devices.

D. All materials and methods specified in this section shall comply with the requirements specified in Division 26 of this specification.

E. All power supply requirements shall be connected to the building electrical distribution system in an approved manner. Do not connect control equipment of circuits common

with other building loads or devices.

F. Temperature control wiring shall be jacketed cables installed with or without conduit as specified below or single conductors installed in conduit. Control wiring shall have minimum 300V insulation for low voltage wiring and 600V insulation for line voltage wiring.

G. All line voltage control wiring, all low voltage control wiring which is exposed in the central plant, penthouse, and other similar spaces; all low voltage control wiring which is routed through concealed inaccessible locations shall be installed in conduit.

H. All low voltage control wiring which is routed through concealed accessible locations may be run without conduit provided that the wiring run without conduit is properly supported from the building structure on maximum 5' centers and does not depend upon the ceiling grid or the ceiling support system for support. Wiring run in plenum spaces shall be plenum rated. Support all plenum wiring in accessible locations in bridle rings, J-hooks, D rings. Plenum wiring is not to be supported within building structure or attached to conduit raceways. All low voltage wiring must be installed through supports. Wires shall be supported on 5’ centers and identified at each termination point and at 50’ centers minimum. Install wire parallel or perpendicular to the structural features of the building.

I. Line and low voltage control wiring shall not be installed in the same conduit with control wiring and shall not be installed in the same conduit with power wiring.

J. All wiring associated with building management and control system cover shall be as follows:
1. Sensor jacket color, Green
2. LAN communications, Yellow
3. All THHN wiring shall comply with Division 26 insulation color identification
4. Terminal Equipment Controller communications twisted pair. Wiring shall be a minimum of 22 AWG twisted and stranded unless controller manufacturer dictates otherwise.

3.7 MISCELLANEOUS

A. Freezer/Cooler Temperature Monitoring:
1. Provide an analog temperature sensor located in the freezer compartment and cooler compartment.
2. Alarms shall be sent through the BMCS to owners personnel when either temperature rises above or falls below operator adjustable setpoints.

POINT DESCRIPTION	TYPE	DEVICE
Freezer Alarm	AI	RTD
Cooler Alarm	AI	RTD

B. Exterior Lighting Control:
1. Provide individual astronomical time/photo sensor and scheduled time-based control of each lighting contactor shown on the drawings and identified on the existing contactor schedule.
2. The exterior lights shall be controlled by the BMCS using both time schedules and astronomical sunrise/sunset. The exterior lights shall automatically come on when the sun sets based on the longitude and latitude coordinates of the facility (adjustable +/- 30 minutes). At 11 p.m. (adjustable) the time schedule shall turn

off the exterior lights. At 4:00 a.m. (adjustable) the exterior lights shall automatically turn on based on time schedule. Upon sunrise, which shall be based on longitude / latitude of the facility the exterior lights shall turn off.

3. Between sunrise and sunset, photo-sensor shall override scheduling if ambient light levels fall below set point (adjustable).
4. Provide momentary push button located at the Principals Office and Main Electrical room to energize exterior lighting for a preprogrammed length of time (adjustable).
   a. Provide separate control of each contactor.
5. BMCS shall monitor auxiliary contacts on each contactor to determine unit status.
6. Provide separate control of each contactor. Refer to contactor schedule on the electrical drawings for the service type of each contactor. Deviations from lighting control zones identified on the contactor schedule are not acceptable.

POINT DESCRIPTION	TYPE	DEVICE
Lighting Contactor	DO	Control Relay
Lighting Contactor Status	DI	Lighting Contactor Aux. Contact
Exterior Lighting Override Station	DI	Exterior Lighting Override Station

C. Photocell: Provide a photocell mounted on the north side of the building. Location is to be approved by Owner / Architect / Engineer.

POINT DESCRIPTION	TYPE	DEVICE
Photocell	AI	Contact

D. Interior Lighting Control:

1. Provide time based control of each lighting contactor shown on the drawings and identified on the existing contactor schedule.
4. Provide momentary push button located at the Administration Reception Area, Custodian office and at each security system keypad to energize interior lighting for a preprogrammed length of time (adjustable).
   a. Provide separate control of each contactor.

POINT DESCRIPTION	TYPE	DEVICE
Lighting Contactor	DO	Control Relay
Lighting Contactor Status	DI	Lighting Contactor Aux. Contact
Interior Lighting Override Station	DI	Interior Lighting Override Station

E. Humidity Sensor: Provide a sensor in Library to monitor space conditions.

POINT DESCRIPTION	TYPE	DEVICE
Library Humidity	AI	Space Sensor

F. Outside Air: Provide a temperature sensor and a humidity sensor to monitor outside air conditions.

POINT DESCRIPTION	TYPE	DEVICE
Outside Temperature	AI	Thermistor
Outside Humidity	AI	Humidity Sensor

G. Temperature Sensor: Provide a temperature sensor in each MDF and IDF rooms to monitor space conditions. BMCS shall send alarm when the temperature (adjustable) is out of range.

POINT DESCRIPTION	TYPE	DEVICE
MDF/IDF Temperature	AI	Space Sensor

H. Electrical Demand Response - The BMCS system shall be provided with Electrical Demand Response as follows:

The user shall have 8 levels of adjustment to reduce the electrical demand of the facility. Each level shall be schedulable, respond to a command from the electrical provider, and have a button for instant activation.

The user shall have the following configuration within each configurable level:

- Setpoint Relaxation
- Outside Air Shutdown
- Equipment Shutdown
- Chiller Plant State Limit
- Chiller Shutdown

Setpoint Relaxation will allow the setpoints to shift away from their current setpoint based on the amount specified in the active demand response level. Outside Air Shutdown will deactivate the outside air equipment. Equipment Shutdown will shut down the HVAC equipment. Chiller Plant State Limit will limit the number of available states the chiller plant can use. A plant state of 0 will shut down the chiller plant. Chiller Shutdown will shut down the chillers but allow the pumps to run maintaining differential pressure setpoint.

All equipment shall be configurable to ignore any or all demand response commands. The user shall have the ability to run a report to adjust each of these parameters.

The Demand Response dashboard shall display all levels and their configuration, the electrical demand of the facility, the current level of reduction scheduled, the button to enable each level, and the average reduction each level is able to achieve.

The campus Demand Response shall be added and displayed on the district level demand response dashboard.

3.8 BUILDING ELECTRICAL USAGE

A. Building electric meter, provided by Division 26 shall send an analog signal representative of the building KW usage to the BMCS. Through the BMCS control module, the building meter shall integrate the input and calculate the buildings KWH usage. The BMCS control module shall show the current usage, monthly usage, year-to-date usage, and time and date of the highest peak demand for the month and year. Demand thresholds may be set to adjust set points and shed loads in order to reduce peak consumption. The usage data shall be sent to the server and stored to be used by the Districts M-Power energy tracking system. The building meter shall monitor for surges and record such surges and notify operator of surges.

B. Electrical Quality monitoring:
   1. Monitor Watts, VA, VAR, Demand, Imbalance, and Power Factor.

C. Provide a separate graphics page for all Electrical meters. The link to the graphics page shall be categorized under Misc. Equipment.

D. Transient Voltage Surge Suppression (TVSS) equipment and any line filtering equipment shall be monitored.

3.9 EXHAUST AND SUPPLY FANS

A. Provide interlocks as scheduled on the plans unless shown on the electrical drawings.

B. Provide BMCS override to disable operation of all exhaust and supply fans interlocked and/or specified throughout project.

C. Dampers and actuators shall be provided by this contractor and shall not be furnished with the exhaust fans. Dampers shall be duct mounted.

POINT DESCRIPTION	TYPE	DEVICE
Start/stop	DO	Control Relay
Outside Air Damper	DO	Electronic Operator
Fan Status	DI	Current Sensitive Relay

3.10 DISHWASHER EXHAUST

A. Interlock exhaust fan to operate when dishwasher is operating. Provide 5 minute (adjustable) run time for fan after dishwasher stops.

3.11 ELECTRIC UNIT HEATERS

A. An electric thermostat shall activate the unit and stage the electric coil to maintain room setpoint.

3.12 SINGLE ZONE VARIABLE AIR VOLUME AIR HANDLING UNIT (AHU-9)

A. This unit is furnished with a chilled water cooling coil, a hot water reheat coil, and a variable frequency drive. Control shall be as follows:
   1. A room Thermistor sensing space temperature through the Direct Digital Control Panel shall vary the speed of the fan to maintain room setpoint. The air volume of

the fan can range from 100% to 30% (adjustable) of the air quantity specified or to the outside air percentage whichever value is larger. A chilled water coil leaving air temperature sensor through the Direct Digital Control Panel shall modulate the cooling coil control valve to maintain the leaving air temperature as scheduled. When the fan is at minimum speed of its specified air quantity and the room temperature is below the room setpoint, the room Thermistor shall modulate the valve on the cooling coil and the valve on the hot water coil in sequence to maintain the desired space temperature. A room humidity sensor shall override the operation of the cooling coil control valve to maintain the relative humidity setpoint in the space. The room temperature sensor shall modulate the hot water reheat coil control valve to maintain the space temperature. The dehumidification sequence only applies after the fan has reached the minimum fan speed.

B. Outside air for these units are being provided pretreated from a separate Outside Air Unit via an Outside Air Variable Air Volume Terminal Unit.

C. Provide CO_2 sensor or sensors located in the return air ductwork from the space being served by unit. The position of the CO_2 sensors shall not be such that the OA being supplied to unit impacts the readings and reading are indicative of the actual space CO_2 levels. Refer to OA VAV terminal sequence and points list for additional information.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Air Flow Sensing Switch
Fan Speed	AO	Variable Frequency Drive
Space Temperature	AI	Space Thermistor
Space Humidity	AI	Humidity Sensor
CHW Valve	AO (1)	Electronic Operator
Reheat HW Valve	AO (1)	Electronic Operator
Cooling Coil Leaving Air Temp.	AI	Averaging Sensor
Discharge Air Temperature	AI	Duct Thermistor

3.13 SINGLE ZONE VARIABLE AIR VOLUME AIR HANDLING UNIT (AHU-7, AHU-10)

A. This unit is furnished with a chilled water cooling coil, a hot water reheat coil, DX cooling coil and a variable frequency drive. Control shall be as follows:

1. Normal Operation - A room Thermistor sensing space temperature through the Direct Digital Control Panel shall vary the speed of the fan to maintain room setpoint. The air volume of the fan can range from 100% to 30% (adjustable) of the air quantity specified or to the outside air percentage whichever value is larger. A chilled water coil leaving air temperature sensor through the Direct Digital Control Panel shall modulate the cooling coil control valve to maintain the leaving air temperature as scheduled. When the fan is at minimum speed of its specified air quantity and the room temperature is below the room setpoint, the

room Thermistor shall modulate the valve on the cooling coil and the valve on the hot water coil in sequence to maintain the desired space temperature. A room humidity sensor shall override the operation of the cooling coil control valve to maintain the relative humidity setpoint in the space. The room temperature sensor shall modulate the hot water reheat coil control valve to maintain the space temperature. The dehumidification sequence only applies after the fan has reached the minimum fan speed.

2. After Hours Operation - A room Thermistor sensing space temperature through the Direct Digital Control Panel, energize the first stage of cooling, modulate the valve on the heating water in sequence, to maintain the desired space temperature. The air handling unit shall be started and stopped from the BMCS System. Supply air CFM shall not be varied when unit is operating on DX cooling.

   The DX operation shall be enabled through user schedule or a virtual button in the unit graphics page. The DX system shall not function when chilled water is available.

B. Outside air for these units are being provided pretreated from a separate Outside Air Unit via an Outside Air Variable Air Volume Terminal Unit.

C. Provide CO_2 sensor or sensors located in the return air ductwork from the space being served by unit. The position of the CO_2 sensors shall not be such that the OA being supplied to unit impacts the readings and reading are indicative of the actual space CO_2 levels. Refer to OA VAV terminal sequence and points list for additional information.

D. If the factory A2L refrigerant leak detector is triggered, BMCS shall receive an alarm and enable air handling unit supply fan, command all variable air volume terminal unit primary air dampers associated with air handling unit to open to their full design airflow position and deactivate variable air volume terminal unit heaters. When the A2L refrigerant leak detection system is reset, all systems shall go back to normal operation. Refer to Air Handling Units specifications for additional information on the A2L refrigerant leak detection system and coordinate with equipment manufacturer to ensure all points and sequence of operations are in compliance with manufacturer requirements.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Air Flow Sensing Switch
Fan Speed	AO	Variable Frequency Drive
Space Temperature	AI	Space Thermistor
Space Humidity	AI	Humidity Sensor
CHW Valve	AO (1)	Electronic Operator
Reheat HW Valve	AO (1)	Electronic Operator
Condensing Unit	DO	Control Relay(s)
CHW Cooling Coil Leaving Air Temp.	AI	Averaging Sensor

POINT DESCRIPTION	TYPES	DEVICE
HW Coil Leaving Air Temp.	AI	Averaging Sensor
DX Cooling Coil Leaving Air Temp.	AI	Averaging Sensor
Discharge Air Temperature	AI	Duct Thermistor
Refrigerant Leak Alarm	DI	Factory Refrig. Leak Det. System

3.14 VARIABLE VOLUME AIR HANDLING UNIT WITH PRETREATED OA (AHU-1, AHU-2, AHU-5, AHU-6, AHU-8, AHU-11, AHU-12, AHU-13)

A. Units consist of a chilled water coil, a fan, and a variable speed drive.

B. The unit shall be started and stopped from the BMCS system.

C. Outside air for these units are being provided pretreated from a separate Outside Air Unit via an Outside Air Variable Air Volume Terminal Unit.

D. Discharge air temperature control:
1. An averaging probe in the chilled water coil discharge shall, through the DDC, modulate the valve on the cooling coil to maintain setpoint. Reference drawing schedule for discharge temperature.

E. Variable air volume control:
1. Duct static pressure sensor shall be located in the duct at a position approximately 2/3 the distance from the fan in the longest duct run. Location is to be approved by Engineer and coordinated with Section 23 05 93.
2. The static pressure sensors shall, through the DDC panel, accept the signal from the operating control sensor to:
   a. Transmit a signal to the supply fan motor speed controller.
   b. Modulate the fan speed to maintain the desired static pressure.
   c. Coordinate signal with the fan motor speed controller specified in another section.
3. Install a static pressure high limit safety device to de-energize the system.
   a. Manual reset.

E. Provide CO_2 sensor or sensors located in the return air ductwork from the space being served by unit. The position of the CO_2 sensors shall not be such that the OA being supplied to unit impacts the readings and reading are indicative of the actual space CO_2 levels. Refer to OA VAV terminal sequence and points list for additional information.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Current Switch
Variable Speed Motor	AO	Motor Controller
CHW Valve	AO	Electronic Operator
CHW Coil Leaving Air Temp.	AI	Averaging Probe

POINT DESCRIPTION	TYPES	DEVICE
Static Pressure	AI	Static Pressure Sensor
Static Pressure High Limit	DI	Static Pressure Switch
Return Air Humidity	AI	Duct Humidity Sensor
Discharge Air Temperature	AI	Duct Thermistor

3.15 VARIABLE VOLUME AIR HANDLING UNIT WITH PRETREATED OA (AHU-3, AHU-4)

A. Units consist of a chilled water coil, DX cooling coil, a fan, and a variable speed drive.

B. The unit shall be started and stopped from the BMCS system.

C. Outside air for these units are being provided pretreated from a separate Outside Air Unit via an Outside Air Variable Air Volume Terminal Unit.

D. Discharge air temperature control:
   1. An averaging probe in the chilled water coil discharge shall, through the DDC, modulate the valve on the cooling coil to maintain setpoint. Reference drawing schedule for discharge temperature.

E. Variable air volume control:
   1. Duct static pressure sensor shall be located in the duct at a position approximately 2/3 the distance from the fan in the longest duct run. Location is to be approved by Engineer and coordinated with Section 23 05 93.
   2. The static pressure sensors shall, through the DDC panel, accept the signal from the operating control sensor to:
      a. Transmit a signal to the supply fan motor speed controller.
      b. Modulate the fan speed to maintain the desired static pressure.
      c. Coordinate signal with the fan motor speed controller specified in another section.
   3. Install a static pressure high limit safety device to de-energize the system.
      a. Manual reset.
   4. During DX cooling operation the BMCS shall limit the reduction of airflow over the DX cooling coil to ensure operation is with an acceptable airflow range per AHU manufacturer. BMCS contractor shall coordinate with AHU manufacturer.

F. AHU-3 - The DX operation shall be enabled through After Hours AC momentary contact button, user schedule or a virtual button in the unit graphics page. The DX system shall not function when chilled water is available.
AHU-4 - The DX operation shall be enabled through user schedule or a virtual button in the unit graphics page. The DX system shall not function when chilled water is available.

G. If the factory A2L refrigerant leak detector is triggered, BMCS shall receive an alarm and enable air handling unit supply fan, command all variable air volume terminal unit primary air dampers associated with air handling unit to open to their full design airflow position and deactivate variable air volume terminal unit heaters. When the A2L refrigerant leak detection system is reset, all systems shall go back to normal operation. Refer to Air Handling Units specifications for additional information on the A2L refrigerant leak detection system and coordinate with equipment manufacturer to ensure all points and sequence of operations are in compliance with manufacturer requirements.

H. Provide CO_2 sensor or sensors located in the return air ductwork from the space being served by unit. The position of the CO_2 sensors shall not be such that the OA being supplied to unit impacts the readings and reading are indicative of the actual space CO_2 levels. Refer to OA VAV terminal sequence and points list for additional information.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Current Switch
Variable Speed Motor	AO	Motor Controller
CHW Valve	AO	Electronic Operator
CHW Coil Leaving Air Temp.	AI	Averaging Probe
Condensing Unit	DO	Control Relay(s)
Static Pressure	AI	Static Pressure Sensor
Static Pressure High Limit	DI	Static Pressure Switch
Return Air Humidity	AI	Duct Humidity Sensor
Discharge Air Temperature	AI	Duct Thermistor
Refrigerant Leak Alarm	DI	Factory Refrig. Leak Det. System

3.16 VARIABLE VOLUME AIR HANDLING UNITS WITH OA SUPPLY FAN (AHU-A)

A. Units consist of a chilled water coil, a fan, a variable speed drive, and outside air fan.

B. The unit shall be started and stopped from the BMCS system.

C. Discharge air temperature control:
   1. A sensor far enough from the fan discharge to be truly representative of the average temperature shall modulate the valve on the cooling coil to maintain setpoint. Reference drawing schedule for discharge temperature.

D. Variable air volume control:
   1. Duct static pressure sensor shall be located in the duct at a position approximately 2/3 the distance from the fan in the longest duct run. Location is to be approved by Engineer and coordinated with Section 23 05 93.
   2. The static pressure sensors shall, through the DDC panel, accept the signal from the operating control sensor to:
      a. Transmit a signal to the supply fan motor speed controller.
      b. Modulate the fan speed to maintain the desired static pressure.
      c. Coordinate signal with the fan motor speed controller specified in another section.
   3. Install a static pressure high limit safety device to de-energize the system.
      a. Manual reset.

E. Outside air Fan control:

1. Each unit will be provided with an outside air supply fan. The supply fan will be activated with the air-handling unit. Open O.A. Damper before starting unit.
2. Provide a temperature low limit switch located on the discharge side of the cooling coil to de-energize the air handling unit, close the outside air damper, open the chilled water valve 100%, start the secondary chilled water pump, signal an alarm to the BMCS when the temperature drops below 37°F. Device shall be manual reset.
3. During warm-up and cool-down periods (optimum start/stop), the outside air fans shall not be activated. During occupied times, the fans shall be activated.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Current Switch
Variable Speed Supply Fan	AO	Motor Controller
CHW Valve	AO	Electronic Operator
Condensing Unit	DO	Control Relay(s)
Cooling Coil Leaving Air Temp.	AI	Averaging Probe
Outside Air Fan	DO	Control Relay
Variable Speed OA Supply Fan	AO	Motor Controller
Duct Static Pressure	AI	Static Pressure Sensor
Return Air Humidity	AI	Duct Humidity Sensor
Freeze Status	DI	Temperature Low Limit Switch
Static Pressure High Limit	DI	Static Pressure Switch
Outside Air Damper	DO	Electronic Operator

3.17 PARALLEL FAN POWERED TERMINAL UNITS

A. Each unit shall consist of a pressure independent variable volume damper, an fan, and a hot water heating coil. Parallel terminal variable volume damper shall open to minimum set point prior AHU fan starts. Controls shall be as follows:

1. A space temperature sensor shall, through the direct digital control system, modulate the variable volume damper from full open to a minimum airflow rate to maintain room setpoint. If heating is required, the variable volume damper shall be modulated to minimum position, the fan shall be energized and the temperature sensor shall modulate the hot water control valve to maintain room setpoint with the variable volume damper in the minimum airflow position.
2. Control valve, and control valve operator are specified in this section.
3. The Controls Contractor shall furnish the terminal box manufacturer with a controller to be factory mounted. The controller shall display cfm, temperature, damper position, and hot water valve position.

POINT DESCRIPTION	TYPES	DEVICE
Space Temperature	AI	Space Thermistor
Primary Air	AO	Variable Volume Damper Operator
HW Valve	AO	Electronic Operator
Start/Stop	DO	Control Relay
Discharge Air Temperature	AI	Duct Thermistor

3.18 CONSTANT VOLUME (SERIES) TERMINAL UNITS (ASSOCIATED WITH AHU-A ONLY)

A. Each unit shall consist of a pressure independent variable volume damper, a constant volume fan, and a hot water heating coil. The fans shall be interlocked with the AHU fan. Constant volume terminal shall start before AHU fan starts. Controls shall be as follows:
   1. A space temperature sensor shall, through the direct digital control system, modulate the variable volume damper from full open to a minimum airflow rate to maintain room setpoint. If heating is required, the temperature sensor shall modulate the hot water control valve to maintain room setpoint with the variable volume damper in the minimum airflow position.
   2. Control valve, and control valve operator are specified in this section.
   3. The Controls Contractor shall furnish the terminal box manufacturer with a controller to be factory mounted. The controller shall display cfm, temperature, damper position, and hot water valve position.

POINT DESCRIPTION	TYPES	DEVICE
Space Temperature	AI	Space Thermistor
Primary Air	AO	Variable Volume Damper Operator
HW Valve	AO	Electronic Operator
Start/Stop	DO	Control Relay
Discharge Air Temperature	AI	Duct Thermistor

3.19 VARIABLE VOLUME OUTSIDE AIR HANDLING UNIT (AHU-14)

A. These units consist of a hot water preheat coil, chilled water cooling coil and a variable frequency drive on the supply air fan. Control shall be as follows:
   1. A temperature sensor located in the discharge of the hot water preheat coil shall, through the Direct Digital Control Panel, modulate the hot water control valve to maintain a discharge air temperature (adjustable) as indicated on the air handling unit schedule.
   2. Provide a temperature low limit switch located on the discharge side of the hot water preheat coil to de-energize the air-handling unit when the temperature drops below 37°F. Device shall be manual reset and signal an alarm to the BMCS. Provide freeze protection sequence.
   3. A temperature sensor located in the discharge of the air handling unit shall,

through the Direct Digital Control Panel, modulate the chilled water control valve to maintain a discharge air temperature (adjustable) as indicated on the air handling unit schedule.

4. Open O.A. Damper before starting unit. Provide end switch to ensure damper is in the open position in either the manual (hand) or auto position of the motor starter.

B. Variable air volume control:

1. Duct static pressure sensor shall be located in the duct at a position approximately 2/3 the distance from the fan in the longest duct run. Location is to be approved by Engineer and coordinated with Section 23 05 93.
2. The static pressure sensors shall, through the DDC panel, accept the signal from the operating control sensor to:
   a. Transmit a signal to the supply fan motor speed controller.
   b. Modulate the fan speed to maintain the desired static pressure.
   c. Coordinate signal with the fan motor speed controller specified in another section.
3. Install a static pressure high limit safety device to de-energize the system.
   a. Manual reset.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Current Switch
Variable Speed Motor	AO	Motor Controller
CHW Valve	AO	Electronic Operator
HW Pre Heat Valve	AO	Electronic Operator
CHW Coil Leaving Air Temp.	AI	Averaging Probe
HW PH Coil Leaving Air Temp.	AI	Averaging Probe
Static Pressure	AI	Static Pressure Sensor
Freeze Status	DI	Temperature Low Limit Switch
Outside Air Damper	DO	Electronic Operator
Discharge Air Temperature	AI	Duct Thermistor
Static Pressure High Limit	DI	Static Pressure Switch

3.20 OUTSIDE AIR VARIABLE VOLUME TERMINAL UNITS

A. Each unit shall consist of a pressure independent variable volume damper. The terminal unit's damper shall be interlocked with the associated AHU fan.

1. The Controls Contractor shall furnish the terminal box manufacturer with a controller to be factory mounted. The controller shall display cfm, temperature, and damper position.
2. A space or return air CO2 sensor associated with the AHU being served by the

OAVAV terminal unit shall provide input to the central BMCS controller. The BMCS shall monitor CO2 levels of the zones served by the associated air handling unit and modulate the pretreated outside air damper to maintain set point 600 PPM (adjustable). This feature shall be user selectable on the AHU graphic page.

3. Terminal units serving Variable Volume Air Handling Units shall not be provided with CO2 control. These unit shall modulate to maintain the scheduled OA CFM during all occupied times.

POINT DESCRIPTION	TYPES	DEVICE
Primary Air	AO	Variable Volume Damper Operator
Discharge Air Temperature	AI	Duct Thermistor
CO2 Concentration	AI	Space or Return Air CO2 Sensor

3.21 CHILLED WATER SYSTEM CONTROL (MAIN CENTRAL PLANT)

A. The system consists of three two air-cooled chillers and two dedicated primary chilled water pumps.

B. Temperature sensors located in the building common chilled water supply and return piping and the turbine flow meter located in the building chilled water common supply piping shall, acting through the DDC system, be used to calculate the building BTUH requirements.

C. During start-up, one primary pump shall start. After flow has been indicated from the flow switch for an adjustable time period, the chiller shall be activated.

D. When the load calculated from the temperature sensors and flow meter exceeds the capacity of one chiller for an adjustable time period, the second primary pump and chiller shall be activated.

E. If the load drops to below half the capacity (adjustable) of one chiller, then the lag chiller will be deactivated. The primary pump serving the chiller will remain on for 3 minutes (adjustable) and then be deactivated.

F. A temperature sensor located in the chiller by-pass piping shall send an alarm to the host computer and shall start the lag chiller after an adjustable time delay, if the temperature in the by-pass is above 3 degrees (adjustable) higher than the temperature in the common supply from the chillers. This indicates the flow is moving from the primary loop to the secondary loop.

G. Provide time delays between pump starts and stops to allow system to stabilize.

H. Change lead/lag rotation on a weekly basis.

I. Provide the Minimum BACnet interface points for remote operations including resetting from central Maintenance (alarms/setpoints) as follows:
   1. Chiller alarms – Low evaporator temp., low evaporator/condenser water flow, loss of power.
   2. Chiller temperature discharge setpoint
   3. Chiller evaporator and condenser pressures
   4. Chiller oil pressure

5. Discharge superheat
6. Condenser and evaporator approach temperatures
7. Condenser and evaporator flows (GPM)
8. Phase readings (volts/amps) for each phase

J. The district participates in a load shedding program during electrical brownouts. There shall be a program in which all the District's chillers' discharge setpoints can be raised immediately. Refer to Demand Response portion of this specification for additional information.

POINT DESCRIPTION	TYPES	DEVICE
Chiller Start/Stop	DO	Control Relay
Chiller % RLA (Each chiller)	AI	Chiller Control Module
Chiller Alarm	DI	Safety Alarm Contact
Chiller Water Supply Temperature	AI	Pipe RTD (Each)
Pump Start/Stop	DO	Control Relay
Pump Status	DI	Current Sensitive Relay
Pump Speed Controller	AO	Motor Controller
Building Flow	AI	Turbine Flow Meter
Building Supply Water Temp.	AI	Temperature Sensors
Building Return Water Temp.	AI	Temperature Sensors
Decoupler Temperature	AI	Temperature Sensor

3.22 SECONDARY CHILLED WATER PUMPING SYSTEM CONTROL

A. The system consists of two variable speed secondary chilled water pumps controlled as follows:
1. The chilled water pumping system will be energized whenever there is a call for cooling in the building system.
2. A system differential pressure sensor shall sequence the pumps and signal the chilled water pump speed controllers.
   a. Stage the pumps to maintain desired system differential pressure.
   b. Modulate the pump speed controllers to maintain desired system differential pressure.
   c. Coordinate with the pump motor speed controller specified in another section.
3. Alternate the lead pump on a daily basis.
4. Location and quantity of sensors to be approved by Engineer.

POINT DESCRIPTION	TYPES	DEVICE
Pump Start/Stop	DO	Control Relay

POINT DESCRIPTION	TYPES	DEVICE
Pump Status	DI	Current Sensitive Relay
System Differential Pressure	AI	Pressure Sensor
Pump Speed Controller	AO	Motor Controller

3.23 HYDRONIC HOT WATER HEATING SYSTEM

A. This system consists of two condensing hot water boilers with constant flow primary boiler pumps and two variable flow hot water secondary pumps. Control of the hydronic hot water heating system is as follows:

1. Energize the hydronic hot water heating system whenever there is a call for heating in the building.
   a. Monitor all control valves to determine if a heating requirement exists.
2. Energize the hybrid sequence controller specified elsewhere.
   a. The hybrid sequence controller shall control all functions and sequencing of the hot water heating boilers.
   b. Connect all boilers to the master boiler controller specified elsewhere with communication cable as required.
3. Hydronic hot water heating system supply temperature reset.
   a. A temperature sensor sensing outdoor temperature shall provide an input to the hybrid sequence controller to reset the hot water supply temperature.
      1) Maintain 180°F supply water temperature whenever the ambient temperature is 20°F and below.
      2) Maintain 120°F supply water temperature whenever the ambient temperature is 60°F and above.
      3) All reset temperatures shall be adjustable through the BMCS.
4. Secondary hot water pump control:
   a. A system differential pressure sensor shall modulate the hot water pump variable frequency drives and stage pumps to maintain system differential pressure.
   b. This system shall be completely adjustable in the field.

POINT DESCRIPTION	TYPES	DEVICE
Sequence Controller	DO	Control Relay
Boiler Alarm Status	DI	Safety Relay (Each Boiler)
Secondary Hot Water Pump Start/Stop/Modulation	AO	Variable Frequency Drive (Each Pump)
Pump Status	DI	Current Switch
Building Hot Water Supply Temp.	AI	Pipe RTD
Building Hot Water Return Temp.	AI	Pipe RTD
Boiler Discharge Water Temp.	AI	Pipe RTD (Each Boiler)
Ambient Temperature	AI	Thermistor

POINT DESCRIPTION	TYPES	DEVICE
Boiler Supply Water Reset	AO	Hybrid Sequence Controller
Inlet Temperature (Read Only		Bacnet Card (Each Boiler)
Outlet Temperature (Read Only)		Bacnet Card (Each Boiler)
Header Temperature (Read Only)		Bacnet Card (Each Boiler
Boiler State (Read Only)		Bacnet Card (Each Boiler)
Error Code (Read Only)		Bacnet Card (Each Boiler)

3.24 ENERGY EFFCIENCY EDUCATIONAL DASHBOARD

A. The “Energy Efficiency Educational Dashboard” is a data monitoring and display system. The system shall include necessary hardware, software and programming that will allow the building owner to share energy efficiency information and green building features/strategies with the occupants of the building. The dashboard is meant to educate individuals on the benefits of sustainable technologies and to create a spirit of cooperation for participation in the end.

B. All displays, and graphics shall be reviewed and approved by the owner and architect prior to installation. Initial setup of the system shall be performed by BMCS contractor and include the following.
   1. Basic graphic installation.
   2. Initial setup of energy graphs.
   3. Green features associated with building to be installed.

C. The system works by feeding “real-time” utility data, such as power, gas and water consumption collected through the Building Management and Control System.

D. This system consists of one 42” diagonal, touch screen monitors mounted where shown of the drawings and a dashboard server as specified. The system will gather and display “real time” information from various sub-systems within the facility and other HTTP sources from the World Wide Webb.
   1. There shall be no annual contract renewal or recurring cost to the school district for maintaining the system.
   2. Graphics modification shall be included in the base bid and shall include 1 year of unlimited graphic modifications to support district.

E. The information will be indexed by touching icons depicting the information to be displayed on the monitor. The “real time” information shall include but not limited to the following:
   1. The Eco-Screen is an interactive tool to help educate the public on the green features and energy efficiency of a facility. It uses the information gathered by the building automation system to display the energy consumption and conditions of the facility. Its dynamic graphics provide an exciting and powerful way to showcase the “hidden” systems within a facility. It also helps to inform the public about green buildings and sustainability.
   2. The system shall feature easy to recognize icons that help user navigate through each category with ease. Other features shall include tabs that show Usage, Comparisons, Ways to Save, Learn More, How it Works, weather and facility information:
      a. The “Usage” tab shows the historical consumption of that type of energy as well as the current demand. The date range for this information can

be easily selected by clicking the calendar icons. The Chart can be displayed as a line graph or bar chart.

b. The “Compare” tab is used to show how many or much of a common item it would take to equal the historical usage.

c. The “Ways to Save” tab shows the different things the user can do to save that type of energy.

d. The “Learn More” tab goes further by pointing out additional interesting facts about that type of energy.

e. The “How it Works” feature shows the details of the mechanical systems, cooling system and Photo-Voltaic Solar Cells. These animated graphics help the user to learn how these systems work by dividing the systems into easy to understand parts and explaining the functionality and purpose.

f. The “Weather” icon shows current weather conditions and a two-day forecast. On sites with their own weather station, detailed information from the system is displayed.

g. The “School Information” icon is a feature that is used to highlight the local district and campus news and information. This can be displayed in a static bill board type screen or linked to the local campus web site.

3. Educational display shall have the ability for school and district personnel to upload their own content and display alongside Energy Display data and information.

3.25 START-UP AND POINT VERIFICATION

A. Final startup and point verification shall include the following information.

1. Field panel checkout:
   a. Verify enclosure is not mounted on vibrating surface.
   b. Verify class I and class II wiring is separated within enclosure.
   c. Check for shorts/grounds/induced voltages/proper voltages.
   d. Verify proper point terminations in accordance with as-builts.
   e. Verify that all modules are in proper place and addressed.
   f. Verify proper power voltage.
   g. Load database and programming.
   h. Startup the panel.
   i. Point and device checkout.
2. Analog input point checkout:
   a. Verify the correct wiring terminations per the design documentation package, at the field panel. Verify that all wiring and terminations are neat and dressed.
   b. Verify the point address by checking that the analog input instrument is wired to the correct piece of field equipment. Do this by altering the environment at the sensing element or by disconnecting one of the wires at the sensor, and verifying that the reading at the field panel has reacted to this change.
   c. Verify the point database to be correct, (i.e., alarmability, alarm limits, slope/intercept, engineering units, etc.). Verify that the correct change of value (COV) limit has been defined.
   d. Verify the sensor has the correct range and input signal. (i.e., 20-120°F, 4 - 20 ma). Verify that the device is mounted in the correct location and is wired and installed correctly per the design documentation package.
   e. Set-up and/or calibrate any associated equipment (i.e., panel LCD meters, loop isolators, etc.). Verify that these auxiliary devices are mounted in the correct location and are wired and installed correctly per the design documentation package.
   f. Verify the correct reading at the field panel using appropriate MMI

devices. Verify that any associated LCD panel meters indicate the correct measured value.

3. Digital input point checkout:
   a. Verify the device is correctly wired and terminated as shown in the design documentation package. Verify that all wiring and terminations are neat and properly secured.
   b. Verify the point address by verifying that the digital input is correctly terminated at the controlled piece of equipment.
   c. Verify the point database is correct (i.e., point name, address, alarmability, etc.).
   d. Set-up and/or calibrate the associated equipment, i.e. smoke detector, high/low temp detector, high/low static switch, end switch, current relay, pressure switch, etc. is mounted in the correct location, and is wired and installed correctly per the control system installation drawings.
   e. With the controlled equipment running or energized as described in the digital output checkout procedures, verify the correct operation of the digital input point and associated equipment by putting the digital input monitored equipment into its two states. Verify that the proof or status point indicates the correct value at the operator's terminal and that the status led is giving the proper indication in each mode of operation (on/off).
4. Digital output point checkout:
   a. Verify that device is correctly wired and terminated as shown in the design documentation package.
   b. Verify that the correct voltage is utilized in the circuit.
   c. Verify the point database to be correct (i.e. point name, address, etc.).
   d. Check and verify that the end device responds appropriately to the digital output(s).
   e. After verifying the set-up and operation of any associated digital input/proof points, check and verify correct operation of the logical point and associated equipment by commanding the point to all possible states (i.e. off, on, fast, slow, auto, etc.). Verify that the defined proof delay is adequate for all modes of operation.
   f. If any interlocked equipment exists that has independent hand-off-auto or auxiliary control wiring, verify correct operation of same. Also check that any interlocked equipment such as EP switches for damper operation or exhaust and return fans are wired correctly and operate correctly.
   g. Verify that the controlled piece or pieces of equipment cannot be caused to change state via the digital output if an associated hand-off-auto switch is in the hand/on or hand/off mode of operation, unless specified as a fireman's override point etc.
5. Analog output point checkout:
   a. Verify the correct wiring or piping terminations per the design documentation package, at the field panel. Verify that all wiring and piping terminations are neat and dressed.
   b. Insure that the correct output device(s) are installed per the Control System Installation Drawings. (i.e., I/P or P/I transducers, transformers, power supply, etc.). Verify that these devices are installed, wired and piped correctly. Verify that any configuration jumpers are in the proper settings for the required application. Verify related transformers are fused in accordance with installation drawings.
   c. Verify the point database to be correct. Verify that the correct COV limit has been defined.
   d. Verify the point address by checking that the analog output is wired

and/or piped to the correct output transducer and/or equipment.

e. Verify that the controlled device is calibrated (i.e., 3-8PSI valve, 8-13 PSI damper motor, 4-20 ma variable frequency drive, etc.) and is in the correct location, and is wired or piped and installed correctly per the design documentation package. If the controlled device is not calibrated, then a three-point (high, low and mid-point) calibration procedure must take place. Verify proper operation of the end device. When calibration has been verified, ensure that installation drawings, point database, and PPCL have been updated.

f. Set-up and or calibrate any associated equipment, (i.e., panel LCD meters, loop isolators, pneumatic gauges, etc.). Also verify that these auxiliary devices are mounted in the correct location, and are wired or piped and installed correctly per the design documentation package.

g. After verifying the set-up and operation of any associated equipment check for the correct operation of the logical point and associated equipment by commanding the analog output to the top and bottom of its range. Verify that the control device(s) responded appropriately as indicated by the design documentation package. Check to insure that all network terminals, host console devices, etc. can also command these outputs.

h. Check that all pneumatic gauges, pilot positioners and LCD panel meters indicate the correct values.

6. Terminal equipment controller checkout:
   a. Load program database
   b. Enable programs
   c. Verify sequence of operations
7. Programming checkout:
   a. Provide checkout for each system and sequence of operation.
   b. The following are sample sequence of operations tests. The intent of these procedures is to provide a plan of action to verify system operations via block checks of the project specific sequence of operations. The procedures may be used in this format, or one procedure to a page should more detail be required. The procedures outlined below should be verified for accuracy, and may be modified to meet your specific requirements.
   c. Description of Test: AHU Alarm Checkout. Verify AHU-1 discharge air temperature alarming is operational and is received at the designated terminal.
   d. Input to Trigger Test: Change discharge temperature high alarm limit through software to a value below the current discharge temperature (discharge temperature - 10°F).
   e. Expected Outcome: A high temperature alarm will be received per the Alarm Definition Report at its designated terminal.
   f. Provide signoff sheet with indication for test Pass, Fail, Date of test and Initials for signoff.
8. Workstation checkout:
   a. Verify the operation of all trunk interface equipment.
   b. Verify all workstation software, including options, based upon the installation instructions for the PC.
   c. Perform software backup (site, options, etc.)
   d. Complete workstation configuration report for owner signoff.
   e. Provide verification that all graphics have been created, as required by project bid documents.

3.26 TESTING AND ACCEPTANCE

A. General:
1. After completion of installation and start-up procedures, commence the specified 3-phase verification and testing sequence leading to final acceptance.
   a. Follow in the order specified.
   b. Each testing phase shall be satisfactorily completed before entering the next phase.
2. Prior to entering each phase of the sequence, submit for approval, a written agenda describing in detail the procedure to be followed to meet the requirements for each specified verification, test or demonstration.
3. Submit for approval, a sample of the form on which the test will be reported.
   a. Identify project.
   b. Provide a list of all points, arrange in numerical order of point addresses.
      1) Show point descriptor and location of each.
      2) Indicate DDC panel that processes each point.
      3) Use the list as a basis for the specified report form.
   c. Signatures of participants and observers.
   d. Results.
   e. Description of adjustment or corrections of points in error.
   f. Date.
4. Provide schedule of tests. Estimate dates of significant events.
5. Test, calibrate and adjust each point in the system as specified.
6. Provide documentation of all tests and verifications as specified.
7. Provide trend reports indicating proper control of all points for an extended period of time.

B. Phase 1 - Testing, Calibrating, and Adjusting:
1. Operate each analog point in the entire system.
   a. At a point in the upper quarter of its range.
   b. At a point in the lower quarter of its range.
   c. At its operating point.
2. Provide personnel and diagnostic instruments at both the central and remote locations.
3. Provide testing stimulants for alarms.
4. Use digital meters of double the accuracy of the instruments being calibrated.
5. Provide an approved test device for simulating high and low temperatures.
6. When the function is performed, read values at the central control and observe the actual function at the field instrument.
7. Exercise each binary point and observe indication at console and simultaneously observe operation in the field.
8. Submit an operation report for each point in the system, in approved format, and describe any corrective or adjusting action taken.
9. Test all power transducers with a Dranetz Power Analyzer.

C. Phase 2 - Equipment and Point Verification:
1. Verify calibration or function of each point.
   a. Verify analog points at operating value.
   b. Record on specified form.
   c. Make approved adjustments to out of tolerance points.
      1) Identify these points for ready reference.
2. After verification procedure in completed:
   a. Verify corrected points.
   b. Record on specified form.
   c. Points requiring correction.
      1) Replace sensor or actuator if electrical measurements indicated

components are out of specified tolerance.

D. Phase 3 - Software Verification:
   1. Submit agenda and report format for software demonstrations.
   2. Demonstrate to the Owner and the Engineer that all software programs and automatic control sequences function as specified.
   3. Demonstrate compliance with response time specifications.
      a. Simulate normal heavy load conditions.
      b. Initiate at least ten successive occurrences on normal heavy load conditions as specified, and measure response time of typical alarms and status changes.
   04. Provide written documentation of demonstration, signed by representatives of the Contractor and Engineer.

E. Provide the following reports to Engineer at final completion of all Testing:
   1. List of all points.
   2. List of all points currently in alarm.
   3. List of all disabled points.
   4. List of all points in over-ride status.
   5. List of all points currently locked out.
   6. List of user accounts and access levels.
   7. List all weekly schedules.
   8. List of holiday programming schedules.
   9. List of limits and deadbands.
   10. System diagnostics reports including, list of DDC panels on line and communicating, status of all DDC terminal units device points.
   11. List of programs.
   12. Provide trend data reports to ensure proper operation and sequence control of BMCS.

F. Substantial Completion of the BMCS will not occur until completion and acceptance of all testing and acceptance procedures.

3.27 TRAINING

A. The contractor shall provide training to owner personnel in a laboratory classroom environment. Each student shall be provided with a dedicated computer workstation utilizing a simulated BAS software platform that is installed for this project. The instructor shall have CEU accreditation for all training courses offered. Provide documentation for this requirement in the initial BAS submittal. If contractor does not have CEU instructor or offer these courses locally include cost for tuition, travel and boarding to send students to manufacturer training facility. The owner shall not incur any additional cost for training classes as listed below for the first 3 years. The following training courses shall be conducted for 4 individuals on 4 separate occasions each year for a 3-year period (12 classes total) following substantial completion:
   1. Operator Overview – Consists of general system navigation, scheduling functions, setpoint modifications and parameter adjustments.
   2. Advanced Topics Overview – Detailed analysis of trend setup/configuration, trend historian, alarm setup, alarm actions (email, printing, etc.), point renaming, and detailed analysis of equipment parameters.
   3. Program/Logic Manipulation – Modify system programs as needed for additions and modifications.
   4. Graphic Manipulation – Modify system graphics as needed for additions and modifications.
   5. Hardware Troubleshooting – Classroom setup shall have HVAC mock-up systems. Operators shall be able to interact with this live system through the BAS

utilized for this project. Class will provide students the ability to identify and repair common problems regularly encountered.

6. Software Troubleshooting - Classroom setup shall have HVAC mock- up systems. Operators shall be able to interact with this live system through the BAS utilized for this project. Class will provide students the ability to identify and repair common issues that can be utilized via software modifications.
7. Central Plant Operation – At a minimum the instructor shall thoroughly explain different types of central plant equipment and proper system modifications that can be made to enhance system performance and energy savings.
8. HVAC System Training – Objective of this class is to provide basic HVAC system knowledge of various types of systems including types of air side distribution and water side distribution. Topics such as thermodynamics, psychometrics, de-humidification, and demand control ventilation shall be thoroughly explained.

B. Since the Owner may require personnel to have more comprehensive understanding of the hardware and software, additional training must be available from the Contractor.

3.28 PROJECT MANAGEMENT

A. Provide a designated project manager who will be responsible for the following:
1. Construct and maintain project schedule.
2. Authorized to accept and execute orders or instructions from General Contractor, Owner / Architect & Engineer.
3. Attend project meetings as necessary to avoid conflict and delays.
4. Make necessary field decisions relating to this section.
5. Coordination / Single point contact.
6. Have Internet access for project management.

3.29 CLEANING

A. Each day clean up debris resulting from work. Remove packaging material as soon as its contents have been removed. Collect waste and place in designated location.

B. On completion of work in each area, clean work debris and equipment. Keep areas free from dust, dirt, and debris.

C. On completion of work, check equipment furnished under this section for paint damage. Repair damaged factory-finished paint to match adjacent areas. Replace deformed cabinets and enclosures with new material and repaint to match adjacent areas.

END OF SECTION

ELECTRICAL KEYED NOTES

KEYED NOTE	Description
1	DETACH THE SHOWN CLASSROOM WALL RECEPTACLES FROM EXISTING CONSTRUCTION. IN A MANNER TO PREVENT DAMAGE, AND PREPARE FOR REUSE. PROVIDE NEW FACEPLATE AND REINSTALL RECEPTACLES IN SAME LOCATION. MAINTAIN CONTINUITY OF CIRCUITS. REFER TO ARCHITECTURAL DRAWINGS FOR SCOPE IN THIS ROOM.

N

1 **ELECTRICAL COMPOSITE PLAN - LEVEL 1**
Scale: 1/16" = 1'-0"

Salas O'Brien
salasobrien.com 281-664-1900
Houston
10930 W. Sam Houston Pkwy North, Suite 900
Houston, TX 77064
Registration: F-4111
Project Number: 2550-00346-00

PROFESSIONAL SEAL

08/26/25

ISSUE DATE	DESCRIPTION
2025-08-11	ISSUE FOR BID

Galena Park ISD — EXCELLENCE IN ALL FOR ALL STUDENTS

2550-00346-00
Galena Park Independent School District

Havard Elementary School HVAC Modifications - GPISD Project #B105

15150 Wallisville Rd, Houston, TX 77049

REVISIONS

Δ	DESCRIPTION	DATE
1	ADDENDUM #5	08/26/2025

CHECKED BY	DRAWN BY
JZ	AW

SHEET NAME

ELECTRICAL COMPOSITE PLAN

SHEET NUMBER	REVISION
E1.00	1

SYMBOL LEGEND	
	POINT OF CONNECTION
	ITEM TO REMAIN
	ITEM TO BE REMOVED
	NEW ITEM

OWNER HAS THE RIGHT TO KEEP POSSESSION OF ANY DEMOLISHED EQUIPMENT/DEVICES. CONTRACTOR TO NOTIFY THE OWNER OF DEMOLISHED EQUIPMENT/DEVICES FOR REUSE OR KEEP AS SPARE PARTS PRIOR TO REMOVAL OFFSITE.

EXISTING RACEWAYS AND LOCATION OF ELECTRICAL BOXES/OUTLETS ON EXISTING WALLS TO REMAIN SHALL BE RE-USED AS PRACTICAL FOR NEW DEVICES AS PART OF NEW WORK.

DEMOLITION / EXISTING DRAWINGS ARE BASED ON CASUAL FIELD OBSERVATION AND EXISTING RECORD DOCUMENTS(WHEN AVAILABLE). CONTRACTOR TO VERIFY EXISTING CONDITIONS ON FIELD AND NOTIFY ENGINEER IF THERE ARE ANY CONFLICTS/DISCREPANCIES BETWEEN EXISTING CONDITIONS AND DRAWINGS PRIOR COMMENCEMENT OF WORK. CONTRACTOR SHALL REMOVE SUCH EXISTING WORK AS CALLED FOR ON THE DRAWINGS TO CLEAR THE AREAS OF NEW CONSTRUCTION.

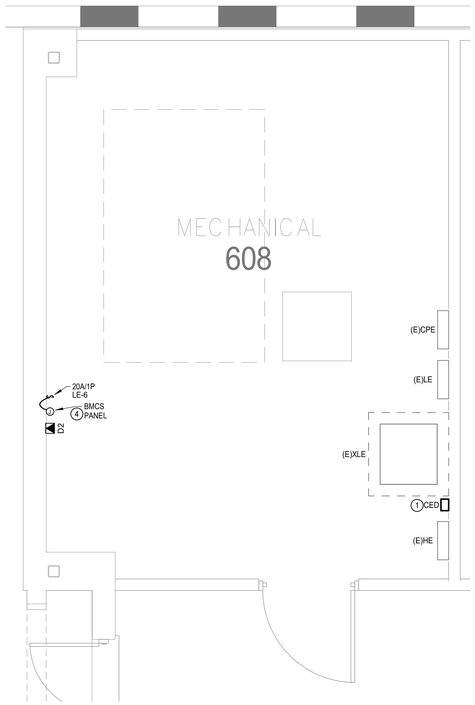
ELECTRICAL GENERAL NOTES:

1. PROTECT EXISTING EQUIPMENT TO REMAIN IN PLACE. KEEP EXISTING POWER CONNECTIONS. ALL EXISTING EQUIPMENT SHALL REMAIN FULLY FUNCTIONAL.
2. REFER TO MECHANICAL AND PLUMBING DRAWINGS FOR EXACT LOCATIONS OF EQUIPMENT AND SCHEDULES.
3. COORDINATE WITH OWNER FOR STORAGING OR DISPOSING ALL REMOVED EQUIPMENT PRIOR COMMENCEMENT OF WORK.
4. ALL EXISTING DISTRIBUTION PANELS AND BREAKERS TO REMAIN UNLESS SPECIFICALLY NOTED OTHERWISE.

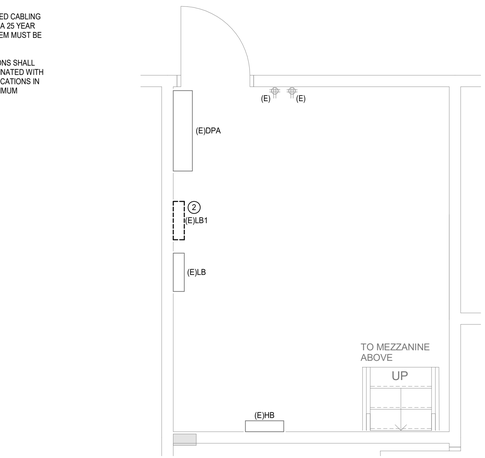
DATA DROPS GENERAL NOTES:

1. STRUCTURED CABLING CONTRACTOR MUST BE A PARTICIPANT OF THE STRUCTURED CABLING MANUFACTURER CERTIFIED INSTALLER PROGRAM AND BE CAPABLE OF OFFERING A 25 YEAR CERTIFICATION PLUS SYSTEM WARRANTY. INSTALLATION CONTRACTOR AND SYSTEM MUST BE MANUFACTURER CERTIFIED.
2. DATA CABLING TO BE A MINIMUM OF CATEGORY 6. FINAL PATCH CABLE CONNECTIONS SHALL MATCH EXISTING CABLE LENGTH IN MDF/IDF LOCATIONS. COLOR SHALL BE COORDINATED WITH OWNER AND MATCH EXISTING BUILDING CABLING MANUFACTURER. FINAL PORT LOCATIONS IN MDF/IDF SHALL BE COORDINATED WITH THE OWNER PRIOR TO INSTALLATION. MAXIMUM HORIZONTAL CABLE RUN FOR DATA DROPS IS 90 METERS.

ELECTRICAL KEYED NOTES	
KEYED NOTE	Description
1	REPLACE EXISTING LIGHTING CONTACTOR BOX. PROVIDE OVERRIDE SWITCH. EXTEND EXISTING CONDUITS, AND RUN NEW CONDUCTORS TO SOURCE PANEL IN SAME ROOM. MAKE ALL FINAL CONNECTIONS.
2	EXISTING PANEL TO BE REPLACED. REMOVE FEEDER CONDUCTORS BACK TO SOURCE. EXISTING CONDUITS AND BRANCH CIRCUITS TO REMAIN.
3	NEW PANEL REPLACING EXISTING. EXTEND EXISTING CONDUITS AND RUN NEW CONDUCTORS. INSTALL NEW BRANCH CIRCUIT BREAKERS AND MAKE ALL FINAL CONNECTIONS.
4	PROVIDE (1) DATA CABLE INSIDE 1" CONDUIT ROUTED FROM NEAREST IDF/MDF ROOM TO BMCS PANEL FOR CONNECTIVITY. MATCH EXISTING BUILDING CABLING MANUFACTURER AND COORDINATE CABLE COLOR WITH OWNER PRIOR TO INSTALLATION.

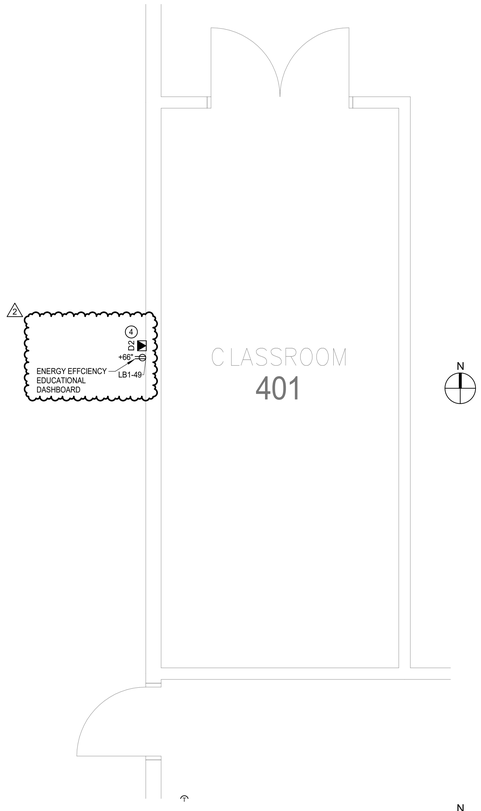


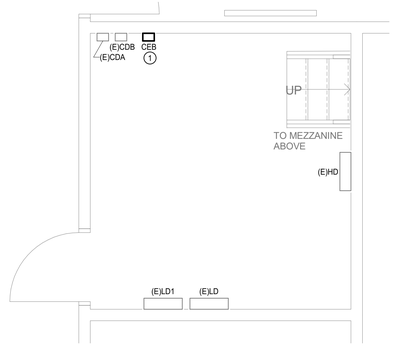
N 7 **ELECTRICAL ENLARGED PLAN - LEVEL 1 - MECH RM#608**
Scale: 3/8" = 1'-0"



N 3 **ELECTRICAL DEMO ENLARGED PLAN - LEVEL 1 - MECH RM#2**
Scale: 3/8" = 1'-0"

N 6 **ELECTRICAL ENLARGED PLAN - LEVEL 1 - MDF**
Scale: 3/8" = 1'-0"





N 5 **ELECTRICAL ENLARGED PLAN - LEVEL 1 - MECH RM#4**
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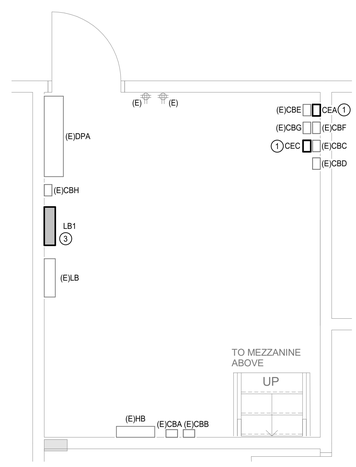
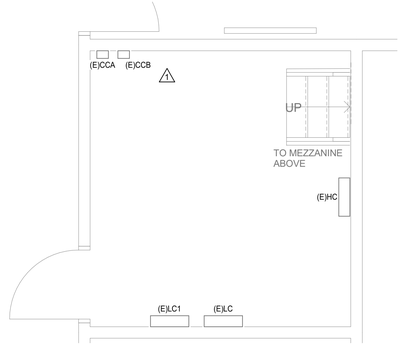
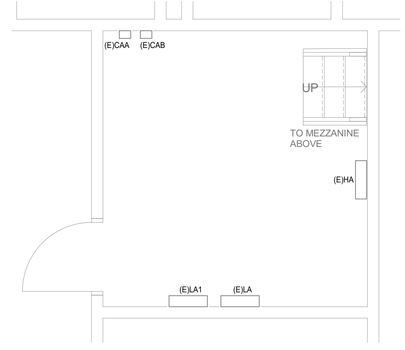


N 2 **ELECTRICAL ENLARGED PLAN - LEVEL 1 - MECH RM#2**
Scale: 3/8" = 1'-0"



N 4 **ELECTRICAL ENLARGED PLAN - LEVEL 1 - MECH RM#3**
Scale: 3/8" = 1'-0"



N 1 **ELECTRICAL ENLARGED PLAN - LEVEL 1 - MECH RM#1**
Scale: 3/8" = 1'-0"

Salas O'Brien
salasobrien.com 281-664-1900
Houston
10930 W. Sam Houston Pkwy North, Suite 900
Houston, TX 77064
Registration: F-4111
Project Number: 2550-00346-00

PROFESSIONAL SEAL

ISSUE DATE	DESCRIPTION
2025-08-11	ISSUE FOR BID

2550-00346-00
Galena Park Independent School District

Havard Elementary School HVAC Modifications - GPISD Project #B105

15150 Wallisville Rd, Houston, TX 77049

REVISIONS

Δ	DESCRIPTION	DATE
1	ADDENDUM #2	08/14/2025
2	ADDENDUM #5	08/26/2025

CHECKED BY	DRAWN BY
JZ	AW

SHEET NAME

ELECTRICAL ENLARGED PLANS- LEVEL 1

SHEET NUMBER	REVISION
E2.04	2

NEW

Branch Panel: LB3

Location: CENTRAL PLANT
Supply From: LB2
Mounting: Surface
Volts: 120/208 Wye
Phases: 3
Wires: 4
A.I.C. Rating: 10,000
Enclosure: Type 1
Mains: 60A MCB

Phase in kVA

Note	CKT	Circuit Description	Wire	Breaker	A	B	C	Breaker	Wire	Circuit Description	CKT	Note
	1	RECEPTS MECH 519	#12	20 1	0.5 / 1.0			1	20	#12 AHUS UV LIGHTS	2	
	3	ROOF RECEPT	#12	20 1		0.2 / 0.4		1	20	#12 EF-9	4	
	5	GWH-2	#12	20 1			0.7 / 0.7	1	20	#12 GWH-1	6	
	7	CP-1	#12	20 1	0.1 / 0.0			1	20	#12 CO MONITORING STATION	8	
	9	CH-1 CONTROLS	#12	20 1		0.2 / 0.2		1	20	#12 CH-1 EVAP HEATER	10	
	11	CH-2 CONTROLS	#12	20 1			0.2 / 1.5	1	20	#12 CH-2 EVAP HEATER	12	
	13	BMCS PANEL	#12	20 1	0.7 / 0.7			1	20	#12 BMCS PANEL	14	
	15	LIGHTING CONTACTOR	#12	20 1		0.5 / 0.0		1	--	-- SPACE	16	--
--	17	SPARE	--	20 1			0.0 / 0.0	1	--	-- SPACE	18	--
--	19	SPARE	--	20 1	0.0 / 0.0			1	--	-- SPACE	20	--
--	21	SPARE	--	20 1		0.0 / 0.0		1	--	-- SPACE	22	--
--	23	SPARE	--	20 1			0.0 / 0.0	1	--	-- SPACE	24	--
--	25	SPARE	--	20 1	0.0 / 0.0			1	--	-- SPACE	26	--
--	27	SPARE	--	20 1		0.0 / 0.0		1	--	-- SPACE	28	--
--	29	SPARE	--	20 1			0.0 / 0.0	1	--	-- SPACE	30	--
--	31	SPACE	--	-- 1	0.0 / 0.0			1	--	-- SPACE	32	--
--	33	SPACE	--	-- 1		0.0 / 0.0		1	--	-- SPACE	34	--
--	35	SPACE	--	-- 1			0.0 / 0.0	1	--	-- SPACE	36	--
--	37	SPACE	--	-- 1	0.0 / 0.2						38	
--	39	SPACE	--	-- 1		0.0 / 0.2		3	30	#10 SPDL	40	
--	41	SPACE	--	-- 1			0.0 / 0.2				42	
			Total Load:		3.2 kVA	1.6 kVA	3.3 kVA					
			Total Amps:		29 A	13 A	29 A					

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
HVAC	0.5 kVA	100.00%	0.5 kVA		
Miscellaneous	5.7 kVA	100.00%	5.7 kVA	**Total Conn. Load:**	8.1 kVA
Receptacles	1.9 kVA	100.00%	1.9 kVA	**Total Est. Demand:**	8.1 kVA
				Total Conn. Current:	23 A
				Total Est. Demand Current:	23 A

Notes:

Abbrevations:
G - PROVIDE GFCI CIRCUIT BREAKER
LF - PROVIDE PERMANENT LOCK-OFF DEVICE
LO - PROVIDE PERMANENT LOCK-ON DEVICE
M - PROVIDE METERING DEVICE

EXISTING

Branch Panel: LD1

Location: MECH RM#4
Supply From:
Mounting: Surface
Volts: 120/208 Wye
Phases: 3
Wires: 4
A.I.C. Rating: 18,000
Enclosure: Type 1
Mains: 225A MLO

Phase in kVA

Note	CKT	Circuit Description	Wire	Breaker	A	B	C	Breaker	Wire	Circuit Description	CKT	Note
	1	COMPUTER RECEPTACLES	(E)	20 1	0.8 / 0.8			1	20	(E) COMPUTER RECEPTACLES	2	
	3	COMPUTER RECEPTACLES	(E)	20 1		1.0 / 1.0		1	20	(E) COMPUTER RECEPTACLES	4	
	5	COMPUTER RECEPTACLES	(E)	20 1			1.0 / 1.0	1	20	(E) COMPUTER RECEPTACLES	6	
	7	COMPUTER RECEPTACLES	(E)	20 1	0.8 / 0.8			1	20	(E) COMPUTER RECEPTACLES	8	
	9	COMPUTER RECEPTACLES	(E)	20 1		0.8 / 0.8		1	20	(E) COMPUTER RECEPTACLES	10	
	11	COMPUTER RECEPTACLES	(E)	20 1			1.0 / 1.0	1	20	(E) COMPUTER RECEPTACLES	12	
	13	COMPUTER RECEPTACLES	(E)	20 1	1.0 / 1.0			1	20	(E) COMPUTER RECEPTACLES	14	
	15	COMPUTER RECEPTACLES	(E)	20 1		0.8 / 0.8		1	20	(E) COMPUTER RECEPTACLES	16	
	17	COMPUTER RECEPTACLES	(E)	20 1			1.0 / 1.0	1	20	(E) COMPUTER RECEPTACLES	18	
	19	COMPUTER RECEPTACLES	(E)	20 1	0.8 / 0.8			1	20	(E) COMPUTER RECEPTACLES	20	
	21	COMPUTER RECEPTACLES	(E)	20 1		0.8 / 0.8		1	20	(E) COMPUTER RECEPTACLES	22	
	23	COMPUTER RECEPTACLES	(E)	20 1			1.0 / 1.0	1	20	(E) COMPUTER RECEPTACLES	24	
	25	COMPUTER RECEPTACLES	(E)	20 1	0.8 / 1.0			1	20	(E) COMPUTER RECEPTACLES	26	
	27	COMPUTER RECEPTACLES	(E)	20 1		0.8 / 0.8		1	20	(E) COMPUTER RECEPTACLES	28	
	29	COMPUTER RECEPTACLES	(E)	20 1			0.8 / 1.0	1	20	(E) COMPUTER RECEPTACLES	30	
	31	COMPUTER RECEPTACLES	(E)	20 1	1.0 / 1.0			1	20	(E) COMPUTER RECEPTACLES	32	
	33	COMPUTER RECEPTACLES	(E)	20 1		0.8 / 0.8		1	20	(E) COMPUTER RECEPTACLES	34	
	35	COMPUTER RECEPTACLES	(E)	20 1			1.0 / 0.8	1	20	(E) COMPUTER RECEPTACLES	36	
	37	COMPUTER RECEPTACLES	(E)	20 1	1.0 / 0.8			1	20	(E) COMPUTER RECEPTACLES	38	
	39	COMPUTER RECEPTACLES	(E)	20 1		0.8 / 0.7		**1**	**20**	**#12 MEZZ BMCS PANEL**	40	**N**
	41	COMPUTER RECEPTACLES	(E)	20 1			1.0 / 0.4	**1**	**20**	**#12 AHU-11&12 UV LIGHT**	42	**N**
			Total Load:		12.0 kVA	11.0 kVA	12.9 kVA					
			Total Amps:		101 A	91 A	109 A					

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Miscellaneous	0.9 kVA	100.00%	0.9 kVA		
Receptacles	35.0 kVA	64.31%	22.5 kVA	**Total Conn. Load:**	35.9 kVA
				Total Est. Demand:	23.4 kVA
				Total Conn. Current:	100 A
				Total Est. Demand Current:	65 A

Notes:

Abbrevations:
G - PROVIDE GFCI CIRCUIT BREAKER
LF - PROVIDE PERMANENT LOCK-OFF DEVICE
LO - PROVIDE PERMANENT LOCK-ON DEVICE
M - PROVIDE METERING DEVICE
N - NEW WORK, NEW CIRCUIT BREAKER

NEW

Branch Panel: LB1

Location: MECH RM#2
Supply From:
Mounting: Surface
Volts: 120/208 Wye
Phases: 3
Wires: 4
A.I.C. Rating: 18,000
Enclosure: Type 1
Mains: 225A MLO

Phase in kVA

Note	CKT	Circuit Description	Wire	Breaker	A	B	C	Breaker	Wire	Circuit Description	CKT	Note
	1	COMPUTER RECEPTACLES	(E)	20 1	0.8 / 0.8			1	20	(E) COMPUTER RECEPTACLES	2	
	3	COMPUTER RECEPTACLES	(E)	20 1		1.0 / 1.0		1	20	(E) COMPUTER RECEPTACLES	4	
	5	COMPUTER RECEPTACLES	(E)	20 1			1.0 / 0.8	1	20	(E) COMPUTER RECEPTACLES	6	
	7	COMPUTER RECEPTACLES	(E)	20 1	0.8 / 0.8			1	20	(E) COMPUTER RECEPTACLES	8	
	9	COMPUTER RECEPTACLES	(E)	20 1		0.5 / 0.8		1	20	(E) COMPUTER RECEPTACLES	10	
	11	COMPUTER RECEPTACLES	(E)	20 1			0.8 / 1.0	1	20	(E) COMPUTER RECEPTACLES	12	
	13	COMPUTER RECEPTACLES	(E)	20 1	1.0 / 0.8			1	20	(E) COMPUTER RECEPTACLES	14	
	15	COMPUTER RECEPTACLES	(E)	20 1		1.0 / 1.0		1	20	(E) COMPUTER RECEPTACLES	16	
	17	COMPUTER RECEPTACLES	(E)	20 1			1.0 / 1.0	1	20	(E) COMPUTER RECEPTACLES	18	
	19	MEDIA RETRIEVEL	(E)	20 1	0.5 / 0.8			1	20	(E) COMPUTER RECEPTACLES	20	
	21	MEDIA RETRIEVEL	(E)	20 1		0.5 / 1.0		1	20	(E) COMPUTER RECEPTACLES	22	
	23	MEDIA RETRIEVEL	(E)	20 1			0.5 / 0.8	1	20	(E) COMPUTER RECEPTACLES	24	
	25	OFFICE COFFE POT	(E)	20 1	1.8 / 0.8			1	20	(E) COMPUTER RECEPTACLES	26	
	27	NEW OFFICE RECEPTS	(E)	20 1		0.5 / 0.8		1	20	(E) COMPUTER RECEPTACLES	28	
	29	NEW WALL RECEPTS	(E)	20 1			0.5 / 0.8	1	20	(E) COMPUTER RECEPTACLES	30	
	31	Existing	(E)	20 1	0.5 / 0.8			1	20	(E) COMPUTER RECEPTACLES	32	
	33	Existing	(E)	20 1		0.5 / 0.8		1	20	(E) COMPUTER RECEPTACLES	34	
	35	LAMINATOR	(E)	20 1			1.5 / 0.8	1	20	(E) A106 COUNTERTOP RECEPT	36	
	37	OFFICE RECEPT	(E)	20 1	0.5 / 1.6			1	20	(E) A106 COUNTERTOP RECEPT	38	
	39	PROJECTOR SCREEN	(E)	20 1		0.5 / 0.5		1	20	(E) Existing	40	
	41	AHU-3,4&13 UV LIGHTS	#12	20 1			0.6 / 0.5	1	20	(E) Existing	42	
	43	ROOF RECEPTACLE	#12	20 1	0.2 / 0.0			1	--	-- SPACE	44	--
	45	MEZZ RECEPT	#12	20 1		0.2 / 0.0		1	--	-- SPACE	46	--
	47	MEZZ AHUS PANEL	#12	20 1			0.7 / 0.0	1	--	-- SPACE	48	--
	49	ENERGY EFFICIENCY EDU DASHBOARD	#12	20 1	0.8 / 0.0			1	--	-- SPACE	50	--
	51	SPACE	--	-- 1		0.0 / 0.0		1	--	-- SPACE	52	--
--	53	SPACE	--	-- 1			0.0 / 0.0	1	--	-- SPACE	54	--
			Total Load:		12.9 kVA	10.4 kVA	12.1 kVA					
			Total Amps:		109 A	87 A	102 A					

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Kitchen Equipment	1.8 kVA	100.00%	1.8 kVA		
Miscellaneous	1.1 kVA	100.00%	1.1 kVA	**Total Conn. Load:**	35.4 kVA
Receptacles	30.5 kVA	66.41%	20.2 kVA	**Total Est. Demand:**	25.6 kVA
Existing	2.0 kVA	125.00%	2.5 kVA	**Total Conn. Current:**	98 A
				Total Est. Demand Current:	71 A

Notes:

Abbrevations:
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LF - PROVIDE PERMANENT LOCK-OFF DEVICE
LO - PROVIDE PERMANENT LOCK-ON DEVICE
M - PROVIDE METERING DEVICE

EXISTING

Branch Panel: LC

Location: MECH RM#3
Supply From:
Mounting: Surface
Volts: 120/208 Wye
Phases: 3
Wires: 4
A.I.C. Rating: 18,000
Enclosure: Type 1
Mains: 225A MCB

Phase in kVA

Note	CKT	Circuit Description	Wire	Breaker	A	B	C	Breaker	Wire	Circuit Description	CKT	Note
	1	RECEPTACLES	(E)	20 1	1.1 / 0.5			1	20	(E) RECEPTACLES	2	
	3	RECEPTACLES	(E)	20 1		1.3 / 0.5		1	20	(E) RECEPTACLES	4	
	5	RECEPTACLES	(E)	20 1			1.1 / 0.5	1	20	(E) RECEPTACLES	6	
	7	RECEPTACLES	(E)	20 1	0.8 / 0.5			1	20	(E) RECEPTACLES	8	
	9	RECEPTACLES	(E)	20 1		1.3 / 0.5		1	20	(E) RECEPTACLES	10	
	11	RECEPTACLES	(E)	20 1			1.3 / 0.5	1	20	(E) RECEPTACLES	12	
	13	COPIER	(E)	20 1	1.8 / 0.5			1	20	(E) CLEAN UP RECEPTACLES	14	
	15	RECEPTACLES	(E)	20 1		1.3 / 0.5		1	20	(E) CLEAN UP RECEPTACLES	16	
	17	RECEPTACLES	(E)	20 1			1.1 / 0.5	1	20	(E) Existing	18	
	19	RECEPTACLES	(E)	20 1	0.8 / 0.5			1	20	(E) RECEPTACLES	20	
	21	RECEPTACLES	(E)	20 1		0.8 / 0.5		1	20	(E) RECEPTACLES	22	
	23	FIRE SMOKE DAMPERS	(E)	20 1			0.6 / 1.6	1	20	(E) EF-3	24	
	25	VAV CONTROL POWER	(E)	20 1	0.5 / 0.5			1	20	(E) CLEAN UP RECEPTACLES	26	
	27	VAV CONTROL POWER	(E)	20 1		0.5 / 0.5		1	20	(E) CLEAN UP RECEPTACLES	28	
	29	VAV CONTROL POWER	(E)	20 1			0.5 / 1.0	1	20	(E) FIRE ALARM	30	LO
N	31	**AHU-5 & 6 UV LIGHTS**	**#12**	**20 1**	0.4 / 0.7			**1**	**20**	**#12 MEZZ BMCS PANEL**	32	**N**
--	33	SHUNT TRIP SPACE FOR CKT 35	--	-- 1		0.0 / 0.0		1	--	-- SPACE	34	--
	35	EDF	(E)	20 1			0.9 / 1.0	1	20	(E) AHU CONTROL POWER	36	
	37				0.2 / 0.0			1	--	-- SPACE	38	--
	39	TVSS	(E)	30 3		0.2 / 0.0		1	--	-- SPACE	40	--
	41						0.2 / 0.0	1	--	-- SPACE	42	--
			Total Load:		8.8 kVA	7.9 kVA	10.8 kVA					
			Total Amps:		74 A	66 A	91 A					

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
HVAC	3.1 kVA	100.00%	3.1 kVA		
Miscellaneous	4.4 kVA	100.00%	4.4 kVA	**Total Conn. Load:**	27.4 kVA
Receptacles	17.9 kVA	77.93%	14.0 kVA	**Total Est. Demand:**	24.0 kVA
Existing	2.0 kVA	125.00%	2.5 kVA	**Total Conn. Current:**	76 A
				Total Est. Demand Current:	66 A

Notes:

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M - PROVIDE METERING DEVICE
N - NEW WORK, NEW CIRCUIT BREAKER

EXISTING

Branch Panel: LA1

Location: MECH RM#1
Supply From:
Mounting: Surface
Volts: 120/208 Wye
Phases: 3
Wires: 4
A.I.C. Rating: 18,000
Enclosure: Type 1
Mains: 225A MLO

Phase in kVA

Note	CKT	Circuit Description	Wire	Breaker	A	B	C	Breaker	Wire	Circuit Description	CKT	Note
	1	COMPUTER RECEPTACLES	(E)	20 1	0.8 / 0.8			1	20	(E) COMPUTER RECEPTACLES	2	
	3	COMPUTER RECEPTACLES	(E)	20 1		1.0 / 1.0		1	20	(E) COMPUTER RECEPTACLES	4	
	5	COMPUTER RECEPTACLES	(E)	20 1			0.8 / 1.0	1	20	(E) COMPUTER RECEPTACLES	6	
	7	COMPUTER RECEPTACLES	(E)	20 1	1.0 / 0.8			1	20	(E) COMPUTER RECEPTACLES	8	
	9	COMPUTER RECEPTACLES	(E)	20 1		1.0 / 1.0		1	20	(E) COMPUTER RECEPTACLES	10	
	11	COMPUTER RECEPTACLES	(E)	20 1			0.8 / 0.8	1	20	(E) COMPUTER RECEPTACLES	12	
	13	COMPUTER RECEPTACLES	(E)	20 1	1.0 / 0.8			1	20	(E) COMPUTER RECEPTACLES	14	
	15	COMPUTER RECEPTACLES	(E)	20 1		0.8 / 1.0		1	20	(E) COMPUTER RECEPTACLES	16	
	17	COMPUTER RECEPTACLES	(E)	20 1			1.0 / 1.0	1	20	(E) COMPUTER RECEPTACLES	18	
	19	COMPUTER RECEPTACLES	(E)	20 1	0.8 / 0.8			1	20	(E) COMPUTER RECEPTACLES	20	
	21	Existing	(E)	20 1		0.5 / 0.5		1	20	(E) COMPUTER RECEPTACLES	22	
	23	Existing	(E)	20 1			0.5 / 0.5	1	20	(E) Existing	24	
	25	Existing	(E)	20 1	0.5 / 0.0			1	20	-- SPARE	26	--
--	27	SPARE	--	20 1		0.0 / 0.0		1	20	-- SPARE	28	--
--	29	SPARE	--	20 1			0.0 / 0.0	1	20	-- SPARE	30	--
	31	COPIER	(E)	20 2	1.5 / 1.5						32	
	33					1.5 / 1.5		2	20	(E) COPIER	34	
--	35	SPACE	--	-- 1			0.0 / 0.0	1	--	-- SPACE	36	--
N	37	**MEZZ BMCS PANEL**	**#12**	**20 1**	0.5 / 0.0			1	--	-- SPACE	38	--
N	39	**MEZZ RECEPT**	**#12**	**20 1**		0.2 / 0.0		1	--	-- SPACE	40	--
N	41	**AHU-1&2 UV LIGHT**	**#12**	**20 1**			0.4 / 0.0	1	--	-- SPACE	42	--
			Total Load:		10.5 kVA	9.9 kVA	6.7 kVA					
			Total Amps:		92 A	87 A	55 A					

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Miscellaneous	0.9 kVA	100.00%	0.9 kVA		
Receptacles	24.2 kVA	70.68%	17.1 kVA	**Total Conn. Load:**	27.1 kVA
Existing	2.0 kVA	125.00%	2.5 kVA	**Total Est. Demand:**	20.5 kVA
				Total Conn. Current:	75 A
				Total Est. Demand Current:	57 A

Notes:

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N - NEW WORK, NEW CIRCUIT BREAKER

PANELBOARD CIRCUIT DIRECTORY:

CONTRACTOR SHALL RECORD AND/OR PRESERVE THE EXISTING CIRCUIT DIRECTORY, IF ANY, FOR THE SOLE PURPOSE UPON COMPLETION OF NEW WORK OF PRODUCING A NEW DIRECTORY.

CONTRACTOR SHALL PROVIDE AS PART OF THE CONSTRUCTION DOCUMENTS A NEW, NEATLY TYPED DIRECTORY. CONTRACTOR SHALL TRACE EXISTING CIRCUITS AND SHALL LEGIBLY IDENTIFY AS TO IT'S CLEAR, EVIDENT, AND SPECIFIC PURPOSE OR USE, LOADS SERVED, LOCATION AND/OR THE PANELBOARD SCHEDULE ON THE DRAWINGS. THE WORD "EXISTING" SHALL NOT BE USED ON PANELBOARD DIRECTORIES. SPARE BREAKERS ARE TO BE LISTED AS "SPARE" AND SWITCHED TO THE OFF POSITION. SPACES WITH NO BREAKERS ARE TO BE LEFT BLANK. REFER TO NEC-2023: 408.4(A) FOR DETAILS.

CONTRACTOR SHALL PERMANENTLY LABEL AS PART OF THE CONSTRUCTION DOCUMENTS ALL SWITCHBOARDS, SWITCHGEAR AND PANELBOARDS TO INDICATE EACH POWER SOURCE. REFER TO NEC-2023: 408.4(A) FOR DETAILS.

Salas O'Brien
salasobrien.com 281-664-1900
Houston
10930 W. Sam Houston Pkwy North, Suite 900
Houston, TX 77064
Registration: F-4111
Project Number: 2550-00346-00

PROFESSIONAL SEAL

STATE OF TEXAS
BRADLEY KALMANS
80219
LICENSED
PROFESSIONAL ENGINEER
08/26/25

ISSUE DATE	DESCRIPTION
2025-08-11	ISSUE FOR BID

Galena Park ISD

2550-00346-00
Galena Park Independent School District

Havard Elementary School HVAC Modifications - GPISD Project #B105

15150 Wallisville Rd, Houston, TX 77049

REVISIONS

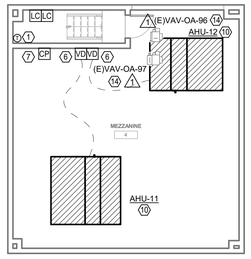
Δ	DESCRIPTION	DATE
1	ADDENDUM #5	08/26/2025

CHECKED BY	DRAWN BY
JZ	AW

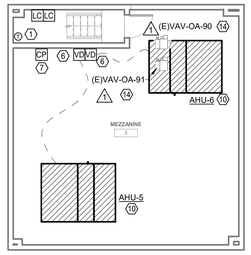
SHEET NAME

ELECTRICAL PANEL SCHEDULES

SHEET NUMBER	REVISION
E4.04	1



5 MECHANICAL PLAN - LEVEL 2 - MEZZANINE 4
Scale: 1/8" = 1'-0"



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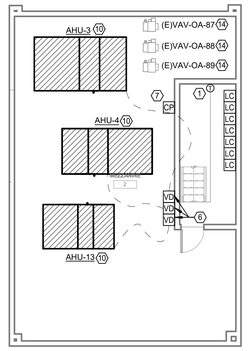
Scale: 1/8" = 1'-0"



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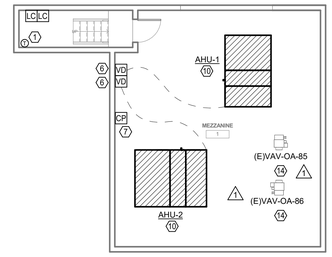
Scale: 1/8" = 1'-0"



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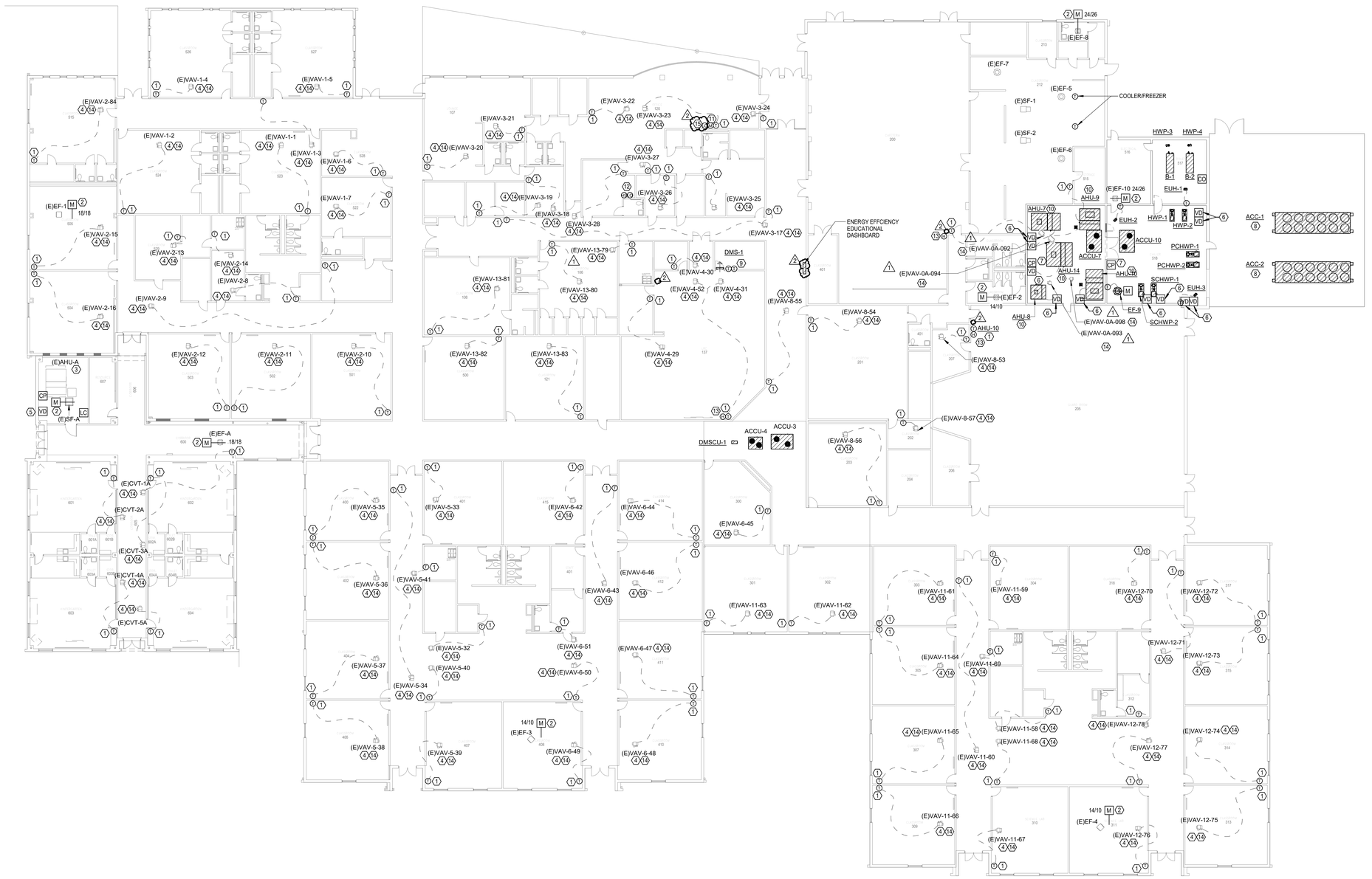
Scale: 1/8" = 1'-0"



1 MECHANICAL BMCS PLAN
Scale: 1/16" = 1'-0"

MECHANICAL GENERAL NOTES

1	ALL MECHANICAL SYSTEMS SHOWN ARE FROM EXISTING DRAWINGS AND PRELIMINARY FIELD WORK. CONTRACTOR IS RESPONSIBLE FOR FIELD VERIFYING ALL LOCATIONS AND SIZES OF MECHANICAL SYSTEMS PRIOR TO START OF WORK.
2	THESE CONSTRUCTION DRAWINGS ARE DIAGRAMMATIC AND DO NOT NECESSARILY REFLECT ACTUAL DIMENSIONS. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO FIELD-VERIFY ALL DIMENSIONS AND COORDINATE PLACEMENT OF ALL EQUIPMENT AND ROUTING OF ALL PIPING AND/OR DUCT SYSTEMS.
3	OWNER SHALL HAVE FIRST RIGHT OF REFUSAL ON ALL HVAC EQUIPMENT BEING REMOVED FROM THIS PROJECT. THIS INCLUDES BUT NOT LIMITED TO CHILLERS, VALVES, CONTROLS, AIR HANDLING UNITS AND PUMPS.
4	REMOVE ALL UNUSED OR ABANDONED HANGER AND SUPPORTS OF DEMOLISHED EQUIPMENT AND MATERIAL
5	MECHANICAL CONTRACTOR SHALL COORDINATE WITH ELECTRICAL CONTRACTOR FOR ALL ELECTRICAL POWER REQUIREMENTS.

MECHANICAL KEYED NOTES

KEYED NOTE	DESCRIPTION
1	PROVIDE NEW DDC TEMPERATURE SENSOR AND CONTROL WIRING. REFER TO SPECIFICATIONS FOR MORE INFORMATION.
2	PROVIDE NEW MOTORIZED DAMPER, ACTUATOR AND CONTROLS. MODIFY EXISTING DUCTWORK AND INSULATION. AFFECTED DUCTWORK SHALL BE SEALED AND RE-INSULATED TO MATCH EXISTING.
3	EXISTING AIR HANDLING UNIT SHALL REMAIN. REPLACE EXISTING CHILLED AND HOT WATER ISOLATION VALVE, BALANCING VALVE, AND CONTROL VALVE WITH NEW. REPLACE EXISTING CHILLED AND HOT WATER PIPING WITH NEW, FOR INSTALLATION OF NEW VALVES AND APPURTENANCES.
4	EXISTING TERMINAL BOX SHALL REMAIN. REPLACE EXISTING HOT WATER ISOLATION VALVE, BALANCING VALVE, AND CONTROL VALVE WITH NEW. REPLACE EXISTING HOT WATER PIPING TO ACCOMODATE THE INSTALLATION OF NEW VALVES AND ASSOCIATED APPURTENANCES.
5	EXISTING VARIABLE FREQUENCY DRIVE SHALL BE REMOVED AND REPLACED WITH NEW VARIABLE FREQUENCY DRIVE TO MATCH EXISTING UNIT HORSEPOWER. EXTEND EXISTING CONDUIT AND PROVIDE NEW WIRE TO MAKE FINAL CONNECTION. DISCONNECT EXISTING FIRE ALARM WIRING FROM EXISTING VARIABLE FREQUENCY DRIVE AND REINSTALL ON NEW. RECOMMISION FIRE ALARM SYSTEM TO ENSURE ALL AIR HANDLING UNITS SHUT DOWN WHEN SIGNALED BY THE FIRE ALARM SYSTEM.
6	PROVIDE NEW VARIABLE FREQUENCY DRIVE (VFD) AT LOCATION SHOWN. VFD SHALL BE CONNECTED TO NEW MECHANICAL EQUIPMENT AS INDICATED. CONTRACTOR SHALL PROVIDE NEW CONTROL WIRING TO MAKE ALL FINAL CONNECTIONS.
7	PROVIDE NEW BMCS PANEL AT LOCATION SHOWN.
8	REFER TO SPECIFICATIONS FOR CONTROLS WORK AT CHILLER.
9	PROVIDE TEMPERATURE SENSOR FOR BMCS.
10	REFER TO SPECIFICATIONS FOR CONTROLS WORK AT NEW AIR HANDLING UNIT.
11	PROVIDE NEW MANUAL OVERRIDE FOR AFTER HOUR DX COOLING SYSTEM. REFER TO SPECIFICATIONS FOR MORE INFORMATION.
12	FIELD VERIFY THE EXACT LOCATION OF THE EXTERIOR LIGHTING OVERRIDE AND HVAC SHUTDOWN STATION WITH OWNER AND ENGINEER PRIOR TO INSTALLATION.
13	PROVIDE NEW HUMIDITY SENSOR AND CONTROL WIRING. REFER TO SPECIFICATIONS FOR MORE INFORMATION.
14	PROVIDE DAMPERS ACTUATOR AND TERMINAL CONTROLLER FOR EXISTING TERMINAL BOX
15	FIELD VERIFY THE EXACT LOCATION OF THE EXTERIOR LIGHTING OVERRIDE STATION WITH OWNER AND ENGINEER PRIOR TO INSTALLATION.

BMCS SYMBOL LEGEND

SYMBOL	DESCRIPTION
VD	VARIABLE FREQUENCY DRIVE
CP	CONTROL PANEL
DS	DISCONNECT SWITCH
M	MOTORIZED DAMPER
RM	REFRIGERANT MONITORING SYSTEM

Salas O'Brien
salasobrien.com 281-664-1900
Houston
10930 W. Sam Houston Pkwy North, Suite 900
Houston, TX 77064
Registration: F-4111
Project Number: 2550-00346-00

PROFESSIONAL SEAL

BRADLEY KALMANS
80219
LICENSED
PROFESSIONAL ENGINEER
STATE OF TEXAS
08/26/25

ISSUE DATE	DESCRIPTION
2025-08-11	ISSUE FOR BID

Galena Park ISD
EXCELLENCE IN ALL FOR ALL STUDENTS

2550-00346-00
Galena Park Independent School District

Havard Elementary School HVAC Modifications - GPISD Project #B105

15150 Wallisville Rd, Houston, TX 77049

REVISIONS

Δ	DESCRIPTION	DATE
1	ADDENDUM #2	08/14/2025
2	ADDENDUM #5	08/26/2025

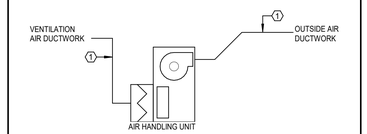
CHECKED BY	DRAWN BY
VP	BB

SHEET NAME

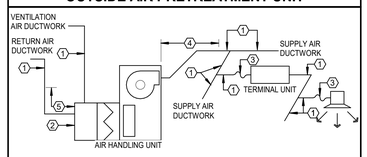
MECHANICAL BMCS PLAN

SHEET NUMBER	REVISION
M3.01	2

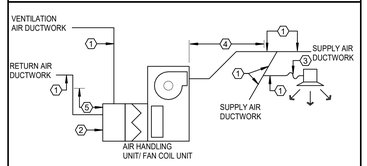
DUCT LINER AND INSULATION



OUTSIDE AIR PRETREATMENT UNIT



VARIABLE AIR VOLUME AIR HANDLING UNITS

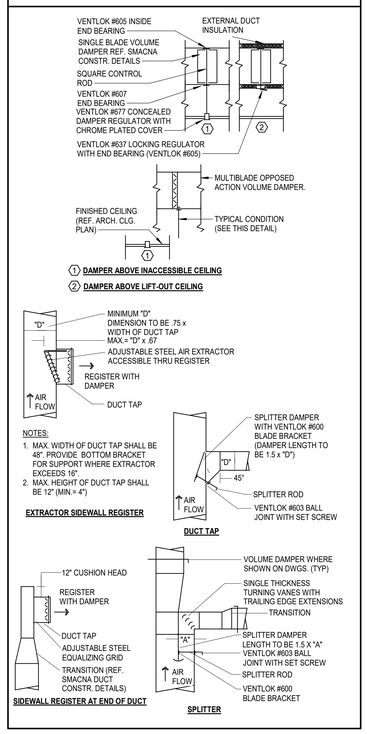


AIR HANDLING UNITS AND FAN COIL UNITS

KEYED NOTES:

1. SHEETMETAL DUCTWORK WITH EXTERNAL DUCTWORK INSULATION AS SPECIFIED.
2. SHEETMETAL DUCTWORK RETURN AIR PLENUM WITH EXTERNAL DUCTWORK INSULATION AS SPECIFIED.
3. FLEXIBLE DUCTWORK WITH EXTERNAL DUCTWORK INSULATION AS SPECIFIED.
4. SHEETMETAL DUCTWORK WITH EXTERNAL DUCTWORK INSULATION AS SPECIFIED AND 1" THICK 1-1/2 LB LINER AS SPECIFIED FROM AIR HANDLING UNIT DISCHARGE TO 10'-0" DOWNSTREAM.
5. SHEETMETAL DUCTWORK WITH EXTERNAL DUCTWORK INSULATION AS SPECIFIED AND 1" THICK 1-1/2 LB LINER AS SPECIFIED FROM AIR HANDLING UNIT INLET TO 10'-0" UPSTREAM.
6. EXHAUST DUCTWORK AS SPECIFIED WITH FIREBOARD INSULATION AS SPECIFIED.
7. SHEETMETAL DUCTWORK ONLY. NO INSULATION REQUIRED.

DUCTWORK CONSTRUCTION DETAILS



PACKAGED AIR COOLED CHILLER - STANDARD EFFICIENCY SCREW

MARK	ACTUAL CAPACITY (TONS)	LEAVING WATER TEMP (°F)	GPM	PRESSURE DROP (FT.)	AMBIENT AIR TEMP. (°F)	CURRENT CHARAC. V	P	F	MOCP	MCA	REMARKS
ACC-1	180	44	310	20.0	95 °F	480	3	60	500	383	(1,2,3,4,5,6)
ACC-2	180	44	310	20.0	95 °F	480	3	60	500	383	(1,2,3,4,5,6)

GENERAL NOTES:
1. MAXIMUM FOULING FACTOR FOR THE EVAPORATOR IS 0.0001
2. MAINTAIN MINIMUM CLEARANCES REQUIRED BY CHILLER MANUFACTURER FOR PROPER AIRFLOW TO FANS AND UNIT. MAINTAIN MINIMUM CLEARANCE TO OPEN ACCESS AND CONTROL DOORS ON EQUIPMENT FOR SERVICE, MAINTENANCE AND INSPECTION. MAINTAIN MINIMUM ELECTRICAL CLEARANCES BY NEC.
3. CHILLER SHALL MEET OR EXCEED BOTH MINIMUM AHRI STANDARDIZED FULL-LOAD AND PART-LOAD EFFICIENCIES INDICATED IN IECC 2015.

REMARKS:
1. PROVIDE WITH LOW AMBIENT HEAD PRESSURE CONTROL.
2. PROVIDE WITH INTEGRAL MAIN ELECTRICAL DISCONNECT SWITCH.
3. PROVIDE WITH INSULATION ON ALL SUCTION LINES.
4. PROVIDE WITH POLYMER CONDENSER FANS AND COMPRESSOR BLANKETS.
5. PROVIDE CHILLER WITH A MINIMUM FULL LOAD EFFICIENCY OF 10.13 EER AND A MINIMUM IPLV OF 16.44.
6. PROVIDE CHILLER RATED FOR 65KA SCCR.

PACKAGED AIR COOLED CHILLER - HIGH EFFICIENCY SCREW

MARK	ACTUAL CAPACITY (TONS)	LEAVING WATER TEMP (°F)	GPM	PRESSURE DROP (FT.)	AMBIENT AIR TEMP. (°F)	CURRENT CHARAC. V	P	F	MOCP	MCA	REMARKS
ACC-1	180	44	310	20.0	95 °F	480	3	60	500	369	(1,2,3,4,5,6)
ACC-2	180	44	310	20.0	95 °F	480	3	60	500	369	(1,2,3,4,5,6)

GENERAL NOTES:
1. MAXIMUM FOULING FACTOR FOR THE EVAPORATOR IS 0.0001
2. MAINTAIN MINIMUM CLEARANCES REQUIRED BY CHILLER MANUFACTURER FOR PROPER AIRFLOW TO FANS AND UNIT. MAINTAIN MINIMUM CLEARANCE TO OPEN ACCESS AND CONTROL DOORS ON EQUIPMENT FOR SERVICE, MAINTENANCE AND INSPECTION. MAINTAIN MINIMUM ELECTRICAL CLEARANCES BY NEC.
3. CHILLER SHALL MEET OR EXCEED BOTH MINIMUM AHRI STANDARDIZED FULL-LOAD AND PART-LOAD EFFICIENCIES INDICATED IN IECC 2015.

REMARKS:
1. PROVIDE WITH LOW AMBIENT HEAD PRESSURE CONTROL.
2. PROVIDE WITH INTEGRAL MAIN ELECTRICAL DISCONNECT SWITCH.
3. PROVIDE WITH INSULATION ON ALL SUCTION LINES.
4. PROVIDE WITH POLYMER CONDENSER FANS AND COMPRESSOR BLANKETS.
5. PROVIDE CHILLER WITH A MINIMUM FULL LOAD EFFICIENCY OF 10.60 EER AND A MINIMUM IPLV OF 19.16.
6. PROVIDE CHILLER RATED FOR 65KA SCCR.

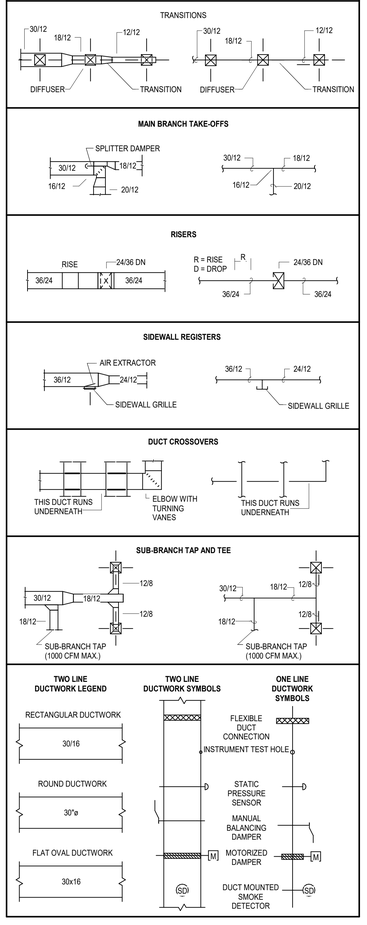
AIR HANDLING UNIT

MARK	SUPPLY CFM	OUTSIDE AIR CFM	EXT. STATIC PRESSURE (IN. W.C)	HORSE POWER	CURRENT V	PH	F	COOLING AIR TEMPERATURE (°F) ENTERING DRY BULB	ENTERING WET BULB	LEAVING WET BULB	WATER ENTERING TEMP. (°F)	GPM	PRESSURE DROP (FT.)	HEATING ENTERING AIR TEMPERATURE (°F)	MIN. HEATING CAPACITY	WATER ENTERING TEMP. (°F)	GPM	PRESSURE DROP (FT.)	PIPE SIZE TO COIL (IN.) CHILLED WATER	HOT WATER	REMARKS
AHU-1	6200	565	1.38	7.5	480	3	60	78.4	65.0	55.0	54.0	45	25.6	15.0	NO HEATING					2"	-	(1,4,5,7,9,15,19)
AHU-2	10800	965	1.38	10.0	480	3	60	77.7	64.4	55.0	54.0	45	41.8	15.0	NO HEATING					2 1/2"	-	(1,4,5,7,9,15,19)
AHU-3	6100	600	1.38	10.0	480	3	60	77.1	64.3	55.0	54.0	45	23.4	15.0	NO HEATING					2"	-	(1,4,5,7,9,15,16,19)
AHU-4	3200	290	1.38	5.0	480	3	60	77.5	64.2	55.0	54.0	45	12.1	15.0	NO HEATING					1 1/4"	-	(1,4,5,7,9,15,17,19)
AHU-5	11300	1,020	1.38	15.0	480	3	60	77.6	64.2	55.0	54.0	45	42.8	15.0	NO HEATING					2 1/2"	-	(1,4,5,7,9,15,19)
AHU-6	9100	820	1.38	10.0	480	3	60	79.3	66.6	55.0	54.0	45	43.8	15.0	NO HEATING					2 1/2"	-	(1,4,5,7,9,15,19)
AHU-7	5500	1,290	1.13	7.5	480	3	60	79.2	66.6	55.0	54.0	45	27.0	15.0	63.7	156,000	180.0	16.0	10.0	2"	1 1/2"	(1,3,6,8,9,11,14,15,18,19)
AHU-8	3500	315	1.38	5.0	480	3	60	77.1	64.3	55.0	54.0	45	14.0	15.0	NO HEATING					1 1/2"	-	(1,3,5,8,9,15,19)
AHU-9	7100	3,850	1.38	7.5	480	3	60	75.0	62.2	55.0	54.0	45	22.0	15.0	49.0	314,400	180.0	32.0	10.0	1"	1"	(1,3,6,8,9,11,14,15,19)
AHU-10	5450	1,290	1.00	7.5	480	3	60	78.8	65.4	55.0	54.0	45	24.0	15.0	63.6	155,200	180.0	16.0	10.0	2"	1 1/2"	(1,3,6,8,9,11,14,15,12,19)
AHU-11	13600	1,235	1.38	15.0	480	3	60	77.7	64.4	55.0	54.0	45	52.6	15.0	NO HEATING					2 1/2"	-	(1,4,5,7,9,15,19)
AHU-12	9150	830	1.38	10.0	480	3	60	78.1	64.6	55.0	54.0	45	36.2	15.0	NO HEATING					2"	-	(1,4,5,7,9,15,19)
AHU-13	4450	410	1.38	5.0	480	3	60	78.3	64.8	55.0	54.0	45	18.0	15.0	NO HEATING					1 1/2"	-	(1,4,5,7,9,15,19)
AHU-14	14850	13,500	1.50	20.0	480	3	60	97.0	77.0	55.0	54.0	45	148.0	15.0	27.0	609,400	180.0	62.0	10.0	4"	2 1/2"	(2,3,8,9,13,15,19)

GENERAL NOTES:
1. EXTERNAL STATIC PRESSURE INCLUDES LOSSES DUE TO DUCTWORK, AIR DEVICES, DAMPERS, AND DUCT MOUNTED HOT WATER COILS WHERE APPLICABLE. DIRTY FILTER AND UNIT CASING MUST BE ADDED TO EXTERNAL STATIC PRESSURE TO OBTAIN TOTAL PRESSURE LOSS. INCREASE HORSEPOWER TO MEET YOUR TOTAL PRESSURE LOSS. COORDINATE WITH ELECTRICIAN.
2. MAINTAIN MINIMUM CLEARANCE FOR COIL PULL AS RECOMMENDED BY UNIT MANUFACTURER. MAINTAIN MINIMUM CLEARANCE TO OPEN ACCESS AND CONTROL DOORS ON UNIT FOR SERVICE, MAINTENANCE, AND INSPECTION. MAINTAIN MINIMUM ELECTRICAL CLEARANCE BY NEC.

REMARKS:
1. VELOCITY NOT TO EXCEED 500 FPM ON COOLING COIL.
2. VELOCITY NOT TO EXCEED 450 FPM ON COOLING COIL.
3. PROVIDE VERTICAL UNIT.
4. PROVIDE HORIZONTAL UNIT.
5. PROVIDE VARIABLE VOLUME UNIT WITH VARIABLE FREQUENCY DRIVE.
6. PROVIDE SINGLE ZONE VAV UNIT WITH VARIABLE FREQUENCY DRIVE.
7. PROVIDE FRONT DISCHARGE.
8. PROVIDE TOP DISCHARGE.
9. PROVIDE TWO-WAY COOLING CONTROL VALVES.
10. PROVIDE THREE-WAY COOLING CONTROL VALVES.
11. PROVIDE TWO-WAY HEATING CONTROL VALVES.
12. PROVIDE DX COOLING COIL DOWNSTREAM OF CHILLED WATER COIL. DX COIL TOTAL CAPACITY SHALL MATCH COOLING CAPACITIES. ENTERING AIR TEMPERATURE CONDITIONS SHALL BE 78.8°F DB / 65.4°F WB. LEAVING AIR TEMPERATURES SHALL BE 55°F DB / 54°F WB.
13. PROVIDE HOT WATER COIL IN PRE-HEAT POSITION.
14. PROVIDE HOT WATER COIL IN REHEAT POSITION.
15. PROVIDE UNIT WITH FLAT FILTER SECTION.
16. PROVIDE DX COOLING COIL DOWNSTREAM OF CHILLED WATER COIL. DX COIL TOTAL CAPACITY SHALL MATCH COOLING CAPACITIES. ENTERING AIR TEMPERATURE CONDITIONS SHALL BE 80°F DB / 66°F WB. LEAVING AIR TEMPERATURES SHALL BE 55°F DB / 54°F WB.
17. PROVIDE DX COOLING COIL DOWNSTREAM OF CHILLED WATER COIL. DX COIL TOTAL CAPACITY SHALL MATCH COOLING CAPACITIES. ENTERING AIR TEMPERATURE CONDITIONS SHALL BE 77.5°F DB / 64.2°F WB. LEAVING AIR TEMPERATURES SHALL BE 55°F DB / 54°F WB.
18. PROVIDE DX COOLING COIL DOWNSTREAM OF CHILLED WATER COIL. DX COIL TOTAL CAPACITY SHALL MATCH COOLING CAPACITIES. ENTERING AIR TEMPERATURE CONDITIONS SHALL BE 79.2°F DB / 66.6°F WB. LEAVING AIR TEMPERATURES SHALL BE 55°F DB / 54°F WB.
19. PROVIDE UV LIGHT PER SPECIFICATIONS. UV LIGHT SHALL HAVE SEPARATE ELECTRICAL CONNECTION FROM AIR HANDLING UNIT. REFER TO ELECTRICAL DRAWINGS.
20. PROVIDE WITH THREE WAY HEATING CONTROL VALVE.

DUCTWORK SYMBOLS LEGEND



AIR COOLED CONDENSING UNIT

MARK	MIN. TOTAL CAPACITY (BTUH)	OUTDOOR AIR TEMP (°F)	MINIMUM EER/ SEER2	CURRENT CHAR. V	P	F	RELATED UNIT MARK	BASIS OF DESIGN MCA	MOCP	REMARKS
ACCU-3	222,332	105	10.5/-	480	3	60	AHU-3	54	70	(1,2,3)
ACCU-4	97,063	105	11.0/-	480	3	60	AHU-4	22	30	(1,2,3)
ACCU-7	212,300	105	10.5/-	480	3	60	AHU-7	54	70	(1,2,3)
ACCU-10	187,450	105	10.5/-	480	3	60	AHU-10	45	60	(1,2,3)

GENERAL NOTES:
A. MINIMUM RECOMMENDEDLD CLEARANCE AROUND UNIT IS 12 INCHES ON NON-SERVICE SIDES AND 30 INCHES ON SERVICE SIDES. MAINTAIN MINIMUM CLEARANCE FOR CONDENSER AIR FLOW AS RECOMMENDED BY UNIT MANUFACTURER. MAINTAIN MINIMUM CLEARANCE TO OPEN ACCESS AND CONTROL DOORS ON UNIT FOR SERVICE, MAINTENANCE, AND INSPECTION. MAINTAIN MINIMUM ELECTRICAL CLEARANCE BY NEC.

REMARKS:
1. PROVIDE WITH LOW AMBIENT CONTROL DOWN TO 20°F.
2. PROVIDE WITH DISCONNECT SWITCH.
3. REFRIGERANT LINES TO BE SIZED PER MANUFACTURER'S REQUIREMENTS.

BOILER

MARK	TYPE	MINIMUM GAS INPUT (MBH)	MINIMUM HEAT OUTPUT (MBH)	PRESSURE DROP (FT.H20)	GPM	FLUE SIZE	ELECTRICAL BLOWER HORSEPOWER	CURRENT V	P	F	MANUFACTURER	MODEL NUMBER	REMARKS
B-1	CONDENSING	1500.0	1426.5	10.0	95.0	6	1	480	3	60	RBI	FLEXCORE 1500	(1,2)
B-2	CONDENSING	1500.0	1426.5	10.0	95.0	6	1	480	3	60	RBI	FLEXCORE 1500	(1,2)

GENERAL NOTES:
1. PROVIDE 8 OUNCE GAS PRESSURE TO BOILER.
2. MAINTAIN MINIMUM CLEARANCE AROUND A BOILER OF 24 INCHES PER TEXAS BOILER LAW. MAINTAIN MINIMUM CLEARANCE TO OPEN ACCESS AND CONTROL DOORS FOR SERVICE, MAINTENANCE AND INSPECTION. MAINTAIN MINIMUM ELECTRICAL CLEARANCES BY NEC.

REMARKS:
1. PROVIDE WITH CIRCULATING PUMP, SIZED BY BOILER MANUFACTURER TO ENSURE CONSTANT FLOW THROUGH BOILER. PUMP TO BE SHIPPED LOOSE. POWER BY ELECTRICAL CONTRACTOR BUT CONTROLLED BY BOILER. CONTRACTOR TO WIRE FROM BOILER PUMP CONTROL CIRCUIT TO PUMP STARTER RELAY.
2. PROVIDE SEALED COMBUSTION BOILER.

PUMP

TAG	SERVICE	TYPE	GPM	HEAD (FT.)	MOTOR HORSE POWER	MAX. RPM	CURRENT CHARAC. V	P	F	MANUFACTURER	MODEL NUMBER	REMARKS
PCHWP-1	CHILLED WATER	HORIZONTAL END SUCTION	310	60.00	15.0	1800	480	3	3	AURORA	3804	(1,2,3,4)
PCHWP-2	CHILLED WATER	HORIZONTAL END SUCTION	310	60.00	15.0	1800	480	3	3	AURORA	3804	(1,2,3,4)
SCHWP-1	CHILLED WATER	HORIZONTAL END SUCTION	270	90.00	20.0	1800	480	3	3	AURORA	3804	(1,2,3,4)
SCHWP-2	CHILLED WATER	HORIZONTAL END SUCTION	270	90.00	20.0	1800	480	3	3	AURORA	3804	(1,2,3,4)
HWP-1	HOT WATER	HORIZONTAL END SUCTION	190	70.00	7.5	1800	480	3	60	AURORA	3804	(1,2,3,4)
HWP-2	HOT WATER	HORIZONTAL END SUCTION	190	70.00	7.5	1800	480	3	60	AURORA	3804	(1,2,3,4)
HWP-3	HOT WATER	INLINE CIRCULATOR	95	20.00	1.5	1800	480	3	60	AURORA	382B	(4,5)
HWP-4	HOT WATER	INLINE CIRCULATOR	95	20.00	1.5	1800	480	3	60	AURORA	382B	(4,5)

GENERAL NOTES:
1. PUMP IS TO HAVE A NON-OVERLOADING MOTOR.
2. MINIMUM RECOMMENDED CLEARANCE AROUND A PUMP IS 24 INCHES. MAINTAIN MINIMUM CLEARANCES FOR SERVICE, MAINTENANCE, AND INSPECTION.

REMARKS:
1. PROVIDE WITH VARIABLE FREQUENCY DRIVE.
2. PROVIDE SUCTION DIFFUSER AT PUMP INLET.
3. PROVIDE WITH BACK PULL OUT.
4. PROVIDE WITH GAUGE TAPPINGS.
5. PUMP SHALL BE SELECTED BY BOILER MANUFACTURER, WITH DISCONNECT AND STARTER BY ELECTRICAL CONTRACTOR AND CONTROLLED BY BOILER.

DUCTLESS MINI-SPLIT - INDOOR UNIT

MARK	FAN SUPPLY AIR CFM	FAN EXT.STATIC PRESSURE (IN. W.C.)	FAN HORSE POWER	FAN CURRENT CHARAC. V	P	F	AIR TEMPERATURE (°F) ENTERING DRY BULB	AIR TEMPERATURE (°F) ENTERING WET BULB	COOLING MIN. TOTAL CAPACITY (BTUH)	COOLING MIN. SENS. CAPACITY (BTUH)	MINIMUM EER/ SEER2	REMARKS
DMS-1	775	0.30	86.0	208	1	60	75.0	62.5	24,000	19,200	-/21	(1,2,3,4,5,6)

GENERAL NOTES:
1. EXTERNAL STATIC PRESSURE INCLUDES LOSSES DUE TO DUCTWORK, AIR DEVICES, DAMPERS, AND DUCT MOUNTED HOT WATER COILS WHERE APPLICABLE. DIRTY FILTER AND UNIT CASING MUST BE ADDED TO EXTERNAL STATIC PRESSURE TO OBTAIN TOTAL PRESSURE LOSS. INCREASE HORSEPOWER TO MEET YOUR TOTAL PRESSURE LOSS. COORDINATE WITH ELECTRICIAN.
2. MAINTAIN MINIMUM CLEARANCE FOR COIL PULL AS RECOMMENDED BY UNIT MANUFACTURER. MAINTAIN MINIMUM CLEARANCE TO OPEN ACCESS AND CONTROL DOORS ON UNIT FOR SERVICE, MAINTENANCE, AND INSPECTION. MAINTAIN MINIMUM ELECTRICAL CLEARANCE BY NEC.

REMARKS:
1. UNIT TO BE INSTALLED PER MANUFACTURER'S INSTALLATION INSTRUCTIONS.
2. CONTROLLED BY PROGRAMMABLE WIRED THERMOSTAT.
3. REFRIGERANT LINES TO BE SIZED PER MANUFACTURER'S REQUIREMENTS.
4. INDOOR UNIT IS POWERED FROM OUTDOOR UNIT.
5. PROVIDE WITH LITTLE GIANT CONDENSATE PUMP MODEL 554652 VCMA-20ULS-C-PRO, 1/30 HP, 115V/1PH/60HZ.
6. PROVIDE UNIT WITH WATER LEVEL SENSING DEVICE. DEVICE SHALL SHUT OFF THE UNIT THE UNIT IN EVENT THE PRIMARY DRAIN LINE BECOMES RESTRICTED.

FAN SCHEDULE

TAG	LOCATION	CFM	EXT. STATIC PRESSURE (IN.W.C.)	MAX RPM	HORSE POWER	CURRENT CHAR V	P	F	LOCALLY SWITCHED	INTERLOCK WITH	FAN TYPE	DRIVE TYPE	MANUFACTURER	MODEL NUMBER	REMARKS
EF-9	CHILLER 518	2500	0.50	1087	0.5	120	1	60	TSTAT	-	ROOF MOUNTED	DIRECT	COOK	ACED	(1,2,3,4)

GENERAL NOTES:
1. EXTERNAL STATIC PRESSURE INCLUDES LOSSES DUE TO DUCTWORK, AIR DEVICES, DAMPERS, AND DUCT MOUNTED HOT WATER COILS WHERE APPLICABLE. DIRTY FILTER AND UNIT CASING MUST BE ADDED TO EXTERNAL STATIC PRESSURE TO OBTAIN TOTAL PRESSURE LOSS. INCREASE HORSEPOWER TO MEET YOUR TOTAL PRESSURE LOSS. COORDINATE WITH ELECTRICIAN.
2. MINIMUM RECOMMENDED CLEARANCE AROUND UNIT IS 12 INCHES ON NON-SERVICE SIDES AND 30 INCHES ON SERVICE SIDES. MAINTAIN MINIMUM CLEARANCE TO OPEN ACCESS AND CONTROL DOORS ON UNIT FOR SERVICE, MAINTENANCE, AND INSPECTION. MAINTAIN MINIMUM ELECTRICAL CLEARANCE BY NEC.

REMARKS:
1. PROVIDE WITH DISCONNECT.
2. PROVIDE WITH ROOF CURB AND BIRD SCREEN.
3. PROVIDE WITH MOTORIZED DAMPER.
4. PROVIDE WITH EC MOTOR WITH FAN SPEED CONTROLLER.

DUCTLESS MINI-SPLIT - OUTDOOR UNIT

MARK	MIN. TOTAL CAPACITY (BTUH)	OUTDOOR AIR TEMP (°F)	MINIMUM EER/ SEER2	CURRENT CHARAC. V	PH	F	RELATED UNIT MARK	REMARKS
DMSCU-1	24,000	95	-/21	208	1	60	DMS-1	(1,2,3)

GENERAL NOTES:
A. MINIMUM RECOMMENDEDLD CLEARANCE AROUND UNIT IS 12 INCHES ON NON-SERVICE SIDES AND 30 INCHES ON SERVICE SIDES. MAINTAIN MINIMUM CLEARANCE FOR CONDENSER AIR FLOW AS RECOMMENDED BY UNIT MANUFACTURER. MAINTAIN MINIMUM CLEARANCE TO OPEN ACCESS AND CONTROL DOORS ON UNIT FOR SERVICE, MAINTENANCE, AND INSPECTION. MAINTAIN MINIMUM ELECTRICAL CLEARANCE BY NEC.

REMARKS:
1. PROVIDE WITH LOW AMBIENT CONTROL DOWN TO 20°F.
2. PROVIDE WITH DISCONNECT SWITCH.
3. REFRIGERANT LINES TO BE SIZED PER MANUFACTURER'S REQUIREMENTS.

DAMPER

MARK	ACTUATOR	DUTY	BLADE ACTION	MANUFACTURER	MODEL NUMBER	REMARKS
D-1	MANUAL BALANCING	UNDER 9" WIDE	N/A	N/A	N/A	SEE SMACNA CONSTRUCTION DETAILS REFERENCED "TYPICAL CONSTRUCTION DETAILS FOR LOW VELOCITY DUCTS."
D-2	MANUAL BALANCING	OVER 9" WIDE	OPPOSED	RUSKIN	MD-35	MANUAL DAMPER WITH STANDARD CONSTRUCTION FEATURES AND VENTLOCK #639 LOCKING REGULATOR.
D-3	MOTORIZED	OVER 9" WIDE	OPPOSED	RUSKIN	CD-60	LOW LEAKAGE DAMPER WITH BLADE SEALS

NOTES:
N/A - NOT APPLICABLE

UNIT HEATER - ELECTRIC

MARK	MINIMUM CAPACITY (BTUH)	KW	CURRENT CHAR. V	P	F	CFM	MANUFACTURER	MODEL	REMARKS
EUH-1	17,060	5	480	3	60	479	REZNOR	EUH	(1,2)
EUH-2	17,060	5	480	3	60	479	REZNOR	EUH	(1,2)
EUH-3	17,060	5	480	3	60	479	REZNOR	EUH	(1,2)

REMARKS:
1. PROVIDE WITH PENDANT MOUNTED THERMOSTAT.
2. REFER TO MANUFACTURER FOR INSTALLATION INSTRUCTIONS AND MOUNTING HEIGHTS.

Salas O'Brien
salasobrien.com 281-664-1900
Houston
10930 W. Sam Houston Pkwy North, Suite 900
Houston, TX 77064
Registration: F-4111
Project Number: 2550-00346-00

PROFESSIONAL SEAL

08/26/25

ISSUE DATE	DESCRIPTION
2025-08-11	ISSUE FOR BID

Galena Park ISD

2550-00346-00
Galena Park Independent School District

Havard Elementary School HVAC Modifications - GPISD Project #B105

15150 Wallisville Rd, Houston, TX 77049

REVISIONS

Δ	DESCRIPTION	DATE
1	ADDENDUM #2	08/14/2025
2	ADDENDUM #5	08/26/2025

CHECKED BY: VP
DRAWN BY: BB

SHEET NAME

MECHANICAL SCHEDULES AND LEGENDS

SHEET NUMBER: M6.01
REVISION: 2

(E)AIR HANDLER PROPERTIES (2003)

MARK	AHU TYPE	CFM		HORSE POWER	CHILLED WATER		HOT WATER (PREHEAT)		HOT WATER (REHEAT)	
		SA	OA		GPM	VALVE TYPE	GPM	VALVE TYPE	GPM	VALVE TYPE
(E)AHU-A	HDT - VAV	7,650	1,560	7.5	62	2-WAY	3	-	-	-

(E)CVB SCHEDULE (2003)

MARK	G.P.M.	PIPE CONNECTION SIZE
(E)CVT-1A	2.4	3/4"
(E)CVT-2A	3.3	3/4"
(E)CVT-3A	3.3	3/4"
(E)CVT-4A	3.4	3/4"
(E)CVT-5A	3.2	3/4"

GENERAL NOTES
1. PROVIDE WITH 2 WAY HEATING VALVES.

(E)FANS INTERLOCK (2003)

MARK	CFM	LOCALLY SWITCHED BY	INTERLOCKED WITH	REMARKS
(E)EF-A	400	-	(E)SF-A	-
(E)SF-A	1,560	-	(E)AHU-A	-

GENERAL NOTES
1. INTERLOCKS ARE SHOWN FOR ASSOCIATION PURPOSES ONLY. SOFTWARE INTERLOCKS ARE ACCEPTABLE.
2. EXISTING EXHAUST FANS EQUIPPED WITH MOTORIZED DAMPER SHALL HAVE THE DAMPER INTERLOCKED.

REMARKS :
N/A

(E)FANS INTERLOCK (1997)

MARK	CFM	LOCALLY SWITCHED BY	INTERLOCKED WITH	REMARKS
(E)EF-1	2,095	-	AHU-14	-
(E)EF-2	885	-	AHU-14	-
(E)EF-3	850	-	AHU-14	-
(E)EF-4	850	-	AHU-14	-
(E)EF-5	3,750	HOOD	-	-
(E)EF-6	3,750	HOOD	-	-
(E)EF-7	1,400	HOOD	-	-
(E)EF-8	455	-	AHU-14	-
(E)EF-9	6,125	TSTAT	-	-
(E)EF-10	1,340	TSTAT	-	-
(E)SF-1	2,300	-	(E)EF-5	-
(E)SF-2	2,300	-	(E)EF-6	-

GENERAL NOTES
1. INTERLOCKS ARE SHOWN FOR ASSOCIATION PURPOSES ONLY. SOFTWARE INTERLOCKS ARE ACCEPTABLE.
2. EXISTING EXHAUST FANS EQUIPPED WITH MOTORIZED DAMPER SHALL HAVE THE DAMPER INTERLOCKED.

REMARKS :
N/A

EXISTING CONTACTOR SCHEDULE

MARK	LOCATION	REMARKS
CAA	ELECTRICAL RM AREA "A"	AREA "A" CLASSROOMS
CAB	ELECTRICAL RM AREA "A"	AREA "A" CLASSROOMS
CBA	ELECTRICAL RM AREA "B"	AREA "B" ADMINISTRATION
CBB	ELECTRICAL RM AREA "B"	AREA "B" CLASSROOMS
CBC	ELECTRICAL RM AREA "B"	AREA "B" LIBRARY
CBD	ELECTRICAL RM AREA "B"	AREA "B" CORRIDORS
CBE	MAIN ELECTRICAL RM	AREA "B" CAFETERIA
CBF	MAIN ELECTRICAL RM	AREA "B" GRAND ROOM
CBG	MAIN ELECTRICAL RM	AREA "B" KITCHEN
CBH	ELECTRICAL RM AREA "B"	AREA "B" CASE LIGHTING
CCA	ELECTRICAL RM AREA "C"	AREA "C" CLASSROOMS
CCB	ELECTRICAL RM AREA "C"	AREA "C" CORRIDORS
CDA	ELECTRICAL RM AREA "D"	AREA "D" CLASSROOMS
CDB	ELECTRICAL RM AREA "D"	AREA "D" CORRIDORS
CEA	ELECTRICAL RM AREA "B"	EXTERIOR LIGHTING
CEB	ELECTRICAL RM AREA "D"	EXTERIOR LIGHTING
CEC	ELECTRICAL RM AREA "B"	PARKING LOT LIGHTING

(E)CVB SCHEDULE (1997)

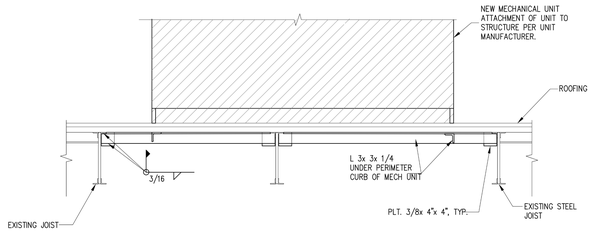
MARK	G.P.M.	PIPE CONNECTION SIZE	REMARKS
(E)VAV-1-1	1.9	3/4"	1
(E)VAV-1-2	1.9	3/4"	1
(E)VAV-1-3	0.7	3/4"	1
(E)VAV-1-4	2.2	3/4"	1
(E)VAV-1-5	2.1	1"	1
(E)VAV-1-6	1.8	3/4"	1
(E)VAV-1-7	1.7	3/4"	1
(E)VAV-2-8	1.3	3/4"	1
(E)VAV-2-9	1.5	3/4"	1
(E)VAV-2-10	1.8	3/4"	1
(E)VAV-2-11	1.6	1"	1
(E)VAV-2-12	2.5	1"	1
(E)VAV-2-13	2.3	3/4"	1
(E)VAV-2-14	-	-	1
(E)VAV-2-15	2.4	1"	1
(E)VAV-2-16	2.5	3/4"	1
(E)VAV-2-84	2.6	3/4"	1
(E)VAV-3-17	0.7	1"	2
(E)VAV-3-18	0.6	1"	2
(E)VAV-3-19	0.6	1"	2
(E)VAV-3-20	1.7	1"	2
(E)VAV-3-21	0.7	1"	2
(E)VAV-3-22	0.6	3/4"	2
(E)VAV-3-23	4.0	1"	2
(E)VAV-3-24	1.0	3/4"	2
(E)VAV-3-25	0.7	3/4"	2
(E)VAV-3-26	0.4	1"	2
(E)VAV-3-27	0.9	3/4"	2
(E)VAV-3-28	0.5	3/4"	2
(E)VAV-4-29	0.8	1"	2
(E)VAV-4-30	0.7	1"	2
(E)VAV-4-31	2.3	1"	2
(E)VAV-4-52	2.3	1"	2
(E)VAV-5-32	1.1	1"	1
(E)VAV-5-33	1.8	3/4"	1
(E)VAV-5-34	2.3	3/4"	1
(E)VAV-5-35	2.5	1"	1
(E)VAV-5-36	2.6	3/4"	1
(E)VAV-5-37	2.6	3/4"	1
(E)VAV-5-38	2.9	1"	1
(E)VAV-5-39	2.5	3/4"	1
(E)VAV-5-40	1.2	3/4"	1
(E)VAV-5-41	-	-	1
(E)VAV-6-42	1.8	3/4"	2
(E)VAV-6-43	1.8	3/4"	2
(E)VAV-6-44	1.8	3/4"	2
(E)VAV-6-45	1.8	1"	2
(E)VAV-6-46	1.8	3/4"	2
(E)VAV-6-47	2.5	3/4"	2
(E)VAV-6-48	2.4	1"	2
(E)VAV-6-49	2.6	3/4"	2
(E)VAV-6-50	1.2	3/4"	2
(E)VAV-6-51	0.6	1"	2

REMARKS:
1. PROVIDE WITH 3 WAY HEATING VALVES.
2. REMOVE EXISTING THREE WAY HEATING VALVE AND PROVIDE NEW TWO WAY HEATING CONTROL VALVE.

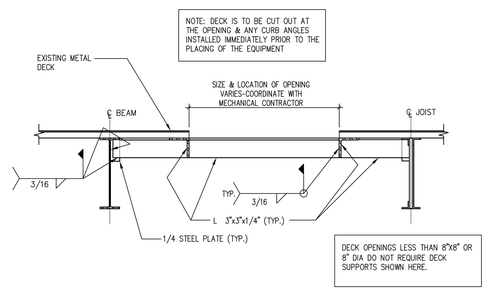
(E)CVB SCHEDULE (1997) CONT.

MARK	G.P.M.	PIPE CONNECTION SIZE	REMARKS
(E)VAV-8-53	1.2	3/4"	2
(E)VAV-8-54	2.7	3/4"	2
(E)VAV-8-55	0.9	3/4"	2
(E)VAV-8-56	1.6	3/4"	2
(E)VAV-8-57	0.6	3/4"	2
(E)VAV-11-58	0.9	3/4"	2
(E)VAV-11-59	1.8	3/4"	2
(E)VAV-11-60	2.1	3/4"	2
(E)VAV-11-61	1.8	3/4"	2
(E)VAV-11-62	2.4	3/4"	2
(E)VAV-11-63	4.4	3/4"	2
(E)VAV-11-64	2.5	3/4"	2
(E)VAV-11-65	2.6	3/4"	2
(E)VAV-11-66	2.9	3/4"	2
(E)VAV-11-67	2.5	3/4"	2
(E)VAV-11-68	1.2	3/4"	2
(E)VAV-11-69	-	-	2
(E)VAV-12-70	1.8	3/4"	2
(E)VAV-12-71	2.0	3/4"	2
(E)VAV-12-72	2.5	3/4"	2
(E)VAV-12-73	2.5	3/4"	2
(E)VAV-12-74	2.5	3/4"	2
(E)VAV-12-75	2.4	3/4"	2
(E)VAV-12-76	2.6	3/4"	2
(E)VAV-12-77	1.5	3/4"	2
(E)VAV-12-78	0.6	3/4"	2
(E)VAV-13-79	-	-	2
(E)VAV-13-80	1.4	3/4"	2
(E)VAV-13-81	1.3	3/4"	2
(E)VAV-13-82	1.8	3/4"	2
(E)VAV-13-83	1.8	3/4"	2
(E)VAV-OA-85	-	-	-
(E)VAV-OA-86	-	-	-
(E)VAV-OA-87	-	-	-
(E)VAV-OA-88	-	-	-
(E)VAV-OA-89	-	-	-
(E)VAV-OA-90	-	-	-
(E)VAV-OA-91	-	-	-
(E)VAV-0A-092	-	-	-
(E)VAV-0A-093	-	-	-
(E)VAV-0A-094	-	-	-
(E)VAV-0A-96	-	-	-
(E)VAV-0A-97	-	-	-
(E)VAV-0A-098	-	-	-

REMARKS:
1. PROVIDE WITH 3 WAY HEATING VALVES.
2. REMOVE EXISTING THREE WAY HEATING VALVE AND PROVIDE NEW TWO WAY HEATING CONTROL VALVE.



1 SECTION @ SUPPORT FOR ROOF TOP UNIT
N.T.S



2 TYP. ROOF DECK OPENING DETAIL
N.T.S.

STATE OF TEXAS
ARIVINDER SINGH RIAR
104774
LICENSED
PROFESSIONAL ENGINEER
08/07/2025

NEXGEN ENGINEERS, LLC TX FIRM REGISTRATION # F-16037 5600 NW CENTRAL DRIVE, #230 HOUSTON TX 77092 PH: 713-462-4269	HAVARD ELEMENTARY SCHOOL 15150 WALLISVILLE RD, HOUSTON, TX PROJECT # 25273 DATE: 08/07/2025 DRAWN BY: AR REVIEWED BY: AR. SHEET: SK-1

Salas O'Brien
salasobrien.com 281-664-1900
Houston
10930 W. Sam Houston Pkwy North, Suite 900
Houston, TX 77064
Registration: F-4111
Project Number: 2550-00346-00

PROFESSIONAL SEAL

STATE OF TEXAS
BRADLEY KALMANS
80219
LICENSED
PROFESSIONAL ENGINEER
08/26/25

ISSUE DATE	DESCRIPTION
2025-08-11	ISSUE FOR BID

Galena Park ISD
EXCELLENCE IN ALL FOR ALL STUDENTS

2550-00346-00
Galena Park Independent School District

Havard Elementary School HVAC Modifications - GPISD Project #B105

15150 Wallisville Rd, Houston, TX 77049

REVISIONS

Δ	DESCRIPTION	DATE
1	ADDENDUM #2	08/14/2025
2	ADDENDUM #5	08/20/2025

CHECKED BY: VP
DRAWN BY: BB

SHEET NAME

MECHANICAL SCHEDULES

SHEET NUMBER: M6.02
REVISION: 2