THE SCHOOL DISTRICT OF PHILADELPHIA

BOARD OF EDUCATION
Office of Capital Programs
440 North Broad Street, 3rd Floor – Suite 371
Philadelphia, PA 19130

TELEPHONE: (215) 400-4730

Addendum No. 2

Subject: **SDP Contracts No. B-011 C, B-012 C, B-013 C and B-014 C of 2017/18 Major Renovation and Addition**

Location: **Ethan Allen Elementary School**

This Addendum, dated June 10, 2020 shall modify and become part of the Contract Documents. Any items not mentioned herein, or affected by, shall remain strictly in accordance with the original document.

NOTICE TO ALL BIDDERS:

Bidders on the Electrical Construction Contract MUST use the attached Revised Bid Proposal Form to provide for PECO Services required in connection with the three trailers being provided by SDP

1. MODIFICATIONS TO GENERAL AND SUPPLEMENTARY CONDITIONS (DIVISION 00)

2. MODIFICATIONS TO DIVISION 01 GENERAL REQUIREMENTS (DIVISION 01)

3. CHANGES TO TECHNICAL SPECIFICATIONS (DIVISIONS 02-36):

A. Specification Section 22 4216.13: Commercial Lavatories: Modify Section 2.1.A as follows:

2.1 SOLID-SURFACE, LINEAR LAVATORY SYSTEM

A. Wash Fountains, L-1: Solid-surface, linear (side-by-side) receptor.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Bradley, Express ELX Series 2-Station.
   b. Approved Equal.

2. Standard: IAPMO IGC 156.
3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. Bowl(s) and Counter:

    a. Standard: ICPA SS-1 for solid-surface bowls manufactured of Terreon.
    b. Height to Rim: 34 inches above floor or as noted on Architectural Drawings.
    c. Color or Finish: Terreon color as selected by Architect from manufacturer's standard color palette.
    d. Number of Bowls: Two.
    e. Drain: Chrome-plated individual waste assembly and tailpiece, chrome plated P-trap.
    f. Backsplash and End Splashes: Maximum 2.5" height. Coordinate exact height with Architect.
    g. Unit includes heavy-gage stainless steel mounting bracket, concealed by high impact polymer trap cover.
5. Faucets: LF-1.
   Water Supply: Thermostatic mixing valve assembly
6. Mounting: Off floor on manufacturers standard angled wall brackets with one located on each of countertop and in between each sink bowl.

PART 2 - PRODUCTS

B. Specification Section 14 2423: Elevator: Modify paragraph 2.1.C as follows:

B. Acceptable Elevator Installers

1. Allied Elevator

2. Code Elevator

3. Low Rise Elevator

4. TEC Elevator

4. CLARIFICATIONS:

A. Drawing A-051: First Floor Demolition Plan – Area A: At Toilet at end of Corridor C, add note to remove existing raised floor – coordinate with drawing A-402. At portion of Corridor C adjacent to existing stair to be removed, add note to grind and remove 1" +/- of existing concrete floor to prepare for new concrete topping. Coordinate with Clarification F. below.

B. Drawing A-052: Second Floor Demolition Plan – Area A: At Office at end of Corridor C and adjacent to link to Addition, add note to remove existing wood flooring (including all floor substrate and subflooring to concrete slab below) and prepare to receive new finish floor. Coordinate with Drawing A-702 and Clarification G. below.

C. Drawing A-053: Third Floor Demolition Plan – Area A: At room marked 'Transition Corridor' (currently an office) at end of Corridor C and adjacent to link to Addition, add note to remove existing wood flooring (including all floor substrate and subflooring to concrete slab below) and prepare to receive new finish floor. Coordinate with Drawing A-703 and Clarification H. below.

D. Drawing A-700: Ground Floor Finish Plan - Area A Finish Notes and Material Legend: At Corridor C (link to Addition) delete the reference to 'K6' in the Finish Tag. Provide 12" x 24" Porcelain Wall tile (color TBD) on the new wall (match height of existing wainscot). Provide Porcelain base and cap wall tile to match height and profile of existing wall. Paint walls above PT-2.

E. Drawing A-700: Ground Floor Finish Plan - Area A – Finish Notes and Material Legend: Corridor 'B': Add Concrete Floor Sealer in accordance with General Finish Note 18.

F. Drawing A-701: First Floor Finish Plan - Area A Finish Notes and Material Legend: At Corridor C (link to Addition) delete the Note: Provide Roppe Rubber Floor Tile #96 with circle with rubber base. Provide stamped and polished concrete floor to match existing color and pattern. Provide 12" x 24" Porcelain Wall tile (color TBD) on the new wall (match height of existing wainscot). Provide Porcelain base and cap wall tile to match height and profile of existing wall. Paint walls above PT-2.

G. Drawing A-702: Second Floor Finish Plan - Area A Finish Notes and Material Legend: At Corridor C (link to Addition) delete the Note: Provide Roppe Rubber Floor Tile #96 with circle with rubber base. Provide stamped and polished concrete floor to match existing color and pattern. Provide 12" x 24" Porcelain Wall tile (color TBD) on the new wall (match height of existing wainscot). Provide Porcelain base and cap wall tile to match height and profile of existing wall. Paint walls above PT-2.

H. Drawing A-703: Third Floor Finish Plan - Area A Finish Notes and Material Legend: At Corridor C (link to Addition), provide stamped and polished concrete floor to match existing color and pattern. Provide 12" x 24" Porcelain Wall tile (color TBD) on the new wall (match height of existing wainscot). Provide Porcelain base and cap wall tile to match height and profile of existing wall. Paint walls above PT-2.

I. Drawing A-701: First Floor Finish Plan - Area A: Finish Notes and Material Legend: Auditorium A113: Provide PT-2 all walls. Paint ceiling PT-9.

J. Drawing A-701: First Floor Finish Plan – Area A: Finish Notes and Material Legend: Corridors 'A' and 'B': Provide PT-2 on all walls above wainscot. Paint ceiling PT-9, including box beam coffered components.

K. Drawing A-702: Second Floor Finish Plan – Area A: Finish Notes and Material Legend: Corridors 'A' and 'B': Provide PT-2 on all walls above wainscot. Paint ceiling PT-9, including box beam coffered components.

L. Drawing A-703: Third Floor Finish Plan – Area A: Finish Notes and Material Legend: Corridors 'A' and 'B': Provide PT-2 on all walls above wainscot. Paint ceiling PT-9, including box beam coffered components.

M. Drawing QF 104: Food Service Equipment Special Conditions Plan: The Walk-in Freezer and Refrigerator Units shall be set on the existing concrete floor slab. An interior ramp shall be provided in accordance with the specification. A depressed slab is NOT required.

N. Drawing M-403: Enlarged Plans Mechanical: Note: The General Contractor shall coordinate with the Mechanical Contractor in reference to the brick removal for the new louvers. The GC shall remove brick infill and provide openings for new louvers as illustrated on attached SKA-01.

5. QUESTIONS AND ANSWERS

ADDENDUM 1 QUESTION CLARIFICATIONS:

Question 8: Please provide what is required for the toilet room vanity enclosures and what type of countertop. If the toilet room vanities are solid surface, are the sinks to be integral?
Answer: See changes to Technical Specifications in Section 3 of this Addendum.

Question 20: On the Door/Frame Schedule almost all the Hardware Sets listed differ from the Hardware Spec's. (Example- On the Door Schedule opening STB2.3 has hardware set 9.0 on the spec's the same opening is on set 11) Which should be followed the Door Schedule or Spec?
Answer: See revised Specification Section 08 0671 – Door Hardware Schedule and revised A-600 – Door Schedule and Details.

Question 21: The following openings do not have any hardware sets listed on the Door/Frame Schedule or Spec's: B019, B019A, B019B
Answer: See response to Question 20.

Question 22: Opening - B014, on the door schedule lists Hardware set 5.1 – which does not exist in the spec's.
Answer: See response to Question 20.

Question 51: Please clarify if undermount sinks are to be provided by the Plumbing prime?

Answer: Undermount sinks are not required for the project. See modification to Specification Section 22 4216.13 in Section 3 of this Addendum.

ADDENDUM 2 QUESTIONS:

Question 58: Reference boiler schedule: (F) The Warranty – Weil Mc-Clain will not provide the 5 year warranty to replace any boiler cast iron components? Will the shop drawings be approved without the warranty?
Answer: Per the specifications, the contractor will be responsible for warranty deficiencies.

Question 59: Will school be in session at any time during construction?
Answer: Yes, school is expected to be in session throughout the normal academic year.

Question 60: Is there direct access to the boiler room from the parking lot, we cannot determine from the virtual tour for demolition purposes.
Answer: There is access to outside from Mechanical Room A010. New openings are required for the louvers which will provide access from the play area.

Question 61: Do you know when an amendment will be issued and if the bid date will be extended? Any insight would be greatly appreciated.
Answer: See Addendum No. 1 for Bid Extension.

Question 62: Can existing modular classrooms be moved and utilized at new location, or are we to provide new temporary modular classrooms?
Answer: New Temporary Classroom Trailers are provided by the School District.

Question 63: Is the breaching material required thru the existing vertical chimney to the top of the chimney?
Answer: Yes, breaching material is required.

Question 64: Item #104 Metro Shelving: Item #1.04 Clarify number of tiers.
Answer: 5-Tier.

Question 65: Also, note some of the shelving shown on layout drawing indicate it is on casters? Please verify if casters are required?
Answer: Please provide shelving with casters.

Question 66: Although we are the basis of design for KVU-1 there are many things that we don't offer as shown in the specifications: These specifications are written as though one of our gas fired units was specified. However, this is a hot water coil/ chilled water coil unit. We do not have the following options:

1.) On Board DDC Communications Card
Answer: All controls, sensors, valves and BAS integration shall be by the controls contractor. See M-302.
2.) Surface Mounted Remote Panel w/ Clogged Filter Switch
Answer: See above. Remote panel per the submitted hood. Controls contractor shall coordinate between hood/EF/KVU and provide complete control system.
3.) Temperature Control/ Hot-Cold Water Controls (Controls/ Valves Are By Others)
Answer: All controls, sensors, valves and BAS integration shall be by the controls contractor. See M-302.

4.) Ionization-Type Smoke Detectors Please let me know how I should proceed. As I stated, all of these options are available for out gas fired units. Maybe the engineer copied and pasted a specification and tried to apply it to a hot/cold water unit.

Answer: Smoke detectors shall be duct mounted. See M-207.

Question 67: RFI Per Addendum #1

a. Drawing -054 Note 19: Note states to disconnect PECO power to the three existing classroom trailers. Will SDP do the demolition of aerial cables, masts and utility poles for communications, fire alarm, clocks and speakers? Is the EC responsible to demolish all conduit and wiring on the interior of the existing building feeding these systems? Who is responsible for the masonry patching of holes thru exterior wall?

Answer: EC is responsible for the demolition of all existing communications, fire alarm, clock, and speaker connections from the existing classroom trailers to the existing school including conduit and wiring on the interior of the existing building. Per the Supplementary Conditions, cutting and patching is by each respective trade.

Question 68: Addendum #1 Clarifications Question 1, Contractor Questions 12 and 29

a. What size electrical service is required to each trailer? Existing trailers each have 200 amp, 120/240 volt service.

Answer: Service to be provided by PECO. See response to Question 68b below.

b. Can you provide a sketch detailing how to tap the existing 2 phase 600 amp service to feed the three new trailers?

Answer: The existing service will not be used. PECO will provide the service and determine the secondary voltage.

c. Is the existing service in the building able to handle this additional load?

Answer: Existing service will not be utilized. New service shall be provided for the new classroom trailers as determined by PECO.

d. Do we connect trailers to existing fire alarm system in building or provide new fire alarm for trailers?

Answer: Provide a new Silent Knight (or equivalent) fire alarm panel with SWIFT Wireless capability to serve all three trailers. The trailer fire alarm panel shall have its own wireless communicator.

e. Do we then connect trailers to the new fire alarm system after it is installed and certified?

Answer: No, the trailers are temporary and have their own independent fire alarm system. All fire alarm equipment installed in the trailers shall be disconnected and returned to the SDP at the conclusion of the project prior to the trailers being removed from the site.

f. Devices for the trailers are not shown on the new fire alarm riser.

Answer: A device layout will be provided. Allow for 1 new Silent Knight (or equivalent) fire alarm panel with SWIFT Wireless capability, 1 wireless communicator, 6 SWIFT wireless pull stations, 6 SWIFT wireless smoke detectors, 3 SWIFT wireless notification devices. Cost should include all connections and equipment necessary to provide a complete system.

g. Is the interior wiring in each trailer complete with power panel, fire alarm devices, data outlets or do we bid to install?

Answer: Each classroom trailer is furnished with a power panel. Fire alarm system and devices to be provided as described above in the answers to Parts d. and f. of this question.

EC to provide data/communication connection as follows: Provide (1) 4-strand multi-mode (indoor/outdoor rated) fiber-optic cable from the 2nd floor MDF Room A214A located in the existing school to trailer closest to the school to wall-mounted fiber WIC in trailer closet. Provide 12-port Cat. 6 patch panel and run (4) Cat.6 cables to each trailer. Outlet boxes and conduit provided by trailer company. Network switch provided by the SDP. Contractor responsible for core drilling through wall to get fiber-optic cable to trailer.

h. How many data lines are required in each trailer? Does the EC furnish house phones and clocks for each trailer?

Answer: The trailers are furnished with phones, clocks, and (4) empty data outlets. EC to wire data drops in accordance to response to Question 68 Part g. above.

i. Does the EC include in the bid to demo the power and systems at the conclusion of the contract?

Answer: Yes.

Question 69: Addendum #1: Question #45 Answer

a. What is the extent of demolition of electrical items not shown on any drawings but called out to be done by MEP contractors? How do we bid this note? License & Inspections requires all electrical work to be shown on "E" drawings for me to apply for permits, not an obscure note on an architectural drawing.

Answer: Elevation Drawings A-300 – A-304: General Demolition Notes: Delete Note #6 which refers to MEP demolition work. For all MEP related demolition, see respective MEP discipline demolition drawings for scope of removal and reinstallation.

Question 70: Food Service Equipment, 11400, Item # 1.04 Metro Shelving - Please verify number of shelf tiers required. Some of the shelving shown on the layout drawing indicate that it is on casters, please verify if casters are required.
Answer: See responses to Questions 64 and 65.

Question 71: Drawing C-102 Grading & Utility Plan - there is a 4" Fire Department line by Robbins Street. This line extends through the new meter pit and to the new building. Is this line existing or proposed? Also, where it conflicts with the new meter pit, will this line go under, around or through the pit?
Answer: The 4" fire line is new and is for the freestanding FDC. This line is shown on C-102 as well as FP-001 and FP-102. The only water line required to go through the new meter pit is the 4" domestic water service. The fire service connections are to be parallel to but outside of the meter pit.

Question 72: The meter pit detail 5/C-109 shows a single 8" line in and out. The utility plan shows a dual 8" & 4" line in and out. Please confirm which it is.
Answer: See response to Question 71.

Question 73: 1/C-110 – details for the barrier mounted fence illustrate the lower barrier portion being made of pre-cast concrete. Temporary fencing contractors no longer offer concrete barriers with fence toppers, they now offer high visibility water-filled polyethylene barriers with integrated fence toppers. Please clarify if water-filled polyethylene barriers with integrated fencing are an acceptable alternative.
Answer: Provide concrete barriers as specified. Proposed substitutions are not reviewed or considered during the bidding period. See General Conditions GC-4.23 SUBSTITUTIONS (OR EQUAL) for procedures and requirements. Proposed substitutions must be equivalent to the basis of

design or specified product or equipment, whether from a named manufacturer or not; otherwise, the basis of design or specified product or equipment must be provided.

Question 74: Addendum No. 1, the answers to RFI Questions #40 & #43 indicate that the General Construction Contractor will be responsible for water testing of roof drains. Please reconsider making this work the responsibility of the Plumbing Prime Contractor since the General Construction Contract does not have any Plumbing work within the scope. It would make more sense to have the Plumbing Prime test and troubleshoot any potential leaks within the system they installed.
Answer: The concept is to identify any roof blockage prior to the commencement of the roof replacement work. At that time, the Owner shall be responsible to unclog any identified blockage. Upon completion of the roof work (by General Contractor), and after another water test, the General Contractor shall be responsible for repair/unclogging of any blockage created during the installation.

Question 75: Addendum No. 1, the answer to RFI Question #42 indicates that the General Construction Contractor will be responsible for removal and replacement of all MEP items located on the roof such as MEP equipment, conduits, supports, etc. Please reconsider making this work the responsibility of the MEP Prime Contractors since the General Construction Contract does not have any MEP work within the scope. It will be difficult for GCs to obtain competitive pricing for this MEP removal and replacement work, especially since the scope has not been clearly defined. It will be more economical (and better for coordination) to have the MEP Prime Contractors include this work under their contract. It would also eliminate potential change orders should a dispute arise concerning limits of responsibility between the GC and an MEP Prime, effectively making all MEP work the responsibility of the respective MEP Prime Contractor.
Answer: For all MEP demolition work on the roof, see respective MEP discipline demolition drawings for scope of removal and reinstallation. The respective MEP Contractor shall be responsible for the removal and reinstallation of this MEP equipment, conduits, supports, etc. Coordinate demolition work with new roof work on drawings A-140 through A-146.

REVISED SPECIFICATION SECTIONS:

- Specification 08 0671 – Door Hardware Schedule
- Specification 23 09 00 – Instrumentation and Control for HVAC

REVISED DRAWINGS:

- A-600: Revised hardware sets to correspond with revised Specification Section 08 0671
- FA-101: Updated to show duct smoke detectors and remove motor operated dampers
- FA-107: Added duct mounted smoke detector and interface modules associated with KVU
- M-207: Added duct mounted smoke detector to KVU ductwork
- M-300: Modified Control Network Architecture Schematic
- M-301: Added Classroom Temperature Monitoring
- M-302: Added note indicating KVU controls by controls contractor.
- M-400: Added penetration note and air compressor scope.
- M-401: Added penetration note.
- M-402: Added louver coordination note.
- M-403: Enlarged Plans – Mechanical.
- SKA-01: Louver Reference Image.

End of Addendum 2

BID PROPOSAL FORM (REVISED)
NEW ADDITION AND RENOVATIONS
AT
ETHAN ALLEN ELEMENTARY SCHOOL

Contract No. B-014C of 2017/18 Electrical Construction

TO: The School District of Philadelphia — **OWNER**
Board of Education

Office of Capital Programs — **ADDRESS**
The School District of Philadelphia
440 North Broad Street
Third Floor - Suite 371
Philadelphia, PA 19130-4015

FROM: _____ **CONTRACTOR**
_____ **ADDRESS**
_____
_____ **CITY/STATE**
_____ **CONTACT NAME**
_____ **PHONE NO.**

BASE CONTRACT PROPOSAL:

1. Having become completely familiar with the local conditions affecting the cost of Work at the place where Work is to be executed, and having carefully examined the site conditions as they currently exist, and having carefully examined the Bidding and Contract Documents prepared for this project, together with any Addenda to such Bidding and Contract Documents as listed hereinafter, the Undersigned hereby proposes and agrees to provide all labor, materials, plant, equipment, transportation and other facilities as necessary and/or required to execute all of the Work described by the Contract Documents for the above cited Contract for the lump sum consideration of:

_____Dollars ($_____), said amount being hereinafter referred to as the Base Proposal Amount. Base proposal Amount includes Unit Price Items listed below, if applicable.

BID ALTERNATES (Not applicable to this Contract – No Alternates)

UNIT PRICES: NOT APPLICABLE TO THIS CONTRACT

ALLOWANCES: ALLOWANCE NO.1- This Allowance is for PECO services required to provide electric power to the three new trailers to be provided by SDP, described in Section 01 1000 Summary of Work and elsewhere, and shown on the Electrical Drawings, to be paid in accordance with Section 01 1650 ALLOWANCES.

AMOUNT OF ALLOWANCE INCLUDED IN BASE BID: $25,000.

ACKNOWLEDGEMENT OF RECEIPT OF ADDENDA:

2. The Undersigned acknowledges receipt of the following Addenda (list by number and date appearing on Addenda):

Addendum No.	Date	Addendum No.	Date
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

TIME OF COMPLETION:

3. The Undersigned agrees to Substantially Complete all Work under this Contract within the time periods specified in Division 1, General Requirements, Section 00 1300 entitled “Time of Completion, Milestones and Phasing or Sequencing Requirements”.

INSURANCE:

4. All Bidders are instructed to refer to Article GC-11 of the General Conditions. All Contractors or Subcontractors bidding Work on the Project shall include in their bids the costs of Workers Compensation and Employer’s Liability Insurance, Commercial General Liability Insurance, Automobile Liability Insurance, Excess Umbrella Liability Insurance (Commercial Umbrella Liability Insurance) and any other types of insurance identified in Division 1- General Requirements, Section 01200 (or 01 1200) entitled “ Special Insurance Requirements”.

LIQUIDATED DAMAGES:

5. Upon failure by the Contractor to achieve Substantial Completion within the time specified in Article GC-8 of the General Conditions from the Date of Commencement as set forth in the Notice to Proceed, the Contractor shall pay to the School District, as liquidated damages and not as a penalty, the sum of One Thousand Dollars ($1,000.00) per day for each consecutive calendar day of delay until such time as Substantial Completion of the Work is achieved.

6. In addition, the Contractor shall be responsible for and pay for the cost of completion of construction of the Work, as well as for any and all additional charges of the School District, Architect/Engineer, other Project Contractors, and any other Consultants to the School District relating to the Contractor's failure to achieve Substantial Completion on a timely basis, including, but not limited to, delay damages, disruption damages, acceleration costs or expenses, investigative expenses, consulting fees, experts' fees, and attorneys' fees.

7. The Contractor and the School District agree that the amounts so fixed herein as liquidated damages are reasonable forecasts of just compensation for the harm that will be caused to the School District by the Contractor's breach.

GENERAL STATEMENT:

8. The Undersigned declares that the person or persons signing this Proposal is/are fully authorized to sign on behalf of the firm listed and to fully bind the firm listed to all the Proposal's conditions and provisions thereof.

9. It is agreed that the Undersigned has complied or will comply with all requirements of local, state, and federal laws, and that no legal requirement has been or will be violated in making or accepting this Proposal, in awarding the Contract to it and/or in prosecution of the Work.

10. Bid Security in the amount of ten percent (10%) of the Base Bid, plus all additive Alternates Proposal amounts, is attached hereto and made a part hereof, without endorsement, in the sum of _____ Dollars ($_____), which shall become the property of the School District in the event the Contract and Performance Bond and Labor and Materialmen's Bond are not executed within the time set forth, as liquidated damages.

11. The Undersigned further agrees within five (5) calendar days from date of Notice of Acceptance of this Proposal or Contract award, to sign and deliver to the School District, all required copies of the School District/Contractor Agreement, the Performance Bond, the Labor and Materialmen's Bond, and the Maintenance Bond, in

the forms included in the Bidding Documents, and the policies of insurance or insurance certificates as required by the General Conditions. In case the undersigned fails or neglects to deliver within the specified time the School District/Contractor Agreement, the Performance Bond, the Labor and Materialmen's Bond, and the Maintenance Bond, and the insurance policies or certificates, all as aforesaid, the undersigned shall be considered as having abandoned the Contract, and the Bid Bond accompanying this Proposal shall be forfeited to the School District by reason of such failure on the part of the undersigned, as liquidated damages and not as a penalty.

12. The Undersigned further agrees that the Bid Security may be retained by the School District and shall remain with the School District until the School District/Contractor Agreement has been signed and delivered to the School District and the Performance Bond, the Labor and Materialmen's Bond, and the Maintenance Bond, and insurance policies or certificates have been made and delivered to the School District.

Respectfully submitted this _____day of _____, 201_.

Individual Proprietorship or Partnership

If Contractor is an individual proprietorship or is a partnership, sign here:

_____
(Trade Name of Firm)

By: _____ By: _____ (SEAL)
(Witness) (Owner or Partner)

Corporation

If Contractor is a corporation, sign here:

_____
(Name of Corporation)

ATTEST:

By: _____ By: _____ (SEAL)
(Secretary or Treasurer) (President or Vice President)

(CORPORATE SEAL)

Signature by anyone other than the President or Vice President and the Secretary or Treasurer of the Corporation must be accompanied by a power of attorney, executed by the proper corporate officers under the corporate seal indicating authority to execute this Bid.

SECTION 08 0671 – DOOR HARDWARE SETS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section references specification sections relating to commercial door hardware for the following:

1. Swinging doors.
2. Sliding Doors.
3. Other doors to the extent indicated.

B. Commercial door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical and access control door hardware.
3. Electromechanical and access control door hardware power supplies, back-ups and surge protection.
4. Automatic operators.
5. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Hollow Metal Doors and Frames”.
2. Division 08 Section “Door Hardware”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. State Building Codes, Local Amendments.

E. Standards: Reference Related Sections for requirements regarding compliance with applicable industry standards.

1.2 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

a. Type, style, function, size, label, hand, and finish of each door hardware item.
b. Manufacturer of each item.
c. Fastenings and other pertinent information.
d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
e. Explanation of abbreviations, symbols, and codes contained in schedule.
f. Mounting locations for door hardware.
g. Door and frame sizes and materials.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.

D. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service representatives. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.

F. Warranties and Maintenance: Special warranties and maintenance agreements specified in the Related Sections.

1.3 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum [5] years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Installer Qualifications: Installers, trained by the primary product manufacturers, with a minimum [3] years documented experience installing both standard and electrified builders hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum [5] years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor in good standing by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

D. Source Limitations: Obtain each type and variety of Door Hardware specified in the Related Sections from a single source, qualified supplier unless otherwise indicated.

E. Regulatory Requirements: Comply with NFPA 70, NFPA 80, NFPA 101 and ANSI A117.1 requirements and guidelines as directed in the applicable model building code.

F. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.5 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door and Frame Preparation: Division 08 Sections (Steel, Aluminum and Wood) doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.6 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

1.7 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. Refer to “PART 3 – EXECUTION” for required specification sections.

PART 3 - EXECUTION

3.1 DOOR HARDWARE SETS

A. The door hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

B. The supplier is responsible for handing and sizing all products and providing the correct option for the appropriate door type and material where more than one is presented in the hardware sets. Quantities listed are for each pair of doors, or for each single door.

C. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

D. Products listed in the Door Hardware Sets must meet the requirements described in the specification sections noted.

1. Section 08 71 00 – Door Hardware.

E. Manufacturer's Abbreviations:

1. MK - McKinney
2. MR - Markar
3. RO - Rockwood
4. YA - Yale
5. RU - Corbin Russwin
6. RF - Rixson
7. NO - Norton
8. PE - Pemko

Hardware Sets

Set: 1.0

Doors: B001, B001A, B006B

2	Continuous Hinge	FS302	630	MR
1	Exit Device (nightlatch)	ED4800 K157ET M52	630	RU

1	Exit Device (exit only)	ED4800 EO M52	630	RU
3	Interchangeable Core	CR8027 PYRAMID	626	RU
1	Door Pull	RM3301-48	US32D	RO
2	Overhead Stop	1-X36 (heavy duty concealed)	630	RF
2	Surface Closer	(P/PRO)7500 M	689	NO
2	Closer Plates	as required	689	NO
1	Threshold	273x3AFG MSES25SS		PE
1	Gasketing	by door supplier		

Notes:
• Opening(s) can be dogged down for push/pull operation via cylinder dogging.

Set: 2.0

1	Continuous Hinge	FS302	630	MR
1	Exit Device (exit only)	ED4200 EO	630	RU
1	Overhead Stop	1-X36 (heavy duty concealed)	630	RF
1	Surface Closer	(P/PRO)7500 M	689	NO
1	Closer Plates	as required	689	NO
1	Threshold	273x3AFG MSES25SS		PE
1	Gasketing	by door supplier		

Notes:
• NO DOORS CURRENTLY IN THIS SET.

Set: 3.0

Doors: B011C, STA1.1, STA2.1

2	Continuous Hinge	FS302	630	MR
2	Exit Device (exit only)	ED5400 EO	630	RU
2	Overhead Stop	1-X36 (heavy duty concealed)	630	RF
2	Surface Closer	(P/PRO)7500 M	689	NO
2	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Threshold	273x3AFG MSES25SS		PE
1	Gasketing	29313CPK TKSP8		PE
2	Door Bottom	217AV TKSP8		PE
1	Astragal	29324CNB TKSP8		PE

Set: 3.1

Doors: A050, A113C, A113D, A113E, A113F

2	Continuous Hinge	FS302	630	MR
1	Exit Device (nightlatch)	ED5400 K157ET M52	630	RU
1	Exit Device (exit only)	ED5400 EO M52	630	RU
3	Interchangeable Core	CR8027 PYRAMID	626	RU
2	Door Pull	RM3301-24	US32D	RO
2	Overhead Stop	1-X36 (heavy duty concealed)	630	RF
2	Surface Closer	(P/PRO)7500 M	689	NO
2	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Threshold	273x3AFG MSES25SS		PE
1	Gasketing	29313CPK TKSP8		PE
2	Door Bottom	217AV TKSP8		PE
1	Astragal	29324CNB TKSP8		PE

Notes:
• Opening(s) can be dogged down for push/pull operation via cylinder dogging.

Set: 4.0

Doors: STB1.0A, STB2.0A

1	Continuous Hinge	FS302	630	MR
1	Exit Device (exit only)	ED5200(A) EO	630	RU
1	Overhead Stop	1-X36 (heavy duty concealed)	630	RF
1	Surface Closer	(P/PRO)7500 M	689	NO
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Threshold	273x3AFG MSES25SS		PE
1	Gasketing	29313CPK TKSP8		PE
1	Door Bottom	217AV TKSP8		PE

Set: 4.1

Doors: A010, B013A

2	Continuous Hinge	FS302	630	MR
2	Flush Bolt	555/557	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Storeroom Lock	R AU 5405LN	626	YA
1	Surface Closer	(P/PRO)7500 M	689	NO
2	Kick Plate	K1050 10" 4BE CSK	US32D	RO

2	Door Stop	403/441CU	US26D	RO
1	Threshold	273x3AFG MSES25SS		PE
1	Gasketing	29313CPK TKSP8		PE
1	Astragal	29324CNB TKSP8		PE

Set: 4.2

Doors: B013B, B014, STB1.4

1	Continuous Hinge	FS302	630	MR
1	Storeroom Lock	R AU 5405LN	626	YA
1	Surface Closer	(P/PRO)7500 M	689	NO
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Door Stop	403/441CU	US26D	RO
1	Threshold	273x3AFG MSES25SS		PE
1	Gasketing	29313CPK TKSP8		PE

Set: 5.0

1	Continuous Hinge	FS302	630	MR
1	Intruder Lock	R AU 5418LN	626	YA
1	Surface Closer	(P/PRO)7500 M	689	NO
1	Closer Plates	as required	689	NO
1	Door Stop	403/441CU	US26D	RO

Notes:
• NO DOORS CURRENTLY IN THIS SET.

Set: 6.0

Doors: B001B, B001C, B006A

2	Continuous Hinge	FS302	630	MR
4	Door Pull	RM3301-48	US32D	RO
2	Overhead Stop	1-X36 (heavy duty concealed)	630	RF
2	Surface Closer	(P/PRO)7500 M	689	NO
2	Closer Plates	as required	689	NO
2	Sign	RM1110H (PUSH)	US32D	RO
2	Sign	RM1110L (PULL)	US32D	RO

Set: 7.0

1	Continuous Hinge	FS302	630	MR
2	Door Pull	RM3301-48	US32D	RO
1	Overhead Stop	1-X36 (heavy duty concealed)	630	RF
1	Surface Closer	(P/PRO)7500 M	689	NO
1	Closer Plates	as required	689	NO
1	Sign	RM1110H (PUSH)	US32D	RO
1	Sign	RM1110L (PULL)	US32D	RO

Notes:
• NO DOORS CURRENTLY IN THIS SET.

Set: 8.0

Doors: A003, A005, B011A, B011B

6	Hinge (heavy weight)	T4A3786	US26D	MK
2	Exit Device (classroom)	ED5470(B) N955ET M55	630	RU
2	Interchangeable Core	CR8027 PYRAMID	626	RU
2	Overhead Stop	1-X36 (heavy duty concealed)	630	RF
2	Surface Closer	(P/PRO)7500 M	689	NO
2	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Gasketing	S44BL (rated openings)		PE
1	Astragal	29324CNB TKSP8 (rated openings)		PE
2	Silencer	608 (non-rated openings)		RO

Set: 9.0

3	Hinge (heavy weight)	T4A3786	US26D	MK
1	Exit Device (classroom)	ED5200(A) N955ET	630	RU
1	Interchangeable Core	CR8027 PYRAMID	626	RU
1	Overhead Stop	1-X36 (heavy duty concealed)	630	RF
1	Surface Closer	(P/PRO)7500 M	689	NO
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Gasketing	S44BL (rated openings)		PE
3	Silencer	608 (non-rated openings)		RO

Notes:
• NO DOORS CURRENTLY IN THIS SET.

Set: 10.0

Doors: B001E, B201, B301

2	Continuous Hinge	FS302	630	MR
2	Exit Device (passage)	ED5470(B) N910ET M55	630	RU
2	Surface Closer	(P/PRO)7500 M	689	NO
2	Kick Plate	K1050 10" 4BE CSK	US32D	RO
2	Door Stop	403/441CU	US26D	RO
1	Gasketing	S44BL (rated openings)		PE
1	Astragal	29324CNB TKSP8		PE
2	Silencer	608 (non-rated openings)		RO

Set: 11.0

Doors: STB1.0, STB1.1, STB1.2, STB1.3, STB2.0, STB2.2, STB2.3

1	Continuous Hinge	FS302	630	MR
1	Exit Device (passage)	ED5200(A) N910ET	630	RU
1	Surface Closer	(P/PRO)7500 M	689	NO
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Door Stop	403/441CU	US26D	RO
1	Gasketing	S44BL (rated openings)		PE
3	Silencer	608 (non-rated openings)		RO

Set: 12.0

Doors: B210, B214

6	Hinge (heavy weight)	T4A3786	US26D	MK
2	Flush Bolt	555/557	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Storeroom Lock	R AU 5405LN	626	YA
1	Surface Closer	(P/PRO)7500 M	689	NO
2	Kick Plate	K1050 10" 4BE CSK	US32D	RO
2	Door Stop	403/441CU	US26D	RO
1	Gasketing	S44BL (rated openings)		PE
1	Astragal	29324CNB TKSP8 (rated openings)		PE
2	Silencer	608 (non-rated openings)		RO

Set: 13.0

Doors: A007

3	Hinge (heavy weight)	T4A3786	US26D	MK
1	Storeroom Lock	R AU 5405LN	626	YA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Door Stop	403/441CU	US26D	RO
3	Silencer	608		RO

Set: 14.0

Doors: B302

3	Hinge (heavy weight)	T4A3786	US26D	MK
1	Storeroom Lock	R AU 5405LN	626	YA
1	Overhead Stop	10-X36 (surface)	630	RF
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
3	Silencer	608		RO

Set: 15.0

Doors: A005A, B302A

3	Hinge (heavy weight)	T4A3786	US26D	MK
1	Storeroom Lock	R AU 5405LN	626	YA
1	Surface Closer	(P/PRO)7500 M	689	NO
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Door Stop	403/441CU	US26D	RO
1	Gasketing	S44BL (rated openings)		PE
3	Silencer	608 (non-rated openings)		RO

Set: 16.0

Doors: B102, B103

3	Hinge (heavy weight)	T4A3786	US26D	MK
1	Storeroom Lock	R AU 5405LN	626	YA
1	Surface Closer	CPS7500 M (stop arm)	689	NO
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Gasketing	S44BL (rated openings)		PE
3	Silencer	608 (non-rated openings)		RO

Set: 17.0

Doors: A112A, B010

3	Hinge (heavy weight)	T4A3786	US26D	MK
1	Entry/Office Lock	R AU 5407LN	626	YA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Door Stop	403/441CU	US26D	RO
3	Silencer	608		RO

Set: 18.0

6	Hinge (heavy weight)	T4A3786	US26D	MK
2	Flush Bolt	555/557	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Classroom Lock	R AU 5408LN	626	YA
2	Kick Plate	K1050 10" 4BE CSK	US32D	RO
2	Door Stop	403/441CU	US26D	RO
2	Silencer	608		RO

Notes:
• NO DOORS CURRENTLY IN THIS SET.

Set: 19.0

Doors: B012

6	Hinge (heavy weight)	T4A3786	US26D	MK
2	Flush Bolt	555/557	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Classroom Lock	R AU 5408LN	626	YA
2	Overhead Stop	10-X36 (surface)	630	RF
2	Kick Plate	K1050 10" 4BE CSK	US32D	RO
2	Silencer	608		RO

Set: 20.0

Doors: A110D

3	Hinge (heavy weight)	T4A3786	US26D	MK
1	Classroom Lock	R AU 5408LN	626	YA
1	Overhead Stop	10-X36 (surface)	630	RF

1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
3	Silencer	608		RO

Set: 20.1

Doors: B010A, B010B

3	Hinge (heavy weight)	T4A3786	US26D	MK
1	Classroom Lock	R AU 5408LN	626	YA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Door Stop	403/441CU	US26D	RO
3	Silencer	608		RO

Set: 21.0

Doors: A006A

3	Hinge (heavy weight)	T4A3786	US26D	MK
1	Classroom Lock	R AU 5408LN	626	YA
1	Surface Closer	(P/PRO)7500 M	689	NO
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Door Stop	403/441CU	US26D	RO
1	Gasketing	S44BL (rated openings)		PE
3	Silencer	608 (non-rated openings)		RO

Set: 22.0

Doors: A101, A102, A104, A106, A108, A109, A110E, A203, A204, A212, A303, B019, B019A, B105, B207, B208, B209, B211, B212, B213, B307, B308, B309, B311, B312, B313

3	Hinge (heavy weight)	T4A3786	US26D	MK
1	Intruder Lock	R AU 5418LN	626	YA
1	Surface Closer	(P/PRO)7500 M	689	NO
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Door Stop	403/441CU	US26D	RO
1	Gasketing	S44BL (rated openings)		PE
3	Silencer	608 (non-rated openings)		RO

Set: 23.0

Doors: B005, B202

3	Hinge (heavy weight)	T4A3786	US26D	MK

1	Corridor Lock	R AU 5422LN	626	YA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Door Stop	403/441CU	US26D	RO
3	Silencer	608		RO
1	Coat Hook	RM802	US26D	RO

Set: 24.0

Doors: A001B

3	Hinge (heavy weight)	T4A3786	US26D	MK
1	Privacy Set	AU 5402LN	626	YA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Door Stop	403/441CU	US26D	RO
3	Silencer	608		RO
1	Coat Hook	RM802	US26D	RO

Set: 25.0

3	Hinge (heavy weight)	T4A3786	US26D	MK
1	Passage Set	AU 5401LN	626	YA
1	Overhead Stop	10-X36 (surface)	630	RF
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
3	Silencer	608		RO

Notes:
• NO DOORS CURRENTLY IN THIS SET.

Set: 25.1

Doors: A001C

3	Hinge (heavy weight)	T4A3786	US26D	MK
1	Passage Set	AU 5401LN	626	YA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Door Stop	403/441CU	US26D	RO
3	Silencer	608		RO

Set: 25.2

Doors: B019B

6	Hinge (heavy weight)	T4A3786	US26D	MK
2	Roller Latch	592	US26D	RO
2	Dummy Trim	AU 455LN	626	YA
2	Overhead Stop	10-X36 (surface)	630	RF
2	Kick Plate	K1050 10" 4BE CSK	US32D	RO

Set: 26.0

2	Hinge (spring)	1502	US26D	MK
1	Door Stop	403/441CU	US26D	RO

Notes:
• NO DOORS CURRENTLY IN THIS SET.

Set: 27.0

Doors: A100

3	Hinge (heavy weight)	T4A3786	US26D	MK
1	Door Pull	RM3301-24	US32D	RO
1	Push Plate	RM1030H	US32D	RO
1	Surface Closer	(P/PRO)7500 M	689	NO
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Door Stop	403/441CU	US26D	RO
3	Silencer	608 (non-rated openings)		RO

END OF SECTION 08 0671

SECTION 23 0900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section

1.2 SCOPE OF WORK

A. General: The control system shall consist of a high-speed, peer-to-peer network of DDC controllers, a control system server, and a web-based operator interface.

B. System software shall be based on a server/thin client architecture, designed around the open standards of web technology. The control system server shall be accessed using a Web browser over the control system network, the owner's local area network, and (at the owner's discretion) over the Internet.

C. The intent of the thin-client architecture is to provide operators complete access to the control system via a Web browser. No special software other than a web browser shall be required to access graphics, point displays, and trends, configure trends, configure points and controllers, or to download programming into the controllers.

D. System shall use the BACnet protocol for communication to the operator workstation or web server and for communication between control modules. I/O points, schedules, setpoints, trends and alarms specified in control drawings shall be BACnet objects.

1.3 QUALITY ASSURANCE

A. Installer and Manufacturer Qualifications

1. Installer shall have an established working relationship with Control System Manufacturer.

2. Installer shall have successfully completed Control System Manufacturer’s control system training. Upon request, Installer shall present record of completed training including course outlines.

1.4 CODES AND STANDARDS

A. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authorities' codes and ordinances or these plans and specifications. As a minimum, the installation shall comply with the current editions in effect 30 days prior to the receipt of bids of the following codes:

1. National Electric Code (NEC)

2. International Building Code (IBC)
   a. Section 719 Ducts and Air Transfer Openings
   b. Section 907 Fire Alarm and Detection Systems
   c. Section 909 Smoke Control Systems

d. Chapter 28 Mechanical

3. International Mechanical Code (IMC)

4. ANSI/ASHRAE Standard 135, BACnet - A Data Communication Protocol for Building Automation and Control Systems

1.5 SYSTEM PERFORMANCE

A. Performance Standards. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for operator workstation (server and browser for web-based systems).

1. Graphic Display.A graphic with 20 dynamic points shall display with current data within 10 sec.

2. Graphic Refresh.A graphic with 20 dynamic points shall update with current data within 8 sec. and shall automatically refresh every 15 sec.

3. Configuration and Tuning Screens. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 sec.

4. Object Command. Devices shall react to command of a binary object within 2 sec. Devices shall begin reacting to command of an analog object within 2 sec.

5. Alarm Response Time. An object that goes into alarm shall be annunciated at the workstation within 45 sec.

6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 sec. Select execution times consistent with the mechanical process under control.

7. Performance. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per sec. Select execution times consistent with the mechanical process under control.

8. Multiple Alarm Annunciation. Each workstation on the network shall receive alarms within 5 sec of other workstations.

9. Reporting Accuracy. System shall report values with minimum end-to-end accuracy listed in Table 1.

10. Control Stability and Accuracy. Control loops shall maintain measured variable at setpoint within tolerances listed in Table 2.

Table-1
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	±0.15º (±0.25ºF)

Relative Humidity	±5% 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	±1% of reading (see Note 3)
Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO2)	±50 ppm

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

Table 2
Control Stability and Accuracy

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

1.6 SUBMITTALS

A. Product Data and Shop Drawings: Meet requirements of Section 01 30 00 on Shop Drawings, Product Data, and Samples. In addition, the contractor shall provide shop drawings or other submittals on hardware, software, and equipment to be installed or provided. No work may begin on any segment of this project until submittals have been approved for conformity with design intent. Provide drawings as AutoCAD compatible files on magnetic or optical disk (file format: .DWG, .DXF, .VSD, or comparable) and three 11" x 17" prints of each drawing. When manufacturer's cutsheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawing shall clearly reference the specification and/or drawing that the submittal is to cover. General catalogs shall not be accepted as cutsheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work. Submittal approval does not relieve Contractor of responsibility to supply sufficient quantities to complete work. Submittals shall be provided within 12 weeks of contract award. Submittals shall include:

1. DDC System Hardware
   a. A complete bill of materials to be used indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.
   b. Manufacturer's description and technical data such as performance curves, product specifications, and installation and maintenance instructions for items listed below and for relevant items not listed below:
      1) Direct digital controllers (controller panels)

2) Transducers and transmitters
3) Sensors (including accuracy data)
4) Actuators
5) Valves
6) Relays and switches
7) Control panels
8) Power supplies
9) Batteries
10) Operator interface equipment
11) Wiring

c. Wiring diagrams and layouts for each control panel. Show termination numbers.
d. Schematic diagrams for all field sensors and controllers. Provide floor plans of all sensor locations and control hardware. Riser diagrams showing control network layout, communication protocol, and wire types.

2. Central System Hardware and Software
a. A complete bill of material of equipment used indicating quantity, manufacturer, model number, and relevant technical.
b. Manufacturer's description and technical data such as product specifications and installation and maintenance instructions for items listed below and for relevant items furnished under this contract not listed below:
1) Central Processing Unit (CPU) or web server
2) Monitors
3) Keyboards
4) Power supplies
5) Battery backups
6) Interface equipment between CPU or server and control panels
7) Operating System software
8) Operator interface software
9) Color graphic software
10) Third-party software
c. Schematic diagrams for all control, communication, and power wiring. Provide a schematic drawing of the central system installation. Label all cables and ports with computer manufacturers' model numbers and functions. Show interface wiring to control system.
d. Network riser diagrams of wiring between central control unit and control panels.

3. Controlled Systems
a. Riser diagrams showing control network layout, communication protocol, and wire types.
b. A schematic diagram of each controlled system. The schematics shall have all control points labeled with point names shown or listed. The schematics shall graphically show the location of all control elements in the system.
c. A schematic wiring diagram of each controlled system. Label control elements and terminals. Where a control element is also shown on control system schematic, use the same name.
d. An instrumentation list (Bill of Materials) for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.
e. A mounting, wiring, and routing plan-view drawing. The design shall take into account HVAC, electrical, and other systems' design and elevation requirements. The drawing shall show the specific location of all concrete pads and bases and any special wall bracing for panels to accommodate this work.
f. A complete description of the operation of the control system, including sequences of operation. The description shall include and reference a schematic diagram of the controlled system.
g. A point list for each control system. List I/O points and software points specified in control drawings. Indicate alarmed and trended points.

4. Quantities of items submitted shall be reviewed but are the responsibility of the Contractor.

5. A description of the proposed process along with all report formats and checklists to be used in Section 23 09 00 Article 3.16 (Control System Demonstration and Acceptance).

6. BACnet Protocol Implementation Conformance Statement (PICS) for each submitted type of controller and operator interface.

B. Schedules

1. Within one month of contract award, provide a schedule of the work indicating the following:
   a. Intended sequence of work items
   b. Start date of each work item
   c. Duration of each work item
   d. Planned delivery dates for ordered material and equipment and expected lead times
   e. Milestones indicating possible restraints on work by other trades or situations

2. Monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated schedule of work.

C. Project Record Documents. Upon completion of installation, submit three copies of record (as-built) documents. The documents shall be submitted for approval prior to final completion and shall include:

1. Project Record Drawings. As-built versions of submittal shop drawings provided as AutoCAD compatible files on magnetic or optical media (file format: .DWG, .DXF,VSD, or comparable) and as 11" x 17" prints.

2. Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements of Section 23 09 00 Article 3.16 (Control System Demonstration and Acceptance).

3. Operation and Maintenance (O&M) Manual.

4. As-built versions of submittal product data.

5. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.

6. Operator's manual with procedures for operating control systems: logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.

7. Programming manual or set of manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.

8. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.

9. Documentation of programs created using custom programming language including setpoints, tuning parameters, and object database. Electronic copies of programs shall meet this requirement if control logic, setpoints, tuning parameters, and objects can be viewed using furnished programming tools.

10. Graphic files, programs, and database on magnetic or optical media.

11. List of recommended spare parts with part numbers and suppliers.

12. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.

13. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation or web server software, and graphics software.

14. Licenses, guarantees, and warranty documents for equipment and systems.

15. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.

D. Training Materials: Provide course outline and materials for each class at least six weeks before first class. Training shall be furnished via instructor-led sessions, computer-based training, or web-based training. Engineer will modify course outlines and materials if necessary to meet Owner's needs. Engineer will review and approve course outlines and materials at least three weeks before first class.

1.7 WARRANTY

A. Warrant work as follows:

1. Warrant labor and materials for specified control system free from defects for a period of 24 months after final acceptance. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request.

2. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.

3. If the engineer determines that equipment and systems operate satisfactorily at the end of final start-up, testing, and commissioning phase, the engineer will certify in writing that control system operation has been tested and accepted in accordance with the terms of this specification. Date of acceptance shall begin warranty period.

4. Provide updates to operator workstation or web server software, project-specific software, graphic software, database software, and firmware that resolve the contractor-identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.

5. Exception: Contractor shall not be required to warrant reused devices except those that have been rebuilt or repaired. Installation labor and materials shall be warranted. Demonstrate operable condition of reused devices at time of Engineer's acceptance.

1.8 OWNERSHIP OF PROPRIETAY MATERIAL

A. Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:

1. Graphics

2. Record drawings

3. Database

4. Application programming code

5. Documentation

1.9 DEFINITIONS

Term	Definition
BACnet Interoperability Building Blocks (BIBB)	A BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBS are combined to build the BACnet functional requirements for a device in a
BACnet/BACnet Standard	BACnet communication requirements as defined by the latest version of ASHRAE/ANSI 135 and approved addenda.

Control Systems Server	A computer(s) that maintain(s) the systems configuration and programming database.
Controller	Intelligent stand-alone control device. Controller is a generic reference to building controllers, custom application control- lers, and application specific controllers.
Direct Digital Control	Microprocessor-based control including Analog/Digital conver- sion and program logic.
Gateway	Bi-directional protocol translator connecting control systems that use different communication protocols.
Local Area Network	Computer or control system communications network limited to local building or campus.
Master-Slave/Token Pass-	Data link protocol as defined by the BACnet standard.
Point-to-Point	Serial communication as defined in the BACnet standard.
Term	Definition
Primary Controlling LAN	High speed, peer-to-peer controller LAN connecting BCs and optionally AACs and ASCs. Refer to System Architecture be-
Protocol Implementation Conformance Statement	A written document that identifies the particular options speci- fied by BACnet that are implemented in a device.
Router	A device that connects two or more networks at the network
Wiring	Raceway, fittings, wire, boxes and related items.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements provide a control system, with products manufactured and installed by one of the following:

1. EcoSave Automation: Joel Nace – Basis of Design

2. Siemens. Corporate Branch Office

3. Johnson Controls. Corporate Branch Office.

2.2 MATERIALS

A. Use new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner. Spare parts shall be available for at least five years after completion of this contract.

2.3 COMMUNICATION

A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ANSI/ASHRAE Standard 135, BACnet.

B. Install new wiring and network devices as required to provide a complete and workable control network.

C. Use existing Ethernet backbone for network segments marked "existing" on project drawings.

D. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.

E. Internetwork operator interface and value passing shall be transparent to internetwork architecture.

1. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, and control algorithms shall be viewable and editable from each internetwork controller.

2. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute control strategies specified in control drawings. An authorized operator shall be able to edit cross- controller links by typing a standard object address or by using a point-and-click interface.

F. Workstations, Building Control Panels, and Controllers with real-time clocks shall use the BACnet Time Synchronization service. System shall automatically synchronize system clocks daily from an operator-designated device via the internetwork. The system shall automatically adjust for daylight saving and standard time as applicable.

G. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.

H. System shall support Web services data exchange with any other system that complies with XML (extensible markup language) and SOAP (simple object access protocol) standards. Web services support shall as a minimum be provided at the workstation or web server level and shall enable data to be read from or written to the system.

1. System shall support Web services read data requests by retrieving requested trend data or point values (I/O hardware points, analog value software points, or binary value software points) from any system controller or from the trend history database.

2. System shall support Web services write data request to each analog and binary object that can be edited through the system operator interface by downloading a numeric value to the specified object.

3. For read or write requests, the system shall require user name and password authentication and shall support SSL (Secure Socket Layer) or equivalent data encryption.

4. System shall support discovery through a Web services connection or shall provide a tool available through the Operator Interface that will reveal the path/identifier needed to allow a third party Web services device to read data from or write data to any object in the system which supports this service.

2.4 OPERATOR INTERFACE

A. Operator Interface. Web server shall reside on high-speed network with building controllers. Each standard browser connected to server shall be able to access all system information. The Operator Workstation or server shall conform to the BACnet Operator Workstation (B- OWS) or BACnet Advanced Workstation (B-AWS) device profile as specified in ASHRAE/ANSI 135 BACnet Annex L.

B. Communication. Web server or workstation and controllers shall communicate using BACnet protocol. Web server or workstation and control network backbone shall communicate using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing as specified in ANSI/ASHRAE 135, BACnet Annex J.

C. Hardware.

1. Workstation or web server. Industry-standard hardware shall meet or exceed DDC system manufacturer's recommended specifications and shall meet response times specified elsewhere in this document. The following hardware requirements also apply:
   a. The hard disk shall have sufficient memory to store:
      1) All required operator workstation software.
      2) A DDC database at least twice the size of the delivered system database.
      3) One year of trend data based on the points specified to be trended at their specified trend intervals.
   b. Provide additional hardware (communication ports, video drivers, network interface cards, cabling, etc.) to facilitate all control functions and software requirements specified for the DDC system.
   c. Minimum hardware configuration shall include the following:
      1) Quad Core Processor
      2) 8 GB RAM
      3) 1 TB hard disk providing data at 3.0 Gb/sec
      4) 16x DVD+/-RW drive
      5) Serial, parallel, and network communication ports and cables as required for proper DDC system operation

D. System Software.

1. Operating System. Web server or workstation shall have an industry-standard professional-grade operating system. Operating system shall meet or exceed the DDC System manufacturers minimum requirements for their software. Acceptable systems include Microsoft Windows 10 or 8, Microsoft Vista, Windows Server 2008 or 2012, Red Hat Enterprise Linux, or Ubuntu Desktop 12.04.

2. System Graphics. The operator interface software shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using dynamic colors to represent zone temperature relative to zone setpoint.
   a. Functionality. Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point-and-click navigation between zones or equipment, and to edit setpoints and other specified parameters.
   b. Animation. Graphics shall be able to animate by displaying different image files for changed object status.
   c. Alarm Indication. Indicate areas or equipment in an alarm condition using color or other visual indicator.
   d. Format. Graphics shall be saved in an industry-standard format such as BMP, JPEG, PNG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in or shall only require widely available no-cost plug-ins (such as Adobe Flash).

3. Custom Graphics. Custom graphic files shall be created with the use of a graphics generation package furnished with the system. The graphics generation package shall be a graphically based system that uses the mouse to create and modify graphics that are saved in the same formats as are used for system graphics.

4. Graphics Library. Furnish a complete library of standard HVAC equipment graphics such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. This library also shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. The library shall be furnished in a file format compatible with the graphics generation package program.

E. System Applications. System shall provide the following functionality to authorized operators as an integral part of the operator interface or as stand-alone software programs. If furnished as part of the interface, the tool shall be available from each workstation or web browser interface. If furnished as a stand-alone program, software shall be installable on standard IBM-compatible PCs with no limit on the number of copies that can be installed under the system license.

1. Automatic System Database Configuration. Each workstation or web server shall store on its hard disk a copy of the current system database, including controller firmware and software. Stored database shall be automatically updated with each system configuration or controller firmware or software change.

2. Manual Controller Memory Download. Operators shall be able to download memory from the system database to each controller.

3. System Configuration. The workstation software shall provide a method of configuring the system. This shall allow for future system changes or additions by users under proper password protection. Operators shall be able to configure the system.

4. On-Line Help. Provide a context-sensitive, on-line help system to assist the operator in operating and editing the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext.

5. Security. Each operator shall be required to log on to the system with user name and password in order to view, edit, add, or delete data.
   a. Operator Access. The user name and password combination shall define accessible viewing, editing, adding, and deleting privileges for that operator. Users with system administrator rights shall be able to create new users and edit the privileges of all existing users. System Administrators shall also be able to vary and deny each operator's privileges based on the geographic location of the equipment, such as the ability to edit operating parameters in Building A, to view but not edit parameters in Building B, and to not even see equipment in Building C.
   b. Automatic Log Out. Automatically log out each operator if no keyboard or mouse activity is detected. This auto logoff time shall be user adjustable.
   c. Encrypted Security Data. Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.

6. System Diagnostics. The system shall automatically monitor the operation of all building management panels and controllers. The failure of any device shall be annunciated to the operator.

7. Alarm Processing. System input and status objects shall be configurable to alarm on departing from and on returning to normal state. Operator shall be able to enable or disable each alarm and to configure alarm limits, alarm limit differentials, alarm states, and alarm reactions for each system object. Configure and enable alarm points as specified in control drawings. Alarms shall be BACnet alarm objects and shall use BACnet alarm services.

8. Alarm Messages. Alarm messages shall use the English language descriptor for the object in alarm in such a way that the operator will be able to recognize the source, location, and nature of the alarm without relying on acronyms or mnemonics.

9. Alarm Reactions. Operator shall be able to configure (by object) what, if any actions are to be taken during an alarm. As a minimum, the workstation or web server shall be able to log, print, start programs, display messages, send e-mail, send page, and audibly annunciate.

10. Alarm and Event log. Operators shall be able to view all system alarms and changes of state from any location in the system. Events shall be listed chronologically. An operator with the proper security level may acknowledge and delete alarms, and archive closed alarms to the workstation or web server hard disk.

11. Trend Logs. The operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs. Controller shall sample and store trend data and shall be able to archive data to the hard disk. Configure trends as specified in Section control drawings. Trends shall be BACnet trend objects.

12. Object and Property Status and Control. Provide a method for the operator to view, and edit if applicable, the status of any object or property in the system. The status shall be available by menu, on graphics, or through custom programs.

13. Reports and Logs. Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs.

14. Standard Reports. Furnish the following standard system reports:
    a. Objects. System objects and current values filtered by object type, by status (in alarm, locked, normal), by equipment, by geographic location, or by combination of filter criteria.
    b. Alarm Summary. Current alarms and closed alarms. System shall retain closed alarms for an adjustable period.
    c. Logs. System shall log the following to a database or text file and shall retain data for an adjustable period:
        1) Alarm History.
        2) Trend Data. Operator shall be able to select trends to be logged.
        3) Operator Activity. At a minimum, system shall log operator log in and log out, control parameter changes, schedule changes, and alarm acknowledgment and deletion. System shall date and time stamp logged activity.

F. Workstation Application Editors. Each PC or browser workstation shall support editing of all system applications. The applications shall be downloaded and executed at one or more of the controller panels.

1. Controller. Provide a full-screen editor for each type of application that shall allow the operator to view and change the configuration, name, control parameters, and set points for all controllers.

2. Scheduling. An editor for the scheduling application shall be provided at each workstation. Provide a method of selecting the desired schedule and schedule type. Exception schedules and holidays shall be shown clearly on the calendar. The start and stop times for each object shall be adjustable from this interface.

3. Custom Application Programming. Provide the tools to create, edit, debug, and download custom programs. System shall be fully operable while custom programs are edited, compiled, and downloaded. Programming language shall have the following features:
   a. Language. Language shall be graphically based and shall use function blocks arranged in a logic diagram that clearly shows control logic flow. Function blocks shall directly provide functions listed below, and operators shall be able to create custom or compound function blocks.
   b. Programming Environment. Tool shall provide a full-screen, cursor-and- mouse-driven programming environment that incorporates word processing features such as cut and paste. Operators shall be able to insert, add, modify, and delete custom programming code, and to copy blocks of code to a file library for reuse in other control programs.
   c. Independent Program Modules. Operator shall be able to develop independently executing program modules that can disable, enable and exchange data with other program modules.
   d. Debugging and Simulation. Operator shall be able to step through the program observing intermediate values and results. Operator shall be able to adjust input variables to simulate actual operating conditions. Operator shall be able to adjust each step's time increment to observe operation of delays, integrators, and other time-sensitive control logic. Debugger shall provide error messages for syntax and for execution errors.
   e. Conditional Statements. Operator shall be able to program conditional logic using compound Boolean (AND, OR, and NOT) and relational (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
   f. Mathematical Functions. Language shall support floating-point addition, subtraction, multiplication, division, and square root operations, as well as absolute value calculation and programmatic selection of minimum and maximum values from a list of values.
   g. Variables. Operator shall be able to use variable values in program conditional statements and mathematical functions.
      1) Time Variables. Operator shall be able to use predefined variables to represent time of day, day of the week, month of the year, and date. Other predefined variables or simple control logic shall provide elapsed time in seconds, minutes, hours, and days. Operator shall be able to start, stop, and reset elapsed time variables using the program language.
      2) System Variables. Operator shall be able to use predefined variables to represent status and results of Controller Software and shall be able to enable, disable, and change setpoints of Controller Software as described in Controller Software section.

G. Portable Operator's Terminal. Provide all necessary software to configure an IBM- compatible laptop computer for use as a Portable Operator's Terminal. Operator shall be able to connect configured Terminal to the system network or directly to each controller for programming, setting up, and troubleshooting.

2.5 CONTROLLER SOFTWARE

A. Furnish the following applications for building and energy management. All software application shall reside and operate in the system controllers. Applications shall be editable through operator workstation, web browser interface, or engineering workstation.

B. System Security. See Paragraph 2.3.E.5 (Security) and Paragraph 2.3.E.14.c.iii (Operator Activity).

C. Scheduling. Provide the capability to execute control functions according to a user created or edited schedule. Each schedule shall provide the following schedule options as a minimum:

1. Weekly Schedule. Provide separate schedules for each day of the week. Each schedule shall be able to include up to 5 occupied periods (5 start-stop pairs or 10 events).

2. Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. Exception schedules may be defined up to a year in advance. Once an exception schedule has executed, the system shall discard and replace the exception schedule with the standard schedule for that day of the week.

3. Holiday Schedules. Provide the capability for the operator to define up to 24 special or holiday schedules. These schedules will be repeated each year. The operator shall be able to define the length of each holiday period.

D. System Coordination. Operator shall be able to group related equipment based on function and location and to use these groups for scheduling and other applications.

E. Binary Alarms. Each binary object shall have the capability to be configured to alarm based on the operator-specified state. Provide the capability to automatically and manually disable alarming.

F. Analog Alarms. Each analog object shall have both high and low alarm limits. The operator shall be able to enable or disable these alarms.

G. Alarm Reporting. The operator shall be able to determine the action to be taken in the event of an alarm. An alarm shall be able to start programs, print, be logged in the event log, generate custom messages, and display on graphics.

H. Remote Communication. System shall automatically contact operator workstation or server on receipt of critical alarms. If no network connection is available, system shall use a modem connection.

I. Demand Limiting.

1. The demand-limiting program shall monitor building power consumption from a building power meter (provided by others) which generates pulse signals or a BACnet communications interface. An acceptable alternative is for the system to monitor a watt transducer or current transformer attached to the building feeder lines.

2. When power consumption exceeds adjustable levels, system shall automatically adjust setpoints, de-energize low-priority equipment, and take other programmatic actions to reduce demand as specified in control drawings. When demand drops below adjustable levels, system shall restore loads as specified.

J. Maintenance Management. The system shall be capable of generating maintenance alarms when equipment exceeds adjustable runtime, equipment starts, or performance limits. Configure and enable maintenance alarms as specified in control drawings.

K. Sequencing. Application software shall sequence chillers, boilers, and pumps as specified in control drawings.

L. PID Control. System shall provide direct- and reverse-acting PID (proportional-integral- derivative) algorithms. Each algorithm shall have anti-windup and selectable controlled variable, setpoint, and PID gains. Each algorithm shall calculate a time-varying analog value that can be used to position an output or to stage a series of outputs. The calculation interval, PID gains, and other tuning parameters shall be adjustable by a user with the correct security level.

M. Staggered Start. System shall stagger controlled equipment restart after power outage. Operator shall be able to adjust equipment restart order and time delay between equipment restarts.

N. Energy Calculations.

1. The system shall accumulate and convert instantaneous power (kW) or flow rates (L/s [gpm]) to energy usage data.

2. The system shall calculate a sliding-window average (rolling average). Operator shall be able to adjust window interval to 15 minutes, 30 minutes, or 60 minutes.

O. Anti-Short Cycling. All binary output objects shall be protected from short cycling by means of adjustable minimum on-time and off-time settings.

P. On and Off Control with Differential. Provide an algorithm that allows a binary output to be cycled based on a controlled variable and a setpoint. The algorithm shall be direct-acting or reverse-acting.

Q. Runtime Totalization. Provide software to totalize runtime for each binary input and output. Operator shall be able to enable runtime alarm based on exceeded adjustable runtime limit. Configure and enable runtime totalization and alarms as specified in control drawings.

2.6 CONTROLLERS

A. General. Provide an adequate number of Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), Smart Actuators (SA), and Smart Sensors (SS) as required to achieve performance specified in Section 23 09 00 Article 1.9 (System Performance). Every device in the system which executes control logic and directly controls HVAC equipment must conform to a standard BACnet Device profile as specified in ANSI/ASHRAE 135, BACnet Annex L. Unless otherwise specified, hardwired actuators and sensors may be used in lieu of BACnet Smart Actuators and Smart Sensors.

B. BACnet.

1. Building Controllers (BCs). Each BC shall conform to BACnet Building Controller (B- BC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L, and shall be listed as a certified B-BC in the BACnet Testing Laboratories (BTL) Product Listing.

2. Advanced Application Controllers (AACs). Each AAC shall conform to BACnet Advanced Application Controller (B-AAC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-AAC in the BACnet Testing Laboratories (BTL) Product Listing.

3. Application Specific Controllers (ASCs). Each ASC shall conform to BACnet Application Specific Controller (B-ASC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-ASC in the BACnet Testing Laboratories (BTL) Product Listing.

4. Smart Sensors (SSs). Each SS shall conform to BACnet Smart Sensor (B-SS) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-SS in the BACnet Testing Laboratories (BTL) Product Listing.

5. BACnet Communication.
   a. Each BC shall reside on or be connected to a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing.
   b. BACnet routing shall be performed by BCs or other BACnet device routers as necessary to connect BCs to networks of AACs and ASCs.

c. Each AAC shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BACnet/IP addressing, or it shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
d. Each ASC shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
e. Each SA shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
f. Each SS shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BACnet/IP addressing, or it shall reside on a BACnet network using ARCNET or MS/TP Data Link/Physical layer protocol.

C. Communication

1. Service Port. 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 where shown on drawings.

2. Signal Management. BC and ASC operating systems shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and to allow for central monitoring and alarms.

3. Data Sharing. Each BC and AAC shall share data as required with each networked BC and AAC.

4. Stand-Alone Operation. Each piece of equipment specified in control drawings 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 such as outdoor air conditions, supply air or water temperature coming from source equipment, etc.

D. Environment. Controller hardware shall be suitable for anticipated ambient conditions.

1. 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).

2. 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).

E. Keypad. Provide a local keypad and display for each BC and AAC. Operator shall be able to use keypad to view and edit data. Keypad and display shall require password to prevent unauthorized use. If the manufacturer does not normally provide a keypad and display for each BC and AAC, provide the software and any interface cabling needed to use a laptop computer as a Portable Operator's Terminal for the system.

F. Real-Time Clock. Controllers that perform scheduling shall have a real-time clock.

G. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to a field-removable modular terminal strip or to a termination card connected by a ribbon cable. Each BC and AAC shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.

H. Memory.

1. Controller memory shall support operating system, database, and programming requirements.

2. Each BC and AAC shall retain BIOS and application programming for at least 72 hours in the event of power loss.

3. Each ASC and SA 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.

I. Immunity to Power and Noise. 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).

J. Transformer. ASC power supply shall be fused or current limiting and shall be rated at a minimum of 125% of ASC power consumption.

2.7 INPUT AND OUTPUT INTERFACE

A. General. Hard-wire input and output points to BCs, AACs, ASCs, or SAs.

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

C. Binary Inputs. Binary inputs shall allow the monitoring of ON/OFF signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against contact bounce and noise. Binary inputs shall sense dry contact closure without application of power external to the controller.

D. Pulse Accumulation Inputs. Pulse accumulation inputs shall conform to binary input requirements and shall also accumulate up to 10 pulses per second.

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

F. Binary Outputs. Binary outputs shall provide for ON/OFF operation or a pulsed low-voltage signal for pulse width modulation control. Binary outputs on Building Controllers shall have three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation.

G. Analog Outputs. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0–10 Vdc or a 4–20 mA signal as required to properly control output devices. Each Building Controller analog output shall have a two- position (auto-manual) switch, a manually adjustable potentiometer, and status lights. Analog outputs shall not drift more than 0.4% of range annually.

H. Tri-State Outputs. Control three-point floating electronic actuators without feedback with tri- state outputs (two coordinated binary outputs). Tri-State outputs may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.

I. Universal Inputs and Outputs. Inputs and outputs that can be designated as either binary or analog in software shall conform to the provisions of this section that are appropriate for their designated use.

J. System Object Capacity. The system size shall be expandable to at least twice the number of input/ output objects required for this project. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity requirement. The operator interfaces installed for this project shall not require any hardware additions or software revisions in order to expand the system

2.8 POWER SUPPLIES AND LINE FILTERING

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

1. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand 150% current overload for at least three seconds without trip-out or failure.
   a. Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
   b. Line voltage units shall be UL recognized and CSA listed.

B. Power Line Filtering.

1. Provide internal or external transient voltage and surge suppression for workstations and controllers. Surge protection shall have:
   a. Dielectric strength of 1000 V minimum
   b. Response time of 10 nanoseconds or less
   c. Transverse mode noise attenuation of 65 dB or greater
   d. Common mode noise attenuation of 150 dB or greater at 40–100 Hz

2.9 AUXILIARY CONTROL DEVICES

A. Motorized Control Dampers, unless otherwise specified elsewhere, shall be as follow.

1. Type. Control dampers shall be the parallel or opposed-blade type as specified below or as scheduled on drawings.
   a. Outdoor and return air mixing dampers and face-and-bypass dampers shall be parallel-blade and shall direct airstreams toward each other.
   b. Other modulating dampers shall be opposed-blade.
   c. Two-position shutoff dampers shall be parallel- or opposed-blade with blade and side seals.

2. Frame. Damper frames shall be 2.38 mm (13 gauge) galvanized steel channel or

3. 3.175 mm (⅛ in.) extruded aluminum with reinforced corner bracing.

4. Blades. Damper blades shall not exceed 20 cm (8 in.) in width or 125 cm (48 in.) in length. Blades shall be suitable for medium velocity (10 m/s [2000 fpm]) performance. Blades shall be not less than 1.5875 mm (16 gauge).

5. Shaft Bearings. Damper shaft bearings shall be as recommended by manufacturer for application, oil impregnated sintered bronze, or better.

6. Seals. Blade edges and frame top and bottom shall have replaceable seals of butyl rubber or neoprene. Side seals shall be spring-loaded stainless steel. Blade seals shall leak no more than 50 $L/s \cdot m^2$ (10 cfm per ft^2) at 1000 Pa (4 in. w.g.) differential pressure. Blades shall be airfoil type suitable for wide-open face velocity of 7.5 m/s (1500 fpm).

7. Sections. Individual damper sections shall not exceed 125 cm × 150 cm (48 in. × 60 in.). Each section shall have at least one damper actuator.

8. Modulating dampers shall provide a linear flow characteristic where possible.

9. Linkages. Dampers shall have exposed linkages.

B. Electric Damper and Valve Actuators.

1. Stall Protection. Mechanical or electronic stall protection shall prevent actuator damage throughout the actuator's rotation.

2. Spring-return Mechanism. Actuators used for power-failure and safety applications shall have an internal mechanical spring-return mechanism or an uninterruptible power supply (UPS).

3. Signal and Range. Proportional actuators shall accept a 0–10 Vdc or a 0–20 mA control signal and shall have a 2–10 Vdc or 4–20 mA operating range. (Floating motor actuators may be substituted for proportional actuators in terminal unit applications as described in paragraph 2.6H.)

4. Wiring. 24 Vac and 24 Vdc actuators shall operate on Class 2 wiring.

5. Manual Positioning. Operators 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 7 N·m (60 in.- lb) torque capacity shall have a manual crank.

C. Control Valves.

1. Control valves shall be two-way or three-way type for two-position or modulating service as shown.

2. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
   a. Water Valves:
      1) Two-way: 150% of total system (pump) head.
      2) Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
   b. Steam Valves: 150% of operating (inlet) pressure.

3. Water Valves.
   a. Body and trim style and materials shall be in accordance with manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating service.
   b. Sizing Criteria:
      1) Two-position service: Line size.
      2) Two-way modulating service: Pressure drop shall be equal to twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 5 psi, whichever is greater.
      3) Three-way modulating service: Pressure drop equal to twice the pressure drop through the coil exchanger (load), 35 kPa (5 psi) maximum.
      4) Valves ½ in. through 2 in. shall be bronze body or cast brass ANSI Class 250, spring-loaded, PTFE packing, quick opening for two- position service. Two-way valves to have replaceable composition disc or stainless steel ball.
      5) Valves 2½ in. and larger shall be cast iron ANSI Class 125 with guided plug and PTFE packing.
   c. Water valves shall fail normally open or closed, as scheduled on plans, or as follows:
      1) Water zone valves—normally open preferred.
      2) Heating coils in air handlers—normally open.
      3) Chilled water control valves—normally closed.
      4) Other applications—as scheduled or as required by sequences of operation.

4. Steam Valves.
   a. Body and trim materials shall be in accordance with manufacturer's recommendations for design conditions and service with linear ports for modulating service.
   b. Sizing Criteria:
      1) Two-position service: pressure drop 10% to 20% of inlet psig.
      2) Modulating service: 100 kPa (15 psig) or less; pressure drop 80% of inlet psig.
      3) Modulating service: 101 to 350 kPa (16 to 50 psig); pressure drop 50% of inlet psig.
      4) Modulating service: over 350 kPa (50 psig); pressure drop as scheduled on plans.

D. Binary Temperature Devices.

1. Low-Voltage Space Thermostats. Low-voltage space thermostats shall be 24 V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed setpoint adjustment, 13°C–30°C (55°F–85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.

2. Line-Voltage Space Thermostats. Line-voltage space thermostats shall be bimetal- actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed setpoint adjustment, 13°C–30°C (55°F–85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.

3. Low-Limit Thermostats. Low-limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 6 m (20 ft) long. Element shall sense temperature in each 30 cm (1 ft) section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only.

E. Temperature Sensors.

1. Type. Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor.

2. Duct Sensors. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 1.5 m (5 ft) in length per 1 m^2(10 ft^2) of duct cross- section.

3. Immersion Sensors. Provide immersion sensors with a separable stainless steel well. Well pressure rating shall be consistent with system pressure it will be immersed in. Well shall withstand pipe design flow velocities.

4. Space Sensors. Space sensors shall have setpoint adjustment, override switch, display, and communication port as shown.

5. Differential Sensors. Provide matched sensors for differential temperature measurement.

F. Humidity Sensors.

1. Duct and room sensors shall have a sensing range of 20%–80%.

2. Duct sensors shall have a sampling chamber.

3. Outdoor air humidity sensors shall have a sensing range of 20%–95% RH and shall be suitable for ambient conditions of -40°C–75°C (-40°F–170°F).

4. Humidity sensors shall not drift more than 1% of full scale annually.

G. Flow Switches. Flow-proving switches shall be paddle (water service only) or differential pressure type (air or water service) as shown. Switches shall be UL listed, SPDT snap- acting, and pilot duty rated (125 VA minimum).

1. Paddle switches shall have adjustable sensitivity and NEMA 1 enclosure unless otherwise specified.

2. Differential pressure switches shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.

H. Relays.

1. Control Relays. Control relays shall be plug-in type, UL listed, and shall have dust cover and LED “energized” indicator. Contact rating, configuration, and coil voltage shall be suitable for application.

2. Time Delay Relays. Time delay relays shall be solid-state plug-in type, UL listed, and shall have adjustable time delay. Delay shall be adjustable ±100% from setpoint shown. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.

I. Override Timers.

1. Unless implemented in control software, override timers shall be spring-wound line voltage, UL Listed, with contact rating and configuration required by application. Provide 0–6 hour calibrated dial unless otherwise specified. Flush mount timer on local control panel face or where shown.

J. Current Transmitters.

1. AC current transmitters shall be self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4–20 mA two-wire output. Full-scale unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment. Unit accuracy shall be ±1% full-scale at 500 ohm maximum burden.

2. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.

3. Unit shall be split-core type for clamp-on installation on existing wiring.

K. Current Transformers.

1. AC current transformers shall be UL/CSA recognized and shall be completely encased (except for terminals) in approved plastic material.

2. Transformers shall be available in various current ratios and shall be selected for

3. ±1% accuracy at 5 A full-scale output.

4. Use fixed-core transformers for new wiring installation and split-core transformers for existing wiring installation.

L. Voltage Transmitters.

1. AC voltage transmitters shall be self-powered single-loop (two-wire) type, 4–20 mA output with zero and span adjustment.

2. Adjustable full-scale unit ranges shall be 100–130 Vac, 200–250 Vac, 250–330 Vac, and 400–600 Vac. Unit accuracy shall be ±1% full-scale at 500 ohm maximum burden.

3. Transmitters shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized at 600 Vac rating.

M. Voltage Transformers.

1. AC voltage transformers shall be UL/CSA recognized, 600 Vac rated, and shall have built-in fuse protection.

2. Transformers shall be suitable for ambient temperatures of 4°C–55°C (40°F–130°F) and shall provide ±0.5% accuracy at 24 Vac and 5 VA load.

3. Windings (except for terminals) shall be completely enclosed with metal or plastic.

N. Power Monitors.

1. Selectable rate pulse output for kWh reading, 4–20 mA output for kW reading, N.O. alarm contact, and ability to operate with 5.0 amp current inputs or 0–0.33 volt inputs.

2. 1.0% full-scale true RMS power accuracy, +0.5 Hz, voltage input range 120–600 V, and auto range select.

3. Under voltage/phase monitor circuitry.

4. NEMA 1 enclosure.

5. Current transformers having a 0.5% FS accuracy, 600 VAC isolation voltage with 0–

6. 0.33 V output. If 0–5 A current transformers are provided, a three-phase disconnect/shorting switch assembly is required.

O. Hydronic Flowmeters

1. Insertion-Type Turbine Meter
   a. Dual counter-rotating axial turbine elements, each with its own rotational sensing system, and an averaging circuit to reduce measurement errors due to swirl and flow profile distortion. Single turbine for piping 2 inches and smaller. Flow sensing turbine rotors shall be non-metallic and not impaired by magnetic drag.
   b. Insertion type complete with 'hot-tap' isolation valves to enable sensor removal without water supply system shutdown.
   c. Sensing method shall be impedance sensing (non magnetic and non photoelectric)
   d. Volumetric accuracy
      1) ± 0.5% of reading at calibrated velocity
      2) ± 1% of reading from 3 to 30 ft/s (10:1 range)
      3) ± 2% of reading from 0.4 to 20 ft/s (50:1 range)
   e. Each sensor shall be individually calibrated and tagged accordingly against the manufacturer's primary standards which must be accurate to within 0.1% of flow rate and traceable to the National Institute of Standards and Technology (NIST).
   f. Maximum operating pressure of 400 psi and maximum operating temperature of 200°F continuous (220°F peak).
   g. All wetted metal parts shall be constructed of 316 stainless steel.
   h. Analog outputs shall consist of non interactive zero and span adjustments, a DC linearly of 0.1% of span, voltage output of 0-10 Vdc, and current output of 4-20 mA.

2. Magnetic Flow-Tube Type Flowmeter
   a. Sensor shall be a magnetic flowmeter, which utilizes Faraday's Law to measure volumetric fluid flow through a pipe. The flowmeter shall consist of two elements, the sensor and the electronics. The sensor shall generate a measuring signal proportional to the flow velocity in the pipe. The electronics shall convert this EMF into a standard current output.
   b. Electronic replacement shall not affect meter accuracy (electronic units are not matched with specific sensors).
   c. Four-wire, externally powered, magnetic type flow transmitter with adjustable span and zero, integrally mounted to flow tube. Output signal shall be a digital pulse proportional to the flow rate (to provide maximum accuracy and to handle abrupt changes in flow). Standard 4-20 mA or 0-10 Vdc outputs may be used provided accuracy is as specified.
   d. Flow Tube:
      1) ANSI class 150 psig steel
      2) ANSI flanges
      3) Protected with PTFE, PFA, or ETFE liner rated for 245°F minimum fluid temperature
   e. Electrode and grounding material
      1) 316L Stainless steel or Hastelloy C

2) Electrodes shall be fused to ceramic liner and not require o-rings.

f. Electrical Enclosure: NEMA 4, 7

g. Approvals:
   1) UL or CSA
   2) NSF Drinking Water approval for domestic water applications

h. Performance
   1) Accuracy shall be ±0.5% of actual reading from 3 to 30 ft/s flow velocities, and 0.015 ft/s from 0.04 to 3 ft/s.
   2) Stability: 0.1% of rate over six months.
   3) Meter repeatability shall be ±0.1% of rate at velocities > 3 ft/s.

3. Magnetic Insertion-Type Flowmeter
   a. Magnetic Faraday point velocity measuring device.
   b. Insertion type complete with hot-tap isolation valves to enable sensor removal without water supply system shutdown.
   c. 4-20 mA transmitter proportional to flow or velocity.
   d. Accuracy: larger of 1% of reading and 0.2 ft/s.
   e. Flow range: 0.2 to 20 ft/s, bidirectional.
   f. Each sensor shall be individually calibrated and tagged accordingly against the manufacturer's primary standards which must be accurate to within 0.1% of flow rate and traceable to the National Institute of Standards and Technology (NIST).

4. Vortex Shedding Flowmeter
   a. Output: 4-20 mA, 0-10 Vdc, 0-5 Vdc.
   b. Maximum Fluid Temperature: 800ºF (427 ºC).
   c. Wetted Parts: Stainless Steel.
   d. Housing: NEMA 4X.
   e. Turndown: 25:1 minimum.
   f. Accuracy: 0.5% of calibrated span for liquids, 1% of calibrated span for steam and gases.
   g. Body: Wafer style or ANSI flanged to match piping specification.

5. Transit-Time Ultrasonic Flowmeter
   a. Clamp-On transit-time ultrasonic flowmeter
   b. Wide-Beam transducer technology
   c. 4-20 mA transmitter proportional to flow or velocity.
   d. Accuracy: 0.5% of reading in range 1 to 30 ft/s, 0.001 ft/s sensitivity.

P. Thermal Energy Meters

1. Matched RTD, solid state, or thermistor temperature sensors with a differential temperature accuracy of ±0.15°F.

2. Flow meter : See "Hydronic Flowmeters" section.

3. Unit accuracy of ±1% factory calibrated, traceable to NIST with certification.

4. NEMA 1 enclosure.

5. Panel mounted display.

6. UL listed.

7. Isolated 4–20 ma signals for energy rate and supply and return temperatures and flow.

Q. Current Switches.

1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. Select switches to match application current and DDC system output requirements.

R. Pressure Transducers.

1. Transducers shall have linear output signal and field-adjustable zero and span.

2. Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50% greater than calibrated span without damage.

3. Water pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Transducer shall have 4–20 mA output, suitable mounting provisions, and block and bleed valves.

4. Water differential pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Over-range limit (differential pressure) and maximum static pressure shall be 2000 kPa (300psi.)Transducer shall have 4–20 mA output, suitable mounting provisions, and 5-valve manifold.

S. Differential Pressure Switches. Differential pressure switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum) and shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.

T. Pressure-Electric (PE) Switches.

1. Shall be metal or neoprene diaphragm actuated, operating pressure rated for 0–175 kPa (0–25 psig), with calibrated scale minimum setpoint range of 14–125 kPa (2–18 psig) minimum, UL listed.

2. Provide one- or two-stage switch action (SPDT, DPST, or DPDT) as required by application. Electrically rated for pilot duty service (125 VA minimum) and/or for motor control.

3. Switches shall be open type (panel-mounted) or enclosed type for remote installation. Enclosed type shall be NEMA 1 unless otherwise specified.

U. Occupancy Sensors. Occupancy sensors shall utilize Passive Infrared (PIR) and/or Microphonic Passive technology to detect the presence of people within a room. Sensors shall be mounted as indicated on the approved drawings. The sensor output shall be accessible by any lighting and/or HVAC controller in the

system. Occupancy sensors shall be capable of being powered from the lighting or HVAC control panel, as shown on the drawings. Occupancy sensor delay shall be software adjustable through the user interface and shall not require manual adjustment at the sensor.

V. Local Control Panels.

1. All indoor control cabinets shall be fully enclosed NEMA 1 construction with (hinged door) key-lock latch and removable subpanels. A single key shall be common to all field panels and subpanels.

2. Interconnections between internal and face-mounted devices shall be prewired with color-coded stranded conductors neatly installed in plastic troughs and/or tie- wrapped. Terminals for field connections shall be UL listed for 600 volt service, individually identified per control/ interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.

3. Provide ON/OFF power switch with overcurrent protection for control power sources to each local panel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. The contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the engineer for resolution before rough-in work is started.

B. The contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate—or if any discrepancies occur between the plans and the contractor's work and the plans and the work of others—the contractor shall report these discrepancies to the engineer and shall obtain written instructions for any changes necessary to accommodate the contractor's work with the work of others. Any changes in the work covered by this specification made necessary by the failure or neglect of the contractor to report such discrepancies shall be made by—and at the expense of— this contractor.

3.2 PROTECTION

A. The contractor shall protect all work and material from damage by his/her work or employees and shall be liable for all damage thus caused.

B. The contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The contractor shall protect any material that is not immediately installed. The contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.3 COORDINATION

A. Site

1. Where the mechanical work will be installed in close proximity to, or will interfere with, work of other trades, the contractor shall assist in working out space conditions to make a satisfactory adjustment. If the contractor installs his/her work before coordinating with other trades, so as to cause any interference with work of other trades, the contractor shall make the necessary changes in his/her work to correct the condition without extra charge.

2. Coordinate and schedule work with other work in the same area and with work dependent upon other work to facilitate mutual progress.

B. Submittals. See Section 23 09 00 Article 1.10 (Submittals).

C. Test and Balance.

1. The contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.

2. The contractor shall provide training in the use of these tools. This training will be planned for a minimum of 4 hours.

3. In addition, the contractor shall provide a qualified technician to assist in the test and balance process, until the first 20 terminal units are balanced.

4. The tools used during the test and balance process will be returned at the completion of the testing and balancing.

D. Life Safety.

1. Duct smoke detectors required for air handler shutdown are provided under Division 28. Interlock smoke detectors to air handlers for shutdown as specified in control drawings.

2. Smoke dampers and actuators required for duct smoke isolation are provided under Division 23. Interlock smoke dampers to air handlers as specified in control drawings.

3. Fire and smoke dampers and actuators required for fire-rated walls are provided under Division 23. Fire and smoke damper control is provided under Division 28.

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

1. All communication media and equipment shall be provided as specified in Section 23 09 00 Article 2.2 (Communication).

2. Each supplier of a controls product is responsible for the configuration, programming, start up, and testing of that product to meet the sequences of operation described in control drawings.

3. The contractor shall coordinate and resolve any incompatibility issues that arise between control products provided under this section and those provided under other sections or divisions of this specification.

4. The contractor is responsible for providing all controls described in the contract documents regardless of where within the contract documents these controls are described.

5. The contractor is responsible for the interface of control products provided by multiple suppliers regardless of where this interface is described within the contract documents.

3.4 GENERAL WORKMANSHIP

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

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

C. Install equipment in readily accessible locations as defined by Chapter 1 Article 100 Part A of the National Electrical Code (NEC).

D. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.

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

3.5 FIELD QUALITY CONTROL

A. All work, materials, and equipment shall comply with rules and regulations of applicable local, state, and federal codes and ordinances as identified in Section 23 09 00 Article 1.8 (Codes and Standards).

B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship.

C. Contractor shall have work inspection by local and/or state authorities having jurisdiction over the work.

3.6 WIRING

A. All control and interlock wiring shall comply with national and local electrical codes, and Division 26 of this specification, Where the requirements of this section differ from Division 26, the requirements of this section shall take precedence.

B. All NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway according to NEC and Division 26 requirements.

C. All low-voltage wiring shall meet NEC Class 2 requirements. Low-voltage power circuits shall be subfused when required to meet Class 2 current limit.

D. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in raceway may be used provided that cables are UL listed for the intended application.

E. All wiring in mechanical, electrical, or service rooms – or where subject to mechanical damage – shall be installed in raceway

F. All communication wiring will be in raceway or EMT

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

H. Do not install wiring in raceway containing tubing.

I. Where Class 2 wiring is run exposed, wiring is to be run parallel along a surface or perpendicular to it and neatly tied at 3 m (10 ft) intervals.

J. Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems.

K. All wire-to-device connections shall be made at a terminal block or terminal strip. All wire-to- wire connections shall be at a terminal block.

L. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

M. Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, the contractor shall provide step-down transformers.

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

O. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.

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

Q. Include one pull string in each raceway 2.5 cm (1 in.) or larger.

R. Use color-coded conductors throughout with conductors of different colors.

S. Control and status relays are to be located in designated enclosures only. These enclosures include packaged equipment control panel enclosures unless they also contain Class 1 starters.

T. Conceal all raceways except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 15 cm (6 in.) from high-temperature equipment (e.g. steam pipes or flues).

U. Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.

V. Adhere to this specification's Division 26 requirements where raceway crosses building expansion joints.

W. Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of vertical raceways.

X. The contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.

Y. Flexible metal raceways and liquid-tight flexible metal raceways shall not exceed 1 m (3 ft) in length and shall be supported at each end. Flexible metal raceway less than ½ in. electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal raceways shall be used.

Z. Raceway must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings (according to code). Terminations must be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

3.7 COMMUNICATION WIRING

A. The contractor shall adhere to the items listed in the "Wiring" article in Part 3 of the specification.

B. All communication wiring will be encased in raceway or EMT

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

D. Do not install communication wiring in raceways and enclosures containing Class 1 or other Class 2 wiring.

E. Maximum pulling, tension, and bend radius for the cable installation, as specified by the cable manufacturer, shall not be exceeded during installation.

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

G. When a cable enters or exits a building, a lightning arrestor must be installed between the lines and ground. The lighting arrestor shall be installed according to manufacturer’s instructions.

H. All runs of communication wiring shall be unspliced length when that length is commercially available.

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

J. Grounding of coaxial cable shall be in accordance with NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."

K. BACnet MS/TP communications wiring shall be installed in accordance with ASHRAE/ANSI Standard 135. This includes but is not limited to:

1. The network shall use shielded, twisted-pair cable with characteristic impedance between 100 and 120 ohms. Distributed capacitance between conductors shall be less than 100 pF per meter (30 pF per foot.)

2. The maximum length of an MS/TP segment is 1200 meters (4000 ft) with AWG 18 cable. The use of greater distances and/or different wire gauges shall comply with the electrical specifications of EIA-485.

3. The maximum number of nodes per segment shall be 32, as specified in the EIA 485 standard. Additional nodes may be accommodated by the use of repeaters.

4. An MS/TP EIA-485 network shall have no T connections.

3.8 FIBER OPTIC CABLE

A. Maximum pulling tensions as specified by the cable manufacturer shall not be exceeded during installation. Post-installation residual cable tension shall be within cable manufacturer's specifications.

B. All cabling and associated components shall be installed in accordance with manufacturers' instructions. Minimum cable and unjacketed fiber bend radii, as specified by cable manufacturer, shall be maintained.

3.9 INSTALLATION OF SENSORS

A. Install sensors in accordance with the manufacturer's recommendations.

B. Mount sensors rigidly and adequately for environment within which the sensor operates.

C. Room temperature sensors shall be installed on concealed junction boxes properly supported by wall framing.

D. All wires attached to sensors shall be sealed in their raceways or in the wall to stop air transmitted from other areas from affecting sensor readings.

E. Sensors used in mixing plenums and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner vertically across the duct. Each bend shall be supported with a capillary clip.

F. Low-limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 3 m (1 ft) of sensing element for each 1 m^2(1 ft^2) of coil area.

G. Do not install temperature sensors within the vapor plume of a humidifier. If installing a sensor downstream of a humidifier, install it at least 3 m (10 ft) downstream.

H. All pipe-mounted temperature sensors shall be installed in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells.

I. Install outdoor air temperature sensors on north wall, complete with sun shield at designated location.

J. Differential Air Static Pressure.

1. Supply Duct Static Pressure. Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the high-pressure tap tubing of the corresponding building static pressure sensor (if applicable) or to the location of the duct high-pressure tap and leave open to the plenum.

2. Return Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Pipe the low-pressure port to a tee in the low-pressure tap tubing of the corresponding building static pressure sensor.

3. Building Static Pressure. Pipe the low-pressure port of the pressure sensor to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe the high-pressure port to a location behind a thermostat cover.

4. The piping to the pressure ports on all pressure transducers shall contain a capped test port located adjacent to the transducer.

5. All pressure transducers, other than those controlling VAV boxes, shall be located in field device panels, not on the equipment monitored or on ductwork. Mount transducers in a location accessible for service without use of ladders or special equipment.

6. All air and water differential pressure sensors shall have gauge tees mounted adjacent to the taps. Water gauges shall also have shut-off valves installed before the tee.

K. Smoke detectors, freezestats, high-pressure cut-offs, and other safety switches shall be hard-wired to de-energize equipment as described in the sequence of operation. Switches shall require manual reset. Provide contacts that allow DDC software to monitor safety switch status.

L. Install humidity sensors for duct mounted humidifiers at least 3 m (10 ft) downstream of the humidifier. Do not install filters between the humidifier and the sensor.

3.10 FLOW SWITCH INSTALLATION

A. Use correct paddle for pipe diameter.

B. Adjust flow switch according to manufacturer's instructions.

3.11 ACTUATORS

A. General. Mount and link control damper actuators according to manufacturer's instructions.

1. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage.

2. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.

3. Provide all mounting hardware and linkages for actuator installation.

B. Electric/Electronic

1. Dampers: Actuators shall be direct mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5° travel available for tightening the damper seal. Actuators shall be mounted following manufacturer's recommendations.

2. Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following the actuator manufacturer's recommendations.

3.12 WARNING LABELS

A. Permanent warning labels shall be affixed to all equipment that can be automatically started by the control system.

1. Labels shall use white lettering (12-point type or larger) on a red background.

2. Warning labels shall read as follows.

3. C A U T I O N
   a. This equipment is operating under automatic control and may start or stop at any time without warning. Switch disconnect to"Off"position before servicing.

B. Permanent warning labels shall be affixed to all motor starters and control panels that are connected to multiple power sources utilizing separate disconnects.

1. Labels shall use white lettering (12-point type or larger) on a red background.

2. Warning labels shall read as follows.

3. C A U T I O N
   a. This equipment is fed from more than one power source with separate disconnects. Disconnect all power sources before servicing.

3.13 IDENTIFICATION OF HARDWARE AND WIRING

A. All wiring and cabling, including that within factory-fabricated panels shall be labeled at each end within 5 cm (2 in.) of termination with control system address or termination number.

B. Permanently label or code each point of field terminal strips to show the instrument or item served.

C. Identify control panels with minimum 1 cm (½ in.) letters on laminated plastic nameplates.

D. Identify all other control components with permanent labels. All plug-in components shall be labeled such that label removal of the component does not remove the label.

E. Identify room sensors related to terminal boxes or valves with nameplates.

F. Manufacturers' nameplates and UL or CSA labels shall be visible and legible after equipment is installed.

G. Identifiers shall match record documents.

3.14 CONTROLLERS

A. Provide a separate controller for each AHU or other HVAC system. A DDC controller may control more than one system provided that all points associated with the system are assigned to the same DDC controller. Points used for control loop reset, such as outside air or space temperature, are exempt from this requirement.

B. Building Controllers and Custom Application Controllers shall be selected to provide the required I/O point capacity required to monitor all of the hardware points listed in control drawings.

3.15 PROGRAMMING

A. Provide sufficient internal memory for the specified sequences of operation and trend logging.

B. Point Naming. Name points as shown on the equipment points list provided with each sequence of operation. See control drawings. If character limitations or space restrictions make it advisable to shorten the name, the abbreviations given in Appendix B to Section 23 09 00 may be used. Where multiple points with the same name reside in the same controller, each point name may be customized with its associated Program Object number. For example, "Zone Temp 1" for Zone 1, "Zone Temp 2" for Zone 2.

C. Software Programming.

1. Provide programming for the system and adhere to the sequences of operation provided. All other system programming necessary for the operation of the system, but not specified in this document, also shall be provided by the contractor. Embed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequences of operation. Use the appropriate technique based on the following programming types:
    a. Text-based:
        1) Must provide actions for all possible situations
        2) Must be modular and structured
        3) Must be commented
    b. Graphic-based:
        1) Must provide actions for all possible situations
        2) Must be documented
    c. Parameter-based:
        1) Must provide actions for all possible situations
        2) Must be documented.

D. Operator Interface.

1. Standard Graphics. Provide graphics for all mechanical systems and floor plans of the building. This includes each chilled water system, hot water system, chiller, boiler, air handler, and all terminal equipment. Point information on the graphic displays shall dynamically update. Show on each graphic all relevant input and output points for that equipment. Also show relevant calculated points such as setpoints. As a minimum, show on each equipment graphic the input and output points and relevant calculated points as indicated on the applicable Points List in control drawings.

2. The contractor shall provide all the labor necessary to install, initialize, start up, and troubleshoot all operator interface software and its functions as described in this section. This includes any operating system software, the operator interface database, and any third-party software installation and integration required for successful operation of the operator interface.

3.16 CONTROL SYSTEM CHECKOUT AND TESTING

A. Startup Testing. All testing listed in this article shall be performed by the contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the owner's representative is notified of the system demonstration.

1. The contractor shall furnish all labor and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification.

2. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.

3. Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures according to manufacturers' recommendations.

4. Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.

5. Verify that all analog output devices (I/Ps, actuators, etc.) are functional, that start and span are correct, and that direction and normal positions are correct. The contractor shall check all control valves and automatic dampers to ensure proper action and closure. The contractor shall make any necessary adjustments to valve stem and damper blade travel.

6. Verify that the system operation adheres to the sequences of operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops.

7. Alarms and Interlocks:
   a. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
   b. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
   c. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action

3.17 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

A. Demonstration.

1. Performance demonstration is required to be presented to the engineer. This demonstration shall be performed by a third party commissioning agent should the owner choose to hire one.

2. Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed his/her own tests.

3. The tests described in this section are to be performed in addition to the tests that the contractor performs as a necessary part of the installation, start-up, and debugging process and as specified in the "Control System Checkout and Testing" article in Part 3 of this specification. The engineer will be present to observe and review these tests. The engineer shall be notified at least 10 days in advance of the start of the testing procedures.

4. The demonstration process shall follow that approved in Part 1, "Submittals." The approved checklists and forms shall be completed for all systems as part of the demonstration.

5. The contractor shall provide at least two persons equipped with two-way communication and shall demonstrate actual field operation of each control and sensing point for all modes of operation including day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure modes. The purpose is to demonstrate the calibration, response, and action of every point and system. Any test equipment required to prove the proper operation shall be provided by and operated by the contractor.

6. As each control input and output is checked, a log shall be completed showing the date, technician's initials, and any corrective action taken or needed.

7. Demonstrate compliance with Part 1, "System Performance."

8. Demonstrate compliance with sequences of operation through all modes of operation.

9. Demonstrate complete operation of operator interface.

10. Additionally, the following items shall be demonstrated:
    a. DDC loop response. The contractor shall supply trend data output in a graphical form showing the step response of each DDC loop. The test shall show the loop's response to a change in set point, which represents a change of actuator position of at least 25% of its full range. The sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. The trend data shall show for each sample the set point, actuator position, and controlled variable values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by the Contractor.
    b. Demand limiting. The contractor shall supply a trend data output showing the action of the demand limiting algorithm. The data shall document the action on a minute-by-minute basis over at least a 30-minute period. Included in the trend shall be building kW, demand limiting set point, and the status of sheddable equipment outputs.
    c. Optimum start/stop. The contractor shall supply a trend data output showing the capability of the algorithm. The change-of-value or change-of-state trends shall include the output status of all optimally started and stopped equipment, as well as temperature sensor inputs of affected areas.
    d. Interface to the building fire alarm system.
    e. Operational logs for each system that indicate all set points, operating points, valve positions, mode, and equipment status shall be submitted to the architect/engineer. These logs shall

cover three 48-hour periods and have a sample frequency of not more than 10 minutes. The logs shall be provided in both printed and disk formats.

11. Any tests that fail to demonstrate the operation of the system shall be repeated at a later date. The contractor shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests.

B. Acceptance.

1. All tests described in this specification shall have been performed to the satisfaction of both the engineer and owner prior to the acceptance of the control system as meeting the requirements of completion. Any tests that cannot be performed due to circumstances beyond the control of the contractor may be exempt from the completion requirements if stated as such in writing by the engineer. Such tests shall then be performed as part of the warranty.

2. The system shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved as required in Part 1, "Submittals."

3.18 CLEANING

A. The contractor shall clean up all debris resulting from his/her activities daily. The contractor shall remove all cartons, containers, crates, etc., under his/her control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.

B. At the completion of work in any area, the contractor shall clean all work, equipment, etc., keeping it free from dust, dirt, and debris, etc.

C. At the completion of work, all equipment furnished under this section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.19 TRAINING

A. Provide training for a designated staff of Owner’s representatives. Training shall be provided via self-paced training, web-based or computer-based training, classroom training, or a combination of training methods.

B. Training shall enable students to accomplish the following objectives.

1. Day-to-day Operators: 8 Hours On-Site Training
   a. Proficiently operate the system
   b. Understand control system architecture and configuration
   c. Understand DDC system components
   d. Understand system operation, including DDC system control and optimizing routines (algorithms)
   e. Operate the workstation and peripherals
   f. Log on and off the system
   g. Access graphics, point reports, and logs
   h. Adjust and change system set points, time schedules, and holiday schedules
   i. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals
   j. Understand system drawings and Operation and Maintenance manual
   k. Understand the job layout and location of control components

l. Access data from DDC controllers and ASCs
m. Operate portable operator's terminals.

2. Advanced Operators and PSD Facilities Service Staff: 8 Hours On-Site Training
   a. Make and change graphics on the workstation
   b. Create, delete, and modify alarms, including annunciation and routing of these
   c. Create, delete, and modify point trend logs and graph or print these both on an ad-hoc basis and at user-definable time intervals
   d. Create, delete, and modify reports
   e. Add, remove, and modify system's physical points
   f. Create, modify, and delete programming
   g. Add panels when required
   h. Add operator interface stations
   i. Create, delete, and modify system displays, both graphical and others
   j. Perform DDC system field checkout procedures
   k. Perform DDC controller unit operation and maintenance procedures
   l. Perform workstation and peripheral operation and maintenance procedures
   m. Perform DDC system diagnostic procedures
   n. Configure hardware including PC boards, switches, communication, and I/O points
   o. Maintain, calibrate, troubleshoot, diagnose, and repair hardware
   p. Adjust, calibrate, and replace system components.

C. Organize the training into sessions or modules for the two levels of operators listed above. (Day-to-Day Operators, Advanced Operators and PSD Facilities Service Staff). Students will receive one or more of the training packages, depending on knowledge level required.

D. Provide course outline and materials according to the "Submittals" article in Part 1 of this specification. Provide one copy of training material per student.

E. The instructor(s) shall be factory-trained and experienced in presenting this material.

F. Classroom training shall be done using a network of working controllers representative of installed hardware.

G. Provide follow-up training at 9 months for the two levels of operators listed above: 8 Hours On-Site Training.

3.20 SEQUENCES OF OPERATION

A. See control drawings.

3.21 APPENDIX A: GLOSSARY OF TERMS

A. Terms used within the Specification Text:

1. Advanced Application Controller (AAC):
   a. A fully programmable control module. This control module may be capable of some of the advanced features found in Building Controllers (storing trends, initiating read and write requests, etc.) but it does not serve as a master controller. Advanced Application Controllers may reside on either the Ethernet/IP backbone or on a subnet.

2. Application Specific Controller (ASC):
   a. A pre-programmed control module which is intended for use in a specific application. ASCs may be configurable, in that the user can choose between various pre-programmed options, but it does not support full custom programming. ASCs are often used on terminal equipment such as VAV boxes or fan coil units. In many vendors' architectures ASCs do not store trends or schedules but instead rely upon a Building Controller to provide those functions.

3. BACnet/IP:
   a. An approved BACnet network type which uses an Ethernet carrier and IP addressing.

4. BACnet MS/TP:
   a. An approved BACnet network type which uses a Master-Slave Token Passing configuration. MS/TP networks are unique to BACnet and utilize EIA485 twisted pair topology running at 9600 to 76,800 bps.

5. BACnet over ARCNET:
   a. An approved BACnet network type which uses an ARCNET (attached resource computer network) carrier. ARCNET is an industry standard that can utilize several speeds and wiring standards. The most common configuration used by BACnet controllers is an EIA485 twisted pair topology running at 156,000 bps.

6. Building Controller (BC):
   a. A fully programmable control module which is capable of storing trends and schedules, serving as a router to devices on a subnet, and initiating read and write requests to other controllers.
   b. Typically this controller is located on the Ethernet/IP backbone of the BAS. In many vendors' ar- chitectures a Building Controller will serve as a master controller, storing schedules and trends for controllers on a subnet underneath the Building Controller.

7. Direct Digital Control (DDC):
   a. A control system in which a digital computer or microprocessor is directly connected to the valves, dampers, and other actuators which control the system, as opposed to indirectly controlling a system by resetting setpoints on an electronic controller.

8. PICS - Protocol Implementation Conformance Statement:
   a. A written document, created by the manufacturer of a device, which identifies the particular options specified by BACnet that are implemented in the device.

9. Smart Actuator (SA):
   a. An actuator which is controlled by a network connection rather than a binary or analog signal. (0-10v, 4-20mA, relay, etc.)

10. Smart Sensor (SS):
    a. A sensor which provides information to the BAS via network connection rather than a binary or analog signal. (0-10000 ohm, 4-20mA, dry contact, etc.)

11. Web services:
    a. Web services are a standard method of exchanging data between computer systems using the XML (extensible markup language) and SOAP (simple object access protocol) standards. Web services can be used at any level within a Building Automation System (BAS), but most commonly they are used to transfer data between BAS using different protocols or between a BAS and a non-BAS system such as a tenant billing system or a utility management system.

B. Terms used within the Sequences of Operation: adj.

1. Adjustable by the end user, through the supplied user interface.

C. AI, AO, etc. (Column Headings on Points List)

1. AI = Analog Input. A physical input to the control module.

2. AO = Analog Output. A physical output from the control module.

3. AV = Analog Value. An intermediate (software) point that may be editable or read-only. Editable AVs are typically used to allow the user to set a fixed control parameter, such as a setpoint.

4. Read Only AVs are typically used to display the status of a control operation.

5. BI = Binary Input. A physical input to the control module.

6. BO = Binary Output. A physical output from the control module.

7. BV = Binary Value. An intermediate (software) point that may be editable or read-only. Editable BVs are typically used to allow the user to set a fixed control parameter, such as a setpoint.

8. Read Only BVs are typically used to display the status of a control operation.

9. Loop = A control loop. Most commonly a PID control loop. Typically a control loop will include a setpoint, an input which is compared to the setpoint, and an output which controls some action based upon the difference between the input and the setpoint. A PID control loop will also in- clude gains for the proportional, integral, and derivative response as well as an interval which controls how frequently the control loop updates its output. These gains may be adjustable by the end user for control loop "tuning," but in self-tuning control loops or loops which have been optimized for a specific application the gains may not be adjustable.

10. Sched = Schedule. The control algorithm for this equipment shall include a user editable schedule.

11. Trend. The control system shall be configured to collect and display a trend log of this object. The trending interval shall be no less than one sample every 5 minutes. (Change of Value trend- ing, where a sample is taken every time the value changes by more than a user-defined mini- mum, is an acceptable alternative.)

12. Alarm. The control system shall be configured to generate an alarm when this object exceeds user definable limits, as described in the Sequence of Controls.

13. Note: If the specifications require use of the BACnet protocol, all of the above shall be provided as BACnet objects.

D. KW Demand Limiting: *

1. An energy management strategy that reduces energy consumption when a system's electric power meter exceeds an operator-defined threshold.

2. When power consumption exceeds defined levels, the system automatically adjust setpoints, de- energizes low priority equipment, and takes other pre-programmed actions to avoid peak demand charges. As the demand drops, the system restores loads in a predetermined manner.

E. Occupant Override Switch, or Timed Local Override:

1. A control option that allows building occupants to override the programmed HVAC schedule for a limited period of time.

2. When the override time expires, the zone returns to its unoccupied state.

F. Occupant Setpoint Adjustment:

1. A control option that allows building occupants to adjust - within limits set by the HVAC control system - the heating and cooling setpoints of selected zones. Typically the user interface for this function is built into the zone sensor.

G. Optimal Start-Up: *

1. A control strategy that automatically starts an HVAC system at the latest possible time yet en- sures comfort conditions by the time the building becomes occupied.

2. In a typical implementation, a controller measures the temperature of the zone and the outside air. Then, using design heating or cooling capacity at the design outside air temperature, the system computes how long a unit must run at maximum capacity to bring the zone temperature to its occupied setpoint. The optimal start algorithm often includes a self-learning feature to adjust for variations from de- sign capacity.

3. A distributed system must use Run on Request with Optimal Start. (See below.)

H. Requested, or Run on Request: *

1. A control strategy that optimizes the runtime of a source piece of equipment that supplies one or more receiving units - such as an air handler unit supplying zone terminal units with heating, cooling, ventilation, or similar service. Source equipment runs only when needed, not on a fixed schedule.

2. The source equipment runs when one or more receiving units request its services. An operator determines how many requests are required to start the source equipment.

3. For example, if all the zones in a building are unoccupied and the zone terminal units do not need heating or cooling, the AHU will shut down. However, if a zone becomes occupied or needs cooling, the terminal unit will send a run request to the AHU to initiate the start-up se- quence. If this AHU depends on a central chiller, it can send a run request to the chiller.

4. The run on request algorithm also allows an operator to schedule occupancy for individual zones based on the needs of the occupants without having to adjust the schedules of related AHUs and chillers.

I. Trim and Respond, or Setpoint Optimization: *

1. A control strategy that optimizes the setpoint of a source piece of equipment that supplies one or more receiving units - such as an air handler unit supplying zone terminal units with heating, cooling, ventilation, or similar service.

2. The source unit communicates with receiving units to determine heating, cooling, and other requirements, and then adjusts its setpoint.

3. For example, if all zones are comfortable and do not request cooling, the AHU will gradually in- crease (trim) its supply air setpoint. When a zone requests cooling, the AHU responds by drop- ping its setpoint. The more zones that request cooling, the more it drops the setpoint. The AHU repeats this process throughout the day to keep zones cool, but with a supply air setpoint that is no cooler than necessary.

J. Contracting Terms:

1. Furnished or Provided:
   a. The act of supplying a device or piece of equipment as required meeting the scope of work specified and making that device or equipment operational. All costs required to furnish the specified device or equipment and make it operational are borne by the division specified to be responsible for providing the device or equipment.

K. Install or Installed:

1. The physical act of mounting, piping or wiring a device or piece of equipment in accordance with the manufacturer's instructions and the scope of work as specified. All costs required to com- plete the installation are borne by the division specified to include labor and any ancillary mate- rials.

L. Interface:

1. The physical device required to provide integration capabilities from an equipment vendor's product to the control system. The equipment vendor most normally furnishes the interface de- vice. An example of an interface is the chilled water temperature reset interface card provided by the chiller manufacturer in order to allow the control system to integrate the chilled water temperature reset function into the control system.

M. Integrate:

1. The physical connections from a control system to all specified equipment through an interface as required to allow the specified control and monitoring functions of the equipment to be per- formed via the control system.

3.22 APPENDIX B: Abbreviations

A. The following abbreviations may be used in graphics, schematics, point names, and other UI applications where space is at a premium.

1. AC - Air Conditioning

2. ACU - Air Conditioning Unit

3. AHU - Air Handling Unit

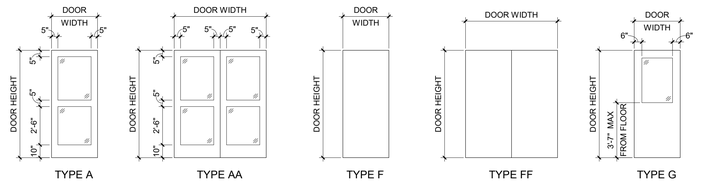
4. AI - Analog Input AO Analog Output AUTO - Automatic AUX - Auxiliary

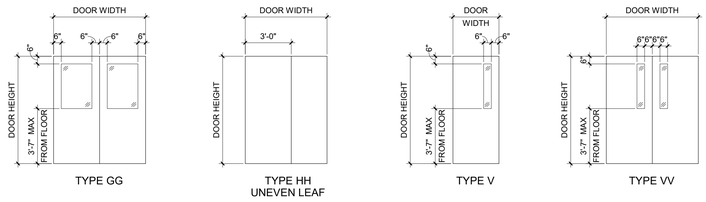
5. BI - Binary Input

6. BO - Binary Output C - Common

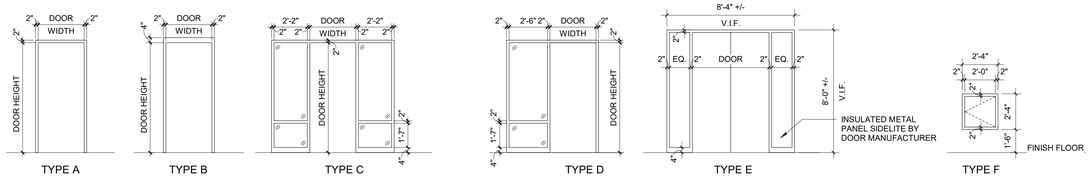
7. CHWP - Chilled Water Pump CHWR - Chilled Water Return CHWS - Chilled Water Supply COND - Condenser

8. CW - Condenser Water
9. CWP - Condenser Water Pump CWR - Condenser Water Return CWS - Condenser Water Supply DA - Discharge Air
10. EA - Exhaust Air
11. EF - Exhaust Fan
12. EVAP - Evaporators
13. FCU - Fan Coil Unit
14. HOA - Hand / Off / Auto HP - Heat Pump
15. HRU - Heat Recovery Unit HTEX - Heat Exchanger
16. HW - Hot Water
17. HWP - Hot Water Pump HHWR – Heating Hot Water Return
18. HHWS – Heating Hot Water Supply
19. MAX - Maximum
20. MIN - Minimum
21. MISC - Miscellaneous NC - Normally Closed NO - Normally Open OA - Outdoor Air
22. RA - Return Air
23. RF - Return Fan
24. RH - Relative Humidity RTU - Roof-top Unit
25. SA - Supply Air
26. SF - Supply Fan
27. SP - Static Pressure TEMP - Temperature UH - Unit Heater
28. VAV - Variable Air Volume
29. W/ - with
30. W/O - without

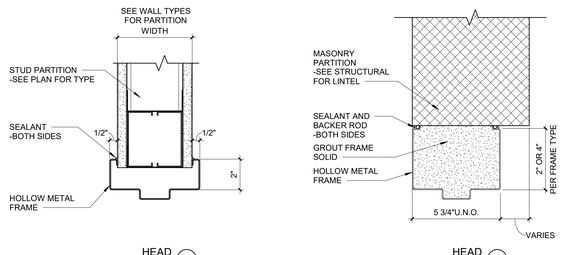




1 DOOR ELEVATIONS
SCALE: 1/4" = 1'-0"



2 DOOR FRAME TYPES
SCALE: 1/4" = 1'-0"



3 DOOR JAMB DETAILS
SCALE: 3" = 1'-0"

DOOR SCHEDULE

DOOR NUMBER	ROOM NAME	DOOR WIDTH	DOOR HEIGHT	DOOR TYPE	DOOR MATERIAL	FRAME TYPE	FRAME HEIGHT	DETAILS HEAD	DETAILS JAMB	HARDWARE SET	WALL FIRE RATING	COMMENTS
A001B	STAFF TOILET	3'-0"	7'-0"	F	WD	A	7'-2"	H1	J1	24.0		
A001C	LOCKERS	3'-0"	7'-0"	F	WD	A	7'-2"	H1	J1	25.1		
A003	CORRIDOR 'B'	6'-0"	7'-0"	VV	HM	B	7'-4"	H2	J2	8.0		
A005	CAFETERIA	5'-4"	7'-0"	VV	HM	B	7'-4"	H2	J2	8.0		UNEVEN LEAF; VERIFY DIMENSIONS IN FIELD
A005A	ELECTRIC CLOSET	2'-0"	2'-0"	F	HM	F		H1	J2	15.0		
A006A	KITCHEN	3'-0"	7'-0"	V	HM	B	7'-4"	H1	J1	21.0		
A007	TOILET	3'-0"	7'-0"	F	HM	ETR				13.0		VERIFY DIMENSIONS IN FIELD
A010	MECHANICAL ROOM	6'-0"	7'-0"	FF	HM	B	7'-4"	H2	J2	4.1		
A050	VESTIBULE	6'-0"	7'-0"	VV	HM	B	7'-4"	H2	J2	3.1		VERIFY DIMENSIONS IN FIELD
A100	GIRLS TOILET	3'-0"	7'-0"	F	WD	ETR				27.0		VERIFY DIMENSIONS IN FIELD
A101	2ND GRADE	3'-0"	7'-0"	V	WD	ETR				22.0		VERIFY DIMENSIONS IN FIELD
A102	CLASSROOM	3'-0"	7'-0"	V	WD	ETR				22.0		VERIFY DIMENSIONS IN FIELD
A104	CLASSROOM	3'-0"	7'-0"	V	WD	ETR				22.0		VERIFY DIMENSIONS IN FIELD
A106	CLASSROOM	3'-0"	7'-0"	V	WD	ETR	7'-2"	H1	J1	22.0		VERIFY DIMENSIONS IN FIELD
A108	KINDERGARTEN	3'-0"	7'-0"	V	WD	ETR	7'-4"			22.0		VERIFY DIMENSIONS IN FIELD
A109	KINDERGARTEN	3'-0"	7'-0"	V	WD	ETR				22.0		VERIFY DIMENSIONS IN FIELD
A110D	KINDERGARTEN	2'-6"	7'-0"	F	WD	ETR				20.0		VERIFY DIMENSIONS IN FIELD
A110E	KINDERGARTEN	3'-0"	7'-0"	V	WD	ETR				22.0		VERIFY DIMENSIONS IN FIELD
A112A	CORRIDOR 'B'	3'-0"	7'-0"	V	WD	B	7'-4"	H2	J2	17.0		
A113C	AUDITORIUM	5'-4"	8'-0"	VV	HM	E				3.1		
A113D	AUDITORIUM	5'-4"	8'-0"	VV	HM	E				3.1		
A113E	AUDITORIUM	5'-4"	8'-0"	VV	HM	E				3.1		
A113F	AUDITORIUM	5'-4"	8'-0"	VV	HM	E				3.1		
A203	CLASSROOM	3'-0"	7'-0"	V	WD	ETR				22.0		VERIFY DIMENSIONS IN FIELD
A204	CLASSROOM	3'-0"	7'-0"	V	WD	ETR				22.0		VERIFY DIMENSIONS IN FIELD
A212	CORRIDOR 'A'	3'-0"	7'-0"	V	WD	ETR				22.0		VERIFY DIMENSIONS IN FIELD
A303	CLASSROOM	3'-0"	7'-0"	V	WD	ETR				22.0		VERIFY DIMENSIONS IN FIELD
B001	VESTIBULE	6'-0"	7'-0"	AA	ALUM	A				1.0		STOREFRONT SYSTEM
B001A	VESTIBULE	6'-0"	7'-0"	AA	ALUM	A				1.0		STOREFRONT SYSTEM
B001B	LOBBY	6'-0"	7'-0"	AA	ALUM	A				6.0		STOREFRONT SYSTEM
B001C	LOBBY	6'-0"	7'-0"	AA	ALUM	A				6.0		STOREFRONT SYSTEM
B001E	TRANSITION CORRIDOR	6'-0"	7'-0"	FF	HM	B	7'-4"	H2	J2	10.0	3 HR RATED	MAGNETIC HOLD-OPEN
B005	LOBBY	3'-0"	7'-0"	F	WD	A	7'-2"	H1	J1	23.0		
B006A	VESTIBULE	6'-0"	7'-0"	AA	ALUM	A				6.0		
B006B	VESTIBULE	6'-0"	7'-0"	AA	ALUM	A				1.0		
B010	GYM OFFICE	3'-0"	7'-0"	F	WD	B	7'-4"	H2	J2	17.0		
B010A	STORAGE	3'-0"	7'-0"	F	WD	B	7'-4"	H2	J2	20.1		
B010B	STORAGE	3'-0"	7'-0"	F	WD	B	7'-4"	H2	J2	20.1		
B011A	GYMNASIUM	6'-0"	7'-0"	VV	WD	B	7'-4"	H2	J2	8.0		
B011B	GYMNASIUM	6'-0"	7'-0"	VV	WD	B	7'-4"	H2	J2	8.0		
B011C	GYMNASIUM	6'-0"	7'-0"	FF	HM	B	7'-4"	H2	J2	3.0		
B012	GYM STORAGE	6'-0"	7'-0"	FF	WD	B	7'-4"	H2	J2	19.0		
B013A	ELECTRIC/ MECHANICAL	6'-0"	7'-0"	FF	HM	B	7'-4"	H2	J2	4.1		
B013B	ELECTRIC/ MECHANICAL	3'-0"	7'-0"	F	HM	B	7'-4"			4.2		
B014	WATER SERVICE	3'-0"	7'-0"	F	HM	B	7'-4"	H2	J2	4.2		
B019	ADMIN	3'-0"	7'-0"	A	HM	D		H1	J1	22.0		
B019A	VESTIBULE	3'-0"	7'-0"	A	HM	C		H1	J1	22.0		
B019B	CLOSET	4'-0"	7'-0"	FF	WD	A	7'-2"	H1	J1	25.2		
B101	CORRIDOR	6'-0"	7'-0"	FF	HM	B	7'-4"	H2	J2	10.0	3 HR RATED	MAGNETIC HOLD-OPEN
B102	ELEVATOR MACHINE	3'-0"	7'-0"	F	WD	A	7'-2"	H1	J1	16.0		
B103	CORRIDOR	3'-0"	7'-0"	F	WD	A	7'-2"	H1	J1	16.0		
B105	ART CLASSROOM	3'-0"	7'-0"	F	WD	A	7'-2"	H1	J1	22.0		
B201	CORRIDOR	6'-0"	7'-0"	FF	HM	B	7'-4"	H2	J2	10.0	3 HR RATED	MAGNETIC HOLD-OPEN
B202	STAFF TOILET	3'-0"	7'-0"	F	WD	A	7'-2"	H1	J1	23.0		
B207	CLASSROOM	3'-0"	7'-0"	V	WD	A	7'-2"	H1	J1	22.0		
B208	CLASSROOM	3'-0"	7'-0"	V	WD	A	7'-2"	H1	J1	22.0		
B209	CLASSROOM	3'-0"	7'-0"	V	WD	A	7'-2"	H1	J1	22.0		
B210	CORRIDOR	5'-4"	7'-0"	F	WD	A	7'-2"	H1	J1	12.0		
B211	CLASSROOM	3'-0"	7'-0"	V	WD	A	7'-2"	H1	J1	22.0		
B212	CLASSROOM	3'-0"	7'-0"	V	WD	A	7'-2"	H1	J1	22.0		
B213	ART CLASSROOM	3'-0"	7'-0"	V	WD	A	7'-2"	H1	J1	22.0		
B214	IT	5'-4"	7'-0"	F	WD	A	7'-2"	H1	J1	12.0		
B301	CORRIDOR	6'-0"	7'-0"	FF	HM	B	7'-4"	H2	J2	10.0	3 HR RATED	MAGNETIC HOLD-OPEN
B302	JANITOR	3'-0"	7'-0"	F	WD	A	7'-2"	H1	J1	14.0		
B302A	ELEC	3'-0"	7'-0"	F	WD	A	7'-2"	H1	J1	14.0		
B307	CLASSROOM	3'-0"	7'-0"	V	WD	A	7'-2"	H1	J1	22.0		
B308	CLASSROOM	3'-0"	7'-0"	V	WD	A	7'-2"	H1	J1	22.0		
B309	CLASSROOM	3'-0"	7'-0"	V	WD	A	7'-2"	H1	J1	22.0		
B311	CLASSROOM	3'-0"	7'-0"	V	WD	A	7'-2"	H1	J1	22.0		
B312	CLASSROOM	3'-0"	7'-0"	V	WD	A	7'-2"	H1	J1	22.0		
B313	SCIENCE CLASSROOM	3'-0"	7'-0"	V	WD	A	7'-2"	H1	J1	22.0		
STA1.1	STAIR A1	6'-0"	7'-0"	VV	HM	B	7'-4"	H2	J2	3.0	1 HR RATED	
STA2.1	STAIR A2	6'-0"	7'-0"	VV	HM	B	7'-4"	H2	J2	3.0		
STB1.0	LOBBY	3'-0"	7'-0"	V	WD	B	7'-4"	H2	J2	11.0	1 HR RATED	
STB1.0A	STAIR B1	3'-0"	7'-0"	F	HM	B	7'-4"	H2	J2	4.0		
STB1.1	STAIR B1	3'-0"	7'-0"	V	WD	B	7'-4"	H2	J2	11.0	1 HR RATED	
STB1.2	STAIR B1	3'-0"	7'-0"	V	WD	B	7'-4"	H2	J2	11.0	1 HR RATED	
STB1.3	STAIR B1	3'-0"	7'-0"	V	WD	B	7'-4"	H2	J2	11.0	1 HR RATED	
STB1.4	STAIR B1	3'-0"	7'-0"	F	HM	B	7'-4"	H2	J2	4.2		
STB2.0	STAIR B2	3'-0"	7'-0"	V	WD	B	7'-4"	H2	J2	11.0	1 HR RATED	
STB2.0A	STAIR B2	3'-0"	7'-0"	F	HM	B	7'-4"	H2	J2	4.0		
STB2.2	STAIR B2	3'-0"	7'-0"	V	WD	B	7'-4"	H2	J2	11.0		
STB2.3	STAIR B2	3'-0"	7'-0"	V	WD	B	7'-4"	H2	J2	11.0		

NOTE: FIELD VERIFY OPENING SIZE OF ALL EXISTING DOOR FRAMES TO RECEIVE RENOVATED DOOR

2

ADDENDUM 1 - 06.09.2020

THE SCHOOL DISTRICT OF PHILADELPHIA

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ISSUED FOR BID
JANUARY 16, 2020

NO.	DATE	REVISION
10		
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3		
2	6.9.20	ADDENDUM 2
1	1.16.20	ISSUED FOR BID

SCHOOL & LOCATION
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PROJECT TITLE

MAJOR RENOVATION AND ADDITION

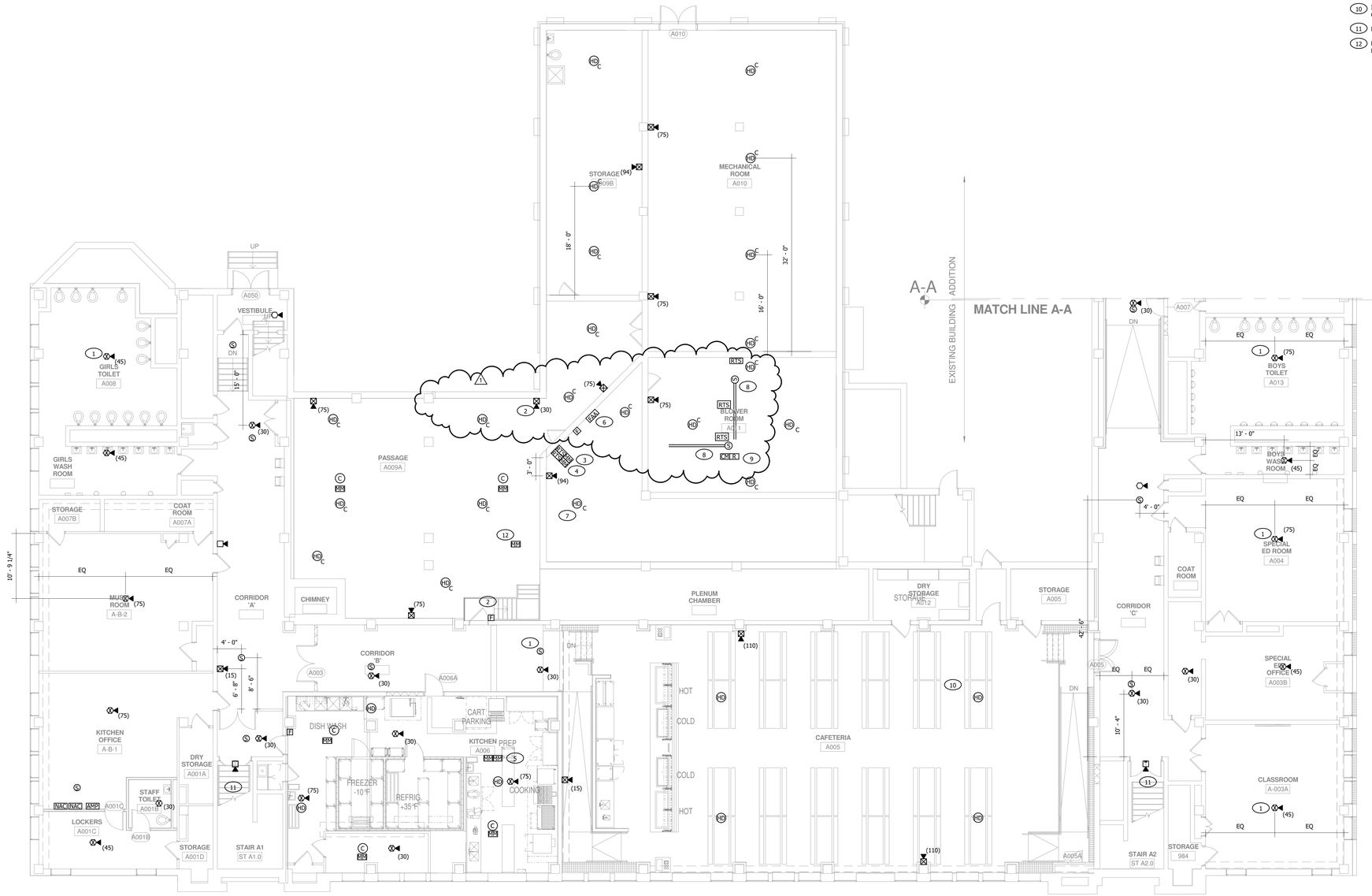
DRAWING TITLE

DOOR SCHEDULE AND DETAILS

DRAWING SCALE: As indicated	
LOCATION NO.: XXXX	FILE NO.: 2018-080
DRAWN BY: Author	CHECKED BY: Checker

GC B-011 C	**OF**	**2017 / 18**
MC B-012 C	**OF**	**2017 / 18**
PC B-013 C	**OF**	**2017 / 18**
EC B-014 C	**OF**	**2017 / 18**

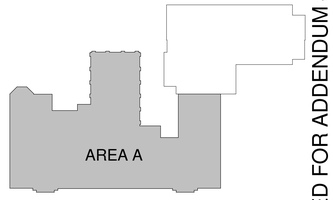
DRAWING NO.
A-600
SHEET X OF XXX



1 / FA-101 GROUND FLOOR RENOVATED PLAN - AREA A - FIRE ALARM
1/8" = 1'-0"

KEYED NOTES:

1. MOUNT TO BOTTOM OF BEAM.
2. PROVIDE NEW DEVICE AT EXISTING LOCATION, AT CODE REQUIRED HEIGHT.
3. REMOTE TEST SWITCH, AND MONITOR MODULE FOR BOILER ROOM HEAT DETECTORS.
4. REMOTE TEST SWITCH AND MONITOR MODULE FOR HEAT DETECTORS IN BLOWER ROOM, CHILLER PLANT ROOM AND STORAGE.
5. PROVIDE MONITOR MODULES FOR KITCHEN HOOD SUPPRESSION SYSTEM.
6. ENGINEER OFFICE LOCATION.
7. MOUNT HEAT DETECTOR APPROXIMATELY 5'-6" FROM NORTH WALL.
8. DOAU1 DUCT SMOKE DETECTORS IN SUPPLY AND RETURN DUCTWORK.
9. PROVIDE CONTROL MODULE AND RELAY FOR DOAU1 UNIT SHUTDOWN.
10. INSTALL HEAT DETECTIORS IN SUSPENDED ACOUSTICAL PANEL CEILING CLOUDS.
11. MOUNT DEVICE ON THE WALL ABOVE THE DOOR. APPROX. 9'6" AFF.
12. PROVIDE MONITOR MODULES TO MONITOR EMERGENCY BOILER SHUT DOWN.



KEY PLAN

PROJECT TRUE

ISSUED FOR ADDENDUM #2 06/09/2020

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ISSUED FOR BID
JANUARY 27, 2020

NO.	DATE	REVISION
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2	6.09.20	ADDENDUM #2
1	1.27.20	ISSUED FOR BID

SCHOOL & LOCATION
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PROJECT TITLE

MAJOR RENOVATION AND ADDITION

DRAWING TITLE

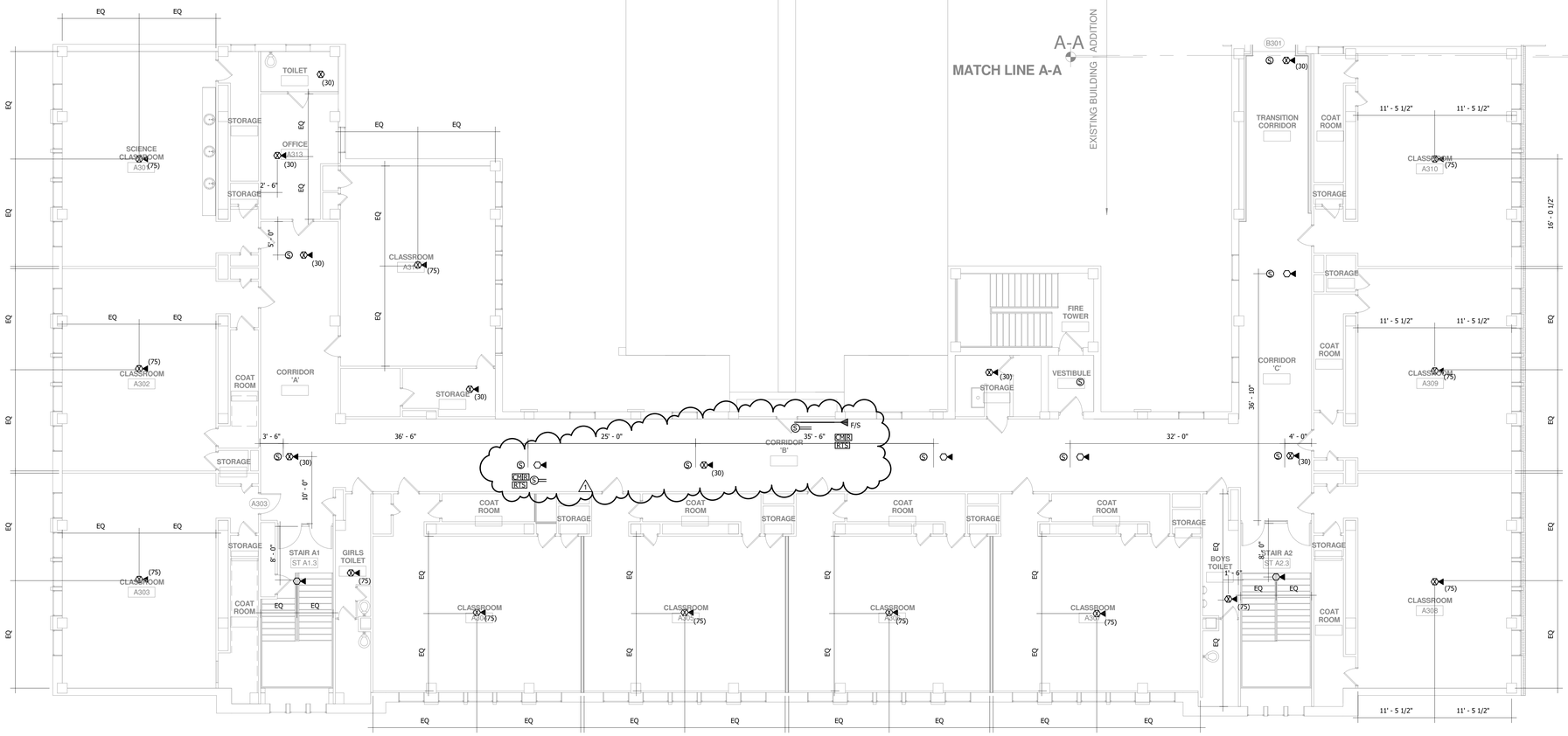
GROUND FLOOR RENOVATED PLAN - AREA A - FIRE ALARM

DRAWING SCALE As Indicated	
LOCATION NO. XXXX	FILE NO. 2018-080
DRAWN BY LEL	CHECKED BY BAS

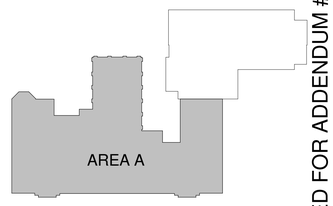
GC B-011 C	OF	2017 / 18
MC B-012 C	OF	2017 / 18
PC B-013 C	OF	2017 / 18
EC B-014 C	OF	2017 / 18

DRAWING NO.
FA-101

SHEET X OF XXX



1 FA-107 THIRD FLOOR RENOVATED PLAN - AREA A - FIRE ALARM
1/8" = 1'-0"



KEY PLAN

PROJECT TRUE

ISSUED FOR ADDENDUM #2 06/09/2020

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JANUARY 27, 2020

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2	6.09.20	ADDENDUM #2
1	1.27.20	ISSUED FOR BID

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PROJECT TITLE
MAJOR RENOVATION AND ADDITION

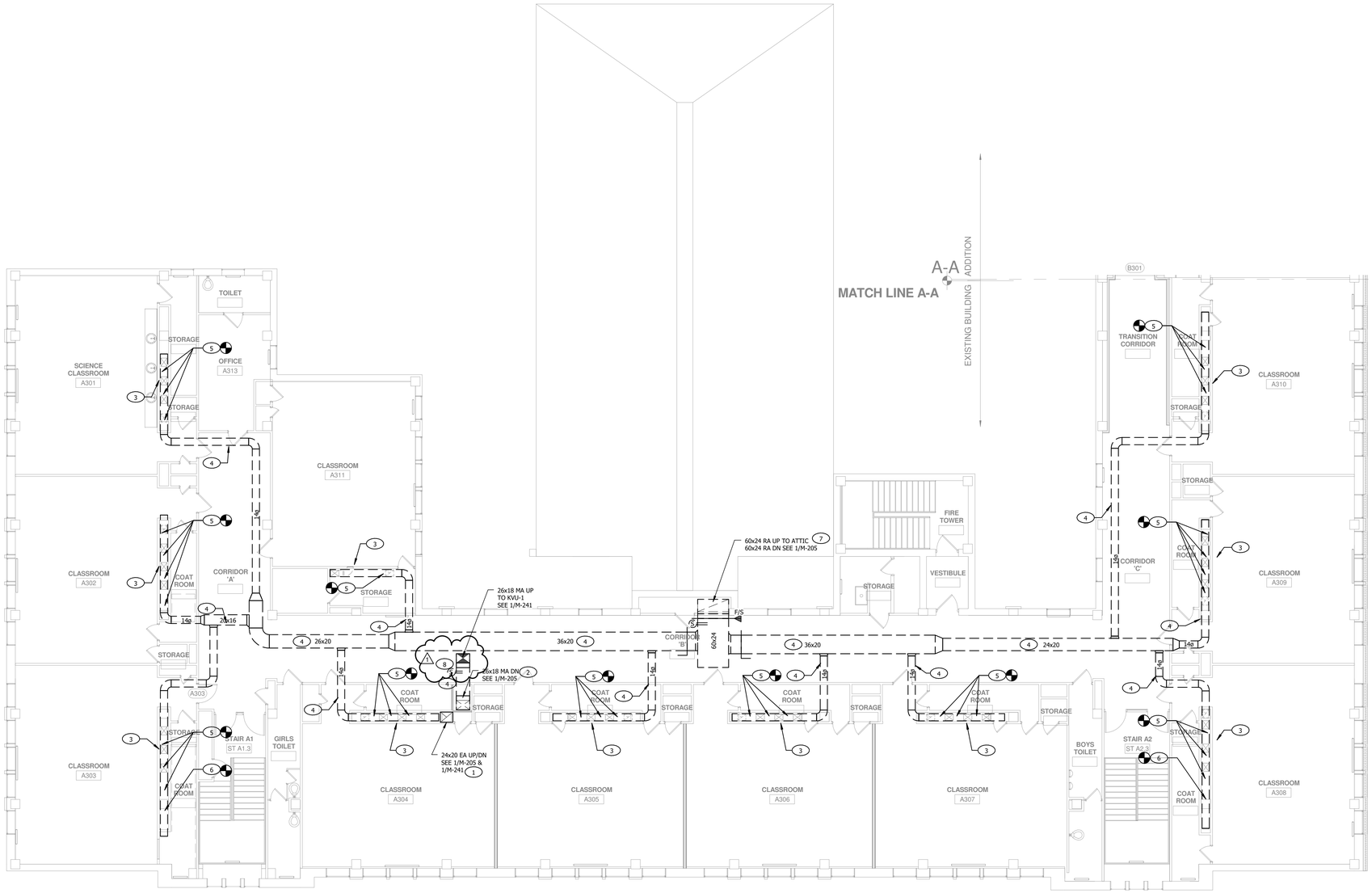
DRAWING TITLE
THIRD FLOOR RENOVATED PLAN - AREA A - FIRE ALARM

DRAWING SCALE As Indicated	
LOCATION NO. XXXX	FILE NO. 2018-080
DRAWN BY IRS	CHECKED BY BAS

GC B-011 C	OF	2017 / 18
MC B-012 C	OF	2017 / 18
PC B-013 C	OF	2017 / 18
EC B-014 C	OF	2017 / 18

DRAWING NO.
FA-107

SHEET X OF XXX



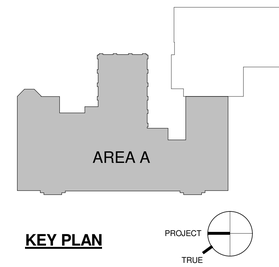
1 M-207 THIRD FLOOR RENOVATED PLAN - AREA A - MECHANICAL DUCTWORK
1/8" = 1'-0"

GENERAL NOTES

1. THE CONTRACTOR SHALL VERIFY ALL EXISTING CONDITIONS IN THE FIELD.
2. THE CONTRACTOR SHALL PATCH, REPAIR, AND SEAL ANY AND ALL HOLES OR OPENINGS IN SUPPLY OR RETURN DUCTWORK WHEN NECESSARY TO MEET SPECIFICATIONS.
3. THE CONTRACTOR SHALL PROVIDE OR REPLACE MISSING OR DAMAGED INSULATION AS NECESSARY TO MEET SPECIFICATIONS.
4. GREASE DUCT SERVING TYPE 1 HOOD THAT PENETRATES A CEILING, WALL, OR FLOOR SHALL BE ENCLOSED FROM THE POINT OF PENETRATION TO THE OUTLET TERMINAL. PROVIDE FIRE RESISTANT RATING OF NOT LESS THAN THE PENETRATED ASSEMBLY.

KEYED NOTES

1. NEW KITCHEN EXHAUST DUCT TO FOLLOW PATH OF DEMOLISHED EXHAUST DUCT TO EXTENTS POSSIBLE.
2. NEW MAKEUP AIR DUCT TO RISE WITHIN NEW SHAFT CREATED IN COAT ROOMS. SEE ARCHITECT PLAN FOR LOCATION.
3. PROVIDE WIRE MESH PROTECTIVE SCREEN OVER SUPPLY AIR OUTLET WITHIN CLASSROOM. SUBMITTED WIRE MESH SCREEN SHALL BE REVIEWED AND APPROVED BY ARCHITECT PRIOR TO ORDER.
4. DASHED DUCTWORK IS LOCATED IN ATTIC SPACE.
5. 16x12 RA CONNECTION TO RISER. SEAL AIR/WATER TIGHT. PROVIDE MANUAL VOLUME DAMPER AND BALANCE TO 380 CFM.
6. 16x12 RA CONNECTION TO RISER. SEAL AIR/WATER TIGHT. PROVIDE MANUAL VOLUME DAMPER AND BALANCE TO 230 CFM.
7. PROVIDE F/S DAMPER AT DUCT PENETRATION.
8. DUCT SMOKE DETECTOR SHALL INTERLOCK TO FAN FOR SHUTDOWN AND TIE INTO FIRE ALARM SYSTEM. REFER TO FIRE PROTECTION PLANS FOR DETAILS. PROVIDE ACCESS AS NEEDED TO DEVICE.



KEY PLAN

ISSUED FOR ADDENDUM #2 06/09/2020

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ISSUED FOR BID
JANUARY 27, 2020

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2	6.09.20	ADDENDUM #2
1	1.27.20	ISSUED FOR BID

SCHOOL & LOCATION
ETHAN ALLEN ELEMENTARY SCHOOL
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PROJECT TITLE
MAJOR RENOVATION AND ADDITION

DRAWING TITLE
THIRD FLOOR RENOVATED PLAN - AREA A - MECHANICAL DUCTWORK

DRAWING SCALE As Indicated	
LOCATION NO. XXXX	FILE NO. 2018-080
DRAWN BY MEP	CHECKED BY JWM

GC B-011 C	OF	2017 / 18
MC B-012 C	OF	2017 / 18
PC B-013 C	OF	2017 / 18
EC B-014 C	OF	2017 / 18

DRAWING NO.
M-207

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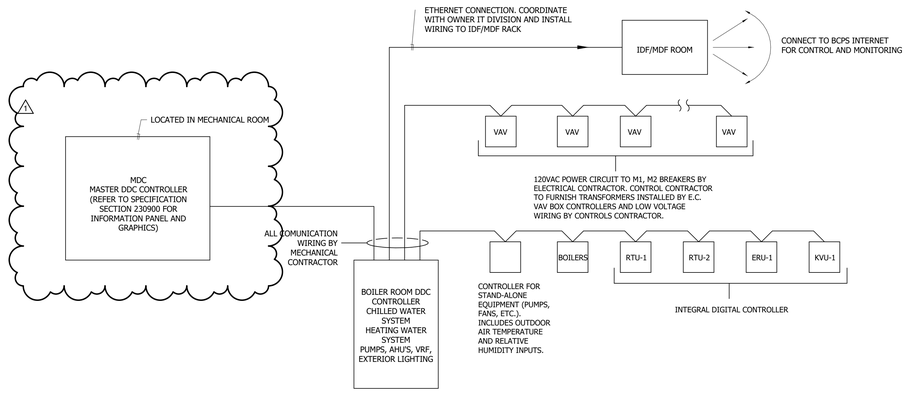

MASTER DDC CONTROLLER(MDC)

1. CONTROL AND MONITOR ALL EQUIPMENT.
2. FLOOR PLAN WITH EQUIPMENT LOCATIONS AND SAME TAG PER MECHANICAL PLANS(CONTROLS CONTRACTOR TO USE MECHANICAL PLANS TAGS AND NOT CUSTOM TAGS)
3. SCHEMATIC MUST BE PER THE MECHANICAL PLANS(CONTROLS CONTRACTOR TO USE MECHANICAL PLANS SCHEMATICS AND NOT CUSTOM SCHEMATICS)

FUNCTIONALITY WITH BUILDING AUTOMATION SYSTEM

1. DISPLAY SYSTEM GRAPHICS FROM THE BUILDING AUTOMATION SYSTEM.
2. EACH SYSTEM UNDER CONTROL OF THE BUILDING AUTOMATION SYSTEM SHALL HAVE ITS OWN UNIQUE GRAPHICAL DISPLAY AS DESCRIBED WITHIN THE SPECIFICATIONS.
3. THE OPERATOR SHALL BE ABLE TO PERFORM TASKS SUCH AS NAVIGATING THE BUILDING AUTOMATION SYSTEM, SETPOINT ADJUSTMENTS, SCHEDULE CHANGES, HEATING/COOLING CHANGEOVER, AND AS DESCRIBED WITHIN THE SPECIFICATIONS VIA THE LCD TOUCH SCREEN DISPLAY WITHOUT THE NEED FOR A PC COMPUTER OR LAPTOP.
4. PROVIDE 72 HOURS OF BATTERY BACKUP FOR ALL EQUIPMENT CONTROL PANELS LOCAL AND THE CENTRAL BMS PANEL IN ORDER TO RETAIN ALL SETPOINTS AND SEQUENCE OF OPERATIONS IN THE EVENT OF A LOSS OF POWER.
5. IN THE EVENT OF LOSS OF POWER AND BATTERY FAILURE SYSTEMS SHALL DEFAULT TO OCCUPIED SCHEDULE MODE.

GENERAL AUTOMATIC TEMPERATURE CONTROL REQUIREMENTS

SCOPE:
THE INTENT IS TO PROVIDE A COMPLETE TEMPERATURE CONTROL SYSTEM CONSISTING OF BUT NOT LIMITED TO ELECTRIC AND ELECTRONIC CONTROLS AND AN AUTOMATED BUILDING MANAGEMENT AND DIGITAL CONTROL SYSTEM.

CONTROL PANEL LOCATION INDICATED ON PLANS. CONTROL PANEL SHALL HAVE DISPLAY OF ALL CONTROL POINTS AND BE ABLE TO BE CONTROLLED AT THIS LOCATION AND REMOTELY TO FACILITY OFFICES VIA STANDARD WEB BROWSER. THIS PANEL SHALL INCLUDE A SECURELY MOUNTED CPU.

THE SYSTEM SHALL CONSIST OF AN ETHERNET BASED, WIDE AREA NETWORK (WAN), WITH OR MULTI LEVEL LOCAL AREA NETWORK (LAN). THE SYSTEM SHALL BE MODULAR AND SHALL PERMIT EXPANSION OF BOTH CAPACITY AND FUNCTIONALITY THROUGH THE ADDITION OF SENSORS, ACTUATORS, BUILDING CONTROLLERS, APPLICATION SPECIFIC CONTROLLERS, ADVANCED APPLICATION CONTROLLERS AND OPERATOR DEVICES.

SYSTEM ARCHITECTURE DESIGN SHALL ELIMINATE DEPENDENCE UPON ANY SINGLE DEVICE FOR ALARM REPORTING AND CONTROL EXECUTION.

SYSTEM SHALL ACCOMMODATE FUTURE EXPANSION OF CONTROL COMPONENTS. PROVIDE 25% SPACE CAPACITY FOR ALL POINT TYPES.

SYSTEM SHALL INCLUDE OPERATING AND SOFTWARE LICENSES FOR A MINIMUM OF 15 USERS.

SYSTEM SET POINTS:
ALL SYSTEM SET POINTS, DURATION, TEMPERATURES, PRESSURES, FLOW RATES, ETC. LISTED HEREIN WITHIN THE CONTRACT DOCUMENTS SHALL BE ADJUSTABLE THROUGH THE BMS.

ZONING AND SCHEDULING
THERE WILL BE A SINGLE USER ADJUSTABLE SCHEDULE. PROVIDE REGULAR, WEEKEND, SPECIAL-USE, AND HOLIDAY TIMES WITHIN THE SCHEDULE. THERE SHALL BE 4 SCHEDULING ZONES. THE SCHEDULING ZONE SHALL BE DIVIDED INTO CLASSROOM ZONE, GYMNASIUM ZONE, KITCHEN/CAFETERIA ZONE, AND ADMINISTRATION OFFICE ZONE. THE PROGRAM SHALL MONITOR THE CONTROLLED EQUIPMENT STATUS, WHERE INDICATED AS SUCH ON THE INPUT/OUTPUT SUMMARY TABLE, TO VERIFY THAT THE START AND STOP COMMAND HAS BEEN CARRIED OUT, AND PROVIDE THE SYSTEM WITH AN ALARM WHEN THE EQUIPMENT DOES NOT START OR STOP, FAILS, OR IS LOCALLY RATED OR STOPPED.

OCCUPIED-UNOCCUPIED CYCLES
WHEN ANY ZONE IS INDEXED TO THE "UNOCCUPIED" CYCLE, ALL AIR HANDLING UNITS, HEATING AND VENTILATING UNITS, ETC. WITHIN THE RESPECTIVE ZONE SHALL STOP, THERMOSTATS SHALL BE INDEXED TO THEIR NIGHT SETTING AND SHALL CONTROL THEIR RESPECTIVE UNITS TO CYCLE THE UNIT TO MAINTAIN A REDUCED SPACE TEMPERATURE. DURING THIS CYCLE ALL ASSOCIATED EHAUST FANS SHALL BE STOPPED AND ALL ASSOCIATED OUTDOOR AND RELIEF DAMPERS SHALL BE CLOSED. WHEN INDEXED TO THE "OCCUPIED" CYCLE, THE UNITS SHALL RUN CONTINUOUSLY AND SHALL BE CONTROLLED AS SPECIFIED HEREINAFTER. THE AUTOMATIC "OCCUPIED" - "UNOCCUPIED" SIGNALS SHALL INCORPORATE AN ADAPTIVE OPTIMUM START ALGORITHM THAT SHALL UTILIZE BOTH THE ZONE TEMPERATURE AND THE OUTSIDE AIR TEMPERATURE TO START THE MECHANICAL EQUIPMENT SO AS TO REACH TEMPERATURE TARGETS JUST IN TIME FOR OCCUPANCY.

FAN INTERLOCK/CONTROLS:
INTERLOCK MOTOR OPERATED EXHAUST AND/OR RELIEF/INTAKE DAMPERS WITH RESPECTIVE FAN OPERATION AS REQUIRED. SEE FAN SCHEDULES, FLOOR PLANS AND CONTROL SCHEMATICS.

GENERAL SYSTEM SAFETIES:
1. ALL EQUIPMENT AND/OR SYSTEMS SAFETIES AND/OR OVERRIDES SUCH AS FREEZE, FIRE AND SMOKE DETECTION SHALL OVERRIDE BMS AS NECESSARY TO EXECUTE THEIR FUNCTIONS. ALL SAFETY CONTROLS SHALL BE WIRED INDEPENDENT OF THE MOTOR STARTERS HOA SWITCHES.
2. PROVIDE AUTOMATIC RESET FREEZE STAT FOR ALL EQUIPMENT CAPABLE OF INTRODUCING OA. UPON DETECTION OF FREEZE CONDITION, THE SYSTEM SHALL DE-ENERGIZE.
3. SMOKE DETECTION UPON SENSING SHALL STOP THEIR RELATED AIR HANDLING UNIT FANS.

SPACE TEMPERATURE SET POINTS:
1. ALL SPACE TEMPERATURE THERMOSTATS SERVING HABITABLE SPACES SHALL HAVE HEATING SETPOINT OF 70°F AND COOLING SETPOINT OF 75°F.
2. UNOCCUPIED NIGHT SETUP SETPOINT (COOLING): 85°F.
3. UNOCCUPIED NIGHT SETBACK SETPOINT (HEATING): 65°F.

GENERAL NOTES:
1. NOT ALL PIPING, VALVES AND ACCESSORIES ARE SHOWN ON CONTROL SCHEMATICS REFER TO OTHER MECHANICAL DRAWINGS AND SPECIFICATIONS FOR COMPLETE SYSTEM.
2. REFER TO SEQUENCE OF OPERATION FOR ADDITIONAL EQUIPMENT CONTROLS.
3. POWER SUPPLY TO ANY ADDITIONAL PANELS REQUIRED BY ATC CONTRACTOR SHALL BE DERIVED OF OR POWER BY E.C. TO ATC PANELS SHOWN.
4. PROVIDE A MANUAL BYPASS TO OPERATE THE BOILER, CHILLER, OR AHU'S UNDER ITS OWN LOCAL CONTROLS IN THE EVENT OF A CONTROL PANEL MALFUNCTION. ALL SAFETIES REMAIN IN EFFECT. ALL SETPOINTS SHALL REMAIN STORED IN THE MEMORY OF THE CONTROL PANEL AND NOT NEED TO BE RE-ENTERED IN THE EVENT OF A FAILURE. PREVIOUS SETPOINTS SHALL AUTOMATICALLY BE IMPLEMENTED WHEN EQUIPMENT RESUMES OPERATION THRU THE CONTROL PANEL.
5. PROVIDE 72 HOUR BATTERY BACK UP FOR ALL CONTROL PANELS.
6. ALL GRAPHICS INCLUDING JOB SPECIFIC FLOOR PLANS AS WELL AS GRAPHICS FOR DEDICATED AND STAND ALONG EQUIPMENT MUST BE FURNISHED BY CONTRACTOR.
7. IT IS THE MECHANICAL CONTRACTOR'S RESPONSIBILITY TO SELECT EQUIPMENT CONTROLS COMPATIBLE WITH THE SPECIFIED OPEN PROTOCOL DDC SYSTEM.

CONTROLS NETWORK ARCHITECTURE SCHEMATIC

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ERIC M. WOLF
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PROJECT TITLE

MAJOR RENOVATION AND ADDITION

DRAWING TITLE

CONTROLS - MECHANICAL

DRAWING SCALE As Indicated	
LOCATION NO. XXXX	FILE NO. 2018-080
DRAWN BY MEP	CHECKED BY JWM

GC 8-011 C	**OF**	**2017 / 18**
MC 8-012 C	**OF**	**2017 / 18**
PC 8-013 C	**OF**	**2017 / 18**
EC 8-014 C	**OF**	**2017 / 18**

DRAWING NO.
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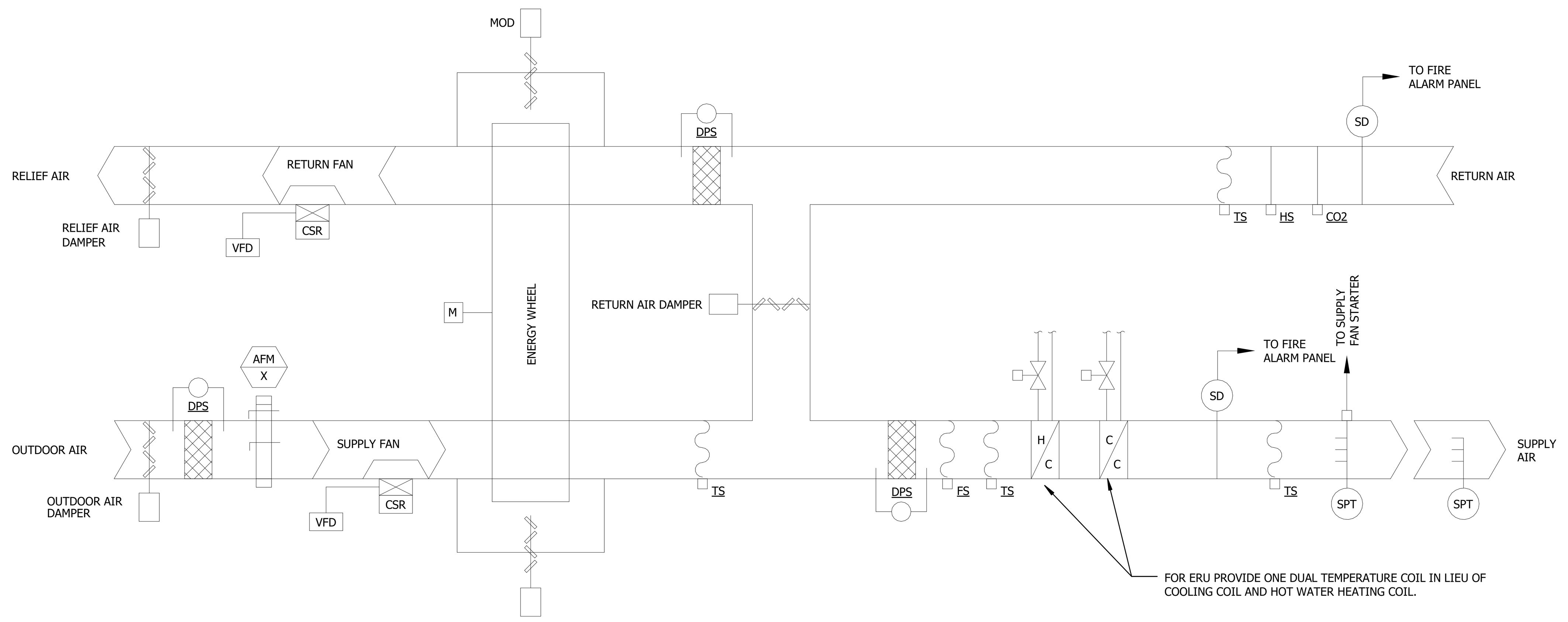
ISSUED FOR ADDENDUM #2 06/09/2020



ROOFTOP UNIT CONTROL DIAGRAM

RTU SEQUENCE OF OPERATION

SPACE TEMPERATURE SENSORS CONTROLLING TERMINAL UNITS SHALL ENABLE THE AHU TO PERFORM COOL-DOWN, NIGHT SET-BACK, AND WARM-UP FUNCTIONS. OTHER THAN FOR COOL-DOWN/WARM-UP AND NIGHT SET-BACK, RTU SHALL BE OFF DURING UNOCCUPIED MODES AND SHALL RUN CONTINUOUSLY DURING OCCUPIED MODES.

SMOKE DETECTOR SHUTDOW: THE UNIT SHALL SHUT DOWN IN RESPONSE TO A SIGNAL FROM THE SMOKE DETECTOR INDICATING THE PRESENCE OF SMOKE. THE SMOKE DETECTOR SHALL BE INTERLOCKED TO THE UNIT THROUGH THE DRY CONTACTS OF THE SMOKE DETECTOR. A MANUAL RESET OF THE SMOKE DETECTOR SHALL BE REQUIRED TO RESTART THE UNIT. SEE FIRE ALARM SYSTEM FOR ADDITIONAL DETAILS.

UNOCCUPIED OPERATIONS :

IN UNOCCUPIED MODES, RTU FANS SHALL NORMALLY BE OFF, CHILLED WATER VALVE CLOSED, THE ENERGY RECOVERY WHEEL (ERW) SHALL BE OFF. THE OUTSIDE AND RELIEF DAMPERS SHALL BE CLOSED, THE RETURN AIR DAMPER SHALL BE OPEN.

1. COOL-DOWN : SUPPLY FAN SHALL RUN AND CHILLED WATER VALVE SHALL MODULATE TO MAINTAIN 55°F SUPPLY AIR TEMP. RETURN FAN SHALL BE ON. COOL-DOWN SHALL BE INITIATED IN RESPONSE TO THE WORST CASE VAV TERMINAL SPACE TEMPERATURE.
2. WARM-UP : SUPPLY FAN SHALL RUN AND CHILLED WATER VALVE SHALL BE CLOSED. RETURN FAN SHALL BE ON. WARM-UP SHALL BE INITIATED IN RESPONSE TO EIGHT VAV TERMINAL SPACES CALLING FOR HEAT.
3. NITE SET-BACK : SUPPLY FAN SHALL BE OFF AND CHILLED WATER VALVE SHALL BE CLOSED. RETURN FAN SHALL BE OFF. SUPPLY AND RETURN FAN SHALL BE INITIATED IN RESPONSE TO EIGHT VAV TERMINAL SPACES CALLING FOR HEAT. SUPPLY AND RETURN FAN SHALL BE DISABLED WHEN RETURN AIR TEMPERATURE REACHES NITE SET-BACK SETPOINT AND LESS THAN 8 ZONES ARE CALLING FOR HEAT.
4. NITE SET-UP: SUPPLY FAN SHALL BE OFF AND CHILLED WATER VALVE SHALL BE CLOSED. RETURN FAN SHALL BE OFF. SUPPLY AND RETURN FAN SHALL BE INITIATED IN RESPONSE TO WORST CASE VAV TERMINAL SPACE TEMPERATURE. MODULATE CHILLED WATER VALVE TO MAINTAIN 55°F SUPPLY AIR TEMPERATURE. SUPPLY AND RETURN FAN SHALL BE DISABLED AND CHILLED WATER VALVE CLOSED WHEN RETURN AIR TEMPERATURE REACHES NITE SET-UP SETPOINT AND RETURN AIR HUMIDITY IS BELOW 60%.
5. RECIRCULATION PUMP OPERATIONS: DURING UNOCCUPIED PERIOD AND DROP IN OUTDOOR AIR TEMPERATURE BELOW 40°F, RECIRCULATION PUMP SHALL ENERGIZE AND RUN CONTINUOUSLY UNTIL OCCUPIED PERIOD OR RISE IN OUTDOOR AIR TEMPERATURE ABOVE 40°F.

OCCUPIED OPERATIONS : SUPPLY AND RETURN FANS SHALL RUN CONTINUOUSLY.

1. DAMPER VENTILATION CONTROL
   OUTDOOR AIR DAMPER SHALL OPEN TO MINIMUM POSITION; RETURN AIR DAMPER SHALL MODULATE TOWARD CLOSED TO MAINTAIN MINIMUM OUTDOOR AIR FLOW RATE, RELIEF DAMPER SHALL TRACK OUTSIDE AIR DAMPER. RETURN AIR DAMPER SHALL NOT DROP BELOW 20% OPEN WHILE ATTEMPTING TO MAINTAIN MINIMUM OUTDOOR AIR QUANTITY.
2. DISCHARGE AIR TEMPERATURE SETPOINT CONTROL :
   A. AHU TEMPERATURE CONTROL SHALL BE BY DISCHARGE AIR TEMPERATURE SENSOR. DISCHARGE AIR SETPOINT SHALL BE 55°F (ADJ.) WHEN OUTDOOR AIR TEMPERATURES ARE ABOVE 60°F (ADJ.).
   B. AT OUTDOOR AIR TEMPERATURE BELOW 60°F, DISCHARGE AIR SETPOINT SHALL BE RESET BY RETURN AIR; AT RETURN AIR TEMPERATURES OF 68°F (ADJ.) OR LOWER, SUPPLY AIR SHALL BE 65°F (ADJ.) AND AT RETURN AIR TEMPERATURES OF 78°F (ADJ.) OR HIGHER, SUPPLY AIR SHALL BE 55°F (ADJ.). WORST CASE SPACE AIR TEMPERATURES SHALL OFFSET SUPPLY AIR SETPOINT WITHIN THE 55-65°F RANGE; LOWERING DISCHARGE AIR TEMPERATURES IF SPACE AIR TEMPERATURE RISES ABOVE SETPOINT WITH THE TERMINAL BOX IN THE FULL COOLING POSITION. TEMPERATURE OFFSET SHALL BE REGULATED TO 1°F CHANGE PER 15 MINUTE TIME INTERVAL.
   C. WHEN RETURN AIR HUMIDITY REACHES 59% SUPPLY AIR TEMPERATURE SHALL BE SET TO 55F UNTIL THE RETURN AIR HUMIDITY REACHES 54%.
3. OCCUPIED TEMPERATURE CONTROL MODES : SUPPLY AND RETURN FANS SHALL RUN CONTINUOUSLY.
   A. ECONOMIZER COOLING: ENABLE WHEN OUTDOOR AIR ENTHALPY IS BELOW ECONOMIZER ENABLE SETPOINT AND BELOW RETURN AIR ENTHALPY. THE OUTDOOR AIR DAMPER AND RETURN DAMPER SHALL MODULATE TO MAINTAIN SUPPLY AIR DISCHARGE SETPOINT. THE ERW SHALL BE DISABLED. THE CHILLED WATER VALVE SHALL CLOSE.
   B. COOLING WITH NO ENERGY RECOVERY: ENABLE WHEN OUTDOOR AIR ENTHALPY IS ABOVE ECONOMIZER ENABLE SETPOINT BUT BELOW RETURN AIR ENTHALPY. THE OUTDOOR AIR DAMPERS SHALL MODULATE TO ITS MINIMUM POSITION AND RETURN AIR DAMPERS SHALL OPERATE BASED ON THE VENTILATION CONTROL SEQUENCE. THE RELIEF AIR DAMPERS SHALL TRACK THE OUTDOOR AIR DAMPER. THE ERW SHALL BE DISABLED. THE CHILLED WATER VALVE SHALL MODULATE TO ALLOW CHILLED WATER TO ENTER COIL TO MAINTAIN SUPPLY AIR TEMPERATURE SETPOINT.
   C. COOLING WITH ENERGY RECOVERY: ENABLE WHEN OUTDOOR AIR ENTHALPY IS ABOVE ECONOMIZER ENABLE SETPOINT AND RETURN AIR ENTHALPY. THE OUTDOOR AIR DAMPERS SHALL MODULATE TO ITS MINIMUM POSITION AND RETURN AIR DAMPERS SHALL OPERATE BASED ON THE VENTILATION CONTROL SEQUENCE. THE RELIEF AIR DAMPERS SHALL TRACK THE OUTDOOR AIR DAMPER. THE ERW SHALL START. THE CHILLED WATER VALVE SHALL MODULATE TO ALLOW CHILLED WATER TO MAINTAIN DISCHARGE AIR TEMPERATURE SETPOINT.
   D. HEATING WITH ENERGY RECOVERY: WHEN OUTSIDE AIR TEMPERATURE IS BELOW 50°F, THE OUTDOOR AIR DAMPERS SHALL MODULATE TO ITS MINIMUM POSITION AND RETURN AIR DAMPERS SHALL OPERATE BASED ON THE VENTILATION CONTROL SEQUENCE. THE RELIEF AIR DAMPERS SHALL TRACK THE OUTDOOR AIR DAMPER. THE ERW SHALL START WHEN MIXED AIR TEMPERATURE IS BELOW SUPPLY AIR SETPOINT. THE HEATING HOT WATER VALVE SHALL MODULATE TO ALLOW HOT WATER TO MAINTAIN DISCHARGE AIR TEMPERATURE SETPOINT.
4. FANS SPEED CONTROL :
   A. SUPPLY FAN VFD SHALL MODULATE TO MAINTAIN SUPPLY AIR STATIC PRESSURE SETPOINT; SETPOINT SHALL BE DETERMINED BY THE AIR BALANCE CONTRACTOR.
   B. DURING OCCUPIED MODE, RETURN FAN SPEED SHALL MODULATE TO MAINTAIN RETURN AIR STATIC PRESSURE SETPOINT. CONTROL TO +0.05 ADJUSTABLE.
   C. RELIEF AIR DAMPER SHALL MODULATE TO MAINTAIN BUILDING STATIC PRESSURE. SENSOR TO BE LOCATED IN FIRST GENERAL COMMON AREA SERVED BY INDIVIDUAL RTU.
   D. SUPPLY FAN SHALL STOP AND REQUIRE MANUAL RESET IF SUPPLY AIR STATIC PRESSURE EXCEEDS HIGH LIMIT; HI-STATIC SAFETY SHALL BE VIA HARD-WIRE HIGH LIMIT STATIC PRESSURE SENSOR NEAR FAN DISCHARGE (NOT VIA BMS).

ERU SEQUENCE OF OPERATION

ERU SHALL BE OFF DURING UNOCCUPIED MODES AND SHALL RUN CONTINUOUSLY DURING OCCUPIED MODES. OCCUPANCY TO BE ADJUSTABLE VIA BAS VIA TIME OF DAY SCHEDULING.

SMOKE DETECTOR SHUTDOW: THE UNIT SHALL SHUT DOWN IN RESPONSE TO A SIGNAL FROM THE SMOKE DETECTOR INDICATING THE PRESENCE OF SMOKE. THE SMOKE DETECTOR SHALL BE INTERLOCKED TO THE UNIT THROUGH THE DRY CONTACTS OF THE SMOKE DETECTOR. A MANUAL RESET OF THE SMOKE DETECTOR SHALL BE REQUIRED TO RESTART THE UNIT. SEE FIRE ALARM SYSTEM FOR ADDITIONAL DETAILS.

UNOCCUPIED OPERATIONS :

IN UNOCCUPIED MODES,ERU FANS SHALL NORMALLY BE OFF, CHILLED WATER AND HOT WATER VALVE CLOSED, THE ENERGY RECOVERY WHEEL (ERW) SHALL BE OFF. THE OUTDOOR AIR, RELIEF AIR, SUPPLY AIR, AND RETURN AIR DAMPERS SHALL BE CLOSED.

RECIRCULATION PUMP OPERATIONS: DURING UNOCCUPIED PERIOD AND DROP IN OUTDOOR AIR TEMPERATURE BELOW 40°F, RECIRCULATION PUMP SHALL ENERGIZE AND RUN CONTINUOUSLY UNTIL OCCUPIED PERIOD OR RISE IN OUTDOOR AIR TEMPERATURE ABOVE 40°F.

OCCUPIED OPERATIONS : SUPPLY AND RETURN FANS SHALL RUN CONTINUOUSLY.

1. DAMPER VENTILATION CONTROL
   OUTDOOR AIR DAMPER SHALL OPEN TO MINIMUM POSITION; RETURN AIR DAMPER SHALL MODULATE TOWARD CLOSED TO MAINTAIN MINIMUM OUTDOOR AIR FLOW RATE, RELIEF DAMPER SHALL TRACK OUTSIDE AIR DAMPER. RETURN AIR DAMPER SHALL NOT DROP BELOW 20% OPEN WHILE ATTEMPTING TO MAINTAIN MINIMUM OUTDOOR AIR QUANTITY.
2. DISCHARGE AIR TEMPERATURE SETPOINT CONTROL :
   A. AHU TEMPERATURE CONTROL SHALL BE BY DISCHARGE AIR TEMPERATURE SENSOR. DISCHARGE AIR SETPOINT SHALL BE 65°F (ADJ.) WHEN OUTDOOR AIR TEMPERATURES ARE ABOVE 60°F (ADJ.).
   B. AT OUTDOOR AIR TEMPERATURE BELOW 60°F, DISCHARGE AIR SETPOINT SHALL BE RESET BY RETURN AIR; AT RETURN AIR TEMPERATURES OF 68°F (ADJ.) OR LOWER, SUPPLY AIR SHALL BE 70°F (ADJ.) AND AT RETURN AIR TEMPERATURES OF 78°F (ADJ.) OR HIGHER, SUPPLY AIR SHALL BE 65°F (ADJ.). WORST CASE SPACE AIR TEMPERATURES SHALL OFFSET SUPPLY AIR SETPOINT WITHIN THE 65-70°F RANGE; LOWERING DISCHARGE AIR TEMPERATURES IF SPACE AIR TEMPERATURE RISES ABOVE SETPOINT. TEMPERATURE OFFSET SHALL BE REGULATED TO 1°F CHANGE PER 15 MINUTE TIME INTERVAL.
   C. WHEN RETURN AIR HUMIDITY REACHES 59% SUPPLY AIR TEMPERATURE SHALL BE SET TO 62F (ADJ) UNTIL THE RETURN AIR HUMIDITY REACHES 54%.
3. OCCUPIED TEMPERATURE CONTROL MODES : SUPPLY AND RETURN FANS SHALL RUN CONTINUOUSLY.
   A. ECONOMIZER COOLING: ENABLE WHEN OUTDOOR AIR ENTHALPY IS BELOW ECONOMIZER ENABLE SETPOINT AND BELOW RETURN AIR ENTHALPY. THE OUTDOOR AIR DAMPER AND RETURN DAMPER SHALL MODULATE TO MAINTAIN SUPPLY AIR DISCHARGE SETPOINT. THE ERW SHALL BE DISABLED. DUAL TEMPERATURE COIL VALVE SHALL CLOSE.
   B. COOLING WITH NO ENERGY RECOVERY: ENABLE WHEN OUTDOOR AIR ENTHALPY IS ABOVE ECONOMIZER ENABLE SETPOINT BUT BELOW RETURN AIR ENTHALPY. THE OUTDOOR AIR DAMPERS SHALL MODULATE TO ITS MINIMUM POSITION AND RETURN AIR DAMPERS SHALL OPERATE BASED ON THE VENTILATION CONTROL SEQUENCE. THE RELIEF AIR DAMPERS SHALL TRACK THE OUTDOOR AIR DAMPER. THE ERW SHALL BE DISABLED. THE DUAL TEMPERATURE COIL VALVE SHALL MODULATE TO ALLOW CHILLED WATER TO ENTER COIL TO MAINTAIN SUPPLY AIR TEMPERATURE SETPOINT.
   C. COOLING WITH ENERGY RECOVERY: ENABLE WHEN OUTDOOR AIR ENTHALPY IS ABOVE ECONOMIZER ENABLE SETPOINT AND RETURN AIR ENTHALPY. THE OUTDOOR AIR DAMPERS SHALL MODULATE TO ITS MINIMUM POSITION AND RETURN AIR DAMPERS SHALL OPERATE BASED ON THE VENTILATION CONTROL SEQUENCE. THE RELIEF AIR DAMPERS SHALL TRACK THE OUTDOOR AIR DAMPER. THE ERW SHALL START. THE DUAL TEMPERATURE VALVE SHALL MODULATE TO ALLOW CHILLED WATER TO MAINTAIN DISCHARGE AIR TEMPERATURE SETPOINT.
   D. HEATING WITH ENERGY RECOVERY: WHEN OUTSIDE AIR TEMPERATURE IS BELOW 50°F, THE OUTDOOR AIR DAMPERS SHALL MODULATE TO ITS MINIMUM POSITION AND RETURN AIR DAMPERS SHALL OPERATE BASED ON THE VENTILATION CONTROL SEQUENCE. THE RELIEF AIR DAMPERS SHALL TRACK THE OUTDOOR AIR DAMPER. THE ERW SHALL START WHEN MIXED AIR TEMPERATURE IS BELOW SUPPLY AIR SETPOINT. THE DUAL TEMPERATURE VALVE SHALL MODULATE TO ALLOW HOT WATER TO MAINTAIN DISCHARGE AIR TEMPERATURE SETPOINT.

EXISTING CLASSROOM TEMPERATURE MONITORING

THE EXISTING CLASSROOM STEAM RADIATOR SYSTEM IS STANDALONE WITH THERMOSTATIC STEAM VALVES WHERE INDICATED. EACH CLASSROOM HAS BEEN PROVIDED WITH A WALL MOUNTED THERMOSTAT WHICH IS TO MONITOR SPACE TEMPERATURE CONDITIONS AND REPORT BACK TO THE BMS. UTILIZE DATA PATHWAYS FOR WIRING ROUTING.

1

INPUT/OUTPUT SUMMARY TABLE

OWNER: SDOP

RTU-1

HARDWARE

POINT DESCRIPTION	Output Digital: Control Relay(s)	Output Digital: Contactor	Output Analog: Transducer	Output Analog: Heating Water Setpoint	Output Analog: Direct	Output Analog: VFD Speed Control	Input Digital: Pressure Switch(es)	Input Digital: Flow Switch(es)	Input Digital: Pulse	Input Digital: Signal Relay(s)	Input Digital: Current Switch(es)	Input Digital: Boiler Controller Status	Input Analog: Temperature	Input Analog: Humidity	Input Analog: Current Transducer	Input Analog: Pressure	Input Analog: Velocity	Input Analog: CFM	Input Analog: Carbon Dioxide	Input Analog: Setpoint Adjustment	Input Analog: Chiller Supply Reset
RTU																					
Supply Fan Array	X					X				X	X					X					
Return Fan Array	X					X				X	X								X		
Supply Air													X								
Return Air													X	X					X		
Mixed Air													X								
Outdoor Air Leaving Energy Wheel													X	X							
OA Damper / Relief Damper					X																
OA Flow																		X			
Return Damper					X																
ERW Bypass Dampers	X																				
Chilled Water Valve					X																
Filters																X					
Energy Wheel Start/Stop	X										X										

SOFTWARE

POINT DESCRIPTION	Alarms Digital: Equipment Status	Alarms Digital: Equipment Failure	Alarms Digital: Smoke	Alarms Digital: Factory Controller Alarm	Alarms Digital: OA Gas Detection	Alarms Analog: High Limit	Alarms Analog: Low Limit	Alarms Analog: Dirty Filter	Scheduled Start/Stop	Optimum Start/Stop	Duty Cycling	Demand Limiting	Timed Program Commands	Temperature Control	Enthalpy Optimization	Run Time	Boiler Lead/Lag	Hot Water Reset	Chilled Water Reset	Chiller Lead/Lag	Condenser Water Reset	VAV Control	Timed Override	Trend Analysis	NOTES
RTU									X	X			X	X	X							X	X	X	
Supply Fan Array	X	X				X																			1
Return Fan Array	X	X																							1
Supply Air						X	X																		
Return Air						X	X																		
Mixed Air							X																		
Outdoor Air Leaving Energy Wheel																									
OA Damper / Relief Damper																									
OA Flow																									
Return Damper																									
ERW Bypass Dampers																									
Chilled Water Valve																									
Filters								X																	
Energy Wheel Start/Stop	X																								

Notes 1. Monitor VFD failure alarm

SPLIT SYSTEM AIR CONDITIONING SEQUENCE OF OPERATION

GENERAL

1. SPLIT AIR CONDITIONING UNITS SHALL BE PROVIDED WITH MANUFACTURER'S SELF CONTAINED CONTROLS AND CENTRAL CONTROLLER FOR CONTROLLING THE OPERATION OF THE OUTDOOR AND INDOOR UNITS.

SPLIT SYSTEM CONTROL DIAGRAM

INPUT/OUTPUT SUMMARY TABLE

OWNER: SDOP

LOCATION: DUCTLESS SPLIT SYSTEMS

HARDWARE

POINT DESCRIPTION	Output Digital: Control Relay(s)	Output Digital: Contactor	Output Analog: Transducer(s)	Output Analog: Unit On/Off	Output Analog: Direct	Output Analog: VFD Speed Control	Input Digital: Pressure Switch(es)	Input Digital: Flow Switch(es)	Input Digital: Pulse	Input Digital: Signal Relay(s)	Input Digital: Current Switch(es)	Input Digital: End Switch	Input Analog: Temperature	Input Analog: Humidity	Input Analog: Condensate Level	Input Analog: Pressure	Input Analog: Velocity	Input Analog: CFM	Input Analog: Carbon Dioxide	Input Analog: Setpoint Adjustment	Input Analog: Thermal-Energy (BTU)
Outdoor Unit (CU)																					
Indoor Units (SS)				X											X						

SOFTWARE

POINT DESCRIPTION	Alarms Digital: Equipment Status	Alarms Digital: Equipment Failure	Alarms Digital: Smoke	Alarms Analog: High Limit	Alarms Analog: Low Limit	Alarms Analog: Condensate High Limit	Scheduled Start/Stop	Optimum Start/Stop	Duty Cycling	Demand Limiting	Timed Program Comm	Temperature Control	Outdoor Air Economize	Run Time	Boiler Lead/Lag	Hot Water Reset	Chilled Water Reset	Chiller Lead/Lag	Condenser Water Rese	VAV Control	Timed Override	Control Panel	Trend Analysis	Notes
Outdoor Unit (CU)	X	X																						
Indoor Units (SS)	X	X				X																		

Notes:
1. Systems are enabled to run 24 hours a day 7 days a week under their own controls.
2. BAS shall monitor equipment status and alarms.

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JANUARY 27, 2020

NO.	DATE	REVISION
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2	6.09.20	ADDENDUM #2
1	1.27.20	ISSUED FOR BID

SCHOOL & LOCATION
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PROJECT TITLE
MAJOR RENOVATION AND ADDITION

DRAWING TITLE
CONTROLS - MECHANICAL

DRAWING SCALE
As Indicated

LOCATION NO.	FILE NO.
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DRAWN BY	CHECKED BY
MEP	JWM

GC B-011 C OF 2017 / 18
MC B-012 C OF 2017 / 18
PC B-013 C OF 2017 / 18
EC B-014 C OF 2017 / 18

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M-301

SHEET X OF XXX

ISSUED FOR ADDENDUM #2 06/09/2020

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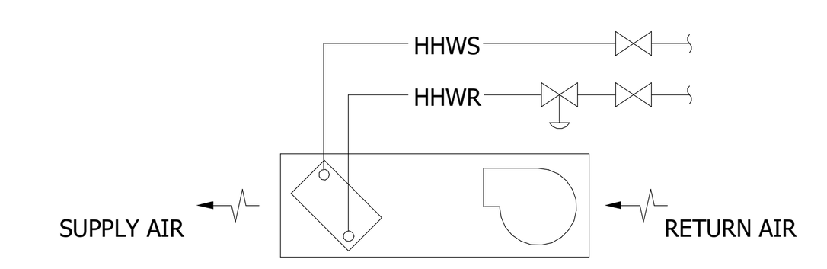


UNIT HEATER CONTROL DIAGRAM

UNIT HEATER SEQUENCE OF OPERATION

GENERAL

1. UNIT SHALL HAVE UNIT MOUNTED THERMOSTAT. WHEN TEMPERATURE FALLS BELOW 65°F (ADJ.) THE FAN SHALL START AND HEATING HOT WATER CONTROL VALVE SHALL OPEN. WHEN TEMPERATURE RISES ABOVE 68°F (ADJ.) THE REVERSE SHALL OCCUR.

INPUT/OUTPUT SUMMARY TABLE

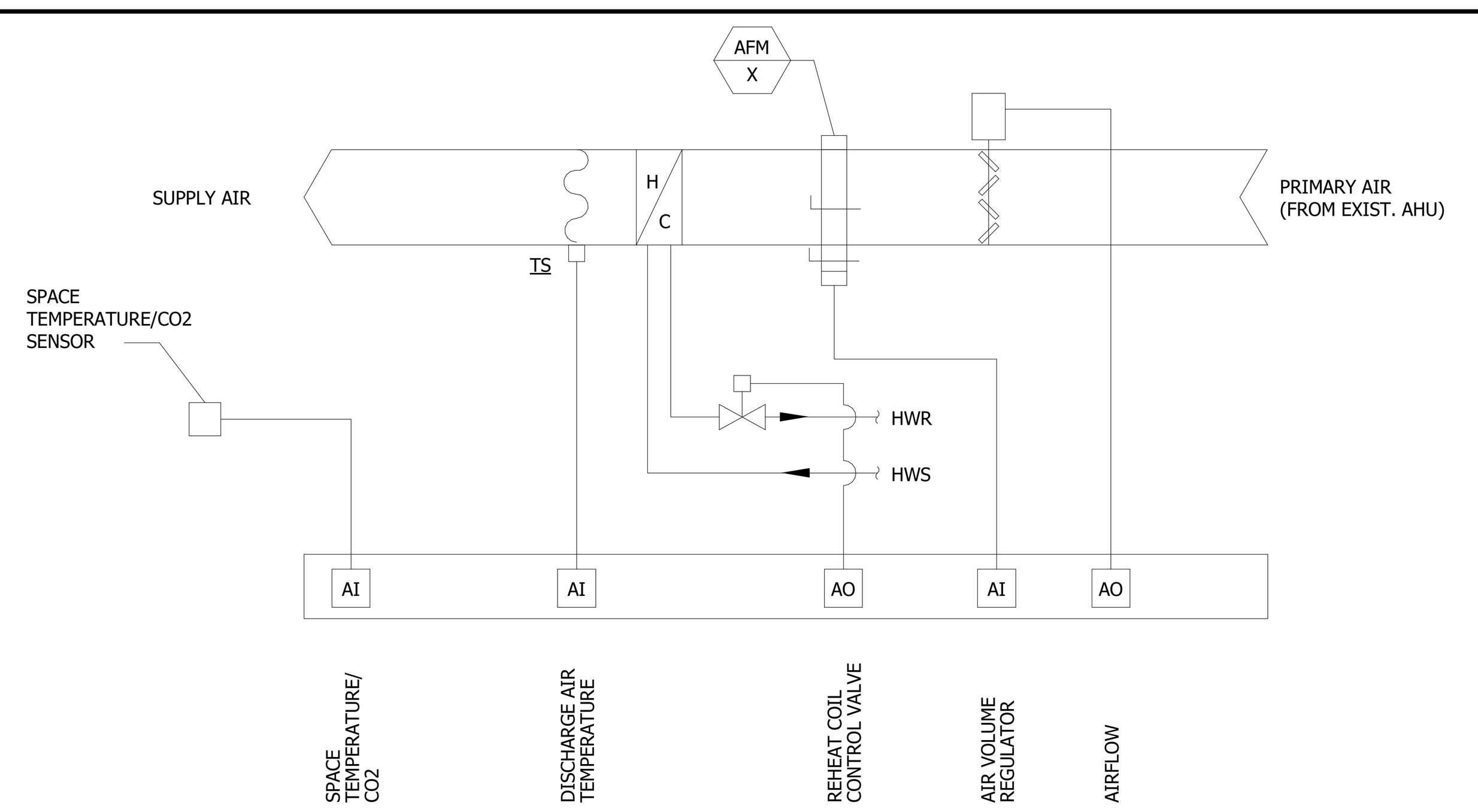
OWNER: SDOP — UNIT HEATERS/WALL HEATERS

HARDWARE — OUTPUT / INPUT

POINT DESCRIPTION	Output Digital: Control Relay(s)	Output Digital: Contactor	Output Analog: Transducer	Output Analog: Direct	Output Analog: VFD Speed Control	Input Digital: Pressure Switch(es)	Input Digital: Flow Switch(es)	Input Digital: Pulse	Input Digital: Signal Relay(s)	Input Digital: Current Switch(es)	Input Digital: End Switch	Input Analog: Temperature	Input Analog: Humidity	Input Analog: Current Transducer	Input Analog: Pressure	Input Analog: Velocity	Input Analog: CFM	Input Analog: Carbon Dioxide	Input Analog: Setpoint Adjustment
UNIT HEATERS																			
Supply Fan	X									X									
Valve	X																		
Supply Air												X							

SOFTWARE — ALARMS / PROGRAMMING

POINT DESCRIPTION	Alarms Digital: Equipment Status	Alarms Digital: Flame Failure	Alarms Digital: Smoke	Alarms Analog: High Limit	Alarms Analog: Low Limit	Scheduled Start/Stop	Optimum Start/Stop	Duty Cycling	Demand Limiting	Timed Program Commands	Temperature Control	Outdoor Air Economizer	Run Time	Boiler Lead/Lag	Hot Water Reset	Chilled Water Reset	Chiller Lead/Lag	Condenser Water Reset	VAV Control	Timed Override	Trend Analysis	Notes
UNIT HEATERS										X	X										X	
Supply Fan	X																					
Valve																						
Supply Air				X	X																	



VARIABLE AIR VOLUME UNIT CONTROL DIAGRAM

VAV UNITS

OPERATION DURING THE OCCUPIED MODE

ON A DROP IN SPACE TEMPERATURE BELOW THE OCCUPIED SETPOINT(72 DEGF ADJ), THE AIR VOLUME REGULATOR SHALL MODULATE CLOSED. WHEN THE AIR VOLUME REGULATOR IS AT ITS MINIMUM POSITION AND THE SPACE TEMPERATURE CONTINUES TO DROP BELOW THE OCCUPIED SET POINT, THE REHEAT VALVE SHALL MODULATE OPEN. IF SPACE TEMPERATURE CONTINUES TO RISE ABOVE OCCUPIED SETPOINT(2 DEGF ADJ) AND AIR VOLUME REGULATOR IS FULLY OPEN, AND PROOF OF OCCUPANCY THE REVERSE SHALL OCCUR.

CO2 SENSOR TO SEND AN ALARAM TO BMS WHEN SPACE EXCEEDS 10% OF THE CO2 SPACE SETPOINT OF 700 PPM AND INITIATE ASSOCIATED AHU CO2 VENTILATION CONTROL.

OPERATION DURING UNOCCUPIED MODE OF THE CENTRAL AHU

THE AIR VOLUME REGULATOR SHALL BE AT ITS MINIMUM POSITION AND THE REHEAT COIL VALVE SHALL BE MODULATED TO MAINTAIN THE UNOCCUPIED SPACE TEMPERATURE SETPOINT.

INPUT/OUTPUT SUMMARY TABLE

OWNER: SDOP — TERMINAL UNITS

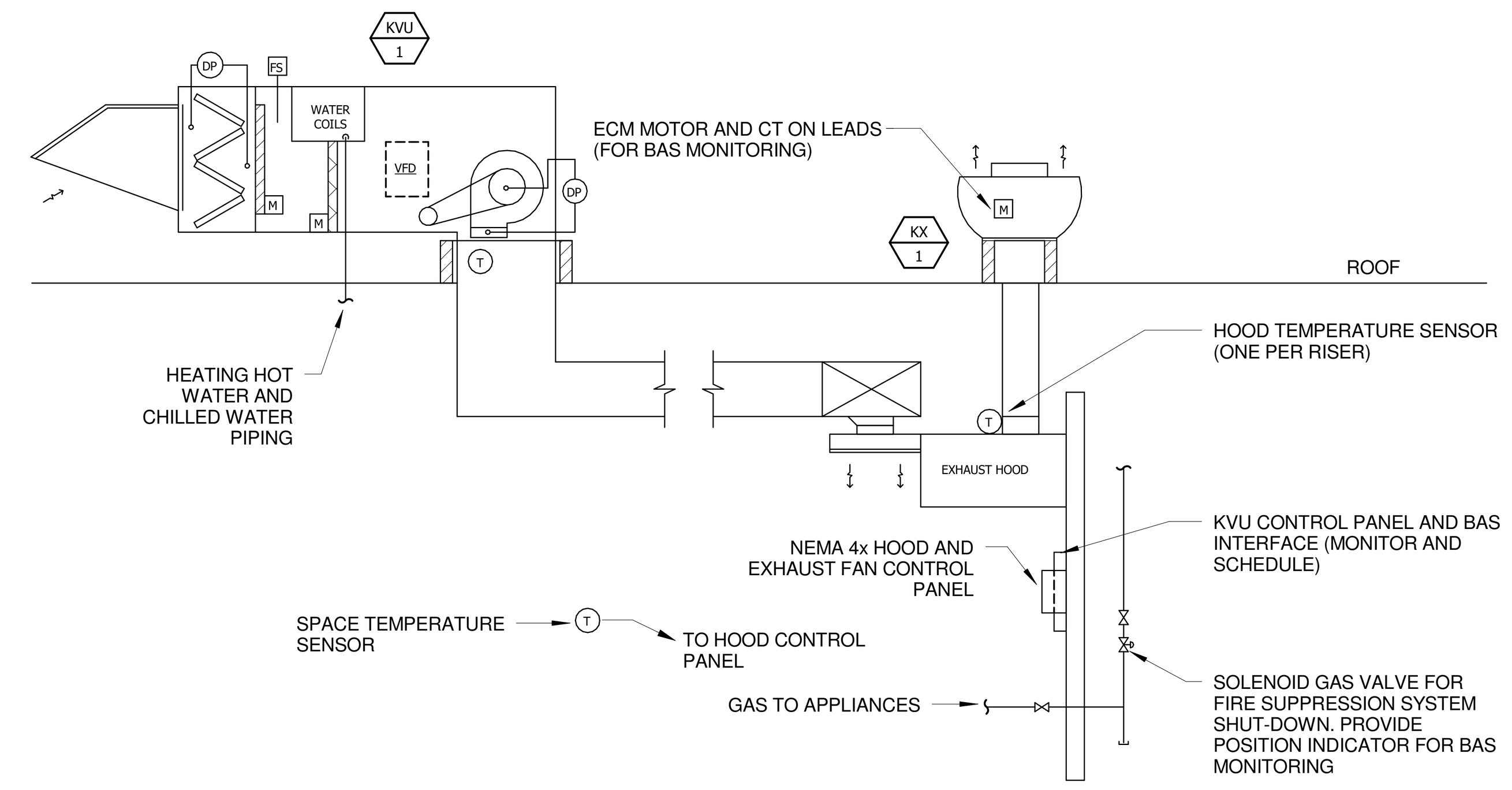
HARDWARE — OUTPUT / INPUT

POINT DESCRIPTION	Output Digital: Control Relay(s)	Output Digital: Contactor	Output Analog: Transducer	Output Analog: Heating Water Setpoint	Output Analog: Direct	Output Analog: VFD Speed Control	Input Digital: Pressure Switch(es)	Input Digital: Flow Switch(es)	Input Digital: Pulse	Input Digital: Signal Relay(s)	Input Digital: Current Switch(es)	Input Digital: Occupancy Override Switch	Input Analog: Temperature	Input Analog: Humidity	Input Analog: Current Transducer	Input Analog: Pressure	Input Analog: Velocity	Input Analog: CFM	Input Analog: Carbon Dioxide	Input Analog: Setpoint Adjustment	Input Analog: Chiller Supply Reset
VAV Terminal Units																					
Supply Air													X								
Hot Water Valve	X																				
Space Air												X	X						X	X	
Damper					X																

SOFTWARE — ALARMS / PROGRAMMING

POINT DESCRIPTION	Alarms Digital: Equipment Status	Alarms Digital: Equipment Failure	Alarms Digital: Smoke	Alarms Digital: Factory Controller Alarm	Alarms Analog: High Limit	Alarms Analog: Low Limit	Scheduled Start/Stop	Optimum Start/Stop	Duty Cycling	Demand Limiting	Timed Program Commands	Temperature Control	Enthalpy Optimization	Run Time	Boiler Lead/Lag	Hot Water Reset	Chilled Water Reset	Chiller Lead/Lag	Condenser Water Reset	VAV Control	Timed Override	AHU Service Override	OA Dpr Override	Trend Analysis	NOTES
VAV Terminal Units							X	X			X	X								X				X	
Supply Air																									
Hot Water Valve																									
Space Air					X	X																			1
Damper																									

Notes 1. CO2 sensor as per drawings.



TYPE I EXHAUST HOOD CONTROL DIAGRAM

KITCHEN EXHAUST AND KITCHEN VENTILATION SYSTEM (TYPE I HOOD):

1. KITCHEN HOOD EXHAUST SYSTEM SHALL OPERATE BASED ON A DEDICATED SCHEDULE, PROGRAMMED AT THE BUILDING AUTOMATION SYSTEM.
2. ON A CALL TO RUN, EXHAUST FAN AND KVU FANS SHALL SOFT START AND RAMP TO FULL SPEED.
3. KITCHEN VENTILATION UNIT SHALL MODULATE OUTPUT CAPACITY TO MAINTAIN CONSTANT DISCHARGE AIR TEMPERATURE SETPOINT, WHICH SHALL BE ADJUSTABLE.
4. MINIMUM DISCHARGE AIR TEMPERATURE SETPOINT SHALL BE DETERMINED AS KITCHEN SPACE TEMPERATURE SETPOINT MINUS 10°F.
5. A MANUAL OVER-RIDE LOCATED IN THE COOKING SPACE SHALL BE PROVIDED TO FORCE EXHAUST AND KVU FANS TO 100% UPON MANUAL ACTIVATION. OVER-RIDE FUNCTION SHALL INCLUDE AN ADJUSTABLE TIMER TO SET DURATION OF 100% OPERATION. AT THE CONCLUSION OF THE TIMED OVER-RIDE CONDITION, EXHAUST FAN AND KVU FAN SHALL REVERT TO NORMAL OPERATION. BAS SYSTEM SHALL LOG A CHANGE IN STATE OF THE SYSTEM WITH THE TIME STAMPS.
6. ALL SETPOINTS AND DATA AVAILABLE AT THE LOCAL CONTROLLER SHALL BE AVAILABLE AT THE BAS.

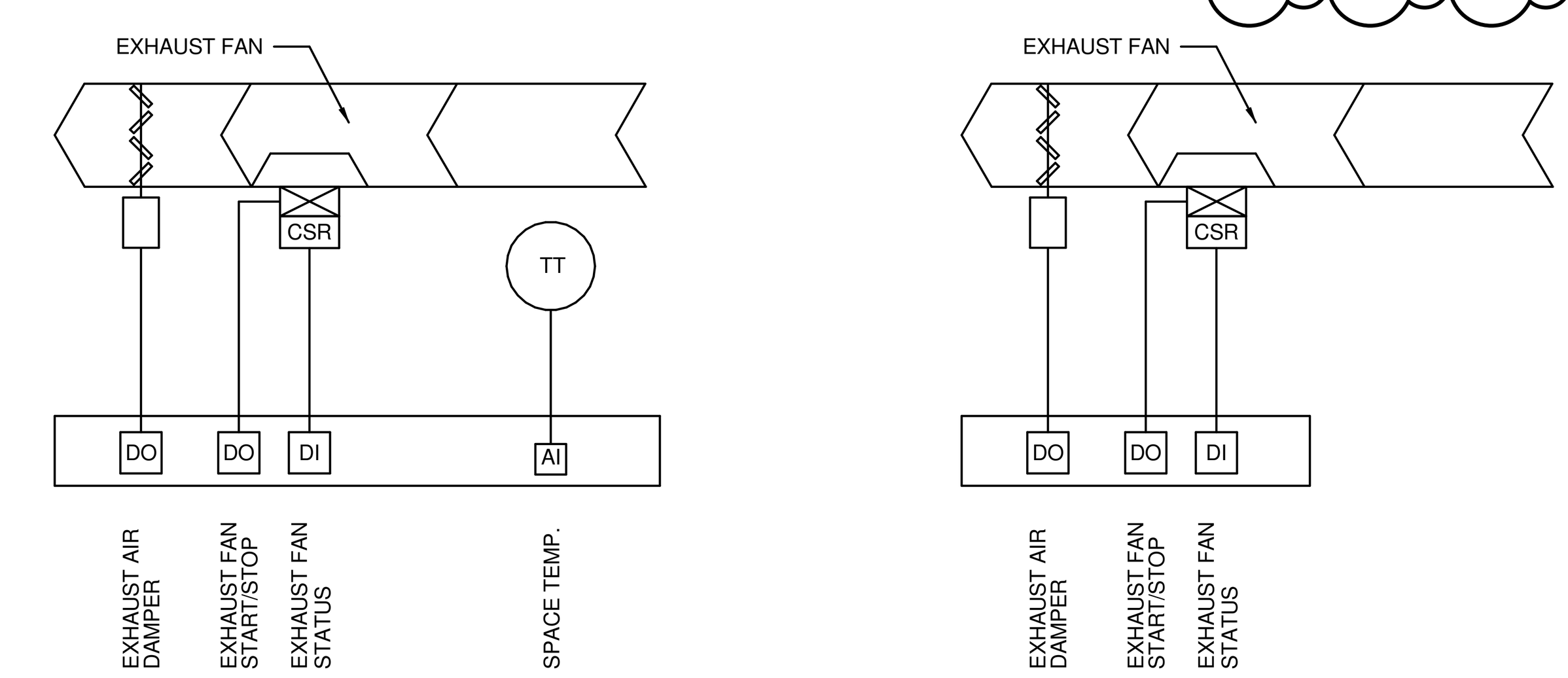
FIRE SUPPRESSION SYSTEM OPERATION:

1. UPON ACTIVATION OF THE ASSOCIATED HOOD FIRE SUPPRESSION SYSTEM, THE HOOD EXHAUST AND KITCHEN VENTILATION SYSTEM SHALL ENTER EMERGENCY MODE. BAS SYSTEM SHALL REGISTER AN EMERGENCY ALARM.
2. EMERGENCY MODE SHALL STOP KITCHEN VENTILATION UNIT BURNER AND THEN SUPPLY FAN. ALL DAMPERS SHALL CLOSE.
3. IF THE ASSOCIATED EXHAUST FAN IS RUNNING, IT SHALL CONTINUE TO RUN AND SHALL RUN CONTINUOUSLY UNTIL MANUAL INTERVENTION.
4. IF THE ASSOCIATED EXHAUST FAN IS NOT RUNNING AT THE TIME THE FIRE SUPPRESSION SYSTEM IS ACTIVATED, FAN SHALL NOT RUN. IF THE MANUAL OVER-RIDE SWITCH IS TURNED ON, FAN SHALL RAMP TO 100% AND SHALL RUN CONTINUOUSLY UNTIL MANUAL INTERVENTION.

NOTES:

1. KVU CONTROLS, SENSORS, VALVES AND BAS INTEGRATION SHALL BE BY CONTROLS CONTRACTOR. COORDINATE WITH SUBMITTED HOOD, PANELS, KVU AND EXHAUST FAN.
2. PROVIDE CONTROLS SYSTEM FOR KITCHEN EXHAUST AND KVU COMPLETE.
3. PROVIDE INTEGRATION TO HOOD FIRE SUPPRESSION SYSTEM (ANSUL).
4. PROVIDE END-SWITCHES OR OPERATOR POSITION INDICATORS WITH EACH MOTORIZED DAMPER.
5. PROVIDE DIRTY FILER SWITCH AND DP TRANSDUCER.

1



EXHAUST FAN SEQUENCE OF OPERATION

GENERAL

1. EXHAUST FAN SHALL RUN CONTINUOUSLY DURING OCCUPIED MODE AFTER MOTOR OPERATED DAMPER CONFIRMS OPEN..
2 BMS SHALL MONITOR CURRENT SWITCH FOR FAN STATUS AND SHALL ENUNCIATE AN ALARM AT THE FRONT END IF MOTOR STATUS DOES NOT MATCH CURRENT CONDITION.
3. RESTROOM EXHAUST FANS SHALL BE CONTROLLED BY SCHEDULES.
4. MECHANICAL AND ELECTRICAL ROOM EXHAUST FANS SHALL BE CONTROLLED BY BAS.

INPUT/OUTPUT SUMMARY TABLE

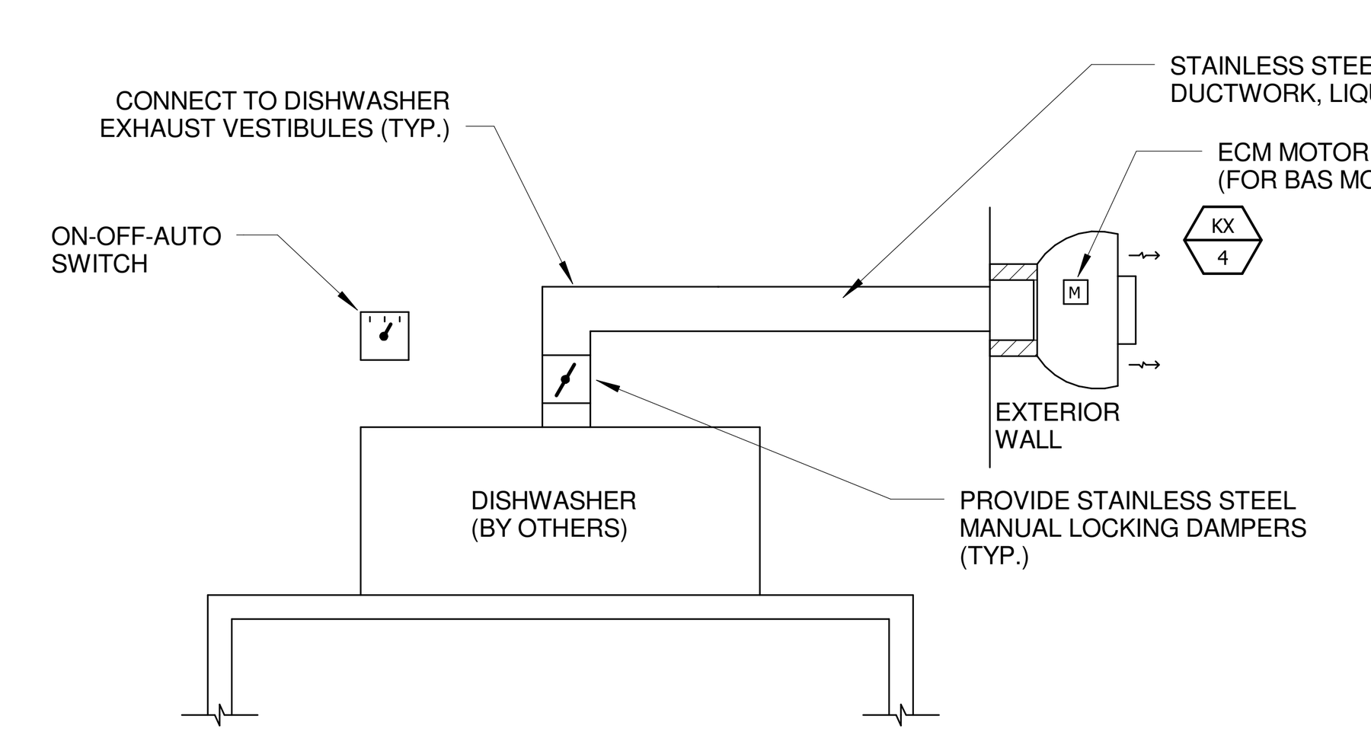
OWNER: SDOP — EXHAUST FANS AND KITCHEN MAKE UP AIR

HARDWARE — OUTPUT / INPUT

POINT DESCRIPTION	Output Digital: Control Relay(s)	Output Digital: Solenoid	Output Digital: Hand/Off/Auto	Output Digital: Off/Auto	Output Analog: Damper Control	Output Analog: Control Set Point Adjustment	Output Analog: Valve Control	Output Analog: Position Adjustment	Input Digital: Pressure	Input Digital: Differential Pressure Switch	Input Digital: Diff. Press. FlowSwitch	Input Digital: Auxilliary Contact	Input Digital: Pulse	Input Digital: Switch Status	Input Digital: Current Sensing Relay	Input Analog: Temperature	Input Analog: Humidity	Input Analog: Static Pressure (PSIG,PSIA,PSID)	Input Analog: Position	Input Analog: Flow	Input Analog: Differential Pressure
EF'S/KVU'S																					
Exhaust Fan Status															X						
Exhaust Fan Start/Stop			X																		
Damper Control	X																				
Space Temp.																X					
Exhaust Fan Status															X						
Exhaust Fan Start/Stop			X																		
Damper Control	X																				
Kitchen Hood EF Status															X						
Kitchen Ventilation Start/Stop			X																		
SA Temperature																X					
Make UP Fan Status															X						
Heating Coil Valve Control						X															
Damper Control	X																				

SOFTWARE — ALARMS / PROGRAMMING

POINT DESCRIPTION	Alarms Digital: Contact Closure	Alarms Digital: High Limit (Critical Spaces)	Alarms Digital: LowLimit (Critical Spaces)	Alarms Analog: High Limit	Alarms Analog: LowLimit	Alarms Analog: Run Time	Alarms Analog: LowLevel	Reheat Coil Reset	Space Temp Reset	Occupied/Unoccupied	Lighting Control	Timed Program Commands	Temperature Control	Failure Mode	NOTES
EF'S/KVU'S															
Exhaust Fan Status		X	X												
Exhaust Fan Start/Stop	X														
Damper Control															
Space Temp.		X	X												
Exhaust Fan Status		X	X												
Exhaust Fan Start/Stop	X														
Damper Control															
Kitchen Hood EF Status		X	X												
Kitchen Ventilation Start/Stop	X														
SA Temperature		X	X												
Make UP Fan Status		X	X												
Heating Coil Valve Control									X						
Damper Control															



DISHWASHER EXHAUST CONTROL SEQUENCE:

1. DISHWASHER EXHAUST SYSTEM CONSISTS OF ONE EXHAUST FAN AND A DUCT SYSTEM.
2. EXHAUST FAN OPERATION SHALL BE SCHEDULED THROUGH THE BAS SYSTEM. ADDITIONALLY, LOCAL ON-OFF-AUTO CONTROLS SHALL BE PROVIDED TO ALLOW MANUAL OVER RIDE.
3. ON A CALL TO RUN, FAN SHALL SOFT START AND RAMP TO 100% (BALANCED AIRFLOW). MAXIMUM AIRFLOW SHALL BE BALANCED UTILIZING THE SPECIFIED ECM MOTOR.
4. FAN SHALL RUN CONTINUOUSLY.
5. DURING UNOCCUPIED PERIODS, FAN SHALL RAMP DOWN AND STOP.

DISHWASHER EXHAUST HOOD CONTROL DIAGRAM

ISSUED FOR ADDENDUM #2 06/09/2020

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PROJECT TITLE
MAJOR RENOVATION AND ADDITION

DRAWING TITLE
CONTROLS - MECHANICAL

DRAWING SCALE
As Indicated

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DRAWING NO.
M-302

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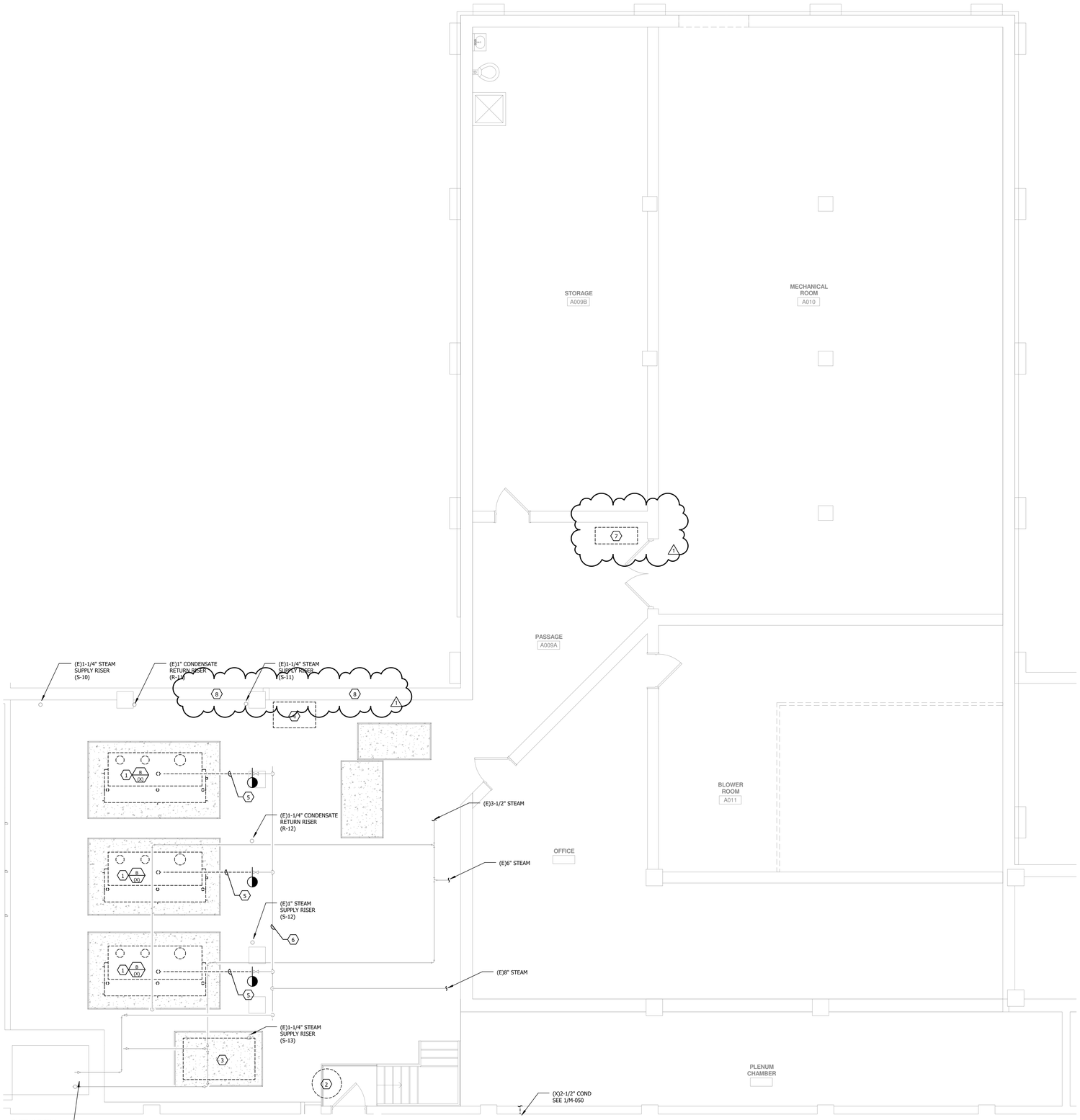

1 M-400 ENLARGED GROUND FLOOR DEMOLITION PLAN - AREA A - MECHANICAL PIPING

1/4" = 1'-0"

GENERAL NOTES

1. THE CONTRACTOR SHALL BECOME FAMILIAR WITH THE EXISTING CONDITIONS AFFECTING THIS PROJECT AND COORDINATE WITH OTHER DISCIPLINES.
2. THE CONTRACTOR SHALL OBTAIN ALL REQUIRED PERMITS AND TURN OFF ALL UTILITIES BEFORE STARTING WORK.
3. ALL DEMOLITION/REMOVAL WORK SHALL BE PERFORMED IN ACCORDANCE WITH APPLICABLE STANDARDS AND REGULATIONS.
4. UNLESS NOTED OTHERWISE ALL EQUIPMENT TO BE REMOVED SHALL BE DISPOSED OF IN A LEGAL MANNER COMPLYING WITH ALL CITY, STATE AND EPA REGULATIONS.
5. PROVIDE 20 HOURS OF 24/7 DRAIN CLEANING SERVICE FOR THE DURATION OF CONSTRUCTION.
6. COMPLETE AND FILE PENNSYLVANIA LABOR AND INDUSTRY'S INTENT TO INSTALL BOILER PERMIT(LIBI-302). CONTRACTOR SHALL OBTAIN AT THEIR COST FROM THE CITY, AIR MANAGEMENT OPERATING AND INSTALLTION PERMITS FOR EACH BIOLER IF SIZE REQUIRES PERMITTING.
7. CONTRACTOR SHALL SNAKE AND ROD ALL EXISTING FLOOR DRAINS LOCATED IN THE BOILER ROOM PRIOR TO CONSTRUCTION AND PROVIDE A WRITTEN REPORT TO THE SCHOOL DISTRICT PROJECT MANAGER. AT PROJECT COMPLETION, THE CONTRACTOR SHALL SNAKE AND ROD ALL EXISTING FLOOR DRAINS LOCATED IN THE BOILER ROOM AND PROVIDE A WRITTEN REPORT TO THE SCHOOL DISTRICT PROJECT MANAGER.
8. TEMPORARY HEAT: THE CONTRACTOR SHALL COORDINATE DEMOLITION OF THE EXISTING BOILER SYSTEM WITH NEW WORK SO A FUNCTIONING HEATING SYSTEM IS ON LINE AND PROVIDING HEAT TO THE BUILDING BY OCTOBER 15TH. IF A BOILER IS NOT PROVIDING SUFFICIENT HEAT(70°F INDOOR/10°F OUTDOOR TEMPERATURE) TO THE BUILDING BY OCTOBER 15TH, THEN THE CONTRACTOR SHALL AT THEIR EXPENSE PROVIDE TEMPORARY HEAT INCLUDING THE NECESSARY FUEL, POWER, INSTALLATION, PERMITS FEES, REMOVAL AND SERVICE PERSONNEL FOR OPERATION OF TEMPORARY BOILER(S) UNTIL THE FIRST BUILDING BOILER IS OPERATIONAL AND PROVIDING SUFFICIENT HEAT TO MAINTAIN BUILDING TEMPERATURE. CONTRACTOR SHALL OPERATE AND MAINTAIN TEMPORARY HEAT UNTIL THE SECOND BUILDING BOILER IS OPERATIONAL AND PROVIDIGN HEAT TO THE BUIDLING NO LATER THAN DECEMBER 1ST. CONTRACTOR SHALL OPERATE AND MAINTAIN TEMPORARY HEAT UNTIL THE THIRD BOILER IS OPERATIONAL AND PROVIDING HEAT TO THE BUILDING NO LATER THAN JANUARY 1ST IN THE EVENT THIS BOILER IS NOT PLACED IN SERVICE.
9. THE CONTRACTOR SHALL VERIFY OTHER PIPING/UTILITIES NOT ASSOCIATED WITH THIS WORK BUT LYING WITHIN THE WORK AREA AND WILL NOT DISTURB THESE. THESE PIPING/UTILITIES SHALL BE PROTECTED SO THAT SERVICE IS NOT INTERRUPTED. THE CONTRACTOR SHALL REPAIR ANY DAMAGE DONE TO THESE PIPING/UTILITES IN THE PERFORMANCE OF THE CONTRACT WORK.
10. RE-USE EXISTING EQUIPMENT PADS TO THE EXTENTS POSSIBLE. PADS SHALL BE LARGE ENOUGH ALLOW FOR THE FULL SWING OF THE BURNER ASSEMBLEY FOR CLEANING/REPAIRS.
11. NO PIPE TRENCHES TO BE PERMITED IN THE BOILER ROOM. INSTALLATION SHALL MINIMIZE TRIPPING HAZARDS AND PROVIDE WALK OVER RAMPS AS REQUIRED.
12. REPLACE EXISTING/RELOCATE RELIEF PIPING AS REQUIRED TO MEET APPLICABLE CODES. NO RELIEF PIPING PERMITTED IN THE STACK.
13. ALL STEAM PRESSURE RELIEF MUST BE PIPED TO FLOOR DRAIN PER CODE.
14. PATCH AND SEAL EXISTING PENETRATIONS TO MATCH EXISTING PER ARCHITECT.

DEMOLITION KEYED NOTES

1. CONTRACTOR SHALL REMOVE AND DISPOSE OF EXISTING BOILERS, BURNER, GAS TRAIN, PIPING, VALVES, HANGERS, CONTROLS AND ALL ACCESSORIES IN ITS ENTIRETY. EXISTING CONCRETE EQUIPMENT PAD TO REMAIN.
2. CONTRACTOR SHALL REMOVE AND DISPOSE EXISTING CONDENSATE PIT. REMOVE DISCHARGE PIPING, VENT PIPING, CONDENSATE RETURN PIPING TO POINTS OF NEW CONNECTIONS, STARTERS, CONTROLLERS, DISCONNECTS, AND CONTROL DEVICES IN THEIR ENTIRETY.
3. CONTRACTOR SHALL REMOVE AND DISPOSE OF THE EXISTING BOILER FEEDWATER UNIT AND ASSOCIATED PIPING, VENTING, CONTROLS, AND APPURTENANCES.
4. CONTRACTOR SHALL REMOVE AND DISPOSE OF THE EXISTING CHEMICAL FEED TANK IN ITS ENTIRETY.
5. CONTRACTOR SHALL REMOVE EXISTING STEAM PIPING TO POINTS INDICATED.
6. EXISTING STEAM HEADER TO REMAIN. PREPARE PIPING FOR NEW STEAM CONNECTION FROM BOILERS.
7. CONTRACTOR SHALL REMOVE EXISTING AIR COMPRESSOR SYSTEM AND ASSOCIATED PNEUMATIC LINES.
8. CONTRACTOR SHALL REMOVE EXISTING VENT/PIPING IN THIS AREA FOR NEW LOUVERS. COORDINATE NEW PIPING WITH FINAL LOUVER OPENINGS.

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ERIC M. WOLF
STATE AND LICENSE NO: PE082549 — DATE 01/27/2020

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ISSUED FOR BID
JANUARY 27, 2020

NO.	DATE	REVISION
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2	6.09.20	ADDENDUM #2
1	1.27.20	ISSUED FOR BID

SCHOOL & LOCATION

ETHAN ALLEN ELEMENTARY SCHOOL
3001 ROBBINS STREET
PHILADELPHIA, PENNSYLVANIA 19149

PROJECT TITLE

MAJOR RENOVATION AND ADDITION

DRAWING TITLE

ENLARGED PLANS - MECHANICAL

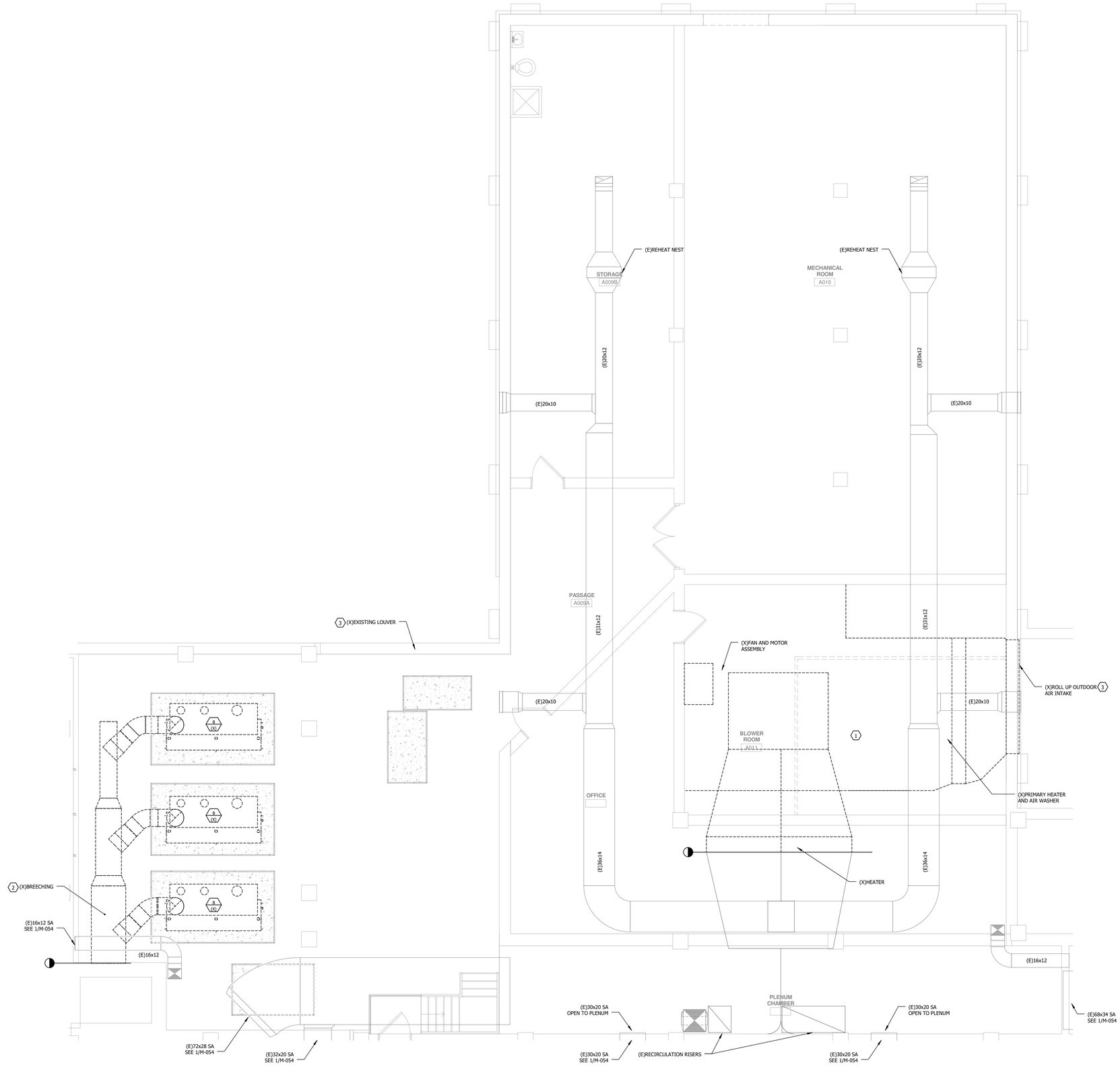
DRAWING SCALE As Indicated	
LOCATION NO. XXXX	FILE NO. 2018-080
DRAWN BY MEP	CHECKED BY JWM

GC B-011 C	OF	2017 / 18
MC B-012 C	OF	2017 / 18
PC B-013 C	OF	2017 / 18
EC B-014 C	OF	2017 / 18

DRAWING NO.
M-400

SHEET X OF XXX

ISSUED FOR ADDENDUM #2 06/09/2020



1 M-401 ENLARGED GROUND FLOOR DEMOLITION PLAN - AREA A - MECHANICAL DUCTWORK

1/4" = 1'-0"

GENERAL NOTES

1. THE CONTRACTOR SHALL BECOME FAMILIAR WITH THE EXISTING CONDITIONS AFFECTING THIS PROJECT AND COORDINATE WITH OTHER DISCIPLINES.
2. THE CONTRACTOR SHALL OBTAIN ALL REQUIRED PERMITS AND TURN OFF ALL UTILITIES BEFORE STARTING WORK.
3. ALL DEMOLITION/REMOVAL WORK SHALL BE PERFORMED IN ACCORDANCE WITH APPLICABLE STANDARDS AND REGULATIONS.
4. UNLESS NOTED OTHERWISE ALL EQUIPMENT TO BE REMOVED SHALL BE DISPOSED OF IN A LEGAL MANNER COMPLYING WITH ALL CITY, STATE AND EPA REGULATIONS.
5. PROVIDE CERTIFIED CHIMNEY INSPECTORS REPORT DETAILING CONDITION AND RECOMMENDED REPAIRS TO RESTORE STACK TO SAFE OPERATIONAL CONDITION.
6. PATCH AND SEAL EXISTING PENETRATIONS TO MATCH EXISTING PER ARCHITECT.

KEYED NOTES

1. THE CONTRACTOR SHALL REMOVE THE EXISTING ROOM AIR HANDLING UNIT AND ASSOCIATED CONTROLS, PIPING, COILS, AIR WASHER, ACCESSORIES, AND APPURTANENCES. REMOVE DUCTWORK TO POINTS INDICATED. REMOVE EXISTING PARTITION WALLS. PREPARE EXISTING DUCTWORK FOR CONNECTION TO NEW AIR HANDLING UNIT.
2. THE CONTRACTOR SHALL REMOVE BREECHING FROM BOILERS. PATCH CHIMNEY TO MATCH EXISTING WHERE NECESSARY. THE EXISTING OPENINGS IN THE CHIMNEY FOR BREECHING SHALL BE SUITABLY REPAIREDTO RECEIVE NEW BREECHING. THE CONTRACTOR SHALL CLEAN THE CHIMNEY FROM INSIDE UP TO 5'0" HIGH ABOVE THE TOP BREECHING CONNECTION. CONTRACTOR SHALL CLEAN OUT AND LEGALLY DISPOSE OF DEBRIS INSIDE CHIMNEY.
3. THE CONTRACTOR SHALL REMOVE TWO EXISTING LOUVERS, DAMPERS, AND ASSOCIATED CONTROLS IN ITS ENTIRETY. NEW OPENINGS SHALL BE PER THE GC, COORDINATE FINAL OPENING WITH MC.

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ERIC M. WOLF
STATE AND LICENSE NO: PE082549

DATE
01/27/2020

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PROJECT TITLE

MAJOR RENOVATION AND ADDITION

DRAWING TITLE

ENLARGED PLANS - MECHANICAL

DRAWING SCALE As Indicated	
LOCATION NO. XXXX	FILE NO. 2018-080
DRAWN BY MEP	CHECKED BY JWM

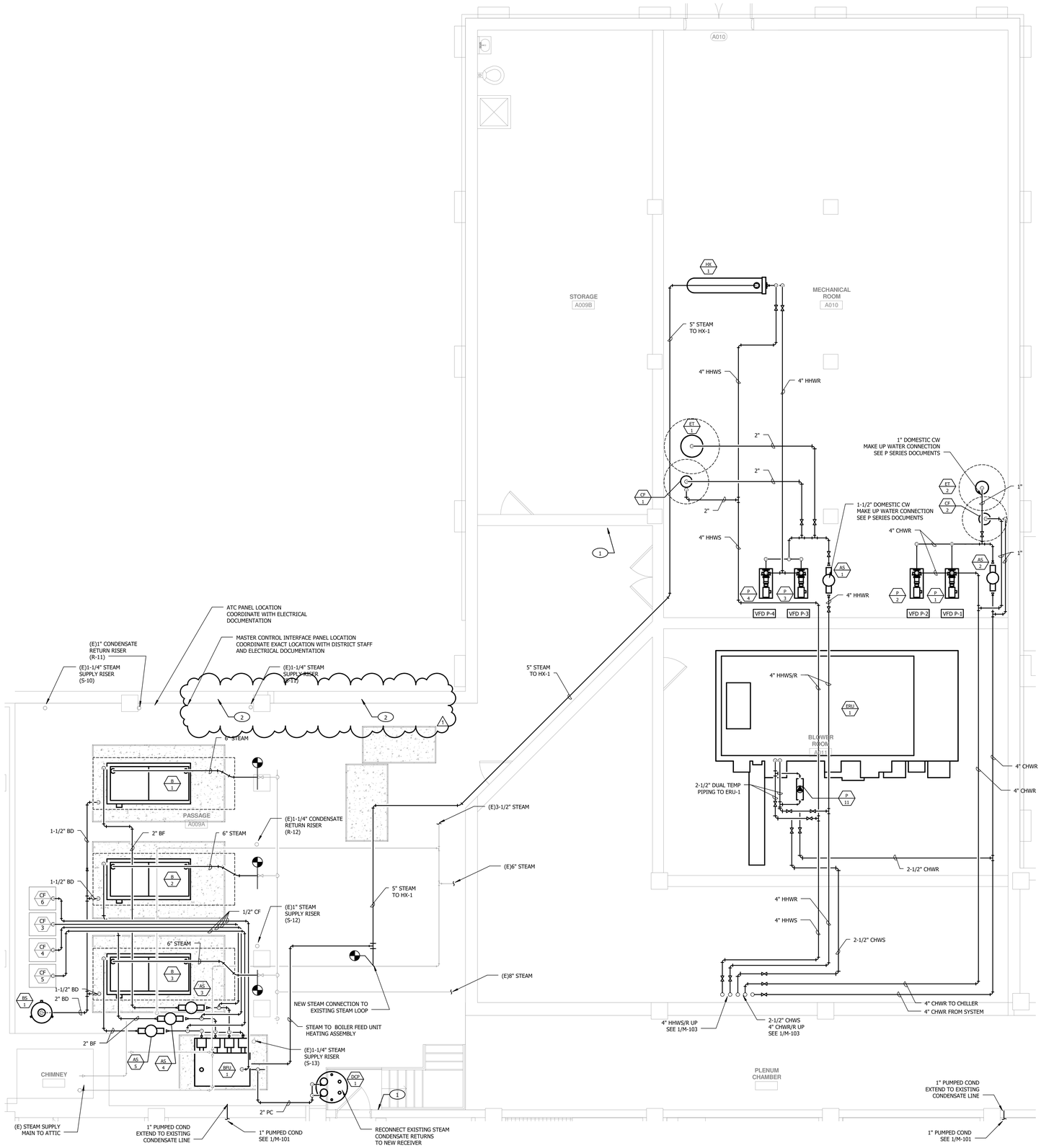
GC B-011 C	OF	2017 / 18
MC B-012 C	OF	2017 / 18
PC B-013 C	OF	2017 / 18
EC B-014 C	OF	2017 / 18

DRAWING NO.

M-401

SHEET X OF XXX

ISSUED FOR ADDENDUM #2 06/09/2020



1 M-402 ENLARGED GROUND FLOOR - AREA A - MECHANICAL PIPING
1/4" = 1'-0"

GENERAL NOTES

1. THE CONTRACTOR SHALL BECOME FAMILIAR WITH THE EXISTING CONDITIONS AFFECTING THIS PROJECT AND COORDINATE WITH OTHER DISCIPLINES.
2. THE CONTRACTOR SHALL OBTAIN ALL REQUIRED PERMITS AND TURN OFF ALL UTILITIES BEFORE STARTING WORK.
3. ALL DEMOLITION/REMOVAL WORK SHALL BE PERFORMED IN ACCORDANCE WITH APPLICABLE STANDARDS AND REGULATIONS.
4. UNLESS NOTED OTHERWISE ALL EQUIPMENT TO BE REMOVED SHALL BE DISPOSED OF IN A LEGAL MANNER COMPLYING WITH ALL CITY, STATE AND EPA REGULATIONS.
5. PROVIDE 20 HOURS OF 24/7 DRAIN CLEANING SERVICE FOR THE DURATION OF CONSTRUCTION.
6. COMPLETE AND FILE PENNSYLVANIA LABOR AND INDUSTRY'S INTENT TO INSTALL BOILER PERMIT(LIBI-302). CONTRACTOR SHALL OBTAIN AT THEIR COST FROM THE CITY, AIR MANAGEMENT OPERATING AND INSTALLTION PERMITS FOR EACH BIOLER IF SIZE REQUIRES PERMITTING.
7. CONTRACTOR SHALL SNAKE AND ROD ALL EXISTING FLOOR DRAINS LOCATED IN THE BOILER ROOM PRIOR TO CONSTRUCTION AND PROVIDE A WRITTEN REPORT TO THE SCHOOL DISTRICT PROJECT MANAGER. AT PROJECT COMPLETION, THE CONTRACTOR SHALL SNAKE AND ROD ALL EXISTING FLOOR DRAINS LOCATED IN THE BOILER ROOM AND PROVIDE A WRITTEN REPORT TO THE SCHOOL DISTRICT PROJECT MANAGER.
8. TEMPORARY HEAT: THE CONTRACTOR SHALL COORDINATE DEMOLITION OF THE EXISTING BOILER SYSTEM WITH NEW WORK SO A FUNCTIONING HEATING SYSTEM IS ON LINE AND PROVIDING HEAT TO THE BUILDING BY OCTOBER 15TH. IF A BOILER IS NOT PROVIDING SUFFICIENT HEAT(70°F INDOOR/10°F OUTDOOR TEMPERATURE) TO THE BUILDING BY OCTOBER 15TH, THEN THE CONTRACTOR SHALL AT THEIR EXPENSE PROVIDE TEMPORARY HEAT INCLUDING THE NECESSARY FUEL, POWER, INSTALLATION, PERMITS FEES, REMOVAL AND SERVICE PERSONNEL FOR OPERATION OF TEMPORARY BOILER(S) UNTIL THE FIRST BUILDING BOILER IS OPERATIONAL AND PROVIDING SUFFICIENT HEAT TO MAINTAIN BUILDING TEMPERATURE. CONTRACTOR SHALL OPERATE AND MAINTAIN TEMPORARY HEAT UNTIL THE SECOND BUILDING BOILER IS OPERATIONAL AND PROVIDIGN HEAT TO THE BUILDING NO LATER THAN DECEMBER 1ST. CONTRACTOR SHALL OPERATE AND MAINTAIN TEMPORARY HEAT UNTIL THE THIRD BOILER IS OPERATIONAL AND PROVIDING HEAT TO THE BUILDING NO LATER THAN JANUARY 1ST IN THE EVENT THIS BOILER IS NOT PLACED IN SERVICE.
9. THE CONTRACTOR SHALL VERIFY OTHER PIPING/UTILITIES NOT ASSOCIATED WITH THIS WORK BUT LYING WITHIN THE WORK AREA AND WILL NOT DISTURB THESE. THESE PIPING/UTILITIES SHALL BE PROTECTED SO THAT SERVICE IS NOT INTERRUPTED. THE CONTRACTOR SHALL REPAIR ANY DAMAGE DONE TO THESE PIPING/UTILITES IN THE PERFORMANCE OF THE CONTRACT WORK.
10. RE-USE EXISTING EQUIPMENT PADS TO THE EXTENTS POSSIBLE. PADS SHALL BE LARGE ENOUGH ALLOW FOR THE FULL SWING OF THE BURNER ASSEMBLEY FOR CLEANING/REPARIS.
11. NO PIPE TRENCHES TO BE PERMITED IN THE BOILER ROOM. INSTALLATION SHALL MINIMIZE TRIPPING HAZARDS AND PROVIDE WALK OVER RAMPS AS REQUIRED.
12. REPLACE EXISTING/RELOCATE RELIEF PIPING AS REQUIRED TO MEET APPLICABLE CODES. NO RELIEF PIPING PERMITTED IN THE STACK.
13. ALL STEAM PRESSURE RELIEF MUST BE PIPED TO FLOOR DRAIN PER CODE.

KEYED NOTES:

1. BOILER SAFETY SHUTDOWN SWITCH WALL LOCATION
2. COORDINATE NEW LOUVERS AT THIS LOCATION WITH NEW/EXISTING RELIEF/VENT PIPING AND OTHER TRADES. MODIFY VENT AND PROVIDE NEW TO ALLOW LOUVERS AS INDICATED. A

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ERIC M. WOLF
STATE AND LICENSE NO: PE082549 — DATE 01/27/2020

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PROJECT TITLE
MAJOR RENOVATION AND ADDITION

DRAWING TITLE
ENLARGED PLANS - MECHANICAL

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EC B-014 C	OF	2017 / 18

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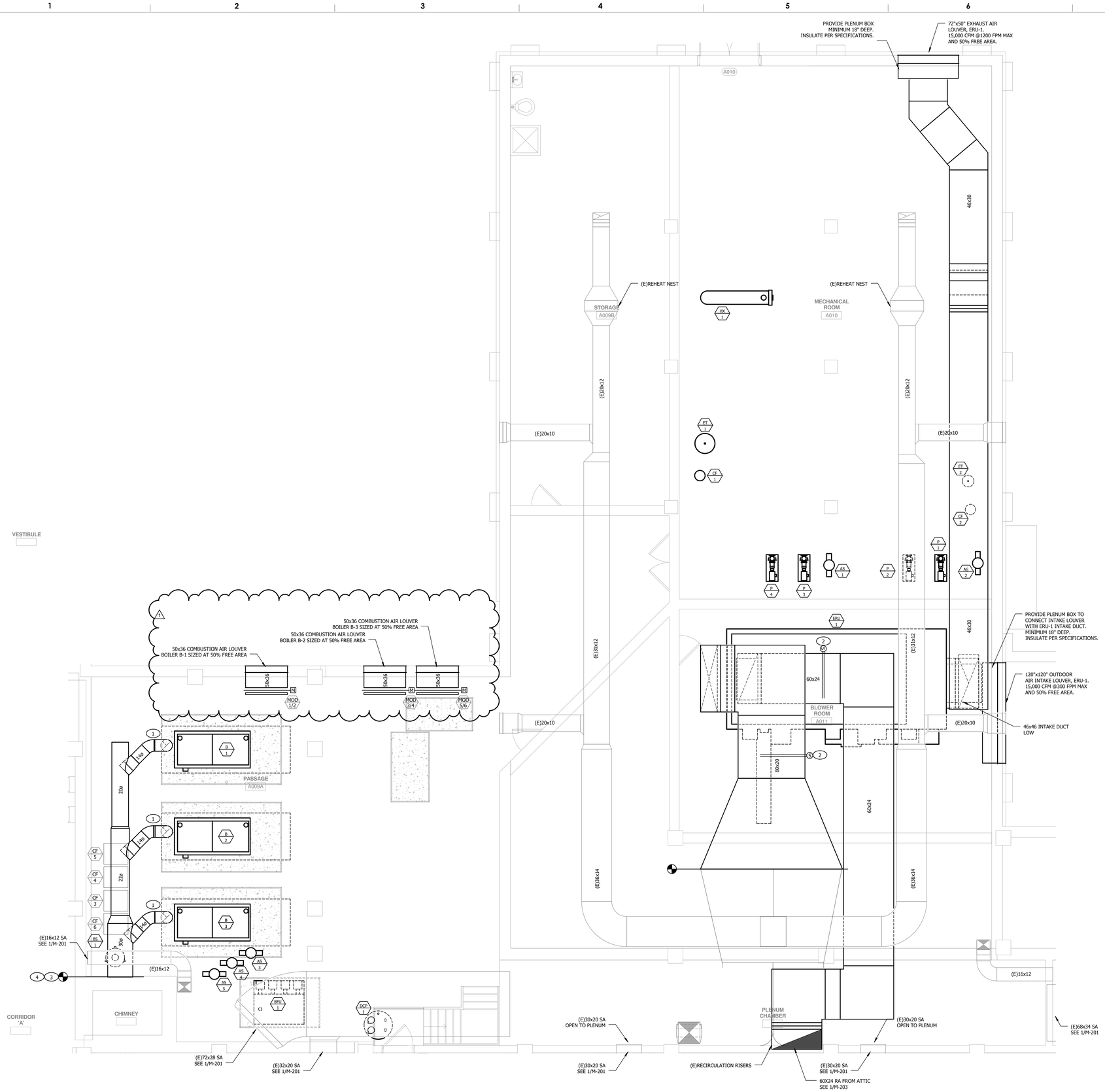
M-402

SHEET X OF XXX

ISSUED FOR ADDENDUM #2 06/09/2020



1 / M-403 ENLARGED GROUND FLOOR - AREA A - MECHANICAL DUCTWORK

1/4" = 1'-0"

KEYED NOTES

1. PROVIDE 14" ID BREECHING CONNECTION TO BOILER WITH BAROMETRIC DAMPER.
2. DUCT SMOKE DETECTOR SHALL INTERLOCK TO FAN FOR SHUTDOWN AND TIE INTO FIRE ALARM SYSTEM. REFER TO FIRE PROTECTION PLANS FOR DETAILS. PROVIDE ACCESS AS NEEDED TO DEVICE.
3. CONTRACTOR SHALL PROVIDE ALL MASONRY WORK REQUIRED TO INSTALL NEW DOUBLE WALL BREECHING IN EXISTING CHIMNEY. CONTRACTOR SHALL PROVIDE NEW GASKETED AND LOCKABLE ACESS DOOR TO BASE OF CHIMNEY.
4. CONTRACTOR SHALL PROVIDE VERTICAL OFFSETS IN BREECHING SECTION AS REQUIRED TO MAINTAIN ELEVATION FOR WALL PENETRATION AT MASONRY CHIMNEY. FIELD VERIFY ALL DIMENSIONS.

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PROJECT TITLE

MAJOR RENOVATION AND ADDITION

DRAWING TITLE

ENLARGED PLANS - MECHANICAL

DRAWING SCALE As Indicated	
LOCATION NO. XXXX	FILE NO. 2018-080
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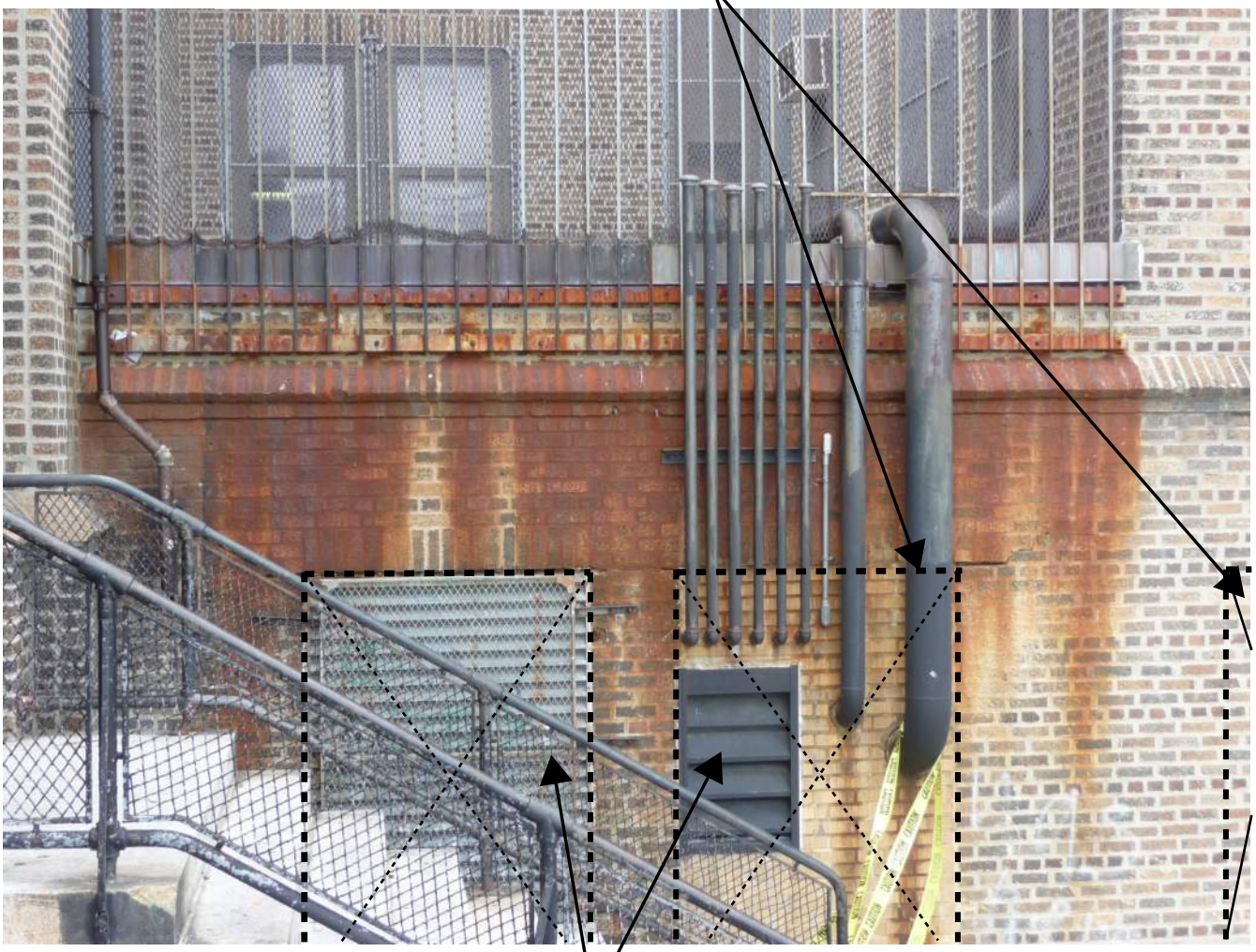
M-403

SHEET X OF XXX

ISSUED FOR ADDENDUM #2 06/09/2020

GC TO REMOVE INFILL BRICK AT (2) LOCATIONS (4'-6" W. X 6'-8" H. VIF) FOR NEW LOUVERS BY MC. PROVIDE GALVANIZED LINTEL.



MC TO REMOVE EXISTING LOUVERS (2)- SEE MECHAHICAL

NOTE: COORDINATE THIS SKA-01 WITH MECHANICAL M-400 - M403.

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PROJECT TYPE

AT/FOR

MAJOR RENOVATION AND ADDITION

FOR/THE

ETHAN ALLEN ELEMENTARY SCHOOL

3001 ROBBINS STREET
PHILADELPHIA, PENNSYLVANIA 19149

Drawing Title:	LOUVER REFERENCE IMAGE
Drawing No.:	SKA-01
Reference RFI:	Reference Drawing:
USA Project No.:	2018-080
Drawn By: Author	Checked By: Checker
Date: 06/09/20	Page: 1 of 1