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Additions and Renovations to Gantner,
Gilbert, and 16th Ave. Elementary Schools
D/R Project No. 4132

January 17, 2024

This Addendum is issued to all Contractors for the purpose of amending the requirements of the Contract Documents, as referred to and noted for the above project, and is hereby made part of said Contract Documents to the same extent as though it were originally included therein. In accordance with laws and the applicable provisions of the Contract Documents, the OWNER hereby issues this Addendum to same. The Contract Documents REQUIRE that each BIDDER acknowledge receipt of this Addendum in the space provided on the Proposal Form. This Addendum shall amend, supplement, and supersede the Contract Documents only as and to the extent explicitly stated herein.

ADDENDUM #2

A. SPECIFICATIONS

1. Spec. Section 230923 – Direct Digital Control (DDC) System for HVAC, dated December 20, 2023. **Replace** both versions with Spec. Section, 230923 – Direct Digital Control (DDC) System for HVAC, dated January 16, 2024, herein attached.

B. DRAWINGS

1. Drawing T1.3, FIRST FLOOR ADDITION EGRESS PLAN, OVERALL FIRE AREA PLAN, FIREPROOFING PLAN (Gilbert ES), dated December 20, 2023. **Replace** with Drawing T1.3, FIRST FLOOR ADDITION EGRESS PLAN, OVERALL FIRE AREA PLAN, FIREPROOFING PLAN (Gilbert ES), dated January 16, 2024, herein attached.

2. Drawing A5.2, ENLARGED PLAN DETAILS (Gilbert ES), dated December 20, 2023. **Replace** with Drawing A5.2, ENLARGED PLAN DETAILS (Gilbert ES), dated January 16, 2024, herein attached.

3. Drawing A5.3, ENLARGED PLAN DETAILS (Gilbert ES), dated December 20, 2023. **Replace** with Drawing A5.3, ENLARGED PLAN DETAILS (Gilbert ES), dated January 16, 2024, herein attached.

4. Drawing FA1.00, FIRE ALARM FIRST LEVEL PLAN (Gantner ES), dated December 20, 2023. **Replace** with Drawing FA1.00, FIRE ALARM FIRST LEVEL PLAN (Gantner ES), dated January 16, 2024, herein attached.

5. Drawing FA1.00, FIRE ALARM FIRST LEVEL (Gilbert ES), dated December 20, 2023. **Replace** with Drawing FA1.00, FIRE ALARM FIRST LEVEL (Gilbert ES), dated January 16, 2024, herein attached.

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6. Drawing FA1.00, FIRE ALARM FIRST LEVEL FLOOR PLAN (16th Ave), dated December 20, 2023. **Replace** with Drawing FA1.00, FIRE ALARM FIRST LEVEL FLOOR PLAN (16th Ave.), dated January 16, 2024, herein attached.

C. MISCELLANEOUS

Pre-Bid RFI#1 from Brahma Construction Corp., Dated January 5, 2024

1. Please provide the current Fire Alarm vendor information

   Response: Alarm & Communications Technologies Tel: 973-664-1440

2. Current building BMS contact information available?

   Response: ATC Systems, Inc., Luke Morahan, Tel: 732-560-0900 email: lmorahan@atcsystems.net

3. Do you expect to encounter any hazardous materials, ACM, lead, contaminated soil, etc.? If so, who is responsible for remediation and/or is there a report available?

   Response: No. If anything is discovered, the owner will handle.

4. Is there a self-performance requirement for the awarded GC?

   Response: While there is no minimum percentage, the contractor must comply with the assignment and subcontracting requirements included in the documents.

5. How will payment for over-excavation be handled if it is required by site soils testing?

   Response: See Unit Price No. GC-2. Quantities will be determined, and the unit price will be used to issue a change order accordingly. Any issues with the amount of excavation should be discussed prior to removal of same.

Pre-Bid RFI#2 from DMD Contracting, Dated January 8, 2024

1. Specifications contain Section 10125 – Display Cases. We are unable to locate where these display cases are located are the drawings. Please provide locations of display cases.

   Response: Disregard this specification section. There are no display cases on this project.

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Pre-Bid RFI#2 from Vanas Construction Co., Inc., Dated January 15, 2024

1. Please advise as to who the existing Fire Alarm Vendor is at 16th Ave, Gilbert and Gantner Elementary Schools.

   Response: See above.

2. Drawing FA1.00 for the Gilbert Ave Elementary School, there is a Key Note 3 shown twice on the floor plan, but there isn't a Key Note 3 description in the Power Plan Key Notes. Please provide a description of Key Note 3.

   Response: See revised drawing, herein attached.

END OF ADDENDUM #2

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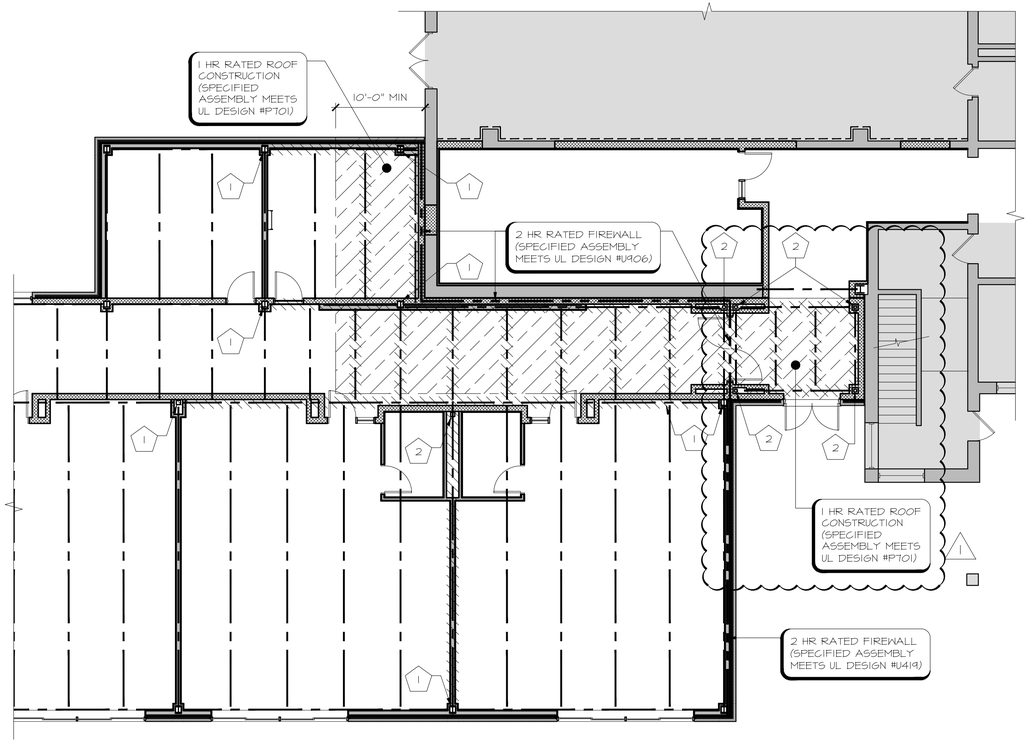
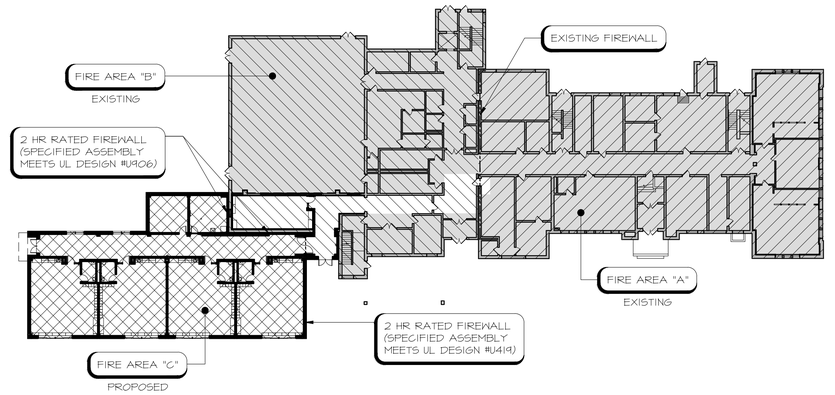


STRUCTURAL FIREPROOFING PLAN | SCALE: 1/8" = 1'-0" | 18



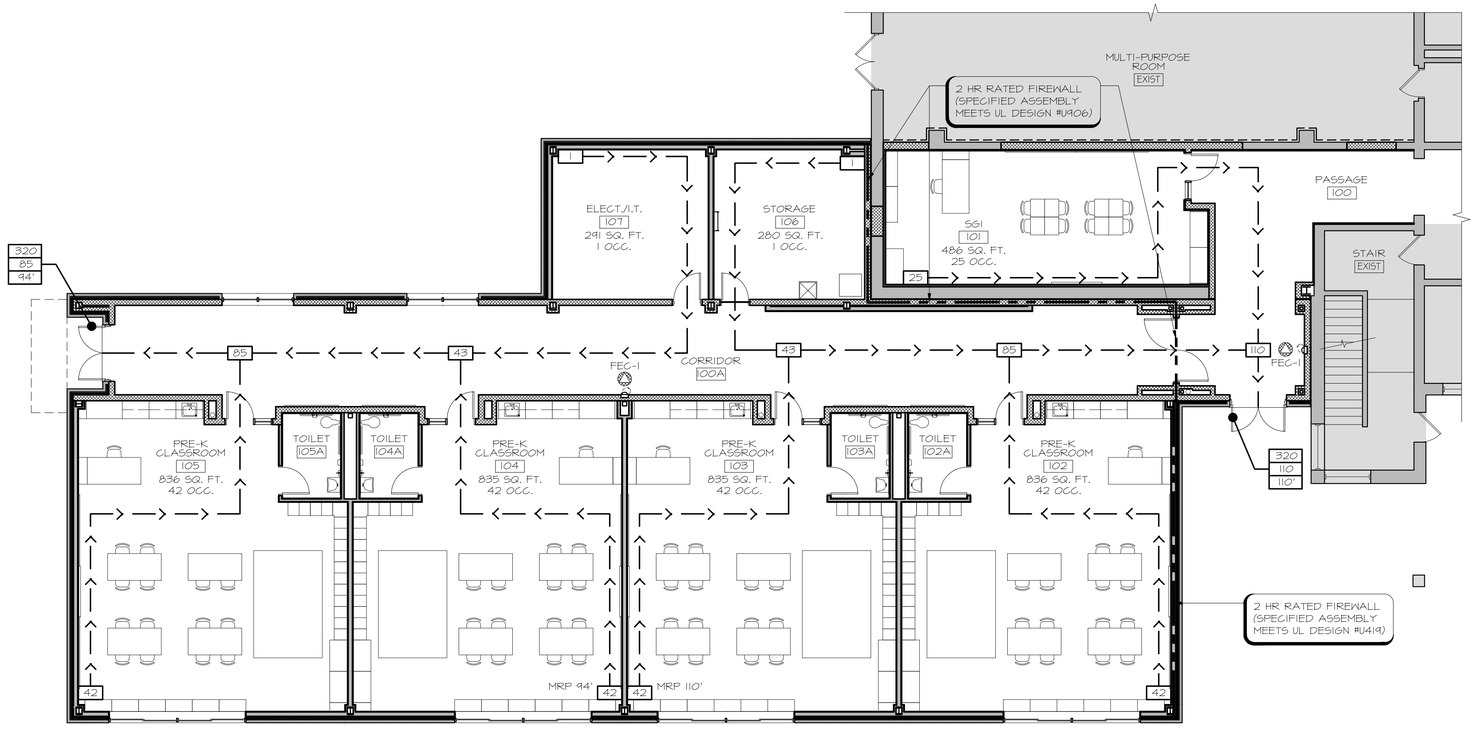
OVERALL FIRST FLOOR FIRE AREA PLAN | SCALE: 1/32" = 1'-0" | 3

FIREPROOFING LEGEND	
— — —	STRUCTURAL ROOF FRAMING, SEE STRUCT. DWGS. FOR MORE INFO.
———	2 HR RATED WALL CONSTRUCTION (SPECIFIED ASSEMBLY MEETS UL DESIGN #U906)
▨	1 HR RATED ROOF CONSTRUCTION (SPECIFIED ASSEMBLY MEETS UL DESIGN #P701)
▨	1 HR RATED STRUCTURAL BEAM/ JOIST (SPECIFIED ASSEMBLY MEETS UL DESIGN #P701)
⬠ 1	1 HR RATED STRUCTURAL STEEL COLUMN (SPECIFIED ASSEMBLY MEETS UL DESIGN #X660)
⬠ 2	1 HR RATED STRUCTURAL STEEL TUBE COLUMN (SPECIFIED ASSEMBLY MEETS UL DESIGN #X661)

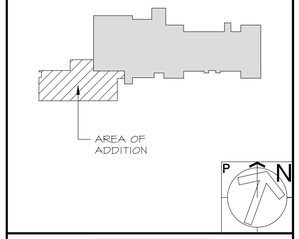
FIREPROOFING LEGEND | SCALE: NTS | 27

EGRESS LEGEND	
X	ROOM EGRESS OCCUPANT LOAD
XXX / XXX / XX'	ALLOWABLE CAPACITY OF DOORS ACTUAL CAPACITY LENGTH OF TRAVEL FROM MOST REMOTE POINT
MRP XX'	MOST REMOTE POINT / LENGTH OF TRAVEL
—> —> —> —	PATH OF EGRESS

EGRESS LEGEND | SCALE: NTS | 26



FIRST FLOOR ADDITION EGRESS PLAN | SCALE: 1/8" = 1'-0" | 1



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Superintendent of Schools

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FIRST FLOOR ADDITION EGRESS PLAN
OVERALL FIRE AREA PLAN
FIREPROOFING PLAN

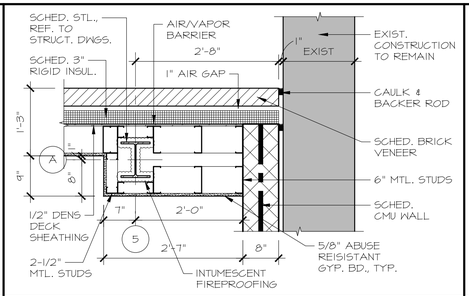
SCALE AS NOTED

REV.	DATE:	DRN	CHK	
	12/20/2023	CG	AB	ISSUED FOR BID
1	1/16/2024	CG	AB	ADDENDUM #2

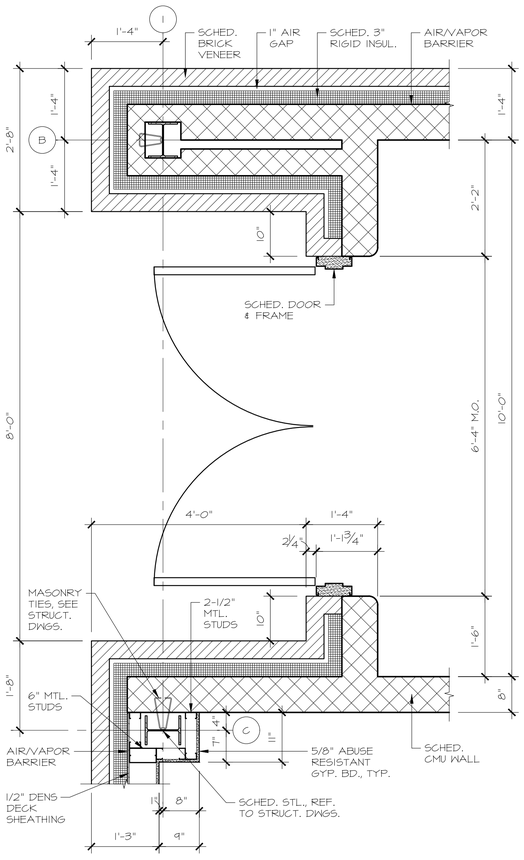
STATE PROJECT NO.
03-1345-080-23-2000

PROJECT NO. 4132B

SHEET NO. T1.3



ENLARGED PLAN DETAIL | SCALE: 3/4" = 1'-0" | 15



ENLARGED PLAN DETAIL | SCALE: 3/4" = 1'-0" | 22

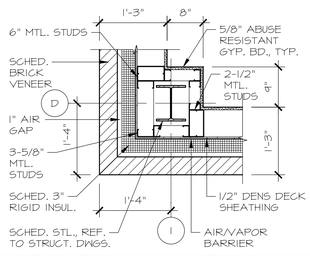
ENLARGED PLAN DETAIL | SCALE: 3/4" = 1'-0" | 19

ENLARGED PLAN DETAIL | SCALE: 3/4" = 1'-0" | 14

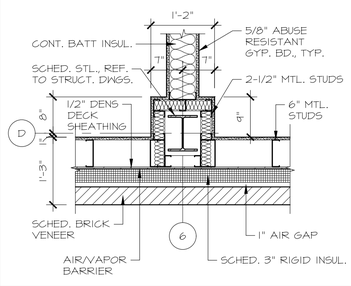
ENLARGED PLAN DETAIL | SCALE: 3/4" = 1'-0" | 13

ENLARGED PLAN DETAIL | SCALE: 3/4" = 1'-0" | 12

ENLARGED PLAN DETAIL | SCALE: 3/4" = 1'-0" | 2



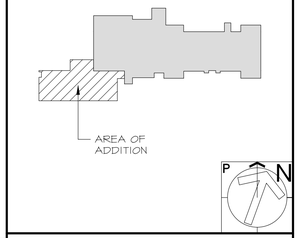
ENLARGED PLAN DETAIL | SCALE: 3/4" = 1'-0" | 26



ENLARGED PLAN DETAIL | SCALE: 3/4" = 1'-0" | 16

TYP. PLAN DETAIL NOTES | SCALE: NTS | 1

NOTES:
- ALL EXPOSED CMU CORNERS TO BE BULLNOSED, TYP.
- ALL EXPOSED GYP. BD. CORNERS SHALL HAVE CORNER BEAD, TYP.



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ENLARGED PLAN DETAILS

SCALE AS NOTED

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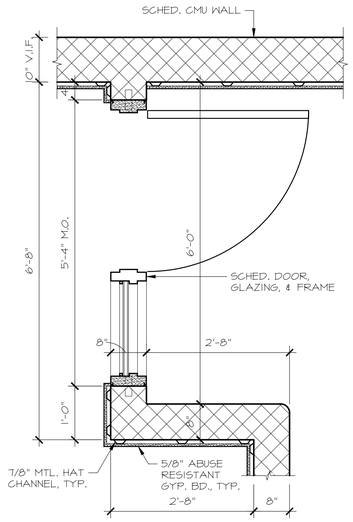
1	1/16/2024	CG	AB	ADDENDUM #2

STATE PROJECT NO.
03-1345-080-23-2000

PROJECT NO. 4132B

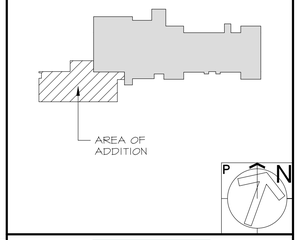
SHEET NO. A5.2

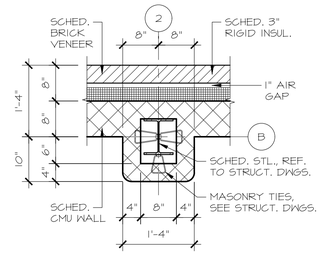


ENLARGED PLAN DETAIL | SCALE: 3/4" = 1'-0" | 14

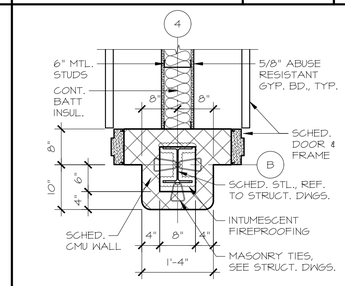
NOTES:
- ALL EXPOSED CMU CORNERS TO BE BULLNOSED, TYP.
- ALL EXPOSED GYP. BD. CORNERS SHALL HAVE CORNER BEAD, TYP.

TYP. PLAN DTL. NOTES | SCALE: NTS | 5

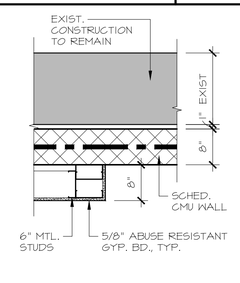




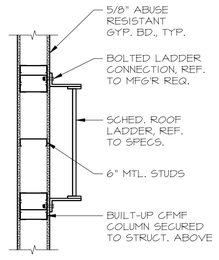
ENLARGED PLAN DETAIL | SCALE: 3/4" = 1'-0" | 28



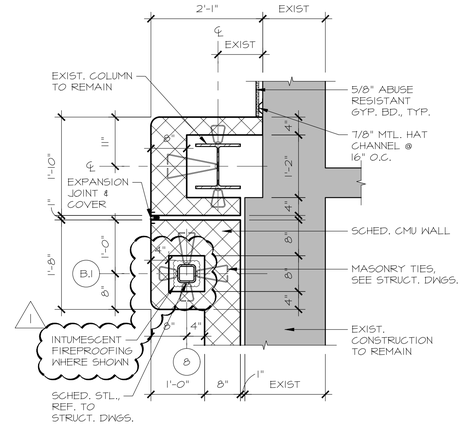
ENLARGED PLAN DETAIL | SCALE: 3/4" = 1'-0" | 23



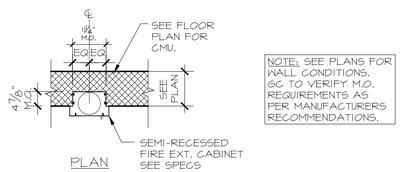
ENLARGED PLAN DETAIL | SCALE: 3/4" = 1'-0" | 18



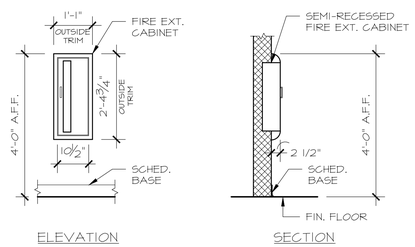
ENLARGED PLAN DETAIL | SCALE: 3/4" = 1'-0" | 13



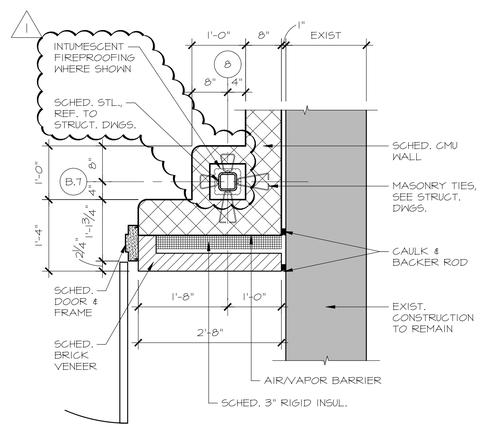
ENLARGED PLAN DETAIL | SCALE: 3/4" = 1'-0" | 3



NOTE: SEE PLANS FOR WALL CONDITIONS. GC TO VERIFY M.O. REQUIREMENTS AS PER MANUFACTURERS RECOMMENDATIONS.



FIRE EXTINGUISHER CABINET DETAILS | SCALE: 1/2" = 1'-0" | 11



ENLARGED PLAN DETAIL | SCALE: 3/4" = 1'-0" | 1

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ENLARGED PLAN DETAILS

SCALE AS NOTED

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STATE PROJECT NO.
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PROJECT NO. 4132B

SHEET NO. A5.3

SECTION 230923 - DIRECT DIGITAL CONTROL (DDC) SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 BMS DESCRIPTION

A. The Building Management System (BMS) shall be a complete system designed for use with the enterprise IT systems. This functionality shall extend into the equipment rooms. Devices residing on the automation network located in equipment rooms and similar shall be fully IT compatible devices that mount and communicate directly on the IT infrastructure in the facility. Contractor shall be responsible for coordination with the owner's IT staff to ensure that the BMS will perform in the owner's environment without disruption to any of the other activities taking place on that LAN.

B. Any and all components of the BMS that are connected via field bus or IP network, including the network controllers, field controllers, application specific controllers, server and user interface software, system and controller programming tools and software applications shall be designed, engineered, and tested to work together as a complete building management system, and shall be manufactured by the same BMS manufacturer. Systems that use or require network controllers, field controllers, application specific controllers, server and user interface software, programming tools and software from more than one BMS manufacturer shall not be accepted.

C. All points of user interface shall be on standard PCs that do not require the purchase of any special software from the BMS manufacturer for use as a building operations terminal. The primary point of interface on these PCs will be a standard Web Browser.

D. Where necessary and as dictated elsewhere in these Specifications, Servers shall be used for the purpose of providing a location for extensive archiving of system configuration data, and historical data such as trend data and operator transactions. All data stored will be through the use of a standard data base platform: Microsoft SQL Server Express or Microsoft SQL Server as dictated elsewhere in this specification.

E. The work of the single BMS Contractor shall be as defined individually and collectively in all Sections of this Division specification together with the associated Point Sheets and Drawings and the associated interfacing work as referenced in the related documents.

F. The BMS work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in these Division documents which are required for the complete, fully functional and commissioned BMS.

G. Provide a complete, neat and workmanlike installation. Use only manufacturer employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project.

H. Manage and coordinate the BMS work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.

I. The BMS as provided shall incorporate, at minimum, the following integrated features, functions and services:

1. Operator information, alarm management and control functions.
2. Enterprise-level information and control access.
3. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
4. Diagnostic monitoring and reporting of BMS functions.
5. Offsite monitoring and management access.
6. Energy management
7. Standard applications for terminal HVAC systems.

J. The BMS contractor shall provide a list of integrated points for review by the EOR and owner. The contractor is to coordinate with the contract drawings. The building management system shall control and monitor the following systems:

1. Packaged Rooftop Units
   a. Monitor and control
      1) Space temperature
      2) Space relative humidity
2. Variable Air Volume Boxes
   a. Space temperature
3. Split AC Units
   a. Monitor and control
      1) Space temperature and unit status

1.2 QUALITY ASSURANCE

A. General

1. The Building Management System Contractor shall be regularly engaged in the engineering, programming, installation and service of total integrated Building Management Systems. The BMS Contractor shall be certified and recognized by a recognized national manufacturer, installer and service provider of BMS.
2. The Building Management System (BMS) installer shall be a BMS manufacturer- owned branch office, or an independent controls contractor who is factory trained and authorized by the BMS manufacturer to sell, service and support the Building Management System specified herein.
3. The BMS Contractor shall have a branch facility within a 100-mile radius of the job site supplying complete maintenance and support services on a 24 hour, 7-day-a- week basis. The BMS Contractor shall have at this facility at least eight (8) factory trained, directly employed and full time technical staff, spare parts inventory, and all necessary test and diagnostic equipment.

4. As evidence and assurance of the contractor's ability to support the Owner's system with service and parts, the contractor must have been in the BMS business for at least the last ten (10) years and have successfully completed total projects of at least 10 times the value of this contract in each of the preceding five years.

5. The Building Management System architecture shall consist of the products of a manufacturer regularly engaged in the production of Building Management Systems, and shall be the manufacturer's latest standard of design at the time of bid.

6. Provide a JCI open Building Management and Temperature Control System incorporating Direct Digital Control (DDC), equipment monitoring, and control consisting of a PC based Operator Work Station with color graphic data displays; microcomputer based General Purpose DDC Controllers interfacing directly with sensors, actuators and environmental delivery systems, electric controls and mechanical systems for all items shown on the HVAC and Fire alarm system contract design drawings for this project, and/or as specified herein.

7. BMS Contractor shall provide an open system that will allow products from various suppliers to be integrated into a unified system in order to provide flexibility for expansion, maintenance, and service of system. Elmwood Park schools shall be the named license holder for all software associated with all of the work on this project.

8. The BMS shall include Haystack tagging and data modeling convention for ease of searching and organizing gathered data.

9. The BMS shall provide the capacity to integrate, collect, configure, and store real time data resources and analytic tools to support the energy management control and monitoring functions. It is the requirement of this specification that all work specified for this project be monitored and controlled via the BMS to unify and integrate data acquisition to take full advantage of the existing building analytics software.

1.3 REFERENCES

A. All work shall conform to the following Codes and Standards, as applicable:

1. National Fire Protection Association (NFPA) Standards.
2. National Electric Code (NEC) and applicable local Electric Code.
3. Underwriters Laboratories (UL) listing and labels.
4. UL 864 UUKL Smoke Control
5. UL 268 Smoke Detectors.
6. UL 916 Energy Management
7. NFPA 70 - National Electrical Code.
8. NFPA 90A - Standard For The Installation Of Air Conditioning And Ventilating Systems.
9. NFPA 92A and 92B Smoke Purge/Control Equipment.
10. Factory Mutual (FM).
11. American National Standards Institute (ANSI).
12. National Electric Manufacturer's Association (NEMA).

13. American Society of Mechanical Engineers (ASME).
14. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
15. Air Movement and Control Association (AMCA).
16. Institute of Electrical and Electronic Engineers (IEEE).
17. American Standard Code for Information Interchange (ASCII).
18. Electronics Industries Association (EIA).
19. Occupational Safety and Health Administration (OSHA).
20. American Society for Testing and Materials (ASTM).
21. Federal Communications Commission (FCC) including Part 15, Radio Frequency Devices.
22. Americans Disability Act (ADA)
23. ANSI/ASHRAE Standard 195-2008 (BACnet)

B. In the case of conflicts or discrepancies, the more stringent regulation shall apply.

C. All work shall meet the approval of the Authorities Having Jurisdiction at the project site.

1.4 SUBMITTALS

A. Shop Drawings, Product Data, and Samples

1. The BMS contractor shall submit a list of all shop drawings with submittals dates within 30 days of contract award.
2. Submittals shall be in defined packages. Each package shall be complete and shall only reference itself and previously submitted packages. The packages shall be as approved by the Architect and Engineer for Contract compliance.
3. Allow 15 working days for the review of each package by the Architect and Engineer in the scheduling of the total BMS work.
4. Equipment and systems requiring approval of local authorities must comply with such regulations and be approved. Filing shall be at the expense of the BMS Contractor where filing is necessary. Provide a copy of all related correspondence and permits to the Owner.
5. Prepare an index of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and item description.
6. The BMS Contractor shall correct any errors or omissions noted in the first review.
7. At a minimum, submit the following:
    - BMS network architecture diagrams including all nodes and interconnections.
    - Systems schematics, sequences, and flow diagrams.
    - Points schedule for each point in the BMS, including: Point Type, Object Name, Expanded ID, Display Units, Controller type, and Address.
    - Samples of Graphic Display screen types and associated menus.

- Detailed Bill of Material list for each system or application, identifying quantities, part numbers, descriptions, and optional features.
- Control Damper Schedule including a separate line for each damper provided under this section and a column for each of the damper attributes, including: Code Number, Fail Position, Damper Type, Damper Operator, Duct Size, Damper Size, Mounting, and Actuator Type.
- Room Schedule including a separate line for each VAV box and/or terminal unit indicating location and address
- Details of all BMS interfaces and connections to the work of other trades.
- Product data sheets or marked catalog pages including part number, photo and description for all products including software.

1.5 RECORD DOCUMENTATION

A. Operation and Maintenance Manuals

1. Three (3) copies of the Operation and Maintenance Manuals shall be provided to the Owner's Representative upon completion of the project. The entire Operation and Maintenance Manual shall be furnished on Compact Disc media, and include the following for the BMS provided:
   - Table of contents.
   - As-built system record drawings. Computer Aided Drawings (CAD) record drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal.
   - Manufacturer’s product data sheets or catalog pages for all products including software.
   - System Operator’s manuals.
   - Archive copy of all site-specific databases and sequences.
   - BMS network diagrams.
   - Interfaces to all third-party products and work by other trades.

B. On-Line documentation: After completion of all tests and adjustments the contractor shall provide a copy of all as-built information and product data to be installed on a customer designated computer workstation or server

1.6 TRAINING

A. The BMS contractor shall provide the following training services:

1. Upon completion of system commissioning and at such time as acceptable performance of the BMS hardware and software has been established, the BMS contractor shall provide two 4-hour on-site training sessions on the operation of all BMS equipment to the Owner’s operating personnel. A competent BMS contractor representative familiar with the BMS software, hardware and accessories shall perform operator instruction during normal working hours. Describe its intended use with respect to the programmed functions specified.

1.7 WARRANTY

A. Standard Material and Labor Warranty:

1. Provide a one-year labor and material warranty on the BMS.
2. If within twelve (12) months from the date of acceptance of product, upon written notice from the owner, it is found to be defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted at the option of the BMS Contractor at the cost of the BMS Contractor.
3. Maintain an adequate supply of materials within 100 miles of the Project site such that replacement of key parts and labor support, including programming. Warranty work shall be done during BMS Contractor's normal business hours

PART 2 – PRODUCTS

2.1 MANUFACTURERS

1- Johnson Controls, Inc.

2- Tridium

2.2 BMS ARCHITECTURE

A. Automation Network

1. The automation network shall be based on a PC industry standard of Ethernet TCP/IP. Where used, LAN controller cards shall be standard "off the shelf" products available through normal PC vendor channels.
2. Supervisory controller shall reside on the automation network.
3. The automation network will be compatible with other enterprise-wide networks. Where indicated, the automation network shall be connected to the enterprise network and share resources with it by way of standard networking devices and practices.
4. The automation network shall be integrated into the existing Building Management System.

B. Control Network

1. Supervisory controller shall provide supervisory control over the control network and shall support the following communication protocol:
    a. BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9
        i. The supervisory controller shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
        ii. The supervisory controller shall be tested and certified as a BACnet Building Controller (B-BC).
2. Control networks shall provide either "Peer-to-Peer," Master-Slave, or Supervised Token Passing communications, and shall operate at a minimum communication speed of 9600 baud.
3. DDC Controllers shall reside on the control network.
4. Control network communication protocol shall be BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135.

5. A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided for each controller device (master or slave) that will communicate on the BACnet MS/TP Bus.

6. The PICS shall be submitted 10 days prior to bidding.

C. Integration

1. BACnet Protocol Integration - BACnet

a. The neutral protocol used between systems will be BACnet over Ethernet and comply with the ASHRAE BACnet standard 135-2008.

b. A complete Protocol Implementation Conformance Statement (PICS) shall be provided for all BACnet system devices.

c. The ability to command, share point object data, change of state (COS) data and schedules between the host and BACnet systems shall be provided.

2.3 USER INTERFACE

A. Dedicated Web Based User Interface

1. Where indicated on plans the BMS Contractor shall provide and install a personal computer for command entry, information management, network alarm management, and database management functions. All real-time control functions, including scheduling, history collection and alarming, shall be resident in the BMS Network Automation Engines to facilitate greater fault tolerance and reliability.

2. Dedicated User Interface Architecture – The architecture of the computer shall be implemented to conform to industry standards, so that it can accommodate applications provided by the BMS Contractor and by other third party applications suppliers, including but not limited to Microsoft Office Applications. Specifically it must be implemented to conform to the following interface standards.

a. Microsoft Internet Explorer for user interface functions

b. Microsoft Office Professional for creation, modification and maintenance of reports, sequences other necessary building management functions

c. Microsoft Outlook or other e-mail program for supplemental alarm functionality and communication of system events, and reports

d. Required network operating system for exchange of data and network functions such as printing of reports, trends and specific system summaries

3. PC Hardware – The personal computer(s) shall be configured as follows:

- Processor: Intel Pentium i7
- Ram Memory: 16 GB (expendable) recommended if a 64-bit installation
- Hard Drive Space: 500 GB
- Ethernet: 100 Mbit or 1Gbit NIC (network interface card) with TCP/IP support
- Valid License
- Internet access for confirming your license

B. User Interface

1. BMS Contractor shall provide and install all computer hardware and software required for the purpose of configuration and consolidation of information and programs required for the delivery of a Task Focused, Web Based Portal to the BMS. The User Interface shall provide a natural, complementary extension to the site management user interface previously described.

2. The user interface architecture shall be implemented to conform to industry standards, so that is can accommodate the required applications provided by the BMS Contractor as well as communicate information to and from any size control system.

3. The exact same user interface shall be accessible from any type of personal computer or mobile device running any type of operating system (ex. iOS, Android, Windows).

4. The interface shall automatically adapt and optimize the information displayed to fit the screen size of the client device and shall also be touch friendly.

5. The user interface shall organize and display information using customer specific locations and spaces. At a minimum, the user interface shall provide:

    a. Organization of all space, equipment and point information in a familiar way, reducing the need for extensive training prior to use.

    b. A navigation mechanism for users to select the specific location or space to display information for – only spaces and locations in the navigation tree, nothing more.

    c. The ability to search for and/or bookmark any location, space, or equipment by name for quick access to critical or troublesome areas.

    d. The same navigation mechanisms apply across any client device (ex. Smart phone, tablet, personal computer) for consistency and ease of use.

6. Plug-ins and special native app software (ex. Downloaded and installed from an app store) shall not be required to conduct daily operations of buildings and equipment.

7. The user interface shall clearly display equipment relationships without custom graphic generation.

8. The user interface shall provide a single display of all potential issues in a facility including items currently in alarm, warning, override, out-of-service and offline.

9. Equipment Activity Log - The user interface shall provide a filterable, single display, of all activity related to a specific piece of equipment including user changes, discarded user changes, pending alarms, discarded alarms, and acknowledged alarms for at least one year of historical data.

10. The user interface shall provide support for up to 100 concurrent users from an unlimited number of individuals with defined password access to the system.

11. Provide the capability to view, command and modify large quantities of similar data in tailored summaries without the use of a secondary application, like a spreadsheet. These summaries shall be automatically generated or user defined. User defined summaries shall allow up to seven user defined columns describing attributes to be displayed including custom column labels. Up to 100 rows per summary shall be supported.

12. The user interface shall provide the capability to view historical trend data from multiple pieces of equipment. The user shall have the ability to easily navigate to a graph of frequently viewed trends. Trend graphs shall have to ability to be smartly auto-generated based on equipment and space relationships.

13. The user interface shall provide the ability to segment access to building data based on the space(s) or location(s) the user is physically located in and/or manages. The user interface shall provide the capability to assign "inherited" space permissions and the ability to assign user's space based access in bulk.

14. The user interface shall provide the ability to view equipment visualizations, floor plans, and/or other graphics on mobile or desktop client devices in a browser environment, without the need for additional plugins or software. Graphics shall be accessible via a space (for floor plans, campus maps, etc.) or equipment dashboard.

15. The user interface shall display an equipment visualization or graphic within the context of its associated space (building, floor, room, etc.) or equipment dashboard or view.

16. The user interface shall provide the capability to display, in a singular view, all the effective schedules in the context of the space (building/floor/room, etc.) or equipment that the schedule effects. The software should have the ability to display an effective schedule, for today, or a future date.

17. The user interface shall provide a report of all schedules affecting a space or equipment. The report shall provide the user details of events that comprise the weekly schedule and exception schedule.

18. The user interface shall provide the capability to efficiently change or modify schedules in mass quantities. This includes the capability to add, in bulk, exceptions to schedules, in addition to assigning, in bulk, weekly schedules.

19. The user interface shall provide notification of new alarms, visually and audibly.

20. The user interface shall provide the ability to view a summary of alarms, including a chart of the number of alarms in each of the defined alarm priority ranges. The priority ranges should be filterable.

21. The user interface shall provide the user with the understanding of what physical space is being affected when an alarm occurs. The user interface shall provide the ability to filter alarms by physical space affected when the alarm occurred.

22. The user interface shall provide the capability to view multiple occurrences of the same alarm, ultimately providing the ability to acknowledge or discard all occurrences of the alarm in a single action.

23. The user interface shall provide the capability to view, and filter on, all alarms present in a well-defined mechanical system using the equipment serving equipment relationships.

24. The user interface shall provide the capability to acknowledge and discard all occurrences of at least 1000 alarms in one operation

25. The user interface shall provide the capability to monitor alarms 24/7 without requiring an active login to the system, accessible via segregated web page. The user interface shall provide the capability to enabled or disable the 24/7 alarm monitor mode if desired.

C. Ready Access Portal User Interface

1. BMS Contractor shall provide and install all computer hardware and software required for the purpose of configuration and consolidation of information and programs required for the delivery of a Task Focused, Web Based Portal to the BMS. The Ready Access Portal shall provide a natural, complementary extension to the site management user interface previously described.

2. Ready Access Portal Architecture – The architecture of the system shall be implemented to conform to industry standards, so that it can accommodate the required applications provided by the BMS Contractor as well as communicate information to and from the system Site Director.

3. PC Hardware – The personal computer(s) shall be configured as follows:

    - Processor: Intel Pentium i7
    - Ram Memory: 16 GB (expendable) recommended if a 64-bit installation
    - Hard Drive Space: 500 GB
    - Ethernet: 100 Mbit or 1Gbit NIC (network interface card) with TCP/IP support
    - Valid License
    - Internet access for confirming your license

5. User Interface Application Components

    a. The ready access portal shall provide an intuitive user interface to key functions and tasks via web browser.

    b. Plug-ins or special software shall not be required for access to alarm, summary, schedule and trend data.

    c. The portal shall include the ability to view full graphical representations of systems and equipment on PC platforms

    d. The control system shall provide Secure Sockets Level (SSL) and Active Directory service support. If the Active Directory service and Single Sign-On features are enabled and the user is logged in to the Windows desktop, the login screen does not appear and access to the system is automatic.

    e. Provide a common tool for graphics creation, schedule creation, custom programming, user access and hardware definition

    f. Information shall be accessible on both personal computer and handheld device platforms as follows:

        - Personal computers – Internet Browser
        - Handheld devices – Internet Browser

6. Operator Interface

    a. Password access shall be as described previously for management portal UI

    b. Once logged in, the System shall display a pre-selected screen tailored to the task requirements of the individual user.

    c. The User Interface shall utilize an intuitive navigation and display method designed for operators who access the system for casual information and control or on an infrequent basis. It shall feature three basic components.

        - Radio buttons for selection of the type of information to be displayed including Alerts, Summary, Schedules and Diagnostics
        - Navigation tree for selection of the specific data to be displayed on screen for the selected type. The navigation tree may be hidden and expanded by

the operator to optimize the display of information

- A display window that provides the selected information by type in a pre-configured tabular format

d. The user interface software shall provide help menus and instructions for each operation and/or application.

e. The system shall provide support for up to 100 concurrent users from an unlimited universe individuals with defined password access to the system

f. The system shall utilize Secure Sockets Level (SSL) support as required to allow the ready access portal to communicate across a network in a way designed to prevent eavesdropping, tampering, and message forgery. It provides endpoint authentication and communications privacy over the network using cryptography

g. The system shall have the capability to display multiple navigation trees that correspond to the user views configured in the management portal UI.

h. The alert summary of the ready access portal shall, at the minimum, provide the following information

- Alert (Alarm) type
- Date and time of alert occurrence
- Priority (color coded to level)
- Item name.
- Item value (if applicable)
- Message
- Any attribute of any object in the system may be designated to report an alarm

i. A standard summary on the ready access portal shall, at the minimum, provide the following information

- Point type graphic icon
- Item name
- Item value
- Item status
- Access to the Change Value window (if applicable) for the purpose of setting, holding or releasing an item value

j. A custom summary on the ready access portal shall display user-specified summaries of key data sets that can be quickly filtered and sorted. Items within these custom summaries can be commanded.

k. A graphic view on the ready access portal shall display as described previously for management portal UI.

l. The schedule detail summary of the ready access portal shall, at the minimum, provide the following information

- Scheduled occurrences including time and value

- Scheduled overrides including start time, end time and value
- A list of all scheduled items including name and attribute, value, status and priority
- Access to the Add Temporary Override window for the purpose of adding a temporary override to the schedule

m. The diagnostic (trend) summary of the ready access portal as viewed on a personal computing device shall provide the following information.

- Item name
- Item status
- Trend name
- Trend status
- Full path name
- Access to trend detail summary including trended value, time and date arranged in a user selectable format of 1 hour, 12 hours, 24 hours, 48 hours or 72 hours

2.4 SUPERVISORY CONTROLLERS

A. Supervisory controllers

1. The supervisory controller shall be fully user-programmable. The supervisory controller shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other controllers.
2. Automation network – The supervisory controller shall reside on the automation network and shall support a subnet of system controllers.
3. User Interface – Each supervisory controller shall have the ability to deliver a web-based User Interface (UI) as previously described. All computers connected physically or virtually to the automation network shall have access to the web based UI.
    a. The web-based UI software shall be imbedded in the supervisory controller. Systems that require a local copy of the system database on the user's personal computer are not acceptable.
    b. The supervisory controller shall support a minimum of two (2) concurrent users.
    c. The web based user shall have the capability to access all system data through one supervisory controller.
    d. Remote users connected to the network through an Internet Service Provider (ISP) or telephone dial up shall also have total system access through one supervisory controller.
    e. Systems that require the user to address more than one supervisory controller to access all system information are not acceptable.
    f. The supervisory controller shall have the capability of generating web-based UI graphics. The graphics capability shall be imbedded in the supervisory controller.
    g. Systems that support UI Graphics from a central database or require the graphics to reside on the user's personal computer are not acceptable.

h. The web-based UI shall support the following functions using a standard version of Microsoft Internet Explorer:

- Configuration
- Commissioning
- Data Archiving
- Monitoring
- Commanding
- System Diagnostics

i. Systems that require workstation software or modified web browsers are not acceptable.

j. The supervisory controller shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems.

4. Processor – The supervisory controller shall be microprocessor-based with a minimum word size of 32 bits. The supervisory controller shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. Supervisory controller size and capability shall be sufficient to fully meet the requirements of this Specification.

5. Memory – Each supervisory controller shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.

6. Hardware Real Time Clock – The supervisory controller shall include an integrated, hardware-Based, real-time clock.

7. The supervisory controller shall include troubleshooting LED indicators to identify the following conditions:

   a. Power - On/Off

   b. Ethernet Traffic – Ethernet Traffic/No Ethernet Traffic

   c. Ethernet Connection Speed – 10 Mbps/100 Mbps

   d. FC Bus – Normal Communications/No Field Communications

   e. Peer Communication – Data Traffic between supervisory controller devices

   f. Run – Supervisory controller running/in startup/shutting down/software not running

   g. Bat Fault – Battery Defective, Data Protection Battery Not Installed

   h. Fault – General Fault

   i. Modem RX – Supervisory Controller Modem Receiving Data

   j. Modem TX – Supervisory Controller Modem Transmitting Data

8. Communications Ports – The supervisory controller shall provide the following ports for operation of operator Input/Output (I/O) devices, such as industry-standard computers, modems, and portable operator's terminals.

   a. USB port

b. RS-232 serial data communication port

c. RS-485 port

d. Ethernet port diagnosis, and diagnosis of all panel components. The Network Automation Engine shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.

9. Diagnostics – The supervisory controller shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network Automation Engine shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.

10. Power Failure – In the event of the loss of normal power, The supervisory controller shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.

    a. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.

    b. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.

11. Certification – The supervisory controller shall be listed by Underwriters Laboratories (UL).

12. Controller network – The supervisory controller shall support all three (3) the following communication protocols on the controller network:

    a. The supervisory controller shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.

    - The supervisory controller shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
    - The supervisory controller shall be tested and certified as a BACnet Building Controller (B-BC) using BACnet Protocol Revision 12 or higher.
    - A BACnet Protocol Implementation Conformance Statement shall be provided for the supervisory controller.
    - The Conformance Statements shall be submitted 10 days prior to bidding.
    - The supervisory controller shall support a minimum of 100 control devices.

2.5 DDC SYSTEM CONTROLLERS

A. Field Equipment Controller

1. The Field Equipment Controller (FEC) shall be a fully user-programmable, digital controller that communicates via BACnet MS/TP protocol or optionally via N2Open Clause 9 on the controller network.

    - The FEC shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
    - The FEC shall be tested and certified as a BACnet Application Specific Controller (B-ASC).

- A BACnet Protocol Implementation Conformance Statement shall be provided for the FEC.
- The Conformance Statement shall be submitted 10 days prior to bidding.

2. The FEC shall employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.
3. Controllers shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only shall not be acceptable. The FEC shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
4. The FEC shall include troubleshooting LED indicators to identify the following conditions:
    a. Power On
    b. Power Off
    c. Download or Startup in progress, not ready for normal operation
    d. No Faults
    e. Device Fault
    f. Field Controller Bus - Normal Data Transmission
    g. Field Controller Bus - No Data Transmission
    h. Field Controller Bus - No Communication
    i. Sensor-Actuator Bus - Normal Data Transmission x. Sensor-Actuator Bus - No Data Transmission
    j. Sensor-Actuator Bus - No Communication
5. The FEC shall accommodate the direct wiring of analog and binary I/O field points.
6. The FEC shall support the following types of inputs and outputs:
    a. Universal Inputs - shall be configured to monitor any of the following:
        - Analog Input, Voltage Mode
        - Analog Input, Current Mode
        - Analog Input, Resistive Mode
        - Binary Input, Dry Contact Maintained Mode
        - Binary Input, Pulse Counter Mode
    b. Binary Inputs - shall be configured to monitor either of the following:
        - Dry Contact Maintained Mode
        - Pulse Counter Mode
    c. Analog Outputs - shall be configured to output either of the following
        - Analog Output, Voltage Mode

- Analog Output, current Mode

d. Binary Outputs - shall output the following:

- 24 VAC Triac

e. Configurable Outputs - shall be capable of the following:

- Analog Output, Voltage Mode
- Binary Output Mode

7. The FEC shall have the ability to reside on a Field Controller Bus (FC Bus).

a. The FC Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.

b. The FC Bus shall support communications between the FECs and the supervisory controller.

c. The FC Bus shall also support Input/Output Module (IOM) communications with the FEC and with the supervisory controller.

d. The FC Bus shall support a minimum of 100 IOMs and FECs in any combination.

e. The FC Bus shall operate at a maximum distance of 15,000 Ft. between the FEC and the furthest connected device.

8. The FEC shall have the ability to monitor and control a network of sensors and actuators over a Sensor-Actuator Bus (SA Bus).

a. The SA Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard Protocol SSPC-135, Clause 9.

b. The SA Bus shall support a minimum of 10 devices per trunk.

c. The SA Bus shall operate at a maximum distance of 1,200 Ft. between the FEC and the furthest connected device.

9. The FEC shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over the FC Bus or the SA Bus.

10. The FEC shall support, but not be limited to, the following applications:

a. Built-up air handling units for special applications

d. Terminal & package units

e. Special programs as required for systems control

2.6 FIELD DEVICES

A. VAV Modular Assembly

a. The VAV Modular Assembly shall provide both standalone and networked direct digital control of pressure-independent, variable air volume terminal units. It shall address both single and dual duct applications.

b. The VMA shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.

i. The VMA shall be tested and certified as a BACnet Application Specific Controller.

ii. A BACnet Protocol Implementation Conformance Statement shall be provided for the VMA.

iii. The Conformance Statement shall be submitted 10 days prior to bidding.

c. The VAV Modular Assembly shall communicate over the Field Controller (FC) Bus using BACnet Standard protocol SSPC-135.

d. The VAV Modular Assembly shall have internal electrical isolation for AC power, DC inputs, and MS/TP communications as provided. An externally mounted isolation transformer shall not be acceptable.

e. The VAV Modular Assembly shall be a configurable digital controller with integral differential pressure transducer and damper actuator. All components shall be connected and mounted as a single assembly that can be removed as one piece. Alternate configurations shall be available as follows:
   i. A configurable digital controller with integral differential pressure transducer but without a damper actuator – for controlling large VAV boxes that require high torque
   ii. A configurable digital controller with an integral damper actuator but without a differential pressure transducer –for commercial zoning applications or for pressure-dependent VAV box applications
   iii. A configurable digital controller with an integral damper actuator and ball valve linkage but without a differential pressure transducer –for chilled beam applications.

f. The VAV Modular Assembly shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB or the controller is designed and suitable for use in other environmental air space (plenums) in accordance with Section 300.252(C) of the National Electrical Code.

g. The integral damper actuator shall be a fast response stepper motor capable of stroking 90 degrees in 60 seconds for quick damper positioning to speed commissioning and troubleshooting tasks.

h. The controller shall determine airflow by a state-of-the-art digital non-flow pressure sensor to provide 14-bit resolution with bidirectional flow operation that supports automatic correction for polarity on high- and low-pressure DP tube connections; this pressure sensor eliminates high- and low-pressure connection mistakes.

i. Each controller shall have the ability to automatically calibrate the flow sensor to eliminate pressure transducer offset error due to ambient temperature / humidity effects.

j. The controller shall utilize a proportional plus integration (PI) algorithm for the space temperature control loops.

k. Each controller shall continuously, adaptively tune the control algorithms to improve control and controller reliability through reduced actuator duty cycle. In addition, this tuning reduces commissioning costs, and eliminates the maintenance costs of manually re-tuning loops to compensate for seasonal or other load changes.

l. The controller shall provide the ability to download and upload VMA configuration files, both locally and via the communications network. Controllers shall be able to be loaded individually or as a group.

m. Control setpoint changes initiated over the network shall be written to VMA non-volatile memory to prevent loss of setpoint changes and to provide consistent operation in the event of communication failure.

n. The controller firmware shall be flash-upgradeable remotely via the communications bus to minimize costs of feature enhancements.

o. The controller shall provide fail-soft operation if the airflow signal becomes unreliable, by automatically reverting to a pressure-dependent control mode.

p. The controller shall interface with balancer tools that allow automatic recalculation of box flow pickup gain ("K" factor), and the ability to directly command the airflow control loop to the box minimum and maximum airflow setpoints.

q. Controller shall have on-board diagnostics. These diagnostics shall consist of control loop performance measurements executing at each control loop's sample interval, which may be used to continuously monitor and document system performance. The VMA shall calculate exponentially weighted moving averages (EWMA) for each of the following. These metrics shall be available to the end user for efficient management of the VAV terminals.

    i. Absolute temperature loop error

    ii. Signed temperature loop error

    iii. Absolute airflow loop error

    iv. Signed airflow loop error

    v. Average damper actuator duty cycle

r. The controller shall detect system error conditions to assist in managing the VAV zones. The error conditions shall consist of:

    i. Unreliable space temperature sensor

    ii. Unreliable differential pressure sensor

    iii. Starved box

    iv. Actuator stall

    v. Insufficient cooling

    vi. Insufficient heating

s. The controller shall provide a flow test function to view damper position vs. flow in a graphical format. The information would alert the user to check damper position. The VMA would also provide a method to calculate actuator duty cycle as an indicator of damper actuator runtime.

t. The controller shall provide a compliant interface for ASHRAE Standard 62.1 (indoor air quality), and shall be capable of resetting the box minimum airflow based on the percent of outdoor air in the primary air stream.

u. The controller shall comply with ASHRAE Standard 90.1 (energy efficiency) by preventing simultaneous heating and cooling, and where the control strategy requires reset of airflow while in reheat, by modulating the box reheat device fully open prior to increasing the airflow in the heating sequence.

v. Inputs:

i. Analog inputs with user defined ranges shall monitor the following analog signals, without the addition of equipment outside the terminal controller cabinet:

- 0-10 VDC Sensors
- 1000ohm RTDs
- NTC Thermistors
- The AVMA shall provide minimum 15 bit A/D resolution for analog inputs

ii. Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input "bouncing."

iii. For noise immunity, the inputs shall be internally isolated from power, communications, and output circuits.

iv. Provide side loop application for humidity control.

w. Outputs

i. Analog outputs shall provide the following control outputs:

- 0-10 VDC
- The AVMA shall provide minimum 15 bit D/A resolution of analog outputs

ii. Binary outputs shall provide a SPST Triac output rated for 500mA at 24 VAC.

iii. For noise immunity, the outputs shall be internally isolated from power, communications, and other output circuits.

x. Application Configuration

i. The VAV Modular Assembly shall be configured with a software tool that provides a simple Question/Answer format for developing applications and downloading.

y. Sensor Support

i. The VAV Modular Assembly shall communicate over the Sensor-Actuator Bus (SA Bus) with a Network Sensor.

ii. The VMA shall support an LCD display room sensor.

iii. The VMA shall also support standard room sensors as defined by analog input requirements.

iv. The VMA shall support humidity sensors defined by the AI side loop.

z. Provide Johnson Controls VMAxx or approved equal as shown on plans

B. Input/Output Module

1. Not used.

2. Not used.

3. The IOM shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.

a. The IOM shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.

b. The IOM shall be tested and certified as a BACnet Application Specific Controller (B-ASC).

c. A BACnet Protocol Implementation Conformance Statement shall be provided for the FEC.

d. The Conformance Statement shall be submitted 10 days prior to bidding.

4. The IOM shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.

5. The IOM shall have a minimum of 4 points to a maximum of 17 points. f.The IOM shall support the following types of inputs and outputs:

a. Universal Inputs - shall be configured to monitor any of the following:

- Analog Input, Voltage Mode
- Analog Input, Current Mode
- Analog Input, Resistive Mode
- Binary Input, Dry Contact Maintained Mode
- Binary Input, Pulse Counter Mode

b. Binary Inputs - shall be configured to monitor either of the following:

- Dry Contact Maintained Mode
- Pulse Counter Mode

c. Analog Outputs - shall be configured to output either of the following

- Analog Output, Voltage Mode
- Analog Output, current Mode

d. Binary Outputs - shall output the following:

- 24 VAC Triac

e. Configurable Outputs - shall be capable of the following:

- Analog Output, Voltage Mode
- Binary Output Mode

6. The IOM shall include troubleshooting LED indicators to identify the following conditions:

a. Power On

b. Power Off

c. Download or Startup in progress, not ready for normal operation

d. No Faults

e. Device Fault

f. Normal Data Transmission

g. No Data Transmission

h. No Communication

C. Network Thermostat

1. The network thermostat shall be capable of controlling cabinet unit heaters, a pressure dependent Variable Air Volume System, zoning type systems employing reheat.

2. Not used.

3. Not used.

4. The network thermostat shall include a 4.2 inch LED backlit touch screen with the following configurable icons.

   a. Home screen configurable icons include

      - On/Off icon
      - Fan override icon
      - Zone temperature icon
      - Hold temperature icon
      - Zone humidity (on applicable models) icon
      - Occupancy status (on applicable models) icon
      - Temperature setpoint icon
      - Alarm icon
      - Unit status icon
      - Date/Time icon
      - Fan override icon

   b. Home screen non-configurable icon includes

      - Menu icon

5. The network thermostat shall provide the flexibility to support any one of the following inputs:

   a. Integral indoor air temperature sensor

   b. Analog input for remote air temperature sensing that supports the following sensor types

      - Nickel
      - Platinum
      - A99B PENN
      - 2.25k ohm NTC
      - 10k ohm NTC
      - 10k ohm NTC Type 3

   c. Universal input that supports the following configurations

      - Analog sensor
      - Cooling when switch is closed
      - Heating when switch is closed

d. Remote indoor air temperature sensor

e. Two configurable binary inputs with the following configurations

- Disabled
- Occupancy
- Override
- Remote PIR
- Dirty filter
- Service
- Fan Lock
- Open door
- Open window

6. The network thermostat shall provide the flexibility to support any one of the following fan outputs:

   a. Three speed fan control

   b. Proportional speed fan control configurable from 0 to 10V

7. The network thermostat shall provide the flexibility to support any one of the following valve outputs:

   a. Two on/off

   b. Two floating

8. The network thermostat shall provide 4 digit passcode security.

9. The network thermostat shall provide the flexibility to adjust the following control parameters:

   a. Adjustable maximum setpoint offset from 0 to 20˚F

   b. Adjustable fan on delay from 0 to 120 seconds

   c. Adjustable fan off delay from 0 to 120 seconds

   d. Adjustable minimum cooling on time from 0 to 360 seconds

   e. Adjustable minimum cooling off time from 0 to 360 seconds vi. Adjustable minimum heating on time from 0 to 360 seconds vii. Adjustable minimum heating off time from 0 to 360 seconds viii. Adjustable minimum reheat on time from 0 to 360 seconds ix. Adjustable minimum reheat off time from 0 to 360 seconds x. Adjustable stroke time from 5 to 300 seconds

   f. Adjustable supply fan minimum command from 0 to 100% xii. Adjustable supply fan Medium command from 0 to 100% xiii. Adjustable supply fan high command from 0 to 100%

   g. Adjustable reheat minimum damper position from 0 to 100%

10. Where required by application and indicated on plans or room schedules provide the network thermostat with an integral Passive Infra-Red (PIR) occupancy sensor models.

11. Where required by application and indicated on plans or room schedules provide the network thermostat with an integral relative humidity sensor model.

12. The network thermostat shall employ nonvolatile electrically erasable programmable read-only memory (EEPROM) for all adjustable parameters.

13. The network thermostat shall have a temperature accuracy of ±0.9F°/±0.5C° at 70.0°F/21.0°C typical calibrated

14. The network thermostat shall have a humidity accuracy of ±5% RH from 20 to 80% RH at 50 to 90°F (10 to 32°C)

15. The network thermostat shall provide user equipment visibility from a mobile device through the Mobil Access Portal (MAP) release 4.0 or later.

D. Network Sensors

1. The Network Sensors (NS) shall have the ability to monitor the following variables as required by the systems sequence of operations:

   a. Zone Temperature

   b. Zone Humidity

   c. Zone Setpoint

   d. Discharge Air Temperature

2. The NS shall transmit the information back to the controller on the Sensor-Actuator Bus (SA Bus) using BACnet Standard protocol SSPC-135, Clause 9.

3. The NS shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.

   a. The NS shall be tested and certified as a BACnet Smart Sensors (B-SS).

   b. A BACnet Protocol Implementation Conformance Statement shall be provided for the NS.

   c. The Conformance Statement shall be submitted 10 days prior to bidding.

4. The Network Zone Temperature Sensors shall include the following items:

   a. A backlit Liquid Crystal Display (LCD) to indicate the Temperature, Humidity and Setpoint

   b. An LED to indicate the status of the Override feature

   b. A button to toggle the temperature display between Fahrenheit and Celsius

   d. a button to program the display for temperature or humidity

   e. A button to initiate a timed override command

   f. Available in either surface mount, wall mount, or flush mount vii. Available with either screw terminals or phone jack

5. The Network Discharge Air Sensors shall include the following:

   a. 4 inch or 8 inch duct insertion probe

   b. 10 foot pigtail lead

   c. Dip Switches for programmable address selection

   d. Ability to provide an averaging temperature from multiple locations

e. Ability to provide a selectable temperature from multiple locations

E. Miscellaneous Devices

1. Local Control Panels

a. All control panels shall be factory constructed, incorporating the BMS manufacturer's standard designs and layouts. All control panels shall be UL inspected and listed as an assembly and carry a UL 508 label listing compliance. Control panels shall be fully enclosed, with perforated sub-panel, hinged door, and slotted flush latch.

b. In general, the control panels shall consist of the DDC controller(s), display module as specified and indicated on the plans, and I/O devices—such as relays, transducers, and so forth—that are not required to be located external to the control panel due to function. Where specified the display module shall be flush mounted in the panel face unless otherwise noted.

c. All I/O connections on the DDC controller shall be provide via removable or fixed screw terminals.

d. Low and line voltage wiring shall be segregated. All provided terminal strips and wiring shall be UL listed, 300-volt service and provide adequate clearance for field wiring.

e. All wiring shall be neatly installed in plastic trays or tie-wrapped.

f. A 120 volt convenience outlet, fused on/off power switch, and required transformers shall be provided in each enclosure.

2. Power Supplies

a. DC power supplies shall be sized for the connected device load. Total rated load shall not exceed 75% of the rated capacity of the power supply.

b. Input: 120 VAC +10%, 60Hz.

c. Output: 24 VDC.

d. Line Regulation: +0.05% for 10% line change.

e. Load Regulation: +0.05% for 50% load change.

f. Ripple and Noise: 1 mV rms, 5 mV peak to peak.

g. An appropriately sized fuse and fuse block shall be provided and located next to the power supply.

h. A power disconnect switch shall be provided next to the power supply.

2.7 ACTUATORS AND OPERATORS

A. Damper and valve actuators shall be electronic and/or pneumatic, as specified in the System Description section.

B. The manufacturer shall be ISO 9001 certified.

C. Electronic Damper Actuators

1. Spring Return Actuators:

a. Manufactured, brand labeled or distributed by Johnson Controls, Inc. or approved equivalent.

b. Regulatory Agency Listing: cULus ,CSA C22.2 No. 24-93, and CE marked

c. Direct-Coupled Design: Requires no crankarm or linkage for mounting to a shaft.

d. Coupling: toothed V-bolt clamp and nuts with toothed cradle.

e. Reversible Mounting: Provides either clockwise or counterclockwise operation.

f. Power Failure Operation: Mechanical spring return system drives load to the home position. Other forms of internal energy storage for power failure operation are not acceptable.

2. Motor Technology:

a. Modulating Types: Microprocessor-controlled Brushless DC motor ii. On/Off Types: DC brush motor.

b. Overload Protection: Electronic stall detection protects from overload at all angles of rotation without the use of end switches.

3. Enclosure Ratings:

a. NEMA type 2 / IP54 mounted in any orientation.

b. Double-Insulated construction: Eliminate the need for electrical ground wires.

c. Wiring: Integral cables with colored and numbered conductors.

d. Sized for torque required to seal damper at load conditions

e. Parallel Operation: Actuators shall be available that are capable of being mechanically or electrically paralleled.

f. Proportional actuators shall be user configurable without the use of external computer software or programming tools. Calibration, input signal range selection, and control logic reversal shall be selectable with an external mode selection switch.

4. Operating Temperature Range:

a. 70 lb·in. Torque and Below: -40°F to 140°F

b. 71 lb·in. Torque and above: -40°F to 131°F

5. Power Requirements:

a. Modulating Types:

- 27 lb·in. Torque and Below: 5VA maximum
- 70 lb·in. to 19 lb·in.Torque: 8VA maximum
- 89 lb·in. to 71 lb·in.Torque: 10VA maximum
- 90 lb·in. to 177 lb·in.Torque: 16VA maximum

b. 2-Position Types:

- 27 lb·in. Torque and Below: 5VA maximum
- 70 lb·in. to 19 lb·in.Torque: 7VA maximum
- 71 lb·in. to 177 lb·in.Torque: 25VA maximum

2.8 SENSORS AND TRANSMITTERS

A. Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.

B. Temperature Sensors

1. General Requirements:

a. Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.

b. The temperature sensor shall be of the resistance type, and shall be either two-wire 1000 ohm nickel RTD, or two-wire 1000 ohm platinum RTD.

c. The following point types (and the accuracy of each) are required, and their associated accuracy values include errors associated with the sensor, lead wire, and A to D conversion:

Point Type	Accuracy
Room Temp	± .5ºF.
Duct Temperature	± .5ºF.

2. Room Temperature Sensors

a. Room sensors shall be constructed for either surface or wall box mounting.

b. Room sensors shall have the following options when specified:

i. Setpoint warmer/cooler dial or reset slide switch providing a ±3 degree (adjustable) range.

ii. Individual heating/cooling setpoint slide switches.

iii. A momentary override request push button for activation of after-hours operation.

iv. Analog thermometer.

3. Thermo wells

a. Thermo well manufacturer shall have models available in stainless steel, brass body, and copper bulb.

b. When thermo wells are required, the sensor and well shall be supplied as a complete assembly, including wellhead and sensor.

c. Thermo wells shall be pressure rated and constructed in accordance with the system working pressure.

d. Thermo wells and sensors shall be mounted in a direct mount (no adapter) offering faster installation or 1/2” NFT saddle and allow easy access to the sensor for repair or replacement.

e. Thermo wells constructed of 316 stainless steel shall comply with Canadian Registration Number (CRN) pressure vessel rating.

4. Outside Air Sensors

a. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.

b. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.

c. Temperature transmitters shall be of NEMA 3R (IP54) or NEMA 4 (IP65) construction and rated for ambient temperatures.

d. The outdoor sensor can be easily mounted on a roof, pole or side of a building utilizing its already assembled mounting bracket.

e. Outside Relative Humidity sensors 0-100% full range of accurate measurement. Operating temperature -4 to 140F (-20 to 60C).

f. Outside temperature sensors operating temperature range is -40 to 140F, +/- .55F (+/- .3C).

5. Duct Mount Sensors

a. Duct mount sensors shall mount in an electrical box through a hole in the duct, and be positioned so as to be easily accessible for repair or replacement.

b. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.

c. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.

6. Averaging Sensors

a. For ductwork greater in any dimension that 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.

b. For plenum applications, such as mixed air temperature measurements, a continuous averaging sensor or a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12-foot long segment.

c. Capillary supports at the sides of the duct shall be provided to support the sensing string.

7. Acceptable Manufacturers: Johnson Controls, Minco, or approved equal

C. Humidity Sensors

1. The sensor shall be a solid-state type, relative humidity sensor of the Thin Film Capacitance or Bulk Polymer Design. The sensor element shall resist service contamination.

2. The humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2-wire isolated loop powered, 4-20 mA, 0-100% linear proportional output.

3. The humidity transmitter shall meet the following overall accuracy, including lead loss and Analog to Digital conversion. 3% between 20% and 80% RH @ 77 Deg F unless specified elsewhere.

4. Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R (IP54) or NEMA 4 (IP65) enclosure with sealtite fittings.

5. A single point humidity calibrator shall be provided, if required, for field calibration. Transmitters shall be shipped factory pre-calibrated.

6. Duct type sensing probes shall be constructed of 304 stainless steel, and shall be equipped with a neoprene grommet, bushings, and a mounting bracket.

7. Acceptable Manufacturers: Johnson Controls, Vaisala, or approved equal.

D. Differential Pressure Transmitters

1. General Air and Water Pressure Transmitter Requirements:

a. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.

b. Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.

c. Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device, and shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the balancing Contractor and Owner permanent, easy-to-use connection.

d. A minimum of a NEMA 1 housing shall be provided for the transmitter. Transmitters shall be located in accessible local control panels wherever possible.

2. Low Differential Air Pressure Applications (0” to 2.5” w.c.).

a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.

b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:

i. (0.00 - 1.00” to 5.00”) w.c. input differential pressure ranges. (Select range appropriate for system application.)

ii. 4-20 mA, 0-5 VDC, 0-10 VDC, output.

iii. Maintain accuracy up to 20 to 1 ratio turndown. iv. Reference Accuracy: +0.25%, or 0.5% of full span.

c. Acceptable Manufacturers: Johnson Controls and Ruskin.

3. Medium Differential Air Pressure Applications (5” to 21” w.c.).

a. The pressure transmitter shall be similar to the Low Air Pressure Transmitter, except that the performance specifications are not as severe. Differential pressure transmitters shall be provided that meet the following performance requirements:

i. Zero & span: (c/o F.S./Deg. F): .04% including linearity, hysteresis and repeatability.

ii. Accuracy: 1% F.S. (best straight line) Static Pressure Effect: 0.5% F.S. (to 100 PSIG.

iii. Thermal Effects: <+.033 F.S./Deg. F. over 40□F. to 100□F. (calibrated at 70□F.).

b. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.

c. Acceptable manufacturers: Johnson Controls and Ruskin.

E. Smoke Detectors

1. Ionization type air duct detectors shall be furnished as specified elsewhere in Division 16 for installation under Division 15. All wiring for air duct detectors shall be provided under Division 16, Fire Alarm System.

F. Status and Safety Switches

1. General Requirements

a. Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the BMS when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.

2. Current Sensing Switches

a. The current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.

b. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.

c. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.

d. Acceptable manufacturers: Johnson Controls

3. Low Temperature Limit Switches

a. The low temperature limit switch shall be of the manual reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120VAC.

b. The sensing element shall be a minimum of 15 feet in length and shall react to the coldest 18-inch section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.

c. For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.

d. The low temperature limit switch shall be equal to Johnson Controls A70.

G. Control Relays

1. Control Pilot Relays

a. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.

b. Mounting Bases shall be snap-mount.

c. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application. d. Contacts shall be rated for 10 amps at 120VAC.

e. Relays shall have an integral indicator light and check button.

f. Acceptable manufacturers: Johnson Controls, Lectro

H. Thermostats

1. Electric room thermostats of the heavy-duty type shall be provided for unit heaters and cabinet unit heaters where required. All these items shall be provided with concealed adjustment. Finish of covers for all room-type instruments shall match and, unless otherwise indicated or specified, covers shall be manufacturer's standard finish.

2.09 CONTROL DAMPERS

A. The BMS Contractor shall furnish all automatic dampers. All automatic dampers shall be sized for the application by the BMS Contractor or as specifically indicated on the Drawings.

B. All dampers used for throttling airflow shall be of the opposed blade type arranged for normally open or normally closed operation, as required. The damper is to be sized so that, when wide open, the pressure drop is a sufficient amount of its close-off pressure drop to shift the characteristic curve to near linear.

C. All dampers used for two-position, open/close control shall be parallel blade type arranged for normally open or closed operation, as required.

D. Damper frames and blades shall be constructed of either galvanized steel or aluminum. Maximum blade length in any section shall be 60". Damper blades shall be 16-gauge minimum and shall not exceed eight (8) inches in width. Damper frames shall be 16-gauge minimum hat channel type with corner bracing. All damper bearings shall be made of reinforced nylon, stainless steel or oil-impregnated bronze. Dampers shall be tight closing, low leakage type, with synthetic elastomer seals on the blade edges and flexible stainless steel side seals. Dampers of 48"x48" size shall not leak in excess of 8.0 cfm per square foot when closed against 4" w.g. static pressure when tested in accordance with AMCA Std. 500.

E. Airfoil blade dampers of double skin construction with linkage out of the air stream shall be used whenever the damper face velocity exceeds 1500 FPM or system pressure exceeds 2.5" w.g., but no more than 4000 FPM or 6" w.g.

1. Acceptable manufacturers are Johnson Controls VD-1250, VD1630, or VD-1330, Ruskin CD50 or CD60, and Vent Products 5650.

F. One piece rolled blade dampers with exposed or concealed linkage may be used with face velocities of 1500 FPM or below.

1. Acceptable manufacturers are: Johnson Controls VD-1620, VD-1320, Ruskin CD36, and Vent Products 5800.

G. Multiple section dampers may be jack-shafted to allow mounting of piston pneumatic actuators and direct connect electronic actuators. Each end of the jackshaft shall receive at least one actuator to reduce jackshaft twist.

PART 3 – PERFORMANCE/EXECUTION

3.1 BMS SPECIFIC REQUIREMENTS

A. Graphic Displays

1. Provide a color graphic system flow diagram display for each system with all points as indicated on the point list. All terminal unit graphic displays shall be from a standard design library.

2. User shall access the various system schematics via a graphical penetration scheme and/or menu selection.

3.2 INSTALLATION PRACTICES

A. BMS Wiring

1. All conduit, wiring, accessories and wiring connections required for the installation of the Building Management System, as herein specified, shall be provided by the BMS Contractor unless specifically shown on the Electrical Drawings under Division 16 Electrical. All wiring shall comply with the requirements of applicable portions of Division 16 and all local and national electric codes, unless specified otherwise in this section.

   a. All BMS wiring materials and installation methods shall comply with BMS manufacturer recommendations.

   b. The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the BMS Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the BMS Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.

   c. Class 2 Wiring

      i. All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified.

      ii. Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5’ from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements.

   d. Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.

   e. Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.

2. BMS Line Voltage Power Source

   a. 120-volt AC circuits used for the Building Management System shall be taken from panel boards and circuit breakers provided by Division 16.

   b. Circuits used for the BMS shall be dedicated to the BMS and shall not be used for any other purposes.

   c. DDC terminal unit controllers may use AC power from motor power circuits.

3. BMS Raceway

a. All wiring shall be installed in conduit or raceway except as noted elsewhere in this specification. Minimum control wiring conduit size 1/2".

b. Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.

c. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.

d. Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls. Flexible Metal Conduit shall be UL listed.

4. Penetrations

a. Provide fire stopping for all penetrations used by dedicated BMS conduits and raceways.

b. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.

c. All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway.

d. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.

5. BMS Identification Standards

a. Node Identification. All nodes shall be identified by a permanent label fastened to the enclosure. Labels shall be suitable for the node location.

b. Cable types specified in Item A shall be color coded for easy identification and troubleshooting.

6. BMS Panel Installation

a. The BMS panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.

b. The BMS contractor shall be responsible for coordinating panel locations with other trades and electrical and mechanical contractors.

7. Input Devices

a. All Input devices shall be installed per the manufacturer recommendation

b. Locate components of the BMS in accessible local control panels wherever possible.

8. HVAC Input Devices – General

a. All Input devices shall be installed per the manufacturer recommendation

b. Locate components of the BMS in accessible local control panels wherever possible.

c. The mechanical contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.

d. Input Flow Measuring Devices shall be installed in strict compliance with ASME guidelines affecting non-standard approach conditions.

e. Outside Air Sensors

i. Sensors shall be mounted on the North wall to minimize solar radiant heat impact or located in a continuous intake flow adequate to monitor outside air conditions accurately.

ii. Sensors shall be installed with a rain proof, perforated cover.

h. Building Differential Air Pressure Applications (-1" to +1" w.c.):

i. Transmitters exterior sensing tip shall be installed with a shielded static air probe to reduce pressure fluctuations caused by wind.

ii. The interior tip shall be inconspicuous and located as shown on the drawings.

i. Duct Temperature Sensors:

i. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.

ii. The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.

iii. For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.

iv. The sensor shall be mounted to suitable supports using factory approved element holders.

j. Space Sensors:

i. Shall be mounted per ADA requirements.

ii. Provide lockable tamper-proof covers in public areas and/or where indicated on the plans.

l. Air Differential Pressure Status Switches:

i. Install with static pressure tips, tubing, fittings, and air filter.

m. Water Differential Pressure Status Switches:

i. Install with shut off valves for isolation.

n. HVAC Output Devices

o. All output devices shall be installed per the manufacturer's recommendation. The mechanical contractor shall install all in-line devices such as control valves, dampers, airflow stations, pressure wells, etc.

p. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke. When any pneumatic actuator is sequenced with another device, pilot positioners shall be installed to allow for proper sequencing.

q. Control Dampers: Shall be opposed blade for modulating control of airflow. Parallel blade dampers shall be installed for two position applications.

s. Electronic Signal Isolation Transducers: Whenever an analog output signal from the Building Management System is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input a signal from a remote system, provide a signal isolation transducer. Signal isolation transducer shall provide ground plane isolation between systems. Signals shall provide optical isolation between systems

3.3 TRAINING

A. The BMS contractor shall provide the following training services:

1. One day of on-site orientation by a system technician who is fully knowledgeable of the specific installation details of the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings, the BMS software layout and naming conventions, and a walk through of the facility to identify panel and device locations.

PART 4 – SEQUENCE OF OPERATION FOR HVAC CONTROLS

VAV ZONE ROOFTOP UNIT RTU-1 (ELECTRIC HEATING, DX, ECONOMIZER, AND DCV)

Mode Enable Sensor

- In a standard VAV application the Supply Air Temperature (SAT) sensor is configured as the Mode Enable Sensor during the Occupied Mode

Occupied Mode Initiation

There are several ways to initiate the Occupied Mode of operation:

- BACnet command
- Pushbutton Override button on a Space Sensor (Override length is user adjustable).

Unoccupied Operation

- If a space temperature sensor or a combination space temperature/humidity sensor is installed, the unit can be configured to use Night Setback Offsets for Heating and Cooling calls and the normal dehumidification setpoint for dehumidification calls. Otherwise, Unoccupied calls can be generated from VAV Boxes equipped with Orion VAV box controllers.
- Outdoor Air Damper will be closed except if the unit is in Unoccupied Economizer Free Cooling mode.
- If there is no call for Heating or Cooling, or if Night Setback operation has not been configured, the unit will be off.

HVAC Modes of Operation

There are 5 possible HVAC Modes of Operation:

- Cooling Mode
- Heating Mode
- Vent Mode
- Dehumidification Mode

- Off Mode

Cooling Mode with Variable Capacity Compressor and Fixed Compressor

- In the cooling mode, as the Supply Air Temperature (SAT) rises above the Active Supply Air Cooling Setpoint (see Supply Air Temperature Setpoint Reset section for explanation), compressors will modulate and stage based on the unit configuration in order to control to the Active Supply Air Cooling Setpoint.
- Each stage must meet its Minimum Off Time (adj.) before it is allowed to energize and successive stages can energize if the SAT rises above the Active Supply Air Cooling Setpoint for the Cooling Stage Up Delay period (adj).
- For compressors to stage down, Minimum Run Times (adj.) must be satisfied, and the SAT needs to be below the Active Supply Air Cooling Setpoint minus the Cooling Stage Control for a period of time equal to the Stage Down Delay.
- Mechanical cooling is disabled if the Outdoor Air Temperature (OAT) falls 1° below the Cooling Lockout Setpoint and will remain disabled until the OAT rises 1° above the Cooling Lockout Setpoint. If the OAT disables mechanical cooling while it is currently operating, mechanical cooling will stage off as minimum run times and stage down delays are satisfied.
- If the Economizer is enabled it will function as the first stage of cooling (see Economizer section).

Heating Mode

- Heating via Modulating SCR Electric heat exchanger.
- Heating can be initiated for Morning Warm Up or for Supply Air Tempering Operation. See those sections for details of how those operations are initiated.
- In the Heating Mode, as the Supply Air Temperature falls below the Active Supply Air Heating Setpoint (see Supply Air Temperature Setpoint Reset section for explanation), the heating will begin to stage on or to modulate. Each stage must meet its Minimum Off Time (adj.) before it is allowed to energize and successive stages are subject to a Heating Stage Up Delay (adj).
- Heating stages will continue to run until the supply air temperature rises above the Active Supply Air Temperature Setpoint plus the Heating Stage Control Window at which point the heating will begin to stage off. Each stage must meet its Minimum Run Time (adj.) before it is allowed to stage off, and successive stages are subject to a Heating Stage Down Delay (adj.).
- Mechanical heating is disabled if the Outdoor Air Temperature (OAT) rises 1° above the Heating Lockout Setpoint and will remain disabled until the OAT falls 1° below the Heating Lockout Setpoint. If the OAT disables mechanical heating while it is currently operating, mechanical heating will stage off as minimum run times and stage down delays are satisfied.

Dehumidification Mode with Variable Capacity Compressor and Fixed Compressor

- Dehumidification is enabled when the Indoor Humidity rises above the Indoor Humidity Enable/Hi Reset Setpoint and is disabled when the Indoor Humidity falls below the Disable/Lo Reset Setpoint and requires the use of the E-BUS Combination Space Temperature/Humidity Sensor.

- Dehumidification can be selected as a priority mode (an All Modes option shown above) to be active anytime the humidity is above the Indoor Humidity Setpoint, otherwise it is only available when heating and cooling demands are satisfied a Vent Mode option shown above.
- Once in dehumidification, the unit will modulate and stage compressors based on the unit configuration in order maintain the Evaporator Coil Suction (Saturation) Temperature at the Coil Suction (Saturation) Temperature Setpoint.

Ventilation Mode

- This mode is only available in the Occupied Mode of operation on units configured for continuous supply fan operation and is generated anytime there is no demand for heating or cooling.
- The fan will operate at the Minimum Vent speed (user adj).

Off Mode

- Off Mode occurs in the Unoccupied Mode when there is no heating, cooling, or dehumidification demand.
- The Supply fan is off and the Outside Air Damper is closed.

Economizer Operation

- Enabled when Outdoor Air (OA) drybulb, wetbulb, or dewpoint temperature falls below the Economizer Enable Setpoint by 1°
- Economizer operation is disabled when the OA temperature rises 1° above the Economizer Enable Setpoint
- Wetbulb or dewpoint operation requires an Outdoor Humidity Sensor.
- Economizer acts as 1st stage of cooling and controls to the Active Supply Air Cooling Setpoint. If the economizer reaches 100% and the supply air temperature is still above setpoint, mechanical cooling is allowed to stage up while the economizer is held at the full open position.
- An Economizer Minimum Position can be configured in the controller.

Supply Fan Operation

- Occupied Mode – Supply fan can be configured to run continuously (default) or to cycle with heating, cooling or dehumidification.
- Unoccupied Mode – Supply fan will cycle on a call for heating, cooling or dehumidification.
- Anytime the Supply Fan is requested to start, a 1 minute minimum off timer must be satisfied. If the timer is satisfied the Supply Fan relay is activated while all other outputs are held off for a period of 1-2 minutes to purge stagnate air from the ductwork before heating or cooling occurs.

- When going into Occupied Mode, an optional “Purge Mode” can be initiated. The fan runs with the Economizer closed, and all Cooling and Heating is de-energized. The length of the Purge Mode is user-adjustable.
- In fan cycle mode or when going unoccupied the supply fan is held on for 2 minutes after the last stage of heating or cooling stages off.

Duct Static Pressure Control

- The VCCX2 Controller can be used to control a Supply Fan VFD or a Zoning Bypass Damper Actuator to maintain a Duct Static Pressure Setpoint.
- The Duct Static Pressure Setpoint, the Setpoint Deadband, the Static Pressure Control Signal, and the Static Control Rate are all user-adjustable

Head Pressure Control

- Using Refrigerant System Module(s), the VCC-X can monitor head pressure transducers and control multiple condenser fans or valves to maintain the head pressure setpoint.
- Can control modulating condenser fans (valves) or utilize condenser fan cycling
- Different head pressure setpoints are used for Cooling Mode and Dehumidification Reheat Mode

Building Pressure Control

  - **Direct Acting**, meaning that on an **increase** in building static pressure, a VFD exhaust fan can be ramped up to maintain the setpoint.

Emergency Shutdown

- A 24 VAC wet contact input is available to be used with a N.C. Smoke Detector, Firestat, or other shutdown condition occurs. If this contact opens, it will initiate immediate shutdown of the VCC-X and will generate an alarm condition.

Trend Logging

- Continuously maintains an Internal Trend Log of over 70 status points and setpoints in memory on the controller at a user defined timed interval (from 1 minute up to 60 minutes).
- 120 log positions (timed retrievals) are available on the controller.
- Once these positions are full, it begins overwriting the oldest data.
- Values can be retrieved using the Prism II graphical front-end software program.
- With Prism running continuously, values can be saved to the computer hard drive at regular intervals in order to keep long-term data.
- See the VCCX2 Controller Technical Guide for a complete list of the Trend Log items.

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VAV BOX WITH ELECTRIC REHEAT:

The VAV box manufacture shall provide the VAV boxes complete with terminal unit velocity sensor and shall factory mount and wire the control devices at his factory. Either ATC manufacture or unit manufacturer shall provide the required terminal equipment controller, actuator, transformer and other required controls for factory installation.

Terminal Unit Velocity Sensors: Probe shall utilize thermal anemometry as the sensing technique. Velocity range shall be 0 to 3250 feet per minute and with an installed accuracy of +25 FPM. The velocity probe shall include an insertion type-mounting bracket, which mounts flush to the supply duct.

Building Automation System Interface:

The Building Automation System (BAS) shall send the controller Occupied and Unoccupied commands. The BAS may also send a Heat/Cool mode, priority shutdown commands, space temperature and/or space temperature setpoint. If communication is lost with the BAS, the VAV controller shall operate using its local setpoints.

The following information shall be available at the central workstation:

a) Reset room set point
b) Read/log room temperature
c) Override day/night operation
d) Change maximum CFM flow rate
e) Change minimum CFM flow rate
f) Assign daily occupied/unoccupied times
g) Read CFM flow rate
h) Supply air temperature
i) Damper position

Occupancy Mode:

The occupancy mode shall be communicated or hardwired to the controller via a binary input. Valid occupancy modes for the unit shall be:

Occupied:

When the zone temperature is between the occupied heating and cooling setpoints (inside of the bias), the primary air damper will be at the minimum CFM and there will be no mechanical heating. On a rise in zone temperature above the cooling setpoint, the primary air damper will increase the CFM and there will be no mechanical heating. On a drop in zone temperature below the heating setpoint, the reheat coil will be used to maintain the zone temperature.

Unoccupied:

Normal operating mode for unoccupied spaces or nighttime operation. When the unit is in unoccupied mode the VAV controller shall maintain the space temperature at the stored unoccupied heating or cooling setpoint regardless of the presence of a hardwired or communicated setpoint. When the space temperature exceeds the active unoccupied setpoint the VAV shall modulate fully closed.

Morning Warm-up Modes:

The primary air damper is driven fully open during the unoccupied mode, to allow for main RTU night setback and morning warm-up heating cycles.

Occupied Bypass:

Mode used to temporarily place the unit into the occupied operation. Tenants shall be able to override the unoccupied mode from the space sensor. The override shall last for a maximum of 4 hours (adj.). The tenants shall be able to cancel the override from the space sensor at any time. During the override the unit shall operate in occupied mode.

Heat/Cool Mode:

The Heat/Cool mode shall be set by a communicated value or automatically by the VAV. In standalone or auto mode the VAV shall compare the primary air temperature with the configured auto changeover setpoint to determine if the air is "hot" or "cold". Heating mode it implies the primary air temperature is hot. Cooling mode it implies the primary air temperature is cold.

Heat/Cool Setpoint:

The space temperature setpoint shall be determined either by a local (e.g., thumbwheel) setpoint, the VAV default setpoint or a communicated value. The VAV shall use the locally stored default setpoints when neither a local setpoint nor communicated setpoint is present. If both a local setpoint and communicated setpoint exist, the VAV shall use the communicated value.

Cooling Mode:

When the unit is in cooling mode, the VAV controller shall maintain the space temperature at the active cooling setpoint by modulating the airflow between the active cooling minimum airflow setpoint to the maximum cooling airflow setpoint. Based on the VAV controller occupancy mode, the active cooling setpoint shall be one of the following:

Setpoint	Default Value:
Occupied Cooling Setpoint -	75.0 deg. F (Adj.)
Unoccupied Cooling Setpoint-	85.0 deg. F (Adj.)
Occupied Min Cooling Airflow Setpoint - See VAV Schedule	
Occupied Max Cooling Airflow Setpoint - See VAV Schedule.	

The VAV shall use the measured space temperature and the active cooling setpoint to determine the requested cooling capacity of the unit. The outputs will be controlled based on the unit configuration and the requested cooling capacity.

Heating Mode:

When the unit is in heating mode, the VAV controller shall maintain the space temperature at the active heating setpoint by modulating the airflow between the active heating minimum airflow setpoint to the maximum heating airflow setpoint. Based on the VAV controller occupancy mode, the active heating setpoint shall be one of the following:

Setpoint	Default Value:
Occupied Heating Setpoint -	72.0 deg. F (Adj.)
Unoccupied Heating Setpoint-	55.0 deg. F (Adj.)
Occupied Min Heating Airflow Setpoint -	See VAV Schedule
Occupied Max Heating Airflow Setpoint -	See VAV Schedule.

The VAV controller shall use the measured space temperature and the active heating setpoint to determine the requested heating capacity of the unit. The outputs will be controlled based on the unit configuration and the requested heating capacity.

Reheat Control:

Reheat will only be allowed when the primary air temperature is 5.0 deg. F below the configured reheat enable setpoint of 72.0 deg. F (adj.). The reheat shall be enabled when the space temperature drops below the active heating setpoint and the minimum airflow requirements are met. During reheat the VAV shall operate as follows:

If the discharge air temperature reaches the design heating discharge air temperature setpoint of 85 Deg F (adj.) and space temperature is below active heating set point , the VAV shall modulate airflow between the minimum heating airflow setpoint and the maximum heating airflow setpoint as required to maintain the space temperature.

Space Sensor Failure:

If there is a fault with the operation of the zone sensor an alarm shall be annunciated at the BAS. Space sensor failure shall cause the VAV to drive the damper to minimum air flow if the VAV is in the occupied mode, or drive it closed if the VAV is in the unoccupied mode.

TOILET EXHAUST FAN:

Toilet exhaust fan to be controlled by timeclock located in electrical room.

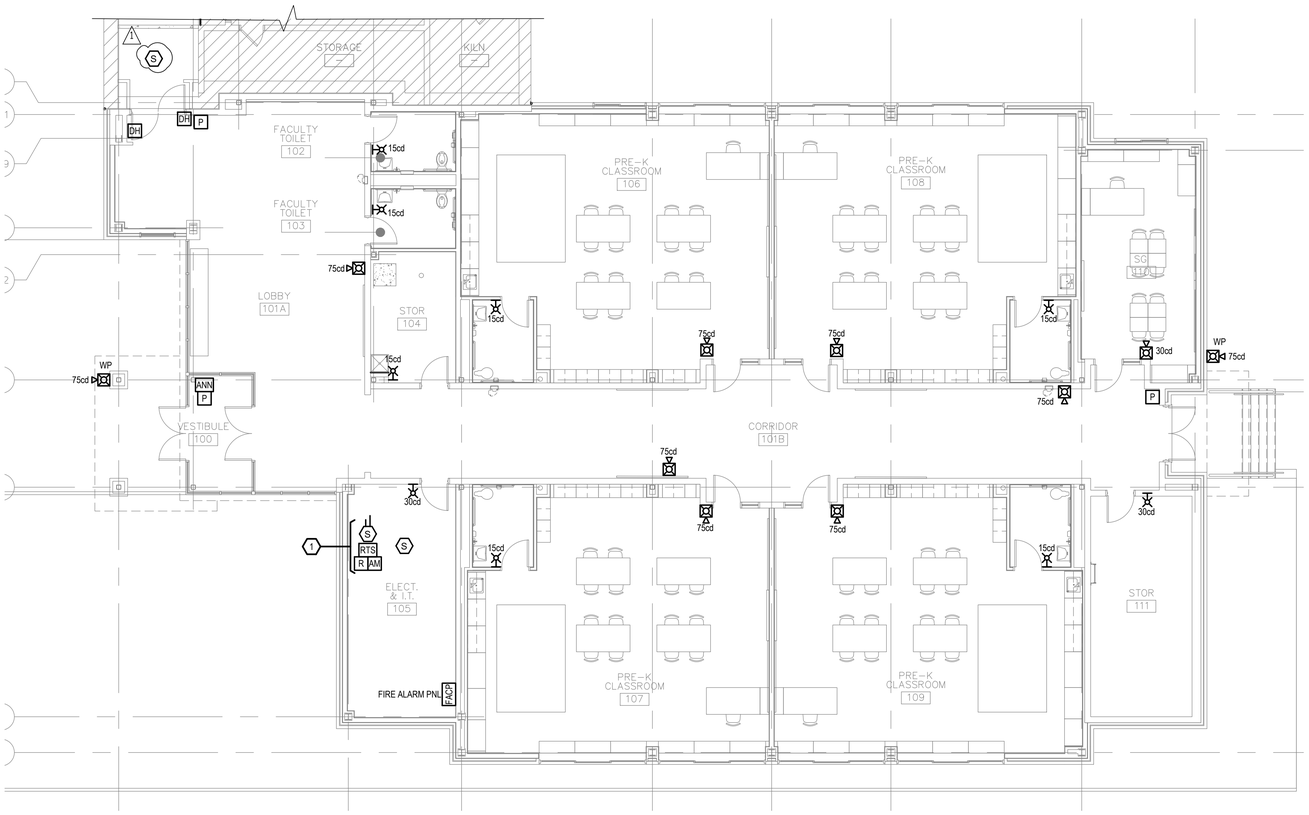
GENERAL EXHAUST FAN:

Dedicated exhaust fans shall be automatically controlled by the space thermostat. The fan exhaust systems in utility rooms shall be indexed ON by the space thermostat upon rise in space temperature above 85ºF (adjustable).

ELECTRIC CABINET UNIT HEATERS:

Provide an integral cabinet unit heater thermostat, SCR (Silicon Controlled Rectifier) and all required controls to perform the sequence of operation below and as indicated on the controls diagram.

Heater shall be enabled when the space temperature drops below the active setpoint of 55 Deg, F (adjustable) (adjustable). Electric heater modulates to maintain discharge air temperature to meeting the set point temperature. There will be no control or monitoring at the BMS.



GENERAL POWER PLAN NOTES:

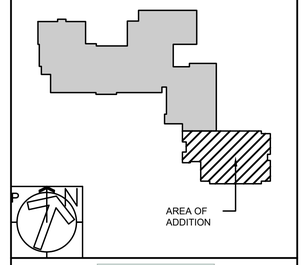
1. REFER TO SYMBOL LEGEND AND ABBREVIATIONS ON SHEET FA0.00.

POWER PLAN KEYED NOTES:

1. PROVIDE DUCT SMOKE DETECTOR ON RETURN SIDE OF RTU-1 (ON ROOF). FIRE ALARM CONTRACTOR FURNISH DUCT SMOKE DETECTOR, MECHANICAL CONTRACTOR TO INSTALL DUCT SMOKE DETECTOR, AND FIRE CONTRACTOR TO PROVIDE WIRING AND FINAL CONNECTIONS FOR FIRE ALARM SYSTEM.
2. CONNECT FIRE ALARM DEVICE TO EXISTING FIRE ALARM SYSTEM SERVING THE MAIN BUILDING. MODIFY/EXTEND WIRING AS NEEDED TO ACCOMMODATE SCOPE OF WORK.

1 FA1.00 — FIRE ALARM FIRST LEVEL PLAN

1/8" = 1'-0"



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FIRE ALARM FIRST LEVEL PLAN

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1	01/16/24	JV	RW	ADDENDUM #2

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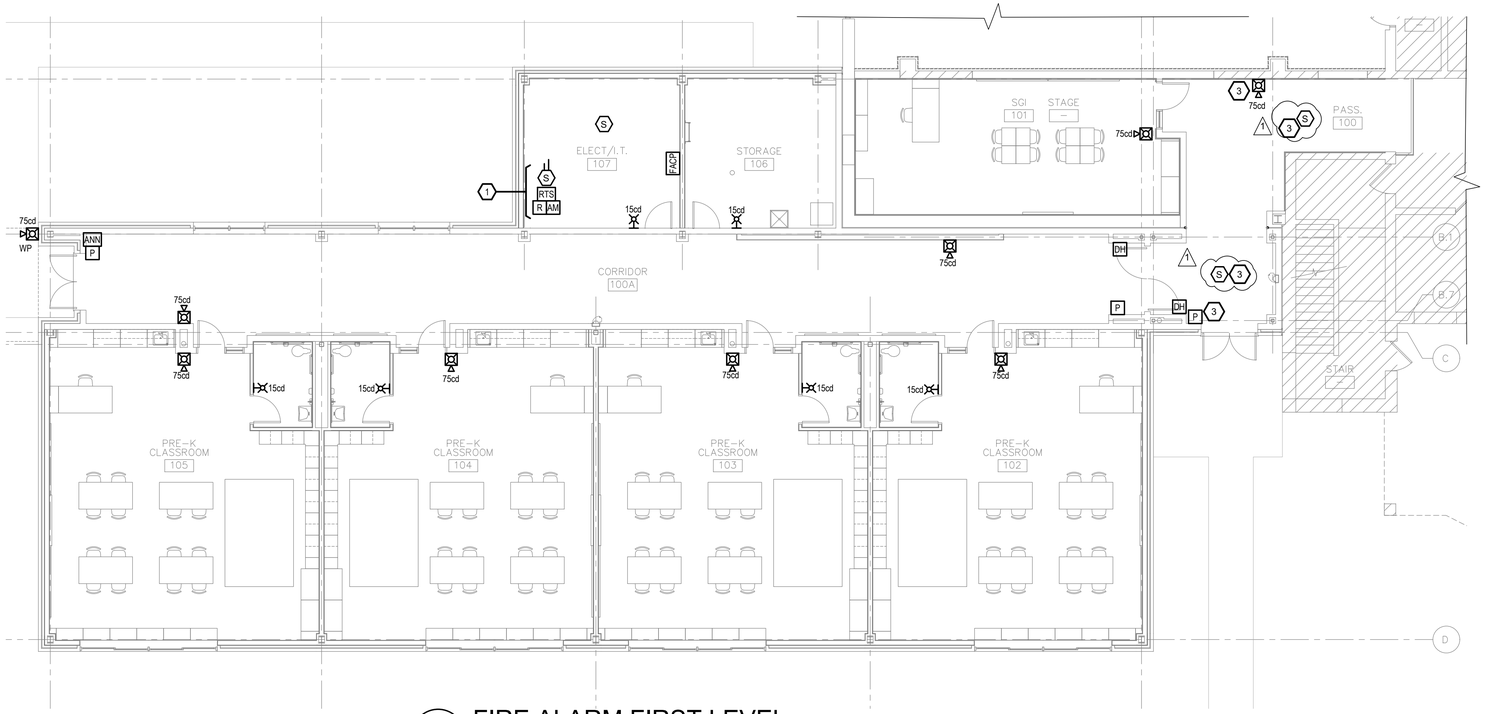
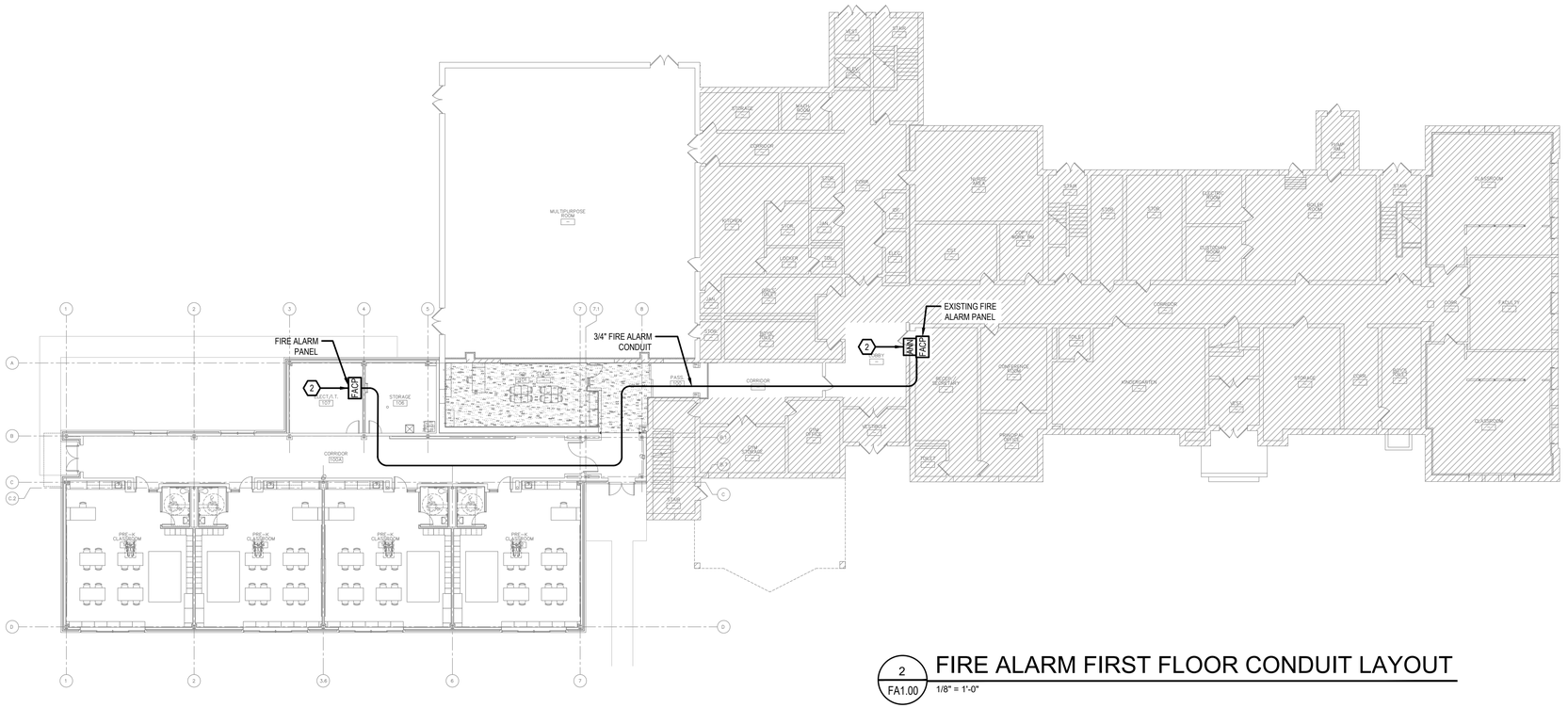
SHEET NO. FA1.00

A&J#2365



1 FA1.00 **FIRE ALARM FIRST LEVEL**

1/8" = 1'-0"



2 FA1.00 **FIRE ALARM FIRST FLOOR CONDUIT LAYOUT**

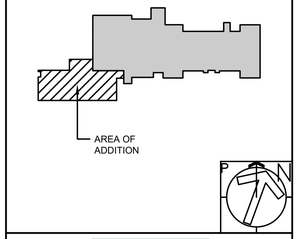
1/8" = 1'-0"

GENERAL POWER PLAN NOTES:

1. REFER TO SYMBOL LEGEND AND ABBREVIATIONS ON SHEET FA0.00.

POWER PLAN KEYED NOTES:

1. PROVIDE DUCT SMOKE DETECTOR ON RETURN SIDE OF RTU-1 (ON ROOF). FIRE ALARM CONTRACTOR FURNISH DUCT SMOKE DETECTOR, MECHANICAL CONTRACTOR TO INSTALL DUCT SMOKE DETECTOR, AND FIRE CONTRACTOR TO PROVIDE WIRING AND FINAL CONNECTIONS FOR FIRE ALARM SYSTEM.
2. CONTRACTOR SHALL PROVIDE INTERCONNECTION BETWEEN FIRE ALARM PANEL IN ADDITION AND FIRE ALARM PANEL IN MAIN BUILDING. FIRE ALARM PANEL SHALL BE INTERLOCKED SUCH THAT THE PANELS WILL HAVE THEIR ALARM STATUSES INTERLOCKED. ADDITIONALLY, A REMOTE ANNUNCIATOR SHALL BE PROVIDED NEXT TO THE EXISTING MAIN BUILDING FIRE ALARM PANEL AND INDICATE THE STATUS OF THE ADDITIONAL FIRE ALARM SYSTEM. CONTRACTOR SHALL VERIFY INTERCONNECTION NEEDED BETWEEN FIRE ALARM PANEL DURING PRE-BID WALKTHROUGH. ADDITIONAL MODULES TO INTERCONNECT FIRE ALARM PANEL SHALL BE PROVIDED AS NEEDED.
3. CONNECT FIRE ALARM DEVICE TO EXISTING FIRE ALARM SYSTEM SERVING THE MAIN BUILDING. MODIFY/EXTEND WIRING AS NEEDED TO ACCOMMODATE SCOPE OF WORK.



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FIRE ALARM FIRST LEVEL

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4132B	FA1.00

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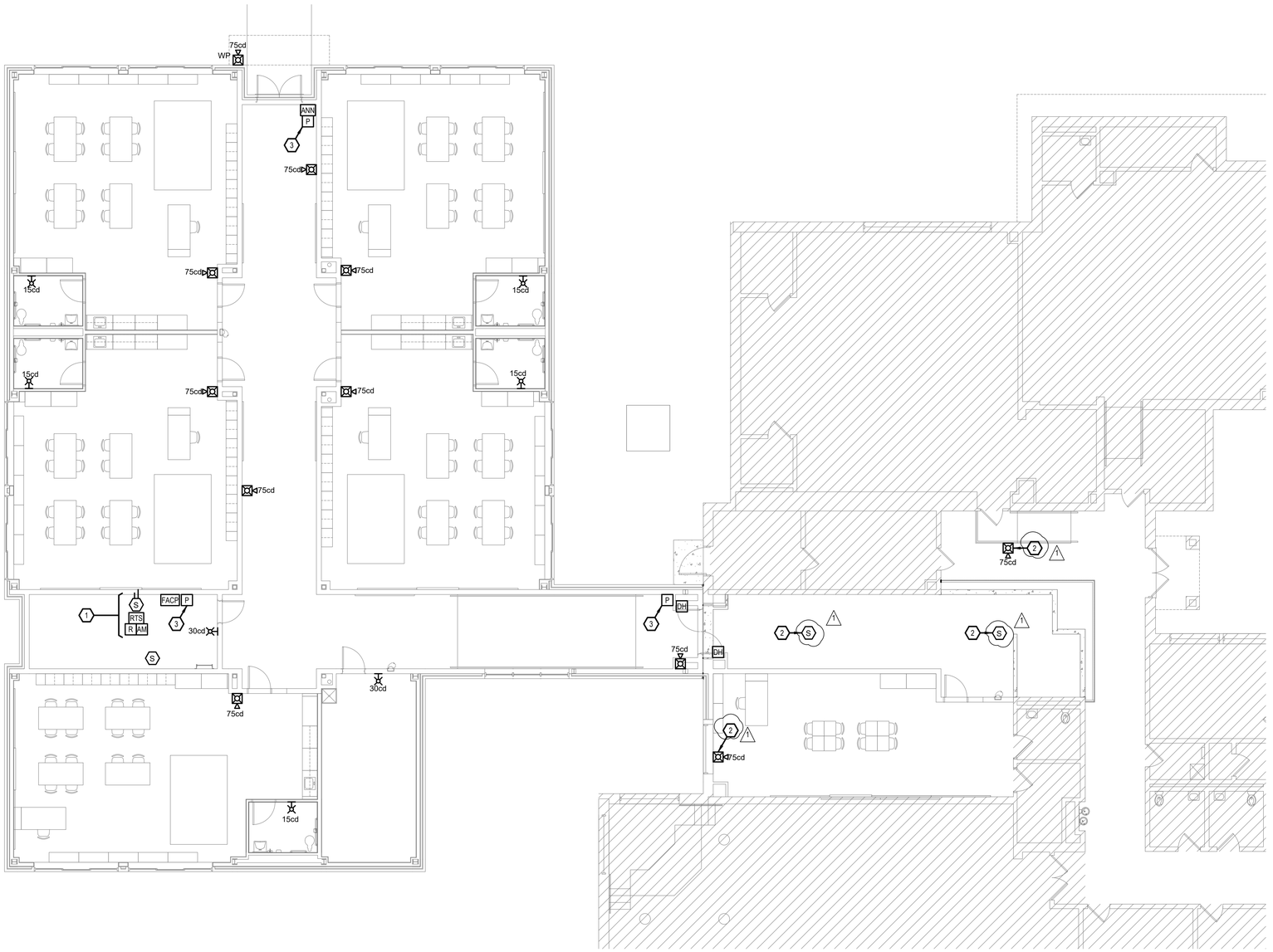

1 FA1.00 FIRE ALARM FIRST LEVEL FLOOR PLAN

1/8" = 1'-0"

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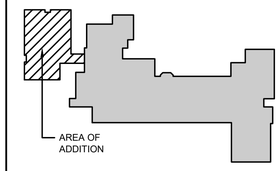
2. CONNECT FIRE ALARM DEVICE TO EXISTING FIRE ALARM SYSTEM SERVING THE MAIN BUILDING. MODIFY/EXTEND WIRING AS NEEDED TO ACCOMMODATE SCOPE OF WORK.
3. PROVIDE PROTECTIVE COVERS TO EACH FIRE ALARM PULL STATION.



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