MCC Addendum #3 Narrative
10/22/24

Sunman-Dearborn Community Schools – BP#2
ADDENDUM #3
October 22, 2024

This Addendum is hereby made a part of the Drawings and Specifications on the subject work as though originally included therein. The following amendments, additions, and/or corrections shall govern this work.

General

1) All contractors **MUST BE** prequalified to submit a bid as a Tier-1 contractor on this project. Reach out to Maxwell Construction if you are unsure if you are pre-qualified.

Attachments

a. Extended Schedule.
b. M – Series Drawing that were missing from Addendum 2.
c. Specs 23 09 00 and 23 09 93 that were missing from Addendum 2.

Bid Category Specifications Clarifications and Questions/ Answers

1. BC-1 HVAC/ Plumbing

- **Clarifications**
  - **Clarification:** RTU's 1-16 were intentionally scheduled to receive Addison Units. These 16 units are to be either Addison, AAON, or Valent. Contractor to be responsible for working with manufactures to verify that lead-times can be met for Summer '25 work.
  - **Clarification:** BC-1 HVAC/ Plumbing Contractor to refer to changed gas line sizing per Addendum 2 Sheet EC301. The change was not clouded in Addendum 2, but the gas line that is being relocated was corrected to reflect a 6" gas line rather than a 3" line as shown on the original bid documents. Contractor to be responsible for saw cutting of concrete as required for relocation of line, relocating line, and Teeing off of 6" line with a 3" line to feed the existing boiler room.

- **Questions and Answers**
  - **Q:** There are several mechanical drawings mentioned in addendum 2 and the description says "refer to attached drawing revision" (MD101E, MD101G, MD101I as examples).
    - **A:** Refer to updated drawings that were not included in Addendum 2.
  - **Q:** Is there any controls work to be included at ECMS?
    - **A:** No controls work to be included at ECMS.
  - **Q:** Are full valves to be replaced for VAV's or just actuators?
    - **A:** Controls upgrades for existing VAV's to include new actuators on existing valves.
  - **Q:** What is to be included for Air Balance at ECHS with the units that are being replaced?
    - **A:** T&B required on all new equipment and on all existing VAV's and RTU's.
  - **Q:** Are we cleaning the existing airflow rings in the VAV boxes that aren't being replaced?
    - **A:** Yes, existing airflow rings are to be cleaned in VAV's that are not being replaced.

2. BC-2 General Trades

- **Questions and Answers**
    - **Q:** Who is responsible for Civil Layout and establishing bench marks at each school?
        - **A:** BC-2 General Trades Contractor to be responsible for layout required for concrete paving, sidewalks, and curbs. BC-8 Paving Contractor to provide layout for all asphalt paving.
        - **A:** BC-2 Contractor to provide an elevation benchmark at each school.

3. BC-3 Masonry

- **N/A**

4. BC-4 Flooring and Tilling

- **N/A**

5. BC-5 Framing, Drywall, and ACT

- **N/A**

6. BC-6 Roofing

- **Questions and Answers**
    - **Q:** What is the thickness of poly-iso insulation for the membrane roofs and BES and the ECHS Maintenance Addition?
        - **A:** Contractor to include 2 layers of 2-inch poly-iso (4" total) and tapered insulation as required per drawings.

7. BC-7 Glazing and Storefronts

- **Questions and Answers**
    - **Q:** Who is responsible for make-up mirror per Detail 12 ECHS Sheet A760?
        - **A:** BC-7 Storefronts and Glazing Contractor to be responsible for Make-up Mirror per Detail 12 ECHS Sheet A760.
    - **Q:** The existing storefronts at BES are red. The spec calls for anodized aluminum. Are the new units to be a custom red or are they to be anodized aluminum?
        - **A:** BC-7 Storefront and Glazing Contractor to include Custom Red Storefront Systems rather than anodized aluminum as spec'd.

8. BC-8 Paving and Milling

- **Questions and Answers**
    - **Q:** Who is responsible for the MIRAFI MTK Self Adhering Waterproofing Membrane in the mill and resurface areas at each of the schools?
        - BC-8 Paving to be responsible for the MIRAFI MTK Self Adhering Waterproofing Membrane at each of the schools.
    - **Q:** Years were not populated on the Extended Schedule that was included in Addendum 2. Can an updated schedule be provided?
        - **A:** BC-8 Paving to be responsible for the MIRAFI MTK Self Adhering Waterproofing Membrane at each of the schools.
    - **Q:** Who is responsible for Civil Layout and establishing benchmarks at each school?
        - **A:** BC-2 General Trades Contractor to be responsible for layout required for concrete paving, sidewalks, and curbs. BC-8 Paving Contractor to provide layout for all asphalt paving.
        - **A:** BC-2 Contractor to provide an elevation benchmark at each school.
    -

9. BC-9 Electrical

- **N/A**

10. BC-10 Soccer Turf

- **Clarifications**
    - **Clarification:** Owner would like to retain topsoil on-site that is stripped from the Soccer field. BC-10 Soccer-Turf Contractor to be responsible to strip topsoil, move it to Northside of ECHS North Parking lot, pile it into a berm, track it in/ seal it off, and seed the area.

11. BC-11 Golf Turf

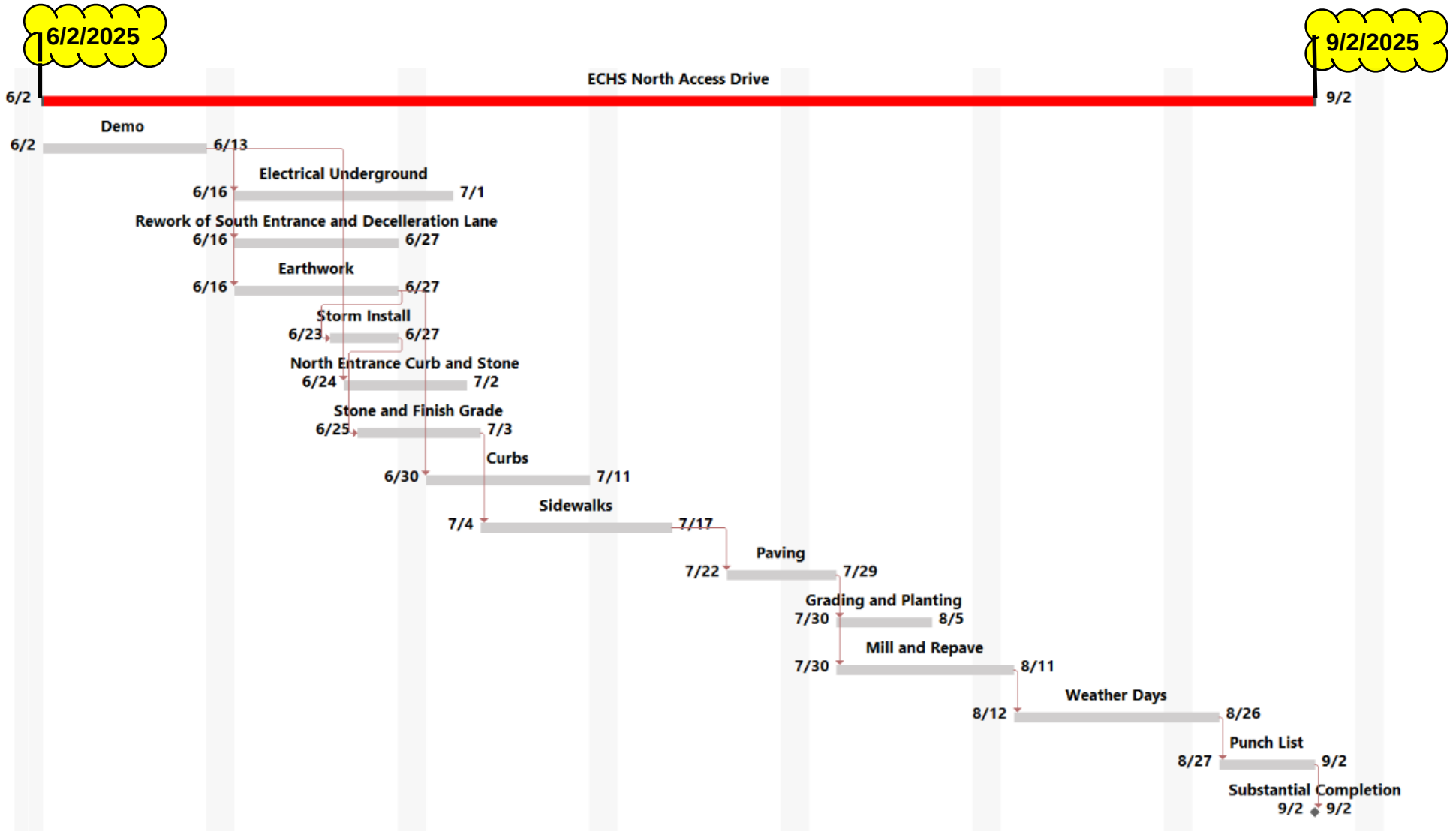
- **N/A**

12. BC-12 Kitchen Appliances

- **N/A**

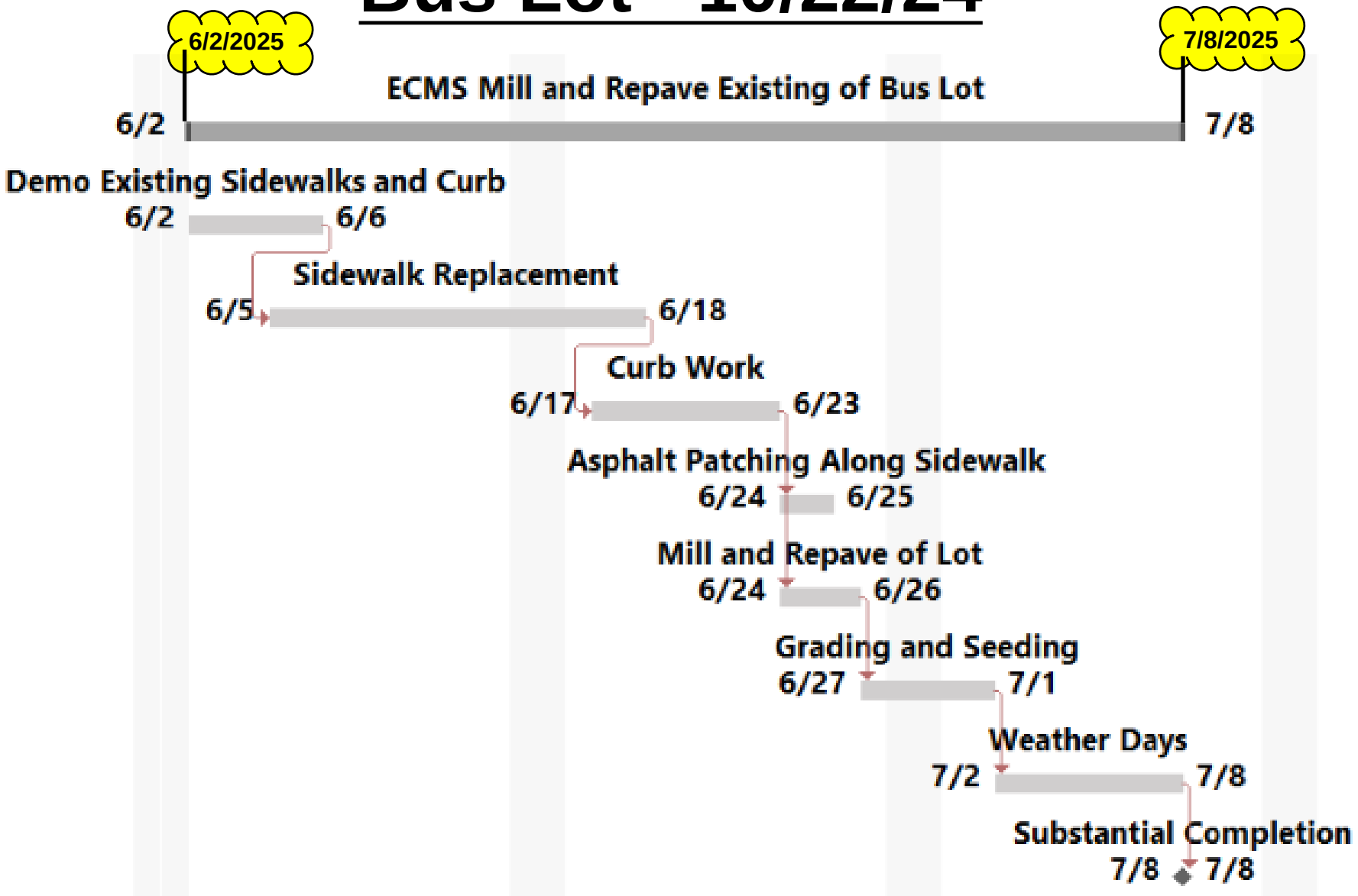
EXTENDED SCHEDULE
10/22/24

ECHS North Access Drive - 10/22/24



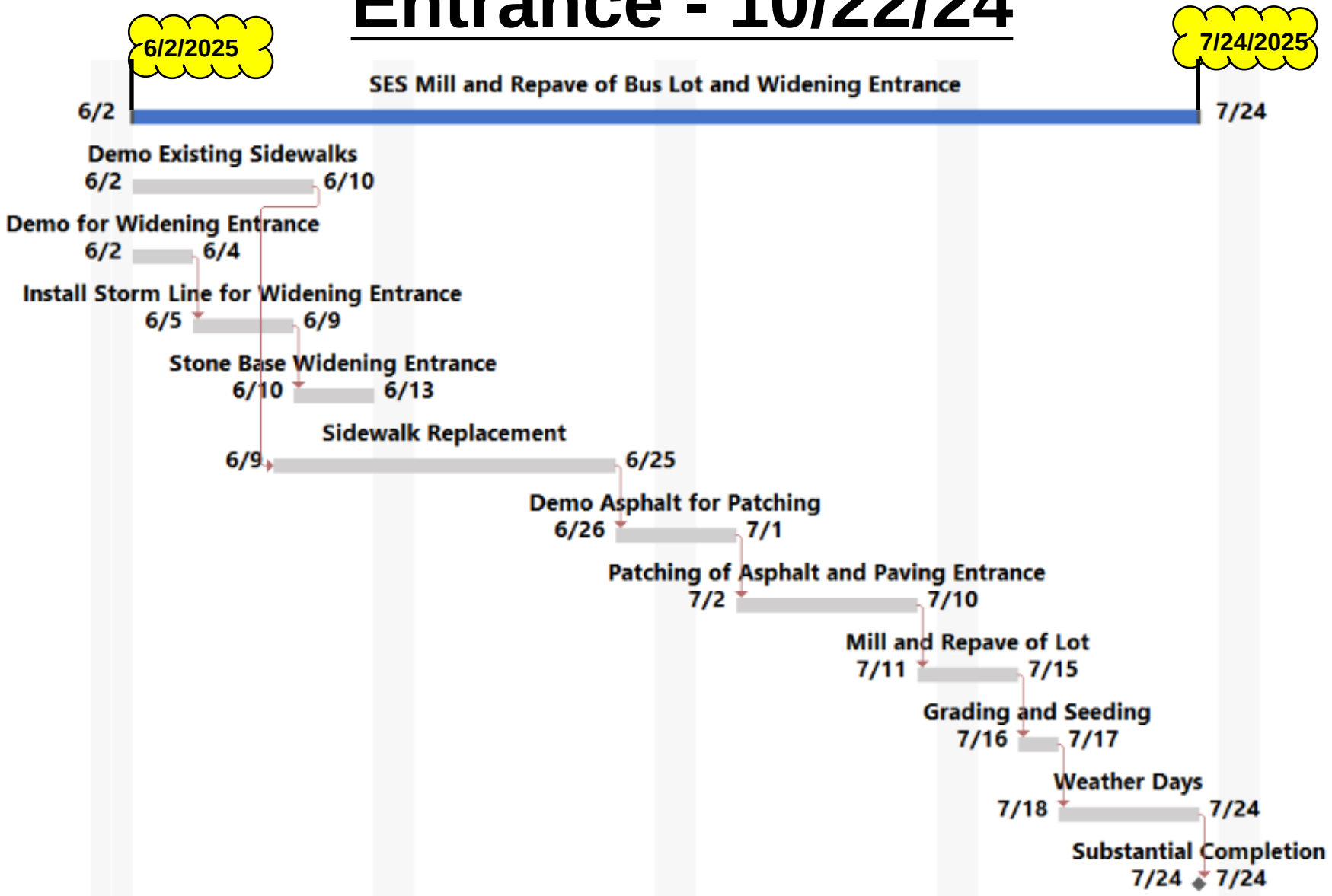
MAXWELL CONSTRUCTION

ECMS Mill & Repave Existing of Bus Lot - 10/22/24



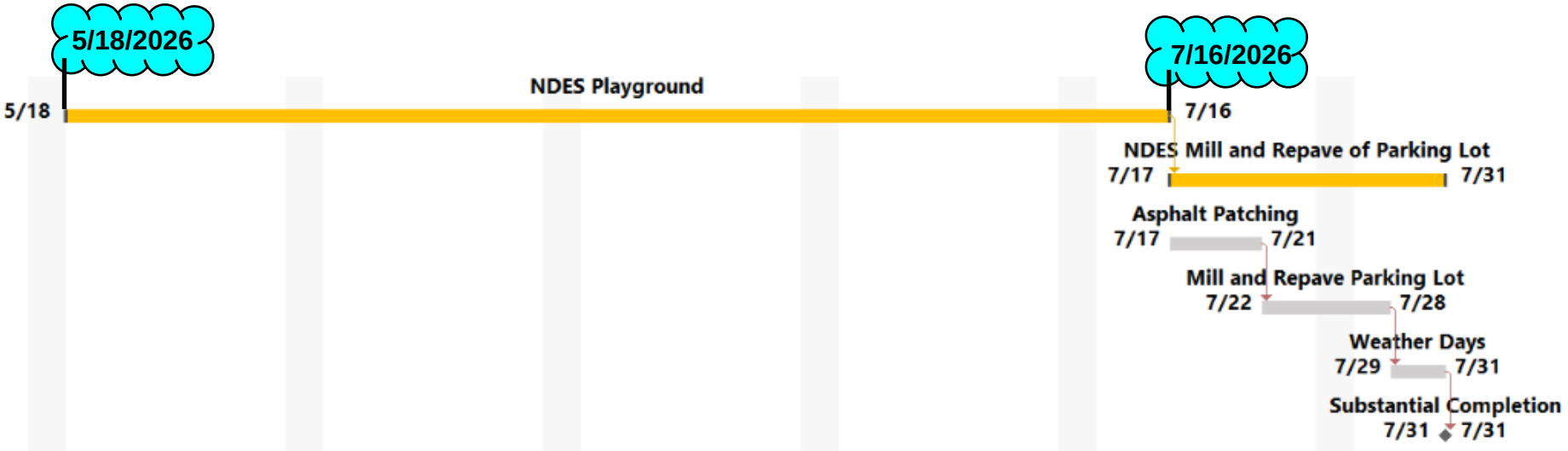
MAXWELL CONSTRUCTION

SES Mill & Repave of Bus Lot & Widening Entrance - 10/22/24



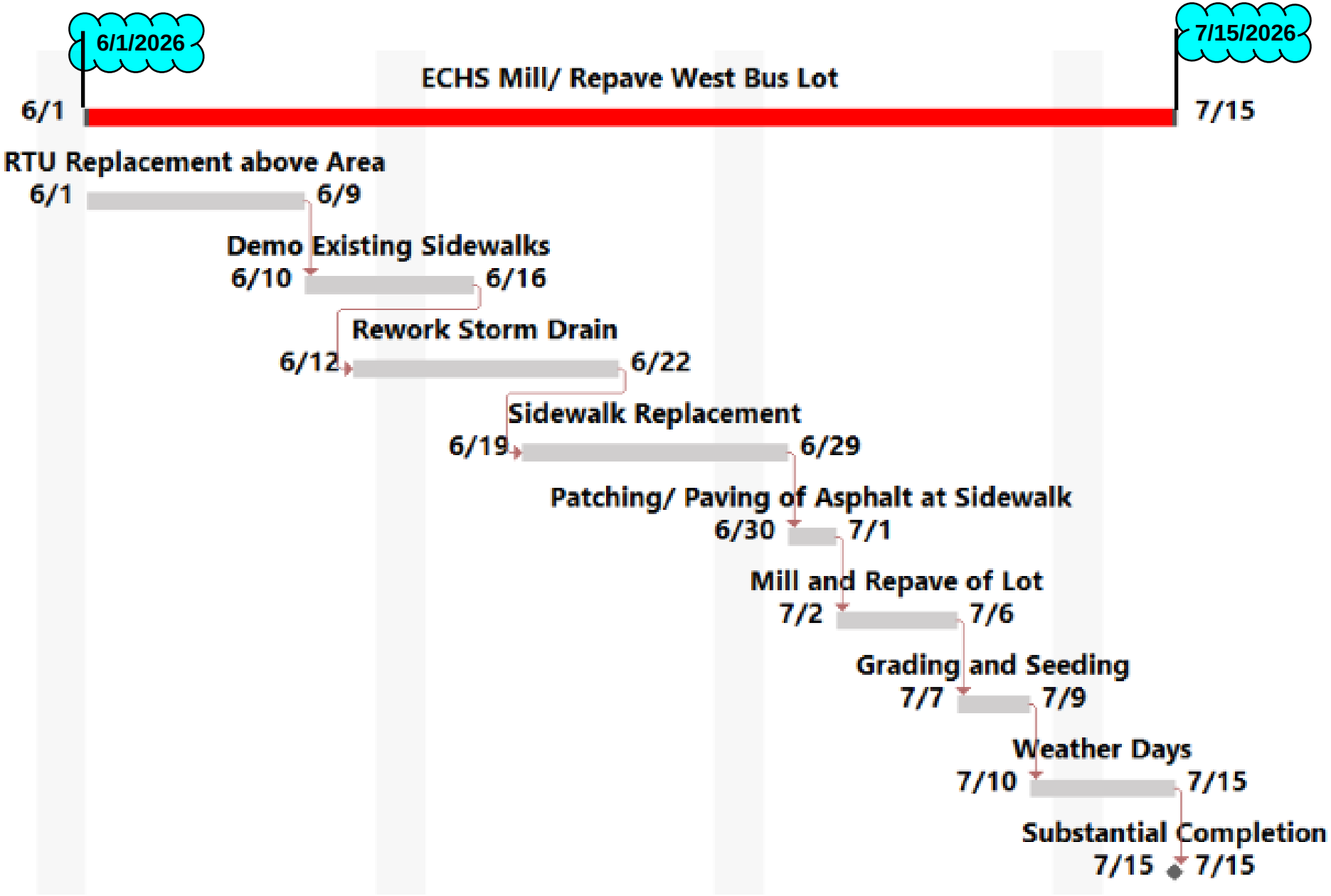
MAXWELL CONSTRUCTION

NDES Playground - 10/22/24



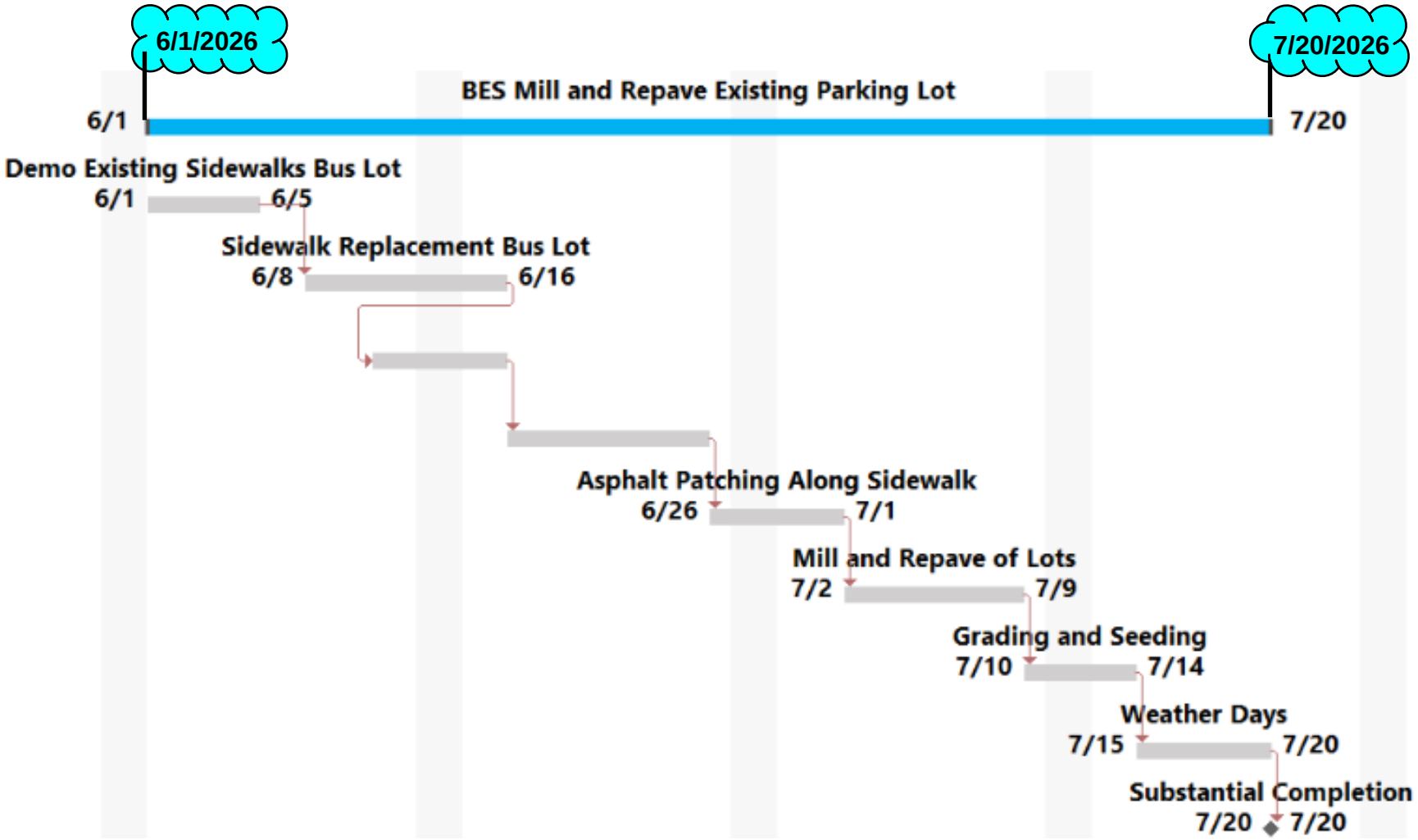
MAXWELL CONSTRUCTION

ECHS Mill / Repave West Bus Lot - 10/22/24



MAXWELL CONSTRUCTION

BES Mill & Repave Existing Parking Lot - 10/22/24



MAXWELL CONSTRUCTION

M-Series Specs Missing from A2
10/22/24

SECTION 23 0900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

B. Related Sections include the following:
1. Division 23 Section "Meters and Gages for HVAC Piping" for measuring equipment that relates to this Section.
2. Division 23 Section "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

1.2 DEFINITIONS

A. AHU: Air handling unit.

B. DDC: Direct digital control.

C. I/O: Input/output.

D. LAN: Local area network for data and communications systems.

E. MS/TP: Master slave/token passing.

F. PC: Personal computer.

G. PID: Proportional plus integral plus derivative.

H. RTD: Resistance temperature detector.

I. VAV: Variable air volume (terminal).

1.3 SYSTEM PERFORMANCE AND DESCRIPTION OF WORK

A. Work Included: It is the intent of this specification such that the building automation system be a complete Direct Digital Control (DDC) system installed as a complete package by a single contractor. This system shall include all computer software and hardware, controllers, sensors, actuators, transmission equipment, wire and cables, workstations, installation, engineering, supervision, commissions, acceptance testing, training, and warranty service.

B. All existing controls in the building (excluding the middle school area in unit Q) shall be removed in their entirety and replaced with new controls. Contractor shall field verify all existing conditions, review current control front end server for equipment counts, etc. as required to identify

C. All low voltage wiring and conduit is the responsibility of this section. 120 volt and higher power wiring between control devices and panels is the responsibility of this section, refer to Division 26 for requirements. Power wiring (120 volt and higher) between slave panels is the responsibility of this contractor.

D. Rough-in of wall boxes for thermostats is the responsibility of this section.

E. The building automation system shall use an 'open protocol' that is non-proprietary for all levels of communication. Acceptable protocol is BACNET and shall be implemented in a manner that allows other system devices from other vendors to communicate with all other devices without limitation and without the use of proprietary gateways. This system shall communicate to third party systems for chillers, boilers, air handlers, fire alarm systems, and access control systems with open and interoperable communications.

F. The building automation system shall utilize it's own CAT6 Ethernet control network that is separate from the Owner's network for communication between network controllers (if required). The Owner's LAN shall be connected via a single point by means of a router provided by this contractor. All network switches, routers, and Ethernet cabling required for the control system shall be included in this scope of work for a fully functional control system in every respect. All Ethernet cable used in this network shall be color coded for identification as prescribed in following sections.

G. The mechanical contractor shall be responsible for all interlock wiring between mechanical equipment and chiller controllers, boiler sequencers, water heaters, and other third party control devices. TCC shall assist with the programming and configuration of these controllers to achieve specified control.

1.4 SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
   1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
   2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
   3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Bill of materials of equipment indicating quantity, manufacturer, and model number.

2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
3. Wiring Diagrams: Power, signal, and control wiring.
4. Details of control panel faces, including controls, instruments, and labeling.
5. Written description of sequence of operation.
6. Schedule of dampers including size, leakage, and flow characteristics.
7. Schedule of valves including flow characteristics.
8. DDC System Hardware:
   a. Wiring diagrams for control units with termination numbers.
   b. Schematic diagrams and floor plans for field sensors and control hardware.
   c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
10. Controlled Systems:
    a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
    b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
    c. Written description of sequence of operation including schematic diagram.
    d. Points list.

C. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135.

D. Software and Firmware Operational Documentation: Include the following:
1. Software operating and upgrade manuals.
2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.
5. Software license required by and installed for DDC workstations and control systems.

E. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.

F. Qualification Data: For Installer and manufacturer.

G. Field quality-control test reports.

H. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
2. Interconnection wiring diagrams with identified and numbered system components and devices.

3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

1.5 PROTECTION OF SOFTWARE RIGHTS

A. Owner shall receive licensed software for all system workstations, portable laptop computers, service tools, and web servers as follows:
1. Enterprise level webservers: (1) licensed installation with the ability for a minimum of 15 simultaneous users.
2. Workstations: (3) licensed installations on desktop and portable laptop computers that include all programming, graphics editing, and service tools. Desktop and portable laptop computers to be furnished by Owner.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project. Installer organization shall submit a list of recent installations that are of similar scope and size with a listing of contact names and phone numbers at these facilities.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Source limitations: obtain control devices of a single type through one source from a single manufacturer.

D. All components and wire installed in return air plenums shall be listed by a recognized listing agency for compliance with smoke and flame spread ratings.

E. Comply with ASHRAE 135 for DDC system components.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

B. System Software: Update to latest version of software at Project completion such that all updates, patches, and new version releases are provided at no additional cost to Owner.

1.8 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.

C. Coordinate equipment with Division 26 Section "Panelboards" to achieve compatibility with starter coils and annunciation devices.

D. Coordinate equipment with Division 26 Section "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Wall thermostat sensors: Provide (5) for every type used.
2. VAV box controller: Provide (2) extra controllers with actuator.

1.10 WARRANTY

A. All control hardware and wiring shall be provided with a full 1-year warranty from the final date of substantial completion on the project. This shall include failure of any sensor, actuator, wiring, or other hardware device on the system with labor and materials covered.

B. For a period of 1 year from the final data of substantial completion, the control contractor shall be required to provide and install all software, firmware, and product enhancement updates that are available, to the Owner at no cost.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CONTROL SYSTEM

A. Manufacturers:
1. Johnson Controls Facility Explorer with Niagara v4 Front End, installed by The Geiler Company, Indianapolis. 800-381-0025.
2. Automated Logic Controls with Niagara v4 Front End, installed by Emcor, Indianapolis. (WebCtrl is not acceptable for the front end.)
3. Johnson Controls Facility Explorer with Niagara v4 Front End, installed by factory authorized branch.

B. The Niagara 4 server shall be an open license that allows multiple control vendors to provide hardware and programming without restriction to the Owner on what vendor works on this system. All licenses shall be in the name of the Owner with no master

passwords that would prevent them from having full control of the control server licensing.

1. The feature name entries shall read as follows:
    a. Station compatibility In = All (Accept.station.in="*")
    b. Station compatibility Out = All (Accept.station.out="*")
    c. Tool compatibility In = All (Accept.wb.in="*")
    d. Tool compatibility Out = All (Accept.wb.out="*")

C. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multi-user, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics. The network shall consist of communication on multiple layers and communication backbones.

1. The top-most communication layer shall consist of an Ethernet network using the TCP/IP BACNET protocol to communicate between workstations, web servers, and building level controllers. Proprietary communications protocols shall not be used at any level and all devices and control point must ultimately be accessible at the top-most level. The building level controllers will then communicate with application specific controllers, sensors, and actuators with either:
    a. A twisted pair network using BACNET MS/TP protocol at a minimum communication speed of 78 Kbps.
    b. An ethernet network using BACNET IP protocol at a minimum communication speed of 10/100 Mbit. Controllers shall utilize dual RJ-45 ports to allow for controllers to daisy chain the communication trunk from one controller to the next. TCC shall be responsible to provide and install all ethernet cabling required for the control network to function.
2. Trend logging abilities shall allow at least 50 different logs to be running simultaneously with a duration of at least 40 hours of data sampled every minute without the need to archive data. Trend logs shall be able to graph/log multiple data points on each trend report with a time and date stamp for each value. At a minimum, the following trends shall be preprogrammed and configured for the system.
    a. Trend outside air temperature and humidity with a data point every hour. Maintain at least 2 months of data active and archive all previous data on a monthly basis. Maximum and minimum values shall be retained for each day of an entire year in a log that is archived.
    b. Trend the temperature of every walk-in food cooler or freezer with data points every 5 minutes and maintain data for at least 3 weeks.
    c. Trend boiler supply and return loop temperatures for one week and archive.
    d. Trend chiller supply and return loop temperature for one week and archive.
    e. Trend the electrical use for the entire building with samples every 5 minutes for an entire day. Take the maximum value from each day and log to a file with time stamp.
    f. <u>All</u> control points shall be configured to trend a minimal amount of data that shall be used in diagnostics. When local memory is filled, all trend data shall be archived to the enterprise server hard drives. All trend data shall be retained for a minimum of 1 calendar year.

3. Alarms shall be configurable such that they may be categorized as “critical”, “attention”, or “informational”. Alarms shall be able to be routed to multiple users by email, onscreen, pager, or alarm printer and shall have ‘time of day’ triggers to determine what alarms are sent out via email/pager/onscreen. Coordinate with Owner for prioritization of alarms and configuration of recipients. At a minimum, the following alarm conditions shall be preprogrammed and configured for the system
4. Failure of any system to start or stop as commanded.
    a. Failure of any device to respond to commands by the BMS.
    b. Failure of any sensor to report a value or if reported value is out of range.
    c. If any space temperature falls below 50 deg F (adjustable).
    d. If any coil freeze-stat trips on low temperature.
    e. If any sump pump/sewage ejector is in a high alarm or general alarm condition.
    f. Failure of any boiler or chiller equipment and associated pumps to operate.
    g. Loss of system pressure on heating or cooling water building loop.
    h. Filter pressure drop exceeds dirty level specified (adjustable).
    i. If temperature of any walk-in cooler/freeze exceeds user specified level.
    j. A loss of utility power or phase loss that exceeds 2 seconds and resumption of utility power.
    k. If any heating or cooling loop exceeds high/low temperature setting or pressure setting.
5. Audit logs shall be kept for all user activities that include, user login, logoff, setpoint change, alarm acknowledgement, override, shutdown, startup, and programming change. This log shall be retained indefinitely on the system.
6. Run time reports shall be maintained for every boiler, chiller, supply fan, return fan, relief fan, exhaust fan, pump, etc. Log all run hours into a cumulative counter that the user can view and reset when desired. User shall be able to create maintenance notifications based on run time for each item for maintenance items such as belt changes, bearing lubrication, seal maintenance, filter maintenance, etc.
7. User security shall be implemented such that every user must provide a username and password to gain access to the control interface. Each user shall have assigned rights and privileges that are assigned based on their role. After a period of inactivity, the user shall automatically be logged off requiring them to re-authenticate with the system.
8. All system and spaces shall be linked to a global room temperature setpoint value that the Owner can change a single value that effectively creates a single temperature setpoint with specified adjustment (+2 deg/-2 deg) that all systems and all spaces use for master control of the facility/campus temperature and energy control.

D. Internet/Web Interface: It is the intent that this control system will provide a single enterprise level web server that is connected to the Owner’s data/communications network that will allow users the ability to view the control system via any computer workstation without the use of any proprietary software such that the only software required is a standard web browser that supports HTML5. Pre-loaded graphics shall not be required to view the system graphics. This web server shall be used to host all buildings under control by this vendor and have the ability to connect all future buildings, as well. This web interface shall provide the following minimum functions.
    1. Login: User shall authenticate with a username and password pair.

2. Graphics: This web interface shall look and feel like the graphical interface available on the workstation.
3. Status: Interface shall allow full view of the status of all equipment, sensors, and data points showing setpoint values, current values, etc.
4. Setpoint override: User shall be able to change setpoint values and start/stop equipment.
5. Scheduling: User shall be able to view existing schedules, edit existing schedules, and create new schedules.
6. Alarms: User shall be able to view alarm status and history.
7. Trends: User shall be able to view existing data trend logs.
8. Trend Archiving: The server shall receive all trend data from the local control panels and archive this data for retrieval via the web interface.
9. Simultaneous Users: The system shall be configured to allow at least (15) simultaneous users.
10. Location of graphics: All graphics for the web interface shall not reside within the operator workstation and shall be accessible if this workstation is offline. Graphics must reside with either a dedicated webserver or within the upper level network controller panels. If a dedicated web server is used, this system must be furnished with a battery back power supply that is capable of providing power for a period of at least 20 minutes on a loss of utility power.

2.3 DDC EQUIPMENT

A. Enterprise Server: Owner's existing Niagara 4 server.
1. Control server environment: Niagara 4 enterprise server with open license to accept control integration from any control vendor without license restriction. Owner shall be the license holder.

B. Application Software:
a. I/O capability from operator station.
b. System security for each operator via software password and access levels.
c. Automatic system diagnostics; monitor system and report failures.
d. Database creation and support.
e. Automatic and manual database save and restore.
f. Dynamic color graphic displays.
g. Custom graphics generation and graphics library of HVAC equipment and symbols.
h. Alarm processing, messages, and reactions.
i. Trend logs retrievable in spreadsheets and database programs.
j. Alarm and event processing.
k. Object and property status and control.
l. Automatic restart of field equipment on restoration of power.
m. Data collection, reports, and logs. Include standard reports for the following:
1) Current values of all objects.
2) Current alarm summary.
3) Disabled objects.
4) Alarm lockout objects.
5) Logs.
n. Custom report development.

o. Utility and weather reports.
p. ASHRAE Guideline 3 report.
q. Workstation application editors for controllers and schedules.
r. Maintenance management.

2. Custom Application Software:
a. English language oriented.
b. Full-screen character editor/programming environment.
c. Allow development of independently executing program modules with debugging/simulation capability.
d. Support conditional statements.
e. Support floating-point arithmetic with mathematic functions.
f. Contains predefined time variables.

C. Local Control Panels: All control units, I/O boards, relays, contactors, switches, transducers, etc. shall be panel mounted in a key lockable NEMA enclosure suitable for the environment. Each panel shall have a 120-volt duplex convenience outlet in the panel. All panels shall have a color-coded wiring schematic of the panel on the inner surface of the hinged door that is accurate to the as-built condition with all wired and terminations identified. All wiring shall be routed with wiring trays in a neat and orderly fashion in accordance with NEMA and UL standards, and shall meet all local electrical codes.

D. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
a. Global communications.
b. Discrete/digital, analog, and pulse I/O.
c. Monitoring, controlling, or addressing data points.
d. Software applications, scheduling, and alarm processing.
e. Testing and developing control algorithms without disrupting field hardware and controlled environment.
3. Standard Application Programs:
a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, anti-short cycling, PID control, DDC with fine tuning, and trend logging.
b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
c. Chiller Control Programs: Control function of condenser-water reset, chilled-water reset, and equipment sequencing.
d. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
e. Remote communications.
f. Maintenance management.
g. Units of Measure: Inch-pound and SI (metric).

4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
5. All controllers that communicate via Ethernet or fiber cables on a TCP/IP network shall support network addressing for both IPv4 and IPv6.

E. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
   a. Global communications.
   b. Discrete/digital, analog, and pulse I/O.
   c. Monitoring, controlling, or addressing data points.
3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.

F. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
1. Binary Inputs: Allow monitoring of on-off signals without external power.
2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights.
5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) with status lights.
6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
7. Universal I/Os: Provide software selectable binary or analog outputs.

G. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
1. Output ripple of 5.0 mV maximum peak to peak.
2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

H. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
1. Minimum dielectric strength of 1000 V.
2. Maximum response time of 10 nanoseconds.
3. Minimum transverse-mode noise attenuation of 65 dB.
4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

2.4 WORKSTATION GRAPHIC STANDARDS

A. Navigation:
1. The operator interface shall have “home page” that is displayed automatically when the system is launched. This page shall contain a master navigation pane that is replicated on every subsequent screen. This navigation pane shall allow the user to jump to any building, floor, air handler, heating plant, or chilled water plant with a navigation tree structure. The user shall have a “back” button allowing return to the previous screen and a “home” button allowing return to the “home page”.
2. The “home page” shall contain a full color graphic of the finished facility and shall display the current outside air conditions, a link to an external weather service, such as weather.com shall also be on this page if a constant connection to the “internet” is active, an alarm status window showing all alarms that have not been previously acknowledged, and a list of maintenance notifications.
3. The graphical interface shall be configured with a second user profile that is specific to mobile devices such as smartphones or tablet computers that utilize a touch screen and do not use a mouse. The nature of this interface profile shall allow the user to interact with the graphic interface without the need for Adobe Flash or Java plug-ins. The graphics shall be designed to be navigated with using touch functions with text links/graphic links of appropriate size that is easily selected by a human finger without errors in navigation due to small icon size. Use of “right-click” mouse functions for any part of the navigation shall not be used. TCC shall review Owner’s mobile device platform (iOS/Android/Windows) prior to graphic creation and test the graphic navigation using selected mobile platform to verify use and function. The following minimum functions shall be displayed in this mobile user profile;
    a. Status values display of each system listing all sensor values, command values, and setpoints.
    b. Setpoint adjustment via either a scroll wheel icon, up/down icon, or direct text entry.
    c. Alarm console listing all alarms in plain text with the ability to acknowledge alarms.
    d. Scheduling allowing the activation of global schedules such as holidays, snow days, weather delay, night purge enable, etc.

B. Graphics:
1. Each graphic depiction of a system shall be comprised of full color photo-realistic images that are animated to indicate operational status. The graphics shall accurately represent the configuration of the system being controlled. All data points (inputs, outputs, set points, etc.) associated with the system shall be shown graphically on the system graphics with the correct units of measure, such as “% Open”, “CFM”, “GPM” and not applied voltages to the actuator. Adjustable set points shall have either a text entry box, scroll bar, or drop-down menu to allow values to be changed.
2. Graphic screen shall be able to display real-time values, animation, color spectrums, logs, graphs, HTML and XML links, schedules, and hyperlinks to other files and locations. It is encouraged to use graphics that are free from use of external browser plug-ins and utilize HTML5 encoding to allow for universal access on platforms that include PC’s, Mac, iPad, Android, etc.

3. Floor Plan Temperature Graphic: Each floor of the facility shall have a graphic screen that shows the actual building floor plan with all zone temperatures shown in text and represented with a dynamic color shade relating to the room temperature. Rooms that are within the deadband range shall be shown with a neutral color. Rooms that are below set point shall have a blue hue of increasing intensity as the room temperature drops farther below set point. Similarly, rooms that are warmer than set point shall be shown with a red hue with increasing intensity. Each zone shall identify the equipment that it is served by. When a user clicks on a specific zone, they shall be directed to a graphic screen showing the specific equipment serving this space (VAV box, unit ventilator, fan coil, finned tube radiation, etc.) At this screen, the user shall have the ability to see the status and values of every data point for that piece of equipment. The floor plan graphics shall show the actual locations of all equipment in the facility that is controlled or monitored by the system. The plan shall also show the physical boundaries of each air handler zone if more than one space is served by it.
4. Boiler plant/chiller plant graphic: A graphic screen shall be created that accurately depicts the piping configuration, location and quantity of all equipment and control devices associated with each system. This graphic shall display all data points, setpoints, over-rides, enable/disable, alarm resets, and status point contained within the BMS. Verify exact configuration of piping and equipment before generating graphics.
5. Equipment/system graphics: Every air handler, pump, VAV terminal, unit ventilator, fan, etc. shall have a graphics screen that shows every data point contained within the BMS. This graphic shall have links that allow the user to jump to a screen associated with any system that is fed from or feeds this system. (Ex. An air handler graphic shall allow the user to jump directly to any VAV connected to this system, the hot water boiler plant, chilled water plant, or any interlocked fans, etc. Additionally, a VAV terminal graphic shall allow the user to jump to the air handler graphic that serves this device and the boiler plant supplying hot water to the reheat coil.)
6. The graphics screens shall also contain links to all product information sheets of the devices installed such as actuators, valves, sensors, controllers, etc. These documents shall be stored and displayed in a standard form such as Adobe PDF files with appropriate viewer software installed.
7. The user shall be able to jump from a specific system graphic screen to the as-built wiring schematics for that system. These files shall be stored in a standard form such as Adobe PDF files. A text narrative of the sequence of operations shall also be linked to each system that the user shall be able to view on demand.
8. Prior to creating any graphics, the temperature control contractor shall meet with the Owner to view examples of graphics for other projects and determine any additional graphical requirements of the Owner. Before final acceptance of graphics, TCC shall schedule a meeting with the Project Engineer to review all graphics for completeness.

C. Control Functions:
1. The Home Page for the campus and each individual building shall contain graphic buttons that enable the user to perform the following actions with a single user operation. Each of these functions shall be available on a campus level and building level.

a. Outside Air Shutdown - Close all outside air dampers, air inlets, and shut down all exhaust fans. Systems shall revert to 100% return air and continue to operate per sequence.
b. Mechanical System Shutdown - Shutdown all mechanical air supply and exhaust systems.
c. Building Purge - Initiate a full building ventilation sequence with all systems running in maximum economizer mode and all exhaust systems on. (Minimum mixed air temperatures shall be still be met to protect water coils from freeze.)
d. Resume Normal operation – Initiates a command to all equipment to return to normal mode with automatic control.
e. Emergency Power Mode – While under generator power with a loss of utility feed, the BMS shall prioritize control functions and fail safe with sequences to ensure continuity of operations. This mode is explained in the sequence of operations but shall be able to be enabled/disabled/tested via the graphic interface.

2.5 UNITARY CONTROLLERS

A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
1. Configuration: Diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72 -hour battery backup.
2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
3. Enclosure: Dustproof rated for operation at 32 to 120 deg F.

2.6 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

B. Thermistor Temperature Sensors and Transmitters:
1. Accuracy: Plus or minus 0.5 deg F at calibration point.
2. Wire: Twisted, shielded-pair cable.
3. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
4. Averaging Elements in Ducts: 72 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft..
5. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
6. Room Sensor Cover Construction: Manufacturer's standard locking covers.
a. Set-Point Adjustment: Concealed.
b. Display current space temperature: Digital LCD readout with large visibility display.
7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.

8. Room Security Sensors: Stainless-steel cover plate with thermistor on back side with insulated back and Torx-Plus security screws.
    a. Plate shall have either an engraved or screen-printed logo to indicate that this is a control device and not a blank cover plate.

C. Thermobuffer Temperature Sensors:
1. Use: Food coolers and freezers.
2. Description: Propylene glycol filled stainless steel chamber with immersion temperature sensor used to prevent false temperature alarms when the doors to the cooler/freezer are opened.
3. Accuracy: Plus or minus 0.5 F at calibration point.
4. Probe length: 4 inches.
5. Installation: Mount inside freezer/cooler enclosure high on wall near door. Seal penetration in accordance with enclosure manufacturer requirements. Seal inside of conduit at wall penetration with a sealant to prevent migration of moisture into the control enclosure.

D. Humidity Sensors: Bulk polymer sensor element.
1. Accuracy: 2 percent full range with linear output.
2. Room Sensor Range: 20 to 80 percent relative humidity.
3. Room Sensor Cover Construction: Manufacturer's standard locking covers.
4. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
5. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of minus 40 to plus 170 deg F.
6. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.

E. Pressure Transmitters/Transducers:
1. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
    a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
    b. Output: 4 to 20 mA.
    c. Building Static-Pressure Range: 0- to 0.25-inch wg.
    d. Duct Static-Pressure Range: 0- to 5-inch wg.
2. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.
3. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.
4. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
5. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.

2.7 STATUS SENSORS

A. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.

B. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.

C. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.

D. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

E. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

2.8 POWER MONITOR PANEL

A. Energy meter with high resolution backlit LCD display and remote monitoring of electrical service.
   1. Manufacturers;
      a. Veris Industries; H81xx series.
   2. Provide with CT sensor for each phase and wire to 3-pole breaker to measure voltage of each phase. Coordinate with electrical service entry for voltage and amp rating of the MDP.
   3. Supply with in-line fuses on each phase leg to protect the meter.
   4. Integration card: Supply with communication card to integrate into BMS and supply the following values;
      a. Voltage of each phase
      b. Current of each phase
      c. Power Factor
      d. kWh consumption
      e. kW real power
      f. Average current
   5. Mounting: Install and wire on main distribution panel board entry of the electrical system. Do not wire into downstream panels. Coordinate with electrical contractor for installation and size/quantity of secondary feeders.
   6. Verification: Validate installation and readings using an independent device and compare output with utility bill to verify proper configuration.

2.9 THERMOSTATS

A. Low-Voltage, Programable Thermostat Sensor: Network communicating, digital temperature sensor, with setpoint adjustment and manual over-ride button.
   1. Temperature sensor: Digital sensor 50 – 104 deg F, accuracy of +/- 0.5 deg F.
      a. With push button schedule over-ride button.
   2. Digital display: Display the current space temperature only.

B. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.
   1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.
   2. Selector Switch: Integral, manual on-off-auto.

C. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point. Sensor shall not be hardwired to the supply fan. Wire into the control system as a software point.
   1. Bulb Length: Minimum 20 feet.
   2. Quantity: One lineal foot of capillary element for every one square foot of coil surface area. Support element every 36” with intermediate supports as needed on the coil face.

2.10 ACTUATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
   1. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
   2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
   3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
   4. Spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
   5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
   6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.

B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
   1. Manufacturers:
      a. Belimo Aircontrols (USA), Inc.
      b. Johnson Controls.
   2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
   3. Dampers: Size for running torque required by damper manufacturer:
      a. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
      b. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.
   4. Coupling: V-bolt and V-shaped, toothed cradle.
   5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.

6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
7. Power Requirements (Two-Position Spring Return): 24 -V ac.
8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
10. Temperature Rating: Minus 22 to plus 122 deg F.
11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F.

2.11 CONTROL VALVES

A. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
1. Control valve shutoff classifications shall be FCI 70-2, Class IV or better unless otherwise indicated.
2. Valve pattern, three-way or straight through, shall be as indicated on Drawings.
3. Modulating straight-through pattern control valves shall have equal percentage flow-throttling characteristics unless otherwise indicated.
4. Modulating three-way pattern water valves shall have linear flow-throttling characteristics. The total flow through the valve shall remain constant regardless of the valve's position.
5. Modulating butterfly valves shall have linear flow-throttling characteristics.
6. Fail positions unless otherwise indicated:
   a. Chilled Water: Last position.
   b. Heating Hot Water: Open.
   c. Steam: Open.
7. Globe-type control valves shall pass the design flow required with not more than 95 percent of stem lift unless otherwise indicated.
8. Rotary-type control valves, such as ball and butterfly valves, shall have Cv falling between 65 and 75 degrees of valve full open position and minimum valve Cv between 15 and 25 percent of open position.
9. Selection shall consider viscosity, flashing, and cavitation corrections.
10. Valves shall have stable operation throughout full range of operation, from design to minimum Cv.
11. Minimum Cv shall be calculated at 10 percent of design flow, with a coincident pressure differential equal to the system design pump head.
12. In water systems, select modulating control valves at terminal equipment for a design Cv based on a pressure drop of 5 psig at design flow unless otherwise indicated.
13. Two-position control valves shall be line size unless otherwise indicated.
14. In water systems, use ball- or globe-style control valves for two-position control for valves NPS 2 and smaller and butterfly style for valves larger than NPS 2.

B. Hydronic system globe valves shall have the following characteristics:
1. NPS 2 and Smaller: Class 250 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with back-seating capacity re-packable under pressure.
2. NPS 2-1/2 and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.

3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.
   a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
   b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.
4. Sizing: 5-psig maximum pressure drop at design flow rate or the following:
   a. Two Position: Line size.
   b. Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.
   c. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.
5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.

C. Butterfly Valves: 200-psig, 150-psig maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
1. Body Style: Wafer, Lug, or Grooved.
2. Disc Type: Elastomer-coated ductile iron or Epoxy-coated ductile iron.
3. Sizing: 1-psig maximum pressure drop at design flow rate.

D. Terminal Unit Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.
1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
2. Sizing: 3-psig maximum pressure drop at design flow rate, to close against pump shutoff head.
3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

2.12 DAMPERS

A. General Requirements:
1. Unless otherwise indicated, use parallel blade configuration for two-position control, equipment isolation service, and when mixing two airstreams. For other applications, use opposed blade configuration.
2. Factory assemble multiple damper sections to provide a single damper assembly of size required by the application.
3. Utilize flanged dampers that join to adjacent ductwork, do not use dampers that sit inside the duct to maximize the free area of the duct. Verify free area of the damper matches that of the ductwork.

B. Manufacturers:
1. Greenheck; VCD-34 and ICD-44 series.
2. Ruskin Manufacturing; CD504 and TED-50 series.
3. TAMCO: Series 1500 and Series 9000.

C. Standard Control Dampers: AMCA-rated, parallel and opposed-blade design; 0.080 inch thick extruded aluminum damper frame and 4 inches deep with extruded aluminum blades and end caps on each blade end.
   1. Secure blades to a heavy-duty zinc-plated steel and aluminum drive linkage within the frame housing, out of the air-stream.
   2. Operating Temperature Range: From minus 40 to plus 200 deg F.
   3. Ultra Low Leakage Blade and Edge Seals, Standard Pressure Applications: Extruded silicone secured in an integral slot within the aluminum extrusions
   4. Leakage Rate: No more than 3 cfm/sq.ft. at 1” w.c for a 48”x48”.
   5. Blade and Jamb Seals: Extruded silicone fixed in a channel within the aluminum extrusion and shall be remain flexible at minus 40 deg F or a flexible metal compression jamb seal.
   6. Application: Use in locations with tempered air streams that are not subject to freeze conditions such as return air and supply air.

D. Cold Environment Insulated Control Dampers: AMCA-rated parallel and opposed blade design; 0.080-inch-thick extruded aluminum or 16 ga. Galvanized frame, 4 inches deep.
   1. Secure blades a heavy-duty zinc-plated steel and aluminum drive linkage within the frame housing, out of the airstream.
   2. Insulated Blades: Extruded aluminum profile or formed galvanized blade insulated with eith3er expanded foam or fiberglass fill.
   3. Operating Temperature Range: From minus 40 to plus 200 deg F.
   4. Leakage Rate: No more than 3 cfm/sq.ft. at 1” w.c. at per AMCA 500-D Standard.
   5. Blade and Jamb Seals: Extruded silicone fixed in a channel within the aluminum extrusion. Seals shall remain flexible at minus 40 deg F.
   6. Application: Use for all dampers that are directly exposed to outside air conditions such as intake dampers, relief dampers, exhaust dampers, etc.

E. Selection Criteria:
   1. Fail positions, unless otherwise indicated:
      a. Supply Air: Open.
      b. Return Air: Open.
      c. Outdoor Air: Close.
      d. Exhaust Air: Close.
   2. Dampers shall have stable operation throughout full range of operation, from design to minimum airflow over varying pressures and temperatures encountered.
   3. Select modulating dampers for a pressure drop of 2 percent of fan total static pressure unless otherwise indicated.
   4. Two-position dampers shall be full size of duct or equipment connection unless otherwise indicated.

F. Use jackshafts and shaft couplings in lieu of blade-to-blade linkages when driving axially aligned damper sections.

2.13 REFRIGERANT MONITORING PANELS

A. Non-dispersive infrared (NDIR) refrigerant leak detection system that consists of a factory tested, calibrated, and certified panel to continuously measure and display the

specific gas concentration, with alarming, equipment shut-down, and ventilation control. Comply with ASHRAE 15 requirements.

1. Acceptable manufacturers:
   a. Chillgard Refrigerant Monitors.
   b. Genesis International.
   c. Toxalert.
2. Refrigerant to be monitored: Verify with chiller manufacturer.
3. Range: 0 to 1000 ppm.
4. Minimum detectability: 10 ppm.
5. Accuracy: Maximum 10% of full scale.
6. Repeatability: Maximum +/- 2% of full scale.
7. Response: Maximum 150 seconds for 90% full scale, and 20 second step change.
8. Number of sensor points: One.
9. Visual alarm: Multi-color strobe lights inside equipment room and red strobe light above door outside room with “Refrigerant Detection” printed on the housing.
10. Audible alarm: Minimum 75 dB at 10 feet, located inside equipment room.
11. Silence button: Shut down audible alarm, maintain visual alarm until condition reset.
12. Alarm sequence:
    a. Detection Level 1 (20 ppm) – Generate critical alarm to BMS and energize ventilation system to allow building staff to occupancy for detection and identification of the leak. Cycle blue strobe lights in the equipment room.
    b. Detection Level 2 (50 ppm) – Generate critical alarm to BMS and energize ventilation system. Cycle yellow strobe lights in equipment room.
    c. Detection Level 3 (250 ppm) – Generate critical alarm to BMS and energize ventilation system. Cycle red strobe lights inside and outside room with alarm horns. Shut down all refrigeration equipment and any combustion process in the equipment room that is not a sealed combustion burner. This shall require a manual reset.
13. Provide a warning sign on the outside of the room near the A/V alarm with red background and white lettering at least ½” tall that reads, “AUDIBLE AND VISUAL ALARM SOUNDING INDICATES REFRIGERANT DETECTION”

2.14 CONTROL CABLE AND WIRING

A. All Ethernet cable installed as part of the top level communications bus shall be CAT6 cable with terminations that comply with the CAT6 specification and able to communicate at 1 GB speeds.

B. All control cables located in mechanical rooms and areas subject to physical damage shall contained in conduit. All conduit used for control cables shall be EMT with a continuous green dyed exterior equal to “Allied TRU COLOR EMT”.

C. **ALL** cable and wires used for building automation and control network shall have a jacket color of **BLUE** for easy identification of this system.

D. All control cables in plenums shall be supported from structure every 4 feet by use of J-hooks and bridle rings. Do not support from any duct, pipe, conduit, light fixture, ceiling grid or tie wires. Cable shall be routed in a neat and orderly fashion parallel and perpendicular to building walls. Do not route control cables in trays with data and voice

cables. All cable and wiring in plenums shall be plenum rated in accordance with UL smoke and flame test requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that conditioned power supply is available to control units and operator workstation.

B. Verify that pneumatic piping and duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

3.2 PROJECT MANAGEMENT

A. Designate a single project manager who shall as part of his duties be responsible for the following activities;
   1. Coordinate between this contractor and all other trades, design engineer, and local authorities.
   2. Schedule manpower, material delivery, and equipment installation in a manner that maintains the overall workflow of the project schedule.
   3. Maintain as-built documentation and field installation details.
   4. Be present and assist with performance testing and commissioning activities.

3.3 INSTALLATION

A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.

B. Connect and configure equipment and software to achieve sequence of operation specified.

C. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 46 inches above the floor to the center of the device in accordance with ADA accessibility guidelines.
   1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

A. Install guards on thermostats in the following locations:
   1. Gymnasiums.
   2. Where indicated.

B. Install stainless steel thermistor plate sensors in the following locations:
   1. Entrances/vestibules.
   2. Public areas such as café, gym, auditorium, hallways, restrooms, etc.

C. Install automatic dampers according to Division 23 Section "Air Duct Accessories."

D. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

E. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."

F. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."

G. Install electronic and fiber-optic cables with hangers as specified.

3.4 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."

B. Install signal and communication cable.
1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
2. Bundle and harness multi-conductor instrument cable in place of single cables where several cables follow a common path.
3. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
4. Code conductors for future identification and service of control system. Numbering shall be on both ends of the cable such that the code at the device end shall designate what control panel it is connected to and the code at the panel end shall designate what sensor it is connected to.
5. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

C. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

D. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:
1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.
3. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
4. Test each point through its full operating range to verify that safety and operating control set points are as required.
5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
6. Test each system for compliance with sequence of operation.

7. Test software and hardware interlocks.
8. Simulate all sequence of control actions such that all modes are tested and verified to be working correctly. Test every alarm condition to verify that alarm is generated and correct control response takes place.

C. DDC Verification:
1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check temperature instruments and material and length of sensing elements.
5. Check control valves. Verify that they are in correct direction.
6. Check DDC system as follows:
   a. Verify that DDC controller power supply is from emergency power supply, if applicable.
   b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
   c. Verify that spare I/O capacity has been provided.
   d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.6 ADJUSTING

A. Calibrating and Adjusting:
1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:
   a. Check analog inputs at 0, 50, and 100 percent of span.
   b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
   c. Check digital inputs using jumper wire.
   d. Check digital outputs using ohmmeter to test for contact making or breaking.
   e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
5. Flow:
   a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
   b. Manually operate flow switches to verify that they make or break contact.
6. Pressure:
   a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
   b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
7. Temperature:

a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
b. Calibrate temperature switches to make or break contacts.

8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
10. Provide diagnostic and test instruments for calibration and adjustment of system.
11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature and humidity set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

3.7 CLOSEOUT DOCUMENTATION

A. As-Built Documents: After successful acceptance demonstration of the control system, the contractor shall submit as-built drawings of the completed project for final approval by the project design engineer. Upon receiving approval, supply six (6) complete as-built drawing sets to the Owner with one copy of as-built drawings on USB removable media drive in an AutoCAD format. Color coded as-built wiring schematics shall also be inserted in each control panel enclosure on the back of each door.

B. Software media: The control contractor shall supply to the Owner (1) physical copy of all software required to view, modify, edit, diagnose, and create new control graphics, programming algorithms, graphic libraries, schedules, trends, etc. This software shall include every possible tool needed to maintain the control system without need for any outside tools. The most current version of these tools shall be provided and for the duration of the warranty period if new versions are created, these shall be supplied to the Owner at no additional cost. The Owner shall be permitted to install these software tools on their Own computer hardware with a minimum of (5) separate seats.

C. Operation and Maintenance Manuals: Submit one (1) copy to the project design engineer for approval. Upon approval, submit three (3) copies to Owner. Manuals shall have a cover and binding, such as a 3-ring binder and contain the following items.
1. Manufacturer’s catalog data and specifications on all sensors, transmitters, controllers, control valves, dampers, actuators, gauges, indicators, terminals, and any other components used. Indicate the exact models and options used.
2. An operators manual that includes detailed instructions for all operations of the system such as creating new schedules, user accounts, trend logs, alarm events and how to adjust setpoints, respond to alarms.
3. An operators reference table that lists all addresses and connected points with normal set values.
4. A printed narrative of all control sequences.

5. A troubleshooting guide for diagnosing problems with the control system.
6. A backup copy of the workstation software installation custom programming database on USB removable media drive for use in reloading software in the event of workstation failure.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 Section "Demonstration and Training."

B. Provide a minimum of 20 hours of onsite training to Owner's staff such that 50% of the hours occurs upon project completion and the remaining hours shall occur at a point 3 months after completion and 12 months after completion. This training shall include the following, as a minimum:
   1. Overview of system architecture and location of each control panel.
   2. Review of each panel and what it's function is and what equipment is served.
   3. Review of basic wiring methods for each type of control device, should a device need to be replaced.
   4. Review of the graphical workstation functions with demonstrations on how to:
      a. Navigate the graphic system.
      b. View and acknowledge alarms.
      c. Configure new alarms.
      d. View and export trend logs.
      e. Configure new trend logs.
      f. Add new users and configure security privileges.
      g. View the control logic and make revisions.
      h. Upload new firmware and programs to logic controllers.
      i. Backup and restore control system software to all devices, workstations, and servers.
      j. Generate maintenance reports for items requiring routine service (Ex. Motor lubrication based on run hours, filter changes based on filter pressure drops, etc.) and how to configure them to automatically print when service is required.

END OF SECTION 23 0900

SECTION 23 0993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes control sequences for HVAC systems, subsystems, and equipment.

B. Related Sections include the following:
1. Division 23 Section "Instrumentation and Control for HVAC" for control equipment and devices and for submittal requirements.

1.2 DEFINITIONS

A. DDC: Direct digital control.

B. VAV: Variable air volume.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 ALARMS

A. Generate an alarm at the PC workstation when any space temperature is <50 def F for 15 minutes (adjustable) and an immediate alarm when any space temperature is <40 deg F (adjustable).

B. Coordinate with the owner to identify alarms as "general" or " critical". General alarms will only be displayed at the PC workstation. Critical alarms will be displayed at the PC workstation and dialed-out to pre-programmed telephone numbers through the internal PC modem.

3.2 MONITORING SEQUENCES

A. Monitor temperature(s) of walk in food freezer and cooler with thermobuffer style sensor and trend this data for a period of two weeks (adjustable) and a sample rate of one reading every 5 minutes (adjustable). Generate an alarm at the PC workstation if the temperature rises above user defined set point.

B. Monitor status of electrical generator transfer switch. On a loss of utility supplied power, generate an alarm at the PC workstation stating, “LOSS OF UTILITY POWER”.

C. Monitor status of electrical power and each phase by adding power monitor on panelboard located in boiler room. Provide 3-pole breaker as needed. On loss of any electrical phase, all 3-phase equipment (Pumps, RTU’s, Air Handlers, Chillers, etc.) shall be immediately shut down. Upon restoration of lost phase, all 3-phase equipment shall return to normal operation with the use of a ‘return to normal’ sequence to stage equipment on in order such that prerequisite systems are started in order. (Ex. Boiler and chiller plants shall be started before air handlers.)

D. Monitor each boiler room containing gas fired boilers or water heaters with a carbon monoxide sensor and trend for a minimum of 48 hours. Provide an audio/visual alarm with a minimum of 85 dB sound level. Provide signage near the alarm reading “Carbon Monoxide Alarm”.
   1. On alarm exceeding 200 ppm, all gas fired equipment shall be shut down.
   2. A local alarm inside the room shall activate with the following levels:
      a. 9 ppm or greater for a duration of 8 hours.
      b. 40 ppm or greater for a duration of 5 hours.
      c. 70 ppm or greater for a duration of 1 hour.
      d. 200 ppm or greater for a duration of 15 minutes.

E. Monitor temperature of domestic hot water downstream of thermostatic mixing valve and generate an alarm if the temperature rises 5 degrees (adjustable) above specified set point.

F. Monitor temperature in each computer rack MDF/IDF room (5 total) and display on control graphic screen. Generate alarm if any space temperature is above Owner specified value of 75 deg F (adj).

3.3 HVAC ZONE CONTROL SEQUENCES

A. Provide software time clock and set-up schedule to place each HVAC system into occupied or unoccupied mode. Provide an override push button on each space temperature sensor to place the respective zone air handler into the occupied mode for a two-hour period (adjustable) when button is pushed. When the button is pushed again prior to the override time expiring, the zone air handler will revert to the scheduled operating mode.

B. Where carbon dioxide (CO2) sensors are present, the BMS shall monitor the space or return duct CO2 concentration and reset the outside air damper to increase ventilation rates to prevent high levels of CO2 in a space.
   1. If CO2 is above 900 ppm for a period of at least 5 minutes and the space in an occupied mode, increase OA damper position 5% every 5 minutes until the space CO2 decreases below 700 ppm, the resume normal OA setpoint.
   2. Maximum outside air damper position shall be determined if supply air temperature setpoint can not be maintained with 100% heating or cooling, depending on mode. Do not sacrifice supply air temperature upper and lower limits during CO2 reset mode.

C. If space has occupancy sensors present, BMS shall integrate them into controls for stand-by mode. TCC shall connect to auxiliary contacts on the sensor where possible, or provide a relay powered by the lighting circuit downstream of the occupancy sensor to indicate occupancy.
   1. If space is in occupied mode, but occupancy is not detected for more than 20 minutes (adj), the BMS shall place the space into standby mode. When occupancy is detected, the BMS shall immediately revert back to normal occupied mode.
   2. If a space is in standby mode and schedule changes to unoccupied mode, the system shall revert to unoccupied mode and discontinue the standby mode.
   3. If a space is placed into standby mode

a. The outside air damper(s) shall close 100% for unit ventilators, fan coils, and single zone air handlers.
b. VAV box zones shall set the box to minimum airflow setting.
c. Maintain space temperature at an offset of 2 deg F (adj) below the current effective space setpoint in heating mode, and 2 deg F (adj) above the current effective space setpoint in cooling mode.

D. All systems and spaces shall be linked to a global room temperature setpoint value that the Owner can change a single value that effectively creates a single temperature setpoint with specified adjustment (+2 deg/-2 deg) that all systems and all spaces use for master control of the facility/campus temperature and energy control.

E. Equipment rotation shall be configured on all systems where more than one equipment item is used to function as a team, such as pumps, chillers, boilers, relief fans, etc. The controls shall be configured to equalize run time on all items. Utilize a “first-on, first-off” approach unless noted otherwise or if Owner’s campus standards stipulate specific rotation schedules.

F. All heating hot water coils shall utilize the following for coil freeze protection if they are the primary heating coil for air handlers, unit ventilators, single zone duct coil, that has outside air to the equipment.
1. If outside air temperature is less than 35 deg F (global adj.) the hot water coil shall never close 100%. Maintain coil a minimum of 10% open at all times, even with equipment fans turned off.
2. If unit is shut off and outside air temperature is less than 35 deg (global adj.), mixed air temperature sensor and freezestat shall monitor temperature inside of air handler equipment such that if duct temperature less than 40 deg F is detected, BMS shall activate fan to circulate air through the unit at minimum speed until mixed air temperature is above 50 deg F and a minimum run time of 15 minutes (global adj).
3. If mixed air temperature drops to below 30 deg F while the unit is off, BMS shall generate critical alarm and open hot water coil 100%.

3.4 TERMINAL UNIT CONTROL SEQUENCES

A. Unit Heater Control: A 24-volt wall mounted thermostat shall cycle fan motor to maintain space temperature between set point and 2 deg F (adjustable) below set point.

B. Cabinet Unit Heater Control:
1. The BMS shall position 2-way control valve to bypass unit when there is no call for heat and outside air temperature is above 50 deg F (adj). When outside air temperature is 50 deg or lower, control valve shall provide full flow to unit at all times to prevent coil freeze. This valve used to maintain minimum loop flow required for pumps in both winter heating and summer reheat modes.
2. BMS shall cycle supply fan motor to maintain space temperature setpoint of 70 deg F (adj).

C. Stand Alone Ceiling Radiation Control: BMS shall cycle a 2-position hot water valve to open when outside air temperature is below 45 deg F (adj).

D. Fan Coil Unit (FCU):
1. Occupied Mode: Open outside air damper to provide minimum ventilation. Continuous fan operation, modulate hot water coil control valve and chilled water coil control valve as required to maintain temperature and relative humidity set point.
2. Unoccupied Mode: Close outside air damper. Cycle fan and modulate hot water coil control valve and chilled water coil control valve to maintain unoccupied set point.

3.5 AIR HANDLING / ROOFTOP UNIT CONTROL SEQUENCES

A. AHU/RTU-X (Variable Volume Supply Fan with Power Relief)
1. Occupied Mode:
a. Supply fan shall operate continuously. Variable speed drive (VSD) shall modulate supply fan to maintain the variable air volume (VAV) terminal unit with the greatest call for cooling at least 85% open. Increase duct static pressure at a rate of 0.25" every 10 minutes (adjustable) until any VAV terminal unit exceeding 95% open, closes down to 85% open. Duct static pressure shall be determined by pressure sensors located 2/3 down the longest duct run or as shown on the drawings. A high limit discharge pressure sensor, located at the fan discharge, shall prevent the supply fan from generating a discharge pressure greater than 4" w.c. (adjustable).
b. The outside air damper shall be opened to provide minimum outside air. Minimum outside air volume shall be maintained by modulating outside air damper and return air damper as required to maintain maximum space CO2 level at 1000 ppm (adj). Outside air damper shall remain open at least 10% (adj) during occupied mode. If outside air temperature is less than space and cooling is required, modulate outside air damper open to provide outside air economizer cooling. A mixed air temperature controller shall maintain a minimum DAT of 55 deg F. Open relief air damper and modulate relief fan speed as required to maintain zone differential static pressure at +0.05" W.C. (adj).
c. Modulate the heating and cooling output to maintain a supply air discharge air temperature to maintain the space with the greatest call for cooling. Reset the supply air temperature setpoint as follows:
1) If OAT is below 45 deg F (adj), supply air temperature setpoint from the unit shall be 70 deg F.
2) If OAT >= 45 deg, then supply air temperature shall be 55 deg F.
d. If any space or return duct humidistat is not satisfied, reset the DAT to minimum set point until all relative humidity's are 2% below set point. DAT shall be set to minimum level and zone VAV terminal unit shall provide reheat as required to maintain space temperature set point.
2. Unoccupied Mode:
a. Close minimum and economizer outside air dampers, unit supply fan to remain off.
b. If any space or return duct humidistat is not satisfied, reset the DAT to minimum set point until all relative humidity's are 2% below set point. DAT shall be set to minimum level and zone VAV terminal unit shall provide reheat as required to maintain space temperature set point.
c. Cycle supply fan and stages of heating and cooling as required to maintain unoccupied space temperature setpoints.

3. Morning Warm-Up: Dependent on space and ambient conditions, the BMS shall determine optimum start time to return zones temperature to their occupied set points 5 to 10 minutes prior to occupied schedule. The outside air damper shall close and the return air damper shall open to its maximum position, hating stages shall modulate to maintain a maximum 125 deg F (adjustable) discharge air temperature, VAV terminals primary air valve shall open to full flow. As a zone reaches occupied heating set point, VAV terminal primary air valve and reheat valve shall modulate to prevent zone over heating. This cycle shall continue until all zones have reached their occupied heating set point temperature.
4. Morning Cool-Down: Dependent on space and ambient conditions, the BMS shall determine optimum start time to return zones temperature to their occupied cooling set points 5 to 10 minutes prior to occupied schedule. The outside air damper shall close and the return damper shall open to its maximum position with stages of DX cooling to maintain a discharge air temperature of 50 deg F, VAV terminal units shall operate as under normal occupied mode. This cycle shall continue until all zones have reached their occupied cooling set point temperature.
5. Night Purge Cycle: The BMS shall initiate a night purge cycle during unoccupied hours to flush the building with outside air for free space cooling to bring space temperature down to cooling occupied set point. During the purge mode, the air handling unit fan shall run and the economizer outside air damper shall be modulated to maintain a 50 deg F (adjustable) discharge air temperature. A low limit mixed air sensor shall prevent mixed air temperature from falling below 45 deg F (adjustable). If enthalpy/humidity sensors indicate the outside air contains more heat of enthalpy than the interior space, the BMS shall over-ride the free cooling night purge cycle. If the outside air temperature is less than 35 deg F (adjustable), the BMS shall over-ride the night purge cycle.
6. Monitor differential pressure across air filter bank(s) to indicate need for filter replacement when differential pressure reaches the loaded filter drop indicated in the air handler unit schedule. Actual pressure drop (in inches water column) shall be accessible through the workstation PC. A maintenance message reading "AHU-XX FILTER CHANGE REQUIRED" shall automatically be displayed on the workstation PC when loaded filter pressure drop is reached.

B. AHU/RTU-X (Constant Volume Supply Fan with Power Relief and Hot Gas Dehum Reheat mode)
   1. Occupied Mode:
      a. Supply fan shall operate continuously. Variable speed drive (VSD) shall modulate supply fan to supply the specified air volume to the space using a VAV single zone approach based on room conditions. Minimum supply air volume shall be 50% of total.
      b. The outside air damper shall be opened to provide minimum outside air. Minimum outside air volume shall be maintained by modulating outside air damper and return air damper as required to maintain maximum space CO2 level at 1000 ppm (adj). Outside air damper shall remain open at least 10% (adj) during occupied mode. If outside air temperature is less than space and cooling is required, modulate outside air damper open to provide outside air economizer cooling. A mixed air temperature controller shall maintain a minimum DAT of 55 deg F. Open relief air damper and modulate relief fan speed as required to maintain zone differential static pressure at +0.05” W.C. (adj).

c. Modulate the heating and cooling output to maintain a supply air discharge air temperature to maintain the space temperature and humidity setpoints.
d. If space or return duct humidistat is not satisfied, reset the DAT to minimum set point and enable hot gas reheat coil to maintain space temperature setpoint until all relative humidity's are 2% below set point.
1) If space temperature is satisfied and dehum mode is needed, modulate the supply fan speed down to reduce airflow to the space while continuing dehum mode with reheat.

2. Unoccupied Mode:
a. Close minimum and economizer outside air dampers, unit supply fan to remain off.
b. Cycle supply fan and stages of heating and cooling as required to maintain unoccupied space temperature setpoints.
c. If space or return duct humidistat is not satisfied, reset the DAT to minimum set point and enable hot gas reheat coil to maintain space temperature setpoint until all relative humidity's are 2% below set point.

3. Morning Warm-Up: Dependent on space and ambient conditions, the BMS shall determine optimum start time to return zones temperature to their occupied set points 5 to 10 minutes prior to occupied schedule. The outside air damper shall close, and the return air damper shall open to its maximum position, hating stages shall modulate to maintain a maximum 125 deg F (adjustable) discharge air temperature.
4. Morning Cool-Down: Dependent on space and ambient conditions, the BMS shall determine optimum start time to return zones temperature to their occupied cooling set points 5 to 10 minutes prior to occupied schedule. The outside air damper shall close, and the return damper shall open to its maximum position with stages of DX cooling to maintain a discharge air temperature of 50 deg F.
5. Night Purge Cycle: The BMS shall initiate a night purge cycle during unoccupied hours to flush the building with outside air for free space cooling to bring space temperature down to cooling occupied set point. During the purge mode, the air handling unit fan shall run and the economizer outside air damper shall be modulated to maintain a 50 deg F (adjustable) discharge air temperature. A low limit mixed air sensor shall prevent mixed air temperature from falling below 45 deg F (adjustable). If enthalpy/humidity sensors indicate the outside air contains more heat of enthalpy than the interior space, the BMS shall over-ride the free cooling night purge cycle. If the outside air temperature is less than 35 deg F (adjustable), the BMS shall over-ride the night purge cycle.
6. Monitor differential pressure across air filter bank(s) to indicate need for filter replacement when differential pressure reaches the loaded filter drop indicated in the air handler unit schedule. Actual pressure drop (in inches water column) shall be accessible through the workstation PC. A maintenance message reading "AHU-XX FILTER CHANGE REQUIRED" shall automatically be displayed on the workstation PC when loaded filter pressure drop is reached.

C. Safety Controls:
1. Provide an adjustable electric automatic reset freezestat element serpentined across the face of the leaving air side of the heating coil which will stop the supply fan and close the outside air damper.
2. Freezestat shall be hardwired to fan circuit. If low limit is detected, the BMS shall close the outside air damper, maintain supply fan on, display a low limit

notification on the graphics, and wait 15 minutes. Reset to normal mode and open outside air damper.

3. If low limit sensor trips 3 times within a 1 hour time frame, generate a critical low limit alarm and lock out the unit requiring a software reset before running. Close outside air damper to 0%, open return damper to 100%, stop all supply, return, and relief fans.
4. Low limit capillary shall have 1 ft of tube for every 1 sq ft of coil surface.
5. Provide a high-limit controller to prevent unit discharge air from rising above 125 deg F (adjustable). Sensor shall be located at the discharge of the unit.

3.6 EXHAUST FAN CONTROL SEQUENCES

A. General: Motorized dampers associated with exhaust fans shall be interlocked to open 100% and prove open prior to fan activation.

B. EF-X: Operate using a schedule linked to the nearest RTU/AHU serving the same area such that if the zone is schedule to be occupied, the fan is scheduled to run.

3.7 SINGLE DUCT SHUT-OFF VAV TERMINAL WITH HOT WATER REHEAT SEQUENCE

A. Occupied Mode: Modulate open primary air valve with a rise in space temperature. With a fall in space temperature, modulate primary air valve towards the minimum setting. With a continued fall in space temperature below the heating set point, modulate open the hot water coil control valve (unit mounted coils and duct mounted booster coils), when valve is 100% open, modulate air valve increasing air flow to maintain space heating set point. In areas with wall radiation, modulate radiation control valve as first stage of heat, modulate reheat coil valve after radiation valve is 100% open. If hot water is not available, close primary air valve 100% with a fall in space temperature below heating set point.

1. The supply air temperature shall be limited to a maximum of 100 deg (adj) to prevent stratification of the space. If the space is not satisfied, modulate the supply air valve open and maintain fixed supply air temperature to satisfy the space.

B. Unoccupied Mode: Open primary air valve, close hot water coil control valve. In areas with wall radiation, modulate radiation control valve as source of heat to maintain reduced heating set point.

3.8 SERIES FAN POWERED VAV TERMINAL UNIT WITH REHEAT SEQUENCE

A. Occupied Mode: Continuous unit fan operation. Modulate open primary air valve with a rise in space temperature. With a fall in temperature, modulate primary air valve towards the minimum setting. With a continued fall in space temperature below the heating set point, modulate open the hot water coil control valve. In areas with wall radiation, modulate radiation control valve as first stage of heat, modulate reheat coil valve after radiation valve is 100% open.

B. Unoccupied Mode: Cycle unit fan and hot water coil valve for full flow to maintain reduced space set point temperature. Close primary air valve. In areas with wall

radiation, modulate radiation control valve as first stage of heat to maintain reduced heating set point.

C. Morning Warm-Up/Cool-Down & Night Purge: Refer to AHU sequence of operation. Provide maximum primary air during night purge, modulating to prevent zone temperature from falling below heating set point.

3.9 PUMP CONTROL SEQUENCES

A. P-X (Boiler Primary Hot Water Loop): Cycle with their respective boilers. BMS shall monitor status of pump, boiler shall control pump. Generate alarm if boiler is firing and pump fails to prove status. Pump shall continue to operate for a period of 30 seconds following shut down of associated boiler burner.

B. P-X (Building Secondary Hot Water Distribution Loop): Variable volume pumping. Energize lead variable volume pump on a call for hot water. Modulate lead pump with a 4-20 mA output to the variable speed drive (VSD) to maintain a 10 PSIG (adjustable) differential pressure across the supply and return approximately 2/3 down the farthest mains. With a failure of the lead pump to establish flow within 15 seconds after a call to operate, start the lag pump and generate an alarm message reading "SECONDARY BUILDING HOT WATER DISTRIBUTION LOOP LEAD PUMP FAILURE" to be automatically displayed on the workstation PC monitor.

3.10 BOILER AND HEATING WATER CONTROL SEQUENCES

A. The BMS shall enable the boiler plant and provide 4-20 mA or 0-10 Volt setpoint to packaged boiler controller. Reset maximum HW Setpoint based on outside air reset schedule (editable via graphics).
1. When outside air is 0 deg F, HW Supply shall be 160 deg F.
2. When outside air is 60 deg F, HW Supply shall be 100 deg F.

B. On a call for hot water the BMS shall energize the hot water distribution pump(s), and packaged controls shall be enabled to maintain the hot water loop temperature. The packaged boiler controls shall activate and stage boilers and their associated pumps as required to maintain the loop supply and return water temperatures. The boiler controller shall sequence the boilers and modulate output such that total system efficiency is maximized by using multiple boilers on low fire. The BMS shall monitor all spaces and set the heating water temperature as low as possible to heat all spaces in the building and send a signal to the packaged controller to reset the supply water temperature. If any space is unable to maintain space temperature, reset the supply water temperature up by 5 deg F and when this space is at setpoint, return to previous value. The packaged controller shall have a set of dry contacts to notify the BMS of any alarm state within the boiler plant or controller.

3.11 LIGHTING CONTROL

A. The BMS shall maintain accurate time on all network controllers with network time synchronization (NTP) and provide astronomical schedule for time of sunrise/sunset to control lighting.

B. All interior corridor lighting contactors shall be put on individual schedules that are programmed as directed by Owner for start of occupancy and end of occupancy each day.

C. All exterior site lighting contactors shall be put on individual schedules to enable/disable. Use sunset/sunrise to turn lights on and off within the schedules. (Ex. On at sunset, off at scheduled time. On at sunset, off at sunrise. On at scheduled time, off at sunrise, etc.)

3.12 GREENHOUSE HEATING

A. The BMS shall monitor temperature of the greenhouse space using an outdoor rated thermostat. When outside air temperature is below 65 deg F (Adj), heating for the greenhouse shall be enabled.

B. Cycle the hot water circulator pump and associated finned tube radiation heat as required to maintain greenhouse space temperature setpoint.

3.13 FAN COILS

A. Occupied mode:
1. Supply fan shall operate continuously. Monitor fan status and generate alarm if fan fails to prove status within 30 seconds.
2. Open outside air damper to provide minimum outside air for ventilation.
3. Modulate hot water heating valve and stages of DX cooling to maintain space temperature setpoint. DX cooling shall be locked out below 35 deg F.

B. Unoccupied mode:
1. Close outside air damper.
2. Cycle supply fan and heating as needed to maintain unoccupied setback temperature setpoint.

END OF SECTION 23 0993

M-Series Drawings Missing from A2
10/22/24

GENERAL DEMOLITION NOTES

1. ALL EXISTING PENETRATIONS FROM DUCT/ PIPE/ WIRE/ CONDUIT THAT IS REMOVED SHALL BE PATCHED BY PROPER TRADES TO MATCH SURROUNDINGS UNLESS PENETRATION IS TO BE REUSED. PATCH ALL FLOOR AND WALL PENETRATIONS TO MAINTAIN FIRE RATED CONSTRUCTION.
2. ALL ROOF PENETRATIONS NOT BEING REUSED SHALL BE PATCHED TO MAINTAIN EXISTING ROOF WARRANTY. EXISTING CURBS TO BE ABANDONED SHALL BE CAPPED WITH ALUMINUM HOOD PAINTED WITH "N.I.S." (NOT IN SERVICE). INSULATE CAVITY BELOW CAP WITH TIGHT FITTING 3" FOAM BOARD WRAPPED WITH SHEET METAL.
3. ALL PIPE SHALL BE REMOVED TO WITHIN AREAS THAT ARE INACCESSIBLE SUCH AS WALL CAVITIES AND BELOW SLAB. IN FINISHED SPACES REMOVE BELOW SURFACE, CAP WATER TIGHT, AND PATCH SURFACE TO MATCH SURROUNDINGS.
4. ALL PATCHING OF WALLS SHALL MATCH MATERIALS AND WHEN COMPLETE SHALL NOT LOOK LIKE A PATCH.
5. TOOTH-IN NEW BRICK/ BLOCK WITH FULL UNITS, DO NOT CUT FILLER PIECES.
6. PRIOR TO CUTTING EXISTING SLAB ON GRADE, CONTRACTOR SHALL VERIFY EXISTENCE OF EXISTING UTILITIES SUCH AS PIPING, CONDUIT, WIRE, ETC. BY MEANS OF GROUND PENETRATING RADAR TO LOCATE AND DETERMINE DEPTH OF BURY. TAKE PRECAUTIONS TO DE-ENERGIZE POWER TO CIRCUITS AND CAREFULLY CUT AND REMOVE SLAB. ANY UTILITIES THAT WERE LOCATED AND SUBSEQUENTLY DAMAGED SHALL BE REPAIRED BY THE CONTRACTOR AT NO ADDED COST TO THE OWNER.

GENERAL MECHANICAL NOTES

1. DUCT AND PIPING LAYOUTS ARE SCHEMATIC IN NATURE. ADDITIONAL TRANSITIONS, ELBOWS, OFFSETS, AND FITTINGS SHALL BE ADDED AS REQUIRED TO COORDINATE WITH OBSTRUCTIONS AND OTHER TRADES.
2. COORDINATE ALL WORK WITH OTHERS TRADES AND EXISTING WORK TO PERMIT ACCESS AND SERVICE CLEARANCES TO ALL SYSTEMS. COORDINATE DUCT WITH ELECTRICAL J-BOXES TO PREVENT OBSTRUCTIONS.
3. DO NOT SCALE DRAWINGS FOR DIMENSIONS. REFER TO DIMENSIONED DRAWINGS.
4. ALL GRILLES, DIFFUSERS, AND REGISTERS SHALL HAVE A VOLUME CONTROL DAMPER UNLESS NOTED OTHERWISE. DAMPER SHALL BE IN AN ACCESSIBLE LOCATION.
5. REFER TO DETAIL SHEETS FOR ADDITIONAL INFORMATION ON INSTALLATION METHODS.
6. DEVIATIONS FROM BASIS OF DESIGN THAT AFFECT OTHER TRADES ARE THE RESPONSIBILITY OF THIS CONTRACTOR. ADDITIONAL COSTS TO PROVIDE LARGER ELECTRICAL CIRCUITS, MORE FLOOR SPACE, ADDITIONAL SUPPORTS, ADDITIONAL MATERIALS, ETC. SHALL BE BORNE BY THIS CONTRACTOR. COORDINATE WITH OTHER TRADES.
7. ALL THERMOSTATS/HUMIDITY SENSORS WITH ADJUSTMENT BUTTONS/ SLIDERS/ KNOBS/ DISPLAYS, ETC. SHALL BE MOUNTED WITH THE TOP OF THE DEVICE NO MORE THAN 48' AFF. IN COMPLIANCE WITH LOCAL AND FEDERAL ADA WHEELCHAIR REACH DISTANCE GUIDELINES. PROVIDE ADDITIONAL SURFACE RACEWAY, BOXES, CONDUIT, ETC AS REQUIRED TO OFFSET AROUND EXISTING DEVICES IN RENOVATION WORK.
8. ALL DUCT SIZES LISTED ARE FOR INTERIOR FREE AREA. ANY DUCTS DESIGNATED OR SPECIFIED TO BE DOUBLE WALL OR INTERNALLY LINED SHALL HAVE OUTER DIMENSIONS ENLARGED TO ACCOMMODATE THE LINER OR INTERSTITIAL INSULATION.

MECHANICAL SYMBOL SCHEDULE

PIPING SYMBOLS

- AUTOMATIC FLOW CONTROL VALVE
- AIR SEPARATOR
- AUTOMATIC AIR VENT
- BALL VALVE
- BUTTERFLY VALVE
- CHECK VALVE
- DOUBLE CHECK BACKFLOW PREVENTER
- FLOW METER
- GAS OUTLET TURRET
- GAS COCK
- GATE VALVE
- GLOBE VALVE
- HOSE THREAD END WITH CAP
- INLINE PIPE DROP
- INLINE PUMP
- INLINE PIPE RISE
- MANUAL FLOW CONTROL VALVE
- MANUAL AIR VENT
- METER
- P&T RELIEF VALVE
- P&T PORT
- PIPE BREAK
- PIPE CAP
- PIPE DROP
- PIPE RISE
- PIPE THERMOMETER
- PRESSURE GAUGE
- PRESSURE INDEPENDENT CONTROL VALVE
- PRESSURE REDUCING VALVE
- PRESSURE REGULATING VALVE
- STRAINER
- STRAINER WITH BLOWDOWN
- STEAM TRAP
- TEMPERATURE SENSOR
- THERMOSTATIC MIXING VALVE
- 2-WAY CONTROL VALVE
- 3-WAY CONTROL VALVE
- UNION

MECHANICAL SYMBOLS

- BACKDRAFT DAMPER
- COMBINATION SMOKE/FIRE DAMPER
- CONTROL DAMPER ACTUATOR
- DOUBLE WALL DUCTWORK
- DUCT CAP
- DUCT MOUNTED COIL
- DUCTWORK WITH DUCT LINER
- DUCTWORK WITHOUT DUCT LINER
- FAN POWERED VAV BOX WITH REHEAT
- FIRE DAMPER
- FIRE DAMPER
- FLEXIBLE DUCT
- INLINE PUMP
- MANUAL AIR VENT
- OPPOSED BLADE BALANCE DAMPER
- RETURN/EXHAUST/ TRANSFER AIR GRILLE
- SHUTOFF VAV BOX WITH REHEAT
- SINGLE BLADE BALANCE DAMPER
- STRAINER
- STRAINER WITH BLOWDOWN
- SUPPLY AIR DIFFUSER
- TEMPERATURE SENSOR
- THERMOMETER
- UNIT HEATER
- WALL MOUNTED PRESSURE GAUGE

MECHANICAL LINE TYPES

- EXISTING DUCT TO REMAIN
- NEW SUPPLY DUCT
- NEW RETURN DUCT
- NEW OUTSIDE AIR DUCT
- NEW EXHAUST DUCT
- DUCT TO BE REMOVED
- HWS — HOT WATER SUPPLY PIPE
- HWR — HOT WATER RETURN PIPE
- CHWS — CHILLED WATER SUPPLY PIPE
- CHWR — CHILLED WATER RETURN PIPE
- GLY — GLYCOL PIPE
- LPSS — LOW PRESSURE STEAM SUPPLY
- LPSR — LOW PRESSURE STEAM RETURN
- HPSS — HIGH PRESSURE STEAM SUPPLY
- HPSR — HIGH PRESSURE STEAM RETURN
- STR — STEAM CONDENSATE
- CWS — CONDENSER WATER SUPPLY
- CWR — CONDENSER WATER RETURN

GENERAL LINE TYPES

- EXISTING TO REMAIN LINE WEIGHT
- EXISTING TO BE DEMOLISHED LINE TYPE AND WEIGHT
- NEW DUCT LINE WEIGHT
- NEW PIPING LINE WEIGHT
- NEW EQUIPMENT LINE WEIGHT

ABBREVIATIONS

ACCU	AIR COOLED CONDENSING UNIT
A.F.F	ABOVE FINISHED FLOOR
AFMS	AIR FLOW MEASURING STATION
AHU	AIR HANDLER
AS	AIR SEPARATOR
ADS	AIR DIRT SEPARATOR
B	BOILER
CF	CEILING FAN
CHLR	CHILLER
CHWR	CHILLED WATER RETURN
CHWS	CHILLED WATER SUPPLY
CO	CARBON MONOXIDE
CO2	CARBON DIOXIDE
COND	CONDENSATE DRAIN
CUH	CABINET UNIT HEATER
CWR	CONDENSER WATER RETURN
CWS	CONDENSER WATER SUPPLY
D	DIFFUSER
DC	DUCT COIL
EF	EXHAUST FAN
EG	EXHAUST GRILLE
ET	EXPANSION TANK
F	FURNACE
FD	FIRE DAMPER
FM	FLOW METER
FTR	FINNED TUBE RADIATION
HPSR	HIGH PRESSURE STEAM RETURN
HPSS	HIGH PRESSURE STEAM SUPPLY
HVAC	HEATING VENTILATING AND COOLING UNIT
HWR	HOT WATER RETURN
HWS	HOT WATER SUPPLY
L	LOUVER
LPSR	LOW PRESSURE STEAM RETURN
LPSS	LOW PRESSURE STEAM SUPPLY
LRP	LINEAR RADIANT PANEL
MAU	MAKE-UP AIR UNIT
OA	OUTSIDE AIR
OAC	OPENING ABOVE CEILING
P	PUMP
RA	RETURN AIR
RAD	RADIANT HEATER
REL	RELIEF AIR
RET	RETURN AIR
RC	ROOF CAP
RF	RELIEF FAN
RG	RETURN GRILLE
RTU	ROOFTOP UNIT
RV	RELIEF VENT
SA	SUPPLY AIR
SFD	SMOKE FIRE DAMPER
SR	SUPPLY REGISTER
TG	TRANSFER GRILLE
UH	UNIT HEATER
UV	UNIT VENTILATOR
VAV	VARIABLE AIR VOLUME BOX

GENERAL SYMBOLS

- EXTENT OF DEMOLITION
- TIE-IN OF NEW TO EXISTING

MECHANICAL CONTROL SYMBOLS

- CARBON DIOXIDE SENSOR
- CARBON MONOXIDE SENSOR
- DUCT OR PIPE PRESSURE SENSOR
- SECURITY TYPE THERMOSTAT
- PNEUMATIC THERMOSTAT
- THERMOSTAT
- THERMOSTAT (LINE VOLTAGE)
- THERMOSTAT WITH HUMIDISTAT AND CO2 SENSOR
- HUMIDISTAT
- DIFFERENTIAL PRESSURE SENSOR

CONTROLS INFORMATION

1. EXISTING CONTROL DAMPERS AND CONTROL VALVES SHALL REMAIN. CONTRACTOR SHALL REMOVE EXISTING ACTUATORS. PROVIDE AND INSTALL NEW ACTUATORS ON EXISTING CONTROL DAMPERS AND CONTROL VALVES. MODIFY EXISTING CONTROL VALVE STEM AND CONTROL DAMPER LINKAGE AS REQUIRED.
2. EXISTING VARIABLE SPEED DRIVES AND AIRFLOW MEASURING STATIONS SHALL REMAIN.
3. CONTRACTOR SHALL REMOVE EXISTING TEMPERATURE CONTROLS CABLING, CONDUIT, WIRING, TUBING, SURFACE RACEWAY, WIREMOLD, AND ASSOCIATED MOUNTING DEVICES.
4. CONTRACTOR SHALL REMOVE ALL EXISTING TEMPERATURE CONTROLS SENSORS, THERMOSTATS, RELAYS, CONTROL PANELS, CONTROL UNITS, UNITARY CONTROLLERS, AND POWER SUPPLIES.
5. CONTRACTOR SHALL REMOVE ALL EXISTING EQUIPMENT LABELS. PROVIDE AND INSTALL NEW EQUIPMENT LABELS ON ALL EXISTING EQUIPMENT. ALL EQUIPMENT IDENTIFICATION AND TAGS SHALL BE UNIQUE. UPDATE EQUIPMENT LABELS AND GRAPHICS INFORMATION AS REQUIRED.
6. CONTRACTOR SHALL CLEAN EXISTING VAV TERMINAL FLOW RING AND TUBING TO REMOVE ALL DUST AND DEBRIS.
7. CONTRACTOR SHALL ENGAGE AABC OR NEBB TAB SPECIALIST TO TEST AND BALANCE ALL EXISTING VAV TERMINALS AND ALL EXISTING CENTRAL STATION AIR HANDLING UNITS.
8. CONTRACTOR SHALL CAREFULLY SALVAGE EXISTING LAY-IN CEILING TILES AND WORK THROUGH EXISTING GRID AS REQUIRED TO GAIN ACCESS FOR WORK. CONTRACTOR SHALL INSTALL SALVAGED CEILING TILES AFTER WORK IS COMPLETE.
9. CONTRACTOR SHALL INCLUDE FURNISH AND INSTALLATION OF MINIMUM (10) 18"x18" CEILING MOUNTED ACCESS DOORS EQUAL TO NYSTROM NMT SERIES AS REQUIRED FOR ACCESS TO WORK ABOVE EXISTING GYPSUM AND PLASTER CEILINGS. REFER TO ACCESS DOOR DETAIL.

CONTROLS RESPONSIBILITY CHART

ITEM	CONTROL CONTRACTOR	MECHANICAL CONTRACTOR	ELECTRICAL CONTRACTOR	REMARKS
FURNISH CONTROL VALVES	X			
INSTALL CONTROL VALVES		X		
ROUGH-IN OF THERMOSTAT WALL BOXES	X			
FURNISH PIPE WELLS FOR SENSORS	X			
INSTALL PIPE WELLS FOR SENSORS		X		
PROVIDE 120 VOLT POWER FOR CONTROL PANELS			X	
PROVIDE INTERLOCK WIRING BETWEEN DEVICES, PANELS, BOILERS, CHILLERS, ETC		X		1
FURNISH VARIABLE SPEED DRIVES	X			2
INSTALL VARIABLE SPEED DRIVES			X	2
PROVIDE LINE AND LOAD WIRING TO VARIABLE SPEED DRIVES			X	
PROVIDE CONTROL WIRING TO VSD	X			
PROGRAM AND STARTUP VSD	X			
PROVIDE 120 VOLT POWER TO CONTROLS			X	
PROVIDE LOW VOLTAGE CABLING TO CONTROLS	X			
FURNISH CONTROL DAMPERS	X	X		3
INSTALL CONTROL DAMPERS		X		
FURNISH DAMPER ACTUATORS	X			
INSTALL DAMPER ACTUATORS	X			
WIRE LOW VOLTAGE DAMPER ACTUATORS	X			
WIRE LINE VOLTAGE DAMPER ACTUATORS			X	
PROGRAM AND COMMISSION BOILER SEQUENCER		X		
PROGRAM AND COMMISSION CHILLER SEQUENCER		X		
COORDINATE PROJECT SCHEDULE WITH ALL TRADES	X	X	X	
PROVIDE SHOP DRAWINGS TO ALL TRADES	X	X		
VERIFY AND TEST SEQUENCE OF OPERATIONS	X			
TERMINATE DUCT DETECTORS	X			
ROOF PENETRATIONS		X		4
PROVIDE DUCT DETECTORS			X	
PROVIDE 120 VOLT POWER TO SOLENOID VALVES			X	5
PROVIDE LOW VOLTAGE CABLING TO SOLENOID VALVES	X			
PROVIDE AND INSTALL REFRIGERANT MONITORING SYSTEM	X			

REMARKS:

1. MECHANICAL CONTRACTOR/MANUFACTURER SHALL PROVIDE AND INSTALL ALL ASSOCIATED INTERLOCK WIRING AND DEVICES FOR A COMPLETE UNIT.
2. PACKAGED VSD'S INTERNAL TO HVAC EQUIPMENTED SHALL BE FURNISHED BY EQUIPMENT MANUFACTURER UNLESS NOTED OTHERWISE. REFER... EQUIPMENT SCHEDULES FOR VSD'S TO BE FURNISHED BY EQUIPMENT MANUFACTURER.
3. PACKAGED CONTROL DAMPERS INTEGRAL TO HVAC EQUIPMENT SHALL BE FURNISHED BY EQUIPMENT MANUFACTURER UNLESS NOTED... REFER TO EQUIPMENT SCHEDULES AND DETAILS FOR MORE INFORMATION.
4. COORDINATE WITH GC FOR ROOF PENETRATIONS.
5. COORDINATE WITH MC FOR REFRIGERANT AND GAS PIPING SOLENOID VALVE LOCATIONS.

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EAST CENTRAL HIGH CHOOL RENOVATIONS
1 TROJAN ROAD

ANDREW STEPHEN LOUDERBACK
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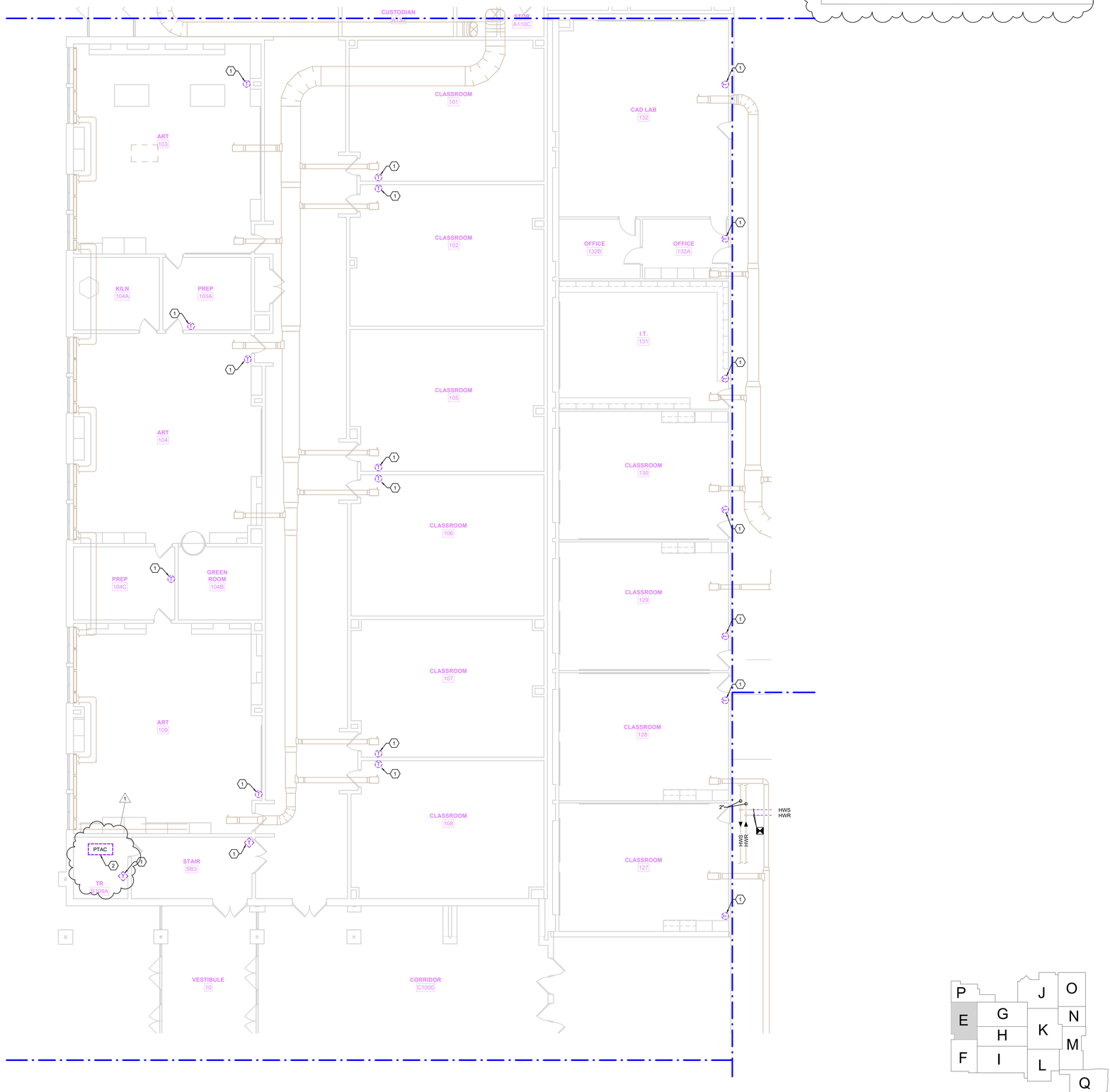
MECHANICAL INFORMATION SHEET

M001

PRIMARY JOB # 24584

DEMOLITION PLAN NOTES

1. REMOVE EXISTING WALL THERMOSTAT/SENSOR AND PREPARE FOR NEW IN SAME LOCATION.
2. REMOVE EXISTING PACKAGED TERMINAL AIR-CONDITIONING UNIT COMPLETE INCLUDING ASSOCIATED PIPING, MOUNTING DEVICES, AND CONTROLS.



1 FIRST FLOOR - MECHANICAL DEMOLITION PLAN - UNIT E

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

SCALE: 1/16" = 1'-0" | SCALE: 3/32" = 1'-0" | SCALE: 1/8" = 1'-0" | SCALE: 1/4" = 1'-0" | SCALE: 1/2" = 1'-0" | SCALE: 3/4" = 1'-0" | SCALE: 1" = 1'-0"

IF THE WHEEL PRINTED BELOW IS NOT SHOWN IN COLOR, THIS SET OF PRINTS IS NOT REPRESENTING ALL LINE TYPES CORRECTLY. CONTACT LANCER ENGINEERING FOR DIRECTIONS ON HOW TO OBTAIN A FULL COLOR SET OF PRINTS

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FIRST FLOOR - MECHANICAL DEMOLITION PLAN - UNIT E

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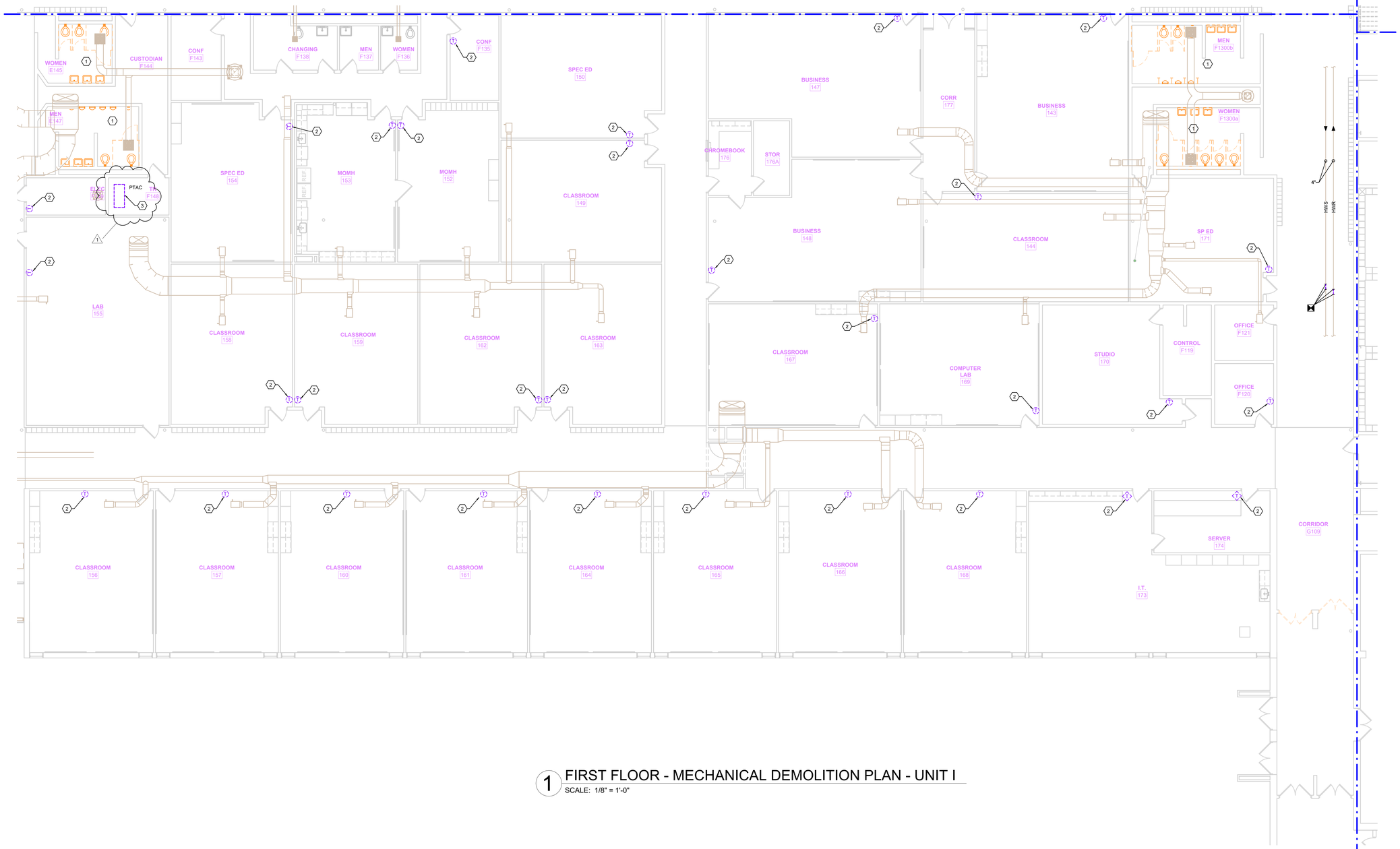
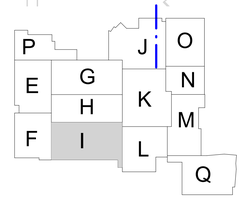


1 FIRST FLOOR - MECHANICAL DEMOLITION PLAN - UNIT I

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

DEMOLITION PLAN NOTES

1. DISCONNECT AND REMOVE ALL EXISTING PLUMBING FIXTURE COMPLETE, THIS ROOM. EXISTING PIPING AND FIXTURE CARRIER TO REMAIN AND RECEIVE NEW FIXTURE.
2. REMOVE EXISTING WALL THERMOSTAN SENSOR AND PREPARE FOR NEW IN SAME LOCATION.
3. REMOVE EXISTING PACKAGED TERMINAL AIR-CONDITIONING UNIT COMPLETE INCLUDING ASSOCIATED PIPING, MOUNTING DEVICES, AND CONTROLS.



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TRUE NORTH

SCALE: 1/16" = 1'-0" | SCALE: 3/32" = 1'-0" | SCALE: 1/8" = 1'-0" | SCALE: 1/4" = 1'-0" | SCALE: 1/2" = 1'-0" | SCALE: 3/4" = 1'-0" | SCALE: 1" = 1'-0"

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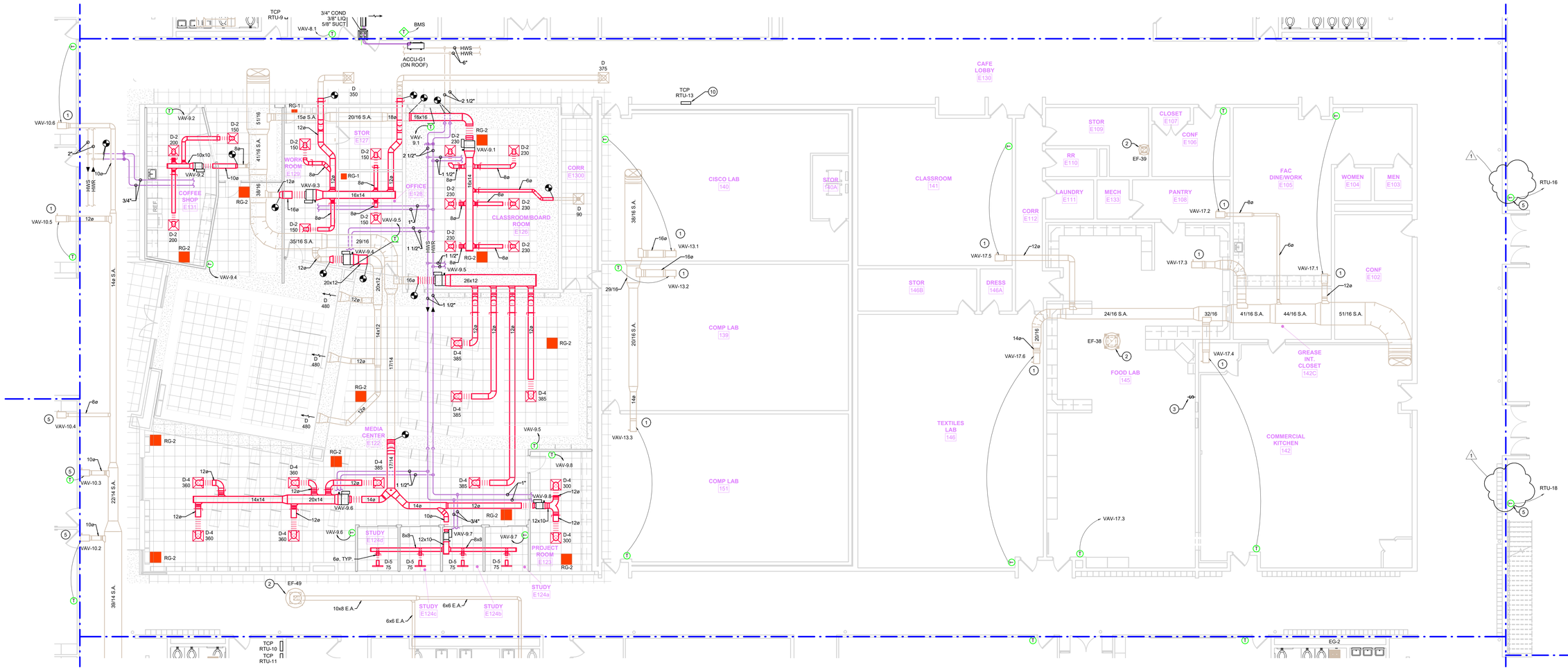
FIRST FLOOR - MECHANICAL DEMOLITION PLAN - UNIT I

MD101I

PRIMARY JOB # 24584

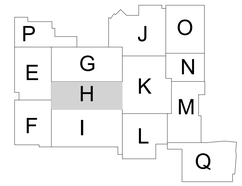
PLAN NOTES

1. REMOVE EXISTING VAV BOX CONTROLS INCLUDING CONTROLLER, ALL SENSORS, ALL ACTUATORS, ASSOCIATED WALL SENSOR(S), AND ALL ASSOCIATED WIRING COMPLETE. PROVIDE NEW CONTROLS SENSORS, ACTUATORS ON DAMPER/COIL WITH NEW WALL SENSOR IN SAME LOCATION. RUN NEW COMMUNICATION TRUNK WIRING. CLEAN VAV FLOW RING AND TUBING OF ALL DUST AND COMMISSION NEW CONTROLS AND VERIFY FLOW SETPOINTS WITH INDEPENDENT TAB.
2. REMOVE EXISTING AND PROVIDE NEW CONTROLS FOR EXHAUST FAN WITH FAN RELAY AND DAMPER ACTUATOR.
3. REMOVE EXISTING AND PROVIDE NEW CONTROLS FOR EXHAUST FAN WITH FAN RELAY AND DAMPER ACTUATOR. ADD WALL SWITCH TO CONTROL FAN VIA BMS.



1 FIRST FLOOR - MECHANICAL PLAN - UNIT H

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



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PLOT DATE/TIME: 10/18/2024 8:54:12 AM

SCALE: 1/16" = 1'-0" | SCALE: 3/32" = 1'-0" | SCALE: 1/8" = 1'-0" | SCALE: 1/4" = 1'-0" | SCALE: 1/2" = 1'-0" | SCALE: 3/4" = 1'-0" | SCALE: 1" = 1'-0"

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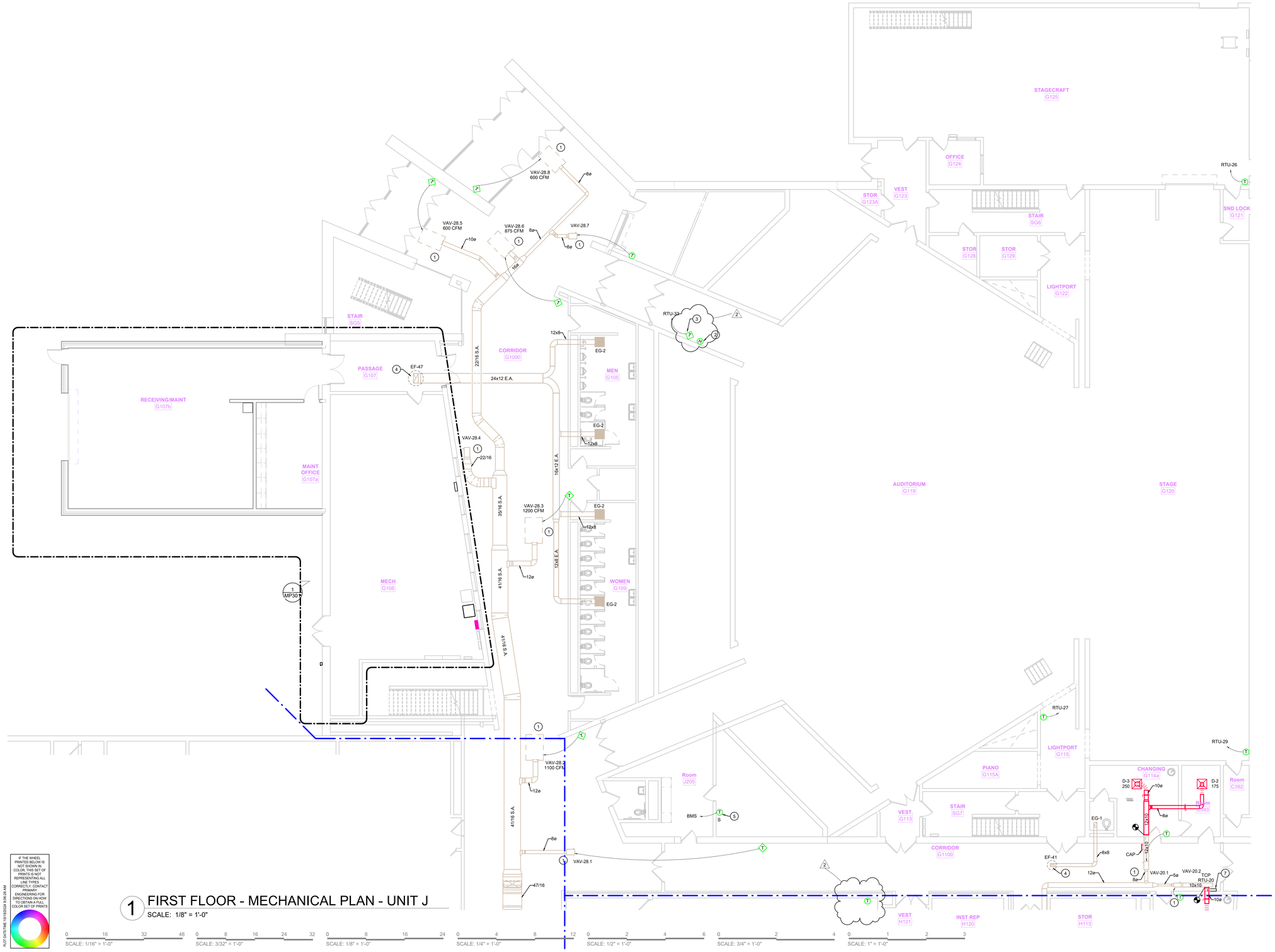
FIRST FLOOR - MECHANICAL PLAN - UNIT H

M101H

PRIMARY JOB # 24584

PLAN NOTES

1. REMOVE EXISTING VAV BOX CONTROLS INCLUDING CONTROLLER, ALL SENSORS, ALL ACTUATORS, ASSOCIATED WALL SENSOR(S), AND ALL ASSOCIATED WIRING COMPLETE. PROVIDE NEW CONTROLS SENSORS, ACTUATORS ON DAMPER/COIL WITH NEW WALL SENSOR IN SAME LOCATION. RUN NEW COMMUNICATION TRUNK WIRING. CLEAN VAV FLOW RING AND TUBING OF ALL DUST AND COMMISSION NEW CONTROLS AND VERIFY FLOW SETPOINTS WITH INDEPENDENT TAB.
2. REMOVE EXISTING HUMIDITY SENSOR AND COVER WITH BLANK COVER PLATE.
3. PROVIDE NEW COMBINATION SENSOR WITH TEMPERATURE, HUMIDITY, CARBON DIOXIDE. NO SET POINT CONTROL OR DISPLAY.
4. REMOVE EXISTING AND PROVIDE NEW CONTROLS FOR EXHAUST FAN WITH FAN RELAY AND DAMPER ACTUATOR.
5. REPLACE EXISTING WALL SENSOR AND PROVIDE NEW TEMPERATURE SENSOR IN MDF/IDF ROOM.
6. REPLACE EXISTING WALL SENSOR AND PROVIDE NEW TEMPERATURE SENSOR FOR RTU.
7. PROVIDE AND INSTALL NEW ROOFTOP UNIT TEMPERATURE CONTROL PANEL ABOVE EXISTING CEILING.



1 FIRST FLOOR - MECHANICAL PLAN - UNIT J
SCALE: 1/8" = 1'-0"

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2	10/16/202	ADDENDUM #2

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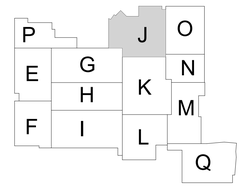
FIRST FLOOR - MECHANICAL PLAN - UNIT J



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M101J

PRIMARY JOB # 24584

PLAN NOTES

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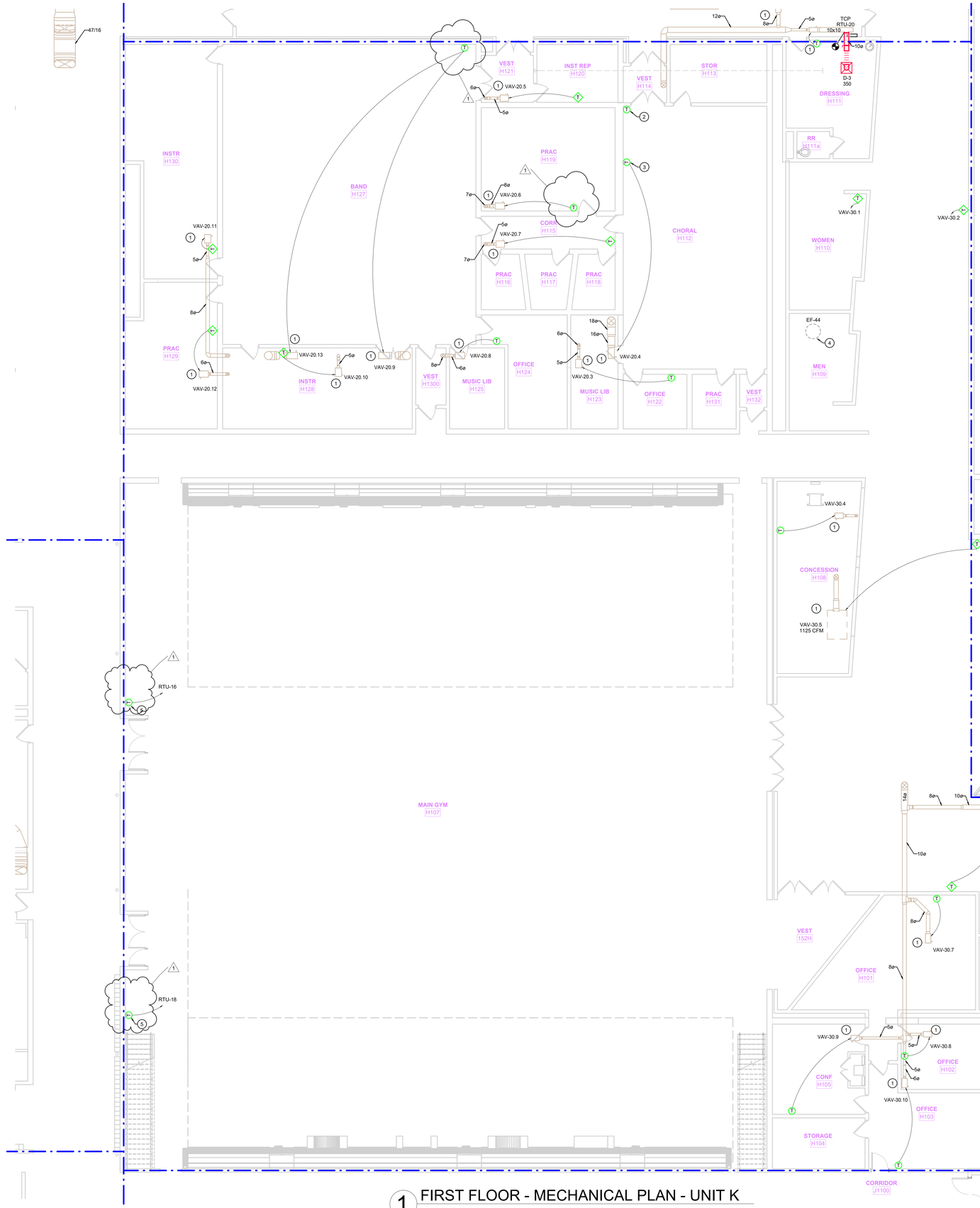
2. REMOVE SENSOR AND MOVE NEW DEVICE TO NEW LOCATION. COVER UNUSED BOX WITH STAINLESS STEEL PLATE.
3. LOCATION OF NEW SENSOR. USE METAL WIREMOLD EXPOSED ON WALL TO NEW LOCATION.
4. REMOVE EXISTING AND PROVIDE NEW CONTROLS FOR EXHAUST FAN WITH FAN RELAY AND DAMPER ACTUATOR.
5. PROVIDE NEW WALL SENSOR FOR ROOFTOP UNIT.
6. PROVIDE AND INSTALL NEW ROOFTOP UNIT TEMPERATURE CONTROL PANEL. MOUNT PANEL ABOVE WALL PADDING AND PROVIDE AND INSTALL WIRE GUARD.



1 FIRST FLOOR - MECHANICAL PLAN - UNIT K
SCALE: 1/8" = 1'-0"

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1 TROJAN ROAD

ANDREW STEPHEN LOCKERBACH REGISTERED PE11700017 STATE OF INDIANA PROFESSIONAL ENGINEER

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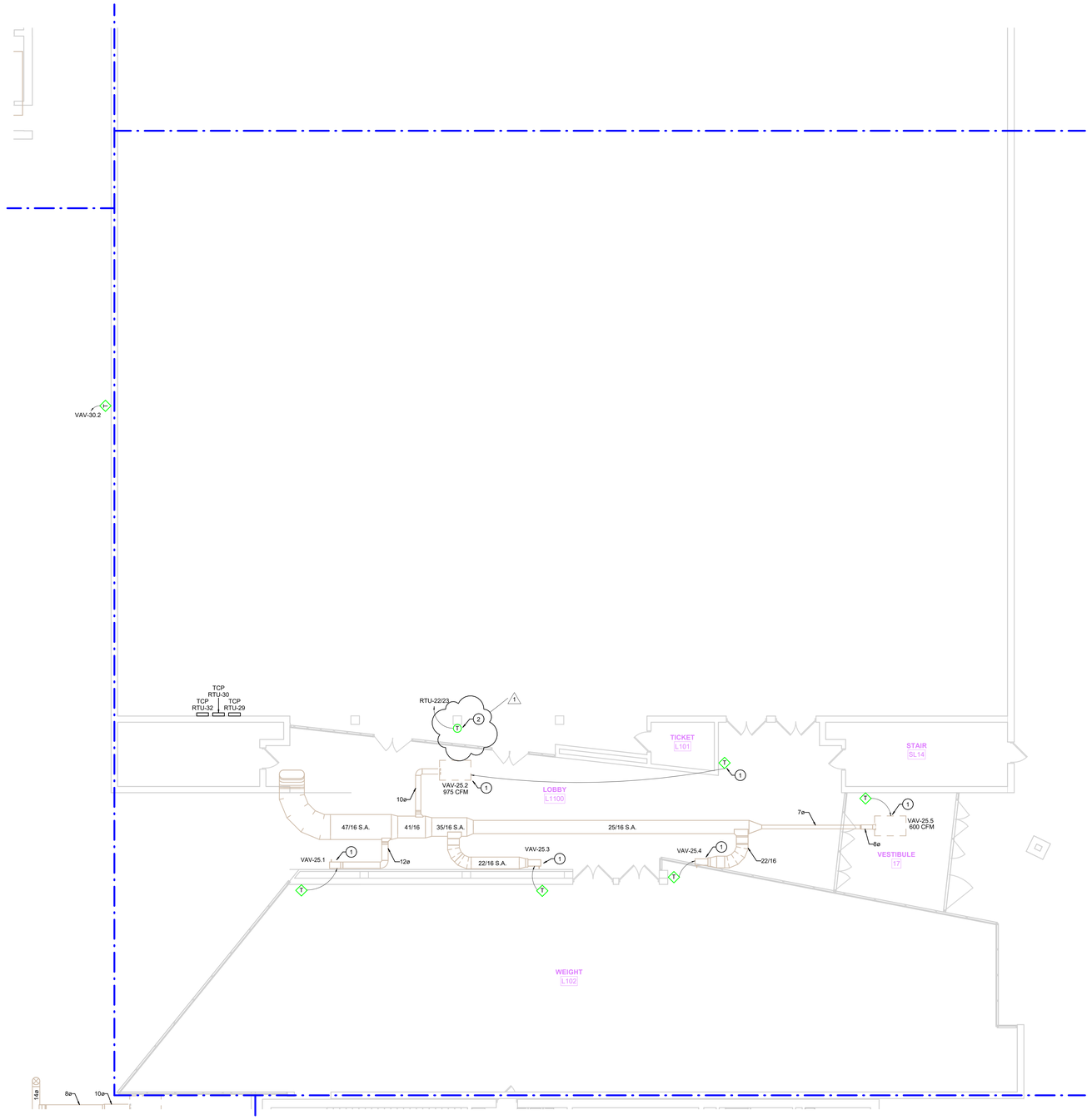
FIRST FLOOR - MECHANICAL PLAN - UNIT K

M101K

PRIMARY JOB # 24584

PLAN NOTES

1. REMOVE EXISTING VAV BOX CONTROLS INCLUDING CONTROLLER, ALL SENSORS, ALL ACTUATORS, ASSOCIATED WALL SENSOR(S), AND ALL ASSOCIATED WIRING COMPLETE. PROVIDE NEW CONTROLS SENSORS, ACTUATORS ON DAMPER/COIL WITH NEW WALL SENSOR IN SAME LOCATION. RUN NEW COMMUNICATION TRUNK WIRING. CLEAN VAV FLOW RING AND TUBING OF ALL DUST AND COMMISSION NEW CONTROLS AND VERIFY FLOW SETPOINTS WITH INDEPENDENT TAB.
2. PROVIDE NEW WALL SENSOR FOR ROOFTOP UNITS.



1 FIRST FLOOR - MECHANICAL PLAN - UNIT N
SCALE: 1/8" = 1'-0"

SCALE: 1/16" = 1'-0" | SCALE: 3/32" = 1'-0" | SCALE: 1/8" = 1'-0" | SCALE: 1/4" = 1'-0" | SCALE: 1/2" = 1'-0" | SCALE: 3/4" = 1'-0" | SCALE: 1" = 1'-0"

IF THE WHEEL PRINTED BELOW IS NOT SHOWN IN COLOR, THESE PRINTS IS NOT REPRESENTING ALL LINE TYPES CORRECTLY. CONTACT PRIMARY ENGINEERING FOR DIRECTIONS ON HOW TO OBTAIN A FULL COLOR SET OF PRINTS

PLOT DATE/TIME: 10/16/2024 9:06:12 AM

LANCER ASSOCIATES ARCHITECTURE
145 NORTH EAST STREET
INDIANAPOLIS, IN 46204

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Fort Wayne
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SUNMAN-DEARBORN COMMUNITY SCHOOLS
EAST CENTRAL HIGH SCHOOL RENOVATIONS
1 TROJAN ROAD

ANDREW STEPHEN LUDWIGSEN BACK
REGISTERED
PE11700017
STATE OF INDIANA
PROFESSIONAL ENGINEER

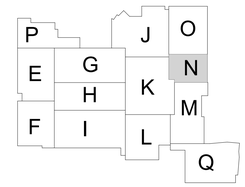
REVISIONS:

#	Date	Desc.
1	10/16/202	ADDENDUM #2
4		

100% CONSTRUCTION DOCUMENTS

PROJECT: #23138
DATE: 09/26/2024
DRAWN BY: ASL

FIRST FLOOR - MECHANICAL PLAN - UNIT N



N
TRUE NORTH

M101N

PRIMARY JOB # 24584

ROOFTOP UNIT SCHEDULE

TAG	RTU-1	RTU-2	RTU-3	RTU-4	RTU-5	RTU-6	RTU-7	RTU-8	RTU-9	RTU-10	RTU-11	RTU-12	RTU-13
MANUFACTURER	ADDISON	ADDISON	ADDISON	ADDISON	ADDISON	ADDISON	ADDISON	ADDISON	ADDISON	ADDISON	ADDISON	CARRIER	ADDISON
MODEL	PRMA 150 C2	PRMA 150 C2	PRRA 120 C2	PRMA 360 D6	PRMK 241 S5	PRMK 241 S5	PRMA 300 D6	PRMA 210 C2	PRMK 241 S5	PRMA 300 D6	PRMK 241 S5	50V2AX28	PRMA 150 C2
SERVICE	2ND FLR P	1ST FLR P	1ST FLR P	1ST FLR E	2ND FLR E/P	2ND FLR E	1ST FLR G	1ST FLR E/G	MEDIA CENTER	1ST FLR E/F/I	1ST FLR I	1ST FLR I	1ST FLR H
TYPE	VAV	VAV	VAV	VAV	VAV	VAV	VAV	VAV	VAV	VAV	VAV	VAV	VAV
ORIENTATION	VERTICAL	VERTICAL	VERTICAL	VERTICAL	VERTICAL	VERTICAL	VERTICAL	VERTICAL	VERTICAL	VERTICAL	VERTICAL	VERTICAL	VERTICAL
UNIT WIEGHT (LBS)	3260	3260	3218	7091	3948	3948	6779	3428	3948	6776	3948	5200	3260
FILTER AREA (S.F.)	40	40	40	108.3	83.3	8.3	108.3	40	83.3	108.3	83.3	-	40
FILTER APD (IN W.C.)	0.46	0.46	0.36	0.52	1.02	1.02	0.29	0.29	0.99	0.31	1.01	-	0.46
FILTER TYPE	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED
FILTER EFF.	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8
SUPPLY FAN	RTU-1	RTU-2	RTU-3	RTU-4	RTU-5	RTU-6	RTU-7	RTU-8	RTU-9	RTU-10	RTU-11	RTU-12	RTU-13
AIRFLOW (CFM)	4950	4950	4400	12775	7950	7950	9505	5000	7840	9775	7925	11300	4950
OUTSIDE AIR (CFM)	1770	930	660	4470	2910	2975	2025	2445	2535	3765	3825	3955	1755
TSP (IN W.C.)	3.01	3.01	2.47	3.52	4.63	4.63	2.53	2.49	4.66	2.86	4.40	-	3.01
ESP (IN W.C.)	1.63	1.63	1.39	2.02	1.58	1.58	1.44	1.63	1.68	1.70	1.36	1.80	1.63
RPM	2110	2110	1894	1609	2246	2246	1816	2029	2245	1884	2202	1942	2110
FAN QUANTITY	1	1	1	1	2	2	1	1	2	1	2	-	1
DRIVE TYPE	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT
MOTOR (HP, EA)	5	5	5	15	6.97	6.97	10	5	6.97	10	6.97	-	5
MOTOR (BHP, EA)	3.84	3.84	2.79	10.92	4.35	4.35	6.9	3.32	4.31	7.76	4.12	8.38	3.84
MOTOR TYPE	4-POLE VFD	4-POLE VFD	4-POLE VFD	4-POLE VFD	ECM	ECM	4-POLE VFD	4-POLE VFD	ECM	4-POLE VFD	ECM	-	4-POLE VFD
EXHAUST FAN	RTU-1	RTU-2	RTU-3	RTU-4	RTU-5	RTU-6	RTU-7	RTU-8	RTU-9	RTU-10	RTU-11	RTU-12	RTU-13
AIRFLOW (CFM)	4950	4950	4400	12775	7950	7950	9505	5000	7840	9775	7925	11300	4950
ESP (IN W.C.)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
RPM	1716	1716	1544	1570	1522	1522	1276	1731	1504	1306	1518	1187	1716
FAN QUANTITY	1	1	1	1	2	2	2	1	2	2	2	-	1
DRIVE TYPE	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT
MOTOR (HP, EA)	2	2	1 1/2	10	3.88	3.88	7 1/2	2	3.88	7 1/2	3.88	-	2
MOTOR (BHP, EA)	1.69	1.69	1.24	8.2	1.14	1.14	2.56	1.73	1.1	3.73	1.13	3.31	1.69
MOTOR TYPE	4-POLE VFD	4-POLE VFD	4-POLE VFD	4-POLE VFD	ECM	ECM	ECM	4-POLE VFD	ECM	ECM	ECM	-	4-POLE VFD
DX COOLING COIL	RTU-1	RTU-2	RTU-3	RTU-4	RTU-5	RTU-6	RTU-7	RTU-8	RTU-9	RTU-10	RTU-11	RTU-12	RTU-13
AIRFLOW (CFM)	4950	4950	4400	12775	7950	7950	9505	5000	7840	9775	7925	11300	4950
TOTAL CAP (MBH)	152	152	123	434	282	282	323	209	281	335	290	346	152
SENS CAP (MBH)	128	128	111	339	221	221	254	150	212	266	218	271	128
EAT DB/WB (DEG F)	80 / 66	80 / 66	78 / 64	81 / 67	81 / 66	81 / 66	78 / 65	81 / 67	81 / 66	81 / 67	83 / 68	81 / 67	80 / 66
LAT DB/WB (DEG F)	56 / 56	56 / 56	54 / 54	56 / 56	54 / 54	54 / 54	53 / 53	53 / 53	54 / 54	56 / 56	56 / 56	59 / 57	56 / 56
ROWS	6	6	6	6	6	6	6	6	6	6	6	-	6
FPI	12	12	12	12	12	12	12	12	12	12	12	-	12
APD (IN W.C.)	0.5	0.5	0.38	0.56	0.72	0.72	0.34	0.36	0.72	0.36	0.73	-	0.5
AIR VELOCITY (FPM)	412	412	366	442	496	496	329	312	490	338	495	-	412
REFRIGERANT	R454B	R454B	R454B	R454B	R454B	R454B	R454B	R454B	R454B	R454B	R454B	R454B	R454B
CIRCUITS	2	2	2	2	2	2	2	2	2	2	2	1	2
AMBIENT (DEG F)	95	95	95	95	95	95	95	95	95	95	95	95	95
STAGES	VFD	VFD	VFD	VFD	VFD	VFD	VFD	VFD	VFD	VFD	VFD	VFD	VFD
EER	9.6	9.6	10.1	10.5	9.6	9.6	10.3	10.5	9.6	10.3	10	10.5	9.6
INDIRECT GAS-FIRED HEAT	RTU-1	RTU-2	RTU-3	RTU-4	RTU-5	RTU-6	RTU-7	RTU-8	RTU-9	RTU-10	RTU-11	RTU-12	RTU-13
AIRFLOW (CFM)	-	-	-	-	-	-	-	-	-	-	-	-	-
INPUT CAP (MBH, EA)	-	-	-	-	-	-	-	-	-	-	-	-	-
OUTPUT CAP (MBH, EA)	-	-	-	-	-	-	-	-	-	-	-	-	-
EAT DB (DEG F)	-	-	-	-	-	-	-	-	-	-	-	-	-
LAT DB (DEG F)	-	-	-	-	-	-	-	-	-	-	-	-	-
FUEL	-	-	-	-	-	-	-	-	-	-	-	-	-
MODULATION	-	-	-	-	-	-	-	-	-	-	-	-	-
EFFICIENCY	-	-	-	-	-	-	-	-	-	-	-	-	-
APD (IN W.C.)	-	-	-	-	-	-	-	-	-	-	-	-	-
ELECTRICAL	RTU-1	RTU-2	RTU-3	RTU-4	RTU-5	RTU-6	RTU-7	RTU-8	RTU-9	RTU-10	RTU-11	RTU-12	RTU-13
VOLTAGE/PHASE	460/3	460/3	460/3	460/3	460/3	460/3	460/3	460/3	460/3	460/3	460/3	460/3	460/3
FLA	34.4	34.4	30.5	100.8	61	61	87.6	43.1	61	87.6	61	-	34.4
MCA	50.2	50.2	48.8	130.5	81.6	81.6	104.4	59.8	81.6	104.4	81.6	80	50.2
MFS	60	60	50	150	90	90	110	60	90	110	90	100	80
EXISTING INFORMATION													
EXISTING TAG	RTU-1 (NORTH)	RTU-2	RTU-3	RTU-4	RTU-5	RTU-6	RTU-7	RTU-8	RTU-9	RTU-10	RTU-11	RTU-12	RTU-13
EXISTING MFR	ADDISON	ADDISON	ADDISON	ADDISON	ADDISON	ADDISON	ADDISON	ADDISON	ADDISON	ADDISON	ADDISON	ADDISON	ADDISON
EXISTING MODEL	ARC150L24A	ARC150L24A	ARC120J24A	DC360P24B	ARC240M24A	ARC240M24A	DC300N24B	ARC200L24A	ARC240M24A	DC300N24B	ARC240M24A	DC300N24B	ARC150L24A
EXISTING SN	50105701001	50105701002	50105702001	50105710001	50105703001	50105703002	50105711001	50105704001	50105722001	50105712001	50105705001	50105723001	50105701003
EXISTING CURB DIM WxL (IN)	58"x120"	58"x120"	58"x120"	74"x318"	58"x144"	58"x144"	74"x318"	58"x144"	58"x144"	74"x318"	58"x150"	74"x318"	58"x120"
EXISTING VOLTAGE/PHASE	460/3	460/3		460/3	460/3		460/3	460/3		460/3			
EXISTING MCA	47.6			97	75.4		82.8	65.5		83.1			
EXISTING MFS	50			110	90		100	80		100			
	RTU-1	RTU-2	RTU-3	RTU-4	RTU-5	RTU-6	RTU-7	RTU-8	RTU-9	RTU-10	RTU-11	RTU-12	RTU-13
REMARKS:	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13

TAG	RTU-14	RTU-15	RTU-16	RTU-17	RTU-18	RTU-19	RTU-20	RTU-21	RTU-22	RTU-23	RTU-24	RTU-25	RTU-26
MANUFACTURER	ADDISON	ADDISON	ADDISON	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER
MODEL	PRMA 420 D6XL	PRMA 360 D6	PRMA 480 E6	50GC-M24	48V2DY34	50V2AX28	50V2AX28	50V2AX28	48V2DY30	48V2DY30	48V2DY30	48V2DX34	48GCRN09
SERVICE	KITCHEN	CAFETERIA	MAIN GYM	1ST FLR H	MAIN GYM	1ST FLR I	1ST FLR K	1ST/2ND O	FIELD HOUSE	FIELD HOUSE	FIELD HOUSE	1ST/2ND N	1ST FLR J
TYPE	SZ, IGH, HGRH	VAV	SZ, IGH, HGRH	VAV	SZ, IGH, HGRH	VAV	VAV	VAV	SZ, IGH, HGRH	SZ, IGH, HGRH	SZ, IGH, HGRH	VAV, IGH	SZ, IGH, HGRH
ORIENTATION	VERTICAL	VERTICAL	VERTICAL	VERTICAL	VERTICAL	VERTICAL	VERTICAL	VERTICAL	VERTICAL	VERTICAL	VERTICAL	VERTICAL	VERTICAL
UNIT WIEGHT (LBS)	7826	7003	9782	2790	6055	5200	5200	5200	6305	6305	6305	6215	1118
FILTER AREA (S.F.)	108.3	108.3	126.1	31.3	-	-	-	-	-	-	-	-	11.1
FILTER APD (IN W.C.)	0.29	0.54	0.34	-	-	-	-	-	-	-	-	-	-
FILTER TYPE	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED
FILTER EFF.	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8
SUPPLY FAN	RTU-14	RTU-15	RTU-16	RTU-17	RTU-18	RTU-19	RTU-20	RTU-21	RTU-22	RTU-23	RTU-24	RTU-25	RTU-26
AIRFLOW (CFM)	9500	12910	15000	8665	15000	10875	9150	10700	12000	12000	12000	15000	3000
OUTSIDE AIR (CFM)	2000	4355	7000	3945	7000	3465	4120	6955	3000	3000	3000	8250	450
TSP (IN W.C.)	3.54	3.72	3.89	-	-	-	-	-	-	-	-	-	-
ESP (IN W.C.)	1.50	2.33	1.20	1.66	1.20	1.70	1.50	1.80	1.20	1.20	1.20	1.20	1.75
RPM	1909	1638	2236	2153	2323	1875	1661	1883	1900	1900	1900	2150	1956
FAN QUANTITY	1	1	2	1	-	-	-	-	-	-	-	-	-
DRIVE TYPE	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT
MOTOR (HP, EA)	10	15	10	-	-	-	-	-	-	-	-	-	-
MOTOR (BHP, EA)	8.35	11.55	7.27	7.39	14.31	7.56	5.26	7.66	7.88	7.88	7.88	11.2	2.77
MOTOR TYPE	4-POLE VFD	4-POLE VFD	4-POLE VFD	-	-	-	-	-	-	-	-	-	-
EXHAUST FAN	RTU-14	RTU-15	RTU-16	RTU-17	RTU-18	RTU-19	RTU-20	RTU-21	RTU-22	RTU-23	RTU-24	RTU-25	RTU-26
AIRFLOW (CFM)	9500	12910	15000	4590	15000	10875	9150	10700	12000	12000	12000	15000	3000
ESP (IN W.C.)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
RPM	1276	1585	2250	-	1038	753	633	741	1523	1523	1520	1874	-
FAN QUANTITY	2	1	2	-	-	-	-	-	-	-	-	-	-
DRIVE TYPE	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT
MOTOR (HP, EA)	7 1/2	10	2	-	-	-	-	-	-	-	-	-	-
MOTOR (BHP, EA)	2.56	8.42	1.8	-	2.1	0.8	0.48	0.76	2.78	2.78	2.78	5.06	-
MOTOR TYPE	ECM	4-POLE VFD	4-POLE VFD	-	-	-	-	-	-	-	-	-	-
DX COOLING COIL	RTU-14	RTU-15	RTU-16	RTU-17	RTU-18	RTU-19	RTU-20	RTU-21	RTU-22	RTU-23	RTU-24	RTU-25	RTU-26
AIRFLOW (CFM)	9500	12910	15000	8665	15000	10875	9150	10700	12000	12000	12000	15000	3000
TOTAL CAP (MBH)	415	378	424	253	401	337	339	363	346	346	346	409	92
SENS CAP (MBH)	293	335	385	203	360	264	250	283	278	278	278	361	72
EAT DB/WB (DEG F)	81 / 67	81 / 66	76 / 64	83 / 68	83 / 68	80 / 66	83 / 68	86 / 70	79 / 65	79 / 65	79 / 65	84 / 69	78 / 64
LAT DB/WB (DEG F)	53 / 53	57 / 56	55 / 54	61 / 59	55 / 55	58 / 56	58 / 56	61 / 60	58 / 56	58 / 56	58 / 56	62 / 61	56 / 54
ROWS	6	6	6	-	-	-	-	-	-	-	-	-	-
FPI	12	12	12	-	-	-	-	-	-	-	-	-	-
APD (IN W.C.)	0.32	0.49	0.39	-	-	-	-	-	-	-	-	-	-
AIR VELOCITY (FPM)	328	446	359	-	-	-	-	-	-	-	-	-	-
REFRIGERANT	R454B	R454B	R454B	R454B	R454B	R454B	R454B	R454B	R454B	R454B	R454B	R454B	R454B
CIRCUITS	2	2	2	1	1	1	1	1	1	1	1	1	1
AMBIENT (DEG F)	95	95	95	95	95	95	95	95	95	95	95	95	95
STAGES	VFD	VFD	VFD	2	VFD	VFD	VFD	VFD	VFD	VFD	VFD	VFD	2
EER	10.8	8.9	13.7	11.6	9.8	10.5	10.5	10.5	10.3	10.3	10.3	9.8	11.8
INDIRECT GAS-FIRED HEAT	RTU-14	RTU-15	RTU-16	RTU-17	RTU-18	RTU-19	RTU-20	RTU-21	RTU-22	RTU-23	RTU-24	RTU-25	RTU-26
AIRFLOW (CFM)	9500	-	15000	-	15000	-	-	-	12000	12000	12000	15000	3000
INPUT CAP (MBH, EA)	800	-	600	-	650	-	-	-	650	650	650	650	180
OUTPUT CAP (MBH, EA)	648	-	486	-	527	-	-	-	527	527	527	527	148
EAT DB (DEG F)	58	-	56	-	38	-	-	-	52	52	52	32	60
LAT DB (DEG F)	121	-	86	-	70	-	-	-	93	93	93	65	106
FUEL	NAT GAS	-	NAT GAS	-	NAT GAS	-	-	-	NAT GAS	NAT GAS	NAT GAS	NAT GAS	NAT GAS
MODULATION	10 TO 1	-	10 TO 1	-	2-STAGE	-	-	-	2-STAGE	2-STAGE	2-STAGE	2-STAGE	2-STAGE
EFFICIENCY	81	-	81	-	81	-	-	-	81	81	81	81	82
APD (IN W.C.)	1.09	-	0.87	-	-	-	-	-	-	-	-	-	-
ELECTRICAL	RTU-14	RTU-15	RTU-16	RTU-17	RTU-18	RTU-19	RTU-20	RTU-21	RTU-22	RTU-23	RTU-24	RTU-25	RTU-26
VOLTAGE/PHASE	460/3	460/3	460/3	460/3	460/3	460/3	460/3	460/3	460/3	460/3	460/3	460/3	460/3
FLA	99.5	100.8	102.68	-	-	-	-	-	-	-	-	-	-
MCA	120.4	130.5	109.7	54	95	80	80	80	87	87	87	101	22
MFS	125	150	125	60	125	100	100	100	110	110	110	125	25
EXISTING INFORMATION													
EXISTING TAG	RTU-14	RTU-15	RTU-16	RTU-17	RTU-18	RTU-19	RTU-20	RTU-21	RTU-22	RTU-23	RTU-24	RTU-25	RTU-26
EXISTING MFR	ADDISON	ADDISON	ADDISON	ADDISON	ADDISON	ADDISON	ADDISON	ADDISON	ADDISON	ADDISON	ADDISON	ADDISON	ADDISON
EXISTING MODEL	DC420N24B	DC360P24B	DC420P24B	ARC240M24A	DC420P24B	DC300N24B	DC300M24B	DC300N24B	DC360N24B	DC360N24B	DC360N24B	DC420P24B	ARC084J24A
EXISTING SN	0501R5713001	50105714001	50105721001	50105705002	50105721002	50105716001	50105717001	50105718001	50105719001	50105719002	50105719003	50105721003	50105706001
EXISTING CURB DIM WxL (IN)	74"x318"	74"x318"	74"x396"	58"x144"	74"x396"	74"x318"	74"x318"	74"x318"	74"x354"	74"x354"	74"x354"	74"x354"	40"x120"
EXISTING VOLTAGE/PHASE	460/3	460/3	460/3	460/3	460/3	460/3		460/3					460/3
EXISTING MCA	102.8	96.8	129	75.3	129	82.8		83.5					
EXISTING MFS	110	110	150	90	150	100		100					30
	RTU-14	RTU-15	RTU-16	RTU-17	RTU-18	RTU-19	RTU-20	RTU-21	RTU-22	RTU-23	RTU-24	RTU-25	RTU-26
REMARKS:	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 16	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16

TAG	RTU-27	RTU-28	RTU-29	RTU-30	RTU-31	RTU-32	RTU-33	RTU-34	RTU-35	RTU-36	RTU-37	RTU-38	RTU-42
MANUFACTURER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER	CARRIER
MODEL	48V2DY28	50GC-M24	48V3DY70	50GC-M20	48V2DY34	48V2DY34	48V2DY28	50GC-N09	48V3DY74	48V2DT54	50GC-N07	48GCTN17	48GCRK06
SERVICE	AUDITORIUM	1ST FLR J	STAGE	1ST FLR K	MAIN GYM	MAIN GYM	AUDITORIUM	3RD FLR J	AUX GYM	1ST FLR F	1ST FLR I	1ST FLR M	MAINT. ADDN.
TYPE	SZ, IGH, HGRH	VAV	SZ, IGH, HGRH	VAV	SZ, IGH, HGRH	SZ, IGH, HGRH	SZ, IGH, HGRH	SZ, HGRH	SZ, IGH, HGRH	VAV, IGH	SZ, HGRH	SZ, IGH, HGRH	SZ, IGH, HGRH
ORIENTATION	VERTICAL	VERTICAL	VERTICAL	VERTICAL	VERTICAL	VERTICAL	VERTICAL	VERTICAL	HORIZONTAL	VERTICAL	VERTICAL	VERTICAL	VERTICAL
UNIT WIEGHT (LBS)	6055	2790	9671	2466	6305	6305	6055	1043	9738	9359	918	2403	1006
FILTER AREA (S.F.)	-	31.3	50	20.8	-	-	-	11.1	50	50	4.4	6.9	-
FILTER APD (IN W.C.)	-	-	0.15	-	-	-	-	-	0.18	0.14	-	-	-
FILTER TYPE	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED	2" PLEATED
FILTER EFF.	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8	MERV 8
SUPPLY FAN	RTU-27	RTU-28	RTU-29	RTU-30	RTU-31	RTU-32	RTU-33	RTU-34	RTU-35	RTU-36	RTU-37	RTU-38	RTU-42
AIRFLOW (CFM)	10000	7500	26000	6325	15000	15000	10000	3200	32000	17420	2700	4920	2200
OUTSIDE AIR (CFM)	4000	2600	1300	2215	7000	7000	4000	0	3000	4980	270	2450	440
TSP (IN W.C.)	-	-	2.3	-	-	-	-	-	2.5	2.2	-	-	-
ESP (IN W.C.)	1.00	1.60	1.00	1.60	1.20	1.20	1.00	0.75	0.90	1.60	1.00	1.00	1.00
RPM	1680	1991	2630	1812	2251	2251	1680	1601	2540	2047	1627	1501	2394
FAN QUANTITY	-	-	4	-	-	-	-	-	6	4	-	-	1
DRIVE TYPE	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT
MOTOR (HP, EA)	-	-	9.4	-	-	-	-	-	9.4	4.8	-	-	-
MOTOR (BHP, EA)	5.46	5.9	6.83	4.47	12.94	12.94	5.46	1.46	6.4	3.14	1.61	2.54	1.45
MOTOR TYPE	-	-	ECM	-	-	-	-	-	ECM	ECM	-	-	-
EXHAUST FAN	RTU-27	RTU-28	RTU-29	RTU-30	RTU-31	RTU-32	RTU-33	RTU-34	RTU-35	RTU-36	RTU-37	RTU-38	RTU-42
AIRFLOW (CFM)	10000	4590	26000	4590	15000	15000	10000	3200	32000	17420	2700	4590	2200
ESP (IN W.C.)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
RPM	1116	-	2161	-	1874	1874	1116	-	2238	2206	-	-	-
FAN QUANTITY	-	-	3	-	-	-	-	-	3	2	-	-	-
DRIVE TYPE	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT	DIRECT
MOTOR (HP, EA)	-	-	9.7	-	-	-	-	-	9.7	9.7	-	-	-
MOTOR (BHP, EA)	2.78	-	4.2	-	5.06	5.06	2.78	-	4.6	4.2	-	-	-
MOTOR TYPE	-	-	ECM	-	-	-	-	-	ECM	ECM	-	-	-
DX COOLING COIL	RTU-27	RTU-28	RTU-29	RTU-30	RTU-31	RTU-32	RTU-33	RTU-34	RTU-35	RTU-36	RTU-37	RTU-38	RTU-42
AIRFLOW (CFM)	10000	7500	26000	6325	15000	15000	10000	3200	35000	17420	2700	4920	2200
TOTAL CAP (MBH)	338	241	720	207	401	401	338	90	842	614	69	183	47
SENS CAP (MBH)	263	178	556	157	360	360	263	71	704	454	56	137	44
EAT DB/WB (DEG F)	82 / 67	81 / 67	76 / 63	81 / 67	83 / 68	83 / 68	82 / 67	75 / 62	77 / 63	80 / 66	77 / 63	83 / 68	80 / 67
LAT DB/WB (DEG F)	58 / 56	59 / 57	56 / 55	58 / 57	55 / 55	55 / 55	58 / 56	55 / 55	56 / 54	58 / 54	58 / 54	57 / 56	55 / 55
ROWS	-	-	6	-	-	-	-	-	6	4	-	-	-
FPI	-	-	12	-	-	-	-	-	12	12	-	-	-
APD (IN W.C.)	-	-	-	-	-	-	-	-	-	-	-	-	-
AIR VELOCITY (FPM)	-	-	-	-	-	-	-	-	-	-	-	-	-
REFRIGERANT	R454B	R454B	R454B	R454B	R454B	R454B	R454B	R454B	R454B	R454B	R454B	R454B	R454B
CIRCUITS	1	1	2	1	1	1	1		2	2	1	1	1
AMBIENT (DEG F)	95	95	95	95	95	95	95	95	95	95	95	95	95
STAGES	VFD	2	VFD	2	VFD	VFD	VFD		VFD	VFD	2	2	2
EER	10.4	11.6	9.8	12	9.8	9.8	10.4		9.5	10.4	12.4	11.8	12.8
INDIRECT GAS-FIRED HEAT	RTU-27	RTU-28	RTU-29	RTU-30	RTU-31	RTU-32	RTU-33	RTU-34	RTU-35	RTU-36	RTU-37	RTU-38	RTU-42
AIRFLOW (CFM)	10000	-	26000	-	15000	15000	10000	-	32000	17420	-	4920	2200
INPUT CAP (MBH, EA)	650	-	1068	-	650	650	650	-	1068	1068	-	400	110
OUTPUT CAP (MBH, EA)	527	-	865	-	527	527	527	-	865	865	-	324	88
EAT DB (DEG F)	42	-	67	-	38	38	42	-	63	50	-	35	60
LAT DB (DEG F)	90	-	96	-	70	70	90	-	94	96	-	96	97
FUEL	NAT GAS	-	NAT GAS	-	NAT GAS	NAT GAS	NAT GAS	-	NAT GAS	NAT GAS	-	NAT GAS	NAT. GAS
MODULATION	2-STAGE	-	2-STAGE	-	2-STAGE	2-STAGE	2-STAGE	-	2-STAGE	2-STAGE	-	2-STAGE	2-STAGE
EFFICIENCY	81	-	81	-	81	81	81	-	81	81	-	81	80
APD (IN W.C.)	-	-	-	-	-	-	-	-	-	-	-	-	-
ELECTRICAL	RTU-27	RTU-28	RTU-29	RTU-30	RTU-31	RTU-32	RTU-33	RTU-34	RTU-35	RTU-36	RTU-37	RTU-38	RTU-42
VOLTAGE/PHASE	460/3	460/3	460/3	460/3	460/3	460/3	460/3	460/3	460/3	460/3	208/3	460/3	460/3
FLA	-	-	183.3	-	-	-	-	-	211.7	139.5	-	-	-
MCA	80	54	190	45	101	101	80	22	219	150	39	39	14
MFS	100	60	200	60	125	125	100	25	225	175	50	50	20
EXISTING INFORMATION													
EXISTING TAG	RTU-27	RTU-28	RTU-29	RTU-30	RTU-31	RTU-32	RTU-33	RTU-34	RTU-35 (EAST)	RTU-1 (SOUTH)	RTU	RTU	-
EXISTING MFR	ADDISON	ADDISON	YORK	ADDISON	ADDISON	ADDISON	ADDISON	ADDISON	YORK	TRANE	CARRIER	CARRIER	-
EXISTING MODEL	DC300M24B	ARC240L24A	YPAL070MVC	ARC200L24A	DC420P24B	DC420P24B	DC300M24B	ARC096G24A	YPAL075MCC	SFHFC554HD	50HCA07A2A5	48HCED20A2	-
EXISTING SN	50105720001	50105707001	RHPM012287	50105708001	50105721004	50105715001	50105720002	50105709001	RGPM011942	J94G72106	1210G10462	4133P20809	-
EXISTING CURB DIM WxL (IN)	74"x354"	58"x146"	88"x450"	58"x146"	74"x396"	99"x396"	74"x354"	58"x98"	92"x454"	-	54"x84"	69"x130"	-
EXISTING VOLTAGE/PHASE	460/3	460/3	460/3		460/3	460/3			460/3	460/3	208-230/3	460/3	-
EXISTING MCA	76.8	69.3	180		129	76.8			151	154	34.3	38.2	-
EXISTING MFS	90	80	200		150	90			175	175	50	50	-
	RTU-27	RTU-28	RTU-29	RTU-30	RTU-31	RTU-32	RTU-33	RTU-34	RTU-35	RTU-36	RTU-37	RTU-38	-
REMARKS:	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 16	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16

REMARKS:

1. PROVIDE AND INSTALL WITH MOTORIZED OUTSIDE AIR DAMPER AND RETURN AIR DAMPER.
2. PROVIDE AND INSTALL WITH PHASE LOSS PROTECTION.
3. PROVIDE AND INSTALL WITH SINGLE POINT ELECTRICAL POWER CONNECTION.
4. PROVIDE AND INSATLL WITH OUTSIDE INTAKE HOOD WITH INLET SCREEN.
5. PROVIDE AND INSTALL WITH FACTORY INSTALLED ELECTRICAL DISCONNECT SWITCH.
6. PROVIDE AND INSTALL WITH HINGED ACCESS DOORS.
7. PROVIDE AND INSTALL WITH LOUVERED HAIL GUARDS ON ALL CONDENSER COILS. SHIP WITH COIL PROTECTION PANELS TO PREVENT DAMAGE DURING SHIPPING, RIGGING, INSTALLATION.
8. PROVIDE AND INSTALL WITH INSULATED METAL CURB ADAPTER.
9. PROVIDE AND INSTALL WITH POWERED EXHAUST.
10. NOT USED.
11. PROVIDE WITH BACNET CONTROLLER SIMILAR TO CARRIER SYSTEM VU.
12. PROVIDE AND INSTALL WITH FACTORY MOUNTED CONVENIENCE RECEPTACLE FOR FIELD WIRING BY EC.
13. PROVIDE AND INSTALL WITH INSULATED STAINLESS STEEL DRAIN PAN.
14. PROVIDE AND INSTALL WITH 24" TALL INSULATED METAL ROOF CURB.
15. PROVIDE AND INSTALL WITH MODULATING HOT GAS REHEAT.
16. PROVIDE AND INSTALL WITH STAINLESS STEEL HEAT EXCHANGER.

2

NOTES:

1. EXISTING EQUIPMENT INFORMATION SHOWN FOR REFERENCE ONLY. CONTRACTOR SHALL VERIFY ALL EXISTING INFORMATION AND CONDITIONS.

BOILER SCHEDULE

TAG	MFR.	MODEL	HEATING INPUT (MBH)	HEATING OUTPUT (MBH)	THERMAL EFF (%)	FUEL	BURNER TURNDOWN	T&P RELIEF PRESS...	FUEL PRESS. (IN W.C.)	GAS CONN (IN)	WATER CONN (IN)	FLUE OUTLET (IN)	FLUE MATL.	DESIGN FLOW (GPM)	MIN FLOW (GPM)	WATER PD (FT)	TEMP RISE (DEG F)	ELEC (V/PH)	FLA	REMARKS
B-1	WEIL-MCLAIN	SVF 2000 - EXISTING	1999	1923	96.2%	NAT. GAS	10:1	50	3.5 - 14	2	3.0	8	PP/CPVC	190	49	4.4	20	120/1	23.2	5, 6
B-2	WEIL-MCLAIN	SVF 2000 - EXISTING	1999	1923	96.2%	NAT. GAS	10:1	50	3.5 - 14	2	3.0	8	PP/CPVC	190	49	4.4	20	120/1	23.2	5, 6
B-3	WEIL-MCLAIN	SVF 2000	1999	1923	96.2%	NAT. GAS	10:1	50	3.5 - 14	2	3.0	8	PP/CPVC	190	49	4.4	20	120/1	23.2	1, 2, 3, 4, 6
B-4	WEIL-MCLAIN	SVF 2000	1999	1923	96.2%	NAT. GAS	10:1	50	3.5 - 14	2	3.0	8	PP/CPVC	190	49	4.4	20	120/1	23.2	1, 2, 3, 4, 6
B-5	WEIL-MCLAIN	SVF 2000	1999	1923	96.2%	NAT. GAS	10:1	50	3.5 - 14	2	3.0	8	PP/CPVC	190	49	4.4	20	120/1	23.2	1, 2, 3, 4, 6
B-6	WEIL-MCLAIN	SVF 2000	1999	1923	96.2%	NAT. GAS	10:1	50	3.5 - 14	2	3.0	8	PP/CPVC	190	49	4.4	20	120/1	23.2	1, 2, 3, 4, 6

REMARKS:

1. PROVIDE AND INSTALL WITH LOW WATER CUT-OFF.
2. PROVIDE WITH CONDENSATE NEUTRALIZATION TANK WITH LIMESTONE.
3. BOILERS SHALL BE PROVIDED WITH INTEGRAL SEQUENCER TO CONNECT ALL BOILERS INTO A COMMON TEAM. PROVIDE ALL ASSOCIATED CONTROLLERS, WIRING, PROGRAMMING, SETUP, ETC. FOR A FULLY FUNCITONAL SYSTEM IN EVERY RESPECT.
4. BOILER MFR SHALL VERIFY ALL FLUE/INTAKE SIZING AND ROUTING.
5. EXISTING EQUIPMENT SHOWN FOR REFERENCE ONLY. INCLUDE FACTORY RE-STARTUP OF THESE BOILERS WITH NEW BOILERS. UPDATE FIRMWARE AS REQURIED FOR ENTIRE TEAM.
6. BOILER MFR SHALL PROVIDE WITH VARIABLE SPEED PRIMARY PUMP AND CONTROL PUMP FROM BOILER. REFER TO PUMP SCHEDULE FOR ADDITIONAL INFORMATION.

HOT WATER CABINET HEATER SCHEDULE

TAG	MFR.	MODEL	LOCATION	TYPE	CAPACITY (MBH)	AIRFLOW (CFM)	MOTOR (HP)	AMPS	RPM	EWT/LWT (DEG F)	FLOW (GPM)	ROWS	FINS/FT	CONTROL VALVE	ELEC (V/PH)	REMARKS
CUH-F1	STERLING	FI-1110-04	UNIT F 1ST FLOOR	FI	27.8	355	1/10	1.4	875	135 / 99	2	2	144	3-WAY	120/1	1, 2, 3
CUH-F2	STERLING	FI-1110-04	UNIT F 1ST FLOOR	FI	27.8	355	1/10	1.4	875	135 / 99	2	2	144	3-WAY	120/1	1, 2, 3
CUH-F3	STERLING	FI-1110-04	UNIT F 1ST FLOOR	FI	27.8	355	1/10	1.4	875	135 / 99	2	2	144	3-WAY	120/1	1, 2, 3
CUH-F4	STERLING	FI-1110-04	UNIT F 1ST FLOOR	FI	27.8	355	1/10	1.4	875	135 / 99	2	2	144	3-WAY	120/1	1, 2, 3

REMARKS:

1. PROVIDE AND INSTALL WITH FACTORY WIRED ELECTRICAL DISCONNECT.
2. PROVIDE WITH TAMPER RESISTANT FASTENERS, AND 16 GA CONTSTRUCTION. PROVIDE 1 KEY FOR EACH UNIT.
3. PROVIDE WITH 2 ROW COIL AND 1" MERV 11 PLEATED FILTER.

IF THE WHEEL PRINTED BELOW IS NOT SHOWN IN COLOR, THIS SET OF PRINTS IS NOT REPRESENTING ALL LINE TYPES CORRECTLY. CONTACT PRIMARY ENGINEERING FOR DIRECTIONS ON HOW TO OBTAIN A FULL COLOR SET OF PRINTS

LANCER ASSOCIATES ARCHITECTURE
145 NORTH EAST STREET
INDIANAPOLIS, IN 46204

PRIMARY ENGINEERING INC
Fort Wayne: 2828 Lake Ave, Fort Wayne, Indiana 46805, 260.424.0444 ph, info@primary-eng.com
Indianapolis: 9780 Crosspoint Blvd., Suite 103, Indianapolis, Indiana 46256, 317.324.1221 ph, www.primary-eng.com

SUNMAN-DEARBORN COMMUNITY SCHOOLS
EAST CENTRAL HIGH CHOOL RENOVATIONS
1 TROJAN ROAD

ANDREW STEPHEN LOUDERBACK
REGISTERED
PE11700017
STATE OF INDIANA
PROFESSIONAL ENGINEER

REVISIONS:

#	Date	Desc.
1	10/11/24	ADDENDUM #1
2	10/18/2024	ADDENDUM #2

100% CONSTRUCTION DOCUMENTS

PROJECT: #23138
DATE: 09/26/2024
DRAWN BY: ASL

MECHANICAL SCHEDULES

M501

PRIMARY JOB # 24584

CONTROLS POINT LIST SCHEDULE

Sunman Dearborn Schools
East Central High School

Point Description	HARDWARE OUTPUT (O) DGTAL: Control Relay/Contactor	Floating Point Control	ANALOG: Solenoid Valve	Pneumatic Transducer	Electrical Transducer	4-20 ma or 0-10 VDC	INPUT (T, D, V, C) DIGITAL: Pressure Switch	Flow Switch	Space Occupancy Sensor	Current Switch	Override Button	Contact Closure	Protocell	Auxiliary Contact	KW Meter Contact	ANALOG: Temperature	Relative Humidity	Set Point Adjustment	Carbon Dioxide Level (ppm)	Carbon Monoxide (ppm)	Lighting Level (foot-candles)	Pressure (in H2O, in H2O, DP)	Flow Measurement (gpm/cfm)	Electrical Current Flow (amps)	Position Feedback	Trending	ALARMS DGTAL: Equipment Alarm	Freezestat Alarm	Maintenance Notification	High Limit	Low Limit (Temperature)	Run Time Alarm	SOFTWARE BMS FUNCTIONS: Scheduled On/Off	Optimum Start/Stop	Totalization	O.A. Reset	Lead/Lag Control	BACNET software point	Lighting Control Integration	Color Graphics Item
Outside Air																																							
Rooftop Unit VAV w/ relief (RTU-1 to 41)																																							
Supply fan(s)																																							
Supply air duct main static pressure						■																																	
OA damper						■																																	
RA damper						■																																	
Cooling stages/modulation (2)	■					■																																	
Heating stages/modulation (2)	■					■																																	
Dehum mode / hot gas reheat																																							
Return air																	■	■																					
Mixed air																	■	■																					
Supply air																	■	■																					
Relief fan(s)						■																				■					■								
Relief damper	■																									■					■								
2 Zone differential pressure																								■														
Space (SZ units only)										■							■	■		■																		
Freezestat											■																	■										
Boiler Plant																																							
Boiler Plant enable/disable	■																																						
Hot water supply setpoint						■																																	
Boiler alarm (6)												■																											
Boiler firing rate (6)																																							
Boiler status (6)																																							
Boiler reserving temp (6)																																							
Boiler pump status (6)																										■												
HWS loop to building																	■											■					■					
HWR loop from building																																							
Hot water pump (HWP-1/2)						■																				■					■								
HWS loop DP sensor																								■														
Boiler Room Carbon Monoxide																					■					■			■									
VAV series fan-reheat boxes (VAV-1 to 15)																																							
Primary air damper						■																																	
Primary airflow (cfm)																										■												
Supply fan						■																				■												
Hot water reheat valve	■																																						
Discharge air																	■	■										■					■					
2 Space												■					■	■		■								■										
VAV shutoff-reheat boxes (all other vav's)																																							
Primary air damper						■																																	
Primary airflow (cfm)																										■												
Hot water reheat valve	■	■																																					
Ceiling radiation heat	■																																						
Discharge air																	■	■										■					■					
2 Space												■					■	■		■								■										
Fan Coil Units (HW/CHW)																																							
Fan start/stop	■																																						
Space												■					■	■		■								■										
Chilled water valve						■																																	
Hot water valve						■																				■												
OA damper																										■												
Toilet Exhaust Fans (EF-#)																																							
Fan start/stop	■																																						
2 Fan motor status																										■												
Control damper	■																									■												
General Exhaust Fans (EF-#)																																							
Local start/stop switch	■																																						
Fan motor status																										■												
Control damper	■																									■												
Domestic water heater plant																																							
Water heater status (2)																																							
Water heater circ pump status (2)																										■												
Storage tank temp																	■																					
Thermostatic mixing valve disch																																							
HWRP-1 and 2 enable/disable	■																									■												
Lighting Control Relays																																							
Exterior photo sensor													■																■									
Exterior lighting contactors (10)	■																																	■					
Exterior lighting contactors (19)	■																																	■					
TORX time clock contactor (1)	■																																	■					
(Refer to electrical drawing for locations)																																							
Greenhouse																																							
Hot water ciriculation pump	■																																						
Space temp sensor																	■											■	■									
Data Room (MDF and IDF's)																																							
Space temperature (5)																	■									■			■									
Power Monitor																																							
Voltage of each phase (3)																																							
Amps of each phase (3)																																							
KW of each phase (3)																																							
Total Amps																																							
Total KW																																							
Cabinet Unit Heaters																																							
Space																	■											■									
HW control valve						■																																	
Supply fan	■																																						
Kitchen																																							
Freezer (1)																	■											■									
Cooler (2)																	■											■									

LANCER ASSOCIATES ARCHITECTURE
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INDIANAPOLIS, IN 46204

SUNMAN-DEARBORN COMMUNITY SCHOOLS
EAST CENTRAL HIGH CHOOL RENOVATIONS
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REVISIONS:

#	Date	Descr.
1	10/11/24	ADDENDUM #1
2	10/18/202	ADDENDUM #2

100% CONSTRUCTION DOCUMENTS

PROJECT: #23138
DATE: 09/26/2024
DRAWN BY: ASL

MECHANICAL CONTROLS

M601

PRIMARY JOB # 24584

IF THE WHEEL PRINTED BELOW IS NOT SHOWN IN COLOR, THIS SET OF PRINTS IS NOT REPRESENTING ALL LINE TYPES CORRECTLY. CONTACT PRIMARY ENGINEERING FOR DIRECTIONS ON HOW TO OBTAIN A FULL COLOR SET OF PRINTS

PLOT DATE/TIME: 10/18/2024 8:54:39 AM