

## ADDENDUM NO. 3

**Chattanooga Public Library  
HVAC and Electrical Renovations, Phase Two  
City Contract No. L-19-001-201  
Chattanooga, Tennessee**

**Date: 21 Oct 2019**

The following amendments to the specifications and/or revisions to the drawings shall be a part of the contract documents. Bidders therefore shall consider them when preparing cost estimates, and the contractors shall be bound by them.

### **CITY OF CHATTANOOGA FORMS**

#### **Exhibit C Release**

Issued as part of this addendum

### **SPECIFICATIONS**

#### **Section 23 09 23 Direct Digital Temperature Controls and EMS**

Re-issued as part of this addendum

### **DRAWINGS**

#### **Sheet MD-100 HVAC Demo Ground Floor**

Re-issued as part of this addendum.

#### **Sheet MD-101 HVAC Demo 1<sup>st</sup> Floor**

Re-issued as part of this addendum.

#### **Sheet MD-102 HVAC Demo 2<sup>nd</sup> Floor**

Re-issued as part of this addendum.

#### **Sheet MD-103 HVAC Demo 3<sup>rd</sup> Floor**

Re-issued as part of this addendum.

#### **Sheet MD-104 HVAC Demo 4<sup>th</sup> Floor**

Re-issued as part of this addendum.

#### **Sheet MD-200 HVAC Piping Demo Ground Floor**

Re-issued as part of this addendum.

#### **Sheet MD-201 HVAC Piping Demo 1<sup>st</sup> Floor**

Re-issued as part of this addendum.

#### **Sheet MD-204 HVAC Piping Demo 4<sup>th</sup> Floor**

Re-issued as part of this addendum.

#### **Sheet E-001 Electrical Legends**

Re-issued as part of this addendum.

#### **Sheet E-100 Electrical Ground Floor**

Re-issued as part of this addendum.

**Sheet E-101 Electrical First Floor**

Re-issued as part of this addendum.

**Sheet E-104 Electrical Fourth Floor**

Re-issued as part of this addendum.

**Sheet E-200 Electrical Riser Diagram**

Re-issued as part of this addendum.

**EXHIBIT C  
RELEASE**

The undersigned, \_\_\_\_\_, as the Owner pursuant to a Construction Contract with \_\_\_\_\_ ("Contractor") dated \_\_\_\_\_ (the "Contract") hereby authorizes SunTrust Bank ("Bank") to release \_\_\_\_\_ (\$) paid as retainage pursuant to that certain Escrow Agreement between and among the undersigned, \_\_\_\_\_, ("Owner"), Contractor, and Bank, and dated the \_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, which agreement is specifically incorporated herein by reference. This release is executed for the sole purpose of releasing the amounts held in escrow as aforesaid and specifically does not, and shall not, be construed to release or otherwise affect any claims or rights which Owner/Borrower has or may have against Contractor pursuant to said contract or the work performed thereunder.

**[Insert Check/Wiring Instructions]**

Attest:

**OWNER:**

\_\_\_\_\_  
Secretary

By:

Title: \_\_\_\_\_

STATE OF  
COUNTY OF

Affiant makes oath that the above is true, as sworn before me, a Notary Public, this \_\_\_\_ day of \_\_\_\_\_, 20\_\_.

\_\_\_\_\_  
Notary Public

(SEAL)

My Commission Expires \_\_\_\_\_

**APPROVED BY CONTRACTOR:**

\_\_\_\_\_

By: \_\_\_\_\_

Title: \_\_\_\_\_

## **SECTION 23 09 23**

### **DIRECT DIGITAL TEMPERATURE CONTROLS AND EMS**

#### **REVISION 1 – 10/21/2019**

#### **PART 1 - GENERAL:**

##### **1.1 OVERVIEW:**

The proposed system shall be an extension of the existing Delta Energy Management and Building Automation System (BAS) at the City of Chattanooga. All modifications to the existing system and building graphics to incorporate the work described under this project specification shall be included. This shall include updating the facility map, building floor plans and applicable indexes. The system shall provide the Direct Digital Control (DDC), Energy Management and Building Automation System (BAS) for the air conditioning, heating and ventilating systems as detailed in the Input/Output Summaries and as specified herein.

##### **1.2 SCOPE OF WORK:**

###### **A. Contractor's Responsibilities:**

1. Controls Contractor shall furnish and install all necessary hardware, wiring, computing equipment and software as defined in this specification. Conduit stub outs within walls shall be furnished and installed under Division 26. In areas with cable tray, the Electrical Contractor shall in each classroom & lab provide a box with conduit stubbed out above ceiling & bushed. HVAC control cables will run in cable tray to EMS panels. In areas without cable tray, the Controls Contractor shall provide & install conduit from the sensor or control point location to the nearest EMS panel. Where an EMS panel is added beyond what is shown on the electrical drawings, the Controls Contractor shall provide & install a 1-1/4" conduit path to the nearest EMS panel.
2. Provide any upgrades as they become available during the course of the project to system software and install them to the system.
3. All electrical wiring for this system shall be furnished and installed by this contractor and shall be of a uniform color throughout the installation.

###### **B. System Requirements:**

1. All material and equipment used shall be standard components, regularly manufactured and available and not custom designed especially for this project. All systems and components, except site-specific software, shall have previously been thoroughly tested and proven in actual use prior to installation on this project.
2. The system architecture shall be fully modular permitting expansion of application software, system peripherals and field hardware.
3. The system, upon completion of the installation and prior to acceptance of the project, shall perform all operating functions as detailed in this specification.

###### **C. Products Furnished But Not Installed Under This Section:**

1. Sensors and Transmitters:
  - a. Flow meters

- b. Press and temp sensor wells & sockets
    - c. Temp sensor wells and sockets
  - 2. Control Valves:
    - a. Control valves
  - 3. Control Dampers:
    - b. Automated Dampers
  
- D. Air Terminal Units:
  - 1. VAV boxes: VAV Terminal Units shall be furnished configured to accept control inputs from an external building automation system controller as specified. Factory mounted safeties and other controls shall not interfere with this controller.
  
- E. Central HVAC Equipment:
  - 1. Packaged AHU or chiller controls: Unit shall be furnished configured to accept control inputs from an external building automation system controller as specified. Factory mounted safeties and other controls shall not interfere with this controller.
  
- F. Decentralized HVAC Equipment:
  - 1. Unit ventilators, unit heaters, fan coils, etc.: Unit ventilators, unit heaters, fan coils, cabinet heaters, convective or fin tube heaters, zone reheat, and similar terminal units: These units shall be furnished configured to accept control inputs from an external building automation system controller as specified. Factory mounted safeties and other controls shall not interfere with this controller.
  
- G. Low-Voltage Controllers:
  - 1. Variable frequency drives: The variable frequency drive (VFD) vendor shall furnish VFDs with an interface to the control and monitoring points specified. These specified points shall be the minimum acceptable interface to the VFD. The connection to these points shall be by Modbus or BACnet. Start/stop and speed control to be hard wired.
  
- H. Communications with Third Party Equipment:
  - 1. Any additional integral control systems included with the products integrated with the work of this section shall be furnished with a BACnet or Modbus interface for integration into the Direct Digital Control System described in this section.
  
- I. Modbus System Intergration:
  - 1. The Network Area Controller shall support the integration of device data from Modbus RTU, ASCII, or TCP control system devices. The connection to the Modbus system shall be via an RS-232, RS485, or Ethernet IP as required by the device.
  - 2. Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of the Modbus system data into the FPMS. Objects provided shall include at a minimum:
    - a. Read/Write Modbus AI Registers
    - b. Read/Write Modbus AO Registers
    - c. Read/Write Modbus BI Registers
    - d. Read/Write Modbus BO Registers
  - 3. All scheduling, alarming, logging, and global supervisory control functions, of the Modbus system devices, shall be performed by the Network Area Controller.
  - 4. The BAS supplier shall provide a Modbus system communications driver. The equipment system vendor that provided the equipment utilizing Modbus shall provide documentation of the system's Modbus interface and shall provide factory support at no charge during system commissioning.

### **1.3 CODES AND STANDARDS:**

- A. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authorities' codes and ordinances or these plans and specifications. As a minimum, the installation shall comply with current editions in effect 30 days prior to receipt of bids of the following codes:
1. National Electric Code (NEC)
  2. International Building Code (IBC)
    - a. Section 719 Ducts and Air Transfer Openings
    - b. Section 907 Fire Alarm and Detection Systems
    - c. Section 909 Smoke Control Systems
    - d. Chapter 28 Mechanical
  3. International Mechanical Code (IMC)
  4. ANSI/ASHRAE 135-2004: Data Communication Protocol for Building Automation and Control Systems (BACnet)

B. Manufacturer's Quality System:

The control system manufacturer shall be ISO9001 listed for design and manufacture of environmental control systems for precise control and comfort, indoor air quality, HVAC plant operation, energy savings and preventative maintenance. ISO Certification shall be by a registrar that is accredited by an internationally recognized organization such as RAB. Copy of ISO9001 certificate shall be submitted with bid.

C. Conflict of Codes:

Where two or more codes conflict, the most restrictive shall apply. Nothing in this specification or related documentation shall be construed to permit work not conforming to applicable codes.

### **1.4 GENERAL CONDITIONS:**

A. Changes in Scope of Work:

Any changes in the scope of work must be authorized by a written Change Order.

B. Correction of Work:

1. Contractor's Responsibility.
  - a. The Contractor shall promptly correct all work Architect/Engineer finds defective or failing to conform to the Contract Documents. The Contractor shall bear all cost of correcting such work.
2. During Warranty.
  - a. If, within the warranty period required by the Contract Documents, any of the work is found to be defective or not in accordance with the Contract Documents, the Contractor shall correct it promptly after receipt of a written notice from Architect/Engineer to do so. Architect/Engineer shall give notice promptly after discovery of the condition.

C. Coordination of Work During Construction:

1. The Contractor shall coordinate any necessary changes in work scheduling with Architect/Engineer to minimize disruption.
2. The Contractor shall protect the installed works by other trades.
3. The Contractor shall coordinate with other trades.
4. The Contractor shall repair any damage caused by his work to building(s) and equipment at no additional cost to the owner.

D. Warranty

Warrant work as follows:

1. Warrant labor and materials for specified control system free from defects for a period of 12 months after final acceptance. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request.
2. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.
3. If Engineer determines that equipment and systems operate satisfactorily at the end of final start-up, testing, and commissioning phase, Engineer will certify in writing that control system operation has been tested and accepted in accordance with the terms of this specification. Date of acceptance shall begin warranty period.
4. Provide updates to operator workstation or web server software, project-specific software, graphic software, database software, and firmware that resolve Contractor-identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.
5. Exception: Contractor shall not be required to warrant reused devices except those that have been rebuilt or repaired. Installation labor and materials shall be warranted. Demonstrate operable condition of reused devices at time of Engineer's acceptance.

**1.5 SYSTEM PERFORMANCE:**

A. Performance Standards

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

1. Graphic Display.
  - a. A graphic with 16 dynamic points shall display with current data within 10 sec.
2. Graphic Refresh.
  - a. A graphic with 16 dynamic points shall update with current data within 8 sec. and shall automatically refresh every 15 sec.
3. Configuration and Tuning Screens.
  - a. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 seconds.
4. Object Command.
  - a. Devices shall react to command of a binary object within 2 sec. Devices shall begin reacting to command of an analog object within 2 sec.
5. Alarm Response Time.
  - a. An object that goes into alarm shall be annunciated at the workstation within 15

sec.

6. Program Execution Frequency.
  - a. Custom and standard applications shall be capable of running as often as once every 5 sec. Select execution times consistent with the mechanical process under control.
7. Performance.
  - a. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per sec. Select execution times consistent with the mechanical process under control.
8. Multiple Alarm Annunciation.
  - a. Each workstation on the network shall receive alarms within 5 sec of other workstations.
9. Reporting Accuracy.
  - a. System shall report values with minimum end-to-end accuracy listed in Table Control Stability and Accuracy.
10. Control Stability and Accuracy.
 

Control loops shall maintain measured variable at setpoint within tolerances listed in Table 2.

**Table 1  
Reporting Accuracy**

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

**Note 1: Accuracy applies to 10% - 100% of scale**

**Note 2: For both absolute and differential pressure**

**Note 3: Not including utility-supplied meters**



**Table 2  
Control Stability and Accuracy**

<b>Controlled Variable</b>	<b>Control Accuracy</b>	<b>Range of Medium</b>
Air Pressure	±50 Pa (±0.2 in. w.g.) ±3 Pa (±0.01 in. w.g.)	0-1.5 kPa (0-6 in. w.g.) -25 to 25 Pa (-0.1 to 0.1 in. w.g.)
Airflow	±10% of full scale	
Space Temperature	±1.0°C (±2.0°F)	
Duct Temperature	±1.5°C (±3°F)	
Humidity	±5% RH	
Fluid Pressure	±10 kPa (±1.5 psi) ±250 Pa (±1.0 in. w.g.)	MPa (1-150 psi) 0-12.5 kPa (0-50 in. w.g.) differential

**1.6 SUBMITTALS, DOCUMENTATION, ACCEPTANCE AND TRAINING:**

A. Submittals:

1. Shop Drawings.
  - a. A minimum of six (6) copies of shop drawings shall be submitted and shall consist of a complete list of equipment, materials, manufacturer's technical literature, cut-sheets, and installation instructions. Drawings shall contain proposed layout, complete wiring, routing, schematic diagrams, tag number of devices, software descriptions, calculations, installation details, and any other details required to demonstrate that the system will function properly.
2. Programming Documentation.
  - a. The Contractor shall provide a printout all Programs, identifying the specific HVAC or mechanical/electrical subsystem being controlled
3. Drawing Approval.
  - a. Shop drawings shall be approved before any equipment is installed. Controls contractor shall allow a minimum of fourteen (14) days for drawing approval.
4. As-Built Drawings.
  - a. All drawings shall be reviewed after the final system checkout and updated or corrected to provide 'as-built' drawings to show exact installation. All shop drawings will be acknowledged in writing by Architect/Engineer before installation is started and again after the final checkout of the system. The system will not be considered complete until the 'as-built' drawings have received their final approval. The Contractor shall deliver six (6) sets of 'as-built' drawings.

B. Documentation:

Operating and Maintenance (O&M) manuals for the system shall be made available electronically using Acrobat 4.x (PDF) format and include the following categories: Workstation User's Manual, Project Engineering Handbook, and Software Documentation.

1. BAS User's Manual shall contain as a minimum:
  - a. System overview
  - b. Networking concepts
  - c. Launching a web browser from a networked PC/PDA and login
  - d. Graphical User Interface (GUI) screen menus and their definitions
  - e. Creating, modifying or deleting schedules

- f. Loading and downloading software to the field hardware
  - g. Creating historical trends, collecting trend data and generating trend graphs
  - h. Enabling and assigning alarms and messages to reporting actions/groups
  - i. Report generation and 'third party software'
  - j. Backing up software and data files
2. Project Engineering Manual shall contain as a minimum:
    - a. System architecture overview
    - b. Hardware cut-sheets and product descriptions.
    - c. The Contractor shall deliver six (6) sets of 'as-built' drawings. All drawings shall be reviewed after the final system checkout and updated to provide 'as-built' drawings. The system will not be considered complete until the 'as-built' drawings have received their final approval.
    - d. Installation, mounting and connection details for all field hardware and accessories
    - e. Commissioning, setup and backup procedures for all control modules/accessories, BAS server software, and database.
    - f. Listing of basic terminology, alarms/messages, error messages and frequently used commands or shortcuts.
  3. BAS Software Documentation shall contain as a minimum:
    - a. The Contractor shall provide a printout all Programs, detailing their application to specific HVAC equipment and electrical/mechanical subsystems, together with a glossary or icon symbol library detailing the function of each graphical icon. Revisions made as a result of the submittal process, during the installation, start-up or acceptance portion of the project, shall be accurately reflected in the "as-builts".
    - b. Graphical representation of the mechanical equipment hierarchy for the project including all equipment controlled by the BAS. For example: a VAV terminal box may be the source for increased cooling demand and require the primary VAV AHU to operate which, in turn, requires the chillers to operate.
    - c. Detailed listing of all alarm and event messages programmed for designated mechanical/electrical equipment and required operator action.
  4. Acceptance Test:
    - a. Acceptance Testing  
Upon completion of the installation, the Contractor shall start up the system and perform all necessary calibration, testing, and debugging operations. The Contractor in the presence of the Owner's representative shall perform an acceptance test.
    - b. Notice of Completion  
When the system performance is deemed satisfactory, the system parts will be accepted for beneficial use and placed under warranty. At this time, Architect/Engineer shall issue a "notice of completion" and the warranty period shall start.
  5. System Training:  
System Use Instructions: Controls Contractor shall provide full Computer Based Training (CBT) in addition to training of designated personnel in the operation, maintenance, and programming of the system. Training shall be for 16 hours and coordinated with the owner.

## **PART 2 – PRODUCTS:**

### **2.1 MATERIALS:**

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

## 2.2 COMMUNICATION:

- A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ANSI/ASHRAE Standard 135-2004, BACnet. No exceptions acceptable.
- B. All database values (e.g., input /output objects and software are variables) of any one controller shall be readable and writeable by any other controller or third party BACnet capable device on the internetwork.
- C. Install new wiring and network devices as required to provide a complete and workable control network. Use existing Ethernet backbone for network segments marked "existing" on project drawings.
- D. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.
- E. Internetwork operator interface and value passing shall be transparent to internetwork architecture.
  - 1. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, and control algorithms shall be viewable and editable from each internetwork controller.
  - 2. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute control strategies specified in Section 15900 Part 5 Sequences of Operation. An authorized operator shall be able to edit cross-controller links by typing a standard object address or by using a point-and-click interface.
- F. Controllers with real-time clocks shall use the BACnet Time Synchronization service. System shall automatically synchronize system clocks daily from an operator-designated controller via the internetwork. System shall automatically adjust for daylight saving and standard time.
- G. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.
- H. System shall support Web services data exchange with any other system that complies with XML (extensible markup language) and SOAP (simple object access protocol) standards specified by the Web Services Interoperability Organization (WS-I) Basic Profile 1.0 or higher. Web services support shall as a minimum be provided at the workstation or web server level and shall enable data to be read from or written to the system.
  - 1. System shall support Web services read data requests by retrieving requested trend data or point values (I/O hardware points, analog value software points, or binary value software points) from any system controller or from the trend history database.
  - 2. System shall support Web services write data request to each analog and binary object that can be edited through the system operator interface by downloading a numeric value to the specified object.
  - 3. For read or write requests, the system shall require user name and password authentication and shall support SSL (Secure Socket Layer) or equivalent data

encryption.

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

## **2.3 OPERATOR INTERFACE:**

### **A. Operator Interface.**

Web server shall reside on high-speed network with building controllers. Each standard browser connected to server shall be able to access all system information. As a minimum, the following capabilities shall be provided through this interface:

1. An operator authentication system that requires an operator to log in before viewing or editing any data, and which can be configured to limit the privileges of an individual operator.
2. The ability to view and acknowledge any alarm in the system. Alarms or links to alarms shall be provided on a contiguous list so the operator can quickly view all alarms.
3. A summary page or pages for each piece of equipment in the system. This page shall include the current values of all critical I/O points and shall allow the operator to lock binary points on or off and to lock analog points to any value within their range.
4. Navigation links that allow the operator to quickly navigate from the home screen to any piece of equipment in the system, and then return to the home screen. These links may be arranged in a hierarchical fashion, such as navigating from the home screen to a particular building, then to a specific floor in the building, and then to a specific room or piece of equipment.

### **B. Communication.**

Web server or workstation and controllers shall communicate using BACnet protocol. Web server or workstation and control network backbone shall communicate using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing as specified in ANSI/ASHRAE 135-2004, BACnet Annex J.

### **C. Operator Functions.**

Operator interface shall allow each authorized operator to execute the following functions as a minimum:

1. Log In and Log Out  
System shall require user name and password to log in to operator interface.
2. Point-and-click Navigation  
Operator interface shall be graphically based and shall allow operators to access graphics for equipment and geographic areas using point-and-click navigation.
3. View and Adjust Equipment Properties  
Operators shall be able to view controlled equipment status and to adjust operating parameters such as setpoints, PID gains, on and off controls, and sensor calibration.
4. View and Adjust Operating Schedules  
Operators shall be able to view scheduled operating hours of each schedulable piece of equipment on a weekly or monthly calendar-based graphical schedule display, to select and adjust each schedule and time period, and to simultaneously schedule related equipment. System shall clearly show exception schedules and holidays on the schedule

- display.
5. View and Respond to Alarms  
Operators shall be able to view a list of currently active system alarms, to acknowledge each alarm, and to clear (delete) unneeded alarms.
  6. View and Configure Trends  
Operators shall be able to view a trend graph of each trended point and to edit graph configuration to display a specific time period or data range. Operator shall be able to create custom trend graphs to display on the same page data from multiple trended points.
  7. View and Configure Reports  
Operators shall be able to run preconfigured reports, to view report results, and to customize report configuration to show data of interest. Operators shall be able to schedule 'standard' or 'custom' reports and automatically email reports based on occurrence of an 'event' or 'schedule'. Reports shall be sent in Microsoft Excel, Acrobat or CSV format.
  8. Manage Control System Hardware  
Operators shall be able to view controller status, to restart (reboot) each controller, download new control operating firmware, re-configure control sequence(s) and download to designated controller(s) via the web browser or network.
  9. Manage Operator Access  
Typically, only a few operators are authorized to manage operator access. Authorized operators shall be able to view a list of operators with system access and of functions they can perform while logged in. Operators shall be able to add operators, to delete operators, and to edit operator function authorization. Operator shall be able to authorize each operator function separately.

D. System Software:

1. Operating System  
Web server shall have an industry-standard professional-grade operating system. Acceptable systems include Microsoft Windows XP Pro, Red Hat Linux, Sun Solaris, or QNXRTOS, I MB J9 JVM, Niagara.
2. System Graphics  
Operator interface shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using dynamic colors to represent zone temperature relative to zone setpoint.
  - a. Functionality  
Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point-and-click navigation between zones or equipment, and to edit setpoints and other specified parameters.
  - b. Animation  
Graphics shall be able to animate by displaying different image files for changed object status.
  - c. Alarm Indication  
Indicate areas or equipment in an alarm condition using color or other visual indicator.
  - d. Format  
Images shall be saved in an industry-standard format such as BMP, JPEG, PNG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no

plug-in (such as HTML and JavaScript) or shall only require widely available no-cost plug-ins (such as Active-X, Java and Macromedia Flash).

#### E. System Tools

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

1. Automatic System Database Configuration  
Each workstation or web server shall store on its hard disk a copy of the current system database, including controller firmware and software. Stored database shall be automatically updated with each system configuration or controller firmware or software change.
2. Controller Memory Download  
Operators shall be able to download memory from the system database to each controller.
3. System Configuration  
Operators shall be able to configure the system.
4. Online Help  
Context-sensitive online help for each tool shall assist operators in operating and editing the system.
5. Security  
System shall require a user name and password to view, edit, add, or delete data.
  - a. Operator Access  
Each user name and password combination shall define accessible viewing, editing, adding, and deleting functions in each system application, editor, and object. Authorized operators shall be able to vary and deny each operator's accessible functions based on equipment or geographic location.
  - b. Automatic Log Out  
Automatically log out each operator if no keyboard or mouse activity is detected. Operators shall be able to adjust automatic log out delay.
  - c. Encrypted Security Data  
Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.
6. System Diagnostics  
System shall automatically monitor controller and I/O point operation. System shall annunciate controller failure and I/O point locking (manual overriding to a fixed value).
7. Alarm Processing  
System input and status objects shall be configurable to alarm on departing from and on returning to normal state. Operator shall be able to enable or disable each alarm and to configure alarm limits, alarm limit differentials, alarm states, and alarm reactions for each system object. Configure and enable alarm points as specified in Sequences of Operation.
8. Alarm Messages  
Alarm messages shall use an English language descriptor without acronyms or mnemonics to describe alarm source, location, and nature.
9. Alarm Reactions  
Operator shall be able to configure (by object) actions workstation or web server shall initiate on receipt of each alarm. As a minimum, workstation or web server shall be able

to log, print, start programs, display messages, send e-mail, send page, and audibly announce. The send e-mail alarm action should be able to run a report and attach it to the e-mail. The e-mail should use SSL to secure the communications between the system server and the mail server. Operator shall also be able to set the following conditions for an alarm action:

- a. Run the alarm action only when the alarm source generates an alarm or when it returns to normal.
  - b. Wait a specified amount of time, then run the alarm action if the alarm has not been acknowledged or has not returned to normal.
  - c. Run if the alarm occurs during the occupied hours defined for a schedule group of run if the alarm occurs during the group's unoccupied hours.
10. Alarm Maintenance  
Operators shall be able to view system alarms and changes of state chronologically, to acknowledge and delete alarms, and to archive closed alarms to the workstation or web server hard disk from each workstation or web browser interface.
11. Trend Configuration  
Operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs. Controller shall sample and store trend data and shall be able to archive data to the hard disk. Configure trends as specified in Sequences of Operation.
12. Object and Property Status and Control  
Operator shall be able to view, and to edit if applicable, the status of each system object and property by menu, on graphics, or through custom programs.
13. Reports and Logs  
Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs.
14. Standard Reports  
Furnish the following standard system reports:
- a. Objects. System objects and current values filtered by object type, by status (in alarm, locked, normal), by equipment, by geographic location, or by combination of filter criteria.
  - b. Alarm Summary. Current alarms and closed alarms. System shall retain closed alarms for an adjustable period.
  - c. Logs  
System shall log the following to a database or text file and shall retain data for an adjustable period:
    - i. Alarm History
    - ii. Trend Data  
Operator shall be able to select trends to be logged.
    - iii. Operator Activity  
At a minimum, system shall log operator log in and log out, control parameter changes, schedule changes, and alarm acknowledgment and deletion. System shall date and time stamp logged activity.
15. Custom Reports  
Operator shall be able to create custom reports that retrieve data, including archived trend data, from the system, that analyze data using common algebraic calculations, and that present results in tabular or graphical format. Reports shall be launched from the operator interface.
16. Graphics Generation  
Graphically based tools and documentation shall allow Operator to edit system graphics,

to create graphics, and to integrate graphics into the system. Operator shall be able to add analog and binary values, dynamic text, static text, and animation files to a background graphic using a mouse.

17. Graphics Library

Complete library of standard HVAC equipment graphics shall include equipment such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. Library shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. Library graphic file format shall be compatible with graphics generation tools.

18. Custom Application Programming

Operator shall be able to create, edit, debug, and download custom programs. System shall be fully operable while custom programs are edited, compiled, and downloaded. Programming language shall have the following features:

a. Language

Language shall be graphically based and shall use function blocks or GCL line programming arranged in a logic diagram that clearly shows control logic flow. Function blocks or GCL line programming shall directly provide functions listed below, and operators shall be able to create custom or compound function blocks.

b. Programming Environment

Tool shall provide a full-screen, cursor-and-mouse-driven programming environment that incorporates word processing features such as cut and paste. Operators shall be able to insert, add, modify, and delete custom programming code, and to copy blocks of code to a file library for reuse in other control programs.

c. Independent Program Modules

Operator shall be able to develop independently executing program modules that can disable, enable and exchange data with other program modules.

d. Debugging and Simulation

Operator shall be able to step through the program observing intermediate values and results. Operator shall be able to adjust input variables to simulate actual operating conditions. Operator shall be able to adjust each step's time increment to observe operation of delays, integrators, and other time-sensitive control logic. Debugger shall provide error messages for syntax and for execution errors.

e. Conditional Statements

Operator shall be able to program conditional logic using compound Boolean (AND, OR, and NOT) and relational (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.

f. Mathematical Functions

Language shall support floating-point addition, subtraction, multiplication, division, and square root operations, as well as absolute value calculation and programmatic selection of minimum and maximum values from a list of values.

g. Variables:

Operator shall be able to use variable values in program conditional statements and mathematical functions.

i. Time Variables

Operator shall be able to use predefined variables to represent time of day, day of the week, month of the year, and date. Other predefined variables or simple control logic shall provide elapsed time in seconds, minutes, hours, and days. Operator shall be able to start, stop, and reset elapsed time variables using the program language.

ii. System Variables

Operator shall be able to use predefined variables to represent status and results of Controller Software and shall be able to enable, disable, and change setpoints



of Controller Software as described in Controller Software section.

## **2.4 CONTROLLER SOFTWARE:**

- A. Building and energy management application software shall reside and operate in system controllers. Applications shall be editable through operator workstation, web browser interface, or engineering workstation.

B. Scheduling

System shall provide the following schedule options as a minimum:

1. Weekly  
Provide separate schedules for each day of the week. Each schedule shall be able to include up to 5 occupied periods (5 start-stop pairs or 10 events).
2. Exception  
Operator shall be able to designate an exception schedule for each of the next 365 days. After an exception schedule has executed, system shall discard and replace exception schedule with standard schedule for that day of the week.
3. Holiday  
Operator shall be able to define 24 special or holiday schedules of varying length on a scheduling calendar that repeats each year.

C. System Coordination

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

D. Remote Communication

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

E. Demand Limiting

1. System shall monitor building power consumption from building power meter pulse generator signals or from building feeder line watt transducer or current transformer.
2. When power consumption exceeds adjustable levels, system shall automatically adjust setpoints, de-energize low-priority equipment, and take other programmatic actions to reduce demand as specified in Sequences of Operation (Sequences of Operation). When demand drops below adjustable levels, system shall restore loads as specified.

F. Maintenance Management

System shall generate maintenance alarms when equipment exceeds adjustable runtime, equipment starts, or performance limits. Configure and enable maintenance alarms as specified in Section 15900 Part 5 Sequences of Operation (Sequences of Operation).

G. Sequencing

Application software shall sequence chillers, boilers, and pumps as specified in Sequences of Operation (Sequences of Operation).

H. PID Control

System shall provide direct- and reverse-acting PID (proportional-integral-derivative) algorithms. Each algorithm shall have anti-windup and selectable controlled variable, setpoint, and PID gains. Each algorithm shall calculate a time-varying analog value that can be used to position an output or to stage a series of outputs.

I. Staggered Start

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

J. Energy Calculations.

1. System shall accumulate and convert instantaneous power (kW) or flow rates (L/s [gpm]) to energy usage data.
2. System shall calculate a sliding-window average (rolling average). Operator shall be able to adjust window interval to 15 minutes, 30 minutes, or 60 minutes.

K. Anti-Short Cycling

Binary output objects shall be protected from short cycling by means of adjustable minimum on-time and off-time settings.

L. On and Off Control with Differential

System shall provide direct- and reverse-acting on and off algorithms with adjustable differential to cycle a binary output based on a controlled variable and setpoint.

M. Runtime Totalization

System shall provide an algorithm that can totalize runtime for each binary input and output. Operator shall be able to enable runtime alarm based on exceeded adjustable runtime limit. Configure and enable runtime totalization and alarms as specified in Sequences of Operation (Sequence of Operations).

## 2.5 **CONTROLLERS:**

A. General

Provide Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), Smart Actuators (SA), and Smart Sensors (SS) as required to achieve performance specified in Section 15900 Article 1.9 (System Performance). Every device in the system which executes control logic and directly controls HVAC equipment must conform to a standard BACnet Device profile as specified in ANSI/ASHRAE 135-2004, BACnet Annex L. Unless otherwise specified, hardwired actuators and sensors may be used in lieu of BACnet Smart Actuators and Smart Sensors.

B. BACnet

1. Building Controllers (BCs)  
Each BC shall conform to BACnet Building Controller (B-BC) device profile as specified in ANSI/ASHRAE 135-2004, BACnet Annex L and shall be listed as a certified B-BC in the BACnet Testing Laboratories (BTL) Product Listing.
2. Advanced Application Controllers (AACs)  
Each AAC shall conform to BACnet Advanced Application Controller (B-AAC) device

profile as specified in ANSI/ASHRAE 135-2004, BACnet Annex L and shall be listed as a certified B-AAC in the BACnet Testing Laboratories (BTL) Product Listing.

3. Application Specific Controllers (ASCs)

Each ASC shall conform to BACnet Application Specific Controller (B-ASC) device profile as specified in ANSI/ASHRAE 135-2004, BACnet Annex L and shall be listed as a certified B-ASC in the BACnet Testing Laboratories (BTL) Product Listing.

4. Smart Actuators (SAs)

Each SA shall conform to BACnet Smart Actuator (B-SA) device profile as specified in ANSI/ASHRAE 135-2004, BACnet Annex L and shall be listed as a certified B-SA in the BACnet Testing Laboratories (BTL) Product Listing.

5. Smart Sensors (SSs)

Each SS shall conform to BACnet Smart Sensor (B-SS) device profile as specified in ANSI/ASHRAE 135-2004, BACnet Annex L and shall be listed as a certified B-SS in the BACnet Testing Laboratories (BTL) Product Listing.

6. BACnet Communication

a. Each BC shall reside on or be connected to a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing.

b. BACnet routing shall be performed by BCs or other BACnet device routers as necessary to connect BCs to networks of AACs and ASCs.

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

d. Each ASC shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.

e. Each SA shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.

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

C. Communication

1. Service Port

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

2. Signal Management

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

3. Data Sharing

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

4. Stand-Alone Operation

Each piece of equipment specified in Section 15900 Part 5 Sequences of Operation shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network.

D. Environment

Controller hardware shall be suitable for anticipated ambient conditions.

1. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof

- enclosures and shall be rated for operation at -29°C to 60°C (-20°F to 140°F).
2. Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 0°C to 50°C (32°F to 120°F).
- E. Real-Time Clock. Controllers that perform scheduling shall have a real-time clock.
- F. Serviceability
1. Controllers shall have diagnostic LEDs for power, communication, and processor.
  2. Wires shall be connected to a field-removable modular terminal strip or to a termination card connected by a ribbon cable.
  3. Each BC and AAC shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.
- G. Memory
1. Controller memory shall support operating system, database, and programming requirements.
  2. Each BC and AAC shall retain BIOS and application programming for at least 72 hours in the event of power loss.
  3. Each ASC and SA shall use nonvolatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.

H. Immunity to Power and Noise

Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).

I. Transformer

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

**2.6 INPUT AND OUTPUT INTERFACE:**

A. General

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

B. Protection

Shorting an input or output point to itself, to another point, or to ground shall cause no controller damage. Input or output point contact with up to 24 V for any duration shall cause no controller damage.

C. Binary Inputs

Binary inputs shall monitor the on and off signal from a remote device. Binary inputs shall provide

a wetting current of at least 12 mA and shall be protected against contact bounce and noise.

Binary inputs shall sense dry contact closure without application of power external to the controller.

D. Pulse Accumulation Inputs

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

E. Analog Inputs

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

F. Binary Outputs

Binary outputs shall send an on-or-off signal for on and off control. Building Controller binary outputs shall have three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation.

G. Analog Outputs

Analog outputs shall send a modulating 0-10 Vdc or 4-20 mA signal as required to properly control output devices. Each Building Controller analog output shall have a two-position (auto-manual) switch and status lights. Analog outputs shall not drift more than 0.4% of range annually.

H. Tri-State Outputs

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

I. Universal Inputs and Outputs

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

**2.7 POWER SUPPLIED AND LINE FILTERING:**

A. Power Supplies

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

1. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be

able to withstand 150% current overload for at least three seconds without trip-out or failure.

- a. Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
- b. Line voltage units shall be UL recognized and CSA listed.

B. Power Line Filtering

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

**2.8 AUXILIARY CONTROL DEVICES:**

A. Motorized control dampers, unless otherwise specified elsewhere, shall be as follows:

1. Control dampers shall be parallel or opposed blade type as below or as scheduled on drawings.
  - a. Outdoor and/or return air mixing dampers and face and bypass (F&BP) dampers shall be parallel blade, arranged to direct air-streams toward each other. Damper motor shall be spring return to ensure closing of outdoor air damper during periods of unit shut down or power failure.
  - b. Other modulating dampers shall be opposed blade type.
  - c. Two-position shutoff dampers may be parallel or opposed blade type with blade and side seals.
2. Damper frames shall be 13 gauge galvanized steel channel or 1/8" extruded aluminum with reinforced corner bracing.
3. Damper blades shall not exceed 20 cm [8"] in width or 125 cm [48"] in length. Blades are to be suitable for medium velocity performance (10 m/s [2,000 fpm]). Blades shall be not less than 16 gauge.
4. Damper shaft bearings shall be as recommended by manufacturer for application, Oilite or better.
5. All blade edges and top and bottom of the frame shall be provided with replaceable butyl rubber or neoprene seals. Side seals shall be spring-loaded stainless steel. The blade seals shall provide for a maximum leakage rate of 50 L/s-m<sup>2</sup> [10 cfm per sq. ft.] at 1000 Pa [4" w.c.] differential pressure. Provide air foil blades suitable for a wide-open face velocity of 7.5 m/s [1,500 fpm].
6. Individual damper sections shall not be larger than 125 cm x 150 cm [48" x 60"]. Provide a minimum of one damper actuator per section.
7. Modulating dampers shall provide a linear flow characteristic where possible.
8. Dampers shall have exposed linkages.

B. Electric damper actuators.

1. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.
2. Where shown, for power-failure/safety applications, an internal mechanical, spring-return mechanism shall be built into the actuator housing.
3. All rotary spring-return actuators shall be capable of both clockwise and counter-

clockwise spring-return operation. Linear actuators shall spring-return to the retracted position.

4. Proportional actuators shall accept a 0 to 10 VDC or 2 to 10vdc operating range.
5. All 24 VAC/VDC actuators shall operate on Class 2 wiring and shall not require more than 10 VA for AC or more than 8 W for DC applications. Actuators operating on 120 VAC or 230 VAC shall not require more than 11 VA.
6. All non-spring-return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring-return actuators with more than 7 N·m [60 in-lb] torque capacity shall have a manual crank for this purpose.
7. Actuators shall be provided with a raceway fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections
8. Actuators shall be UL Standard 873 Listed and CSA Class 4813 02 Certified as meeting correct safety requirements and recognized industry standards.
9. Actuators shall be designed for a minimum of 60,000 full-stroke cycles at the actuator's rated torque.
10. Actuators may be Siemens or Belimo.

C. Control valves.

1. Control valves shall be two-way or three-way type for two-position or modulating service as shown.
2. Globe valves shall be used for modulating service, acceptable manufacturers are Siemens V599 series valves with SSB, SQX, or SKD actuators, or Honeywell V5860 valves with M6410 actuators, V501 and VGF2 valves with ML series actuators.
3. Full ported ball valves or butterfly valves shall be used for two-position or isolation service and shall be line size. Acceptable manufacturers of ball valves are Siemens 599 series with Siemens actuators or Delta Control Products Soft Touch valves with DC series actuators. Acceptable manufacturers of butterfly valves are Siemens BV series or Delta Control Products valves with DC or DCS actuators.
4. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
  - a. Water Valves:
    - i. Two-way: 150% of total system (pump) head.
    - ii. Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
5. Water Valves:
  - a. Body and trim style and materials shall be per manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating service.
  - b. Sizing Criteria:
    - i. Two-position service: Line size.
    - ii. Two-way modulating service: Pressure drop shall be equal to twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 35kPa [5 psi], whichever is greater
    - iii. Three-way modulating service: Pressure drop equal to twice the pressure drop through the coil exchanger (load), 35 kPa [5 psi] maximum.
    - iv. Valves ½" through 2" shall be bronze body or cast brass ANSI Class 250, spring-loaded, Teflon packing, quick opening for two-position service. Two-way valves to have replaceable composition disc, or stainless steel ball.
    - v. 2½" valves and larger shall be cast iron ANSI Class 125 with guided plug and

Teflon packing.

- c. Water valves shall fail normally open or closed as scheduled on plans, or as follows:
  - i. Water zone valves - normally open {preferred}.
  - ii. Heating coils in air handlers - normally open
  - iii. Chilled water control valves - normally closed.
  - iv. Other applications - as scheduled or as required by sequences of operation.

D. Binary Temperature Devices.

1. Low-voltage space thermostat shall be 24 V, bimetal-operated, with either adjustable or fixed anticipation heater, concealed setpoint adjustment, 13°C to 30°C [55°F to 85°F] setpoint range, 1°C [2°F] maximum differential, and vented ABS plastic cover.
2. Line-voltage space thermostat shall be bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch type, or equivalent solid-state type, with heat anticipator, UL listed for electrical rating, concealed setpoint adjustment, 13°C to 30°C [55°F to 85°F] setpoint range, 1°C [2°F] maximum differential, and vented ABS plastic cover.
3. Low-limit thermostats. Low-limit thermostats shall be vapor pressure type with an element 6 m [20 ft] minimum length. Element shall respond to the lowest temperature sensed by any 30 cm [1 ft] section. The low-limit thermostat shall be manual reset only and be supplied as DPST.

E. Temperature sensors.

1. Temperature sensors shall be thermistors.
2. Duct sensors shall be rigid or averaging as shown. Averaging sensors shall be a minimum of 1.5 m [5 feet] in length.
3. Immersion sensors shall be provided with a separable brass well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed.
4. Space sensors shall be equipped with the following:
  - a. 3-value, 96-segment LCD display when room humidity sensor is specified. Temp +/- 2°F, when humidity is not specified.
5. Provide matched temperature sensors for differential temperature measurement.

F. Humidity sensors.

1. Duct and room sensors shall have a sensing range of 20% to 80%.
2. Duct sensors shall be provided with a sampling chamber.
3. Outdoor air humidity sensors shall have a sensing range of 20% to 95% RH. They shall be suitable for ambient conditions of -40°C to 75°C [-40°F to 170°F].
4. Humidity sensor's drift shall not exceed 3% of full scale per year.

G. Flow switches.

1. Flow-proving switches shall be either paddle or differential pressure type, as shown.
2. Paddle type switches (water service only) shall be UL Listed, SPDT snap-acting with pilot duty rating (125 VA minimum). Adjustable sensitivity with NEMA 1 enclosure unless otherwise specified.
3. Differential pressure type switches (air or water service) shall be UL Listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure, with scale range and differential suitable for intended application, or as specified.

H. Relays.

1. Control relays shall be UL Listed plug-in type with dust cover or Functional Devices Relay In a box (RIB). Contact rating, configuration, and coil voltage suitable for application
2. Time delay relays shall be UL Listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable ±200% (minimum) from setpoint shown on plans. Contact



rating, configuration, and coil voltage suitable for application. Provide NEMA 1 enclosure when not installed in local control panel.

I. Override timers.

1. Override timers shall be spring-wound line voltage UL Listed, contact rating and configuration as required by application. Provide 0-to-6-hour calibrated dial unless otherwise specified; suitable for flush mounting on control panel face, located on local control panels or where shown.

J. Current transmitters.

1. AC current transmitters shall be self-powered combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 0 – 5vdc two-wire output. Unit ranges shall be 70A, 60A and 120A full scale, internal zero and span adjustment, and  $\pm 1\%$  full scale accuracy at 500 ohm maximum burden
2. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.
3. Unit shall be split-core type for clamp-on installation.
4. Current switches are not acceptable.

K. Current transformers.

1. AC current transformers shall be UL/CSA recognized and completely encased (except for terminals) in approved plastic material.
2. Transformers shall be available in various current ratios and shall be selected for  $\pm 1\%$  accuracy at 5 A full scale output.
3. Transformers shall be split-core type for installation on new or existing wiring.

L. Voltage transmitters.

1. AC voltage transmitters shall be self-powered single loop (two-wire) type, 4 to 20 mA output with zero and span adjustment.
2. Ranges shall include 100 to 130 VAC, 200 to 250 VAC, 250 to 330 VAC, and 400 to 600 VAC full-scale, adjustable, with  $\pm 1\%$  full-scale accuracy with 500 ohm maximum burden.
3. Transmitters shall be UL/CSA recognized at 600 VAC rating and meet or exceed ANSI/ISA S50.1 requirements.

M. Voltage transformers.

1. AC voltage transformers shall be UL/CSA recognized, 600 VAC rated, complete with built-in fuse protection.
2. Transformers shall be suitable for ambient temperatures of 4 to 55°C [40 to 130°F] and shall provide  $\pm 0.5\%$  accuracy at 24 VAC and a 5 VA load.
3. Windings (except for terminals) shall be completely enclosed with metal or plastic material.

N. Power monitors.

1. Power monitors shall be three-phase type furnished with three-phase disconnect/shorting switch assembly, UL Listed voltage transformers and UL Listed split-core current transformers.
2. Shall provide a selectable rate pulse output for kWh reading and a 1 –5vdc or 4 to 20 mA output for kW reading. Shall operate with 5 A current inputs with a maximum error of  $\pm 2\%$  at 1.0 power factor or  $\pm 2.5\%$  at 0.5 power factor.

O. Pressure transducers.

1. Transducer shall have linear output signal. Zero and span shall be field-adjustable.

2. Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50% greater than calibrated span without damage
  3. Water pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Transducer shall be complete with 1 - 5vdc or 4 to 20 mA output, required mounting brackets, and block and bleed valves.
  4. Water differential pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (differential pressure) and maximum static pressure shall be 300 psi. Transducer shall be complete with 1 – 5vdc or 4 to 20 mA output, required mounting brackets, and five-valve manifold.
- P. Differential pressure type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure, with scale range and differential suitable for intended application, or as shown.
- Q. Pressure-Electric (PE) Switches.
1. Shall be metal or neoprene diaphragm actuated, operating pressure rated 0–175 kPa [0–25 psig], with calibrated scale setpoint range of 14–125 kPa [2–18 psig] minimum, UL listed
  2. Provide one- or two-stage switch action SPDT, DPST, or DPDT, as required by application.
  3. Shall be open type (panel-mounted) or enclosed type for remote installation. Enclosed type shall be NEMA 1 unless otherwise specified
  4. Shall have a permanent indicating gauge on each pneumatic signal line to PE switches.
- R. Electro-pneumatic (E/P) transducers.
1. Electronic/pneumatic transducer shall provide a proportional 20 to 100 kPa [3 to 15 psig] output signal from a 0 to 10 VDC analog control input.
- S. Local control panels.
1. All indoor control cabinets shall be fully enclosed NEMA 1 construction with [hinged door], key-lock latch, removable sub-panels. A single key shall be common to all field panels and sub-panels.
  2. Interconnections between internal and face-mounted devices pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL Listed for 600 volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings
  3. Provide 120v receptacle at each local panel location.

### **PART 3 – EXECUTION:**

#### **3.1 PREPARATION:**

Protection of Persons and Property:

A. Safety Precautions and Programs. The Controls Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the work.

B. Safety of Persons and Property. The Controls Contractor shall take all reasonable precautions

and provide all reasonable protection to prevent damage, injury or loss to:

1. All employees on the installation sites and all other persons who may be affected.
2. All work, materials and equipment to be incorporated therein, whether in storage on or off the site, under the care, custody or control of the Controls Contractor or any Subcontractor or Sub-contractor.
3. Other property at the site or adjacent thereto. The Controls Contractor shall comply with all applicable laws, ordinances, rules, regulations and lawful orders or any public authority having jurisdiction for the safety of persons or property or to protect them from damage, injury or loss. It shall erect and maintain, as required by existing conditions and progress of the work, all reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards, promulgating safety regulations and notifying owners and users of adjacent utilities.

### **3.2 HARDWARE INSTALLATION:**

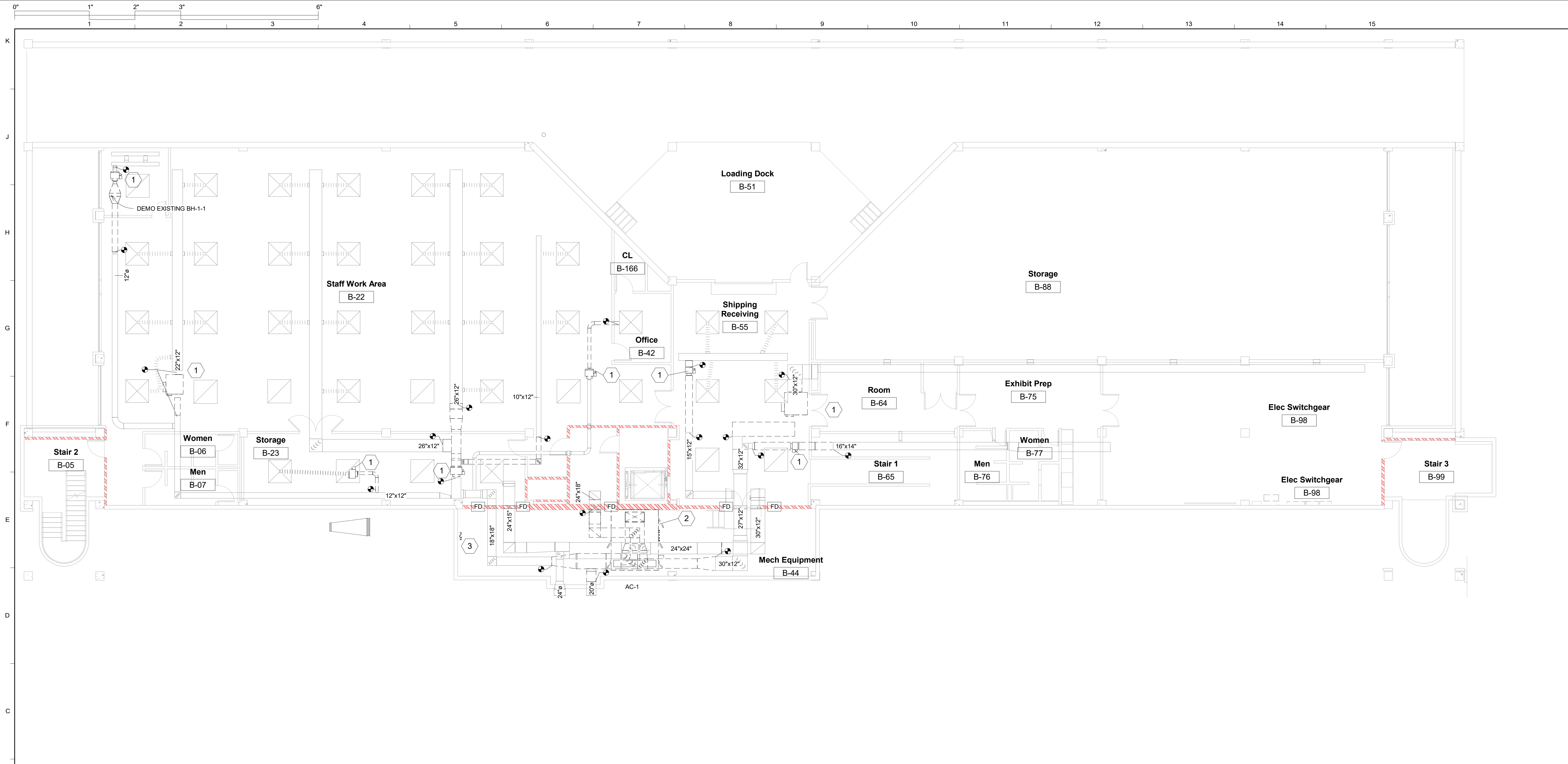
#### **A. Utility Company Equipment:**

1. The Chattanooga Public Library shall arrange installation of electric billing meters with demand signal pulses.

#### **B. Wiring:**

1. The Controls Contractor shall finish and install all communication wires to/from Control Modules.
2. The Controls Contractor shall install wires for the room temperature sensors (from sensor to the appropriate control module.)
3. The Controls Contractor shall install all sensing devices and the wiring to modules.
4. The Controls Contractor shall install all control and monitoring wiring.
5. Low voltage wire shall be not less than 22 AWG. All line voltage wire shall be THHN/TFFN. 600 volt rated.
6. All line voltage wire shall be run in conduit (EMT). All exposed wiring shall be run in conduit. Wiring in walls, mechanical rooms, fan rooms, above limited access ceilings, shall be run in conduit. All conduits shall be furnished and installed under Division 26. Plenum-rated wire run in accessible concealed areas may be run without conduit using gutters and wiring trays and when applicable, the owners wiring tray and wall penetrations. See electrical drawings and specifications. Accessible concealed wire run in return air plenums shall meet NEC 725 (b) code.
7. All electrical wiring for this system shall be furnished and installed by this contractor and shall be of a uniform color throughout the installation.
8. The Controls Contractor shall install the air purifications systems per Section 23 40 01.

**END OF SECTION**



- DEMO NOTES - CALLOUTS**
1. DEMO EXISTING VAV BOXES, CONTROLS, CONNECTIONS.
  2. DEMO AC-1 AND ALL ASSOCIATED DUCT (TO NOTED POINTS), ELECTRICAL CONNECTIONS, PNEUMATIC CONTROLS, HYDRONIC PIPE AS SHOWN.
  3. DEMO LTW PUMP #3 AND ASSOCIATED CONTROLS.

- HVAC DEMO GENERAL NOTES**
1. CONTRACTOR SHALL REMOVE AND DISPOSE OF ITEMS NOTED IN THIS DRAWING PACKAGE. IF EXISTING CONDITIONS REQUIRE EQUIPMENT OR DISTRIBUTION TO BE RELOCATED TO ACCOMMODATE THESE ACTIVITIES, THE CONTRACTOR SHALL CONSULT THE ENGINEER PRIOR TO ENGAGING IN DEMOLITION.
  2. PRIOR TO DEMOLITION OF MAJOR SYSTEMS, CONTRACTOR SHALL IDENTIFY AFFECTED AREAS AND PROVIDE AT LEAST 48 HOURS NOTICE TO LIBRARY PERSONNEL.
  3. DEMOLISH DUCT TO POINTS SHOWN.
  4. ALL EXISTING PNEUMATIC CONTROLS ASSOCIATED WITH REPLACED EQUIPMENT SHALL BE REMOVED.

**WALL LEGEND**  
 2 HOUR FIREWALL

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**DEMO HVAC GROUND FLOOR** ①  
 SCALE: 1/8" = 1'-0"



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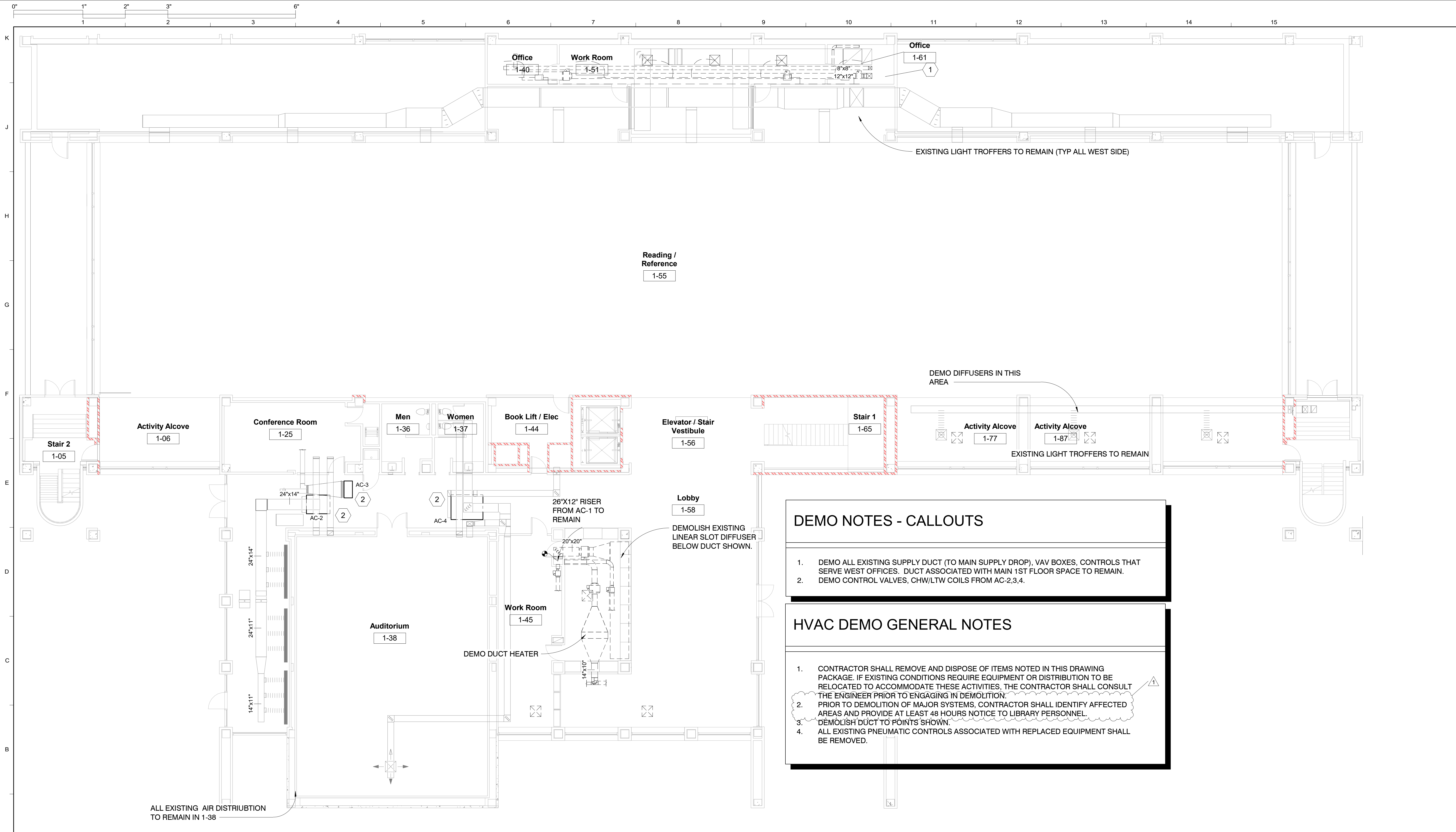
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 File No. 2180a  
 Phase Two

Revisions		
Number	Description	Date
1	Addendum 3	10/21/2019



Title:  
**HVAC DEMO GROUND FLOOR**

Sheet No.  
**MD-100**



**DEMO NOTES - CALLOUTS**

1. DEMO ALL EXISTING SUPPLY DUCT (TO MAIN SUPPLY DROP), VAV BOXES, CONTROLS THAT SERVE WEST OFFICES. DUCT ASSOCIATED WITH MAIN 1ST FLOOR SPACE TO REMAIN.
2. DEMO CONTROL VALVES, CHW/LTW COILS FROM AC-2,3,4.

**HVAC DEMO GENERAL NOTES**

1. CONTRACTOR SHALL REMOVE AND DISPOSE OF ITEMS NOTED IN THIS DRAWING PACKAGE. IF EXISTING CONDITIONS REQUIRE EQUIPMENT OR DISTRIBUTION TO BE RELOCATED TO ACCOMMODATE THESE ACTIVITIES, THE CONTRACTOR SHALL CONSULT THE ENGINEER PRIOR TO ENGAGING IN DEMOLITION.
2. PRIOR TO DEMOLITION OF MAJOR SYSTEMS, CONTRACTOR SHALL IDENTIFY AFFECTED AREAS AND PROVIDE AT LEAST 48 HOURS NOTICE TO LIBRARY PERSONNEL.
3. DEMOLISH DUCT TO POINTS SHOWN.
4. ALL EXISTING PNEUMATIC CONTROLS ASSOCIATED WITH REPLACED EQUIPMENT SHALL BE REMOVED.

ALL EXISTING AIR DISTRIBUTION TO REMAIN IN 1-38

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**DEMO HVAC 1ST FLOOR** ①  
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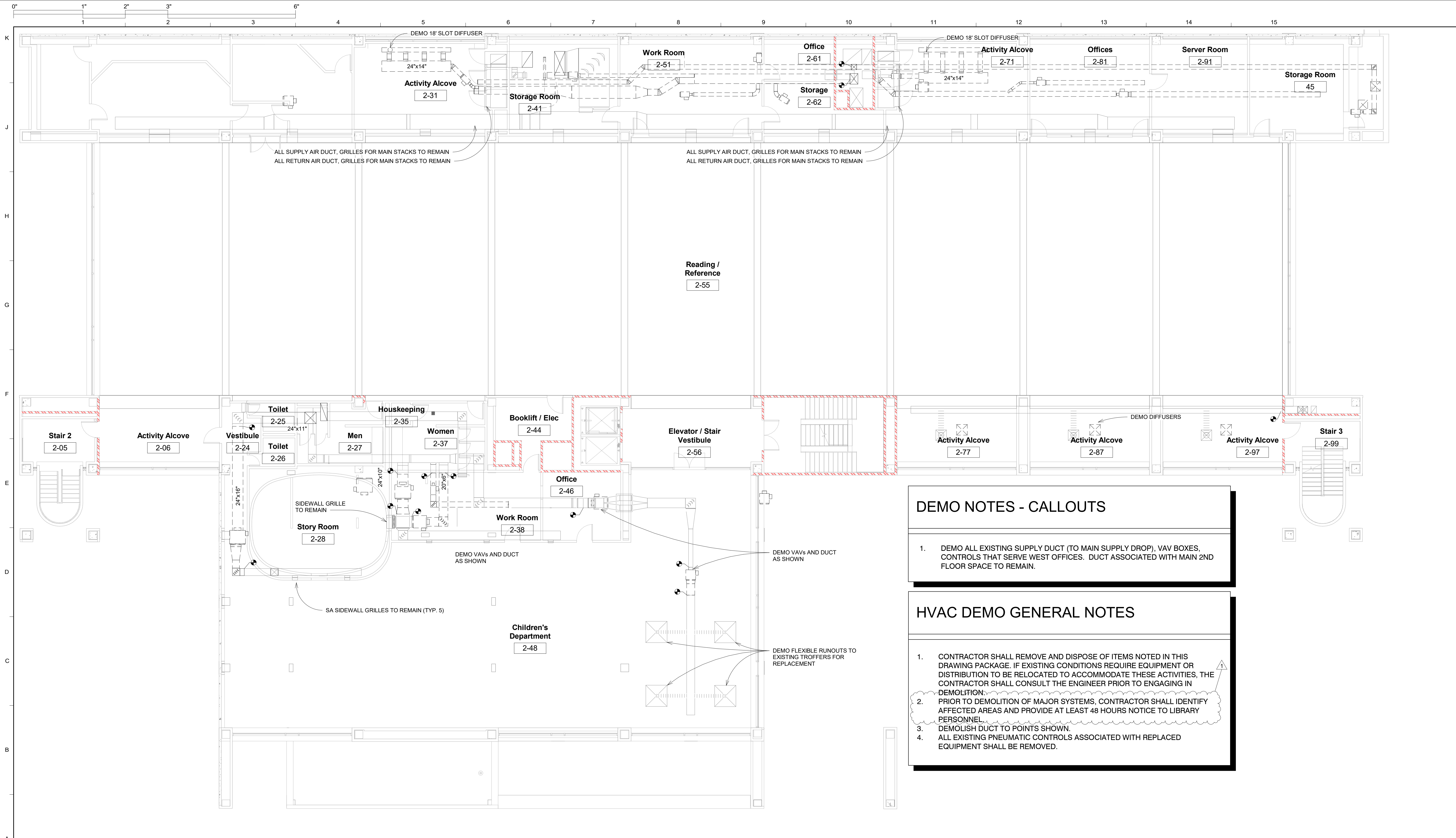
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**HVAC and Electrical Renovation**  
 File No. 2180a  
 Phase Two

Revisions		
Number	Description	Date
1	Addendum 3	10/21/2019



Title: **HVAC DEMO - 1ST FLOOR**

Sheet No. **MD-101**



**DEMO NOTES - CALLOUTS**

- DEMO ALL EXISTING SUPPLY DUCT (TO MAIN SUPPLY DROP), VAV BOXES, CONTROLS THAT SERVE WEST OFFICES. DUCT ASSOCIATED WITH MAIN 2ND FLOOR SPACE TO REMAIN.

**HVAC DEMO GENERAL NOTES**

- CONTRACTOR SHALL REMOVE AND DISPOSE OF ITEMS NOTED IN THIS DRAWING PACKAGE. IF EXISTING CONDITIONS REQUIRE EQUIPMENT OR DISTRIBUTION TO BE RELOCATED TO ACCOMMODATE THESE ACTIVITIES, THE CONTRACTOR SHALL CONSULT THE ENGINEER PRIOR TO ENGAGING IN DEMOLITION.
- PRIOR TO DEMOLITION OF MAJOR SYSTEMS, CONTRACTOR SHALL IDENTIFY AFFECTED AREAS AND PROVIDE AT LEAST 48 HOURS NOTICE TO LIBRARY PERSONNEL.
- DEMOLISH DUCT TO POINTS SHOWN.
- ALL EXISTING PNEUMATIC CONTROLS ASSOCIATED WITH REPLACED EQUIPMENT SHALL BE REMOVED.

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**DEMO HVAC 2ND FLOOR** ①  
 SCALE: 1/8" = 1'-0"

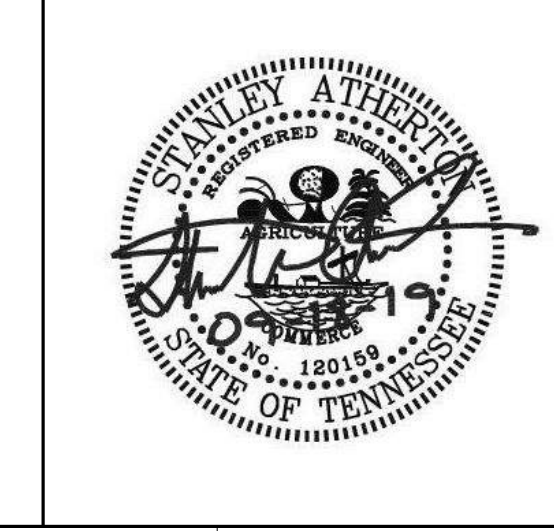


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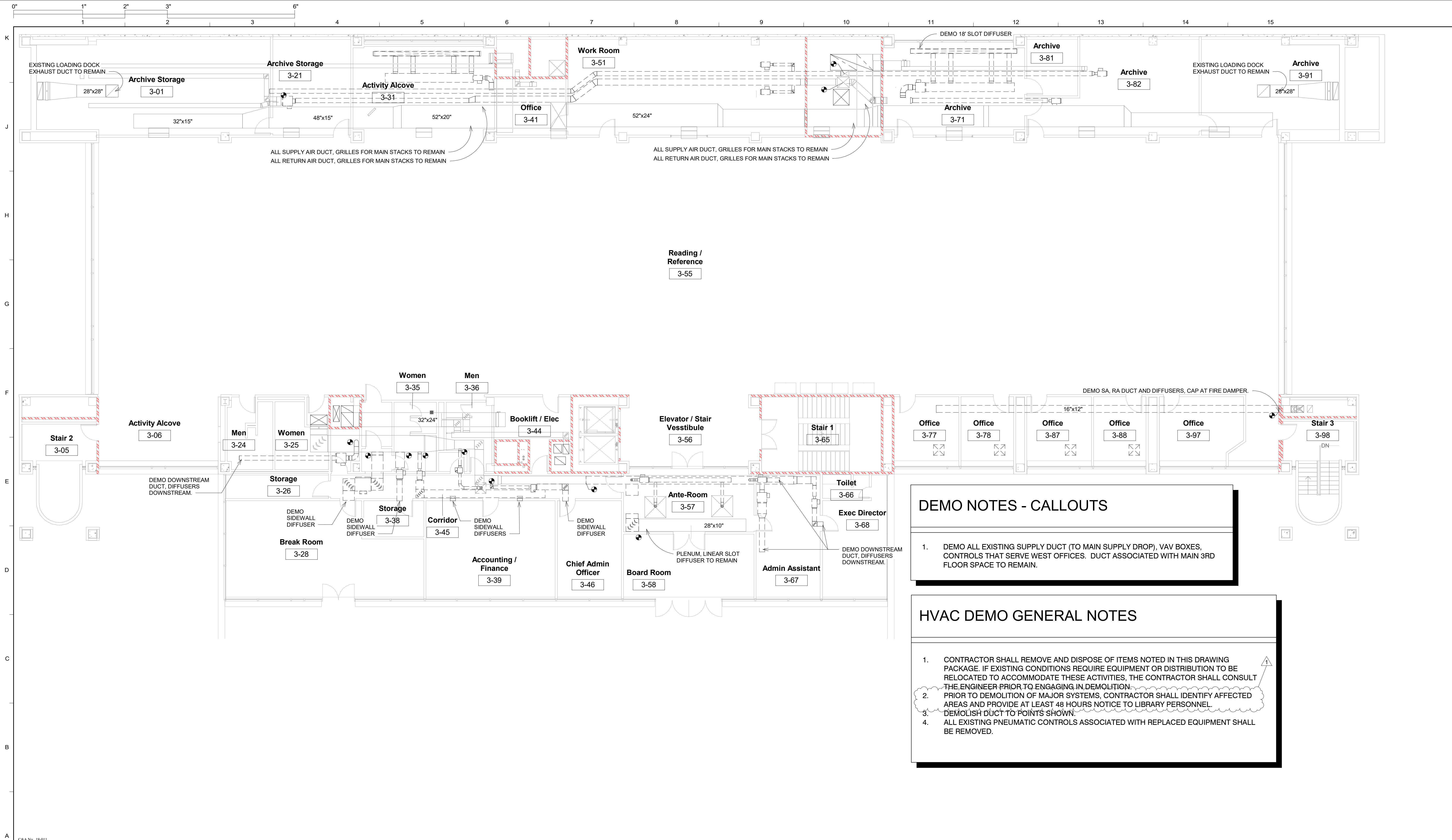
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 Phase Two**

Revisions		
Number	Description	Date
1	Addendum 3	10/21/2019



Title: **HVAC DEMO - 2ND FLOOR**

Sheet No. **MD-102**



**DEMO NOTES - CALLOUTS**

1. DEMO ALL EXISTING SUPPLY DUCT (TO MAIN SUPPLY DROP), VAV BOXES, CONTROLS THAT SERVE WEST OFFICES. DUCT ASSOCIATED WITH MAIN 3RD FLOOR SPACE TO REMAIN.

**HVAC DEMO GENERAL NOTES**

1. CONTRACTOR SHALL REMOVE AND DISPOSE OF ITEMS NOTED IN THIS DRAWING PACKAGE. IF EXISTING CONDITIONS REQUIRE EQUIPMENT OR DISTRIBUTION TO BE RELOCATED TO ACCOMMODATE THESE ACTIVITIES, THE CONTRACTOR SHALL CONSULT THE ENGINEER PRIOR TO ENGAGING IN DEMOLITION.
2. PRIOR TO DEMOLITION OF MAJOR SYSTEMS, CONTRACTOR SHALL IDENTIFY AFFECTED AREAS AND PROVIDE AT LEAST 48 HOURS NOTICE TO LIBRARY PERSONNEL.
3. DEMOLISH DUCT TO POINTS SHOWN.
4. ALL EXISTING PNEUMATIC CONTROLS ASSOCIATED WITH REPLACED EQUIPMENT SHALL BE REMOVED.

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**DEMO HVAC 3RD FLOOR**

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

1



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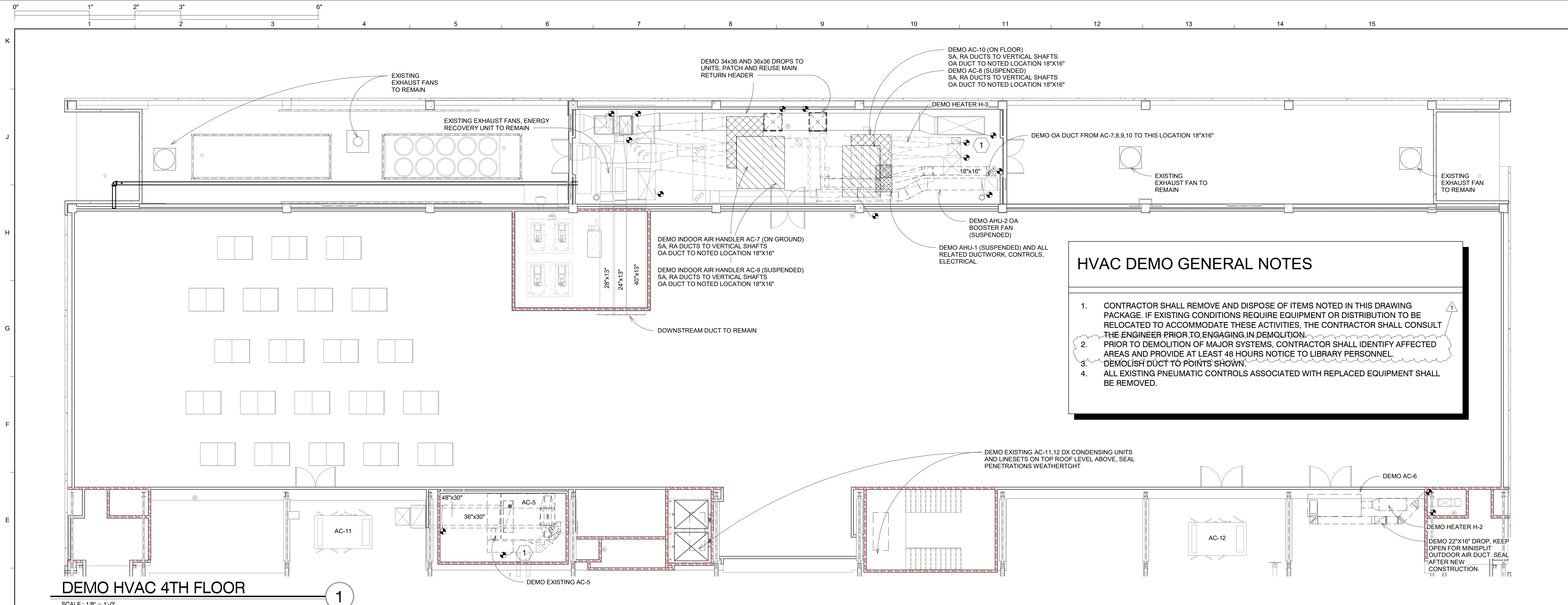
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**HVAC and Electrical Renovation**  
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 Phase Two

Revisions		
Number	Description	Date
1	Addendum 3	10/21/2019



Title: **HVAC DEMO - 3RD FLOOR**

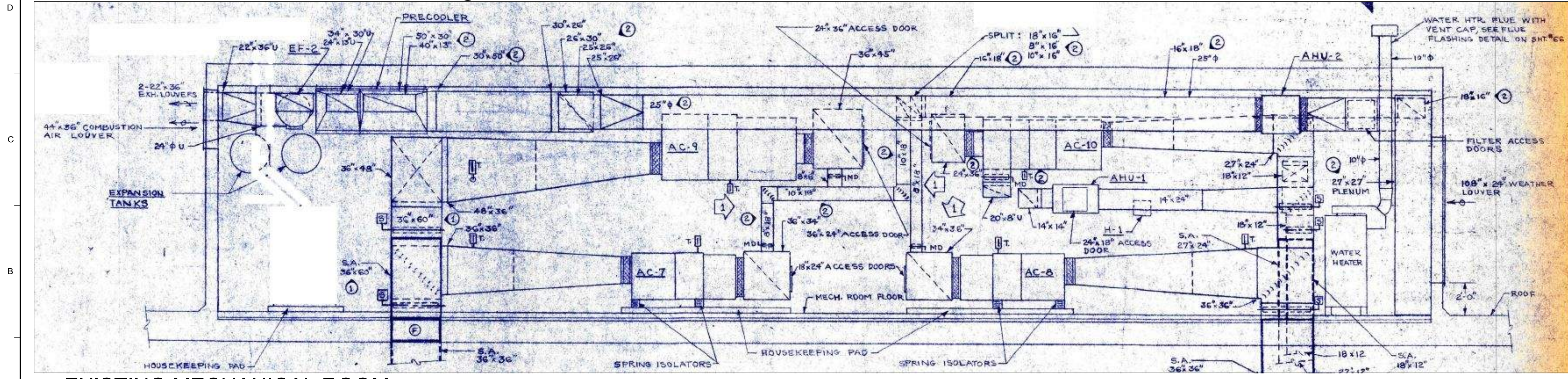
Sheet No. **MD-103**



### HVAC DEMO GENERAL NOTES

- CONTRACTOR SHALL REMOVE AND DISPOSE OF ITEMS NOTED IN THIS DRAWING PACKAGE. IF EXISTING CONDITIONS REQUIRE EQUIPMENT OR DISTRIBUTION TO BE RELOCATED TO ACCOMMODATE THESE ACTIVITIES, THE CONTRACTOR SHALL CONSULT THE ENGINEER PRIOR TO ENGAGING IN DEMOLITION.
- PRIOR TO DEMOLITION OF MAJOR SYSTEMS, CONTRACTOR SHALL IDENTIFY AFFECTED AREAS AND PROVIDE AT LEAST 48 HOURS NOTICE TO LIBRARY PERSONNEL.
- DEMOLISH DUCT TO POINTS SHOWN.
- ALL EXISTING PNEUMATIC CONTROLS ASSOCIATED WITH REPLACED EQUIPMENT SHALL BE REMOVED.

**DEMO HVAC 4TH FLOOR**  
SCALE: 1/8" = 1'-0"



### HVAC NOTES - CONSTRUCTION ALTERNATE

- CONTRACTOR SHALL PROVIDE A BASE BID TO INCLUDE ALL WORK AS SHOWN IN THESE DESIGN DOCUMENTS EXCEPT THE REPLACEMENT OF UNITS AC-11 AND AC-12.
  - THE BASE BID SHALL INCLUDE INTEGRATION OF EXISTING AC-11,12 INTO THE NEW BUILDING AUTOMATION SYSTEM, NEW LTW CONTROL VALVES, NEW STAINLESS STEEL DRAIN PANS WITH FLOAT SWITCHES.
- CONTRACTOR WILL PROVIDE AN ALTERNATE BID TO INCLUDE THE FULL REPLACEMENT OF AC-11 AND AC-12.

**EXISTING MECHANICAL ROOM**

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**HVAC and Electrical Renovation**  
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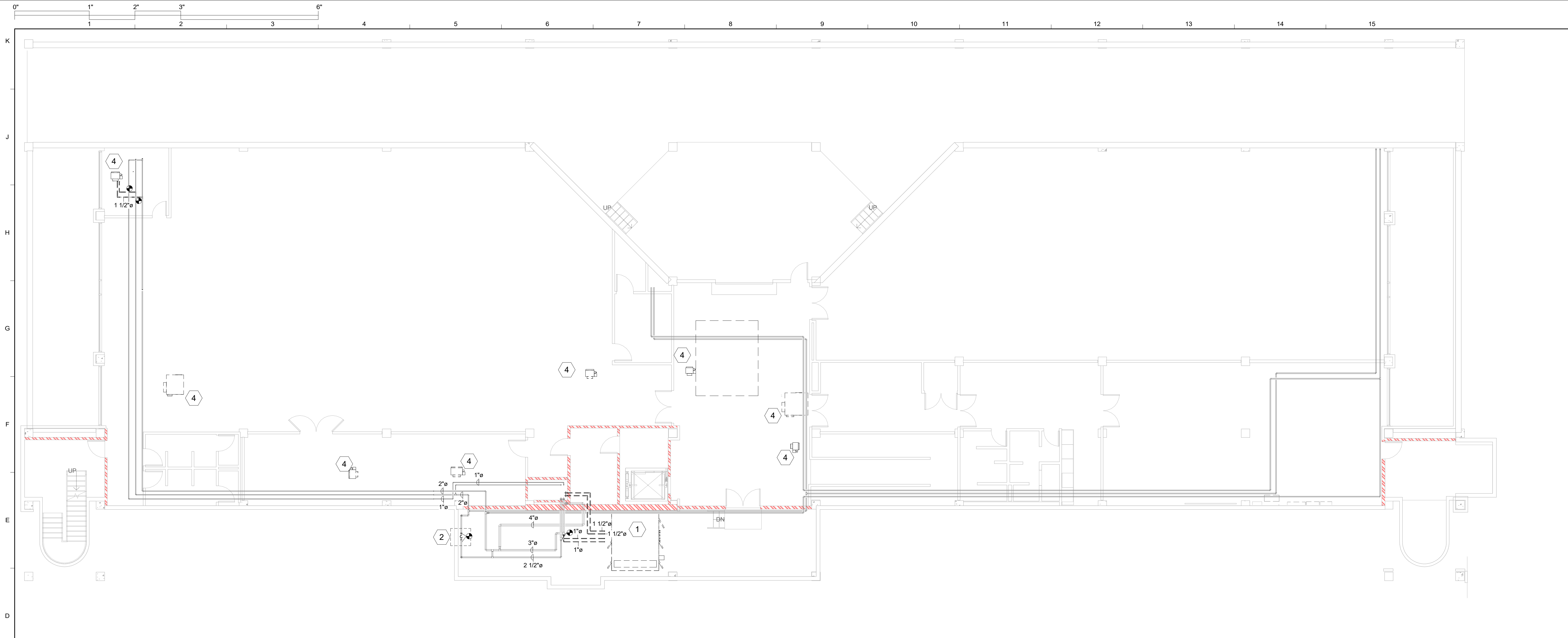
Revisions		
Number	Description	Date
1	Addendum 3	10/21/2019



Title: **HVAC DEMO - 4TH FLOOR**

Sheet No. **MD-104**





- DEMO NOTES - CALLOUTS**
1. DEMO EXISTING AC-1 PIPING, CONTROLS, VALVES AS SHOWN.
  2. DEMO AC-1 AND ALL ASSOCIATED DUCT (TO NOTED POINTS), ELECTRICAL CONNECTIONS, PNEUMATIC CONTROLS, HYDRONIC PIPE AS SHOWN.
  3. DEMO LTW PUMP #3 AND ASSOCIATED CONTROLS.
  4. DEMO EXISTING VAVS, RUNOUTS.

- HVAC DEMO GENERAL NOTES**
1. CONTRACTOR SHALL REMOVE AND DISPOSE OF ITEMS NOTED IN THIS DRAWING PACKAGE. IF EXISTING CONDITIONS REQUIRE EQUIPMENT OR DISTRIBUTION TO BE RELOCATED TO ACCOMMODATE THESE ACTIVITIES, THE CONTRACTOR SHALL CONSULT THE ENGINEER PRIOR TO ENGAGING IN DEMOLITION.
  2. PRIOR TO DEMOLITION OF MAJOR SYSTEMS, CONTRACTOR SHALL IDENTIFY AFFECTED AREAS AND PROVIDE AT LEAST 48 HOURS NOTICE TO LIBRARY PERSONNEL.
  3. DEMOLISH PIPE TO POINTS SHOWN.

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**DEMO PIPE GROUND FLOOR** ①  
 SCALE: 1/8" = 1'-0"

Revisions

Number	Description	Date
1	Addendum 3	10/21/2019



Title:  
**HVAC PIPING DEMO - GROUND FLOOR**

Sheet No.  
**MD-200**

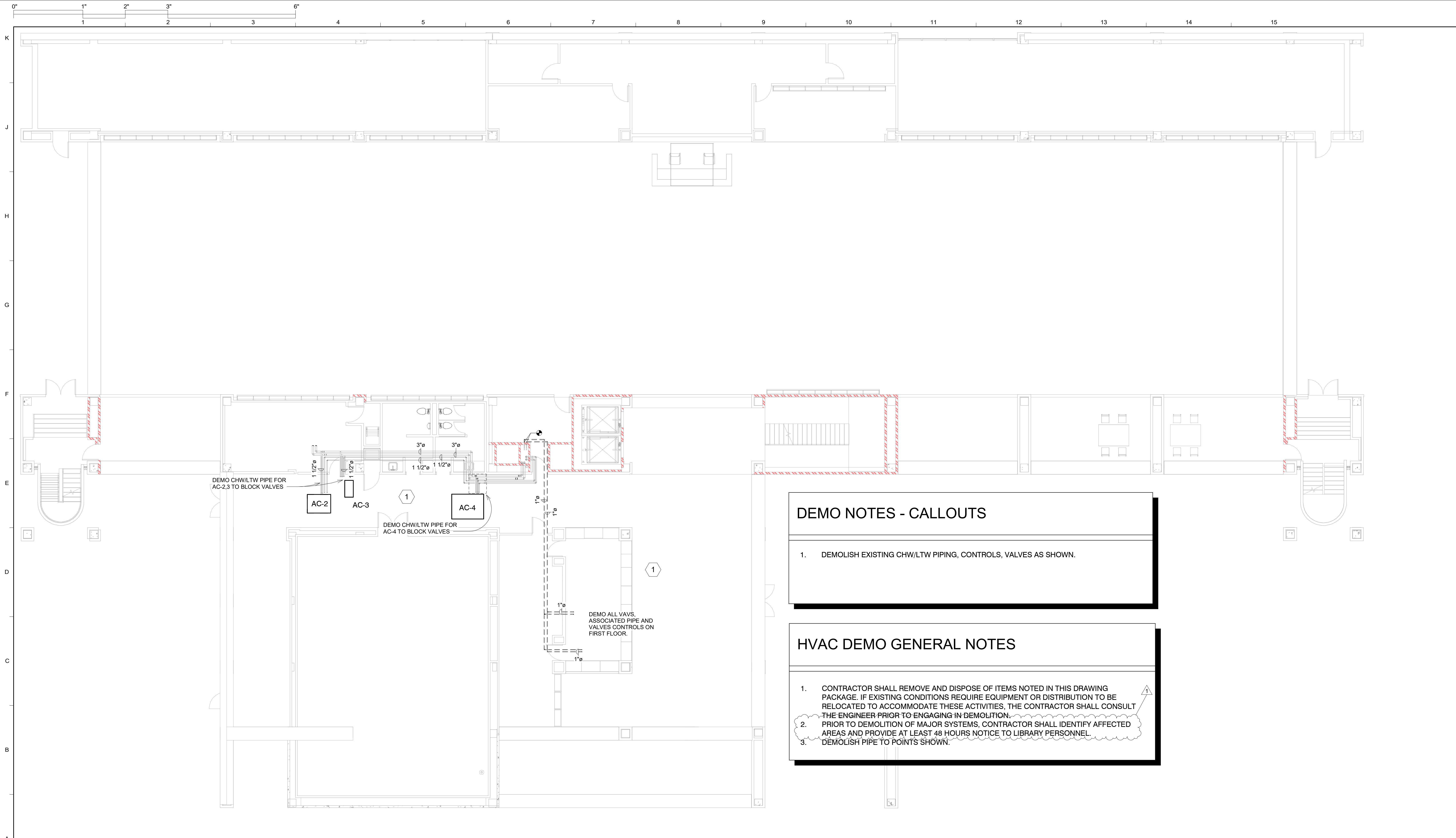


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**DEMO NOTES - CALLOUTS**

- DEMOLISH EXISTING CHW/LTW PIPING, CONTROLS, VALVES AS SHOWN.

**HVAC DEMO GENERAL NOTES**

- CONTRACTOR SHALL REMOVE AND DISPOSE OF ITEMS NOTED IN THIS DRAWING PACKAGE. IF EXISTING CONDITIONS REQUIRE EQUIPMENT OR DISTRIBUTION TO BE RELOCATED TO ACCOMMODATE THESE ACTIVITIES, THE CONTRACTOR SHALL CONSULT THE ENGINEER PRIOR TO ENGAGING IN DEMOLITION.
- PRIOR TO DEMOLITION OF MAJOR SYSTEMS, CONTRACTOR SHALL IDENTIFY AFFECTED AREAS AND PROVIDE AT LEAST 48 HOURS NOTICE TO LIBRARY PERSONNEL.
- DEMOLISH PIPE TO POINTS SHOWN.

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**DEMO PIPE 1ST FLOOR**

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

1

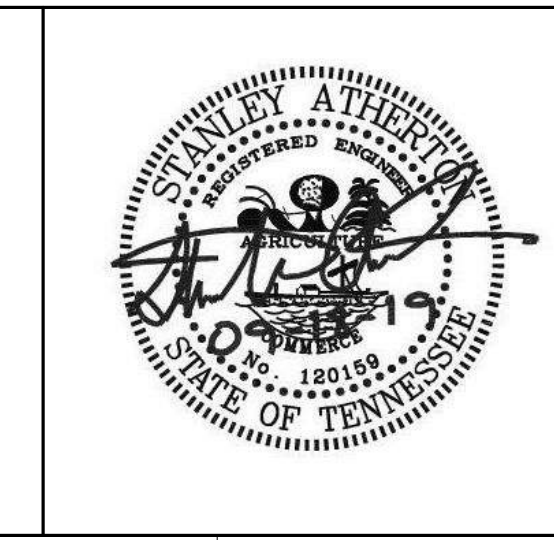
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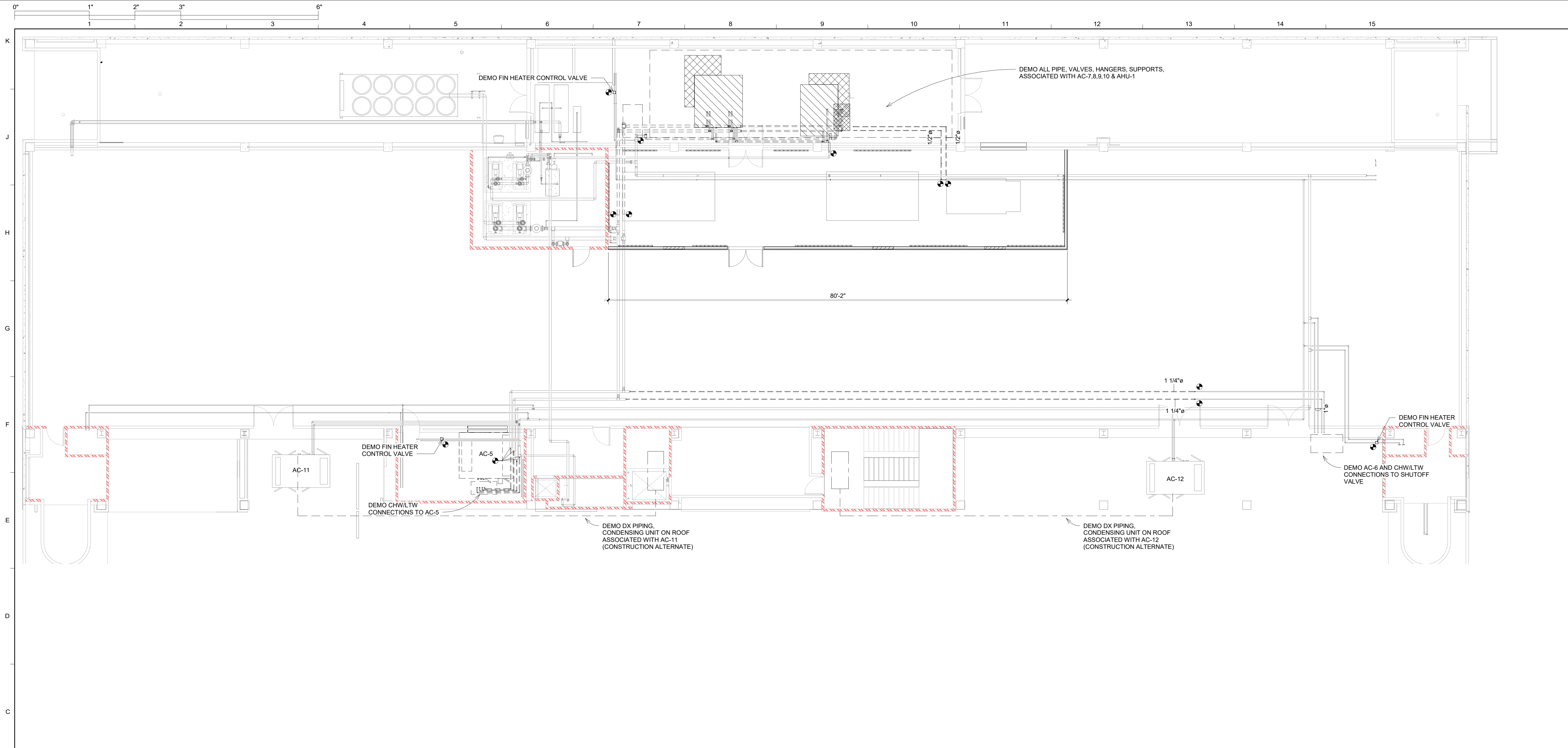


Title:

**HVAC PIPING DEMO - 1ST FLOOR**

Sheet No.

**MD-201**



**DEMO NOTES - CALLOUTS**

1. DEMOLISH EXISTING CHW/LTW PIPING, CONTROLS, VALVES AS SHOWN.
2. DEMOLISH PIPING, VALVES, FOR AC-11,12 BACK TO MAIN DISTRIBUTION PIPE. THIS DEMO ACTIVITY IS INCLUDED IN CONSTRUCTION ALTERNATE.

**HVAC DEMO GENERAL NOTES**

1. CONTRACTOR SHALL REMOVE AND DISPOSE OF ITEMS NOTED IN THIS DRAWING PACKAGE. IF EXISTING CONDITIONS REQUIRE EQUIPMENT OR DISTRIBUTION TO BE RELOCATED TO ACCOMMODATE THESE ACTIVITIES, THE CONTRACTOR SHALL CONSULT THE ENGINEER PRIOR TO ENGAGING IN DEMOLITION.
2. PRIOR TO DEMOLITION OF MAJOR SYSTEMS, CONTRACTOR SHALL IDENTIFY AFFECTED AREAS AND PROVIDE AT LEAST 48 HOURS NOTICE TO LIBRARY PERSONNEL.
3. DEMOLISH PIPE TO POINTS SHOWN.

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**DEMO PIPE 4TH FLOOR**  
 SCALE: 1/8" = 1'-0"  
 1

Revisions		
Number	Description	Date
1	Addendum 3	10/21/2019



Title:  
**HVAC PIPING DEMO - 4TH FLOOR**

Sheet No.  
**MD-204**



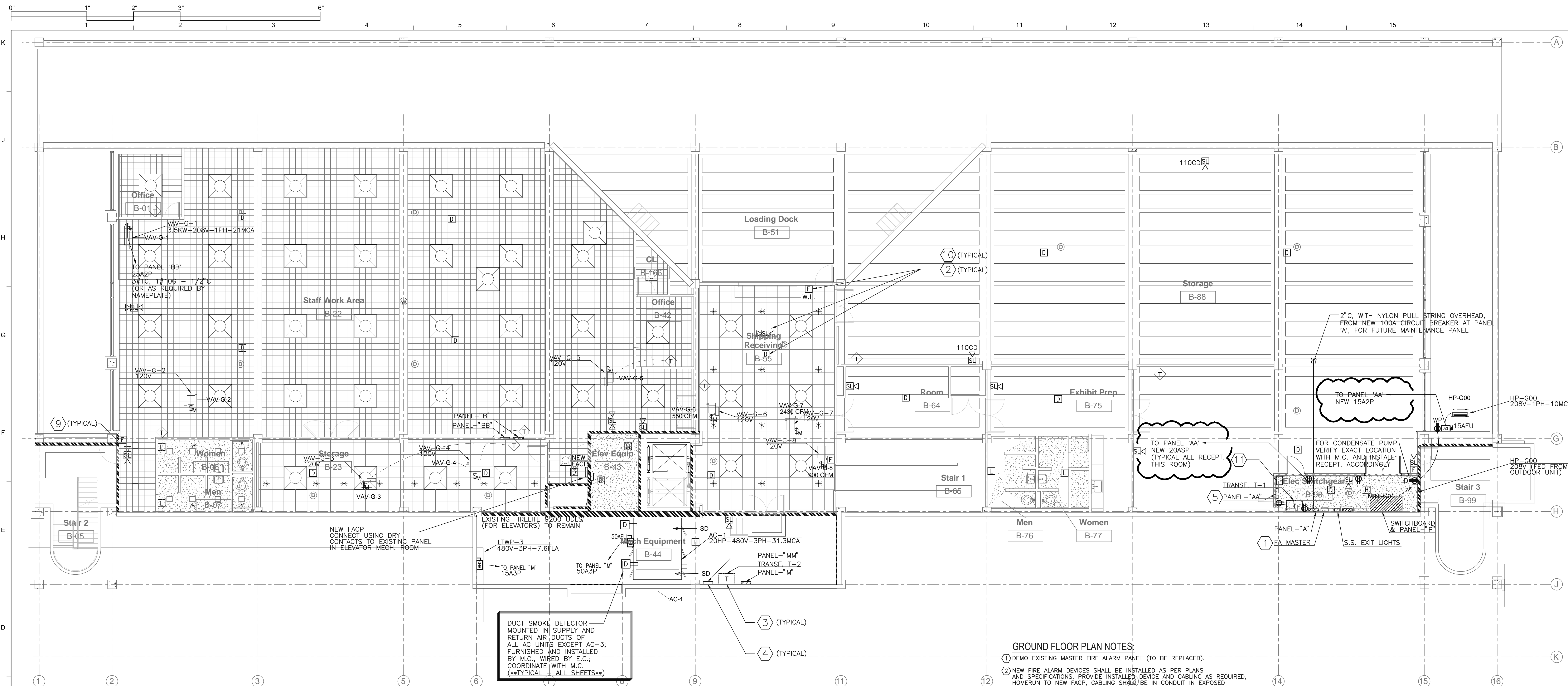
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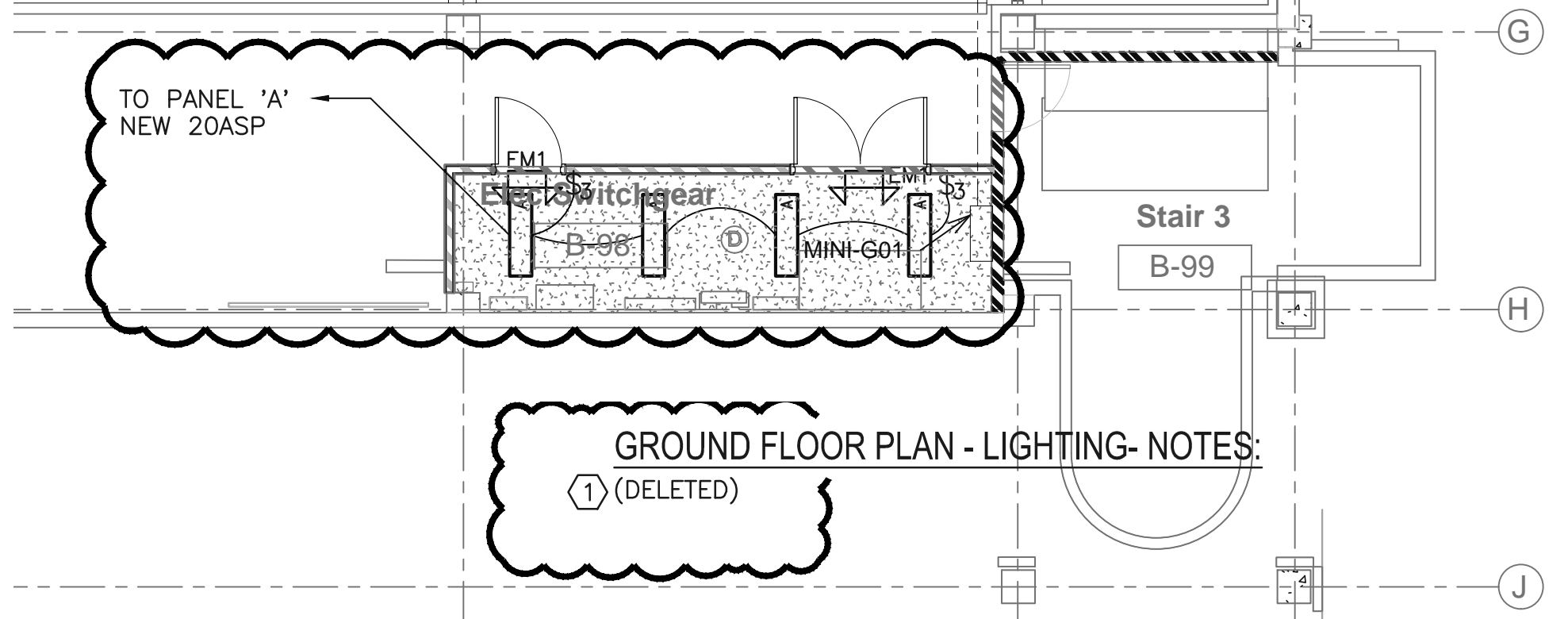


**ELECTRICAL - GROUND FLOOR**  
1/8" = 1'-0"

DUCT SMOKE DETECTOR MOUNTED IN SUPPLY AND RETURN AIR DUCTS OF ALL AC UNITS EXCEPT AC-3; FURNISHED AND INSTALLED BY M.C.; WIRED BY E.C.; COORDINATE WITH M.C. (\*\*TYPICAL - ALL SHEETS\*\*)

**GROUND FLOOR PLAN NOTES:**

- 1 DEMO EXISTING MASTER FIRE ALARM PANEL (TO BE REPLACED).
- 2 NEW FIRE ALARM DEVICES SHALL BE INSTALLED AS PER PLANS AND SPECIFICATIONS. PROVIDE INSTALLED DEVICE AND CABLING AS REQUIRED. HOMERUN TO NEW FAC. CABLING SHALL BE IN CONDUIT IN EXPOSED LOCATIONS AND SHALL BE PLENUM RATED WHERE ABOVE CEILING (REFER TO SPECIFICATIONS).
- 3 EXISTING STEP DOWN TRANSFORMERS, TO REMAIN.
- 4 EXISTING PANEL BOARDS/SWITCH BOARDS SHALL BE REPLACED WITH NEW AT EXISTING LOCATIONS. REMOVE EXISTING PANEL, LABEL AND SET BRANCH CIRCUIT CONDUCTORS ASIDE. INSTALL NEW PANEL WITH SAME QUANTITY/SIZE CIRCUIT BREAKERS AS PANEL REMOVED, RECONNECT (RE-FEED) EXISTING BRANCH CIRCUITS FROM NEW AND LABEL ACCORDINGLY.
- 5 EXISTING PANEL 'A' LOCATION SHALL REQUIRE TO BE RELOCATED DUE TO CONSTRUCTION OF NEW WALLS/STRUCTURE OF NEW ELECTRICAL ROOM. TYPICAL NOTES DEPICTING THE WORK OF REPLACING PANELS, BREAKERS, RECONNECTING EXISTING FEEDERS, UTILIZING EXISTING PANEL FEEDERS, ETC. SHALL APPLY. HOWEVER E.C. IS TO INSTALL NEW PANEL AT APPROXIMATE LOCATION AS SHOWN ON THIS PLAN. EXTEND AND/OR REWORK EXISTING FEEDERS AND BRANCH CIRCUIT CONDUCTORS AS REQUIRED TO ACCOMMODATE NEW PANEL LOCATION.
- 6 ALL VAV'S FURNISHED W/ 12V/24V STEP DOWN BY MECH. INSTALLED/WIRED BY ELECTRICAL CONTRACTOR; E.C. SHALL PROVIDE NEW 120V 20A CIRCUIT FED FROM NEAREST AVAILABLE 120/208V PANEL (CIRCUIT MAY BE SHARED WITH MULTIPLE VAV LOCATIONS ON SAME FLOOR ONLY (MAX 1800VA PER 20A CKT).
- 7 ALL ELEVATOR FA DEVICES EXISTING, FIELD VERIFY.
- 8 EXISTING FLOW/TAMPER SWITCHES SHALL BE REPLACED WITH NEW AND CONNECTED TO NEW PANEL.
- 9 UTILIZE EXISTING PULL STATION LOCATIONS. WHERE PULL STATIONS ARE SHOWN AND NO PREVIOUS DEVICE EXISTS; PULL STATIONS SHALL BE WIRELESS AND SHALL COMMUNICATE WITH BUILDING FA SYSTEM.
- 10 REFER TO ARCHITECTURAL DRAWINGS FOR EXACT LOCATION OF CEILING MOUNTED DEVICE.
- 11 RELOCATE EXISTING SURFACE MOUNTED DISCONNECTS FROM COLUMN TO NEW WALL. EXTEND CONDUCTORS AS REQUIRED TO ACCOMMODATE NEW LOCATIONS.



**ELECTRICAL - GROUND FLOOR - PARTIAL LIGHTING**

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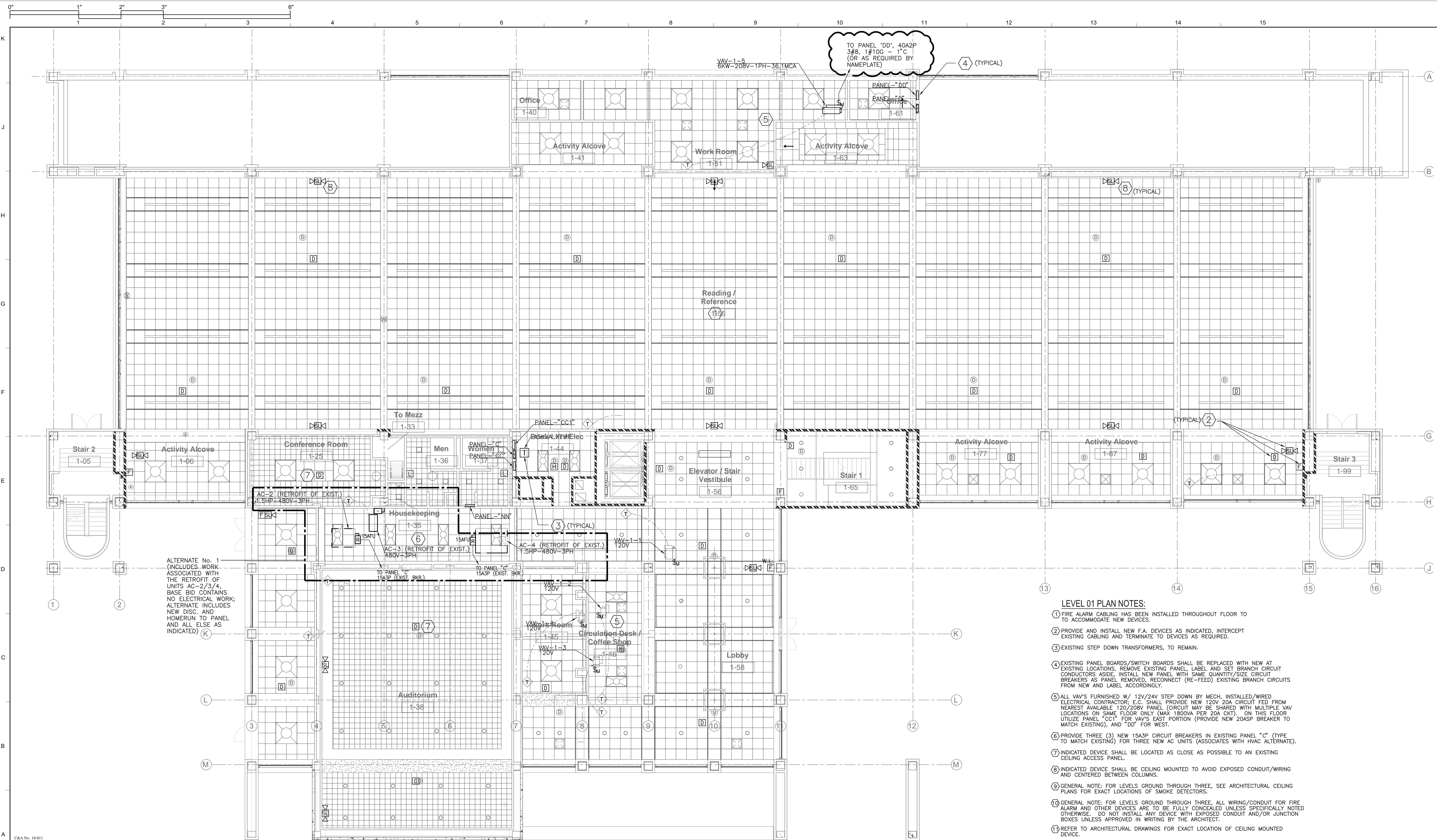


Title:

**ELECTRICAL - GROUND FLOOR**

Sheet No.

**E-100**



ALTERNATE No. 1  
(INCLUDES WORK ASSOCIATED WITH THE RETROFIT OF UNITS AC-2/3/4. BASE BID CONTAINS NO ELECTRICAL WORK; ALTERNATE INCLUDES NEW DISC. AND HOMERUN TO PANEL AND ALL ELSE AS INDICATED)

- LEVEL 01 PLAN NOTES:**
- ① FIRE ALARM CABLING HAS BEEN INSTALLED THROUGHOUT FLOOR TO ACCOMMODATE NEW DEVICES.
  - ② PROVIDE AND INSTALL NEW F.A. DEVICES AS INDICATED. INTERCEPT EXISTING CABLING AND TERMINATE TO DEVICES AS REQUIRED.
  - ③ EXISTING STEP DOWN TRANSFORMERS, TO REMAIN.
  - ④ EXISTING PANEL BOARDS/SWITCH BOARDS SHALL BE REPLACED WITH NEW AT EXISTING LOCATIONS. REMOVE EXISTING PANEL, LABEL AND SET BRANCH CIRCUIT CONDUCTORS ASIDE. INSTALL NEW PANEL WITH SAME QUANTITY/SIZE CIRCUIT BREAKERS AS PANEL REMOVED. RECONNECT (RE-FEED) EXISTING BRANCH CIRCUITS FROM NEW AND LABEL ACCORDINGLY.
  - ⑤ ALL VAV'S FURNISHED W/ 12V/24V STEP DOWN BY MECH. INSTALLED/WIRED ELECTRICAL CONTRACTOR; E.C. SHALL PROVIDE NEW 120V 20A CIRCUIT FED FROM NEAREST AVAILABLE 120/208V PANEL (CIRCUIT MAY BE SHARED WITH MULTIPLE VAV LOCATIONS ON SAME FLOOR ONLY (MAX 1800VA PER 20A CKT)). ON THIS FLOOR UTILIZE PANEL "CC" FOR VAV'S EAST PORTION (PROVIDE NEW 20ASP BREAKER TO MATCH EXISTING), AND "DD" FOR WEST.
  - ⑥ PROVIDE THREE (3) NEW 15A3P CIRCUIT BREAKERS IN EXISTING PANEL "C" (TYPE TO MATCH EXISTING) FOR THREE NEW AC UNITS (ASSOCIATES WITH HVAC ALTERNATE).
  - ⑦ INDICATED DEVICE SHALL BE LOCATED AS CLOSE AS POSSIBLE TO AN EXISTING CEILING ACCESS PANEL.
  - ⑧ INDICATED DEVICE SHALL BE CEILING MOUNTED TO AVOID EXPOSED CONDUIT/WIRING AND CENTERED BETWEEN COLUMNS.
  - ⑨ GENERAL NOTE: FOR LEVELS GROUND THROUGH THREE, SEE ARCHITECTURAL CEILING PLANS FOR EXACT LOCATIONS OF SMOKE DETECTORS.
  - ⑩ GENERAL NOTE: FOR LEVELS GROUND THROUGH THREE, ALL WIRING/CONDUIT FOR FIRE ALARM AND OTHER DEVICES ARE TO BE FULLY CONCEALED UNLESS SPECIFICALLY NOTED OTHERWISE. DO NOT INSTALL ANY DEVICE WITH EXPOSED CONDUIT AND/OR JUNCTION BOXES UNLESS APPROVED IN WRITING BY THE ARCHITECT.
  - ⑪ REFER TO ARCHITECTURAL DRAWINGS FOR EXACT LOCATION OF CEILING MOUNTED DEVICE.
  - ⑫ UTILIZE EXISTING PULL STATION LOCATIONS. WHERE PULL STATIONS ARE SHOWN AND NO PREVIOUS DEVICE EXISTS, PULL STATIONS SHALL BE WIRELESS AND SHALL COMMUNICATE WITH BUILDING FA SYSTEM.

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**ELECTRICAL - 1ST FLOOR**  
1/8" = 1'-0"

**DH&W**  
ARCHITECTURE INTERIORS PLANNING

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**Chattanooga Public Library  
HVAC and Electrical Renovation  
File No. 2180a  
Phase Two**

Revisions		
Number	Description	Date
1	Addendum 3	10/21/2019

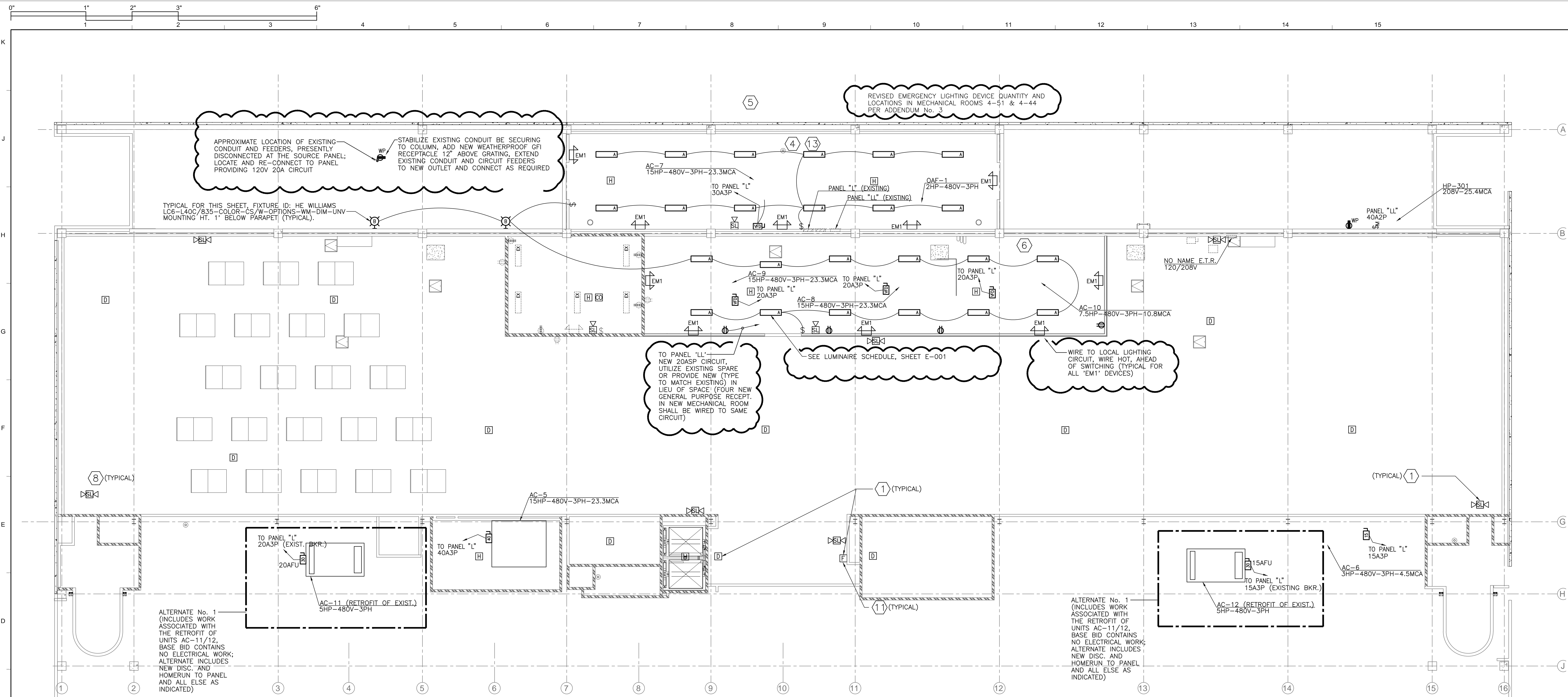


Title:

**ELECTRICAL -  
1ST FLOOR**

Sheet No.

**E-101**



**ELECTRICAL - 4TH FLOOR**

1/8" = 1'-0"

**LEVEL 04 PLAN NOTES:**

- ① NEW FIRE ALARM DEVICES SHALL BE INSTALLED AS PER PLANS AND SPECIFICATIONS. PROVIDE INSTALLED DEVICE AND CABLING AS REQUIRED. HOMERUN TO NEW FAC. CABLING SHALL BE IN CONDUIT IN EXPOSED LOCATIONS (REFER TO SPECIFICATIONS).
- ② EXISTING STEP DOWN TRANSFORMERS, TO REMAIN.
- ③ EXISTING PANEL BOARDS/SWITCH BOARDS SHALL BE REPLACED WITH NEW AT EXISTING LOCATIONS. REMOVE EXISTING PANEL, LABEL AND SET BRANCH CIRCUIT CONDUCTORS ASIDE. INSTALL NEW PANEL WITH SAME QUANTITY/SIZE CIRCUIT BREAKERS AS PANEL REMOVED. RECONNECT (RE-FEED) EXISTING BRANCH CIRCUITS FROM NEW AND LABEL ACCORDINGLY.
- ④ DEMO ALL FEEDERS TO HVAC EQUIPMENT SCHEDULE FOR REMOVAL, PROVIDE NEW FEEDERS TO ALL NEW EQUIPMENT AS REQUIRED.
- ⑤ FOR EXISTING 4TH FLOOR MECHANICAL ROOM AND ROOF WELLS: ALL INTERIOR LIGHTING FIXTURES SHALL BE DEMOLISHED. INSTALL NEW LIGHTING IN THE INDOOR AND OUTDOOR AREAS AS INDICATED. UTILIZE EXISTING CIRCUITING; EXTEND, REWORK, ETC. AS REQUIRED TO ACCOMMODATE NEW LIGHT FIXTURES AND LOCATIONS. PROVIDE NEW SWITCHES AS INDICATED. COORDINATE INTERIOR LIGHT FIXTURE LOCATIONS WITH MECHANICAL EQUIPMENT, SUSPEND SUCH THAT INTERIOR FIXTURES IS APPROX 7'-8" A.F.F. AND AS CLOSE TO EVEN WITH THE BOTTOM OF THE HIGH ELEVATION DUCT AS POSSIBLE.
- ⑥ FOR NEW 4TH FLOOR MECHANICAL ROOM, AND AFFECTED SPACE FORMERLY GENERAL PURPOSE ROOM: RELOCATE EXISTING FIXTURES SO AS TO REMAIN IN GENERAL PURPOSE SPACE. COORDINATE EXACT LOCATIONS WITH OWNER. UTILIZE EXISTING CIRCUITING; EXTEND, REWORK, ETC. AS REQUIRED TO ACCOMMODATE NEW CONSTRUCTION OF MECHANICAL SPACE. FIXTURES WITHIN NEW MECH. RM ARE NEW. COORDINATE INTERIOR LIGHT FIXTURE LOCATIONS WITH MECHANICAL EQUIPMENT, SUSPEND SUCH THAT INTERIOR FIXTURES ARE AT HEIGHT A.F.F. AS PER ARCHITECT, AND AS CLOSE TO EVEN WITH THE BOTTOM OF THE HIGH ELEVATION DUCT AS POSSIBLE. FEED FROM NEW 20ASP CIRCUIT IN PANEL "L". NEW LIGHTING AT EXTERIOR (TYPE 'C') SHALL BE FED FROM SAME CIRCUIT.
- ⑦ (RESERVED)
- ⑧ EXPOSED CONDUIT FOR SPEAKER/STROBES ON THIS FLOOR SHALL BE ACCEPTABLE.
- ⑨ (RESERVED)
- ⑩ GENERAL NOTE: ALL WIRING/CONDUIT FOR FIRE ALARM AND OTHER DEVICES ARE TO BE FULLY CONCEALED IN GENERAL PURPOSE ROOM UNLESS SPECIFICALLY NOTED OTHERWISE. DO NOT INSTALL ANY DEVICE WITH EXPOSED CONDUIT AND/OR JUNCTION BOXES UNLESS APPROVED IN WRITING BY THE ARCHITECT.
- ⑪ UTILIZE EXISTING PULL STATION LOCATIONS. WHERE PULL STATIONS ARE SHOWN AND NO PREVIOUS DEVICE EXISTS; PULL STATIONS SHALL BE WIRELESS AND SHALL COMMUNICATE WITH BUILDING FA SYSTEM.
- ⑫ REFER TO ARCHITECTURAL DRAWINGS FOR EXACT LOCATION OF CEILING MOUNTED DEVICE.
- ⑬ (DELETED)

C&A No. 18-011

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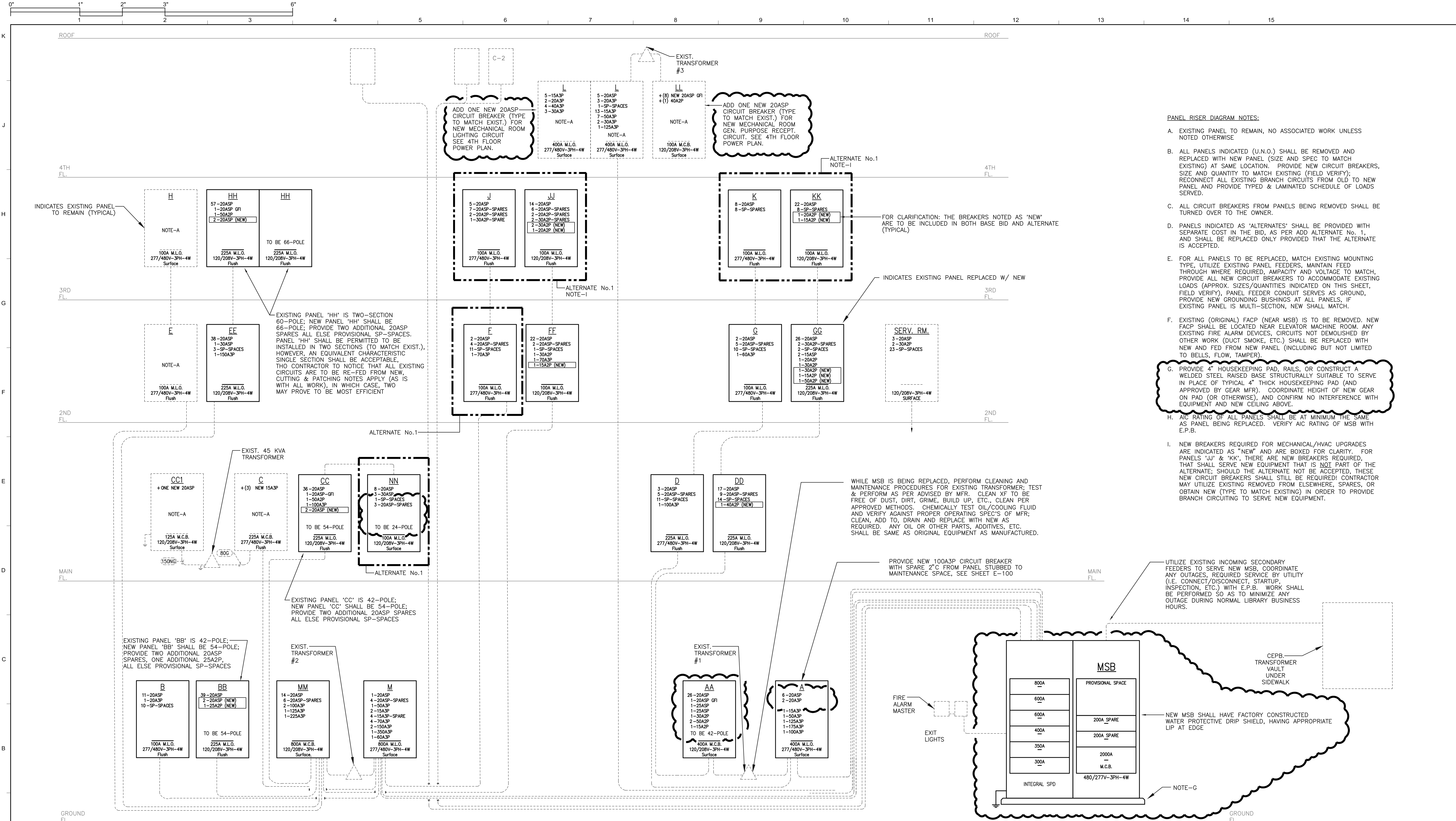


Title:

**ELECTRICAL - 4TH FLOOR**

Sheet No.

**E-104**



**PANEL RISER DIAGRAM**

SCALE: NONE

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Title: **ELECTRICAL - RISER DIAGRAM**

Sheet No. **E-200**