

January 8, 2019
BOARD OF COUNTY COMMISSIONERS
ORANGE COUNTY, FLORIDA
Y19-726-JS / ADDENDUM # 1
ORANGE COUNTY CONVENTION CENTER
NORTH/SOUTH BUILDING AUTOMATION SYSTEM (BAS) UPGRADE

Bid Opening Date: January 29, 2019

This addendum is hereby incorporated into the bid documents of the project referenced above. The following items are clarifications, corrections, additions, deletions and/or revisions to and shall take precedence over the original documents. Underlining indicates additions, deletions are indicated by ~~strikethrough~~.

- A. The Bid Opening Date remains as January 29, 2019.

- B. A site visit has been scheduled for January 14, 2019 after the Pre-Bid Meeting.**

- C. The following are questions/responses/clarifications:

- 1. Siemens is currently not listed in the specification, however the specification does allow Siemens to provide a proposal if Siemens is pre-approved. Can you please confirm that Siemens would be an acceptable bidder on this project.

Response: Only the (3) three listed manufacturers in specification 230900, 2.2.A shall be allowed to bid the project and 3 (three) manufacturers have been listed per CCNA guidelines which is per Florida Statute FS-287, FS-287.055, FS-287.057 and other related requirements. This is addressed in the attached revised Spec Section 23 09 00, Part 2.2.A.

- 2. Under the Specification Section INSTRUMENTATION AND CONTROL FOR THE HVAC SECTION 230900, Subsection 2.2 Control System, A. Manufacturers: 1. Honeywell – Local Branch Office (No substitutions). 2. Johnson Controls Inc. 3. Trane. 4. Pre-approved substitute. We are requesting to submit per 4. Pre-approved Substitution. We are respectfully requesting the Siemens BACnet Talon product to be accepted as an alternate product. The Siemens BACnet Talon will meet and exceed the specification section 230900.

Response: Only the (3) three listed manufacturers in specification 230900, 2.2.A shall be allowed to bid the project and 3 (three) manufacturers have been listed per CCNA guidelines which is per Florida Statute FS-287, FS-287.055, FS-287.057 and other related requirements. This is addressed in the attached revised Spec Section 23 09 00, Part 2.2.A.

3. Building Department Comment: Sheets M2.107 - M2.111 indicate new louvers which appear to be in exterior walls. Please provide structural details for the new openings and Florida Product Approval for the louvers.

Response: Refer to revised louver note on attached revised sheets M2.107 thru M2.111 to show as existing. Added general note #23 to sheet M-001.

4. Building Department Comment: M 401.5 - INTAKE OPENING PROTECTION: Air intake openings that terminate outdoors shall be protected with corrosion-resistant screens, louvers or grilles. Openings shall be sized in accordance with Table 401.5 or prescribed per product manufacturers installation instruction. (FBC 401.5).

Response: Louvers are existing to remain refer to attached revised sheets M2.107 thru M2.111. Added general note #23 to sheet M-001.

5. Building Department Comment: SHEET M2.107 - M2.11 INDICATES NEW 24X24 LOUVERS OPENINGS. NEED TO PROVIDE LOUVERS, CUT-SHEETS AND STRUCTURAL FRAMING DETAILS. FBC 107.

Response: Refer to revised louver note on attached revised sheets M2.107 thru M2.111 to show as existing.

6. Building Department Comment: M 607.2 - INSTALLATION: Fire dampers, Combination fire/smoke dampers, Radiation dampers and Smoke dampers shall be installed in accordance with the requirements of the manufacturers instructions and listing and the damper instruction shall be provided with plans for approval. Engineered generic details does not provide specific detailed information for the mechanical inspection process to be completed on each type of damper(s) to be installed. (FBCM 607.1) NOTE: Plans shall document all Exception notation to be used to omit the installation of any damper. (FBCM 607.1).

Response: Fire dampers are existing to remain. Refer to added general note #24 on attached revised sheet M-001.

D. ATTACHMENTS:

1. **Revised Specification Section 230900 INSTRUMENTATION AND CONTROL FOR HVAC, Part 2.2.A.**
2. **Revised Drawing Sheets M-001, M2-107, M2-108, M2-109, M2-110 and M2-111.**

E. All other term and conditions of the IFB remain the same.

F. The Proposer shall acknowledge receipt of this addendum by completing the applicable section in the solicitation or by completion of the acknowledgement information on the addendum. Either form of acknowledgement must be completed and returned not later than the date and time for receipt of the proposal.

Receipt acknowledged by:

Authorized Signature

Date Signed

Title

Name of Firm

SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes open protocol DDC control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls and make-up water meter.
- B. The intent of this specification is to ensure that the provided solution utilizes an open system communication protocol, so that system data is openly communicated utilizing BACnet protocol communication standards in a non-proprietary format so that other 3rd party client systems can easily identify data points and interoperate. All the existing Virtual Servers' software will be modified with the new points and graphics.

1.3 DEFINITIONS

- A. DDC: Direct digital control.
- B. I/O: Input/output.
- C. BACnet: A communication protocol defined for the Building Automation and Control Network (BACnet) by ASHRAE, SSPC 135-2004 with associated Annex's released to date. BACnet solutions consist of BACnet Client, Server, and Controllers solutions.
- D. MS/TP: Master slave/token passing. BACnet standard for 485 communications
- E. PC: Personal computer.
- F. PID: Proportional plus integral plus derivative.
- G. BACnet/IP - The use of the Ethernet and IP data/network link protocols for the transport of BACnet messages.
- H. BTL - BACnet Testing Laboratory. Provides BACnet conformance testing (e.g., to confirm that a B-BC device meets the minimum requirements for the Building Controller profile as defined in the BACnet standard). If the device passes BTL testing it is said to be "BTL-listed" as, say, a "B-BC device". Also, note that devices tested by an ISO accredited laboratory may also issue a certificate, and be referred to as "BTL-certified" device.

- I. MS/TP - An EIA-485 data link technology unique to and defined by BACnet for the transport of BACnet messages.
- J. PICS – Protocol Implementation Conformance Statement. A BACnet form that must be used for BTL – listing in which the device’s BACnet device profile, required feature choices, and optional features are to be documented.
- K. Thick Client – A PC or Server that must have Operator Interface Software installed on it to perform operator interface functions.

1.4 SYSTEM PERFORMANCE

- A. Comply with the following performance requirements:
 - 1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
 - 2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
 - 3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
 - 4. Object Scan: Transmit change of state and change of analog values to control units or Virtual Server within six seconds.
 - 5. Alarm Response Time: Annunciate alarm at Virtual Server within 45 seconds. Multiple Virtual Servers must receive alarms within five seconds of each other.
 - 6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
 - 7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
 - 8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
 - a. Water Temperature: Plus or minus 1 deg F (0.5 deg C).
 - b. Water Flow: Plus or minus 5 percent of full scale.
 - c. Water Pressure: Plus or minus 2 percent of full scale.
 - d. Space Temperature: Plus or minus 0.36 deg F (0.5 deg C).
 - e. Ducted Air Temperature: Plus or minus 0.35 deg F (0.5 deg C).
 - f. Outside Air Temperature: Plus or minus 0.35 deg F (1.0 deg C).
 - g. Dew Point Temperature: Plus or minus 0.35 deg F (1.5 deg C).
 - h. Temperature Differential: Plus or minus 0.25 deg F (0.15 deg C).
 - i. Relative Humidity: Plus or minus 2 percent.
 - j. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
 - k. Airflow (Terminal): Plus or minus 10 percent of full scale.
 - l. Air Pressure (Ducts): Plus or minus 0.1-inch wg (25 Pa).
 - m. Carbon Dioxide: Plus or minus 50 ppm.
 - n. Electrical: Plus or minus 5 percent of reading.

1.5 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 Virtual Server 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, all 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 Virtual Server 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. A copy of sequence of operation and schematic diagram shall be placed in all AHU and pump control cabinets.
 - d. Points list.
- C. **Data Communications Protocol Certificates:** Certify that each proposed DDC system component complies with ASHRAE 135 and that system is Open Protocol.
- 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 Virtual Servers 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. 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.

1.6 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.
- 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.

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.

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 Virtual Server.

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

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. Honeywell - Local Branch Office (No Substitutions)
 - 2. Johnson Controls Inc.
 - 3. Trane
 - 4. ~~Pre approved Substitute~~
- B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator Virtual Server 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.

2.3 DDC EQUIPMENT

- A. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and; 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 Virtual Server.
 - 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 (only for units serving

- support areas), on-off control with differential sequencing, staggered start, antishort 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, tertiary pumps reset, and equipment sequencing.
- d. Programming Application Features: Include trend point; alarm processing and messaging; daily, 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.
- h. Service Intervals based on run time/operating hours.
- 4. Local operator interface provides for download from or upload to operator Virtual Server or diagnostic terminal unit.
- 5. Contractor shall meet with Owner after 90 days of operation to review system and make any necessary changes.
- 6. BACnet Compliance: DDC equipment shall be BTL- listed BACnet communicating Direct Digital Control (DDC) Controllers.
- B. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source. When power is restored, all affected hardware shall return to normal without Owner intervention.
 - 1. Units monitor or control each I/O point, process information, and download from or upload to operator Virtual Server 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 Virtual Server or diagnostic terminal unit.
 - 4. Network Connection – Control Units shall connect to the site’s Virtual Servers via IP ports on the Customer’s Lan (VLAN). BACnet Compliance: Control units shall be BTL - listed BACnet communicating Operator Interface software, conventional electric/electronic controls, and equipment-mounted controls
- C. 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)
 - 5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
 - 6. Universal I/Os: Provide software selectable binary or analog outputs.

- D. 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.
- E. Power Line Filtering: Internal or external transient voltage and surge suppression for Virtual Servers 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 SYSTEM SOFTWARE

A. General:

1. Contractor shall provide all software required for efficient operation of all functions required by this specification. Software shall be modular in design for flexibility in expansion or revision of the system. Software shall, as a minimum, include:
 - a. Complete database entry.
 - b. Configuration of all application programs to provide the sequence of operation indicated.
 - c. Complete graphics package, including graphics floor plans and individual graphics, for each system.
 - d. Alarm limits and alarm messages for all critical and non-critical alarms.
 - e. Configuration of all reports and point summaries indicated.
2. System software shall be complete such that each control loop shall function as specified in the Sequence of Operation.
3. Building control system manufacturer shall be required to write the software program and test the operation of every control loop. A letter certifying that the system is ready for inspection shall be submitted to the engineer prior to the controllers being shipped to the field. The Engineer may at his option visit the contractor's office and witness proper operation of each control loop prior to shipping from the contractor's point of fabrication. The control contractor shall provide a means of simulating every input to the system as a requirement for debugging the software. Prior to shipping of the microprocessor controller, the debugged software shall be transmitted to the owner for approval.
4. After all field connections have been made and control power is available in the control panel, the owner shall be notified and the control system shall be energized. Any required reloading of the software shall be performed and start-up of the mechanical system and building control system shall commence.
5. Building control contractor shall be responsible for all necessary revisions to the software as required to provide a complete and workable system consistent with the letter and intent of the specification. All control performance criteria are specified in the Sequence of Operations section of the specification.

6. After the system has operated properly for 90 days following start-up of the final component of the heating and air conditioning systems, an as-built copy of the software shall be transmitted to the owner for permanent record purposes. Any software upgrading or enhancements to improve the system operation or as required for proper operation of the system during the first year of operation is the responsibility of the building control system contractor. Any changes to the software shall be immediately transmitted to the Owner.
 7. The Building DDC Controllers shall Communicate via the customer furnish LAN/WAN. Virtual Server computers will supervise the remote panels and alarm if the communication is lost as well as any control function alarm. The Server computer will also be the area of trending archives.
 8. Software required to provide the initial operation routines shall not consume more than 70% of the programmable capability of the controller.
 9. Software shall be provided in these five categories:
 - a. System executive software.
 - b. Software for user control over system configuration at the Central Site location, and by Maintenance Personnel in the field.
 - c. Facility monitoring functions.
 - d. Direct digital control.
 - e. Application software.
 10. Each category of software shall consist of interactive software modules. Each module shall have an associated priority level and shall execute as determined by the program controller as defined in the real time operating system.
 11. Building operator shall be able to communicate and direct all control functions through the use of a 2-button "mouse" operator interface to monitor and control all functions and sequences within the system.
 12. Central site shall allow receipt of alarms and messages while in a functional mode other than energy management. I.e. incoming alarms shall be displayed while the operator is in a word processing, spreadsheet or other operating mode. The system must automatically switch from a non- energy management mode, respond to an alarm, and return to the exact position left in the previous functional mode.
 13. Central site must be able to generate standard ASCII file formats to allow use with third-party software (**Microsoft Excel**) to generate and store owner-designed reports.
- B. Systems Software:
1. Central site shall display graphically, in up to 64 different colors, the following system information:
 - a. Floor plan maps shall show heating and cooling zones throughout the buildings in a range of colors which provide a visual display of temperature relative to their respective setpoints. The colors shall be updated dynamically as zones' comfort condition change. Locations of space sensors shall also be shown for each zone. Identification nomenclature to match physical labels on devices in the spaces. Setpoint adjustment and color band displays shall be provided as specified.
 - b. Mechanical system graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. It shall also provide a current status of all I/O points being controlled and applicable to each piece of equipment including analog readouts in appropriate engineering units at appropriate locations on the graphic representation.

- c. Overrides or manual commands shall have a "time out" option.
 - d. The following information shall be selected from a "pop- up" menu available on various graphics:
 - 1) Alarms.
 - 2) Messages.
 - 3) Module Status.
 - 4) Programming Parameters.
 - 5) Quit.
 - 6) Schedules.
 - 7) Schedule Graphs.
 - 8) Schedule Groups.
 - 9) Setpoints.
 - 10) Trends.
 - 11) Utilities.
 - e. Programming, scheduling and set-point changes shall be accessible for modification on each menu for the associated equipment. Operator shall be able to automatically download changes from the server to the appropriate program for the equipment being controlled. Operator shall be able to upload information from the field modules to the server.
2. Input Format:
- a. Allowable operators, as defined under user access, shall be able to control system functions by their inputs at an appropriate user terminal. Primary operator interface shall be via two button mouse.
3. Verification of Operator Input:
- a. System shall acknowledge all inputs as functions or commands to be performed. System's handling of operator inputs, such as requests to start a motor, output a log, change a time program, acknowledge an alarm, or do any of the other commands described in this specification, shall be in a similar format.
4. Operator Commands:
- a. All operator commands shall be in graphics data base and menu driven. After the operator selects the desired object item or menu, the system shall display either the status of selected object item or the allowable options available. Upon entry of a command to the point or points desired as described above, the system shall, before performing any command requested and any entered data. System shall include error monitoring software for user's input error.
5. Output Format:
- a. The system shall operate on a System Format basis, regardless of the manner or hardware configuration in which the data is acquired. A "system" shall consist of a logical grouping of data points, related to a piece of mechanical equipment, an energy distribution system, or an architectural area. For example, in some cases, it may be desired to display, as a single system, a space temperature with its associated air handling unit, and in other cases to display all space temperatures on a floor or in a building. The DDC shall allow such determinations to be made without regard to the physical hardware locations of a point or group of points. Likewise, the system shall accommodate future changes of system grouping and operations without field hardware changes.
 - b. All displays and logs shall contain a header line indicating date, day-of-week, and time.

- c. All output displays or logs of a point or group of points shall contain, as a minimum, the following information:
 - 1) Graphic presentation of the System.
 - 2) User name of point.
 - 3) Point descriptor.
 - 4) Current value/status.
 - 5) Associated engineering units.
 - 6) Alarm description.
 - d. User names, point descriptors, and engineering units shall be operator definable on a per point basis.
6. Set points:
- a. System shall utilize a contiguous band of colors each corresponding to actual zone temperatures relative to the desired heating and cooling setpoints. The ideal temperature shall be shown as a green color band. This color band corresponds to the dead band between the onset of mechanical heating or cooling. Temperatures warmer than ideal shall be shown in orange.
 - b. Temperatures cooler than ideal shall be blue. All alarm colors shall be in red.
 - c. System shall be capable of utilizing the mouse operator interface device to change individual zone temperature setpoints. The change shall be accomplished by pointing to a graphic temperature bar and by depressing a button, moving the mouse cursor to an increased or decreased temperature set-point within that zone. System shall also be capable of utilizing the mouse interface device or a conventional keyboard to change a numeric temperature set-point value instead of utilizing the graphic temperature bar. Floor plan graphic shall then be able to change colors on a zone by zone basis to reflect the actual temperature in each zone relative to the changed desired heating or cooling set-point.
 - d. System shall be capable of globally changing all setpoints or a customized group of setpoints which can created/modified as needed by authorized users. The global change capability shall be accessed via a "pop up menu" called by depressing a button on the mouse.
 - e. Graphics shall be provided at remote building for both north and south tertiary CHW pumps.

G

Main greeting page will have links for all building monitored for quick access.

Once a building is selected a picture of the building will be displayed along with a menu of all systems controlled from this section. There will also be links for the floor plans.

Once the floor plan has been chosen, the selected graphic page will display the architectural floor plan. This plan will have temperature readings and Setpoints of all VAV's within this floor. There will also be links or button depicting the location and equipment number that is serving that area. This link will hyperlink into the graphic of the AHU. The temperature and setpoint reading will hyperlink to the selected VAV graphic for further review. If the floor has too many VAV data readings to display for an easy reading the floor plan may be broken into sections so that the view is easily readable.

Graphical VAV – The VAV box will be a graphical representation of a VAV box. The data shown on the box will be as follows:

Box Flow

Box Flow Trend hyperlink

Box Flow Setpoint

Box Flow Trend hyperlink

Box Flow Min Setpoint
Box Flow Max Setpoint
Box Flow Reheat Min Setpoint (if applicable)
Reheat Stage Commands (if applicable)
Supply Air Temperature (with reheat)
Room Setpoint
Room Setpoint Trend hyperlink
Room Temperature
Room Temperature Trend hyperlink
Room Humidity (If applicable)
Room Humidity Trend hyperlink
Room Humidity Setpoint (if applicable)
Room Humidify Setpoint Trend hyperlink
All points above to show a different status color if overridden
Graphical AHU – The AHU will be a graphical representation of the physical air handling unit specified. The data will be located on the AHU as physically located on the unit. The data on the AHU will be as follows:
Schedule for Unit hyperlink – link to the scheduling editor
Schedule for Ventilation hyperlink – link to the scheduling editor.
Occupied/Unoccupied status for each schedule
Fan command
Fan status
Fan speed
Fan VFD alarm
Temperature sensors as specified in the control sequence of operation and trending points
All setpoints as specified in the sequence of operation
Example – VAV AHU will have a supply air temperature and setpoint
Supply air static and trend hyperlink
Supply air static Setpoint and trend hyperlink
Return air damper position
Outside air damper position
Outside air flow and trend hyperlink
Outside air flow setpoint and trend hyperlink
Outside air heater command
Outside air heater setpoint
Any misc points needed from a sequence of operation
All points above to show a different status color if overridden
Graphical Chiller plant – The plant will be a graphical representation of the physical chiller plant as specified and installed. The data will be located on the graphical screen as physically installed in the plant.
All Chiller interface data
Enable/Disable of Chillers and isolation valves
Primary pump command and status
Secondary Pump command, status, speed, and general alarm from the VFD.
Flow meters
Temperature sensors

Misc. Points and graphical screens

Graphical representation of text on the screens – The text blocks will have an opposing color for easier reading

Graphical representation of the trends – each point to be trended will have an icon next to the point being trended. This icon will hyperlink to the trending chart builder for the individual trend screen. A trend icon on the main building screen will be a trendchart builder. This trend builder will allow to select multiple trends from a list, pick whether recent trending data or archived (in the server), date range, etc. Then after selection the trend chart builder will compile the data and build the trend for viewing or exporting to a spread sheet. This all happens with a standard web browser.

A text block for an overridable point shall be highlighted when a mouse is scrolled over an object. When the text block and or pint is overridden the graphical point will turn to a different color. This allows for easy viewing of which points are overridden on a graphic screen.

7. **User Access Restriction.** Operator sign-on shall require an assignable password. Passwords shall have six (6) levels of system access **or user defined:**
 - a. Level 1 - Trainee: The level shall allow readout of data only. System shall display all operation data base.
 - b. Level 3 - Maintenance 1: This level shall allow all of Level 2 functions plus the changing of all schedules.
 - c. Level 2 - Maintenance 2: This level shall allow performance of Level 1 functions plus the changing of all set points.
 - d. Level 4 - Supervisor: This level shall allow performance of Level 3 functions plus the changing of all system parameters.
 - e. Level 5 - System Programmer: This level shall allow performance of Level 4 functions plus the modifying the system configuration.
 - f. Level 6 - System Manager: This level shall allow performance of Level 5 functions plus the changing of passwords.
8. **Power Failure/Automatic Restart:**
 - a. Power failures shall cause the system to go into an orderly shutdown with no loss of program memory.
 - b. Upon resumption of power, the system shall automatically restart and send alarm with the time and date of the power failure and restoration at the Central Site. "Restart" program shall automatically restart affected field equipment. Operator shall be able to define an automatic power up time delay for each piece of equipment under control.
 - c. **User Control Over System Configuration:**
 - 1) **Database Creation and Modification.** All changes shall be done utilizing standard procedures and be capable of being done while the system is on-line and operational. The system shall allow changes to be made through the portable operator terminal and form the central site. To aid the user, instructive prompting software shall be provided.
 - 2) System shall permit the operator, with proper password, to perform as a minimum the following:
 - a) Add and delete points.
 - b) Modify point parameters.
 - c) Create and modify control sequences.
 - d) Reconfigure application programs.
 - e) Add and/or modify graphics.

- 3) All data points within the database shall be completely accessible as independent or dependent variables for custom programming, calculation, interlocking, or manipulation.
- 4) Graphics Software:
 - a) Graphics software shall permit the easy construction of infinitely variable shapes and sizes through the use of the mouse pointing device.
 - b) A selection of 64 colors and various fill textures, line types and text styles shall all be accessible through the use of the mouse interface. The software shall resemble many of the computer aided design programs currently available and allow graphics to be easily moved, edited, added or deleted.
 - c) Graphics software shall be fully implemented and operational to accomplish the following:
 - d) 1. Create a new graphic picture.
 - e) 2. Modify a portion of a graphic picture.
 - f) 3. Delete a graphic picture, or any portion thereof.
 - g) 4. Call up a graphic picture.
 - h) 5. Cancel the display of a graphic picture.
 - i) 6. Assign conditions which automatically initiate the display.
 - j) 7. Overlay alphanumeric and graphics.
 - k) 8. Save the graphic picture.
 - l) 9. Display latest process data fully integrated with the graphic display
 - m)
- d. Facility Management Functions:
 - 1) Trend Logging:
 - a) System shall be able to trend and display either numerically or graphically any analog or digital points in the system.
 - b) System shall be able to simultaneously graphically display any two trended points within a module function block or any point in the module versus the outside air temperature, enthalpy or relative humidity.
 - c) Each field module shall be capable of storing the most recent 60 samples for each single trend point or the most recent 30 samples for each of two trended points from one module function block.
 - d) Each module shall be capable of automatically uploading on a daily basis all accumulated trend data to the central site for permanent storage on hard disk.
 - 2) Run Time:
 - a) System shall provide run time information for all digital output and input points on command from the operator. Maximum run time limits shall be operator definable and shall be capable of automatically issuing a **visual** when the run time maximum is exceeded. Operator shall be able to reset the run time accumulator.
 - b) Run time hours and start time date shall be retained in non-volatile module memory.

- c) Each module shall be capable of automatically uploading all accumulated data to the central site for permanent storage on hard disk.
- 3) Alarm Conditions and Maintenance Messages:
 - a) Central site shall allow receipt of alarms and messages. i.e., Incoming alarms shall be displayed **and generate an audible alarm** while the operator is utilizing another mode such as word processing and allow the operator to automatically return to word processing after the alarm is received.
 - b) System shall distinguish between alarms and messages with alarms having a higher priority.
 - c) System shall be capable of calling up to three different remote locations to deliver an alarm or message **through E-Mail, E-Page or alphanumeric page**. Operator shall determine if alarms or messages are to be based on temperature limit, status or off-normal reporting.
 - d) System shall be capable of printing maintenance messages when run time accumulation maximum limits are exceeded.
 - e) Text for operator alarm and messages shall be operator definable. System shall be capable of storing at least 100 messages each of any length. Generic messages used for multiple points throughout the system shall only count as one message. In the event the central site is powered down, alarms shall be stored in the modules until the central site is restored.
 - f) Central site shall be capable of transferring all alarms to hard disk for storage.
- 4) Reports and Archiving:
 - a) Field modules shall be capable of calling the central site during off peak phone rate hours to automatically upload all current and accumulated data. This shall be delivered to the central site for printing and/or permanent storage on hard disk. The system shall further be capable of transferring hard disk information onto a CD or USB external drive for remote site storage.
 - b) System shall be capable of reporting and archiving the following information as a minimum:
 - 5) Outside air temperature history and degree day history.
 - 6) Electric demand and usage history.
 - 7) All trended points.
 - 8) All alarms and messages.
 - 9) Equipment runtime information.
 - a) The system shall also provide the following additional reports for which archiving is not applicable:
 - b) All points summary.
 - c) Building operating schedules.
 - d) Printout of any graphic screen.
 - e) System shall be capable of providing all points summaries on a hierarchical basis. e.g., only the points associated with a particular graphic shall be selectable and printed. For example, if the operator is viewing an air handling unit (AHU), he may request an all points

summary at this level and receive only the points associated with the AHU. If the building is being viewed and an all points summary selected, all building points will be listed. Similarly, the system shall print building operating schedules pertinent to the graphic level being viewed. e.g., if a zone or tenant zone group is being viewed on the graphic display, then the system shall be capable of printing the building operating schedules for the zone or tenant zone group. If the entire building graphic is being viewed, the system shall be capable of printing schedules at the building level. All systems reports shall be capable to being viewed at the operators' terminal and printed at the operator's discretion.

- e. Direct Digital Control Software:
 - 1) System shall continuously perform DDC functions at the local DDC controller in a stand-alone mode. The operator shall be able to design and modify the control loops to meet the requirements of the system being operated. Operators shall use system provided displays for tuning of PID loops. These displays shall include the past three input variable values, the set point for the loop as well as the sample interval and the results of the proportional, integral and derivative effects of the final output.
 - 2) Each Controller shall perform the following functions:
 - a) Identify and report alarm conditions.
 - b) Execute DDC algorithms.
 - c) Execute all application programs indicated on the I/O Summary table.
 - d) Trend and store data.
 - 3) In the event of a Controller failure, all points under its control shall be commanded to the failure mode.
 - 4) All DDC software shall reside in the respective DDC Controller.
- f. Application Software:
 - 1) Application software shall be as required to produce the sequence of operation specified.

2.5 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
- B. Temperature Sensors: 20K resistor style.
 - 1. Accuracy: Plus or minus 0.35 deg F (0.2 deg C) at calibration point.
 - 2. Wire: Twisted, shielded-pair cable.
 - 3. Insertion Elements in Ducts: Single point, 8 inches (200 mm) long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).
 - 4. Averaging Elements in Ducts: 36 inches (915 mm) long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft. (1 sq. m).
 - 5. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches (64 mm).
 - 6. Room Sensor Cover Construction: Manufacturer's standard covers.

- a. Thermometer: Digital temperature display.
 - b. Color: Beige
 - c. Orientation: Vertical.
 - d. Occupancy Override: Exposed only for support offices.
 7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
- C. Humidity Sensors: Bulk polymer sensor element.
1. Accuracy: 2 percent full range with linear output.
 2. Room Sensor Range: 0 to 100 percent relative humidity.
 3. Room Sensor Cover Construction: Manufacturer's standard covers.
 - a. Set-Point Adjustment: Concealed.
 - b. Set-Point Indication: Exposed.
 - c. Humidity: Digital humidity display
 - d. Color: Beige.
 - e. Orientation: Vertical.
 4. Calibration: Single point.
- D. 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 (0 to 62 Pa).
 - d. Duct Static-Pressure Range: 0- to 5-inch wg (0 to 1240 Pa).
 2. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure; linear output 4 to 20 mA.
 3. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure and tested to 300-psig (2070-kPa); 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.
- E. Room sensor accessories include the following:
1. Guards: Metal wire, tamperproof for sensors located in gymnasiums, locker room, corridors, cafeteria, media center and multipurpose rooms.
- 2.6 STATUS SENSORS
- A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg (0 to 1240 Pa).
- B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig (55 to 414 kPa), piped across pump.

- C. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
- D. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
- E. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.

2.7 GAS DETECTION EQUIPMENT

- A. Carbon Dioxide Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 23 to 130 deg F (minus 5 to plus 55 deg C) and calibrated for 0 to 2 percent, with continuous or averaged reading, 4- to 20-mA output; for wall mounting.

2.8 FLOW MEASURING STATIONS

- A. Duct Airflow Station: Thermal Dispersion Technology.
 - 1. Manufacturers:
 - a. Ebtron.
 - b. Tekair.
 - 2. Each measuring device shall consist of one or more multi-point measuring probes and single microprocessor-base transmitter. Each transmitter shall have an LCD display capable of displaying airflow and temperature. Airflow shall be field configurable to display as a velocity or volumetric rate. Each transmitter shall operate at 24V.
 - 3. Each sensing point shall independently determine the airflow rate and temperature, which shall be equally weighted and average by the transmitter prior to the output. Devices, which average multiple non-linear sensing points signals, are not acceptable. Pitot tubes arrays are not acceptable.
 - 4. The operation air flow range shall be 0 – 5,000 FPM.
 - 5. The operation temperature range for the measuring probes shall be -20°F to 160°F.
 - 6. Accuracy: Each independent airflow sensor shall have a laboratory accuracy of ±2% and each independent temperature sensor shall have a laboratory accuracy of ±0.15°F.
 - 7. The transmitter shall be capable of communicating with the host controls using the following interface options:
 - a. Linear analog output signal: Field selectable, fuse protected and isolated, 0-10VDC and 4-20mA (4-wire).
- B. Pipe Flow Metter: Electromagnetic Flow Meter.
 - 1. Manufacturer:
 - a. Onicon.
 - 2. Accuracy: ±1.0% of reading at calibration velocity.
 - 3. Sensing Method: Electromagnetic sensing (no moving parts).
 - 4. Pipe Size Range: 3” through 72”.
 - 5. Supply Voltage: 24 V AC/DC at 250 mA.

6. Liquid Temperature Range: 15°F to 250°F peak.
7. Operating Pressure: 400 psi.

2.9 ENERGY METER

A. BTU Meter.

1. Manufacturer:
 - a. Onicon
2. Accuracy: Differential temperature accuracy $\pm 0.15^\circ\text{F}$.
3. Memory: Non-volatile EEPROM memory retains all parameters and totalized values in the event of power loss.
4. Flow meter: Flow meter by Onicon. Flow meter shall meet the requirements of section 2.7.C on these specifications.
5. Temperature sensors: Solid state sensors.
6. Temperature Range: 32°F to 200°F.
7. Display: Alphanumeric LCD display total energy, total flow, energy rate, flow rate, supply temperature and return temperature.
8. Output Signal: BACnet.

2.10 THERMOSTATS

- A. 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 of 125% of service equipment; with exposed set-point adjustment, 55 to 85 deg F (13 to 30 deg C) set-point range, and 2 deg F (1 deg C) maximum differential.

2.11 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
 1. 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.
 2. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).
 3. Spring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).
 4. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).
 5. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).
- 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. Schneider Electric Dura Drive
- c. Honeywell
2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
3. Dampers: Size for running torque calculated as follows:
 - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. (86.8 kg-cm/sq. m) of damper.
 - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. (62 kg-cm/sq. m) of damper.
 - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft (49.6 kg-cm/sq. m) of damper.
 - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. (37.2 kg-cm/sq. m) of damper.
 - e. Dampers with 2- to 3-Inch wg (500 to 750 Pa) of Pressure Drop or Face Velocities of 1000 to 2500 fpm (5 to 13 m/s): Increase running torque by 1.5.
 - f. Dampers with 3- to 4-Inch wg (750 to 1000 Pa) of Pressure Drop or Face Velocities of 2500 to 3000 fpm (13 to 15 m/s): 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 (Minus 30 to plus 50 deg C).
11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F (Minus 30 to plus 121 deg C).
12. Run Time: 12 seconds open, 5 seconds closed.

2.12 CONTROL VALVES

- A. Manufacturers:
 1. Belimo.
 2. Schneider Electric
 3. Honeywell
- B. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
- C. Ball Valves: NPS 2 and Smaller: Two-Piece, Copper-Alloy Ball Valves: Brass or bronze body with full or regular-port, chrome-plated bronze ball; PTFE or TFE seats; and **600-psig (4140-kPa)** minimum CWP rating and blowout-proof stem. NPS 2-1/2 and Larger: Class 150, ferrous alloy.

- D. Butterfly Valves: 200-psig (1380-kPa), 150-psig (1034-kPa) 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 or Grooved.
 - 2. Disc Type: Nickel-plated ductile iron.
 - 3. Sizing: 1-psig (7-kPa) maximum pressure drop at design flow rate.
 - 4.

- E. 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 (860 kPa) and 250 deg F (121 deg C) operating conditions.
 - 2. Sizing: 3-psig (21-kPa) 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.

2.13 DAMPERS

- A. Dampers: AMCA-rated, opposed blade design; 0.108-inch- (2.8-mm-) minimum thick, galvanized-steel or 0.125-inch- (3.2-mm-) minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- (1.6-mm-) thick galvanized steel with maximum blade width of 8 inches (200 mm) and length of 48 inches (1220 mm).
 - 1. Secure blades to 1/2-inch- (13-mm-) diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
 - 2. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).
 - 3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
 - 4. Edge Seals, Low-Leakage Applications: Use replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. (50 L/s per sq. m) of damper area, at differential pressure of 4-inch wg (1000 Pa) when damper is held by torque of 50 in. x lbf (5.6 N x m); when tested according to AMCA 500D.

2.14 CONTROL CABLE

- A. Electronic and fiber-optic cables for control wiring are specified in Division 27 Section "Data Communications Integrations."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that power supply is available to control units and operator Virtual Server.

3.2 INSTALLATION

- A. Install software in control units and operator Virtual Server(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 48 inches (1220 mm) above the floor.
 - 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- 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
- F. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Install building wire and cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Install signal and communication cable according to Division 27 Sections
 - 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
 - 2. Install exposed cable in raceway.
 - 3. Install concealed cable in raceway.
 - 4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
 - 5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 - 6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
 - 7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
- D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 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.
- 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 instrument tubing for proper fittings, slope, material, and support.
 - 5. Check installation of air supply for each instrument.
 - 6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
 - 7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
 - 8. Check temperature instruments and material and length of sensing elements.
 - 9. Check control valves. Verify that they are in correct direction.
 - 10. 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.
- E. After start-up and calibration, Building Controls Contractor shall submit to the Engineer trend logs of all points on each system demonstrating stable and proper operation. The trend logs shall be as follows:
 - 1. 24 hour period at 15 minutes intervals.
 - 2. 3 hour start-up period at 5 minute intervals.
 - 3. A total of two sets covering two days during each period are required.

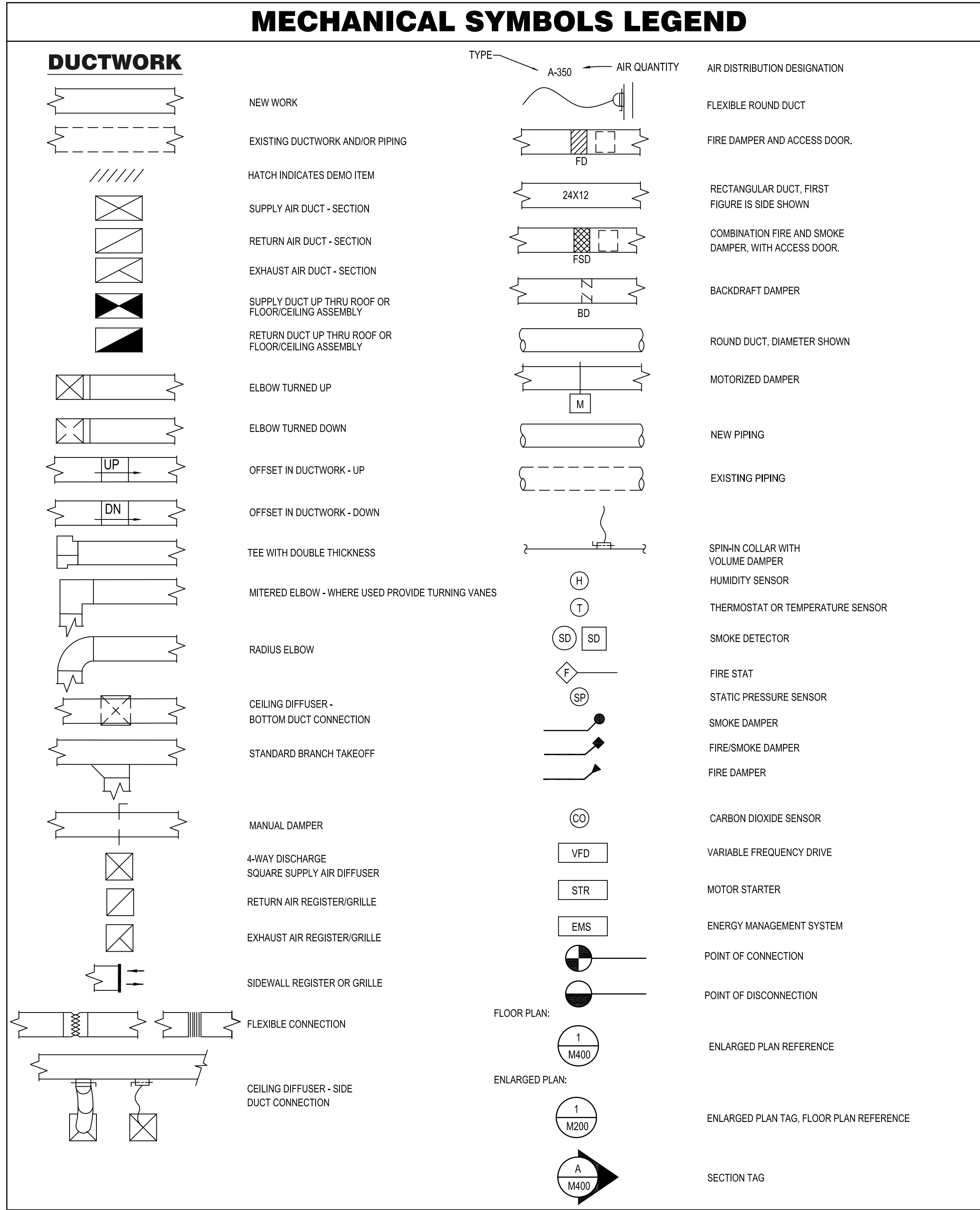
3.5 ADJUSTING

- 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: After 90 days, contractor shall meet with Owner to review system and make any necessary changes. 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.

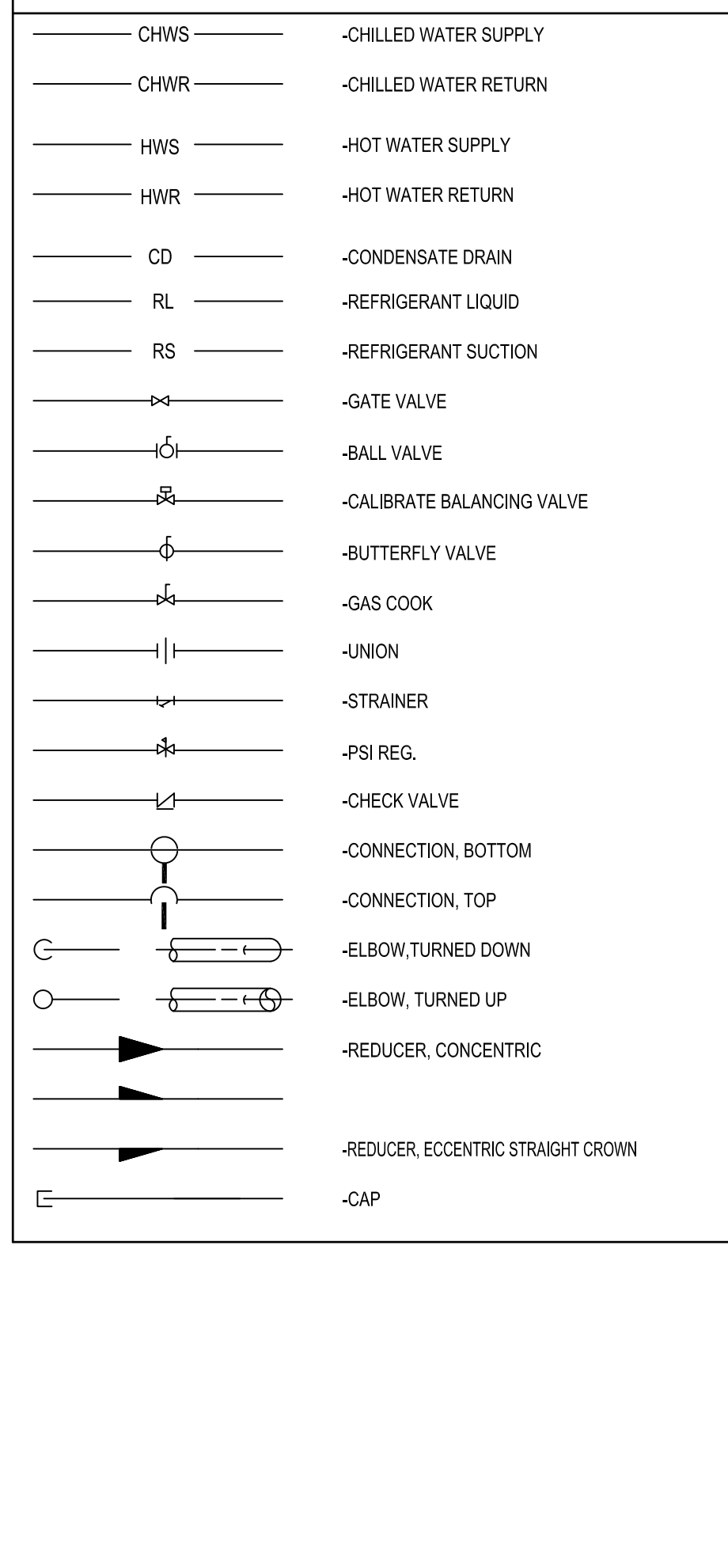
3.6 DEMONSTRATION

- 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."

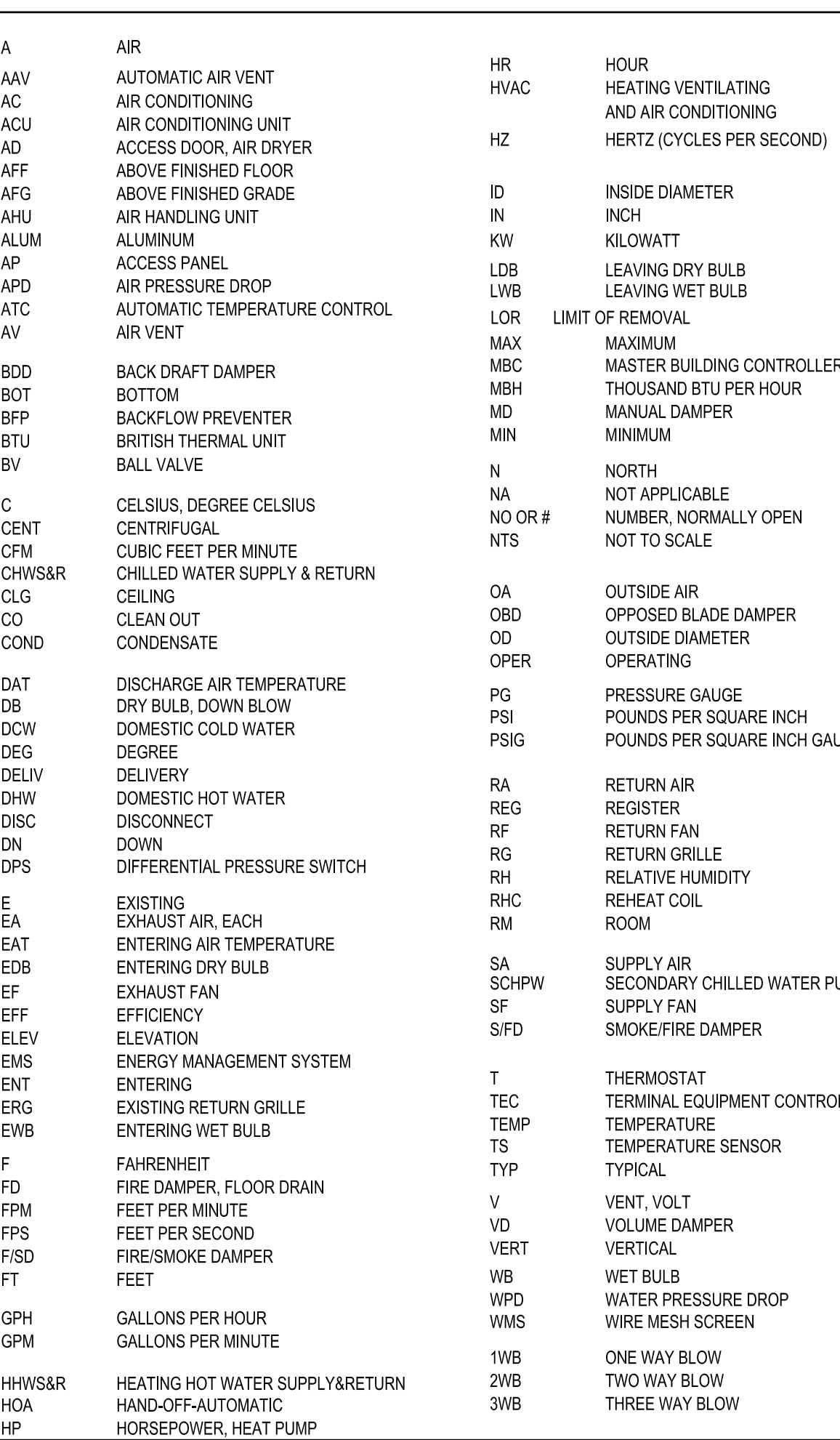
END OF SECTION



MECHANICAL LEGEND



MECHANICAL ABBREVIATIONS



SCOPE OF WORK:

- PROVIDE BACNET BASED PRODUCTS THAT COMMUNICATE ON MULTIPLE CHANNELS TO MEET THE FUNCTIONAL SPECIFICATIONS AS INDICATED ON THE DRAWINGS AND THE DEDICATED PRODUCT FUNCTIONAL SPECIFICATIONS AND PROFILES SPECIFIED IN OTHER SECTIONS. ALL BACNET EQUIPMENT MUST BE NEW.
- PROVIDE BACNET ROUTERS AS REQUIRED TO COMBINE DIFFERENT COMMUNICATION CHANNELS ONTO A CENTRAL FIELD BUS OR AS REQUIRED TO SEGMENT GROUPS OF INTELLIGENT DEVICES AND/OR CONTROL UNITS. EACH BACNET MSTP CHANNEL SHALL HAVE NO MORE THAN THIRTY MSTP DEVICES. EACH BACNET MSTP CHANNEL SHALL ORIGINATE FROM AN IP BACNET ROUTER.
- PROVIDE INTELLIGENT CONTROL DEVICES, PROGRAMMABLE CONTROLLERS, AND APPLICATION SPECIFIC CONTROLLERS AS HEREIN SPECIFIED, AS NEEDED TO PERFORM FUNCTIONS INDICATED IN THE INPUT OUTPUT SUMMARIES AND SEQUENCES OF OPERATION, AND/OR INDICATED ON THE HVAC DRAWINGS.
- PROVIDE WIRE, RACEWAY SYSTEMS, 24 VDC AND/OR 24 VAC POWER SUPPLIES, AND FINAL CONNECTIONS TO NODES PROVIDED BY THIS CONTRACT, MUST COMPLY WITH DIVISION 26 REQUIREMENTS.
- THE CONTRACTOR SHALL PROVIDE ALL CONTROLS AND SEQUENCE OF OPERATIONS AS REQUIRED BY THESE SPECIFICATIONS AND BY THE DRAWINGS. PROVIDE ALL REQUIRED DEVICES, SENSORS, HARDWARE, SOFTWARE, WIRING, CONTROLLERS, ETC. INCLUDING ANY REQUIRED AND NOT SPECIFICALLY ADDRESSED IN THIS SPECIFICATION BUT REQUIRED FOR SYSTEM FUNCTIONALITY. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO PROVIDE A COMPLETE AND FUNCTIONAL SYSTEM.
- THE SYSTEM SHALL ALLOW FOR FUTURE INTEGRATION OF OTHER SYSTEMS ON THE NETWORK PROPOSED IN THIS DOCUMENT AND ALSO SHARE A COMMON INFRASTRUCTURE FOR NETWORK COMMUNICATIONS, TIME SCHEDULING, ALARM HANDLING, HISTORY LOGGING, MONITORING AND SYSTEM CONTROL.
- THE WORK SCOPE SHALL ALSO INCLUDE THE FURNISHING OF SERVICES OF VARIOUS ENGINEERING DISCIPLINES BOTH IN THE FIELD AND IN HOME OFFICE IN ORDER TO COMPLETE THE WORK IN A SATISFACTORY AND PROFESSIONAL MANNER. THE CONTROL SYSTEM CONTRACTOR IS RESPONSIBLE FOR PROVIDING THESE ENGINEERING SERVICES.
- PROVIDE TECHNICAL DIRECTION OF THE INSTALLATION AS SPECIFIED HEREIN.
- PROVIDE FIELD CALIBRATION, TESTING AND

- COMMISSIONING OF EQUIPMENT AS SPECIFIED HEREIN. REFER TO PROJECT SPECIFICATIONS.
- INCORPORATE UNINTERRUPTIBLE POWER SUPPLY SYSTEM TO PROTECT ELECTRICAL COMPONENTS IN ALL BACNET CONTROLLERS, REMOTE CONTROLLERS, AND OPERATOR'S WORKSTATIONS.
 - PROVIDE SUBMITTALS, SOFTWARE, DATA ENTRY FACILITIES PORTABLE OPERATORS TERMINAL (POT), PROGRAMMING STARTUP, TEST AND VALIDATION, TRAINING OF THE CUSTODIAN AND MAINTENANCE REPRESENTATIVE ON MAINTENANCE AND OPERATION, ASBUILT DOCUMENTATION AND SYSTEM WARRANTY.
 - PROVIDE SPECIAL TOOLS, TESTING EQUIPMENT AS REQUIRED FOR OPERATION, INSTALLATION, AND MAINTENANCE OF THE EQUIPMENT SPECIFIED HEREIN.
 - PROVIDE DATA COMMUNICATION WIRING AND CONNECTIONS BETWEEN BACNET CONTROLLERS.
 - PROVIDE START-UP AND SYSTEM COMMISSIONING.
 - PROVIDE ACCURATE AND CURRENT DATABASE BACKUP OF ANY EXISTING INSTALLED BMS SYSTEM PRIOR TO ANY MODIFICATIONS TO THE SAME SYSTEM.
 - PROVIDE DOCUMENTATION ON ALL POINT NAMING CONVENTIONS TO THE ARCHITECT/ENGINEER OF RECORD/ FOR INCORPORATION INTO THE GUI.
 - PROVIDE A CD BACKUP OF THE SYSTEM DATABASE UPON ANY CHANGES OR UPDATES TO THE DATABASE.
 - THE NETWORK INFRASTRUCTURE SHALL CONFORM TO THE PUBLISHED GUIDELINES FOR WIRE TYPE, LENGTH, NUMBER OF DEVICES PER CHANNEL, TERMINATION, AND OTHER RELEVANT WIRING AND INFRASTRUCTURE CRITERIA AS PUBLISHED.
 - ANY HOST PC GUI INTERFACE SHALL BE OPENLY AVAILABLE SOFTWARE PACKAGES THAT ARE NONEXCLUSIVE. NO CLOSED SOFTWARE WILL BE ACCEPTED. SOFTWARE MUST BE GENERALLY AVAILABLE ON THE MARKET FROM MULTIPLE SOURCES.
 - CONTRACTOR SHALL PROVIDE REFERENCES OF PRIOR SUCCESSFUL EXPERIENCE.
 - CONTRACTOR MUST DEMONSTRATE ABILITY AND INTENT TO DESIGN, ARCHITECT, AND INSTALL AN OPEN, BACNET SYSTEM.

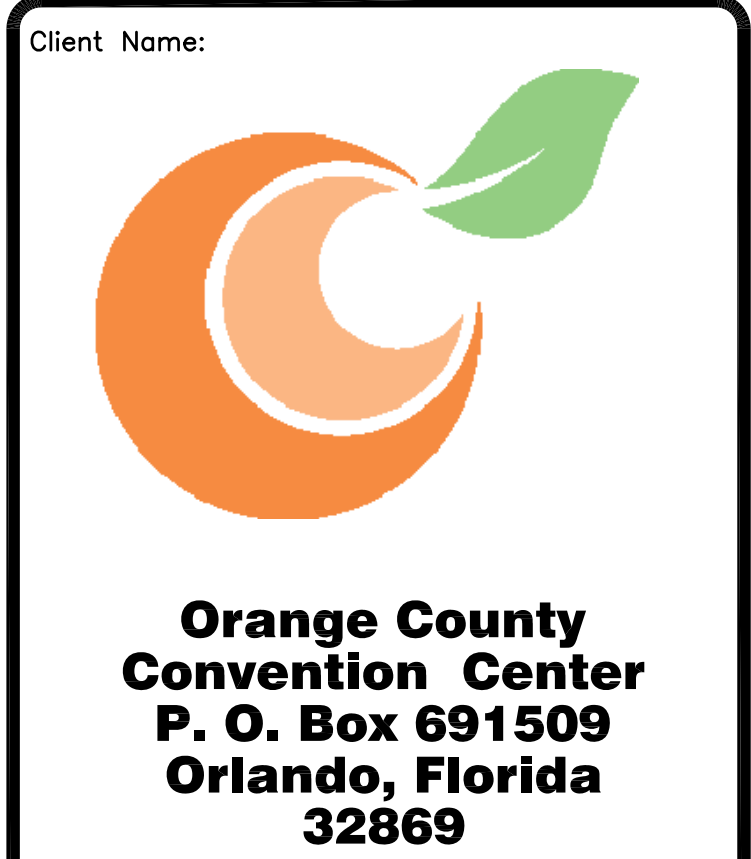
- NO EXCLUSIVE OR NON-OPEN INTEGRATION TOOLS, DEVICES, OR HOST SOFTWARE SHALL BE USED AS PART OF THIS OPEN SYSTEM.
- IP CONNECTIVITY IS REQUIRED FOR THIS PROJECT. ALL DEVICES CONNECTING TO THE LAN SHALL USE THE TCP / IP PROTOCOL STACK. SPECIFIC IP INTERCONNECTIVITY SHALL FOLLOW OCCC IT STANDARDS FOR SECURITY, FIREWALLS, ADDRESS, ETC. PUBLISHED IN SEPARATE DOCUMENTS (IF APPROPRIATE), AND SHALL FOLLOW OCC ISS STANDARDS.
- THE CONTROL SYSTEM SHALL BE INSTALLED BACNET PRODUCTS FROM THE CURRENTLY AVAILABLE SUPPLIERS THAT MEET THE SYSTEM SPECIFICATION. CONTROLLERS FROM MULTIPLE MANUFACTURERS ARE NOT ACCEPTABLE.
- THE SYSTEM INTEGRATOR SHALL PROVIDE A PROTOCOL ANALYZER LOG SUMMARY FOR EACH CHANNEL FOR A MINIMUM OF 24 HOURS SHOWING SYSTEM PERFORMANCE. THE STATISTICAL SUMMARY SHALL SHOW THAT ALL BANDWIDTH UTILIZATION AND ERROR LIMITS ARE WITHIN ACCEPTABLE RANGES AND THAT THERE ARE NO NETWORK TRAFFIC PROBLEMS, NODE COMMUNICATION PROBLEMS, OR SYSTEM SIZING PROBLEMS.
- ALL REQUIRED SERVERS WILL BE VIRTUAL AND SUPPLIED BY OCCC AND MEET ORANGE COUNTY IT AND ISS STANDARDS.
- ALL REQUIRED PC WORKSTATIONS / LAPTOPS WILL BE SUPPLIED BY OCCC AND MEET ORANGE COUNTY IT AND ISS STANDARDS.
- CONTRACTOR WILL SUPPLY SERVER / WORKSTATION / LAPTOP / DATABASE APPLICATION SOFTWARE AND MEET ORANGE COUNTY IT AND ISS STANDARDS.
- CONTRACTOR SYSTEM ETHERNET BASED COMPONENTS WILL UTILIZE THE EXISTING OCCC BUILDING SYSTEM NETWORK.
- ALL WORK SHALL BE IN COMPLIANCE WITH THE ORANGE COUNTY IT AND ISS STANDARDS.
- ALL CO2 SENSORS SHALL BE REPLACED.
- CONTRACTOR SHALL COORDINATE ALL WORK FOR BAS CONTROLS UPGRADE PROJECT WITH PHASING OF ON GOING SMOKE CONTROL PROJECT.

MECHANICAL GENERAL NOTES

- THE CONTRACTOR SHALL DEMONSTRATE EACH HVAC SYSTEMS PERFORMANCE IN THE PRESENCE OF THE ARCHITECT AND THE OWNER'S PROJECT MANAGER. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE COST OF AN ADDITIONAL SYSTEM TEST REQUIRED IF IN THE OPINION OF THE ARCHITECT AND THE OWNER'S PROJECT MANAGER THE SYSTEMS DO NOT PERFORM AS SPECIFIED.
- IF THE INTENT OF ARCHITECT/ENGINEER WITH REGARD TO ANY DETAIL IS NOT CLEAR, OR IS CAPABLE OF MORE THAN ONE INTERPRETATION, SUCH MATTERS WILL BE BROUGHT TO THE ATTENTION OF THE ARCHITECT/ENGINEER IN WRITING BEFORE THE SUBMISSION OF BIDS. AND THE ARCHITECT/ENGINEER SHALL MAKE CORRECTION OR EXPLANATION IN WRITING. OTHERWISE, NO EXTRA CHARGE WILL BE ALLOWED FOR THE WORK OR MATERIAL WHICH THE ARCHITECT/ENGINEER WILL REQUIRE. PROVIDED THAT IT COMES WITHIN A REASONABLE INTERPRETATION OF THE DRAWINGS AND SPECIFICATIONS.
- THE PLANS AND SPECIFICATIONS ARE INTENDED AS A GENERAL DESCRIPTION OF THE WORK TO BE PERFORMED. ALL ITEMS NOT SPECIFICALLY MENTIONED OR SHOWN, BUT NECESSARY FOR THE COMPLETION OF THE INSTALLATION, SHALL BE FURNISHED AND INSTALLED BY THIS CONTRACTOR. THIS CONTRACTOR SHALL THOROUGHLY ACQUAINT HIMSELF WITH THE MECHANICAL, ARCHITECTURAL, STRUCTURAL AND ELECTRICAL PLANS BEFORE SUBMITTING HIS FINAL BID. NO ADDITIONAL COMPENSATION WILL BE ALLOWED DUE TO THE CONTRACTOR'S FAILURE TO FAMILIARIZE HIMSELF WITH THE PLANS.
- UNFORESEEN CONDITIONS MAY EXIST AND WORK MAY NOT BE FIELD LOCATED EXACTLY AS SHOWN ON THE DRAWINGS. COOPERATION WITH OTHER TRADES IN ROUTING AND/OR BURIAL DEPTHS AS DETERMINED DURING CONSTRUCTION AND AS DIRECTED BY THE ARCHITECT/ENGINEER MAY BE NECESSARY. IT IS INTENDED THAT SUCH DEVIATIONS SHALL BE CONSIDERED AS PART OF THIS CONTRACT. SUCH DEVIATIONS MAY NOT BE CONSIDERED AS PART OF THIS CONTRACT WHEN PROPERLY DOCUMENTED IN WRITING. THE PLANS ARE NOT COMPLETELY TO SCALE. CONTRACTOR IS TO FIELD VERIFY DIMENSIONS OF ALL SITE UTILITIES ECT PRIOR TO BID AND INCLUDE ANY DEVIATIONS IN THE CONTRACT.
- ALL WORK SHALL BE IN ACCORDANCE WITH THE 2017 FLORIDA BUILDING CODE AND ALL LOCAL CODES.
- THE SIZE AND LOCATION OF EQUIPMENT INSTALLED UNDER DIVISION 23 MECHANICAL SHALL BE COORDINATED WITH OTHER TRADES. CONNECTION TO EQUIPMENT SHALL BE VERIFIED WITH MANUFACTURER'S CERTIFIED DRAWINGS. TRANSITIONS TO ALL EQUIPMENT SHALL BE VERIFIED AND PROVIDED FOR EQUIPMENT FURNISHED.
- VERIFY EXISTING CONDITIONS IN FIELD AND COORDINATE WITH ALL TRADES INCLUDING, BUT NOT LIMITED TO, ARCHITECTURAL, STRUCTURAL, LIGHTING, POWER, SYSTEMS, PLUMBING, FIRE PROTECTION AND OTHER EXISTING AND NEW WORK.
- INTERRUPTION OF EXISTING SERVICES SHALL BE MINIMAL AND SHALL BE FULLY COORDINATED WITH THE OWNER AND ALL TRADES IN ADVANCE TO SCHEDULE ALL INTERRUPTIONS DURING NON-CRITICAL TIMES.
- DISCONNECT SWITCHES REQUIRED FOR THE MECHANICAL EQUIPMENT SHALL BE PROVIDED BY DIVISION 26 ELECTRICAL EXCEPT WHEN INDICATED ON SCHEDULE.
- ALL EQUIPMENT, DUCTWORK, ETC. SHALL BE SUPPORTED AS DETAILED AND/OR SPECIFIED. PROVIDE ADDITIONAL SUPPORTS AS REQUIRED TO PROVIDE A VIBRATION-FREE, RIGID INSTALLATION. SUPPORT ALL OBJECTS FROM STRUCTURE WITHOUT PENETRATING THE CEILING.
- ALL WORK SHALL BE COORDINATED WITH ALL TRADES INVOLVED.
- ACCESS PANELS IN DUCTWORK AND CEILINGS SHALL BE PROVIDED WHERE REQUIRED FOR OPERATION, BALANCING AND MAINTENANCE OF ALL MECHANICAL EQUIPMENT.
- MAINTAIN CLEARANCE OF A MINIMUM OF 6" BETWEEN DUCTWORK, PIPING, EQUIPMENT, ETC., AND ALL FIRE RATED AND FIRE/SMOKE RATED PARTITIONS TO ALLOW FOR INSPECTIONS OF RATED WALLS.
- DAMPERS AND INSIDES OF DUCTS VISIBLE THROUGH GRILLES, REGISTERS AND DIFFUSERS SHALL BE PAINTED FLAT BLACK.
- ALL OPERABLE THERMOSTAT PARTS SHALL BE MOUNTED 48" ABOVE FINISHED FLOOR.
- COORDINATE THERMOSTAT AND HUMIDISTAT LOCATIONS WITH FURNITURE/EQUIPMENT LAYOUTS, WINDOWS AND DOOR SWING AREAS.
- ALL CONTROL WIRING AND HARDWARE TO COMPLETE THE HVAC CONTROL SYSTEM SHALL BE FURNISHED AND INSTALLED UNDER DIVISION 23 MECHANICAL OF THESE CONTRACT DOCUMENTS UNLESS INDICATED OTHERWISE ON DRAWINGS.
- PROVIDE ALL MANUFACTURER INSTALLATION AND MAINTENANCE MANUALS FOR EQUIPMENT INSTALLED FOR ENGINEER REVIEW BEFORE RELEASE TO THE OWNER.
- CONTRACTOR SHALL FIELD VERIFY ALL EXISTING MATERIALS, EQUIPMENT, APPLIANCES AND DEVICES THAT ARE TO BE REUSED SHALL BE RECONDITIONED, TESTED AND PLACED IN GOOD AND PROPER WORKING CONDITION AND APPROVED. ANY DISCREPANCIES MUST BE BROUGHT TO THE ATTENTION OF THE ENGINEER PRIOR TO BID.
- THE OWNER RESERVES THE RIGHT TO PROVIDE VERIFICATION OF THE TEST AND BALANCE REPORTS AND SUCH VERIFICATION SHALL BE BY A SECOND INDEPENDENT BALANCER. REPORTS FOUND TO BE INACCURATE WILL BE DISALLOWED AND THE BALANCER WILL BE REQUIRED TO REPEAT OPERATIONS UNDER THE SUPERVISION OF THE SECOND INDEPENDENT BALANCER UNTIL ACCURATE REPORTS ARE COMPLETED AND AGREED UPON. THE COST OF SUCH CHECKING AND REPEAT OPERATIONS BY THE CONTRACTOR, UNLESS THE INITIAL REPORT IS FOUND TO BE INACCURATE AND/OR INCOMPLETE. IN SUCH CASE, THE COSTS OF THE VERIFICATION TEST AND BALANCE AND ALL SUBSEQUENT COSTS OF SUPERVISION IN ORDER TO SECURE ACCEPTABLE REPORTS WILL BE BY THE BALANCER.
- CONTRACTOR SHALL ASSIST THE OWNERS COMMISSIONING AGENT TO COMMISSION THE HVAC SYSTEM.
- CONTROL DEVICE MOTORS (DAMPERS, ETC.) SHALL BE 24VAC TYPE WITH ALL ELECTRICAL POWER REQUIREMENTS CLEARLY NOTED ON THE CONSTRUCTION DRAWINGS.
- ALL INTAKE AND EXHAUST AIR LOUVERS ARE EXISTING TO REMAIN AND SHOWN AS REFERENCE ONLY (TYP. FOR ALL IN ENTIRE PROJECT).
- ALL FIRE, SMOKE/FIRE AND SMOKE DAMPERS ARE EXISTING TO REMAIN AND SHOWN AS REFERENCE ONLY (TYP. FOR ALL IN ENTIRE PROJECT).

OCCC MECHANICAL GENERAL NOTES

- PROVIDE AIR AND WATER FLOW DIAGRAMS INSTALLED IN WATERPROOF LAMINATED FRAMES ON THE WALL IN EACH MECHANICAL ROOM. AIR FLOW DIAGRAMS SHALL SHOW LOCATIONS OF DAMPERS, SENSORS, AND EXHAUST FANS ASSOCIATED WITH THE AIR HANDLING UNIT. WATER FLOW DIAGRAMS SHALL SHOW SHUT OFF VALVES, CONTROL VALVE LOCATIONS. ALL DIAGRAMS SHOULD BE IN PLAN VIEW AND EASY TO ACCESS AND READ.
- DO NOT ATTACH ANY CONDUIT, JUNCTION BOXES, SENSORS, OR ANYTHING ELSE ON THE ACCESS PANELS OF THE AIR HANDLING UNITS.
- ALL EQUIPMENT SHALL BE FREE OF ANY DAMAGE AT THE TIME OF ACCEPTANCE. ALL DENTS, SCRATCHES, AND ANY OTHER DAMAGE MUST BE REPAIRED PRIOR TO THE INSTALLATION OF THE EQUIPMENT.
- ALL DUCTWORK ACCESSORIES THAT PENETRATE THE SHEET METAL DUCT SHALL BE PROPERLY FASTENED, SEALED, AND INSULATED.
- THE CONTRACTOR IS SOLELY RESPONSIBLE FOR COORDINATING HISHER WORK WITH THE TEST AND BALANCE FIRM PRIOR TO TEST AND BALANCE. THE CONTRACTOR SHALL NOT STOP, PRE-BALANCE, AND REPLACE ALL AIR FILTERS FOR EVERY AHU BEING TESTED. ALL DISCREPANCIES, DRIVE CHANGES, ETC. REPORTED BY ENGINEER OR TEST AND BALANCE FIRM SHALL BE CORRECTED BY CONTRACTOR WITHIN FIVE CALENDAR DAYS. IF NO ADDITIONAL COST, TEST AND BALANCE SHALL BE COMPLETED PRIOR TO SUBSTANTIAL COMPLETION. THE TEST AND BALANCE SHALL BE INCLUDED IN CONTRACTOR'S SCOPE OF WORK.
- OPERATION AND MAINTENANCE MANUALS SHALL INCLUDE AS A SEPARATE SUBMITTAL ITEM A LIST OF ALL EQUIPMENT INSTALLED, AND PREVENTATIVE MAINTENANCE REQUIREMENTS ALONG WITH TIME SCHEDULES) FOR EACH ITEM. THE SEQUENCE OF OPERATION SHALL ALSO INCLUDE A DEFINITIVE SEQUENCE OF OPERATION OF THE MECHANICAL SYSTEM AND COMPONENTS AS THEY FUNCTION INTEGRALLY AND INDEPENDENTLY WITH THE SYSTEM. THE CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATING TRANSFERRING CONTROL OF THE SYSTEM TO THE OWNER ENERGY CONTROL DEPARTMENT PRIOR TO FINAL CLOSEOUT OF THE PROJECT. THIS IS REQUIRED PRIOR TO ISSUANCE OF ANY FORM OF OCCUPANCY CERTIFICATE. CONTRACTOR SHALL ALSO PROVIDE DOCUMENTATION OF ALL EXISTING DEVICES, SENSORS, ACTUATORS, ETC. THAT ARE INTENT TO BE EXISTING TO REMAIN AND VERIFY FUNCTIONAL.
- PROVIDE THERMOMETERS AT ALL OF THE APPROPRIATE LOCATIONS ON THE CHILLED WATER LINES. THERMOMETER WELL SHALL BE IN THE ACTUAL STREAM AND NOT BRANCHED OR TIED FROM THE WATER STREAM. THERMOMETER WELL SHALL BE OF THE APPROPRIATE SIZE TO MATCH THE THERMOMETER WELL. SPECIFY THERMOMETERS OF THE APPROPRIATE GRADUATION (0 TO 100 DEGREES F FOR CHILLED WATER AND 30-240 DEGREES F FOR HOT WATER) WITH BLUE DYE TEST PORTS (PETES PLUGS) SHALL ALSO BE PROVIDED AT APPROPRIATE LOCATIONS ON PIPING FOR INSERTING THERMOMETERS TO VERIFY THE ACCURACY OF WELL THERMOMETERS.
- ALL CHILLED WATER PNEUMATICALS SHALL BE MOUNTED IN THE VERTICAL POSITION. ELECTRIC ACTUATORS ARE PREFERRED. PNEUMATICALS ACTUATORS ARE NOT ACCEPTABLE DUE TO HIGH MAINTENANCE COSTS. OCCC STANDARD FOR VALVES ACTUATORS ARE BELMO ENERGY VALVE.
- THE HVAC SYSTEMS SHOULD BE TESTED AND BALANCED IN THE DIRECTION OF A PROFESSIONAL ENGINEER OR BY AN AABC OR NEBB CERTIFIED TEST AND BALANCE CONTRACTOR EMPLOYED BY THE CONSTRUCTION MANAGER. TEST AND BALANCE SHALL BE COMPLETED PRIOR TO SUBSTANTIAL COMPLETION. THE TEST AND BALANCE SHALL BE INCLUDED IN CONTRACTOR'S SCOPE OF WORK.
- ORANGE COUNTY GOVERNMENT'S ACCESSIBILITY STATEMENT (HTTP://WWW.OCCFL.NET/ACCESSIBILITY/) CALLS FOR COMPLIANCE WITH 2010 AMERICAN WITH DISABILITIES ACT ACCESSIBILITY GUIDELINES. IT IS OUR REQUIREMENT THAT ALL OF ORANGE COUNTY'S DIGITAL PRODUCTS COMPLY WITH THE SECTION 508 OF THE AMERICANS WITH DISABILITIES ACT, INCLUDING WCAG 2.0 LEVEL AA.
- GENERAL CONTRACTOR SHALL PROVIDE AND INSTALL ALL SOFTWARE, CABLES AND HANDHELD DEVICES FOR THE BAS SYSTEM, AND THEY WILL REMAIN AND BECOME PROPERTY OF THE OCCC.
- GENERAL CONTRACTOR SHALL FOLLOW ALL THE GUIDELINES OF THE ORANGE COUNTY IT DEPARTMENT STANDARDS AS WELL AS THE OCCC CONSTRUCTION GUIDELINES. THE GENERAL CONTRACTOR SHALL ENSURE TO FOLLOW AND APPLY ALL THE UPDATES OF THE OCCC IT DEPARTMENT STANDARDS. OCCC WILL PROVIDE THESE STANDARDS AND GUIDELINES TO THE GC.
- GC SHALL PROVIDE OWNER WITH COPIES OF ALL SOFTWARE INSTALLED.
- FOR ALL HVAC SYSTEMS - NO END USER SHALL HAVE AVAILABLE THE CAPACITY TO OVERRIDE TEMPERATURE SENSORS SETPOINTS.
- BAS SYSTEM TO INTEGRATE WITH COOLER / FREEZER ALERT SYSTEM.



Issue: 12-6-18 100% CONSTRUCTION DOCUMENTS

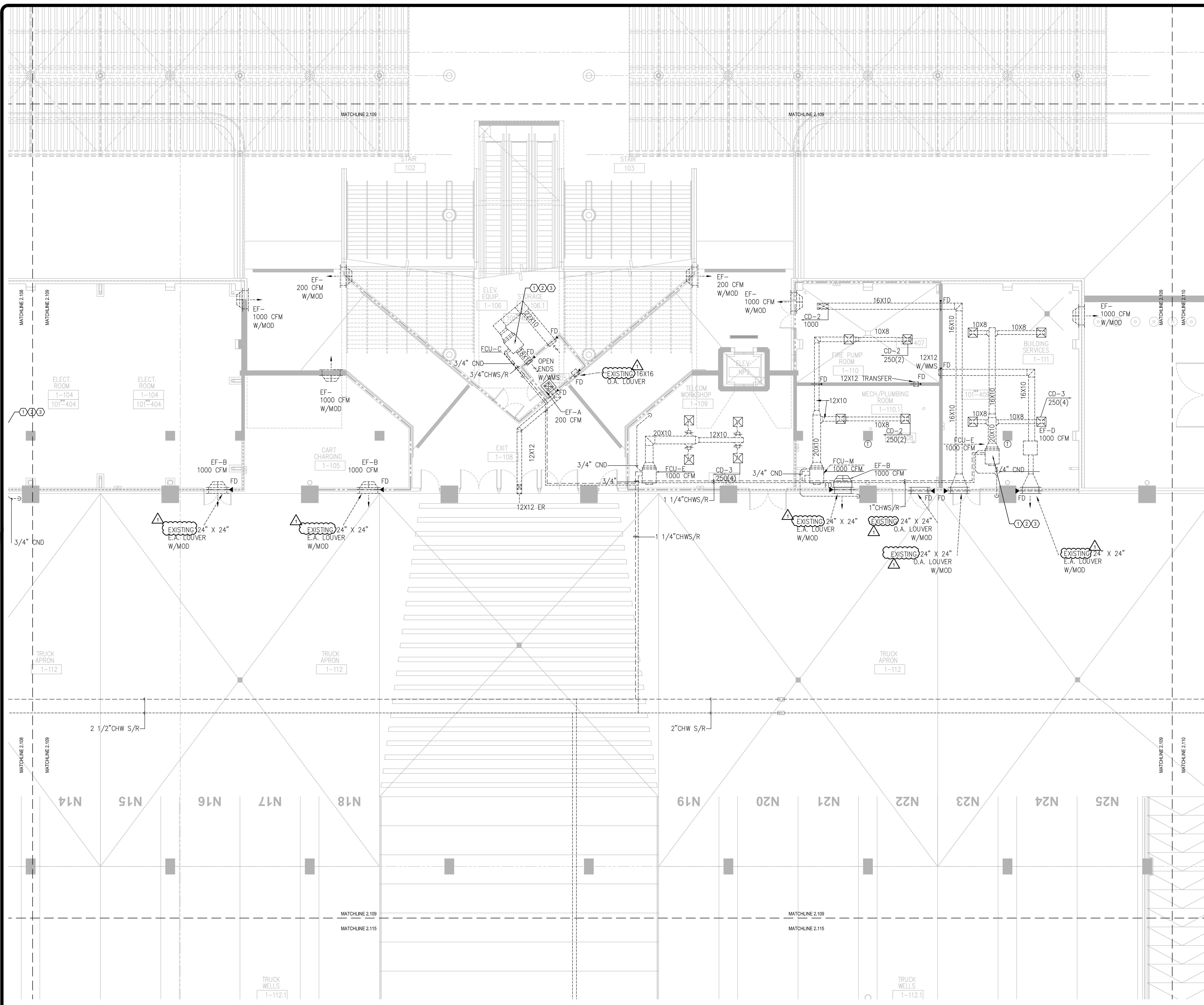
No.	Date	Description
1	01-08-19	BLDG. DEPT. COMMENTS

Project Name: **OCCC NORTH SOUTH BUILDINGS BAS CONTROLS UPGRADE**

OCCC Project Number: Y17-813
 Drawing File Name: 1500-M001-2017220.DWG
 Scale: AS SHOWN
 Design By: CS
 Drawn By: CS
 Checked By: BBS
 Engineer of Record: QULAH R. SHANMUGAM
 License Number: FL1204

Sheet Name: **MECHANICAL SYMBOLS LEGEND AND GENERAL NOTES**

Sheet Number: **M-001**



GENERAL NOTES:

- a. REFER TO SHEET M-001 FOR MECHANICAL GENERAL NOTES AND SYMBOLS LEGEND.
- b. COORDINATE WORK SCHEDULE WITH OCCC PROJECT MANAGER. DISRUPTION OF COOLING TO THE ADJACENT SPACES IS NOT ALLOWED. ANY PROLONGED OUTAGES REQUIRES PROJECT MANAGER APPROVAL.
- c. DRAWINGS ARE DIAGRAMMATIC AND REPRESENT THE GENERAL LAYOUT OF MECHANICAL COMPONENTS.
- d. LOCATE EQUIPMENT SO THAT MANUFACTURER SERVICE CLEARANCES ARE MAINTAINED.
- e. COORDINATE WITH ELECTRICAL CONTRACTOR LOCATION OF DISCONNECTS. DO NOT BLOCK SERVICE CLEARANCE TO EQUIPMENT.
- f. REFER TO PROJECT SPECIFICATIONS FOR EQUIPMENT AND INSTALLATION REQUIREMENTS. IF THERE IS ANY DISCREPANCY BETWEEN THE SPECIFICATIONS AND DRAWINGS, THE MOST STRINGENT REQUIREMENT SHALL APPLY.
- g. ALL EXISTING DUCTWORK, REGISTER GRILLES, EQUIPMENT AND PIPING IS SHOWN FOR REFERENCE ONLY.
- h. SCOPE OF WORK - VAV'S (TYPICAL 265): PROVIDE NEW DA TEMPERATURE SENSOR, SPACE TEMPERATURE SENSOR, SPACE TEMPERATURE SETPOINT AND OVERRIDE, FIBS (TYPICAL 202); PROVIDE NEW DA TEMPERATURE SENSOR, SPACE TEMPERATURE SENSOR, SPACE TEMPERATURE SETPOINT AND OVERRIDE, FCUS (TYPICAL 47); PROVIDE NEW RA AND SA TEMPERATURE SENSOR, PROVIDE NEW ZONE TEMPERATURE SENSOR, EFS AND SF'S (TYPICAL 117); EXISTING DEVICES TO REMAIN REFER TO MECHANICAL CONTROL SHEETS, M600-M626, FOR DETAILS.
- i. REPLACE BAS CABINET WITH NEW, PROVIDE NEW CAT6 PLENUM CABLE AT NEAREST IDF CABINET/ROOM.

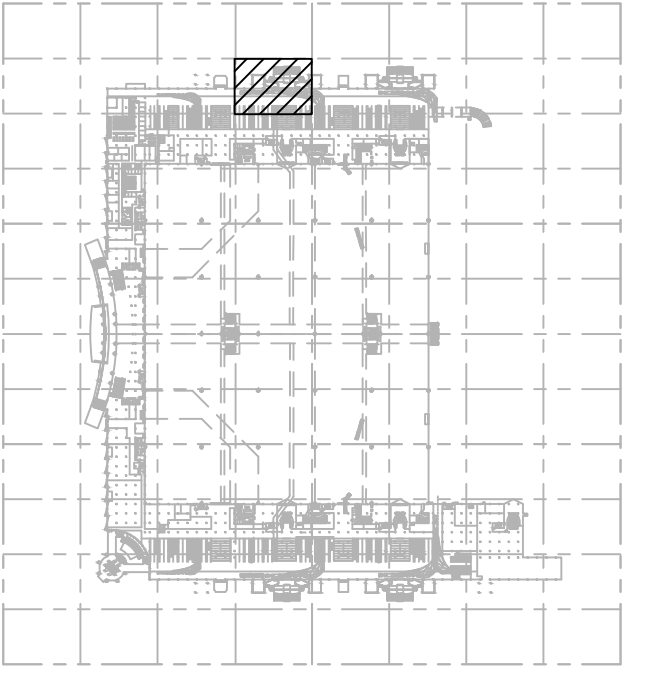
PLAN KEY NOTES:

- 1. PROVIDE NEW RA TEMPERATURE SENSORS.
- 2. PROVIDE NEW ZONE TEMPERATURE SENSOR.
- 3. REFER TO CONTROLS SHEETS FOR DETAILS.

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KEY PLAN

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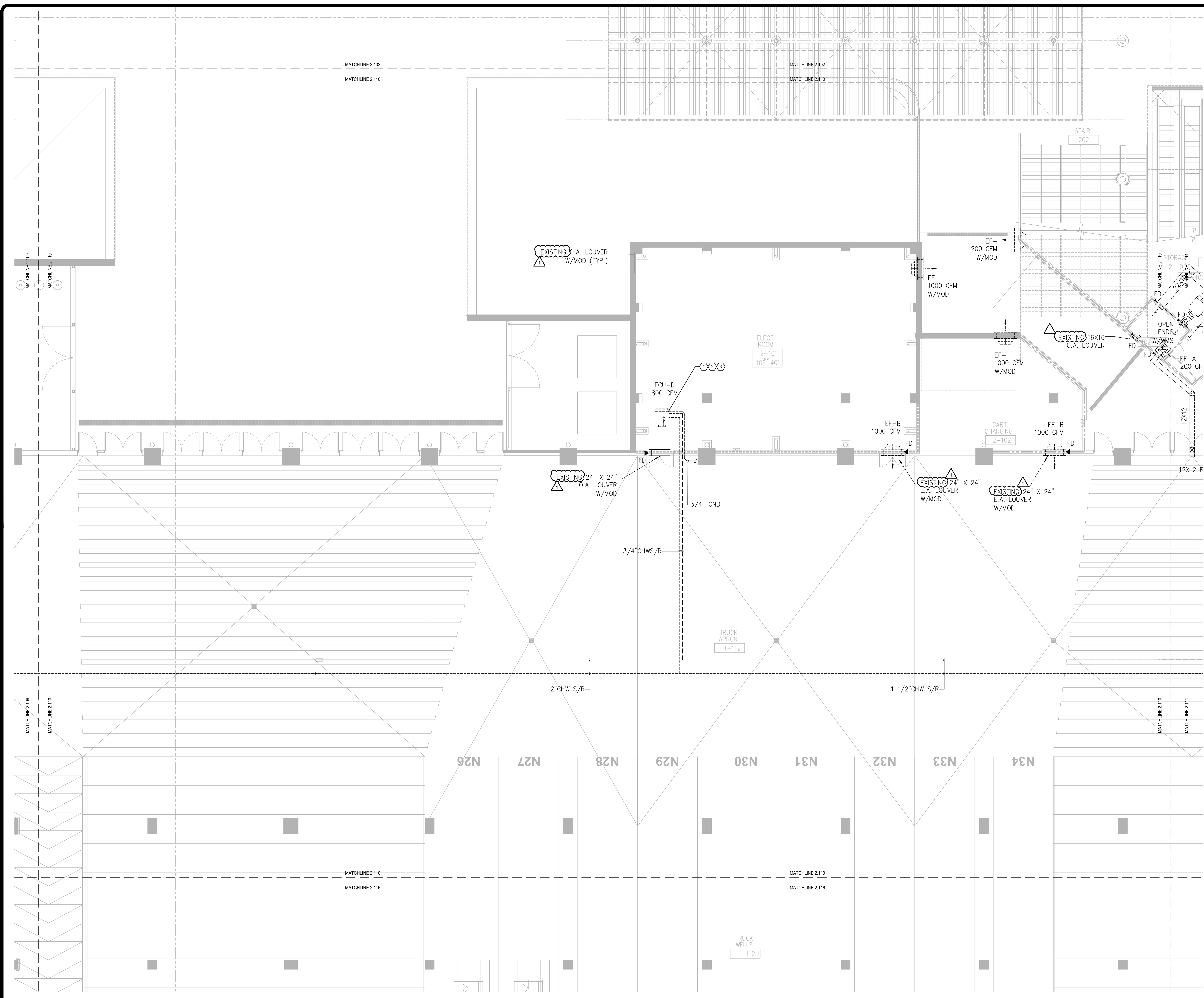
Project Name:
OCC NORTH SOUTH BUILDINGS BAS CONTROLS UPGRADE

OCC Project Number: Y17-813
Drawing File Name: 1500-M2107-2017220.DWG
Scale: AS SHOWN
Design By: CS
Drawn By: CS
Checked By: BBS
Engineer of Record: OHLAM R. SHANNI
License Number: FL41204

Sheet Name:
MECHANICAL EXHIBIT LEVEL PARTIAL FLOOR PLAN - PART 9

Sheet Number:
M2.109

MECHANICAL EXHIBIT LEVEL PARTIAL FLOOR PLAN - PART 9
SCALE: 1/8"=1'-0"



GENERAL NOTES:

- REFER TO SHEET M-001 FOR MECHANICAL GENERAL NOTES AND SYMBOLS LEGEND.
- COORDINATE WORK SCHEDULE WITH OCCC PROJECT MANAGER. DISRUPTION OF COOLING TO THE ADJACENT SPACES IS NOT ALLOWED. ANY PROLONGED OUTAGES REQUIRES PROJECT MANAGER APPROVAL.
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- LOCATE EQUIPMENT SO THAT MANUFACTURER SERVICE CLEARANCES ARE MAINTAINED.
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- REFER TO PROJECT SPECIFICATIONS FOR EQUIPMENT AND INSTALLATION REQUIREMENTS. IF THERE IS ANY DISCREPANCY BETWEEN SPECIFICATIONS AND DRAWINGS, THE MOST STRINGENT REQUIREMENT SHALL APPLY.
- ALL EXISTING DUCTWORK, REGISTER GRILLES, EQUIPMENT AND PIPING IS SHOWN FOR REFERENCE ONLY.
- SCOPE OF WORK - VAV'S (TYPICAL 265): PROVIDE NEW DA TEMPERATURE SENSOR, SPACE TEMPERATURE SENSOR, SPACE TEMPERATURE SETPOINT AND OVERRIDE. EPB'S (TYPICAL 202); PROVIDE NEW DA TEMPERATURE SENSOR, SPACE TEMPERATURE SENSOR, SPACE TEMPERATURE SETPOINT AND OVERRIDE. EQU'S (TYPICAL 47); PROVIDE NEW RA AND SA TEMPERATURE SENSOR, PROVIDE NEW ZONE TEMPERATURE SENSOR. EF'S AND SF'S (TYPICAL 117); EXISTING DEVICES TO REMAIN. REFER TO MECHANICAL CONTROL SHEETS, M600-M609, FOR DETAILS.
- REPLACE BAS CABINET WITH NEW. PROVIDE NEW CAT5 FIBER OPTIC CABLE AT NEAREST IDF CABINET/ROOM.

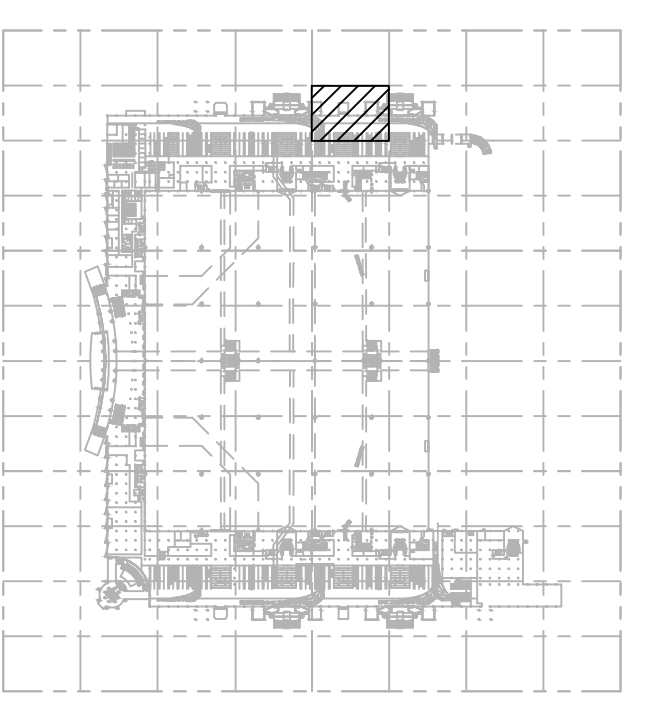
PLAN KEY NOTES:

- PROVIDE NEW RA TEMPERATURE SENSORS.
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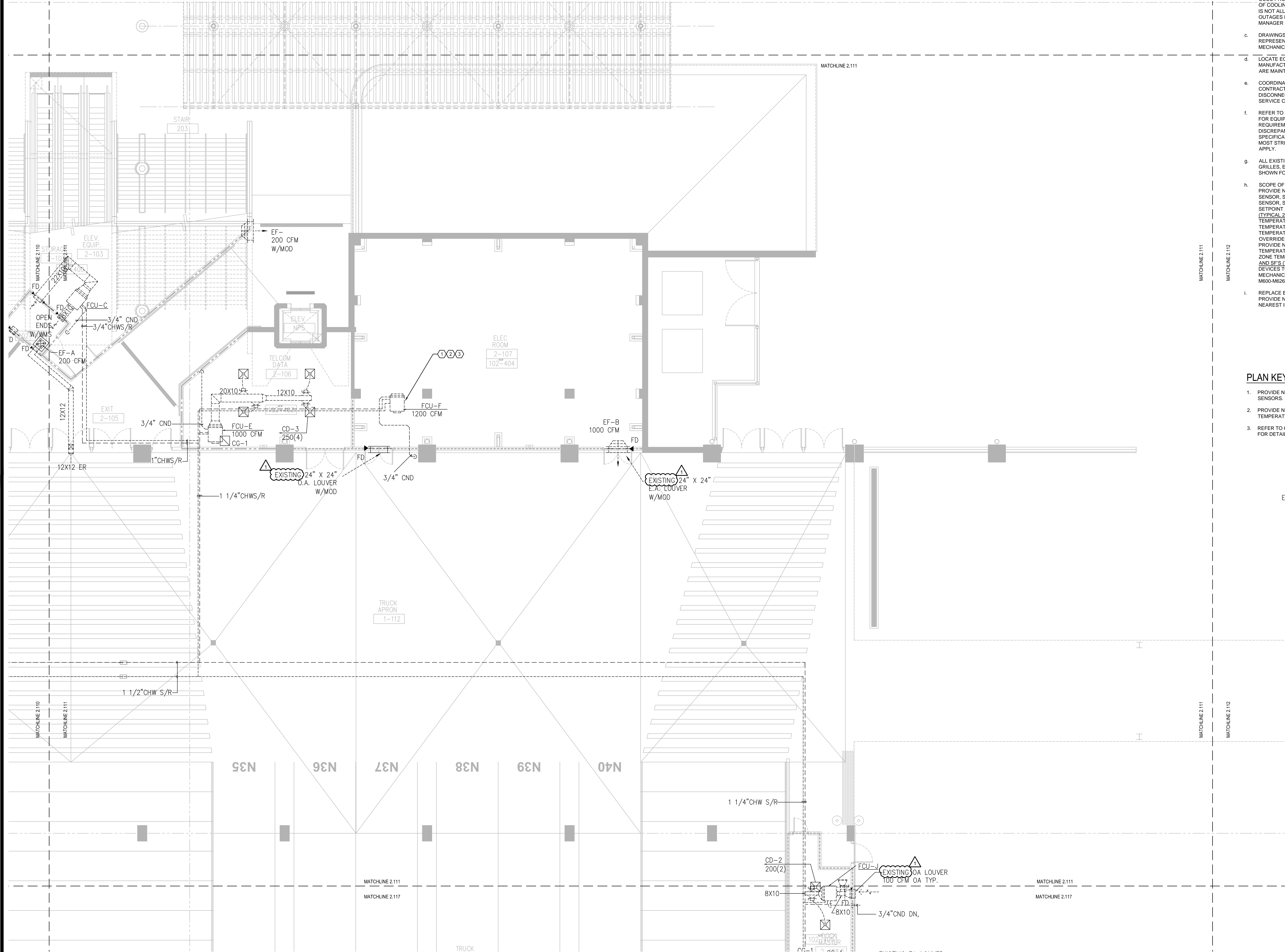
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 Drawn By: CS
 Checked By: BBS
 Engineer of Record: OJULIAN R. SHAWMME
 License Number: FL41204

Sheet Name:
MECHANICAL EXHIBIT LEVEL PARTIAL FLOOR PLAN - PART 10

Sheet Number:
M2.110

MECHANICAL EXHIBIT LEVEL PARTIAL FLOOR PLAN - PART 10
 SCALE: 1/8"=1'-0"



GENERAL NOTES:

- a. REFER TO SHEET M-001 FOR MECHANICAL GENERAL NOTES AND SYMBOLS LEGEND.
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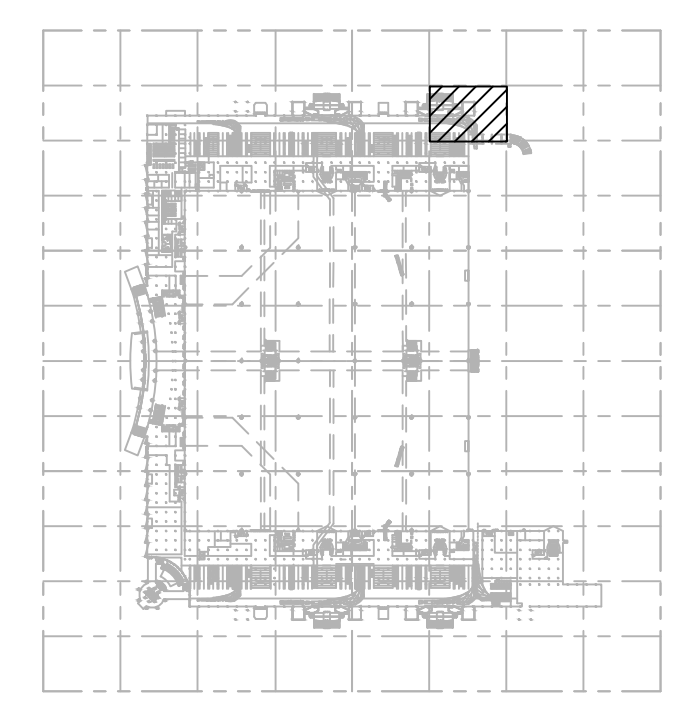
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- 3. REFER TO CONTROLS SHEETS FOR DETAILS.

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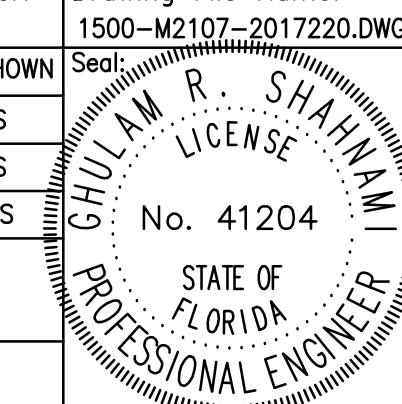
KEY PLAN

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OCCC NORTH SOUTH BUILDINGS BAS CONTROLS UPGRADE

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Sheet Name:
MECHANICAL EXHIBIT LEVEL PARTIAL FLOOR PLAN - PART 11

Sheet Number:
M2.111

MECHANICAL EXHIBIT LEVEL PARTIAL FLOOR PLAN - PART 11
 SCALE: 1/8"=1'-0"
