

December 16, 2015
BOARD OF COUNTY COMMISSIONERS
ORANGE COUNTY, FLORIDA
Addendum No. 5, IFB Y16-713-CC

**JOHN BRIDGES COMMUNITY CENTER BUILDINGS D & F HVAC
REPLACEMENT**

Bid Opening Date: January 7, 2016 at 2:00 p.m.

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 is January 7, 2016 at 2:00 p.m.
- B. Reliable Controls are an approved equal for HVAC Controls.
- C. Attached with this addendum are temporary chiller connections, web-based controls specification and chilled water piping clarifications with a narrative that explains the changes made to the drawings and specifications. Drawings included with attachment are M-002, MD-102, M-101, M-102, M-201, M-301, E-002. Specification section included with attachment is section 230900.
- D. Attached with this addendum are clarifications associated with the cafeteria exhaust fan system with a narrative that explains the clarifications. Drawings included with attachment are MD-101, M-101, M-402.
- E. Additional requirement added to specification section 230900 INSTRUMENTATION AND CONTROL FOR HVAC, paragraph 1.2 SUMMARY, subparagraph A, "The BAS system shall be capable of expansion to HVAC systems serving the entire campus including Buildings A, B, and C in the future."
- F. Questions and Answers:
 - 1. **Question** – Is it acceptable to use Schedule 40 steel pre-insulated pipe for the underground piping on this project?
Response – Yes, provide Thermacor Process Inc., STEEL-THERM or equal, if Contractor chooses to provide steel pre-insulated pipe for the underground piping.

2. **Question** – the HVAC piping insulation specification section 230719-3 part 2.1 G 1 calls for one of the following, but then only list Thermacor Process Inc Polycor HDPE or equal with no other options listed. Please provide clarification as to whether there are other options or if HDPE is the only choice.
Response – It is acceptable to provide schedule 40 steel pipe, provide Thermacor Process Inc., STEEL-THERM or equal as a pre-insulated piping system.
3. **Question** – Please identify the current fire alarm and the contact for that system.
Response – Building D fire alarm system is silent knight by Honeywell model SK-5208. Building F fire alarm systems is Silent Knight by Honeywell Intelliknight model 5808.
4. **Question** – Please identify the current ABS system and the contact for that system.
Response – There is no current campus wide Building Automation System (BAS), units are controlled electrically via wall mounted Honeywell thermostats.
5. **Question** – Drawing Sheet M-101, it shows two 1.5” chilled water piping entering building D in room 104. Is it acceptable to hang the chilled water lines below the hard lid ceiling?
Response – Yes, it is acceptable to route piping below the ceiling in the Storage Room and Janitor’s Closet only. The chilled water piping shall not be routed over electrical equipment.
6. **Question** – In Building D, where it is unavoidable to hang the chilled water piping below the hard ceiling. Is it required to paint the entire ceiling to match our patch work or is it acceptable to only paint the patch work itself.
Response – It is required to paint the entire ceiling to match existing.
7. **Question** – Is the existing fence around the single condenser unit on Building D going to remain, or do we need to demo it out with the unit?
Response – The fence on the south side of Building D around the existing condensing units shall remain. The fence on the west side of Building D around the existing packaged unit is to be demolished and replaced with a new fence.

8. **Question** – The plans and specifications do not specify the type of construction material to be used for the fencing required on this project.
Response – Provide a six (6) foot high chain link fence with aluminum wire fabric per ASTM F 1183 with mill finish and wire diameter of 0.148 inch, mesh size of 2-inches. Posts shall be round galvanized steel pipe Schedule 40, line posts are 2-inches outside diameter and end, corner and pull posts are 3.5-inches outside diameter. Provide double swing gates with lockable latches.
9. **Question** – The existing ductwork off of FCU D-1 is fabricated out of fiberglass. Does this ductwork require resurfacing the interior with an antimicrobial coating after the cleaning procedure is performed?
Response – Yes, resurface the interior of fiberglass ductwork with an antimicrobial coating after cleaning.
10. **Question** – Building D demolition plan shows EF-3 to be abandoned in place. Building D new plan shows the fan in the same location as EF-2. Please clarify. Is the associated ductwork to remain in place?
Response – In the cafeteria, the exhaust fan, associated ductwork and grilles are to be removed. The associated electrical is to removed back to the panel. Roof curb to be capped and sealed and exhaust grille locations to be patched and painted to match existing ceiling.
11. **Question** - One of the existing FCUs in Building D is hooked up with duct board and the other is with sheet metal. We assume all new hookups to be with sheet metal. Please confirm.
Response – All new ductwork connections shall be sheet metal.
12. **Question** – What are the hours of operation for the John Bridges Community Center?
Response – The hours of operation for the John Bridges Community Center is Monday through Friday 8:00a.m. to 5:00p.m.

A. ACKNOWLEDGEMENT OF ADDENDA

1. The Bidder/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 bid or proposal.
2. All other terms and conditions of the IFB remain the same.
3. **Receipt acknowledged by:**

Authorized Signature

Date Signed

Title

Name of Firm

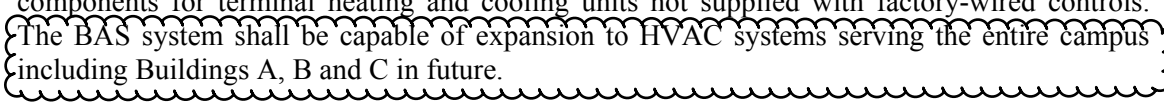
SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

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 control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls. The BAS system shall be capable of expansion to HVAC systems serving the entire campus including Buildings A, B and C in future. 
- B. Related Sections include the following:
 - 1. Section 230519 "Meters and Gages for HVAC Piping" for measuring equipment that relates to this Section.
 - 2. Section 230993 "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

1.3 DEFINITIONS

- A. DDC: Direct digital control.
- B. I/O: Input/output.
- C. MS/TP: Master slave/token passing.
- D. PC: Personal computer.
- E. PID: Proportional plus integral plus derivative.
- F. RTD: Resistance temperature detector.

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 workstation within six seconds.
5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations 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.
 - 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 1 deg F.
 - e. Ducted Air Temperature: Plus or minus 1 deg F.
 - f. Outside Air Temperature: Plus or minus 2 deg F.
 - g. Dew Point Temperature: Plus or minus 3 deg F.
 - h. Temperature Differential: Plus or minus 0.25 deg F.
 - i. Relative Humidity: Plus or minus 5 percent.
 - j. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
 - k. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
 - l. Airflow (Terminal): Plus or minus 10 percent of full scale.
 - m. Air Pressure (Space): Plus or minus 0.01-inch wg.
 - n. Air Pressure (Ducts): Plus or minus 0.1-inch wg.
 - o. Carbon Monoxide: Plus or minus 5 percent of reading.
 - p. Carbon Dioxide: Plus or minus 50 ppm.
 - q. Electrical: Plus or minus 5 percent of reading.

1.5 SEQUENCE OF OPERATION

1.6 ACTION SUBMITTALS

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

- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
 2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 3. Wiring Diagrams: Power, signal, and control wiring.
 4. Details of control panel faces, including controls, instruments, and labeling.
 5. Written description of sequence of operation.
 6. Schedule of dampers including size, leakage, and flow characteristics.
 7. Schedule of valves including flow characteristics.
 8. DDC System Hardware:
 - a. Wiring diagrams for control units with termination numbers.
 - b. Schematic diagrams and floor plans for field sensors and control hardware.
 - c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
 9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
 10. Controlled Systems:
 - a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
 - b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
 - c. Written description of sequence of operation including schematic diagram.
 - d. Points list.
- C. Samples for Initial Selection: For each color required, of each type of thermostat or sensor cover with factory-applied color finishes.
- D. Samples for Verification: For each color required, of each type of thermostat or sensor cover.

1.7 INFORMATIONAL SUBMITTALS

- A. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135.
- B. Qualification Data: For Installer and manufacturer.
- C. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.
- D. Field quality-control test reports.

1.8 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "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.
- B. Software and Firmware Operational Documentation: Include the following:
1. Software operating and upgrade manuals.
 2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
 3. Device address list.
 4. Printout of software application and graphic screens.
 5. Software license required by and installed for DDC workstations and control systems.

1.9 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Replacement Materials: One replacement diaphragm or relay mechanism for each unique valve motor, controller, thermostat and positioning relay.
 2. Maintenance Materials: One thermostat adjusting key(s).

1.10 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.
- C. Comply with ASHRAE 135 for DDC system components.

1.11 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.

1.12 COORDINATION

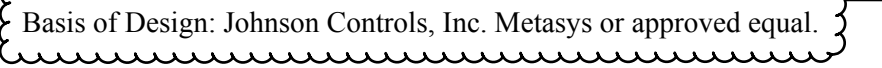
- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- B. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.
- C. Coordinate equipment with Section 260913 "Electrical Power Monitoring and Control" to achieve compatibility of communication interfaces.
- D. Coordinate equipment with Section 262416 "Panelboards" to achieve compatibility with starter coils and annunciation devices.
- E. Coordinate equipment with Section 262419 "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.
- F. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

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. Basis of Design: Johnson Controls, Inc. Metasys or approved equal. 
- B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.
- C. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via

dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

D. Control system shall include the following:

1. Building intrusion detection system specified in Section 281600 "Intrusion Detection."
2. Building clock control system specified in Section 275313 "Clock Systems."
3. Building lighting control system specified in Section 260943.13 "Addressable-Fixture Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls."
4. Fire alarm system specified in Section 283111 "Digital, Addressable Fire-Alarm System" and Section 283112 "Zoned (DC Loop) Fire-Alarm System."

2.3 WEB ACCESS

A. DDC system shall be Web based.

1. Web-Based Access to DDC System:
 - a. DDC system software shall be based on server thin-client architecture, designed around open standards of Web technology. DDC system server shall be accessed using a Web browser over DDC system network, using Owner's LAN, and remotely over Internet through Owner's LAN.
 - b. Intent of thin-client architecture is to provide operators complete access to DDC system via a Web browser. No special software other than a Web browser shall be required to access graphics, point displays, and trends; to configure trends, points, and controllers; and to edit programming.
 - c. Web access shall be password protected.

2.4 DDC EQUIPMENT

A. Operator Workstation: One PC-based microcomputer(s) with minimum configuration as follows:

1. Motherboard: With 8 integrated USB 2.0 ports, integrated Intel Pro 10/100 (Ethernet), integrated audio, bios, and hardware monitoring.
2. Processor: Intel Pentium 4.
3. Random-Access Memory: 512 MB.
4. Graphics: Video adapter, minimum 1280 x 1024 pixels, 64-MB video memory, with TV out.
5. Monitor: 17 inches, LCD color.
6. Keyboard: QWERTY, 105 keys in ergonomic shape.
7. Floppy-Disk Drive: 1.44 MB.
8. Hard-Disk Drive: 80 GB.
9. CD-ROM Read/Write Drive: 48x24x48.
10. Mouse: Three button, optical.
11. Uninterruptible Power Supply: 2 kVa.
12. Operating System: Microsoft Windows 7 or 8 with high-speed Internet access.

- a. ASHRAE 135 Compliance: Workstation shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.

13. Application Software:

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

14. Custom Application Software:

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

- B. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.

1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

- a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 - d. Software applications, scheduling, and alarm processing.
 - e. Testing and developing control algorithms without disrupting field hardware and controlled environment.
3. Standard Application Programs:
- a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, 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, and equipment sequencing.
 - d. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
 - e. Remote communications.
 - f. Maintenance management.
 - g. Units of Measure: Inch-pound and SI (metric).
4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
5. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
- C. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
 4. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
- D. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
1. Binary Inputs: Allow monitoring of on-off signals without external power.

2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
 3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
 4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights.
 5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) with status lights, two-position (auto-manual) switch, and manually adjustable potentiometer.
 6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
 7. Universal I/Os: Provide software selectable binary or analog outputs.
- E. 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.
- F. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
1. Minimum dielectric strength of 1000 V.
 2. Maximum response time of 10 nanoseconds.
 3. Minimum transverse-mode noise attenuation of 65 dB.
 4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

2.5 UNITARY CONTROLLERS

- A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
 2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform automatic system diagnostics; monitor system and report failures.
 3. ASHRAE 135 Compliance: Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135. Reside on network using MS/TP datalink/physical layer protocol and have service communication port for connection to diagnostic terminal unit.
 4. Enclosure: Dustproof rated for operation at 32 to 120 deg F.
 5. Enclosure: Waterproof rated for operation at 40 to 150 deg F.

2.6 ALARM PANELS

- A. Unitized cabinet with suitable brackets for wall or floor mounting. Fabricate of 0.06-inch-thick, furniture-quality steel or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish.
- B. Indicating light for each alarm point, single horn, acknowledge switch, and test switch, mounted on hinged cover.
 - 1. Alarm Condition: Indicating light flashes and horn sounds.
 - 2. Acknowledge Switch: Horn is silent and indicating light is steady.
 - 3. Second Alarm: Horn sounds and indicating light is steady.
 - 4. Alarm Condition Cleared: System is reset and indicating light is extinguished.
 - 5. Contacts in alarm panel allow remote monitoring by independent alarm company.

2.7 ANALOG CONTROLLERS

- A. Step Controllers: 6- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.
- B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F, and single- or double-pole contacts.
- C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.
 - 1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.
- D. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.
- E. Receiver Controllers: Single- or multiple-input models with control-point adjustment, direct or reverse acting with mechanical set-point adjustment with locking device, proportional band adjustment, authority adjustment, and proportional control mode.
 - 1. Remote-control-point adjustment shall be plus or minus 20 percent of sensor span, input signal of 3 to 13 psig.
 - 2. Proportional band shall extend from 2 to 20 percent for 5 psig.
 - 3. Authority shall be 20 to 200 percent.
 - 4. Air-supply pressure of 18 psig, input signal of 3 to 15 psig, and output signal of zero to supply pressure.
 - 5. Gages: 1-1/2 inches in diameter, 2.5 percent wide-scale accuracy, and range to match transmitter input or output pressure.

2.8 TIME CLOCKS

A. Manufacturers:

1. ATC-Diversified Electronics.
2. Grasslin Controls Corporation.
3. Paragon Electric Co., Inc.
4. Precision Multiple Controls, Inc.
5. SSAC Inc.; ABB USA.
6. TCS/Basys Controls.
7. Theben AG - Lumilite Control Technology, Inc.
8. Time Mark Corporation.

B. Seven-day, programming-switch timer with synchronous-timing motor and seven-day dial; continuously charged, nickel-cadmium-battery-driven, eight-hour, power-failure carryover; multiple-switch trippers; minimum of two and maximum of eight signals per day with two normally open and two normally closed output contacts.

C. Solid-state, programmable time control with 4 separate programs each with up to 100 on-off operations; 1-second resolution; lithium battery backup; keyboard interface and manual override; individual on-off-auto switches for each program; 365-day calendar with 20 programmable holidays; choice of fail-safe operation for each program; system fault alarm; and communications package allowing networking of time controls and programming from PC.

2.9 ELECTRONIC SENSORS

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

B. Thermistor Temperature Sensors and Transmitters:

1. Manufacturers:

- a. BEC Controls Corporation.
- b. Ebtron, Inc.
- c. Heat-Timer Corporation.
- d. I.T.M. Instruments Inc.
- e. MAMAC Systems, Inc.
- f. RDF Corporation.

2. Accuracy: Plus or minus 0.5 deg F at calibration point.

3. Wire: Twisted, shielded-pair cable.

4. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.

5. Averaging Elements in Ducts: 36 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft.

6. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.

7. Room Sensor Cover Construction: Manufacturer's standard locking covers.

- a. Set-Point Adjustment: Concealed.
 - b. Set-Point Indication: Exposed.
 - c. Thermometer: Concealed.
8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
 9. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
- C. RTDs and Transmitters:
1. Manufacturers:
 - a. BEC Controls Corporation.
 - b. MAMAC Systems, Inc.
 - c. RDF Corporation.
 2. Accuracy: Plus or minus 0.2 percent at calibration point.
 3. Wire: Twisted, shielded-pair cable.
 4. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
 5. Averaging Elements in Ducts: 18 inches long, rigid; use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.
 6. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
 7. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - a. Set-Point Adjustment: Concealed.
 - b. Set-Point Indication: Exposed.
 - c. Thermometer: Concealed.
 8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
 9. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
- D. Humidity Sensors: Bulk polymer sensor element.
1. Manufacturers:
 - a. BEC Controls Corporation.
 - b. General Eastern Instruments.
 - c. MAMAC Systems, Inc.
 - d. ROTRONIC Instrument Corp.
 - e. TCS/Basys Controls.
 - f. Vaisala.
 2. Accuracy: 5 percent full range with linear output.
 3. Room Sensor Range: 20 to 80 percent relative humidity.
 4. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - a. Set-Point Adjustment: Concealed.

- b. Set-Point Indication: Concealed.
 - c. Thermometer: Concealed.
 5. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
 6. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of 32 to 120 deg F.
 7. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.
- E. Pressure Transmitters/Transducers:
 1. Manufacturers:
 - a. BEC Controls Corporation.
 - b. General Eastern Instruments.
 - c. MAMAC Systems, Inc.
 - d. ROTRONIC Instrument Corp.
 - e. TCS/Basys Controls.
 - f. Vaisala.
 2. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
 - a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
 - b. Output: 4 to 20 mA.
 - c. Building Static-Pressure Range: 0- to 0.25-inch wg.
 - d. Duct Static-Pressure Range: 0- to 5-inch wg.
 3. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.
 4. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.
 5. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
 6. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.
- F. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 1. Set-Point Adjustment: Concealed.
 2. Set-Point Indication: Exposed.
 3. Thermometer: Concealed.
- G. Room sensor accessories include the following:
 1. Insulating Bases: For sensors located on exterior walls.
 2. Guards: Locking; heavy-duty, transparent plastic; mounted on separate base.
 3. Adjusting Key: As required for calibration and cover screws.

2.10 STATUS SENSORS

- A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.
- B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig, piped across pump.
- C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
- D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.
- E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.
- F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
- G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
- H. 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.
 - 1. Manufacturers:
 - a. BEC Controls Corporation.
 - b. I.T.M. Instruments Inc.
 - c. Johnson Controls

2.11 FLOW MEASURING STATIONS

- A. Duct Airflow Station: Combination of air straightener and multiport, self-averaging pitot tube station.
 - 1. Manufacturers:
 - a. Ebtron or equal
 - 2. Casing: Galvanized-steel frame.
 - 3. Flow Straightener: Aluminum honeycomb, 3/4-inch parallel cell, 3 inches deep.
 - 4. Sensing Manifold: Copper manifold with bullet-nosed static pressure sensors positioned on equal area basis.

2.12 THERMOSTATS

A. Manufacturers:

1. Erie Controls.
2. Danfoss Inc.; Air-Conditioning and Refrigeration Div.
3. Heat-Timer Corporation.
4. Sauter Controls Corporation.
5. tekmar Control Systems, Inc.
6. Theben AG - Lumilite Control Technology, Inc.

B. Combination Thermostat and Fan Switches: Line-voltage thermostat with push-button or lever-operated fan switch.

1. Label switches "FAN ON-OFF".
2. Mount on single electric switch box.

C. Electric, solid-state, microcomputer-based room thermostat with remote sensor.

1. Automatic switching from heating to cooling.
2. Preferential rate control to minimize overshoot and deviation from set point.
3. Set up for four separate temperatures per day.
4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
5. Short-cycle protection.
6. Programming based on weekday, Saturday, and Sunday.
7. Selection features include degree F or degree C display, 12- or 24-hour clock, keyboard disable, remote sensor, and fan on-auto.
8. Battery replacement without program loss.
9. Thermostat display features include the following:
 - a. Time of day.
 - b. Actual room temperature.
 - c. Programmed temperature.
 - d. Programmed time.
 - e. Duration of timed override.
 - f. Day of week.
 - g. System mode indications include "heating," "off," "fan auto," and "fan on."

D. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.

E. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.

1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.
2. Selector Switch: Integral, manual on-off-auto.

- F. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.
1. Bulbs in water lines with separate wells of same material as bulb.
 2. Bulbs in air ducts with flanges and shields.
 3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.
 4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
 5. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.
 6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.
- G. Fire-Protection Thermostats: Listed and labeled by an NRTL acceptable to authorities having jurisdiction; with fixed or adjustable settings to operate at not less than 75 deg F above normal maximum operating temperature, and the following:
1. Reset: Manual.
 2. Reset: Automatic, with control circuit arranged to require manual reset at central control panel; with pilot light and reset switch on panel labeled to indicate operation.
- H. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.
- I. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.
- J. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual-or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.
1. Bulb Length: Minimum 20 feet.
 2. Quantity: One thermostat for every 20 sq. ft. of coil surface.
- K. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual-or automatic- reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above set point.
1. Bulb Length: Minimum 20 feet.
 2. Quantity: One thermostat for every 20 sq. ft. of coil surface.
- L. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, with molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psig, and cast housing with position indicator and adjusting knob.

2.13 HUMIDISTATS

- A. Manufacturers:
 - 1. MAMAC Systems, Inc.
 - 2. ROTRONIC Instrument Corp.
 - 3. Honeywell.
- B. Pneumatic Room Humidistats: Wall-mounting, proportioning type with adjustable throttling range, 20 to 90 percent operating range, and cover matching room thermostat cover.
- C. Duct-Mounting Humidistats: Electric insertion, 2-position type with adjustable, 2 percent throttling range, 20 to 80 percent operating range, and single- or double-pole contacts.

2.14 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
 - 1. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 - 3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 - 4. Spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
 - 5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 - 6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.
- B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
 - 1. Manufacturers:
 - a. Belimo Aircontrols (USA), Inc. or equal
 - 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. of damper.
 - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
 - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. of damper.
 - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.

- e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
 - f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.
4. Coupling: V-bolt and V-shaped, toothed cradle.
 5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
 6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
 7. Power Requirements (Two-Position Spring Return): 24-V ac.
 8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
 9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
 10. Temperature Rating: Minus 22 to plus 122 deg F.
 11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F.
 12. Run Time: 12 seconds open, 5 seconds closed.

2.15 CONTROL VALVES

A. Manufacturers:

1. Danfoss Inc.; Air Conditioning & Refrigeration Div.
2. Erie Controls.
3. Hayward Industrial Products, Inc.
4. Magnatrol Valve Corporation.
5. Neles-Jamesbury.
6. Parker Hannifin Corporation; Skinner Valve Division.
7. Pneuline Controls.
8. Sauter Controls Corporation.

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. Hydronic system globe valves shall have the following characteristics:

1. NPS 2 and Smaller: Class 125 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
2. NPS 2-1/2 and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.
 - a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
 - b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.
4. Sizing: 3-psig maximum pressure drop at design flow rate or the following:
 - a. Two Position: Line size.

- b. Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.
 - c. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.
- 5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
 - 6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.
- D. Butterfly Valves: 200-psig, 150-psig maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
- 1. Body Style: Wafer.
 - 2. Disc Type: Nickel-plated ductile iron.
 - 3. Sizing: 1-psig maximum pressure drop at design flow rate.
- 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 and 250 deg F operating conditions.
 - 2. Sizing: 3-psig maximum pressure drop at design flow rate, to close against pump shutoff head.
 - 3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
- F. Self-Contained Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.
- 1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
 - 2. Thermostatic Operator: Wax-filled integral sensor with integral adjustable dial.

2.16 DAMPERS

- A. Manufacturers:
- 1. Air Balance Inc.
 - 2. Don Park Inc.; Autodamp Div.
 - 3. TAMCO (T. A. Morrison & Co. Inc.).
 - 4. United Enertech Corp.
 - 5. Vent Products Company, Inc.
- B. Dampers: AMCA-rated, opposed-blade design; 0.108-inch-minimum thick, galvanized-steel or 0.125-inch-minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.

1. Secure blades to 1/2-inch-diameter, zinc-plated axles using zinc-plated hardware, with nylon 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.
3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x lbf; when tested according to AMCA 500D.

2.17 CONTROL CABLE

- A. Electronic and fiber-optic cables for control wiring are specified in Section 271500 "Communications Horizontal Cabling."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that conditioned power supply is available to control units and operator workstation.
- B. Verify that pneumatic piping and duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

3.2 INSTALLATION

- A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- B. Connect and configure equipment and software to achieve sequence of operation specified.
- C. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor.
 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- D. Install guards on thermostats in the following locations:
 1. Entrances.
 2. Public areas.
 3. Where indicated.
- E. Install automatic dampers according to Section 233300 "Air Duct Accessories."
- F. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

- G. Install labels and nameplates to identify control components according to Section 230553 "Identification for HVAC Piping and Equipment."
- H. Install hydronic instrument wells, valves, and other accessories according to Section 232113 "Hydronic Piping."
- I. Install duct volume-control dampers according to Section 233113 "Metal Ducts".
- J. Install electronic and fiber-optic cables according to Section 271500 "Communications Horizontal Cabling."

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Section 260533 "Raceways and Boxes for Electrical Systems."
- B. Install building wire and cable according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Install signal and communication cable according to Section 271500 "Communications Horizontal Cabling."
 - 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. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
4. Pressure test control air piping at 30 psig or 1.5 times the operating pressure for 24 hours, with maximum 5-psig loss.
5. Pressure test high-pressure control air piping at 150 psig and low-pressure control air piping at 30 psig for 2 hours, with maximum 1-psig loss.
6. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
7. Test each point through its full operating range to verify that safety and operating control set points are as required.
8. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
9. Test each system for compliance with sequence of operation.
10. 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 air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
11. Check DDC system as follows:
 - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 - c. Verify that spare I/O capacity has been provided.
 - d. Verify that DDC controllers are protected from power supply surges.

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

3.5 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 milliamper meter at 0, 50, and 100 percent output.
 - c. Check digital inputs using jumper wire.
 - d. Check digital outputs using ohmmeter to test for contact making or breaking.
 - e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
 5. Flow:
 - a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
 - b. Manually operate flow switches to verify that they make or break contact.
 6. Pressure:
 - a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
 - b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
 7. Temperature:
 - a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
 - b. Calibrate temperature switches to make or break contacts.
 8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
 9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
 10. Provide diagnostic and test instruments for calibration and adjustment of system.
 11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.
- B. Adjust initial temperature and humidity set points.
- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls.

END OF SECTION 230900

**Orange County John Bridges Community Center
Buildings D and F HVAC Replacement
Y16-713-CC, Addendum No. 5
12/16/15**

| Sheet | Description of Revision |
|--------------|---|
| M-002 | -Added valves and valve boxes to chilled water piping -Added temporary chiller connections to chilled water piping |
| MD-101 | -Revised exhaust grilles, ductwork and fan EF-3 to be removed |
| MD-102 | -Revised Demo Note #4 -Added note to Mechanical room 107 return duct -Revised notes for Mechanical 116 and 131 return duct smoke detector |
| M-101 | -General Note 5 added -Added areas with hard ceilings -added 3 notes for chilled water pipe routing -added valves in storage room and in mechanical rooms - added new duct smoke detector to AHU-D-1 return duct -Revised Roof curb to be capped and sealed and exhaust grille locations to be patched and painted to match existing ceiling |
| M-102 | -Revised General note #4 -Relocated duct smoke detectors in Mechanical rooms 107 and 123 - Changed "Existing" to "New" in four duct smoke detector notes |
| M-201 | -Section D note, changed "Reuse existing" to "and new duct" |
| M-301 | -Added temporary chiller connections to CHWS&R on the Chiller Water System schematic (1) -Added valves and blind flanges to chilled water distribution piping schematic (5) |
| M-402 | -Added Detail 4 |
| E-002 | -Added Keyed Notes 3 and 4 -Added "(ETR)" to one-line diagram call outs |
| 23 09 00 | -Page 1, added requirement of BAS system capability to be expanded to serve entire campus including building A, B and C in the future. -Page 5, 2.2.A changed Manufacturers list to Basis of Design: Johnson Controls Inc. Metasys or approved equal. |

CONSULTANT:

CLIENT:

PROJECT NAME:

Orange County John Bridges Community Center Buildings D & F HVAC Replacement

445 W 13th Street Apopka, FL 32703

100045176

| No. | Date | Description |
|-----|------------|----------------|
| 1 | 12/15/2015 | ADDENDUM NO. 5 |

ISSUE LOG

PROFESSIONAL SEALS:

SHEET TITLE:

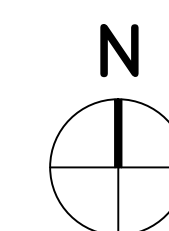
CHILLED WATER PIPING SITE PLAN

SHEET INFORMATION:

| | |
|--------------------------|-------------------------------|
| JOB No. 100045178 | Date Issued: NOVEMBER 5, 2015 |
| Designed By: RJB | Sheet Number: |
| Checked By: DLH | M-002 |
| QC Review: T.J.F. | |
| Phase: | |



A CHILLED WATER PIPING SITE PLAN
SCALE: 3/32" = 1'-0"



CONSULTANT:

CLIENT:

PROJECT NAME:

**Orange County John Bridges Community Center
Buildings D & F HVAC Replacement**
445 W 13th Street Apopka, FL 32703
100045176

| No. | Date | Description |
|-----|------------|----------------|
| 1 | 12/15/2015 | ADDENDUM NO. 5 |
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ISSUE LOG
PROFESSIONAL SEALS:

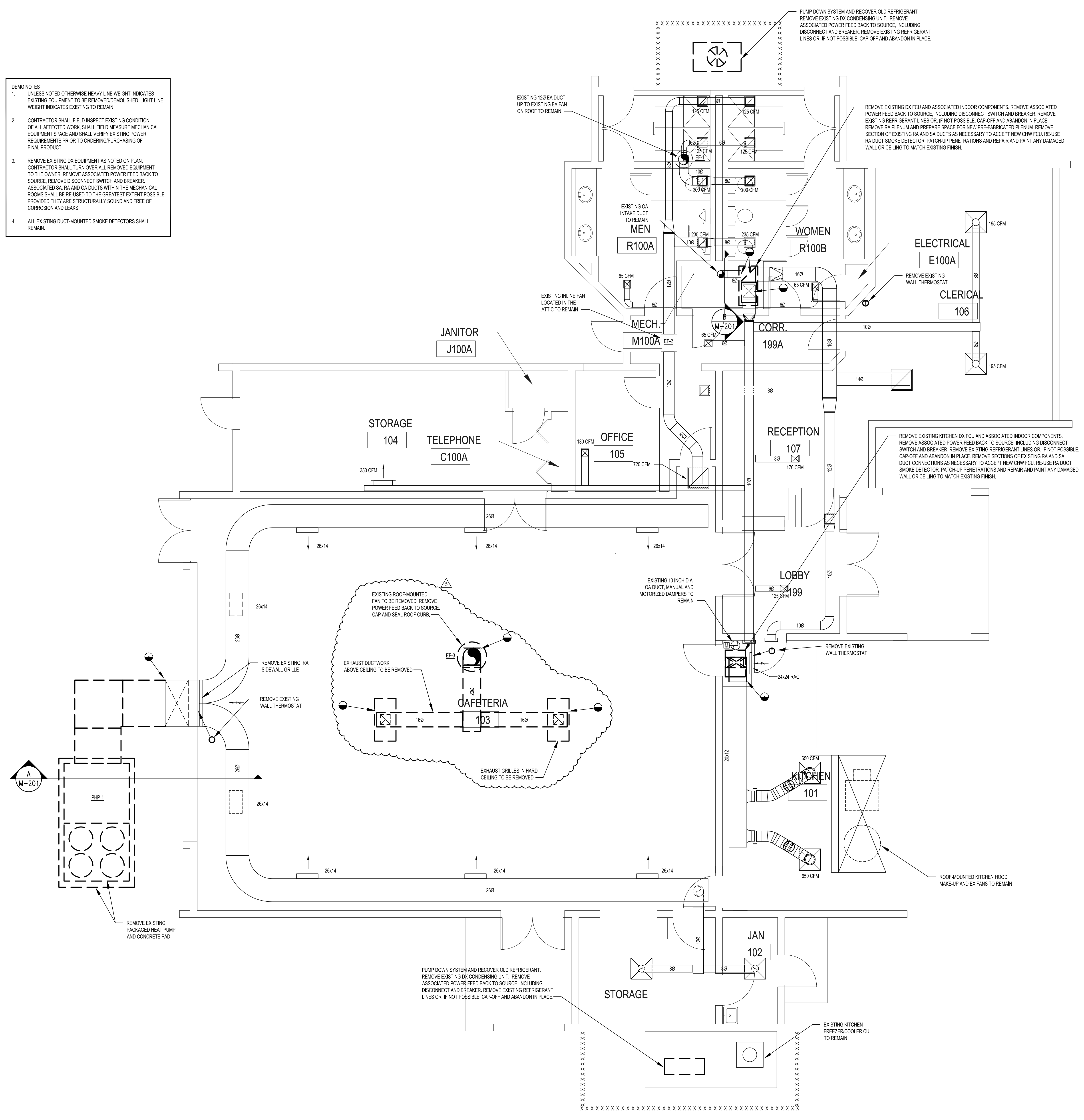
SHEET TITLE:

BLDG D HVAC DEMO PLAN

SHEET INFORMATION:

| | |
|--------------------------|-------------------------------|
| JOB No. 100045178 | Date Issued: NOVEMBER 5, 2015 |
| Designed By: RJB | Sheet Number: |
| Checked By: DLH | MD-101 |
| OC Review: T,JF | |
| Phase: | |

- DEMO NOTES
- UNLESS NOTED OTHERWISE HEAVY LINE WEIGHT INDICATES EXISTING EQUIPMENT TO BE REMOVED/DEMOLISHED. LIGHT LINE WEIGHT INDICATES EXISTING TO REMAIN.
 - CONTRACTOR SHALL FIELD INSPECT EXISTING CONDITION OF ALL AFFECTED WORK. SHALL FIELD MEASURE MECHANICAL EQUIPMENT SPACE AND SHALL VERIFY EXISTING POWER REQUIREMENTS PRIOR TO ORDERING/PURCHASING OF FINAL PRODUCT.
 - REMOVE EXISTING DX EQUIPMENT AS NOTED ON PLAN. CONTRACTOR SHALL TURN OVER ALL REMOVED EQUIPMENT TO THE OWNER. REMOVE ASSOCIATED POWER FEED BACK TO SOURCE. REMOVE DISCONNECT SWITCH AND BREAKER. ASSOCIATED SA, RA AND OA DUCTS WITHIN THE MECHANICAL ROOMS SHALL BE RE-USED TO THE GREATEST EXTENT POSSIBLE PROVIDED THEY ARE STRUCTURALLY SOUND AND FREE OF CORROSION AND LEAKS.
 - ALL EXISTING DUCT-MOUNTED SMOKE DETECTORS SHALL REMAIN.



A BLDG D HVAC DEMO PLAN
SCALE: 1/4" = 1'-0"
N

CONSULTANT:

CLIENT:

PROJECT NAME:

Orange County John Bridges Community Center Buildings D & F HVAC Replacement

445 W 13th Street Apopka, FL 32703

100045176

| No. | Date | Description |
|-----|------------|----------------|
| 1 | 12/15/2015 | ADDENDUM NO. 5 |

ISSUE LOG

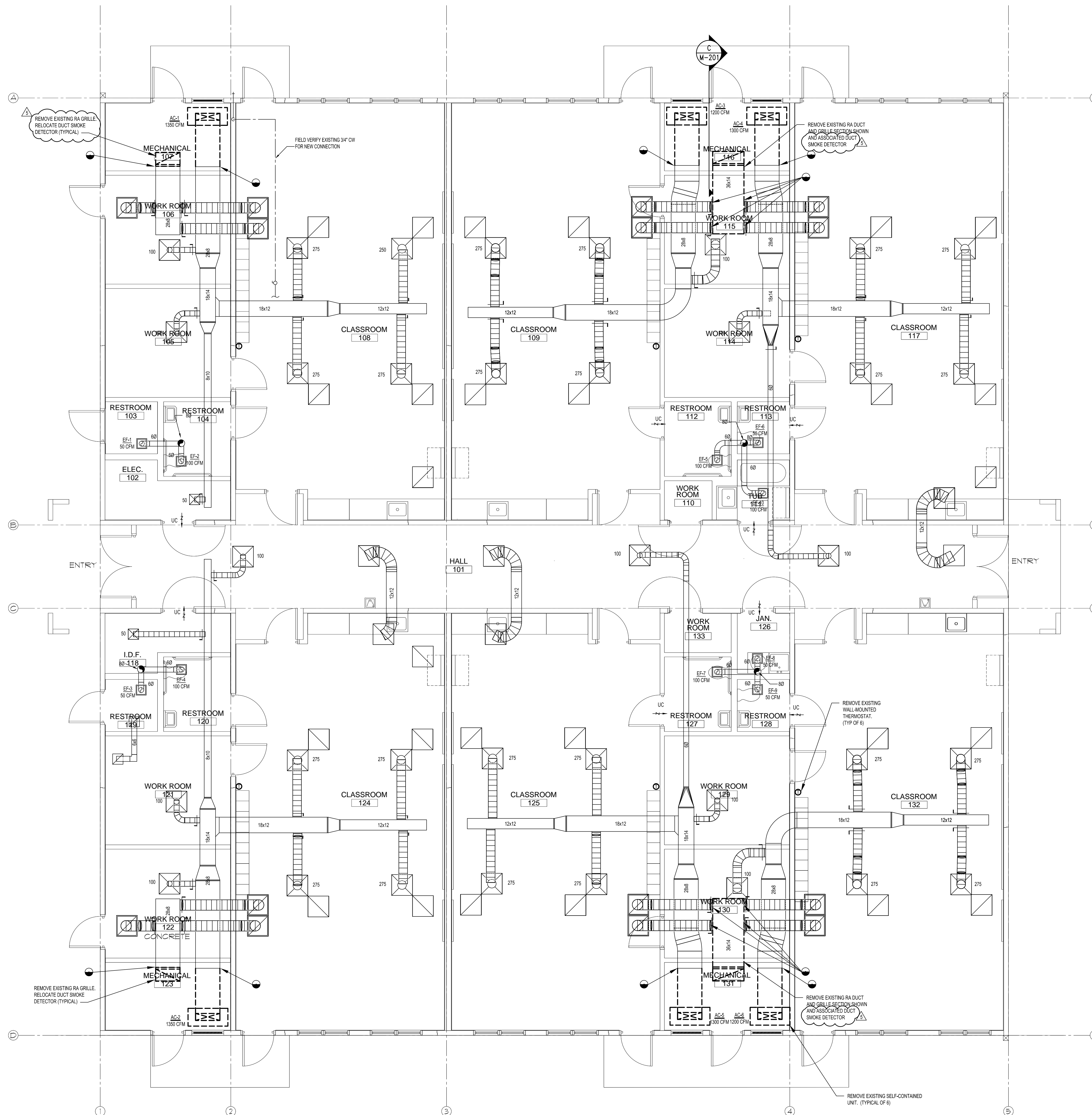
PROFESSIONAL SEALS:

SHEET TITLE:

BLDG F HVAC DEMO PLAN

| SHEET INFORMATION: | |
|--------------------------|-------------------------------|
| JOB No. 100045176 | Date Issued: NOVEMBER 5, 2015 |
| Designed By: RJB | Sheet Number: |
| Checked By: DLH | |
| OC Reviewer: T.J.F. | MD-102 |
| Phase: | |

- DEMO NOTES**
- UNLESS NOTED OTHERWISE HEAVY LINE WEIGHT INDICATES EXISTING EQUIPMENT TO BE REMOVED/DISMISHED. LIGHT LINE WEIGHT INDICATES EXISTING TO REMAIN.
 - CONTRACTOR SHALL FIELD INSPECT EXISTING CONDITION OF ALL AFFECTED WORK. SHALL FIELD MEASURE MECHANICAL EQUIPMENT SPACE AND SHALL VERIFY EXISTING POWER REQUIREMENTS PRIOR TO ORDERING/PURCHASING OF FINAL PRODUCT.
 - REMOVE EXISTING DX EQUIPMENT AS NOTED ON PLAN. CONTRACTOR SHALL TURN OVER ALL REMOVED EQUIPMENT TO THE OWNER. REMOVE ASSOCIATED POWER FEED BACK TO SOURCE, INCLUDING DISCONNECT SWITCH AND BREAKER. ASSOCIATED SA DUCTS WITHIN THE MECHANICAL ROOMS SHALL BE RE-USED TO THE GREATEST EXTENT POSSIBLE PROVIDED THEY ARE STRUCTURALLY SOUND AND FREE OF CORROSION AND LEAKS.
 - TWO EXISTING DUCT-MOUNTED SMOKE DETECTORS FOR AC-1 AND AC-2 SHALL REMAIN.



BLDG F HVAC DEMO PLAN
SCALE: 1/4" = 1'-0"

ATKINS

482 SOUTH KELLER ROAD
ORLANDO, FL 32810
PHONE: 407.647.7275 FAX: 407.740.8958

CONSULTANT:

CLIENT:

PROJECT NAME:

Orange County John Bridges Community Center Buildings D & F HVAC Replacement

445 W 13th Street Apopka, FL 32703
100045176

| No. | Date | Description |
|-----|------------|----------------|
| 1 | 12/15/2015 | ADDENDUM NO. 5 |

ISSUE LOG
PROFESSIONAL SEALS:

SHEET TITLE:

BLDG D NEW WORK HVAC PLAN

| SHEET INFORMATION: | | |
|--------------------|-----------|-------------------------------|
| JOB No. | 100045178 | Date Issued: NOVEMBER 5, 2015 |
| Designed By: | RJB | Sheet Number: |
| Checked By: | DLH | |
| OC Review: | TJF | |
| Phase: | | |

- GENERAL NOTES**
- CONTRACTOR SHALL REPAIR, PATCH AND OR REPLACE DUCTS AND INSULATION TO PROVIDE A LEAK FREE AND THERMALLY PROTECTED AIR-DISTRIBUTION SYSTEM.
 - THE EXISTING AIR DISTRIBUTION SYSTEM SHALL BE PROFESSIONALLY CLEANED. THIS INCLUDES ALL DUCTWORK, REGISTERS AND GRILLES. (REFER TO SPECIFICATIONS)
 - TEST AND BALANCE NEW SYSTEMS PER SPECIFICATIONS. AIR HANDLING UNIT SHALL BE BALANCED TO NEW AIRFLOWS SHOWN ON PLANS.
 - CONNECT NEW UNITS TO EXISTING SA, RA AND OA DUCTS. EXISTING DUCT SMOKE DETECTORS TO REMAIN. PROVIDE NEW POWER FEED BACK TO SOURCE AND PROVIDE NEW DISCONNECT AND BREAKER. PROVIDE NEW CONDENSATE LINE AND NEW CHILLED WATER PIPING. BALANCE SYSTEM TO AIRFLOWS INDICATED ON PLANS.
 - CHILLED WATER PIPING SHALL BE ROUTED ABOVE HARD CEILINGS IN ALL PUBLIC SPACES INCLUDING CORRIDORS, OFFICE, RECEPTION AND LOBBY. CUT CEILINGS FOR INSTALLATION OF NEW PIPING. PATCH AND REPAIR WITH NEW GYPSUM BOARD MATCHING EXISTING GYP BOARD THICKNESS AND TYPE. PAINT ENTIRE CEILING OF SPACES EFFECTED TO MATCH EXISTING.

1-1/2" CHWSR TO CH1
SEE SHEET M-022 FOR
CONTINUATION

2" CHWSR TO CH1
SEE SHEET M-022 FOR
CONTINUATION

PROVIDE NEW 6 FT CHAIN LINK
FENCE AROUND MECHANICAL
YARD AND PROVIDE A ROCK
OR STONE BED AROUND THE
CONCRETE PAD

PROVIDE NEW CONCRETE PAD
6 INCH HIGH TO SUIT THE
NEW UNITS FOOT-PRINT

ROUTE TRAPPED CONDENSATE
DRAIN FULL-SIZE TO NEW DRY-WELL
SEE DETAIL ON SHEET M-402

NEW WALL-MOUNTED TEMPERATURE
AND HUMIDITY SENSORS

PROVIDE NEW RA DUCT
CONNECTION TO EXISTING
RA DUCT AND PROVIDE
NEW RA DIFFUSER

BALANCE AHU-D-1
DIFFUSERS TO
NEW AIRFLOW
(TYP OF 10)

EXTEND EXISTING STRAIGHT TAP
AS NECESSARY TO FIT NEW MANUAL
BALANCING DAMPER. PROVIDE NEW
12x10 SIDE-WALL GRILLE. BALANCE NEW
GRILLE TO 340 CFM. GRILLES BASIS OF
DESIGN IS TITUS 300RS. FINISH TO MATCH
EXISTING EXPOSED DUCTWORK. (TYPICAL
OF 8 IN THE CAFETERIA)

ROUTE NEW TRAPPED
CONDENSATE DRAIN TO
NEW CW PUMP AND
CONNECT TO EXISTING
CW DRAIN LINE

CONNECT EXISTING 10 INCH DIA
OA INTAKE DUCT AND 24x24 RA
PLENUM BLANK-OFF (UNUSED
PORTIONS OF RA GRILLE TO
PROVIDE AN AIRTIGHT SEAL.

NEW WALL TEMPERATURE
SENSOR

PROVIDE NEW SA DUCT
CONNECTION TO
EXISTING SA DUCT

ROUTE NEW TRAPPED
CONDENSATE DRAIN TO
NEW CW PUMP AND
CONNECT TO EXISTING
CW DRAIN LINE

CHILLED WATER PIPING
SHALL BE ROUTED ABOVE
HARD CEILINGS IN PUBLIC
SPACES

EXISTING ELECTRICAL PANEL
DO NOT ROUTE PIPING OVER
ELECTRICAL EQUIPMENT

CHILLED WATER PIPING
MAY BE ROUTED EXPOSED
BELOW HARD CEILING
IN STORAGE ROOM AND
JANITOR CLOSET

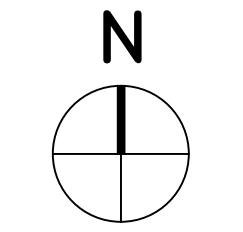
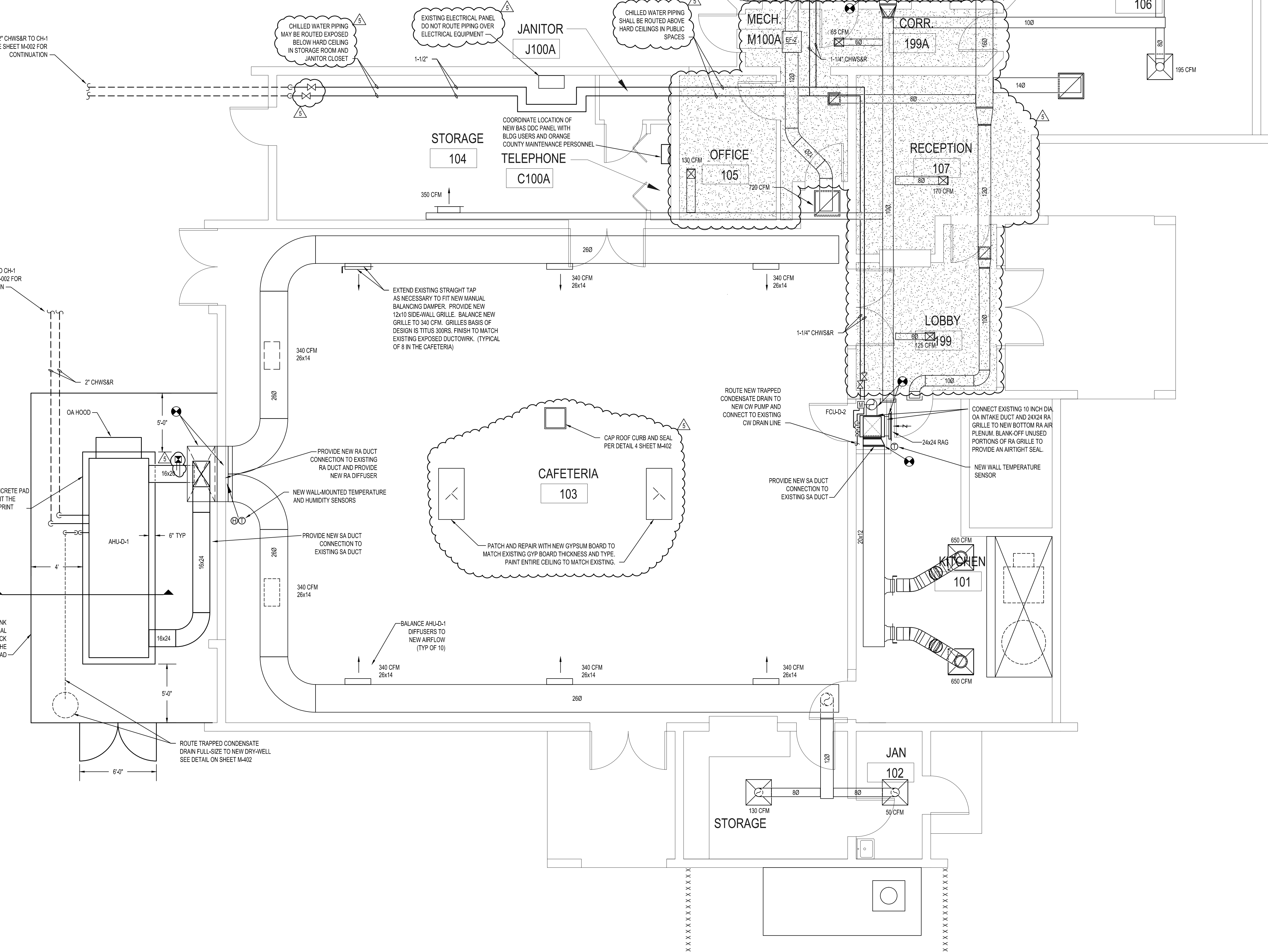
COORDINATE LOCATION OF
NEW BAS DDC PANEL WITH
BLDG USERS AND ORANGE
COUNTY MAINTENANCE PERSONNEL

1-1/2" CHWSR

PROVIDE OA DUCT
WITH MANUAL AIRFLOW
BALANCING DAMPER

ROUTE NEW TRAPPED
CONDENSATE DRAIN TO
NEW CW PUMP AND
CONNECT TO EXISTING
CW DRAIN LINE

NEW WALL TEMPERATURE
SENSOR



CONSULTANT:

CLIENT:

PROJECT NAME:

Orange County John Bridges Community Center Buildings D & F HVAC Replacement

445 W 13th Street Apopka, FL 32703

100045176

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ISSUE LOG

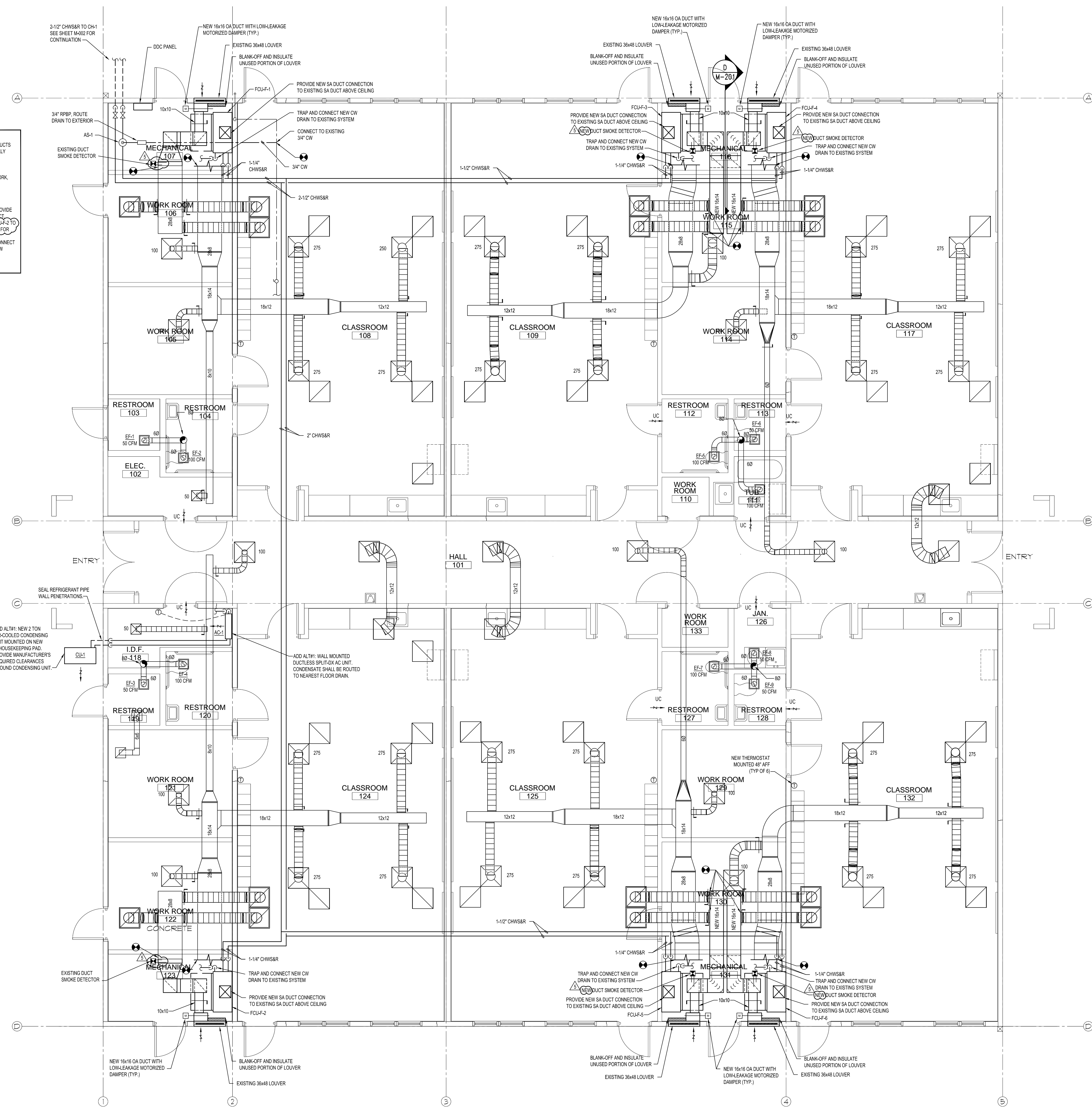
PROFESSIONAL SEALS:

SHEET TITLE:

**BLDG F NEW WORK
HVAC PLAN**

| SHEET INFORMATION: | |
|--------------------------|-------------------------------|
| JOB No. 100045178 | Date Issued: NOVEMBER 5, 2015 |
| Designed By: RJB | Sheet Number: |
| Checked By: DLH | |
| QC Reviewer: T.J.F. | |
| Phase: | M-102 |

- GENERAL NOTES**
- CONTRACTOR SHALL REPAIR, PATCH AND/OR REPLACE DUCTS AND INSULATION TO PROVIDE A LEAK FREE AND THERMALLY PROTECTED AIR-DISTRIBUTION SYSTEM.
 - THE EXISTING AIR DISTRIBUTION SYSTEM SHALL BE PROFESSIONALLY CLEANED. THIS INCLUDES ALL DUCTWORK, REGISTERS AND GRILLES. (REFER TO SPECIFICATIONS)
 - TEST AND BALANCE NEW SYSTEMS PER SPECIFICATIONS.
 - CONNECT NEW UNITS TO EXISTING SA AND RA DUCTS. PROVIDE NEW SA DUCT FROM EXISTING UNITS TO RA DUCT. EXISTING DUCT SMOKE DETECTORS FOR FCU-F-1 AND FCU-F-2 TO BE RELOCATED. PROVIDE NEW DUCT SMOKE DETECTORS FOR FCU-F-3, FCU-F-4, FCU-F-5 AND FCU-F-6. PROVIDE NEW POWER FEED BACK TO SOURCE AND PROVIDE NEW DISCONNECT AND BREAKER. PROVIDE NEW CONDENSATE LINE AND NEW CHILLED WATER PIPING. BALANCE SYSTEM TO AIRFLOWS INDICATED ON PLANS.



BLDG F NEW WORK HVAC PLAN
SCALE: 1/4" = 1'-0"
A Z

CONSULTANT:

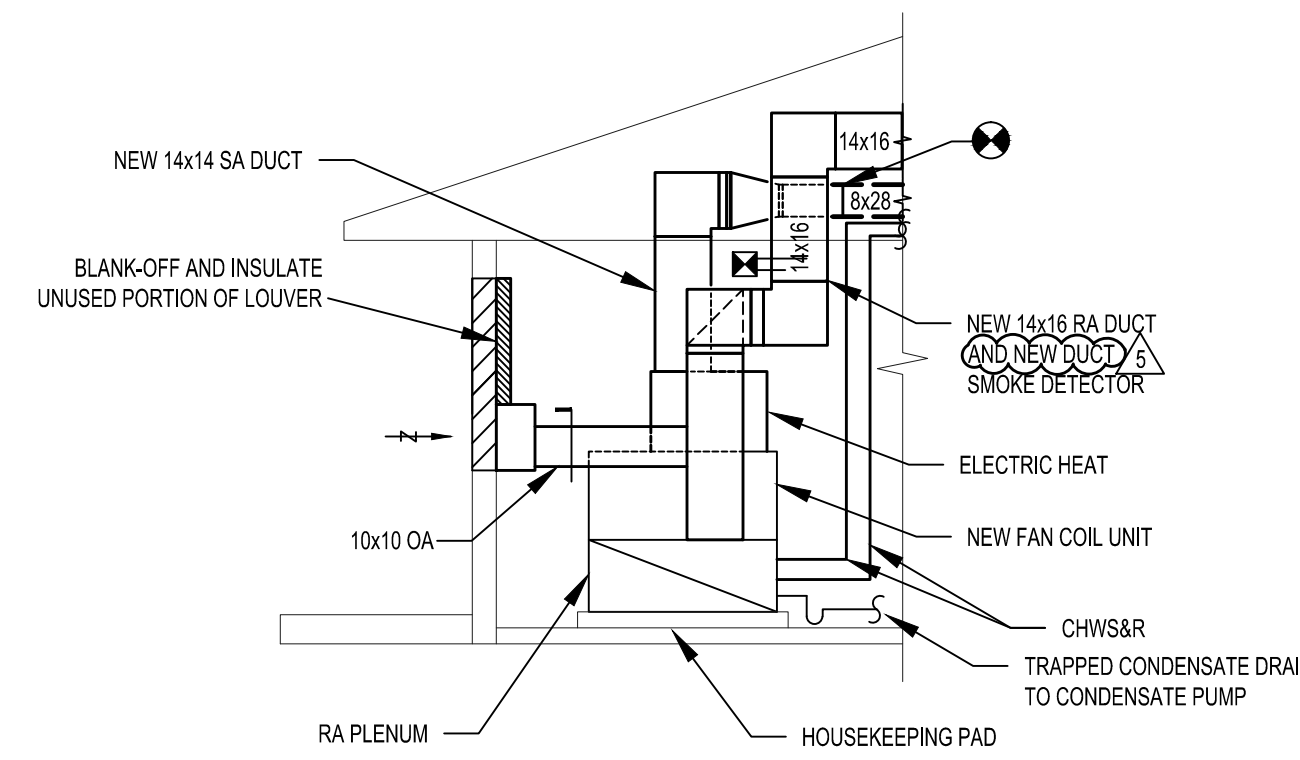
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PROJECT NAME:

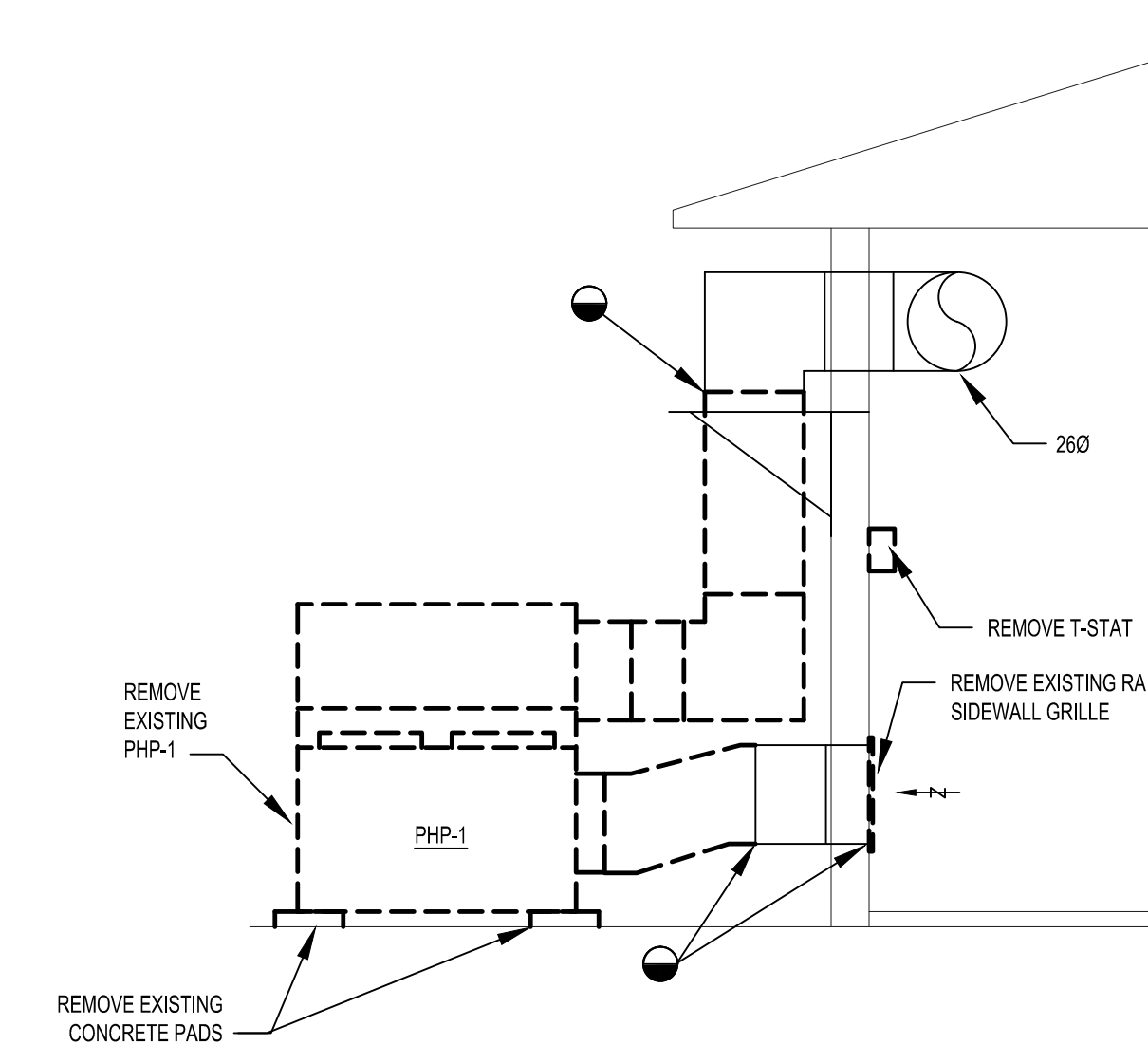
Orange County John Bridges Community Center Buildings D & F HVAC Replacement

445 W 13th Street Apopka, FL 32703

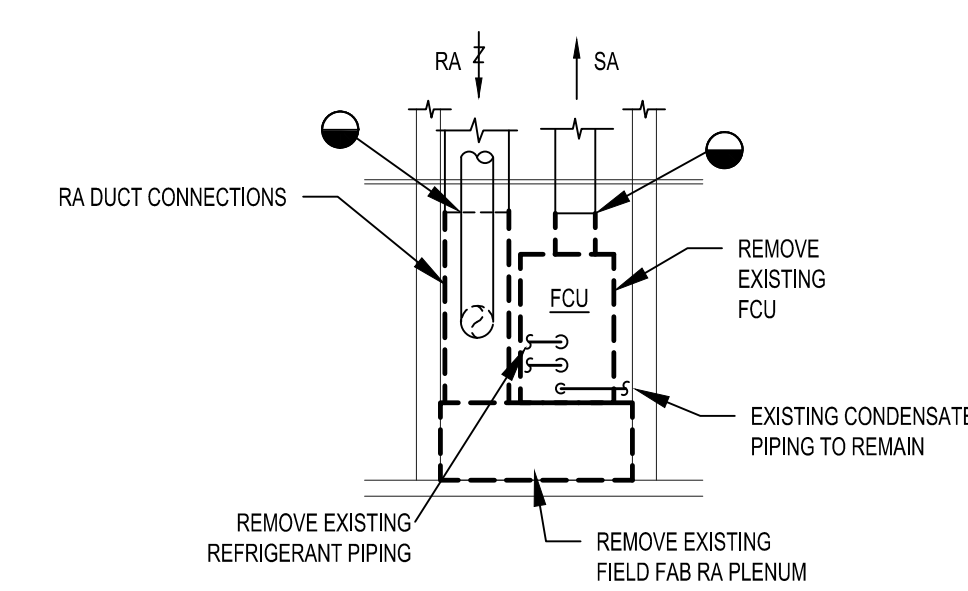
100045176



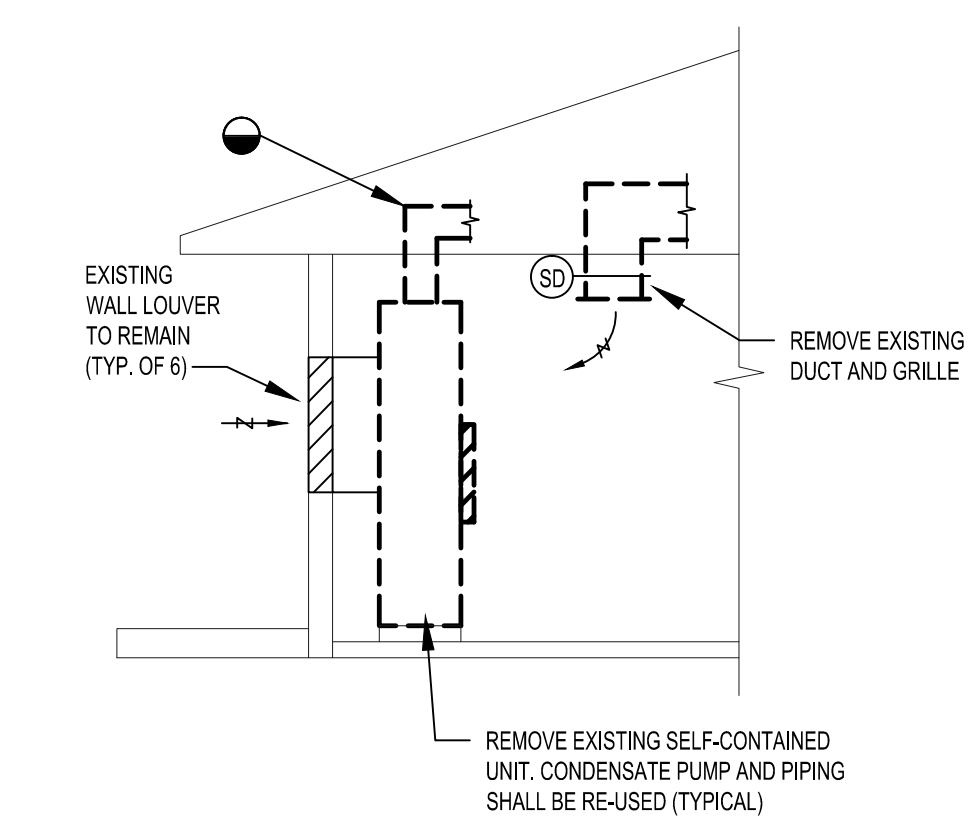
D BLDG F TYPICAL MECH. RM. NEW SECTION
SCALE: 1/4" = 1'-0"



A BLDG D - PHP-1 DEMO SECTION
SCALE: 1/4" = 1'-0"



B BLDG D MECH. RM. M100A DEMO SECTION
SCALE: 1/4" = 1'-0"



C BLDG F TYPICAL MECH. RM. DEMO SECTION
SCALE: 1/4" = 1'-0"

| No. | Date | Description |
|-----|------------|----------------|
| △ | 12/15/2015 | ADDENDUM NO. 5 |
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ISSUE LOG

PROFESSIONAL SEALS:

SHEET TITLE:

HVAC SECTIONS

SHEET INFORMATION:

| | |
|--------------------------|-------------------------------|
| JOB No. 100045178 | Date Issued: NOVEMBER 5, 2015 |
| Designed By: RJB | Sheet Number: |
| Checked By: DLH | M-201 |
| QC Review: T.J.F. | |
| Phase: | |

Orange County John Bridges Community Center Buildings D & F HVAC Replacement

445 W 13th Street Apopka, FL 32703

100045176

| No. | Date | Description |
|-----|------------|----------------|
| 1 | 12/15/2015 | ADDENDUM NO. 5 |

ISSUE LOG

PROFESSIONAL SEALS:

SHEET TITLE:

HVAC CONTROLS

SHEET INFORMATION:

JOB No. **100045178** Date Issued: NOVEMBER 5, 2015

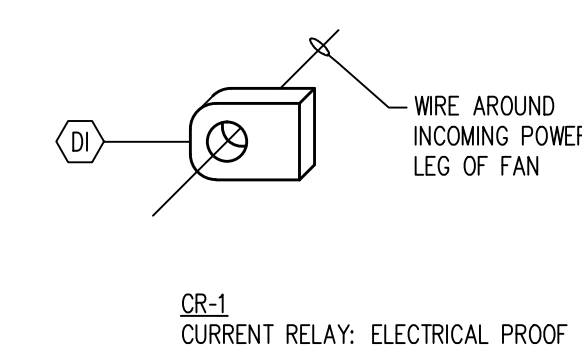
Designed By: RJB Sheet Number:

Checked By: DLH

QC Review: T.J.F.

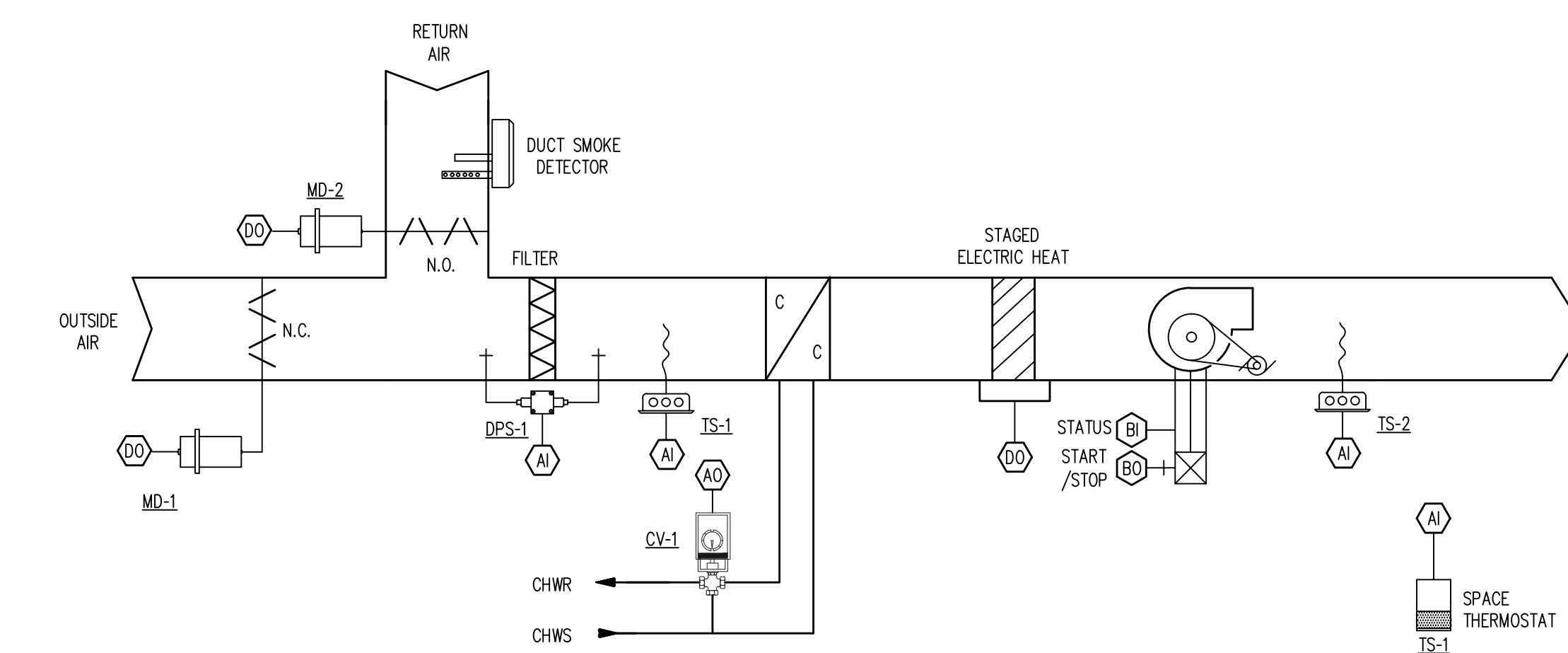
Phase:

M-301



TYPICAL FAN/PUMP MONITORING
No Scale

3



SEQUENCE OF OPERATION

- GENERAL: UNIT IS CONSTANT VOLUME AIR HANDLING UNIT (AHU) PROVIDING COOLING, HEATING, AND VENTILATION FOR THE CAFETERIA AREA AS SHOWN ON THE DRAWINGS. THE UNIT WILL BE CONTROLLED LOCALLY BY TEMPERATURE AND HUMIDITY SENSORS LOCATED IN THE CAFETERIA. BMCS WILL BE CAPABLE OF CONTROL BUT WILL UNDER NORMAL OPERATING CONDITIONS ONLY MONITOR THE AHU OPERATION.
- OPERATION: UPON A CALL TO OPERATE, THE OUTSIDE AIR DAMPER SHALL OPEN TO MINIMUM POSITION, AND THE SUPPLY FAN SHALL START AND RUN CONTINUOUSLY. ALARM BMCS OPERATOR IF THE FAN DOES NOT "PROVE" START OR STOP AFTER CALLED TO OPERATE. WHEN UNIT IS OFF ALL MOTORIZED CONTROL VALVES SHALL BE CLOSED.
- TEMPERATURE CONTROL:
 - COOLING: WHEN THE SPACE TEMPERATURE SETPOINT (ADJ.) CALLS FOR COOLING, THE COOLING COIL CONTROL VALVE SHALL MODULATE TO MAINTAIN SETPOINT.
 - HEATING: WHEN THE SPACE TEMPERATURE SETPOINT (ADJ.) CALLS FOR HEATING, THE ELECTRIC HEATING COIL SHALL BE ENERGIZED TO MAINTAIN SPACE TEMPERATURE.
- DEHUMIDIFICATION: WHEN SPACE HUMIDITY SENSOR DETECTS RH ABOVE 65% (ADJ.), COOLING COIL CONTROL VALVE SHALL MODULATE FULL OPEN TO DEHUMIDIFY & HEATING COIL SHALL MODULATE TO SATISFY SPACE TEMPERATURE SETPOINT.
- FILTER STATUS: DIFFERENTIAL PRESSURE SWITCH SHALL ALARM THE BMCS OPERATOR TO SIGNAL FILTER MAINTENANCE SHOULD THE DIFFERENTIAL PRESSURE ACROSS THE FILTER BANK RISE ABOVE PREDETERMINED SETPOINTS (ADJ.).
- SMOKE SHUTDOWN/FIRE ALARM: WHEN SMOKE RETURN AIR DETECTOR ALARMS OR UPON A SIGNAL FROM THE FIRE ALARM SYSTEM, BMCS OPERATOR SHALL BE NOTIFIED & FIRE ALARM SHALL THEN SHUTDOWN THE SUPPLY FAN.

BMCS POINT SCHEDULE

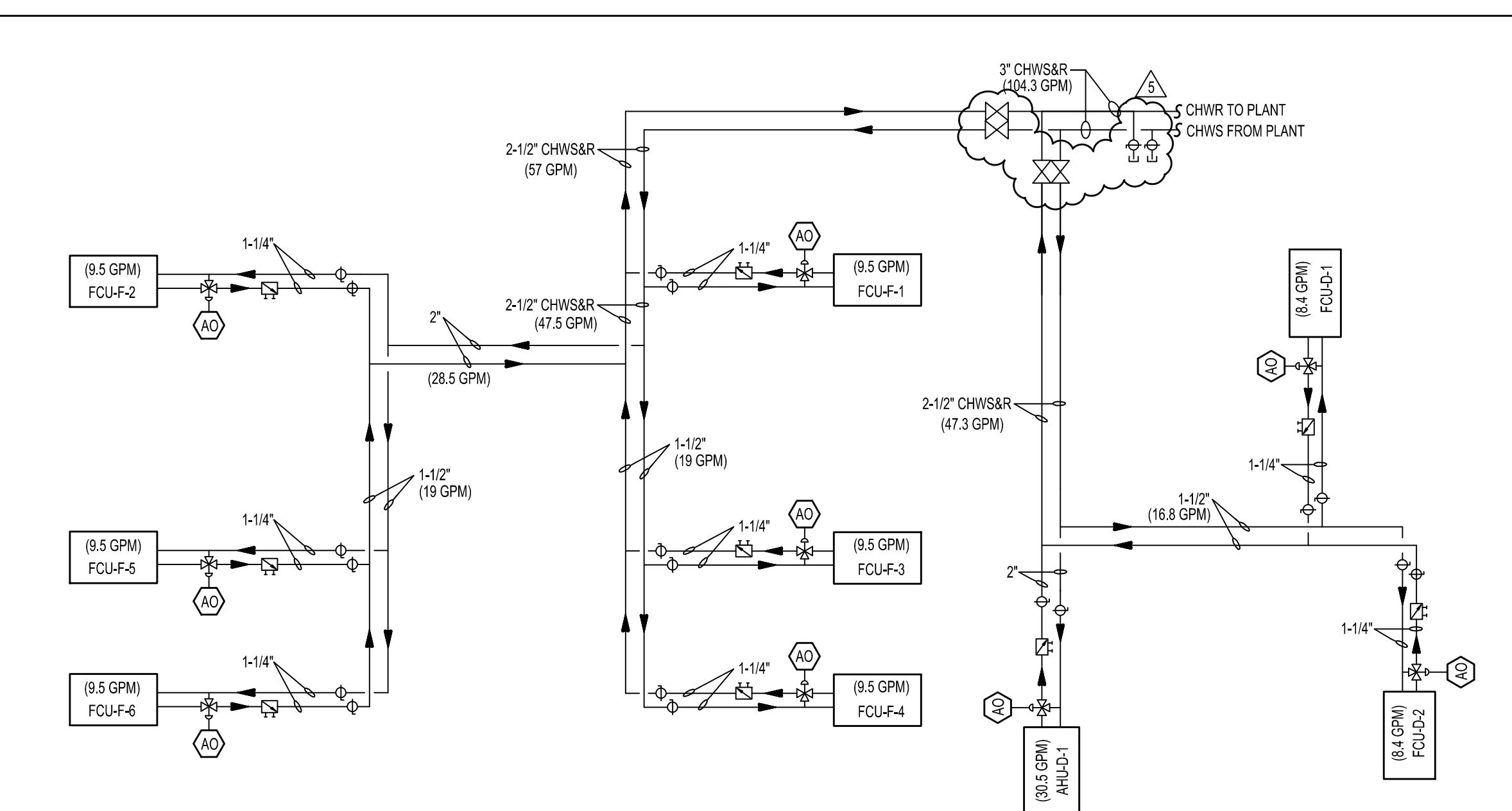
| SYSTEM APPARATUS, OR AREA DESCRIPTION | INPUTS | | | | OUTPUTS | | | | ALARMS | | | | NOTES | |
|---------------------------------------|-------------|--------|--------|--------|---------|--------|--------|--------|--------|--------|--------|--------|-------|--------|
| | TEMPERATURE | ANALOG | BINARY | ANALOG | BINARY | ANALOG | BINARY | ANALOG | BINARY | ANALOG | BINARY | ANALOG | | BINARY |
| SUPPLY FAN (AHU-1) | | | | | | | | | | | | | | 1 |
| SUPPLY AIR | | | | | | | | | | | | | | |
| COOLING COIL CONTROL VALVE (CV-1) | | | | | | | | | | | | | | |
| ELECTRIC HEATING COIL | | | | | | | | | | | | | | |
| FILTERS | | | | | | | | | | | | | | |
| OUTSIDE AIR DAMPER (MD-1) | | | | | | | | | | | | | | 2 |
| DUCT SMOKE DETECTOR (EACH) | | | | | | | | | | | | | | |

NOTES: 1 PROVIDE DISPLAY ALARM IF SUPPLY FAN FAILS TO START
2 PROVIDE DISPLAY ALARM IF OUTDOOR AIR DAMPER FAILS TO OPEN

2

CONSTANT VOLUME AHU (CONSTANT)

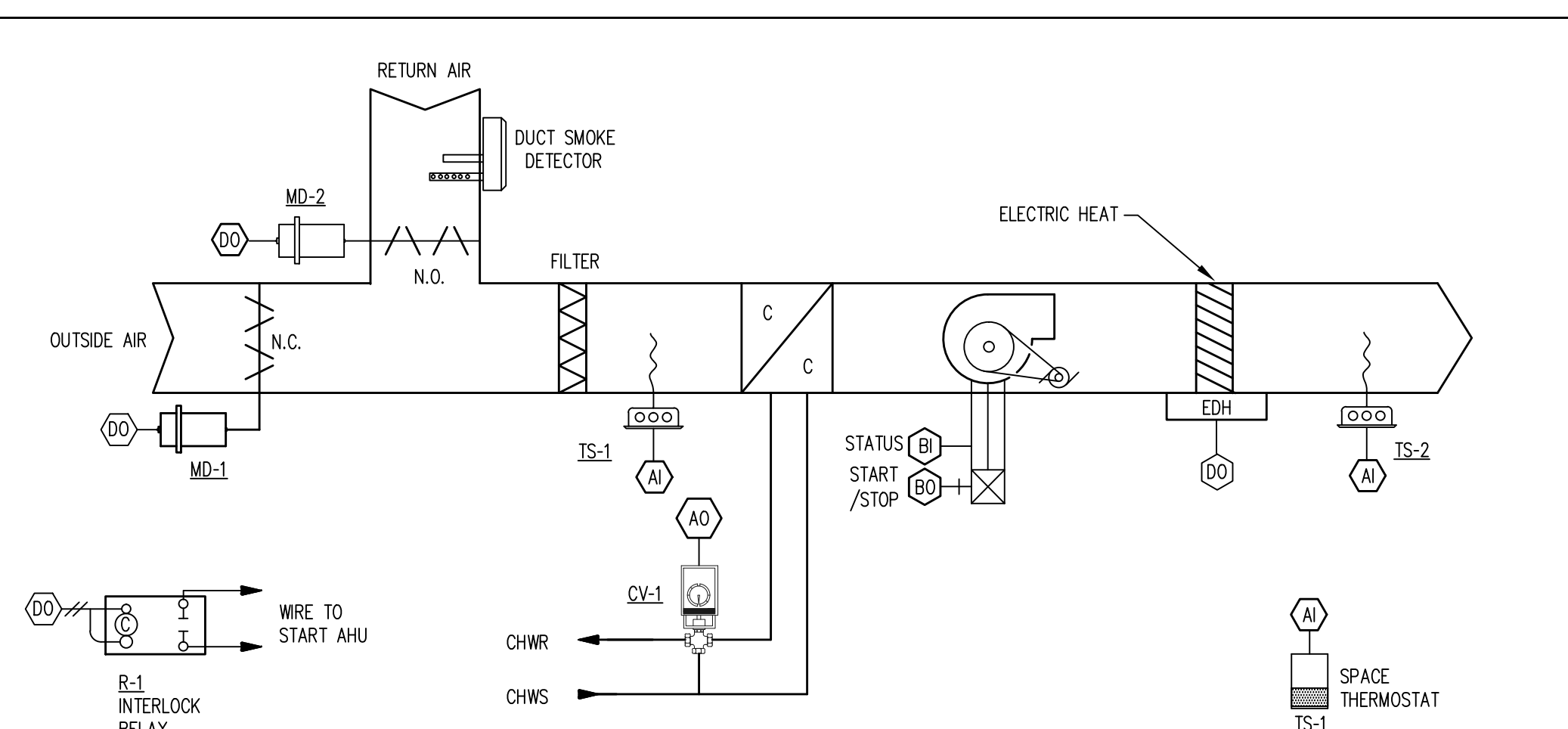
No Scale



CHILLED WATER DISTRIBUTION PIPING SCHEMATIC

No Scale

5



BMCS POINT SCHEDULE

| SYSTEM APPARATUS, OR AREA DESCRIPTION | INPUTS | | | | OUTPUTS | | | | ALARMS | | | | NOTES | |
|---------------------------------------|-------------|--------|--------|--------|---------|--------|--------|--------|--------|--------|--------|--------|-------|--------|
| | TEMPERATURE | ANALOG | BINARY | ANALOG | BINARY | ANALOG | BINARY | ANALOG | BINARY | ANALOG | BINARY | ANALOG | | BINARY |
| SUPPLY FAN (FCU) | | | | | | | | | | | | | | 1 |
| SUPPLY AIR | | | | | | | | | | | | | | |
| COOLING COIL CONTROL VALVE (CV-1) | | | | | | | | | | | | | | |
| HEATING - ELECTRIC | | | | | | | | | | | | | | |
| OUTSIDE AIR DAMPER (MD-1) | | | | | | | | | | | | | | 2 |

NOTES: 1 PROVIDE DISPLAY ALARM IF SUPPLY FAN FAILS TO START
2 PROVIDE DISPLAY ALARM IF OUTDOOR AIR DAMPER FAILS TO OPEN

SEQUENCE OF OPERATION - CONSTANT VOLUME FAN COIL UNIT

GENERAL: THE SYSTEM CONSISTS OF A CONSTANT VOLUME SA FAN, CHW COIL WITH A THREE-WAY MODULATING VALVE, TWO-POSITION OA DAMPER AND ELECTRIC HEAT. THE UNIT IS DDC CONTROLLED UTILIZING ELECTRIC ACTIVATION.

TYPICAL FCU'S SHALL BE STARTED/STOPPED DURING OCCUPIED/UNOCCUPIED PERIODS AND CONTROLLED ON A SEVEN-DAY SCHEDULE AUTOMATICALLY THROUGH THE LOCAL DDC CONTROLLER WHEN THE H-O-A SWITCH IS IN THE "AUTO" POSITION. IF THE H-O-A SWITCH IS SWITCHED TO THE "HAND" POSITION, THE FAN SHALL BE SIGNALLED TO START MANUALLY THROUGH THE BYPASS CONTACTOR.

OCCUPIED MODE: WHEN THE SYSTEM IS SIGNALLED TO START, THE NORMALLY CLOSED OA DAMPER SHALL BE OPENED (CONFIRMED BY END SWITCH). AFTER AN ADJUSTABLE TIME DELAY, THE FAN COIL UNIT FANS SHALL START. THE DDC CONTROLLER SHALL MONITOR THE STATUS OF THE FAN COIL UNIT FANS THROUGH A CURRENT SWITCH AT THE FAN MOTOR.

COOLING: THE DDC CONTROLLER SHALL MONITOR THE SPACE TEMPERATURE VIA A SPACE-MOUNTED TEMPERATURE SENSOR. THE CONTROLLER SHALL MAINTAIN SPACE TEMPERATURE AT COOLING SETPOINT 75° (ADJ.). THE CHW THREE-WAY CONTROL VALVE SHALL MODULATE TO MAINTAIN SPACE TEMPERATURE SETPOINT OF 75° (ADJ.). UPON A FALL IN SPACE TEMPERATURE BELOW 72° (ADJ.), THE CHW VALVE BE FULLY CLOSED TO THE COIL.

HEATING: THE HEATING SYSTEM CONSISTS OF ELECTRIC HEATING. UPON A FALL IN SPACE TEMPERATURE BELOW 72° (ADJ.), THE DDC CONTROLLER SHALL SEND A SIGNAL TO THE CHILLED WATER VALVE TO CLOSE POSITION. WHEN THE SPACE TEMPERATURE HAS DROPPED BELOW 68° (ADJ.) OR WHEN OUTSIDE AIR TEMPERATURE DROPS BELOW 54° (ADJUSTABLE), THE ELECTRIC HEATING COIL SHALL BE ENERGIZED TO MAINTAIN THE HEATING SETPOINT (72° F ADJUSTABLE).

UNOCCUPIED MODE: THE OA DAMPER SHALL BE CLOSED AND THE FCU SHALL BE OFF. UPON A CALL FOR COOLING OR HEATING TO MAINTAIN UNOCCUPIED SPACE TEMPERATURE SETPOINTS, THE FCU SHALL START AND THE CONTROL VALVE SHALL MODULATE ACCORDING TO THE OPERATING MODE REQUIRED TO MAINTAIN SPACE TEMPERATURE SETPOINT. THE OA DAMPER SHALL REMAIN CLOSED.

VERRIDE: WHEN A TIMED OVERRIDE MODE IS ENABLED FROM THE DDC CONTROLLER, THE FCU SHALL BE INDEXED TO THE OCCUPIED MODE FOR AN ADJUSTABLE TIME PERIOD OF 2 HOURS.

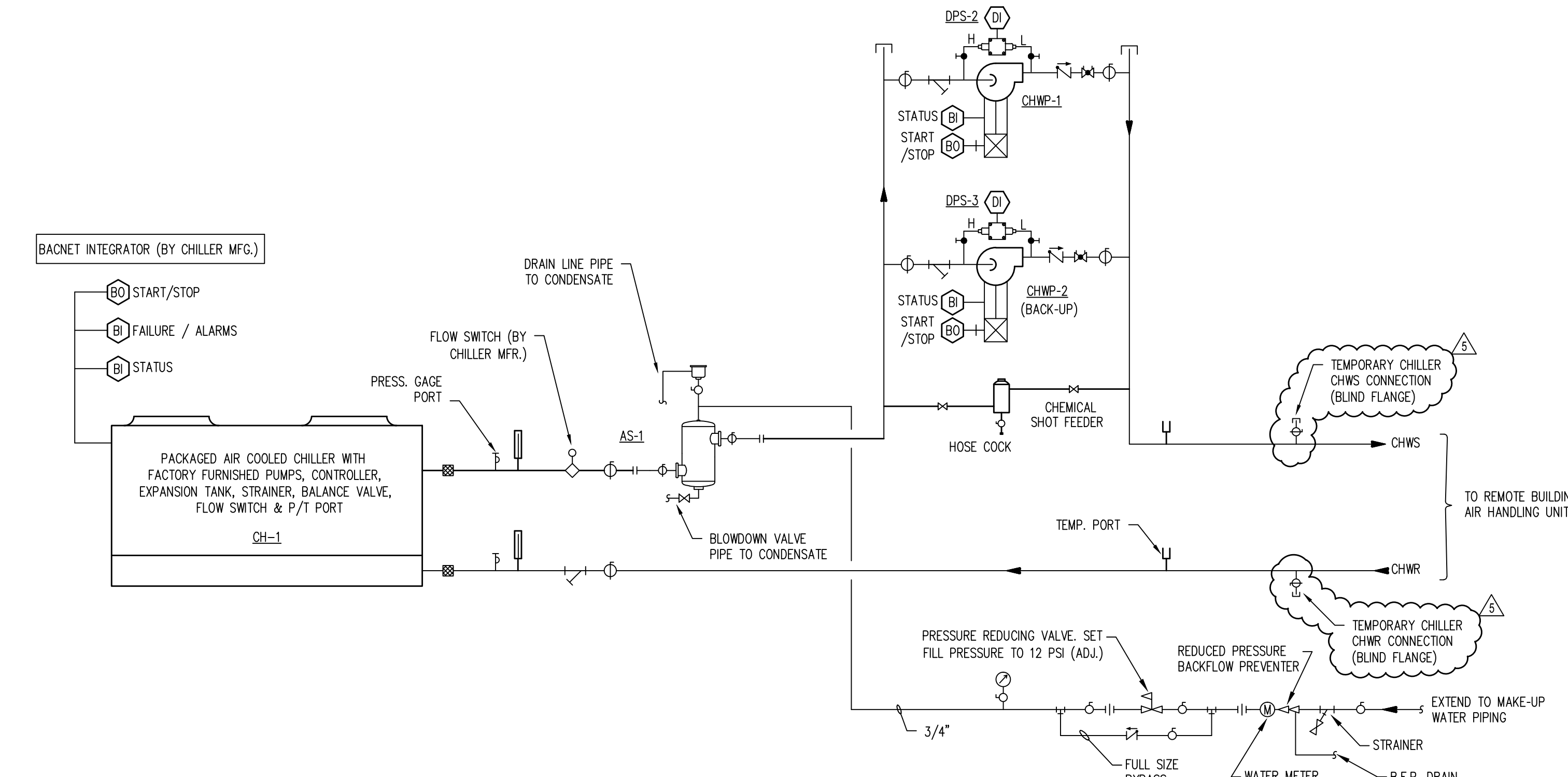
SAFETIES: ACTIVATION OF THE RETURN AIR DUCT SMOKE DETECTOR OR THE BUILDING FIRE ALARM SYSTEM SHALL AUTOMATICALLY SHUT DOWN THE FCU. THESE SAFETIES SHALL BE INTERLOCKED WITH THE FANS WHEN OPERATING THROUGH THE DDC CONTROLLER OR BYPASS CONTACTOR.

DURING WARM-UP OR COOL DOWN PRIOR TO OCCUPANCY, THE OUTSIDE AIR DAMPER WILL REMAIN CLOSED. THE OPTIMUM START ROUTINE WILL PRESTART THE FAN COIL UNIT TO PRE-HEAT OR COOL THE SPACE PRIOR TO OCCUPANCY.

FAN COIL UNITS

No Scale

4



CENTRAL COOLING PLANT SEQUENCE OF OPERATION

CHILLED WATER PLANT GENERAL:

THE CHILLER PLANT SERVING BUILDINGS D & F CONSISTS OF ONE (1) AIR-COOLED SCROLL CHILLER, CH-1, PIPED IN PRIMARY-FLOW CONFIGURATION AND DESIGNED TO PRODUCE CHILLED WATER AT 44° (ADJ.). CHILLED WATER IS DISTRIBUTED TO THE BUILDINGS BY CONSTANT VOLUME PUMPS, CHWP-1 & CHWP-2, ON DUTY AND STAND-BY OPERATION RESPECTIVELY.

SEQUENCE OF OPERATION:

- THE BUILDING AUTOMATION SYSTEM (BAS) SHALL CONTROL THE OPERATION OF THE CHILLER PLANT BASED ON AN OPTIMAL START/STOP PROGRAM OR FROM MANUAL COMMAND FROM THE OPERATOR.
- ON A START COMMAND FROM THE BAS, THE CHILLED WATER SYSTEM SHALL ENABLE THE CHILLER'S CHILLED WATER PUMP AND AFTER FLOW IS PROVEN AT THE CHILLED WATER BARRELS (VIA FLOW SWITCH) THE CHILLER SHALL BE ENABLED TO OPERATE.
- THE PACKAGED CHILLER DDC CONTROLS SHALL THEN MODULATE THE COMPRESSORS TO MAINTAIN 44° (ADJ.) LEAVING CHILLED WATER SUPPLY TEMPERATURE AT THE CHILLER.
- BAS SHALL INTERFACE WITH THE CHILLER AND SHALL BE ABLE TO RESET THE CHILLED WATER SUPPLY TEMPERATURE THROUGH THE BAS AND THE PACKAGED CHILLER CONTROLS.
- IF THE OUTSIDE AIR TEMPERATURE DROPS BELOW 36° (ADJ.) THE CHILLED WATER PUMPS SHALL BE SIGNALLED TO START. THE PUMP SHALL CONTINUE TO OPERATE UNTIL THE OUTSIDE AIR TEMPERATURE REACHES 38° (ADJ.) AT WHICH TIME THE PUMP SHALL SHUT OFF.
- CHILLED WATER PUMPS, CHWP-1 AND CHWP-2, SHALL BE ROTATED FROM DUTY TO STAND-BY ON A WEEKLY BASIS. WHEN CHILLER OPERATION IS DISCONTINUED, THE CHILLER PUMP SHALL CONTINUE TO OPERATE FOR A PERIOD OF ONE MINUTE (ADJ.) TO REMOVE RESIDUAL REFRIGERANT CAPACITY.

ALARMS:

- IF EITHER CHW PUMP FAILS TO START AFTER BEING CALLED TO OPERATE, THE BAS SHALL ALARM THE OPERATOR AND THE DDC CONTROLLER SHALL ENABLE STAND-BY SYSTEM CHW PUMP.
- IF CHWS TEMPERATURE RISES ABOVE PREDETERMINED SETPOINT, BAS SHALL ALARM OPERATOR.
- BMCS SHALL MONITOR GENERAL ALARM FROM PACKAGED CHILLER CONTROLS AND SHALL SIGNAL ALARM TO OPERATOR.

CHILLER PLANT BMCS POINT SCHEDULE

| SYSTEM APPARATUS, OR AREA DESCRIPTION | INPUTS | | | | OUTPUTS | | | | ALARMS | | | | NOTES | |
|---------------------------------------|------------------|--------|--------|--------|---------|--------|--------|--------|--------|--------|--------|--------|-------|--------|
| | TEMPERATURE (°F) | ANALOG | BINARY | ANALOG | BINARY | ANALOG | BINARY | ANALOG | BINARY | ANALOG | BINARY | ANALOG | | BINARY |
| LEAVING CHILLED WATER TEMP. | | | | | | | | | | | | | | 1 |
| RETURNING CHILLED WATER TEMP. | | | | | | | | | | | | | | 1 |
| CHILLER (CH-1) | | | | | | | | | | | | | | 2 |
| CHWP-1 | | | | | | | | | | | | | | 1 |
| CHWP-2 | | | | | | | | | | | | | | 1 |

NOTES:

- AS A MINIMUM, PROVIDE THE ABOVE POINTS OF CONTROL AND/OR MONITORING AT THE BUILDING AUTOMATION SYSTEM. PROVIDE ALL REQUIRED HARDWIRED INTERLOCKS BETWEEN CHILLER AND ASSOCIATED PUMPS, FLOW SWITCHES AND/OR DIFFERENTIAL PRESSURE SWITCHES TO MAINTAIN CHILLER WARRANTY. CHILLER'S CONTRACTOR AND CHILLER MANUFACTURER SHALL COORDINATE REQUIREMENTS.
- PROVIDE GRAPHIC SHOWING INSTANTANEOUS COOLING TONNAGE OUTPUT AND STORE DATA FOR TRENDS LOGGING.

1

CONSULTANT:

CLIENT:

PROJECT NAME:

Orange County John Bridges Community Center Buildings D & F HVAC Replacement

445 W 13th Street Apopka, FL 32703

100045176

| No. | Date | Description |
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| △ | 12/15/2015 | ADDENDUM NO. 5 |
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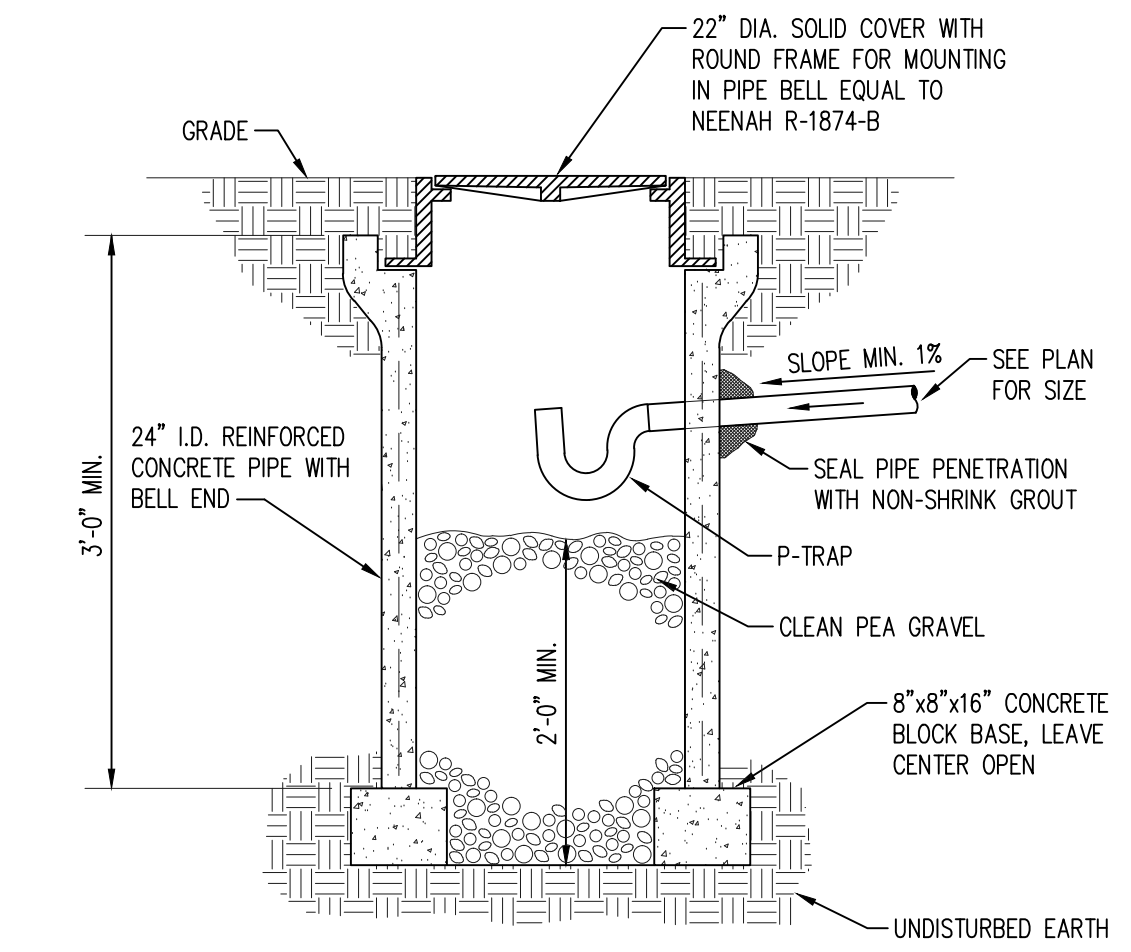
ISSUE LOG

PROFESSIONAL SEALS:

SHEET TITLE:

HVAC DETAILS

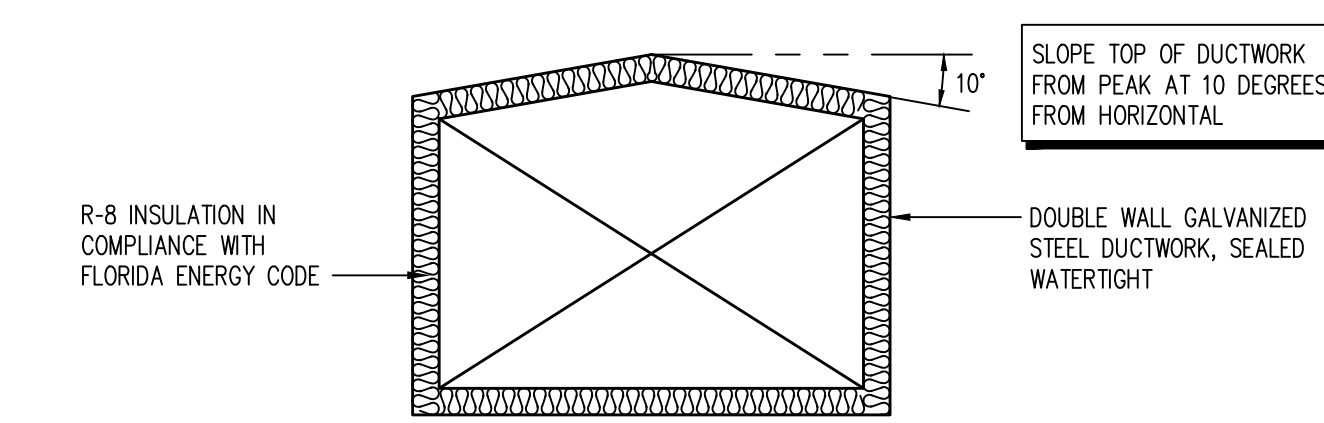
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| JOB No. 100045178 | Date Issued: NOVEMBER 5, 2015 | |
| Designed By: RJB | Sheet Number: | |
| Checked By: DLH | | |
| QC Review: T.J.F. | | |
| Phase: | | |



DRY WELL

No Scale

3

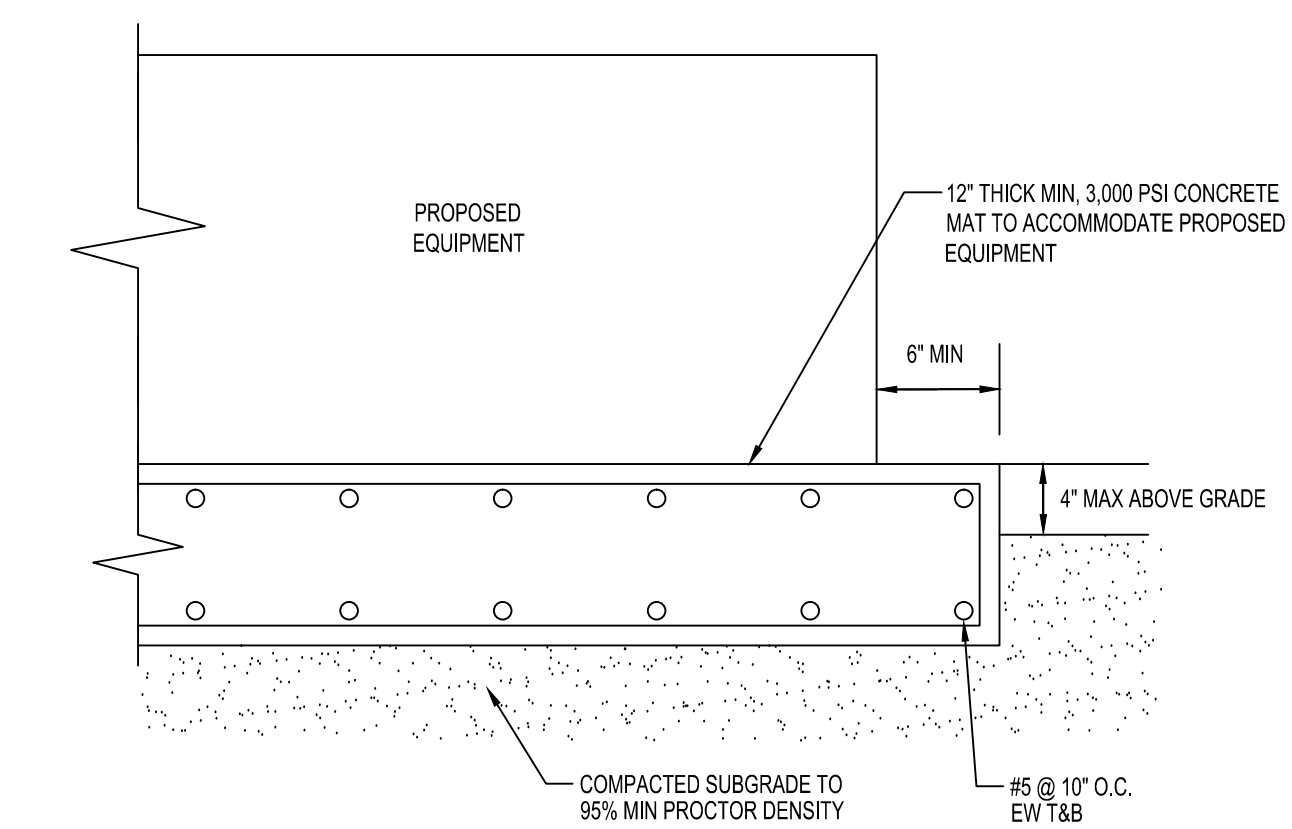


SECTIONAL VIEW THROUGH TYPICAL ROOFTOP DUCTWORK

EXTERIOR DUCTWORK

No Scale

2

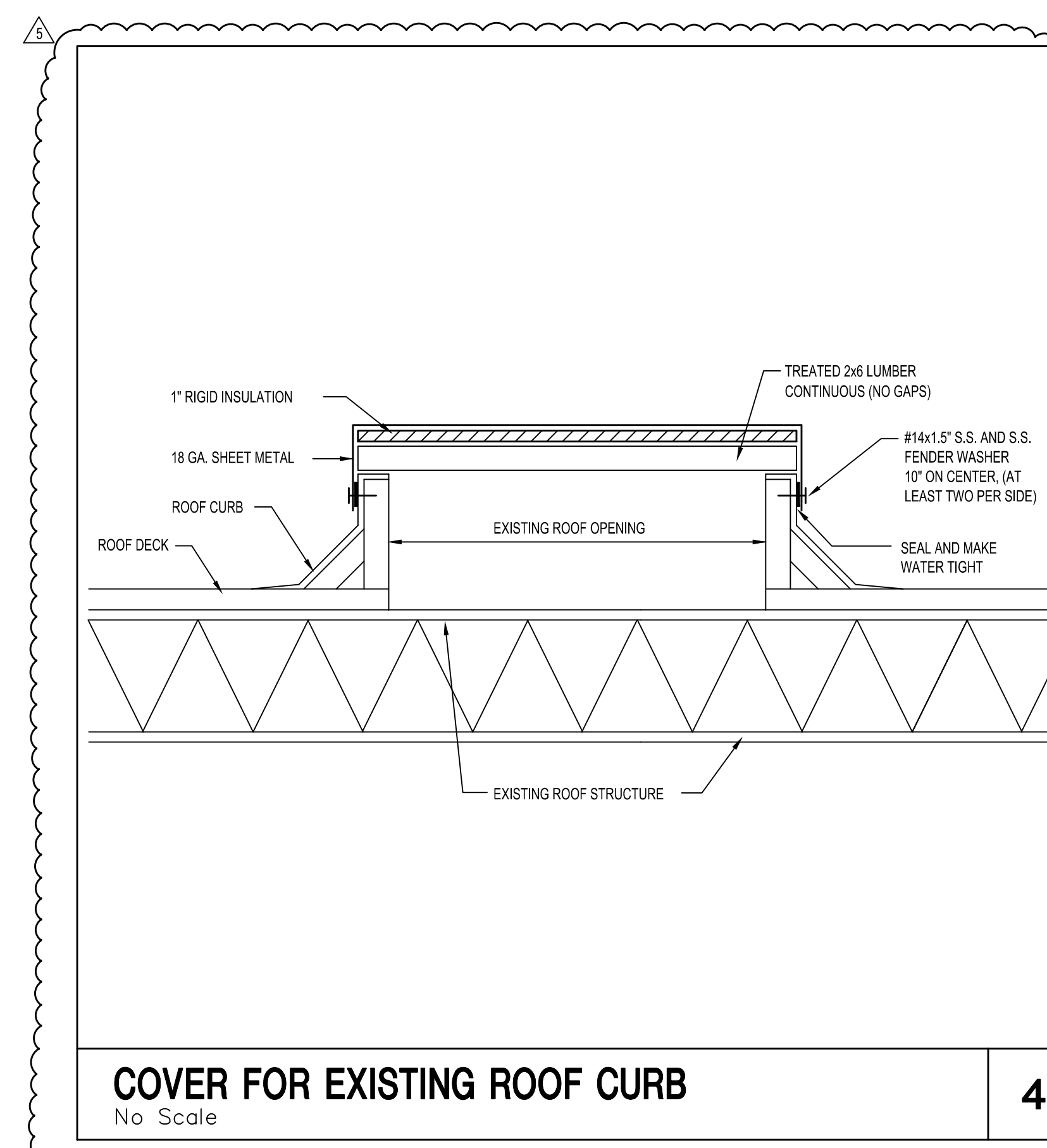


NOTE: ANCHORAGE TO CONCRETE TO BE PROVIDED AND DETAILED BY MTR

CONCRETE PAD DETAIL (AHU-D-1 AND CH-1)

No Scale

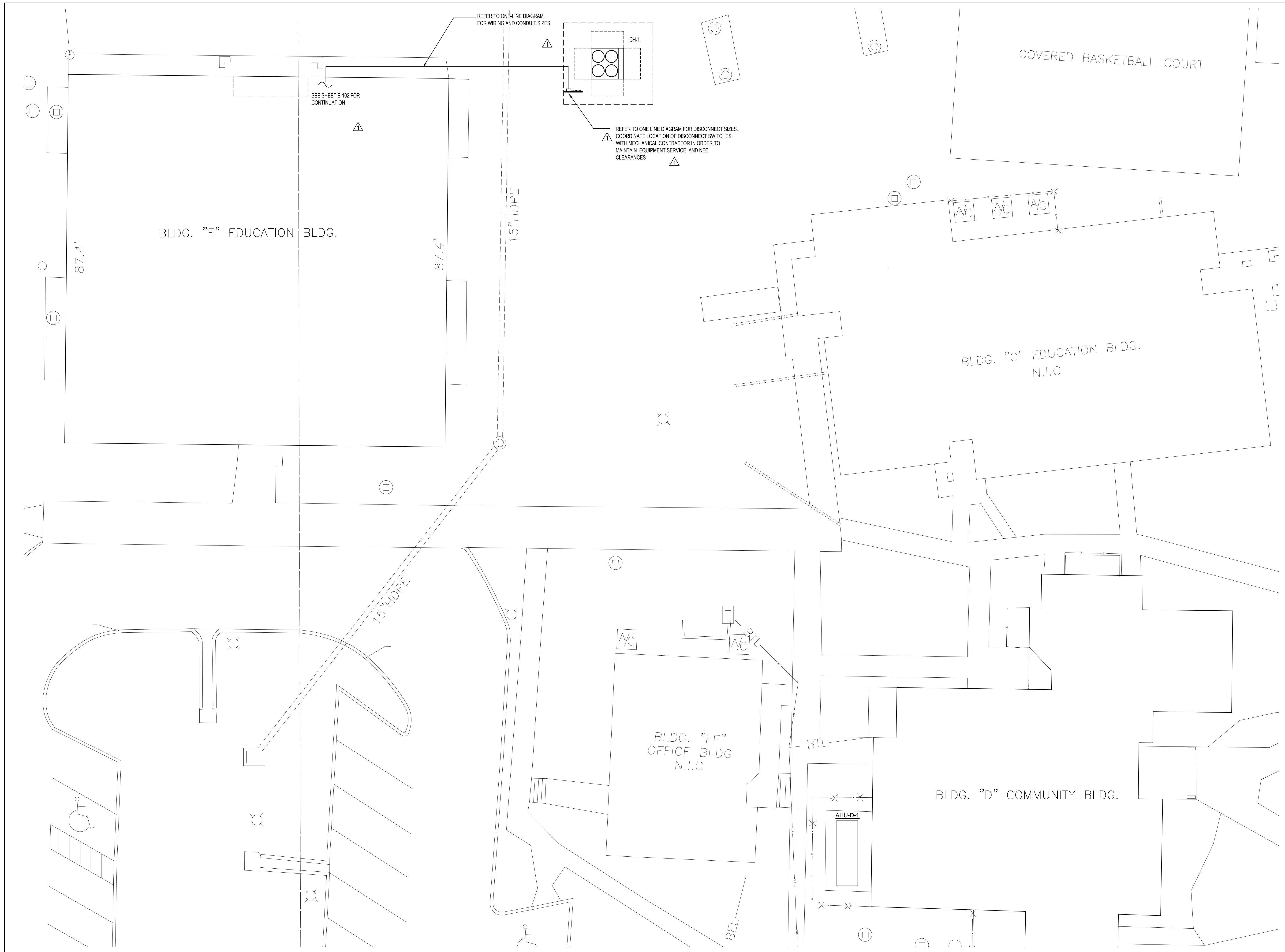
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COVER FOR EXISTING ROOF CURB

No Scale

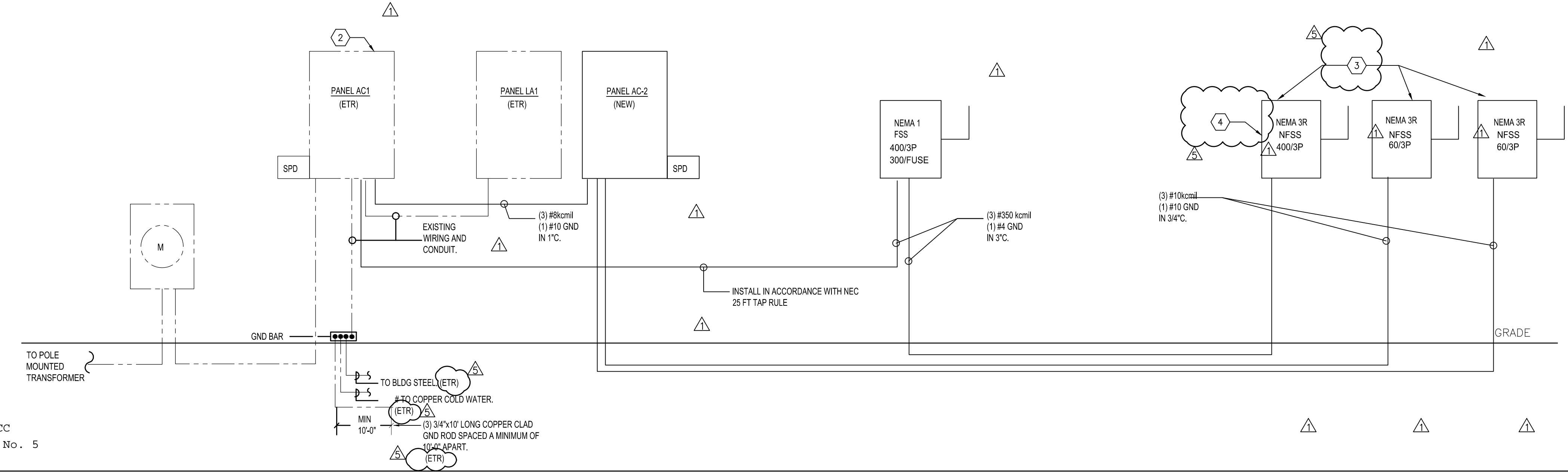
4



- SHEET NOTES:**
- EXISTING EQUIPMENT IS SHOWN FOR INFORMATION PURPOSES ONLY AND SHALL REMAIN AS IS, UNLESS NOTED OTHERWISE.
 - ONE-LINE DRAWINGS ARE BASED ON EXISTING DRAWINGS FROM "PENINSULA ENGINEERING INC." DATED 03/15/2011. CONTRACTOR SHALL FIELD VERIFY EXISTING CONDITIONS AND CONTACT CONTRACTING OFFICER IF DISCREPANCIES ARE FOUND.
- KEYED NOTES:**
- PROVIDE POST AND RACKING SYSTEM FOR CH-1, CHWP-1 AND CHWP-2 DISCONNECTS.
 - THE DESIGN INTENT IS TO PROVIDE FEED THROUGH LUGS ON EXISTING PANEL AC1 BUS AND FEED THE NEW CHILLER DISCONNECT SWITCH USING THE NEC 25 FT TAP RULE. IF IT IS NOT POSSIBLE TO INSTALL NEW LUGS IN EXISTING PANEL AC1 IN ACCORDANCE WITH U.L. RULES AND REGULATIONS, REPLACE PANEL AC1 WITH A NEW UL TYPE SERVICE-ENTRANCE PANELBOARD. TO INCLUDE A 300 AMP CIRCUIT BREAKER FOR THE CHILLER. UNDER THIS OPTION, EXISTING SPD UNIT MAYBE RE-USED, AND THE NEW 400 AMP CHILLER FSS MAY BE DELETED.
 - NFSS FOR NEW CHILLER AND CHILLED WATER PUMPS.
 - MAKE CONNECTION FROM NEW CHILLER TO NFSS IN SUCH A MANNER AS TO FACILITATE FUTURE DISCONNECTION OF CHILLER FOR SERVICE AND CONNECTION OF TEMPORARY PORTABLE CHILLER. CHILLER SERVICE DISCONNECT WILL POWER NEW CHILLER AND FUTURE PORTABLE CHILLER, BUT NOT BOTH SIMULTANEOUSLY.

A EXISTING ELECTRICAL SITE PLAN
SCALE: 3/32" = 1'-0"

PARTIAL EXISTING ONE-LINE BUILDING "F"



CONSULTANT:

CLIENT:

PROJECT NAME:

**Orange County John Bridges Community Center
Buildings D & F HVAC Replacement**
445 W 13th Street Apopka, FL 32703
100045176

| No. | Date | Description |
|-----|----------|----------------|
| 1 | 11/05/15 | ADDENDUM NO. 1 |
| 2 | 12/15/15 | ADDENDUM NO. 5 |

ISSUE LOG
PROFESSIONAL SEALS:

SHEET TITLE:

EXISTING ELECTRICAL SITE PLAN

SHEET INFORMATION:

| | |
|--------------------------|-------------------------------|
| JOB No. 100045178 | Date Issued: NOVEMBER 5, 2015 |
| Designed By: LF | Sheet Number: |
| Checked By: FL | |
| OC Review: GFH | |
| Phase: | E-002 |