NEW YORK CITY DEPARTMENT OF CORRECTION
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April 25, 2017

ADDENDUM #3 to PIN 072201723CPD
Air Conditioning System Replacement at AMKC,
Modular Building Number #1

Dear Prospective Bidder:

Pursuant to 3-02(i)(2) of the Procurement Policy Board (PPB) Rules, the Department of Correction (Department) is issuing Addendum #3 to the solicitation for the services referenced above.

EXTENDED BID DATE

Please be advised that the Bid Opening Date for the above referenced procurement has been extended from:

- **Thursday, April 27, 2017 to Thursday, May 4, 2017**
- **The time (11:00AM) is unchanged**
- **Location: Bulova Corporate Center, Central Office of Procurement 75-20 Astoria Boulevard, Suite 160, East Elmhurst, NY 11370.**

Please be further advised that the Department of Correction is extending the bid due date to provide all prospective bidders sufficient time in preparing their bid price. If you are planning to mail your bid package, please make sure that we receive it on or before the indicated date and time, otherwise your bid will not be accepted.

DESCRIPTION OF CHANGES:

1) The Addendum includes revisions to the contract documents as generally outlined herein. For detailed revisions please review all the attached documents.
    a. Responses to contractors' Request for Information (RFI)
    b. Inclusion of Inflatable Damper Copper Tubing Raceway/Tray
    c. Inclusion of Control Panel and Workstation Location
    d. Inclusion of Conduit Types for control wiring
    e. Revision of Inflatable Damper system

2) Revisions to drawings are shown clouded with triangle number 3. Please note that while substantial revisions have been clouded, not necessarily all revisions are shown clouded. It will be contractor's responsibility to include all the revisions since the bid set in his bid price whether clouded or otherwise.

3) **Specification revisions are shown bold and in red. Please note that while substantial revisions have been indicated in bold, not necessarily all revisions are shown bold. It will be contractor's responsibility to include all the revisions since the bid set in his bid price whether shown bold and red or otherwise.**

CLARIFICATON REGARDING DRAWING T002.00 IN ADDENDUM #2

Q. We don't see any equipment schedule for the new Chilled Glycol Air Handling Units. Please provide the equipment schedule with the performance specifications for these units.

A. See Addendum No. 3 drawing M501.00. All Air Handling Unit Cooling and Heating Coils to be sized for 40% Propylene Glycol.

SPECIFICATION CHANGES:

1) Spec section 23 09 00 – Direct Digital/Automatic Temperature Controls

2) Spec section 23 09 98 – Sequences of Operation

3) Spec section 23 31 00 – Sheetmetal Work and Accessories

DRAWING CHANGES:

The below description only provides a general overview of the revisions to the specific drawings. It will be the contractor's responsibility to review each and every document for actual scope of work.

1) Revised DM102.00 – Revised location of existing exhaust fan.

2) Revised M201.00 – Added Inflatable Damper Copper Tubing Raceway/Tray and Workstation.

3) Revised M202.00 – Added Inflatable Damper Copper Tubing Raceway/Tray.

4) Revised M203.00 – Added Inflatable Damper Copper Tubing Raceway/Tray and Control Panel.

5) Revised M306.00 – Added part plan for workstation location.

6) Revised M501.00 – Added Note #12 to Air Handling Units Schedule.

7) Revised M607.00 – Revised Inflatable Damper System Detail.

Please sign below in acknowledgment of this addendum. ***Submit this addendum with your bid.***

Agency Chief Contracting Officer

I acknowledge receipt of this addendum.

Proposer/Company Name (Print)

Authorized Representative (Print Name)

Authorized Representative (Signature) Date

SECTION 23 09 00 – DIRECT DIGITAL/AUTOMATIC TEMPERATURE CONTROLS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.02 WORK INCLUDED

A. Furnish and install a complete system of automatic temperature controls to make a fully operational and controllable building HVAC system.

B. The system shall be all electric DDC (direct digital control).

C. All system components shall be installed in accordance with local and State codes.

D. Secure all permits and local/State approval for all components and installation as specified under this Section.

E. Provide complete commissioning for all control system components and sequences of operation.

F. Preparation and submission of shop drawings.

1.03 RELATED SECTIONS

A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

B. Division 21

C. Division 22

D. Division 23

E. Division 25

F. Division 26

1.04 REFERENCES

A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.

B. Material standards shall be as specified or detailed hereinafter and as follows:

1. NFPA 70 – National Electric Code.

2. UL-916 – Energy Management Systems.

3. UL-873 – Temperature Indication and Regulating Equipment.

4. FCC; Part 15, Subpart J – Class A computing Equipment.

5. UL-864 – Fire and Smoke Control.

1.05 SYSTEM DESCRIPTION

A. Furnish and install, as hereinafter specified, a combination direct digital/ electric/electronic temperature control system and Building Automation System (BAS). The system shall be comprised of a network of various independent Stand-alone Digital Controllers, electric/electronic control equipment, thermostats, sensors, controllers, valves, dampers, actuators, panels and related hardware, software and other accessory equipment, along with a complete system of electrical control wiring, and software generation to fill the intent of the specifications and provide for a complete and operable system.

B. The controls systems shall be installed by competent control mechanics and electricians regularly employed by the manufacturer of the control equipment. All control equipment shall be the product of one (1) manufacturer and all components shall be capable of interfacing with the HVAC equipment. The factory trained Contractor must maintain adequate staff and offer standard services to fully support the owner in the timely maintenance, repair, and operation of the control system. Contractors who do not maintain such staff and offer services or must develop some for this project are not acceptable.

C. Bids from franchised dealers or others whose principal business is not the manufacture, installation and service of temperature control systems will not be acceptable.

D. The Contractor shall submit a copy of the manufacturer's standard software and firmware licensing agreement for the owner's signature. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets constrained within such software.

E. All products of the Building Automation System shall be provided with the following agency approvals. With the submittal documents, verification that the approvals exist for all submitted products shall be provided. Systems or products not currently offering the following approvals are not acceptable.

1. UL-916; Energy Management Systems

2. UL-873; Temperature Indication and Regulating Equipment UL-864; Subcategories UUKL, QVAX, UDTZ; Fire and Smoke Control Systems

3. FCC; Part 15, Subpart J, Class A Computing Devices

F. All products shall be labeled with the appropriate approval markings. System installation shall comply with NFPA, NEMA, Local and National Codes.

1.06 SUBMITTALS

A. See Section 230500 and General Conditions for additional requirements.

B. Product Data: Provide data for each system component and software module.

C. Shop Drawings.

1. Indicate trunk cable schematic showing programmable control unit locations and trunk data conductors.

2. List connected data points, including connected control unit and input device.

3. Indicate all system graphics for all controlled systems including all air handling systems, hydronic pumping systems, monitored systems, data (connected and calculated) point addresses and operator notations.

4. Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems and interconnections.

5. Indicate description and sequence of operation of operating, user and application software

6. Develop and provide emergency, fire, smoke management control and device response matrices in an MS Excel spreadsheet format.

7. Show electronic ranges for each valve, damper, inlet vanes actuators etc., (i.e. 8-13 psi or 0-10 vdc).

8. Show system network **Engineering** with high level and lower level transmission and communications network to include all addressable controllers, communication repeaters, routers, gateways, operator workstations, terminal connection ports, network servers, printers, etc.

9. All control logic and controllable components shall be depicted and identified within each matrices developed.

D. Manufacturer's Installation Instructions: Indicate manufacturer's installation instructions for all manufactured components.

E. Project Record Documents: Record actual locations of control components, including control units, thermostats and sensors, trunk cable routing, junction boxes, transformers, VAV terminal box power circuiting, box addresser.

1. Revise shop drawings to reflect actual installation and operating sequences.

2. Include submittal data in final "Record Documents" form.

3. All start-up/checkout documentation shall be initial and signed by the on-site control technician with intimate knowledge of the project.

4. Provide start-up/checkout documentations for all DDC controllers connected to the BMS network. Documentation shall include all controller points used and unused (spare). Furthermore, all final settings, calibration, coefficient valves, K factors, spanning, actual spring ranges, etc., shall be indicated for all active points in use.

5. Revise all control sequence for all controlled sequences for operation. Sequence of operation that restate the Design Engineer's sequences will not be acceptable. Complete details will be given within the sequences of operation provided by the Contractor. Details shall include but not limited to the following items control strategy, timers, delays, logic sequencing, start/stop, end devices involved, sensors involved, set points, globally commanded valves, shared data between panels and controllers.

F. Operations and Maintenance Data:

1. Include interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.

2. Include keyboard illustrations and step-by-step procedures indexed for each operator function.

3. Include inspection period, cleaning methods, cleaning materials recommended and calibration tolerances.

1.07 QUALITY ASSURANCE

A. Perform work in accordance with NFPA 70 and Divisions 26, 27 and 28 specifications.

B. Design system software under direct supervision of a Professional Engineer experienced in design of this Work and licensed within the State in which the project is located.

C. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten (10) years of documented experience.

D. Installer Qualifications: Company specializing in performing the type of work specified in this section with minimum ten (10) years of documented experience and approved by manufacturer.

E. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. and testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.08 WARRANTY

A. See Section 230500 and General Conditions for additional requirements.

B. The system specified herein and shown on the drawings shall be guaranteed to be free from original defects in both material and workmanship for a period of twelve (12) months of normal use and service, excepting damages from other causes. This guarantee shall become effective starting the date the Contract work is accepted as complete by the Owner and in accordance with the General Provisions/Conditions.

C. Provide five (5) year manufacturer's warranty for field programmable micro-processor based units.

D. Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.09 MAINTENANCE SERVICE

A. Provide service and maintenance of energy management and control systems for one (1) year from Data of Substantial Completion.

B. Provide two (2) complete inspections during the first year, one (1) in each season, to inspect, calibrate and adjust controls as required and submit written reports.

1.10 PROTECTION OF SOFTWARE RIGHTS

A. Prior to delivery of software, the Owner and the party providing the software shall enter into a software license agreement with provisions for the following:

1. Limiting use of software to equipment provided under these specifications.

2. Limiting copying.

3. Preserving confidentiality.

4. Prohibiting transfer to a third party.

1.11 GENERAL

A. Acceptable manufactures subject to compliance with the specifications

1. Siemens

2. Johnson Controls

3. Honeywell

4. **(Deleted)**

5. Approved Equal

B. The entire system and all control components shall be powered with emergency power.

C. All electrical work shall comply with Divisions 25, 27 and 28 Specifications.

PART 2 - PRODUCTS

2.01 ELECTRIC LOW VOLTAGE WIRING

A. Furnish all labor and material to install the necessary wiring to accomplish the successful and complete operation of the new automatic system (DDC).

B. All electric wiring, wiring connections and all interlocking required for the installation of the temperature control system, as herein specified, shall be provided by the Contractor, unless specifically shown on the Electrical drawings or called for in the Electrical specifications.

C. Furnish all labor and material to install necessary relays, general purpose enclosures and appurtenances to control designated devices relative to the DDC.

D. All wiring throughout shall be concealed where possible.

E. All conduit used shall be **Rigid Galvanized Steel (RGS) or Electrical Metallic Tubing (EMT) as indicated below,** 3/4" minimum size or larger. Conduit sizes shall be large enough to permit the individual conductors to be readily installed or withdrawn without damage to the conductors or their insulation. Splicing of wires will be permitted only in junction boxes or pull boxes. Conduit shall be rigid up to 12’-0″ AFF in mechanical rooms.

F. Conduit shall never to be relied upon for a fault current and safety ground return conductor.

G. The ground system shall not be used as a current carrying conductor except for faults and noise suppression. The grounding system shall be used to control noise and transients which might affect the operation of the automation system. As such, the ground requirements shall be in excess of a grounding system used solely for physical protection minimum (Code requirement).

H. In all cases, the bond to ground shall be as short as possible. A ground point shall be derated by one (1) point (in order of preference) for each 50’-0″ of conductor run between it and the automation equipment to be grounded. Therefore, a water pipe bond located 10’-0″ away will be preferable to a structural steel bond located 150’-0″ away.

I. Set screw connectors shall be galvanized or plated steel. White metal cast type will not be permitted.

J. Flexible conduit shall be used at field devices, i.e., pressure switches, flow switches, temperature devices, etc. Convolutions shall be steel, interlocked continuously. Aluminum will not be permitted. "Liquidtight" shall be used in wet locations. Flexible connector shall be a minimum of 18" long.

K. Only core drilling is permitted to pierce the floors in the electrical closets and elsewhere. The use of water for drilling shall be controlled by a suitable vacuum system, using proper

dams to prevent damage to floors below. The ATC Contractor shall be responsible for providing a suitable sleeve in all core drilled holes as specified herein.

L. **All wiring shall be run in RGS or EMT or Metal Clad and as noted below:**

1.	**Concealed Behind Walls:**	**In new Conduit (EMT)**
2.	**Concealed Above Ceilings:**	**In New Conduit (EMT) or MC Cable**
3.	**Exposed in Non-Inmate Spaces:**	**In New Conduit (RGS)**
4.	**Exposed in Supervised Inmate Spaces:**	**In New Conduit (RGS) with Security Caulking**
5.	**Exposed in Other Inmate Spaces:**	**Not Allowed**
6.	**Anywhere in Mechanical Rooms:**	**In New Conduit (RGS)**

M. Wiring

1. Type THHN solid #18 AWG for control wiring in dry location up to 194°F.

2. Type THWN in wet location up to 167°F (solid #18 AWG).

3. Twisted shielded pair (18 gauge), with PVC cover, Belden #8760 or approved equal.

4. Conduit is not considered as a shield.

5. All wiring associated with the control signals to the smoke damper control/sequence must be in approved conduit.

6. All signal wiring to all field devices shall be run with no splices, separately from any wiring having voltage greater than 30 volts.

N. The Contractor shall install all shielded cable and ground systems in accordance with Division 23. The installation of ground loops shall not affect any sensing or control circuits.

O. All devices and equipment shall be mounted in minimum NEMA 1 enclosures.

P. In addition to the requirements specified above, all communication wiring cables shall include a minimum of (1) individually 100% shielded pair ([2] conductors) as unused spare conductors. Where the number of conductors and specific cable specified above for each type of communication wiring will not meet this requirement for spare conductors, Contractor shall provide approved equivalent product of Belden or other manufacturer with the necessary number of conductors and which meets the requirements specified above.

Q. Low Voltage Control Wiring (30 VAC or Less)

1. Low voltage control wiring shall be minimum 16 gauge, or heavier if required, twisted pair, 100% shielded with PVC cover Belden #9316 or approved equivalent product of other manufacturers run in conduit with no splices, separate from any wiring above 30 volts.

R. Coordination of Interfacing/Interlocking

1. The Contractor shall be responsible for coordinating all required interface/interlocking software, software logic, sequencing and wiring necessary to provide a fully automated and fully functional operable system to met or exceed the intent of the Design Engineer's Sequence of Operation. Coordination may include but not limited to the following at no additional cost to the Owner. Variable frequency drive (VFD) interlocking and wiring logic including software, relays factory/field installed wiring and/or VFD drive modifications. This would include coordination of miscellaneous points as specified under point list in this specification. Systems to include all points analog, digital, pneumatic sensors wiring, software, wiring, communications gateways, etc., to connect and communicate to any Fire, Plumbing, HVAC, Lighting, ATC, Security, World Wide Web (Internet) systems installed under this project.

S. **All control devices including dampers, actuators, relays and all other controls shall operate on 24 volt low voltage only. Contractor shall provide all required Power Distribution Cabinets (PDC) or Power Distribution Enclosures (PDE) for all control devises wherein electrical power at 120 volts shall be provided by the electrical contractor to the PDC/PDE from where the controls contractor shall provide all 24 voltage devices and wiring.**

T. **Metal Clad Cables –**

1. **Metal Clad Cable (Type MC) shall be a factory assembly of conductors, each insulated and enclosed in a metallic flexible interlocking metal tape armor of galvanized steel or aluminum. A bare internal grounding conductor shall be included and insulated from the outer metal armor. All conductors, including grounding conductor, shall be a minimum of #12 AWG. The assembly shall be UL listed and rated at 600V, 90Deg.C**

U. **Sensors**

1. **All duct mounted temperature sensors regardless of any other description elsewhere shall include the following:**

a. **Accuracy:**

1) **Thermistor:±0.50 (0.28)**

2) **RTD:±0.60 (0.33)**

b. **Sensor Type:**

1) **Thermistor:2.252 kΩ, 3 kΩ, 10 kΩ Type II, III & III w/11K shunt, 20 kΩ, 100 kΩ**

c. **RTD:**

1) **Type 71,81:100Ω Pt 385 Curve**

2) **Type 85:1000Ω Pt 385 Curve**

3) **Type 91:1000Ω Pt 375 Curve**

d. **Temperature Range:**

1) **Thermistor/RTD:-40° to 221 (-40° to 105)**

e. **Temperature Coefficient:**

1) **Thermistor: Negative temperature coefficient**

2) **RTD: Positive temperature coefficient**

f. **Temperature Stability:**

1) **Thermistor:0.24 (0.13) over five years**

2) **RTD: Max 0.04% after 1k hours @ 500**

g. **Heat Dissipation:2.7 mW/°C (power needed to raise the temperature 1°C)**

h. **Enclosure Rating:NEMA 1, white plastic**

i. **Mounting: Directly to well, duct, or wall**

j. **Wiring Terminations: 8', 24 AWG gray wire leads, type 71 & 81 sensors have 18" leads**

k. **Probe: Seamless 304 stainless steel tube, 1⁄4" OD, 4.87" long**

l. **Manufacturer: Control System Manufacturer made product Comparable to Kele KTUS/KTOS Series or approved equal.**

2.02 BUILDING AUTOMATION SYSTEM ENGINEERING

A. General

1. The Building Automation System shall consist of a number of Nodes and associated equipment connected by industry standard network practices. All communication between Nodes shall be by digital means only.

2. The Building Automation System network shall at minimum comprise of the following:

    a. Operator Workstations – fixed and portable.

    b. Network processing, data storage and communication equipment including file servers.

    c. Routers, bridges, switches, hubs, modems and the like communications equipment.

    d. Active processing Nodes including field panels.

    e. Intelligent and addressable elements and end devices.

    f. Third-party equipment interfaces.

    g. Other components required for a complete and working Building Automation System.

3. The Building Automation System shall be accessible via Enterprise Intranet and Internet browser with security protection for user access.

4. The Building Automation System shall support auto-dial/auto-answer communications to allow Building Automation System Nodes to communicate with other remote BMS Nodes via standard telephone lines.

5. The PC Workstations, File servers and principal network equipment shall be standard products of recognized major manufacturers available through normal PC vendor channels. "Clones" are not acceptable.

6. Provide licenses for all software residing in the Building Automation System and transfer these licenses to the Owner prior to completion.

B. Network

1. The Building Automation System shall incorporate a primary Tier 1 network. At the Contractor's option, the Building Automation System may also incorporate integrated secondary Tier 2 and tertiary Tier 3 networks.

2. The Building Automation System Network shall utilize an open **Engineering** capable of:

    a. Utilizing standard Ethernet communications and operate at a minimum speed of 10Mb/sec

    b. Connecting via BACnet.

    c. Connecting via LonMark.

3. The Building Automation System network shall support both copper and optical fiber communication media.

C. Third-Party Interfaces

1. Building Automation System Contractor shall integrate real-time data from systems supplied by other trades as required.

2. The Building Automation System shall include necessary Building Automation System hardware equipment and software to allow data communications between the Building Automation System and systems supplied by other trades.

3. The trade contractor supplying other systems will provide their necessary hardware and software and will cooperate fully with the Building Automation System Contractor in a timely manner at their cost to ensure the complete data integration.

4. The Building Automation System Contractor shall provide all necessary coordination with vendors, contractors, owners, engineers, and other representatives at no additional cost to the Owner. Provide a completed fully functional, operational, integrated and seamless communicating infrastructure system.

D. Power Fail / Auto Restart

1. Provide for the automatic orderly and predefined shutdown of parts or all of the Building Automation System following total loss of power to parts or all of the Building Automation System.

2. Provide for the automatic orderly and predefined startup of parts or all of the Building Automation System following total loss of power to those parts or all of the Building Automation System. Archive and annunciate time and details of restoration.

3. Provide for the orderly and predefined scheduling of controlled return to normal, automatically time scheduled, operation of controlled equipment as a result of the auto restart processes.

4. Maintain the Building Automation System real-time clock operation during periods of power outage for a minimum of 72 hours.

5. As part of this required feature of Power Fail/Auto Restart, the ATC Contractor shall provide uninterruptible power supplies (UPS) for the entire Building Automation System networked infrastructure including all third party interfaces and determine feasibility, time, delays, shutdown network traffic anticipated, etc.

E. Downloading and Uploading

1. Provide the capability to generate Building Automation System software-based sequences, database items and associated operational definition information and

user-required revisions to same on designated Operator Workstations and the means to download same to the associated Application Nodes.

2. Provide the capability to upload Building Automation System operating software information, database items, sequences and alarms to the designated Operator Workstations with automatic archiving of same on the Operator Workstations. The functions of this Part shall be governed by the codes, approvals and regulations applying to each individual Building Automation System application.

3. The entire control system shall be approved and listed by UL 916 - Energy Management.

4. All DDC panels shall be powered through uninterruptible power sources (UPS) with sufficient capacity to ride through a (2) minute power interruption between transfers from normal to emergency power. UPS's and wiring shall be provided by the ATC Contractor.

5. Uploading or downloading functions performed at any location shall not affect controllers, communications, inputs, outputs at any location or address within the Building Automation Control **Engineering** nor shall any controller level functions be disrupted in any manner.

F. Application Nodes (AN)

1. General

a. The Application Nodes shall include all monitoring, control and information Nodes including field panels.

b. Application Nodes shall be programmable and governed by the requirements of their applicable codes, approvals and regulations.

c. The Application Nodes shall be designed, packaged, installed, programmed and commissioned in consideration of their specific service and prevailing operating conditions. They shall be proven standard product of their original manufacturer and not a custom product for this Project.

d. A failure at an Application Node shall not cause failures or non-normal operation at any other system Application Node other than the possible loss of active real-time information from the failed Application Node.

e. Ancillary Application Node equipment, including interfaces and power supplies, shall not be operated at more than 80% of their rated service capacity.

2. HVAC Node

a. HVAC Node shall provide both standalone and networked direct digital control of HVAC systems.

b. A dedicated HVAC Node shall be configured and provided for each primary HVAC system (air handler, chiller, pumps, heat exchanger, fans) and each terminal HVAC system.

c. Each HVAC Node shall be able to retain program, control algorithms, setpoints, logic and command information through the use of non-volatile memory (flash, EEPROM). Other information such as trend data, historical data schedules will be maintained for at least 72 hours in the failure and shall return to normal operation upon restoration of power.

d. Each HVAC Node shall report its communication status to the Building Automation System. The Building Automation System shall provide a system advisory upon communication failure and restoration.

e. For each primary HVAC system, provide means of indication of system performance and setpoints at, or adjacent to the HVAC Node.

f. For each primary HVAC system, provide a means to adjust setpoints and start/stop equipment at, or adjacent to the HVAC Node.

g. Provide a means to prevent unauthorized personnel form accessing setpoint adjustments and equipment control functions.

h. The HVAC Node shall provide the ability to download and upload configuration data, both locally at the Node and via the FMS communications network.

i. The HVAC Node shall be provided with a permanently-mounted local graphic terminal where required in the sequences of this specification. The local graphic terminal shall provide a dynamic graphical representation of the associated system status with the ability for the operator to enter commands and review data through the use of project specific drill down type menu structure with proper password protection.

j. Each HVAC mode shall be a dedicated controller without the need to use expansion modules to accomplish the entire primary control sequences. Sharing controller, sensor, input/output data over any high level or low level network to accomplish the specified control sequences is unacceptable.

k. Global sharing of general data such as OA-T, OA-RH OA-CO2 levels between controllers over the BMS network is acceptable as long as speed of transmitting the data des not impact the HVAC mode controller ability to perform in any mode of operation.

l. If it is determined that the HVAC mode controller cannot perform specified sequence of operation because of dependency for shared information that Contractor shall provide a higher level controller at no additional cost. This change shall be identified by separate submittal to Design Engineers.

2.03 PORTABLE OPERATOR'S TERMINAL

A. Acceptable Manufacturers subject to compliance with the specification:

1. Dell

2. **HP**

3. **Sony**

4. **Approved Equal**

B. Provide one (1) portable operator terminal with a minimum LCD display of 80 characters by 25 lines and a full featured keyboard. The portable operator's terminal shall be hand-held and plug directly into individual distribution control panels as described below. Provide a user friendly, English language prompted interface for quick access to system information, not codes requiring look-up charts.

C. General

1. Furnish portable operator's terminal for system. Portable operator's terminal shall allow for local accessing of program information.

2. Laptop terminal portable operator's terminal shall have the following features:

a. Intel Core i5 2.9 GHz microprocessor

b. Full active matrix color display with minimum 1920 x 1080 resolution, 15".

c. AC adapter

d. Battery pack / battery charger

e. 500 GB fixed disk drive

f. 8 GB of Memory

g. 24X DVD drive

h. PCMCIA card modem

i. Audio built in

j. Latest version of Microsoft DOS

k. PCMC1A Ethernet Adapter Card with UTP/BNC connector

l. Equipped with both 1 Type III or 2 Type II PCMCIA Slots

1) Type III 4

2) Type II PCMC1A Slots

m. Integrated pointing device

D. Functionality of the portable operator's terminal connected at any high or lower level controller:

1. Access all controllers on the network.

2. Backup and/or restore controller data bases for all system panels, not just the DDC controller.

3. Display all point, selected point and alarm point summaries.

4. Display trending, historical and totalization information.

5. Add, modify, and/or delete any existing or new system point.

6. Command, change setpoint, enable/disable any system point vertical or physical.

7. Program and load custom control sequences as well as standard energy management programs.

E. Connection of a POT on controller to a distributed control processor shall not interrupt nor interfere with normal network operation in any way, prevent alarms from being transmitted or preclude centrally-initiated commands and system modification.

F. Portable operator terminal access to controller shall be password-controlled and menu-driven.

2.04 OPERATOR INTERFACE WORKSTATION (TYPICAL FOR [1])

A. The Contractor shall provide all the necessary hardware and software to interface with the existing Central Facility Management System. A gateway between each system provided under this section and the CFMS system shall be provided by the ATC Contractor. The gateway shall allow the following:

1. Monitoring and commanding of all points of each system. Limited point sharing between the OCC and native systems is not acceptable except when using bundled point technology to control terminal equipment (e.g. VAV box, RHC). The bundle point information may be passed to the CFMS via a virtual terminal direct connection. This connection shall be over the Ethernet data highway and shown

on the CFMS PC as an inset window on the screen. Each bundled point shall be unbundled to continuously pass the actual value of the controlled variable (e.g. room temperature, face velocity) and the controlled variable setpoint. If a virtual terminal connection is not possible, the ATC Contractor shall pass the bundled point through the gateway and Comdale shall unbundle the information for display. Bundled points shall not be allowed for primary HVAC equipment (e.g. Chillers, AHUs, Pumps, Fans, heat exchangers).

2. Trend reports shall be compiled by the CFMS; however, point information and format shall be provided to the CFMS from the native system as directed.

3. The CAD drawings for the native system shall be capable of being located into the CFMS for the purpose of making dynamic graphics.

B. Transmission of the native system to the CFMS shall be via Ethernet. All necessary labor and material to tie into the existing campus Ethernet data highway shall be provided under this section.

C. Each native system shall have an CFMS gateway unless otherwise provided for in the specification.

D. The cost to develop the gateway shall be provided under this section. The labor to check out and verify each developed gateway shall be included under this section. The gateway operation must be verified in the presence of and signed-off by the Owner's CFMS representative.

E. The cost to create graphics, check out, program and any other work necessary to provide a fully functioning CFMS interface with the new Building Automation System control systems shall be included under this section.

F. The ATC Contractor shall develop all software interfaces for the Vivarium/Animal Facility Monitoring and Control system, to provide a simple computer interface and operating systems for use by the Animal Research Staff in monitoring and resetting temperature, humidity, lighting control, etc. within the animal research spaces.

G. Provided with a UPS system with one hour backup.

2.05 OPERATOR WORKSTATIONS

A. Basic Interface Description

1. Command Entry/Menu Selection Process: Operator Workstation interface software shall minimize operator training through the use of English language prompting, English language point identification, and industry standard PC application software. The operator interface shall minimize the use of a typewriter style keyboard through the use of a mouse or similar pointing device, and "point and click" approach to menu selection. Users shall be able to start and stop equipment or change setpoints from graphical displays through the use of a mouse or similar pointing device.

2. Graphical and Text-Based Displays: At the option of the user, Operator Workstations shall provide consistent graphical or text-based displays of all system point and application data described in this specification. Point identification, engineering units, status indication, and application naming conventions shall be the same at all workstations.

B. Computer System Access Operation Control Stations (OCS) Description: This system access workstation is also referred to as the Building Automation System "Front end".

C. Provided Workstation with:

1. Workstation shall be general purpose, commercially available, personal computer with sufficient memory and processor capacity to perform all functions described in this specification.

2. Sufficient hard drive memory storage shall be provided to accommodate all fully configured point data bases, all application databases, all graphics data bases, all user-defined reports, and all historical data archival as described in this specification.

3. The display provided for system operation shall have a diagonal screen measurement of no less than 15" (i.e. nominal 17" unit) and a minimum display resolution of no less than 640 x 320 pixels. Separate controls shall be provided for color, contrast, and brightness. The screen shall be non-reflective.

4. Each shall include the following:

a. 3.3 GHz Intel Core i5 processor with 8 GB of (SDRAM) random access memory.

b. 17" color monitor 1920x1080(SGVA).

c. SVGA video output (4 MB RAM).

d. 1TB fixed disk.

e. HI-RES bus mouse.

f. (1) Printer for alarms, minimum 240 characters/seconds.

g. (1) Printer for reports, minimum Laser printer similar to HP 4000.

h. 48X Read/Write CD Rom

i. Wireless + Bluetooth

j. Campus network interface card

k. Zip drive

l. Server type platform shall have high performance RAID multiple fixed disk for hot redundancy. Provide minimum three fixed disks.

5. The operator functions provided by the system access Operator Terminal shall include, but not be limited to, the following:

a. Start and Stop Points

b. Modify Setpoints

c. Modify PID Loop Setpoints

d. Override PID Control

e. Change Time/Date

f. Add/Modify Start/Stop Weekly Scheduling

g. Add/Modify Setpoint Weekly Scheduling

h. Enter Temporary Override Schedules

i. Define Holiday Schedules

j. View Analog Limits

k. Enter/Modify Analog Warning Limits

l. Enter/Modify Analog Alarm Limits

m. Enter/Modify Analog Differentials

n. View Point History Files

6. UPS system with one hour backup.

7. The workstation shall provide access to all real or calculated points in the controller to which it is connected, or any other controller in the network. This capability shall not be restricted to a subset of predefined "global points", but shall provide totally open exchange of data between the operator terminal and any DDC panel in the network.

8. Provide English language prompting to eliminate the need for the user to remember command formats or point names. Prompting shall be provided consistent with a user's password clearance and the types of points being displayed, to eliminate the possibility of operator error. Operator shall not require the use of special templates for navigation.

9. On-line, interactive user's "Help" manuals and tutorials shall be provided. Based upon operator request, the "help" function shall provide general system operating

instructions, and specific descriptions of commands available in the currently displayed menus.

10. Identification for all real or calculated points shall be consistent for all network devices.

11. In addition to instantaneous summaries, the Operator's Terminal shall allow a user to view a Point History file for system points. Point History files shall provide a record of value of analog points over the last 24 hours, at 30 minute intervals, or a record of the last (10) status changes for binary type points.

D. Dynamic Color Graphic Displays: Color graphics shall be provided as specified in the Execution portion of this specification to optimize system performance analysis and speed alarm recognition.

1. System Selection/Penetration: The operator interface shall allow users to access the various system schematics and floor plans via a graphical penetration drill down scheme, menu selection, and text-based commands.

2. Dynamic Data Displays: Dynamic temperature values, humidity values, flow values, and status indication shall be shown in their actual respective locations, and shall automatically update to represent current conditions without operator intervention.

3. Windowing: The windowing environment of the workstation shall allow the user to simultaneously view several graphics at the same time to analyze total building operation, or to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.

4. Graphics Definition Package: Graphic generation software shall be provided to allow the user to add, modify, or delete system graphic displays.

a. The Contractor shall provide libraries of pre-engineered screens and symbols depicting standard air handling unit components (e.g. fans, cooling coils, filters, dampers, etc.), complete mechanical systems (e.g. constant volume-terminal reheat, VAV, etc.) and electrical symbols.

b. The graphic development package shall use a mouse or similar pointing device in conjunction with a drawing program to allow the user to perform the following:

1) Define symbols

2) Position and size symbols

3) Define background screens

4) Define connecting lines and curves

5) Locate, orient and size descriptive text

6) Define and display colors for all elements

7) Establish correlation between symbols or text and associated system points or other displays.

c. Graphical displays can be created to represent any logical grouping of system points or calculated data based upon building function, mechanical system, building layout, or any other logical grouping of points which aids the operator in the analysis of the facility. To accomplish this, the user shall be able to build graphic displays that include point data from multiple DDC panels, including application specific controllers used for DDC unitary or VAV terminal unit control.

5. Graphic

a. Provide graphic screens each system for this project.

b. Provide the following as a minimum:

1) Each air handling unit

2) Glycol chilled water system.

3) Steam system.

4) Glycol hot water system.

5) Each heat exchanger.

6) Each chiller.

7) Each exhaust fan.

8) Each piece of equipment.

9) Each controlled system.

c. Provide graphic representation of building's form and site plans locating all equipment and panels.

d. Each hardware point shall be represented on graphic screen.

e. Selected software points shall be represented on respective process system graph as determined by the Owner. Examples of these software points are:

1) Control loop setpoint value.

2) Control loop auto/manual selection.

3) Lead/lag selection for pumps and other motors.

4) Campus chilled water global points.

5) Calculated points such as run time.

6) Other vertical software points as required.

f. The Contractor shall coordinate all required graphical modes, features, binding, logic, etc., for a complete fully functional graphical operating system. All graphical schemes shall be submitted and approved by Engineer/Engineer and Owner prior to programming.

E. Database Configuration

1. Provide database configuration for each hardware and software point.

2. Specific point parameters, such as alarm limits, alarm message, point name and point description shall be as approved by the Owner.

F. Trends

1. Provide real time and historical trends for hardware and software points as directed by the Owner.

2. Archiving or transfer of trend and historical data information shall not interfere, reduce communication throughout stow network speed or reduce local controller operation by any measure, due to trend or historical data capture rates and storage routines.

G. Internet / Intranet Browser

1. A multi-user color graphics and textual interface shall be provided that allows customers to access their Building Automation System data via the Internet or Intranet. This interface shall use HTML-based pages to send and receive data from a Building Automation System to a web browser.

2. Browser shall:

a. Automatically reflect any changes made to the Building Automation System without additional programming.

b. When installed behind a corporate firewall, shall work in conjunction with other security measures that have been implemented.

c. Allow the user to navigate and command the Building Automation System using the same format as the Operator Workstation.

d. Be an industry-standard browser

e. Provide user password access control.

f. Provide the means by which the user can create, edit and view groups of FMS data points.

g. Provide navigation tools for moving between the views. In addition, it shall provide tools for gaining access to help and for logging out of the system.

H. Paging

1. Provide the means of automatic alphanumeric paging of personnel for user-defined Building Automation System events.

a. System shall support both numeric and alpha-numeric pagers, using Alphanumeric, PET, or IXO Protocol at the owner's option.

b. Users shall have the ability to modify the phone number or message to be displayed on the pager through the system software.

c. System shall utilize pager schedules to send pages to the personnel that are "on-call".

d. Contractor shall be responsible for providing a modem for connection to the paging service.

I. Reports

1. Provide real time reports for hardware and software points as directed by the Owner.

2. The ATC Contractor shall program and test all alarming and alarm report routing to final devices such as printer, computers, pagers, monitors, cell phones, www, etc. Alarming requirements and routing shall be coordinated with the Owner by first compiling and all points listing for Owner's review prior to any programming.

J. Network Speed and Transmission

1. Network speed (communication rate) 10 megabits per second (MBPS) for all level one controllers.

2. Network configurations shall be Star, Bus or mixed (Star and Bus).

K. **Workstation Locations**

1. **Workstation shall <u>each</u> be provided at the first floor control room, maintenance supervisor's office and the central control room in Rikers Island Firehouse. Workstation at Mod. 1 shall be the hub for the control systems and**

the other two workstations shall be auxiliary stations connected to the hub work station with all access and capability as the hub work station.

2. **Workstations at the Maintenance Supervisors office and the Central Control Room in in Rikers Island Firehouse shall be capable of connecting to wireless modem remotely to access the information from the work station located in the Mod. 1 Control room. Provide all required routers, transmitters, switches, receivers and all other devises and wiring as required including all required power, communication and control connections for such remote access.**

2.06 DIAL-UP COMMUNICATIONS

A. Auto-dial/auto-answer communications shall be provided to allow stand-alone DDC panels to communicate with remote operator stations on an intermittent basis via telephone lines.

1. Dial-Up Stand-Alone DDC Panels: Auto-dial panels shall automatically place calls to workstations to report critical alarms, or to upload trend and historical information for archiving.

a. Stand-alone DDC panels shall analyze and prioritize all alarms to minimize the initiation of calls. Non-critical alarms shall be buffered in memory and reported as a group of alarms, or until an operator manually requests an upload of all alarms.

b. The auto-dial shall include provisions for handling busy signals, "no answers", and incomplete data transfers. Default devices shall be called when communications cannot be established with primary devices.

2. Dial-Up Workstations: Operators at dial-up workstations shall be able to perform all control functions, all report functions, and all database generation and modification functions as described for workstations connected via the local area network. Routines shall be provided to automatically answer calls, and either file or display information sent from remote DDC panels, The fact that communications is taking place with remote control systems over telephone lines shall be completely transparent to an operator.

a. An operator shall be able to access remote buildings by selection of any facility by its logical name. The PC dial-up program shall maintain a user-definable cross-reference of buildings and associated telephone numbers, so the user shall not be required to remember or manually dial telephone numbers.

b. A PC workstation may serve as an operator device on a local area network, as well as a dial-up workstation for multiple auto-dial DDC panels or networks. Alarm and data file transfers handled via dial-up transactions shall not interfere with local area network activity, nor shall local area network activity keep the workstation from handling incoming calls.

3. Modem Characteristics: Dial-up communications shall make use of Hayes compatible 56K modems and voice grade telephone lines. Each stand-alone DDC panel may have its own modem, or a group of stand-alone DDC panels may share a modem.

2.07 CONTROL PANEL

A. **Provide a local aluminum control panel for each air handling, fan, chilled water, steam and hot water control system in the nearest Mechanical room housing the air handling systems.**

B. **Panels shall be unitized construction and securely mounted where shown on the Drawings or directed by the Authority near its respective controlled apparatus in the mechanical equipment room. Submit sample of construction for approval with the shop drawings.**

1. **Fabricate panels of 16-gage furniture-grade steel or 6063-T5 extruded aluminum alloy, totally enclosed on four sides, with hinged door and keyed lock with manufacturer's standard shop-painted finish and color.**

2. **Provide UL-listed cabinets for use with line voltage devices.**

3. **Within each panel/cabinet shall be mounted all relays, switches and accessories for the respective system. Mount all required gauges, thermometers adjusting dials etc. on the door face.**

4. **Electric devices, where panel mounted, shall be factory wired to a terminal strip. All electric devices shall be factory grounded to the cabinet.**

5. **On the outside of the door face of each panel shall be a full color schematic diagram of the system it controls. Diagram shall be etched onto a Bakelite panel or secured to the panel face and covered with rigid Plexiglas in a hermetic manner.**

6. **Provide securely laminated, embossed identifying nameplates or numbers on or near each automatic sensing, control motor or operating device.**

7. **Unit shall provide for manual override to the next scheduled event. Unit shall provide LCD display of time and day.**

8. **The panels for Air Handling Units shall include the following:**

   a. **Hand-Off-Auto Mode switch for supply fan**

   b. **Air Handling unit status – On, Off, Alarm**

   c. **Outside Temperature (Dry, Wet), Humidity.**

d. **Space Temperature (Dry, Wet), Humidity as sensed by the return air sensor in the duct main.**

e. **Graphic of the supply fan and the interlocked Exhaust/Return Fans with numbers and service.**

f. **Hand-Off-Auto Mode switch for each return /exhaust fans**

g. **For each Return and/or Exhaust Fan, Fan status – On, Off, Alarm**

9. **The panels for Standalone Exhaust Fans shall include the following:**

a. **Hand-Off-Auto Mode switch for Each exhaust fans**

b. **For each Exhaust Fan, the fan status – On, Off, Alarm**

10. **The panels for Chillers shall include the following:**

a. **Hand-Off-Auto Mode switch for Chillers.**

b. **Chiller status – No of chiller modules in operation, On, Off, Alarm**

c. **Outside Temperature (Dry, Wet), Humidity.**

d. **Chilled water entering and leaving Temperature.**

e. **Chilled water flow rate, GPM**

f. **Graphic of the chiller and the interlocked pumps with numbers and service.**

g. **Hand-Off-Auto Mode switch for Pumps.**

h. **All Pump status – On, Off, Alarm**

11. **The panels for heat exchangers shall include the following:**

a. **Heat Exchanger status – Heat Exchanger No of active exchanger in operation.**

b. **Outside Temperature (Dry, Wet), Humidity.**

c. **Steam Pressure, PSI**

d. **Hot water entering and leaving Temperature.**

e. **Hot water flow rate, GPM**

f. **Hot Water Pressure Entering and Leaving, PSI**

g. **Graphic of the heat exchanger and the interlocked pumps with numbers and service.**

h. **Hand-Off-Auto Mode switch for Pumps.**

i. **All Pump status – On, Off, Alarm**

PART 3 - EXECUTION

3.01 PROJECT MANAGEMENT

A. The ATC Contractor shall designate a project manager who will be responsible for the following:

1. Construct and maintain project schedule.

2. On-site coordination with all applicable trades and subcontractors.

3. Authorized to accept and execute orders or instructions from Owner/Engineer.

4. Attend project meetings as necessary to avoid conflicts and delays.

5. Make necessary field decisions relating to this scope of work.

6. Coordination/Single point of contact.

3.02 NUMBERING/NAMING CONVENTIONS

A. The Contractor shall collaborate with the Owner directly to determine the Owner's preference for naming conventions, etc. before entering the data in the system.

B. As a minimum the ATC Contractor shall submit to the Engineer/Engineer and Owner the layout of the network, identifying all DDC controllers. Each controller will be identified by address and system being served. All physical and software generated objects, points and attributes shall be listed along with a description.

3.03 START-UP AND COMMISSIONING

A. When installation of the system is complete, calibrate equipment and verify transmission media operation before the system is placed on-line. All testing, calibrating, adjusting and final field tests shall be completed by the installer. Verify that all systems are operable from local controls in the specified failure mode upon panel failure or loss of power.

B. Provide any recommendation for system modification in writing to Owner. Do not make any system modification, including operating parameters and control settings, without prior approval of Owner.

C. The ATC Contractor will provide industry standard checkout and startup checklists for each DDC controller installed for the project. If not standard is available, the ATC

Contractor shall develop a spreadsheet in MS Excel format and submit to the Engineer for approval prior to system checkout.

D. **See additional commissioning requirements under section 230800**

3.04 INSTRUCTION AND ADJUSTMENT

A. The Contractor shall provide factory-trained instructor to give full instructions to the owner designated personnel in the operation of the system installed. Instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach. The Contractor shall provide all students with a student binder containing product specific training modules for the system installed. All training shall be held during normal working hours of 8:00 AM to 5:00 PM weekdays.

B. Upon completion of the project, the Contractor shall:

1. Fine-tune and "de-bug" all software control loops, routines, programs and sequences of control associated with the control system supplied.

2. Completely adjust and make ready for use, all transmitters, relays, damper operators, valves, etc., provided under this Section. This Contractor shall furnish copies of complete, detailed, calibrating checkout and **commissioning** documentation for reach controller. Documentation shall list each procedure and shall be signed by the control specialist performing the service.

3. Furnish a complete set of system operation manual, including standard manufacturers' operating manuals, complete as-built installation diagrams, and complete software hardcopy documentation, as well as a magnetic media back-up.

4. Provide an on-site training program for the Owner's staff in the operation and use of the control system. Training shall include three (2) segments, as follows:

a. Segment 1 shall include 16 hours of classroom and hands-on training. This segment shall instruct personnel in the system configuration, component characteristics, control strategy on each controlled system and all requirements for daily operation and use of the system. This segment shall give the Owner's representative a working proficiency in the day-to-day operational requirements (i.e., system monitoring, alarm acknowledgment, HVAC system troubleshooting techniques, setpoint and time schedule adjustments, manual override, etc.).

b. Segment 2 shall include 6 hours of on-site training. This segment will be geared for the Owner's designated prime operator. An emphasis on overall software management and manipulation shall be made, to allow the prime operator(s) to make control strategy and overall facility and system management changes as required. Attendees shall have attended Segment 1.

c. All training shall take place at the site and at times mutually agreed to between that ATC Contractor and the Owner. The ATC Contractor shall provide to the Owner's designated representative, at least three (3) weeks before each segment, a course syllabus outline and schedule.

d. The ATC Contractor shall provide all training material, reference material and training aids, as required, all as part of his Contract cost.

END OF SECTION 23 09 00

SECTION 23 09 98 – SEQUENCES OF OPERATION

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.02 WORK INCLUDED

A. Furnish and install temperature controls.

1.03 RELATED SECTIONS

A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

1.04 SUBMITTALS

A. See Section 250500 and General Conditions for Additional Requirements.

A. Product Data: Provide data for duct materials.

B. Prepare and submit sequences and drawings.

C. Manufacturer's Installation Instructions.

1.05. QUALITY ASSURANCE

A. All sequences shall be made functional.

PART 2 – PRODUCTS

2.01 GENERAL

A. Sequences

1. Air Handling Units - 100% Outside Air

2. Air Handling Unit - Recirculating

3. Exhaust Air Fans

4. Differential Pressure Bypass Valve Arrangement

5. Variable Speed Pumping Systems (VFD)

6. Heat Exchanger Control

7. Chilled Water System

8. Variable Speed Drives

9. Optimized Start-Up After Power Failure

10. In-Duct Zone Heating Coils (Area Heating)

11. Chemical Treatment Systems

12. Post Fire Purge System

13. Pumps

2.02 AIR HANDLING UNITS - 100% OUTSIDE AIR AHU-1 AND AHU-2 WITH CHILLED WATER COILS AND LPS HEATING COILS (NORMAL)

A. **Unit shall be controlled from their Hand-Off-Auto Switches to be under BMS system control in Auto mode. In Auto mode the fans shall be programmed to normally run continuously with program overrides for other scheduled operations.** Upon initial starting of AHU, exhaust systems shall be directed to start prior to supply systems due to "exhaust" flow control basis of the pressurization control systems. When supply fan(s) are started by the BMS system **or at local control panel**, the following sequence shall occur: (normal)

1. The outside air damper shall open to full position, verify damper is open.

2. Unit shall be equipped with supply fan discharge and intake isolation dampers. The fan shall be ramp started to minimum fan speed of 15 Hz (adj.) via individual signal to fan's VFD. After fan is at 15 Hz, the fan isolation dampers shall open and when both dampers end switches prove the dampers are open the fans will be allowed to increase in speed. If differential pressure across fan has not reached 1.0" w.c. after 60 seconds, the fan shall be deactivated and its isolation dampers closed. The rate of fan speed ramp-up shall be adjustable. When fan is off, isolation dampers shall close. If at any time during operation of fan, the differential pressure across a fan is sensed as less than 1.0" w.c. (adj.), that fan shall be deactivated, its isolation dampers closed and alarm sent to the BAS (Building Automation System).

3. Damper actuators shall be by **Automatic Temperature Control Contractor (ATC)** hired by the **mechanical contractor**. Outside air actuators shall be industrial grade electric.

4. When a fan is off, its isolation dampers shall be closed.

B. Averaging type temperature sensor sensing cooling coil, heating coil and discharge air temperature, will provide a signal to the DDC panel. The cooling coil and heating coil

valves shall be controlled by the unit discharge air temperature sensor. On a rise in cooling coil discharge air temperature above 52°F setpoint (adj.), the cooling coil control valve will be modulated open. On a drop in discharge temperature the reverse sequence shall occur.

C. Upon a drop in discharge air temperature, the cooling coil valve shall close and the LPS heating coil shall modulate toward open to maintain 52°F (adj.) discharge air temperature.

D. Provide a series of low temperature thermostat freezestats at the downstream section of each of the heating coils which will stop the unit if the discharge temperature falls below 38°F (adj.). The sensor downstream of the heating shall announce an alarm condition if the temperature drops to 42°F or lower.

E. A smoke detector in each of the supply air discharge ducts shall be interlocked to fans through the DDC system to shut down upon activation. Smoke detectors shall be furnished, mounted and wired to fire alarm by Electrical Subcontractor.

F. When supply fan stop, the outside air dampers will close, and the cooling coil will be de-energized. The heating coil control valve shall be modulated to maintain 52°F (adj.) at the heating coil temperature sensor.

G. Cooling Coil Freeze Protection

1. Whenever the air temperature inside the cooling coil section of the air handling unit is <40°F (adj.), the cooling coil control valve shall be opened position to allow chilled water to flow through the coil and an alarm shall be sent to the BAS.

H. Air Volumetric Control

1. This portion of the specification includes the furnishing and installing of a **variable** air volume DDC control system, as herein described, for achieving air volume measurement for air handling unit supply air **and associated exhaust fans**. The air volume control shall include all sensors for air volume, velocity and pressure as required. The supply **and exhaust air** volume shall be controlled by varying the speed of the manually adjustable pitch vaneaxial fans through the associated VFDs.

2. The air volume control system shall be furnished and installed by the ATC Contractor, except that the airflow measuring stations shall be mounted in the built-up air handling units by the HVAC Contractor, but wired and controlled by the ATC Contractor who shall provide all control stations, selector relays, etc. **The inflatable damper controls shall be provided by the inflatable damper manufacturer in Bacnet Protocol and interlocked with the AHU controls for seamless operation.** Coordinate with the HVAC Contractor. Mount station from floor. Duct mounted static pressure sensing stations (SPSS) shall be furnished by the ATC Contractor and installed from 2/3 to 3/4 of the way along the longest duct run for each unit, in the vertical duct riser **(for systems with vertical ducts).** Provide access to the sensors.

3. It is the intent of this portion of the specification to provide for a fully synchronized volume measurement system for each supply air unit **along with the inflatable dampers**. The ATC Contractor shall furnish and install a fan volume control center which shall include all arithmetic and logic functions and other auxiliary devices required to maintain airflow conditions in accordance with job requirements.

4. The fan volume control components shall be equipped with operating features described herein and capable of performing the outlined performances. The direct digital control shall be capable of 3-mode control, proportional, plus reset, plus gain. The velocity pressure sensors shall provide a signal to the DDC panel to provide for control functions, and shall be equal to the Setra #261 differential pressure transmitter.

5. The fan volume control supplier (ATC Contractor) shall provide all necessary factory and field labor for the complete installation and calibration, and shall be responsible to provide an operating sequence to the complete satisfaction of the Mechanical Engineer. In addition, the fan volume control supplier shall guarantee the proper operation of the system and shall furnish all required service and maintenance from the local office to provide twelve (12) months, fully guaranteed system. Factory trained engineers and installers shall be located within a 75 mile radius of the job site so that proper service may be performed on this project.

6. Upon start-up of the supply **and exhaust** fans, the static pressure sensor sends static pressure signal to the VFDs serving the fans to maintain the supply **and exhaust** system at a constant static pressure. Each fan shall receive the same signal from the PLC loop, except during fan start-up and when a fan is off. Each fan VFD shall receive a separate speed signal from the PLC. All required auxiliary devices shall be provided by the ATC Contractor. Provide DDC panel face indication to indicate each unit's supply air volume and system static pressure**. The supply and exhaust fan VFDs shall be interlocked to synchronize the fan speed for optimal air flow relationship.**

7. **The inflatable dampers under the control of the return duct sensors shall modulate the airflow from maximum design setting to minimum supply airflow rate of 50 CFM (adjustable) for single occupancy cells and 100 CFM (Adjustable) for multiple occupancy cells and minimum exhaust airflow rate of 90 CFM (adjustable) for single occupancy cells and 290 CFM (Adjustable) for multiple occupancy cells.**

8. **Upon closure of inflatable dampers and increase in pressure corresponding to minimum 60% (adjustable) airflow on the main supply duct, the following optimization shall occur:**

    a. **The inflatable dampers shall deflate.**

    b. **The supply and exhaust air fans shall increase speed in conjunction with the chilled/steam control valve modulation, as stated below, to satisfy the return air duct sensor setting.**

c. **The chilled water coil valve (in cooling mode) and hot water valves (in heating mode) shall modulate close to increase (chilled) / decrease (hot) discharge air temperatures in 2 deg. F (Adjustable) increments for every 15 minutes till return air sensor is satisfied.**

d. **The fan speed increase will be the lead operation and the control valve modulation will be the lag operation to satisfy the sensor setting.**

9. Provide a differential pressure sensor across the fan and before the fan isolation damper. The VFD shall start to increase fan speed. When the differential pressure across the fan reaches 3.0" w.c. (adj.), the isolation damper shall start to open. If, when the fan is running and the differential pressure across the fan drops below 2.0" w.c. (adj.) setpoint, the fan shall be disabled and the isolation damper shall close, and trigger alarm. Additionally, a pair of differential pressure switches mounted across the supply fan shall shut down the fan should a differential pressure greater than 6.0" (adj.) be sensed. Hi-static and low-static conditions shall alarm the DDC system.

10. Furnish and install duct mounted static pressure sensors.

11. The BAS shall continuously monitor the airflow readings and motor amperage readings supply fan within each AHU. If the differences in flow/amperage of the fans vary by 15% (adj.) or more, an alarm shall be annunciated at the BAS.

12. The air volumetric control shall have a special feature to be reset for a higher CFM. See turbo mode sequence.

I. All control sequences as listed above shall fully function in either the hand or automatic modes as selected at the VFD drive control panel. The ATC Contractor will provide all required hardware, programming, wiring, relays, coordination, etc., to provide a complete fully functional system that operates automatically with no intervention beyond switching the drive mode switch at the VFD panel.

J. VFD bypass mode of operation, if VFD drives have bypass mode installed as an optional feature the ATC Contractor will provide “detailed” instructions as how the system, controls, VFD drives (s) etc., must be manipulated to allow system to operate in a safe manner. Instructions shall be attached to each affected VFD drive, printed and laminated for operators use.

2.03 AIR HANDLING UNIT - RECIRCULATING SINGLE FAN- (AHU-3 & 4, AHU- 5, 6 & 7)

A. **Unit shall be controlled from their Hand-Off-Auto Switches to be under BMS system control in Auto mode. In Auto mode the fans shall be programmed to normally run continuously with program overrides for other scheduled operations.** When supply fan(s) are started by the BMS system **or at local control panel**, the following sequence shall occur: (normal)

1. Unit shall be equipped with outside air, return, the economizer (relief) dampers. When dampers open and after they reach 80% open position, as determined by an

end switch, the supply fan shall start at low VFD speed. After the supply fan has started, the return fan shall start through a separate output from the DDC panel at low VFD speed.

2. The unit shall have modulating outside air damper. The outside air damper shall open to minimum position and the return air and exhaust air dampers will take corresponding positions as determined by an FMS in the return duct.

3. If either the supply fan or return fan stop, the other fan shall also stop.

B. An averaging temperature sensor sensing cooling coil discharge temperature will provide a signal to the DDC panel a unit discharge air temperature shall be used to control the cooling coil 2-way modulating control valve, the outside air dampers, return air damper and economizer air damper in sequence to maintain the (adjustable) discharge air temperature. Sensor shall be installed downstream of the cooling coil. On a rise in cooling coil discharge air temperature, the outside air damper, return air dampers and economizer air damper will modulate to the 100% outside air position. On a further rise in temperature, the cooling coil control valve will be modulated open. On a drop in discharge temperature, the reverse sequence shall occur. The discharge control sequence shall maintain a constant temperature of 52°F (adj.) in the cooling mode. An outside air sensor will provide a signal to the DDC panel to modulate the outside air damper to its minimum CFM position, the return air damper to its fully open position, and the economizer damper to its minimum position whenever the outside air enthalpy is greater than the return air enthalpy. At outside air temperature of 50°F (adj.) or lower, the cooling coil valve shall be shut (refer to cooling coil freeze-protection sequence).

C. A discharge air temperature sensor shall override the discharge control sequence and control the dampers to maintain 50°F (adj.) minimum mixed air temperature and signal an alarm condition.

D. The discharge temperature control shall modulate the unit's modulating 2-way LPS control valve for AHU-3 and 4 and hot water heating control valve for AHU- 5, 6 & 7 in sequence to maintain 52°F (adj.) heating coil leaving air temperature setpoint. At no time shall the heating coil and cooling coil be open at the same time Provide a heating coil leaving air temperature sensor which shall act as a low limit selector to prohibit leaving coil temperature from dropping to below 45°F (adj.).

E. Provide a series of low limit temperature thermostats in the leaving air section of each of the heating coils which will stop the unit if the discharge temperature falls below 38°F (adj.). An alarm shall be announced if the temperature drops below 42°F (adj.).

F. Smoke detectors in the supply and return plenums shall be interlocked to fans to shut down upon activation. Smoke detectors shall be furnished, installed in ductwork and wired to the fire alarm by the Electrical Subcontractor. The supply and return fans shall stop when either the supply or return air smoke detector is activated via a signal from the fire alarm system to the BAS.

G. When the supply fan stops, the return fan will stop, the outside air and economizer air dampers will close, the cooling coil will be de-energized and the return air damper will be

open. The heating coil control valve shall be modulated to maintain 55°F (adj.) at the heating coil temperature sensor. If the unit is off and the air temperature inside the cooling section of the unit is below 32°F (adj.), the chilled water valve shall be opened to 30% (adj.) flow position for freeze protection and an alarm shall be sent to the BAS.

H. Air Volumetric Control

1. This portion of the specification includes the furnishing and installing of a complete air volume DDC control system, as herein described, for achieving air volume DDC control for the air handling unit supply and return fans, and assuring minimum outside air quantities.

   The air volume control shall include all sensors for air volume, velocity and pressure, as required. The supply and return air fan volumes shall be controlled by varying the speed of manually adjustable pitch vaneaxial fans through their associated VFDs.

2. The air volume control system shall be furnished and controlled by the ATC Contractor, except that the airflow measuring stations shall be installed by the HVAC Contractor, but furnished by the ATC Contractor, and shall include all control stations, selector relays, etc.

3. It is the intent of this portion of the specifications for a fully synchronized control system between the supply air (VFD) volume and return air (VFD) volume. The ATC Contractor shall furnish and install a fan volume control center which shall include arithmetic and logic functions and other auxiliary devices required to maintain airflow conditions in accordance with job requirements.

4. The fan volume control components (via VFD) shall be equipped with operating features described herein and capable of performing the outlined performances. The direct digital control shall be capable of 3-mode control, proportional, plus reset, plus gain. The velocity pressure sensors shall provide a signal to the DDC panel to provide for control functions, and shall be equal to Setra Model #261.

5. The fan volume control supplier shall provide all necessary factory and field labor for the complete installation and calibration, and shall be responsible to provide an operating sequence to the complete satisfaction of the HVAC Engineer. In addition, the fan volume control supplier shall guarantee the proper operation of the system and shall furnish all required service and maintenance from the local office to provide for one (1) year, fully guaranteed system. Factory trained engineers and installers shall be located within a 75 mile radius of the job site so that proper service may be performed on this project.

6. Upon start-up of the supply fan and return fan, the fan volume control center shall place the supply and return fan VFD in the zero (0) speed mode. As the DDC panel receives static pressure signal, the speed of the supply fan and return fan shall increase the supply system static pressure to maintain setpoint at the duct mounted SPSS located 2/3 to 3/4 along the longest duct run. The supply air fan speed shall be controlled to maintain the desired duct static pressure. The supply fan volume

(measured at the FMS in the duct provided by the ATC Contractor) shall be measured. The return fan volume shall be controlled (via speed control through the VFD) to maintain a pre-set (adj.) CFM offset between the supply and return air volume (return air volume shall be measured at the FMS, provided by the ATC Contractor, in the main return air duct). Upon startup, the return fan volume (cfm) shall match the supply fan volume until the supply fan reaches 50% of system rated cfm (adj.). On a decrease in supply air static or volume, the reverse sequence will occur. All required auxiliary devices shall be provided by the ATC Contractor. Provide DDC panel face indication to indicate supply air volume and return air volume.

7. **For AHU 5 (Offices) and 7 (Control Room), the inflatable dampers under the control of the return duct sensors shall modulate the airflow from maximum design setting to minimum supply airflow rate of 30% total air (adjustable).**

8. **Upon closure of inflatable dampers and increase in pressure corresponding to minimum 60% (adjustable) airflow on the main supply duct, the following optimization shall occur:**

   a. **The inflatable dampers shall deflate.**

   b. **The supply air fans shall increase speed in conjunction with the chilled/steam control valve modulation, as stated below, to satisfy the return air duct sensor setting.**

   c. **The chilled water coil valve (in cooling mode) and hot water valves (in heating mode) shall modulate close to increase (chilled) / decrease (hot) discharge air temperatures in 2 deg. F (Adjustable) increments for every 15 minutes till return air sensor is satisfied.**

   d. **The fan speed increase will be the lead operation and the control valve modulation will be the lag operation to satisfy the sensor setting.**

9. Provide a differential pressure sensor across the fan. The VFD shall start to increase fan speed. If, when the fan is running and the differential pressure across the fan drops below 2.0" w.c. (adj.) setpoint, the fan shall be disabled and the isolation damper shall close, and trigger alarm. Additionally, pressure switches mounted across the supply fans and the return fan shall shut down the fan should a pressure greater than 6" (adj.) supply and 2.0" (adj.) return be sensed. Total of two (2) switches.

I. Automatically restart all fans after resumption of normal power following power outages and dropouts.

J. The air volumetric control shall have a special feature to be reset for a higher CFM. See turbo mode sequence.

K. All control sequences as listed above shall fully function in either the hand or automatic modes as selected at the VFD drive control panel. The ATC Contractor will provide all

required hardware, programming, wiring, relays, coordination, etc., to provide a complete fully functional system that operates automatically with no intervention beyond switching the drive mode switch at the VFD panel.

L. VFD bypass mode of operation, if VFD drives have bypass mode installed as an optional feature the ATC Contractor will provide "detailed" instructions as how the system, controls, VFD drives (s) etc., must be manipulated to allow system to operate in a safe manner. Instructions shall be attached to each affected VFD drive, printed and laminated for operators use.

2.04 AIR HANDLING UNITS TURBO MODE SEQUENCE

A. AHU-1 and AHU-2

1. When AHU-1 fails an alarm in the building control automation system or in the facility's office shall be activated.

2. Power to AHU-1 shall be switched off and AHU-2 shall be switched to turbo mode.

3. LPS and Chilled Water control valves shall close for AHU-1.

4. AHU-2 shall be switched to turbo mode and shall command supply fan motor through VFD to run at higher set RPM to deliver 9750 CFM, 100% OA.

5. When AHU-2 is in turbo, LPS and chilled water control valves shall modulate for greater volume as required by space demand.

6. When AHU-2 is in turbo, AHU-1 supply air motorized damper MD-1 and MD-T7 shall close, MD-T1 shall open to allow AHU-2 to serve both areas served by AHU-1 and AHU-2. Related motorized dampers (MD-T8, MD-2) shall adjust accordingly.

7. When AHU-1 is restored, AHU-2 shall be switched back to normal operation by slowing down the fan RPM through VFD, and motorized dampers MD-T1 shall close, and MD-1, MD-6, MD-T7 and MD-T8 shall be in normal open position.

8. When AHU-2 fails, AHU-1 shall be switched to turbo and will similarly operate as described for AHU-2.

B. AHU-3 & AHU-4

1. When AHU-3 fails, an alarm in the building automation system or in the facility's office shall be activated.

2. Power to AHU-3 and return fan RF-1 shall be switched off and AHU-4 and RF-2 shall be switched to turbo mode.

3. LPS and chilled water control valves shall close for AHU-3.

4. AHU-4 shall be switched to turbo mode and shall command supply fan motor through VFD to run higher set RPM to deliver 12,375 CFM. Return fan RF-2 shall modulate accordingly.

5. When AHU-4 is in turbo mode, LPS and chilled water control valves shall modulate for greater volume as required by space demand.

6. When AHU-4 is in turbo, motorized dampers MD-3, MD-5 and MD-7 shall close MD-T2 which shall open to allow AHU-4 to serve the areas served by AHU-3 and AHU-4. Motorized damper MD-T3 shall open to allow air to return from areas served by AHU-3 and AHU-4. Return fan RF-2 shall modulate accordingly. MD-4 and MD-6 shall remain open, MD-8, MD-10 and MD-12 shall remain energized to modulate accordingly.

7. When AHU-3 is restored, AHU-4 shall be switched to normal operation for 8250 CFM, and all related dampers shall return to normal positions.

8. When AHU-4 fails, AHU-3 shall be switched to turbo and will similarly operate as described for AHU-3.

9. When AHU-3 and RAF-2 fail at the same time, an alarm shall be activated at the facility's office or building automation system. AHU-3 and RAF-2 shall be off. AHU-4 and RAF-1 shall be switched to turbo. Motorized dampers MD-T3, MD-T5, MD-T2, MD-4 shall open. Motorized dampers MD-10, MD-12 and MD-7 to modulate accordingly, and motorized dampers MD-6, MD-T6, MD-8, MD-11, MD-9, and MD-3 shall close. Similar sequence will follow when AHU-4 and RAF-1 fails.

C. AHU-5, 6 & 7

1. When any of the 3 AHU's (AHU-5, 6, 7) fails, an alarm in the building automation system or in the facility's office shall be activated.

2. Power to the failed AHU and associated relief fan shall be switched off and the remaining air handling units shall be switched to turbo mode to deliver 2500 CFM EA.

3. Chilled water and hot water control valves to the failed AHU shall close. Chilled water and hot water valves to remaining operating AHU's shall modulate accordingly, but in the no case shall both open at the same time

4. When failed AHU is restored, the AHU's in tu zrbo shall be switched to normal operation, and all associated dampers and fans shall be in normal position

2.05 EXHAUST AIR FANS/SUPPLY AIR FANS

A. For all exhaust/supply fans, which are not located in AHU's, furnish for installation by the HVAC Contractor, automatic supply and/or discharge air dampers and interlock with fans

to "open/close" when fans are "on/off". For fan designations and areas served by each fan, see schedule on drawings.

B. Toilet exhaust fans shall run continuously 24/7. **Provide VFD and interlock with the supply fan for synchronous reduce in airflow corresponding to supply air reduction or increase.**

C. Return fans RAF-1 and RAF-2 shall be interlocked with AHU-3 and AHU-4 accordingly with AHU's mode of operation. **Provide VFD and interlock with the supply fan for synchronous reduce in airflow corresponding to supply air reduction or increase.**

D. Fan EF-8, EF-9 and EF-10 shall be interlocked with AHU-5, AHU-6 and AHU-7 and shall modulate **airflow through VFD** accordingly with AHU's mode of operation.

E. **Fan EF-1, EF-2, EF-3 and EF-4 shall be interlocked with AHU-1 and AHU-2 and shall modulate airflow through VFD accordingly with AHU's mode of operation.**

2.06 DIFFERENTIAL PRESSURE BYPASS VALVE ARRANGEMENT

A. Provide a differential pressure sensor, reporting to the DDC panel and valve(s) to maintain constant pressure differential between supply and return piping mains, to automatically bypass water and compensate for pressure fluctuations in the systems. Pressure sensor shall have sensing tips in the supply and return water lines.

1. Hot Glycol System: One (1) Valve

2. Chilled Glycol System: One (1) Valve

2.07 VARIABLE SPEED PUMPING AND FAN SYSTEMS (VFD)

A. VFD's shall be furnished and installed by the HVAC Contractor. The Electrical Contractor shall provide power to each VFD. The ATC Contractor shall provide all control wiring for each VFD.

B. Provide two (2) pair differential pressure sensors for each VFD controlled pumping system. The ATC Contractor shall furnish and the HVAC Contractor shall install all sensors.

C. The VFD shall vary the speed of the pump or fan to maintain the differential pressure set point at the D.P. sensor in each of the two (2) major piping or duct branches (control to maintain pressure at lowest of the pressure at the [2] sensors).

D. Each VFD controlled pumping system shall also have a differential pressure bypass assembly provided to operate only in the event of a VFD malfunction. When full speed VFD bypass is selected. All VFD's on pumps shall have automatic full speed bypass enabled whenever a fault is sensed in the VFD or the pump motor.

2.08 HEAT EXCHANGER CONTROL

A. The heating systems share a common heat exchanger system which shall generate constant temperature (180° adj.) hot water (Glycol) year-round. Piping to the building serves a year-round constant temperature reheat loop and AHUs 5,6 and 7 heating coils served by VFD driven pumps, and with zone temperature valves.

B. Heat Exchanger/ Hot Water Loop

1. Provide temperature monitoring sensors at each heat exchanger hot water supply and return piping connection, reporting to the DDC panel. The common hot water supply and return piping temperatures shall be sensed. Hot water pumps shall be activated by the DDC system and shall run continuously, until deactivated by DOC system.

2. The DDC panel shall modulate the steam valve to maintain hot water supply temperature of 180°F (adj.).

3. When the hot water (Glycol) pump is off, the steam valves shall be closed.

4. Heat exchanger pair (primary/standby) will need only one (1) pair of steam control valves.

5. Provide a flow switch to indicate flow through heat exchanger. Steam valves shall be closed unless flow is proven.

2.09 SMOKE MANAGEMENT SYSTEM

A. The building is not required by Code to have an "Engineered Smoke Control System". However, various fan overrides and smoke detector systems are required.

B. Fire Alarm and DDC System Interface Panel

1. The Electrical Contractor shall provide a FAS/ATC interface panel. The ATC Contractor shall wire from the BAS to the interface panel. The Electrical Subcontractor shall wire to the various contacts from the fire alarm panel to this interface panel, to enable the ATC system to activate the following sequence/functions.

C. Fire Command Center Override

1. Each of the fans in the following systems shall be interlocked through the DDC system to an H/O/A switch within the fire command center, located on the first floor. The ATC Contractor shall receive a dry contact closure at the FCC for each H-O-A to represent "Hand", at which time the associated fan shall start. When "Off" is selected, the ATC system shall deactivate the associate fan. Provide an actual status feedback DO to the FCC indicating each fan's "actual" on-off status:

2. The Electrical Contractor shall furnish H/O/A switches, within the fire command center, for connections by the ATC Contractor. The ATC Contractor shall wire

from the switches to the Building Automation System to control each of the above designated HVAC fan systems.

3. When "hand" is selected at the fire command center, all safeties except static pressure switches and static pressure control shall be overridden. Normal discharge temperatures shall be maintained as closely as possible.

2.10 CHILLED WATER SYSTEM

A. The ATC Contractor shall provide all interlocking wiring to the chiller control panel provided by the chiller manufacturer to activate/deactivate chiller, as hereinafter specified. All remote sensors, differential pressure switches and other control devices furnished as part of this control system shall be provided by the ATC Contractor. The HVAC Contractor shall install wells, etc., as directed by the ATC Contractor.

B. The chiller control system shall provide all sequences for chiller and interlocking provision with chilled water pumps. The ATC Contractor shall interlock each chiller and pump to the DDC control system.

C. Provide vapor tight flow switches for each chilled water pump and interlock to the chiller to prevent chiller operation until the chilled water pump is operating to provide flow through the chiller. Provide flow switches at the outlet of each chiller.

D. Provide all sensors, relays and other control devices necessary for a complete and workable chilled water system. Coordinate the entire chilled water control installation with the chiller manufacturer.

E. Chillers shall be controlled as follows:

1. The chilled water shall start via the DDC system. When flow is established by differential pressure and flow switches, the chiller will start. Pressure switches shall be installed across each chiller and wired to the local DDC and chiller control panel to provide proof of flow.

2. When one chiller cannot maintain 40°F (adj.) leaving water temperature, the other chiller system shall be enabled. Provide lead-lag of chillers.

F. Chiller system as specified below shall be controlled by a dedicated PLC. Control of other major systems (i.e., air handling units, etc.) on this PLC shall not be acceptable.

G. The following information shall be permanently displayed at the DDC without the requirement of manual data retrieval.

1. Chilled water supply temperature

2. Chilled water return temperature

3. Chilled water pump status

2.11 VARIABLE SPEED DRIVES

A. For each VFD, provide the following through the PLC:

1. Motor run feedback points to provide run status in both VFD and bypass mode.

2. Provide mode feedback (VFD and bypass mode).

3. Speed control output signal to VFD.

4. Feedback indicating speed (Hz) and amperage.

5. General alarm from VFD.

6. Start/stop output to VFD.

2.12 OPTIMIZED START-UP AFTER POWER FAILURE

A. The ATC Contractor shall start systems and equipment in a staggered manner after a power failure such that systems and equipment do not start all at once and overload electrical service nor create an excess negative or positive pressure in the building. Provide a 5 second (adj.) delay between start-up of each system.

B. All equipment - any piece of equipment or system that is stopped for any reason other than loss of normal or emergency power must be alarmed and may only reset manually via the BAS. Power failure shall be as sensed by the undercurrent relays and normal/emergency power relays at the electrical automatic transfer switches.

2.13 IN-DUCT ZONE HEATING COIL (AREA HEATING)

A. Area heating coil normally open 2-way hot water coil shall be modulated to maintain space temperature at the DDC thermostat. Valve shall be normally open.

2.14 CHEMICAL TREATMENT

A. Chemical treatment systems shall be provided by the HVAC Contractor for all water systems. The ATC Contractor shall provide wiring between all components of the chemical treatment systems.

2.15 POST FIRE PURGE SYSTEM

A. Purge System sequence and operations shall be as indicated on contract drawing.

B. Post fire combination return fan and purge system shall operate as follows under control of the fire alarm system:

1. When system is indexed to purge by purge enable switch at the fire alarm panel, the smoke purge panel shall be activated,

2. The AHU supply fan shall energize with associated fire/smoke damper to provide makeup air, the fire/smoke damper serving the floor supply shall close, the supply air duct damper serving the floor not purged shall also be closed and only the damper serving the purged floor shall open, relief air damper shall open, outside air damper shall open fully.

3. The respective Return Fan shall start. All fire and smoke dampers in the return ductwork shall open to **purge** on a floor/zone basis.

4. The return fan shall energize with associated fire/smoke damper to provide purge of the space, the fire/smoke damper serving the floor return shall close, the return air duct damper serving the floor not purged shall also be closed and only the damper serving the purged floor shall open, relief air damper shall open.

5. Upon completion of the **purge** sequence for the building. The purge panel shall be reset and the purge **enable** switch shall be deactivated at the fire alarm panel.

6. All the AHUs and RTUs shall be reset at the BMS system for normal mode operation.

2.16 PUMPS

A. Chilled water pumps CHW GP-1 and CHW GP-2

1. Chilled water pumps CHW GP-1 and CHW GP-2 shall be started manually or automatically and through a digital controller or building automation system.

2. Chilled water pumps shall operate with 1 active and 1 stand-by arrangement, and could be re-scheduled to alternate function.

3. When chilled water pump is indexed on, the active pump shall be energized and shall run when chilled water is demanded in the system through the chilled water control valve end switch.

4. Active pump shall run and modulate through UFD to meet chilled water demand.

5. When active pump fails, an alarm shall be activated, and stand-by pump shall operate.

6. When all chilled water control valves are closed, chilled water pumps shall be off.

B. Hot water pumps HWP-1 and HWP-2

1. Hot water pumps HWP-1 and HWP-2 shall be started manually or through a digital controller or building automation system.

2. Hot water pumps shall operate with 1 active and 1 stand-by arrangement, and could be re-scheduled to alternate function.

3. When hot water pump is indexed to on, the active pump shall be energized and shall run when hot water is demanded in the system- AHU's 5, 6 and 7 and reheat coils, though the hot water control valves end switches.

4. Active pump shall run and add water through UFD to meet hot water demand.

5. When active pump fails, an alarm shall be activated, and stand-by pump will operate when all hot water control valves are closed, hot water pump shall be off.

2.17 INFLATABLE DAMPER

A. **Inflatable damper shall be factory set to minimum outside air/exhaust air flow rate and maximum flow as per design drawings.**

B. **Damper shall at all times be under control of the Return/Exhaust air duct mounted smart sensor to modulate the damper to maintain space temperature.**

C. **A supply air duct pressure sensor installed in the main duct shall modulate the air handling unit fan speed.**

D. **Air handling unit shall optimize discharge air temperature in multiples of 2 deg F (adjustable) by modulating chilled water flow rate at the coil if the supply duct pressure consistently maintains at the minimum air flow setting of the air handling unit for more than 15 minutes (Adjustable)**

END OF SECTION 23 09 98

SECTION 23 31 00 – SHEET METAL WORK AND ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.02 WORK INCLUDED

A. Furnish and install a complete system of air distribution, including accessories, to all areas indicated on the contractor drawings.

B. Create, coordinate and submit ¼" scale Coordination Drawing in accordance with Section 230500.

C. Provide all ductwork, fittings and accessories to make a complete and operational system in all respects.

1.03 RELATED SECTIONS

A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

1.04 REFERENCES

A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.

B. Material standards shall be as specified or detailed hereinafter and as follows:

1. ASTM A 36/A 36M – Standard Specification for Carbon Structural Steel.

2. ASTM A 1008/A 1008M – Standard Specification for Steel, Sheet, Carbon, Cold Rolled, Commercial Quality.

3. ASTM A 1011/A 1011M – Standard Specification for Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality.

4. ASTM A 653/A 653M – Standard Specification for Steel Sheets, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process.

5. ASTM A 666 – Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

6. ASTM B 209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

7. ASTM B 209M – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

8. ASTM C 443 – Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

9. ASTM C 443M – Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets (Metric).

10. NFPA 90A – Installation of Air Conditioning and Ventilating Systems.

11. NFPA 90B – Installation of Warm Air Heating and Air Conditioning Systems.

12. NFPA 96 – Installation of Equipment for the Removal of Smoke and Grease-laden Vapors from Commercial Cooking Equipment.

13. SMACNA (LEAK) – HVAC Air Duct Leakage Test Manual.

14. SMACNA (DCS) – HVAC Duct Construction Standards – Metal and Flexible.

15. UL 181 – Factory-Made Air Ducts and Connectors.

1.05 SUBMITTALS

A. See Section 230500 and General Conditions for Additional Requirements.

B. Product Data: Provide data for duct materials, duct connectors and all accessories. Include sound attenuator test data in accordance with ASTM E477.

C. The Sheet Metal Contractor shall submit duct fabrication standards and methods of installation, in compliance with SMACNA and these specifications, for review and approval by the Engineer, clearly indicating the combination of metal gauges and reinforcement intended for use for each pressure classification. Duct fabrication shall not be allowed until a satisfactory review of this Standard has been performed and fabrication drawings have been reviewed and coordinated. MERELY SUBMITTING COPIES OF THE SMACNA PRESSURE CLASS TABLES DOES NOT COMPLY WITH THIS REQUIREMENT.

D. Provide scaled ductwork fabrication drawings. Fabrication drawings shall be double line and as a minimum include elevations, dimensions, sizes, all offsets rises and drops, air distribution devices.

E. Provide scaled ductwork coordination drawings for all floors and systems in accordance with Section 230500, Submittals.

F. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA– HVAC Air Duct Leakage Test Manual.

G. Manufacturer's Installation Instructions: Indicate special procedures for glass fiber ducts.

H. Manufacturer's Certificate: Certify that installation of glass fiber ductwork meet or exceed recommended fabrication and installation requirements.

I. Project Record Documents: Record actual locations of ducts, duct fittings and all accessories. Record changes in fitting location and type. Show additional fittings used.

1.06 QUALITY ASSURANCE

A. All ducts and fittings shall be manufactured by a sheet metal fabrication company whose primary business experience is the manufacture of commercial and industrial quality ducts and fittings. Sheet Metal Contractor shall have adequate experience of building ductwork of the types required for this project as well as successful experience with projects of similar scope. Bids from sheet metal shops which do not meet the specified requirements shall not be acceptable.

B. No Ductmate, Ward, Nixon or similar factory made slip-on connections will be permitted.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 - PRODUCTS

2.01 SHEET METAL WORK

A. General

1. Acceptable Manufacturers (Provided they are in compliance with these specifications)

a. Sheet Metal

1) All ducts and fittings shall be manufactured by a sheet metal fabrication company whose primary business experience is the manufacture of commercial and industrial quality ducts and fittings. Sheet Metal Contractor shall have adequate experience of building ductwork of the types required for this project as well as successful experience with projects of similar scope. Bids from sheet metal shops which do not meet the specified requirements shall not be acceptable.

b. Sheet Metal Accessories

1) Access Doors

a) Ruskin
b) Air Balance
c) Buckley Associates
d) Ductmate

2) Flexible Connectors

a) Ventlock
b) Elgen Manufacturing
c) Duro Dyne
d) Ventglass

3) Flexible Ductwork

a) Clevepak Corp.
b) Flexible Technologies
c) Unaflex Rubber Corp.
d) Flexmaster

4) Fire Dampers

a) Ruskin
b) Prefco
c) Air Balance
d) Greenheck Fan Corp.
e) Nailor Industries
f) NCA Manufacturing Inc.

5) Fire/Smoke Dampers

a) Ruskin
b) Prefco
c) Air Balance
d) Greenheck Fan Corp.
e) Nailor Industries

6) Smoke Dampers

a) Ruskin
b) Prefco
c) Air Balance
d) Greenheck Fan Corp.
e) Nailor Industries

7) Automatic Dampers Airfoil

a) Ruskin
b) Greenheck Fan Corp.
c) Nailor Industries
d) T.A. Morrison & Co. Inc. (TAMCO)
e) NCA Manufacturing Inc.

8) Balancing Dampers (OBD)

a) Ruskin
b) Young Regulator
c) Prefco
d) Greenheck Fan Corp.
e) Nailor Industries
f) NCA Manufacturing Inc.

9) Small Balancing Damper less than 48x12

a) Ruskin
b) Young Regulator
c) Ventlock
d) Duro Dyne

2. Unless otherwise noted, all supply, return and exhaust air ductwork of all types shall be constructed of galvanized sheet metal based on the "Pressure Class" indicated in the "Minimum SMACNA Construction Standards" table found hereinafter.

3. The drawings are diagrammatic and indicate the arrangements of the principal apparatus, ductwork and piping and shall be followed as closely as possible. Because of the scale of the drawings, it is not possible to show all offsets, rises, drops, rises, fittings, accessories, etc. The Contractor shall carefully investigate the structure, finish conditions, and the work of other trades affecting the work and arrange ductwork, piping, equipment, accessories, etc. accordingly. Provide the best possible arrangement so as to provide the maximum headroom and access to apparatus while providing the minimum resistance to airflow. This work and any extra fittings and offsets required shall be included in the project without extra charge.

4. In addition to sheet metal ductwork provided under this Contract furnish and/or install accessories and devices furnished by others, including but not limited to smoke detectors. Provide and install miscellaneous sheet metal work including safing, mixing baffles, and blank off panels at unused louver areas.

5. All duct systems specified to be installed under this Contract, shall conform to the drawings, specifications, Standards, details and recommendations of the latest Edition of SMACNA "HVAC Duct Construction Standards - Metal and Flexible"; and "Round and Industrial Duct Construction Standards" (hereinafter referred to as Duct Manual). Where the requirements under this Section exceed the requirements of the Duct Manual, the specification shall govern. Wherever the word "should" appears, replace with the word "shall".

6. The Sheet Metal Contractor shall submit duct fabrication standards and methods of installation, in compliance with SMACNA and these specifications, for review and approval by the Engineer, clearly indicating the combination of metal gauges and reinforcement intended for use for each pressure classification. Duct fabrication shall not be allowed until a satisfactory review of this Standard has been performed. MERELY SUBMITTING COPIES OF THE SMACNA

PRESSURE CLASS TABLES DOES NOT COMPLY WITH THIS REQUIREMENT.

7. All galvanized steel sheet metal shall conform to ASTM A653/A653M (G-90) having not less than 1.25 oz. of zinc on each side of each square foot of sheet. All other duct materials shall be as hereinafter specified as applicable to this Contract.

8. The Sheet Metal Contractor shall install all duct mounted smoke detectors.

9. The Sheet Metal Contractor shall furnish and install all plenums with automatic or manual dampers attached to louvers.

10. The Sheet Metal Contractor shall fabricate and install all canopy hoods, flexible "elephant trunk" exhaust outlets as detailed or noted in the Construction Documents.

11. The Sheet Metal Contractor shall furnish and install exhaust ductwork from emergency generator outlet to exhaust louver including transitions, drains, access doors, flexible connections and baffles to isolate intake from exhaust.

12. There will be no supply and/or return air system ductwork internally lined unless otherwise noted.

13. The Sheet Metal Contractor shall clean and provide temporary caps on all ductwork during installation to prevent dust, dirt and debris from entering ducts during construction, including during shipping, handling and storage in the field.

14. All shop applied fabrication labels shall be applied to the exterior of the ducts. The Sheet Metal Contractor shall remove any material applied to the inside of the ducts before installation.

15. All inline fans shall have companion flanges intake and discharge for removal for servicing.

16. Seal all joints to VAV/VCV/SAV/EV in the field, including reheat coils and sound attenuators.

2.02 DUCT CONSTRUCTION

A. Duct Construction Schedule

Minimum SMACNA Construction Standards						
Ductwork Location	Pressure Class Inches W.G.	Seal Class	Leakage Class	Material	Sound Lining	Table Notes
Supply from Air Handling units to terminal boxes	±6	A	4	G-90	No	
Within 50'-0" from Air Handling units	±6	A	4	G-90	Yes	1

Minimum SMACNA Construction Standards						
Ductwork Location	Pressure Class Inches W.G.	Seal Class	Leakage Class	Material	Sound Lining	Table Notes
Supply from terminal boxes to outlets	±2	A	4	G-90	No	
Return from Air Handling units to terminal boxes	-6	A	4	G-90	No	
Return within 50'-0" of the Air Handling units	-6	A	4	G-90	Yes	1
Return from outlets to terminal boxes	-2	A	4	G-90	No	2
Exhaust from Exhaust Air Handling units to terminal boxes	-6	A	4	G-90	No	
Exhaust within 50'-0" of the Exhaust Air Handling units	-6	A	4	G-90	Yes	1
Exhaust from outlets to terminal boxes	-2	A	4	G-90	No	2
Return to Air Handling units constant volume systems.	-4	A	4	G-90	No	
Supply from Air Handling units constant volume systems	±4	A	4	G-90	No	
Toilet exhaust	-3	A	4	G-90	No	2
General exhaust	-3	A	4	G-90	No	2
Within 30'-0" of each side of exhaust fan (suction & discharge)	±3	A	4	G-90	Yes	2
Plenums	±4	A	4	Same as Ducts	As In-dictated	2
Other	±3	A	4	G-90	No	2

EDIT AS REQUIRED

Table Notes
1 Ductwork shall be double wall with solid metal liner.
2 Ductwork in the following locations shall be constructed of aluminum or stainless steel and continuously welded (Joints & Seams) and pitched back to the outlets. · Within 20'-0" of a shower area exhaust. · Within 20'-0" downstream and 5'-0" upstream of a duct humidifier. · Within 20'-0" of a sterilizer area exhaust. · Within 15'-0" of an outside air intake. · Within 20'-0" of a cartwasher exhaust. · Within 20'-0" of a locker room and within room (exhaust). · Within 20'-0" of a locker room and within room (supply).
3 Pitch horizontal duct back to hood equipment where exhaust originates.

2.03 ADDITIONAL CONSTRUCTION REQUIREMENTS

A. Minimum Requirements

1. The minimum gauge for any steel duct over 2" or under -2" pressure class shall be 24 gauge except when specified heavier.

2. The minimum gauge for black steel kitchen exhaust ductwork shall be 16 gauge.

3. The minimum diameter of any tie rod shall be 1/2".

4. The maximum tie rod spacing shall be 42" unless specifically engineered in accordance with the SMACNA Industrial Rectangular Duct Standard.

5. When tie rods intersect, they shall be welded to each other.

6. No ductwork shall be constructed to less than ±2" w.g. This means nothing is constructed to a standard between –2" w.g. and +2" w.g.

7. Duct dimensions indicated are clear inside dimensions. The sheet metal dimensions shall be increased to accommodate internal liner where liner is required.

B. All joints and seams in all ductwork and casings shall be sealed to SMACNA Seal Class "A". In finished areas, sealing compound shall be neatly applied to exposed ductwork and bands shall be provided over, to cover the sealant.

1. Some SMACNA constructions may not be suitable for the leakage classes specified even though they may meet the pressure class and should not be used.

2. Seal class A Welded means all welded (i.e. transverse joints, longitudinal seams, spiral seams, fire dampers, volume dampers or any accessories)and in addition it means continuously welded.

3. All sealants, adhesives and coatings shall be of approved kinds and qualities for each point of application, complying with recommendations for the use and storage.

4. The method of installation and materials for sealing the ductwork shall be submitted by the Sheet Metal Contractor for review and approval by the Engineer, as part of the ductwork construction standards and installation submittal.

C. All longitudinal seams in all ductwork in excess of +2" w.g. or less then -2" w.g pressure class shall be made with formed Pittsburgh locks.

D. Grooved seam/flat lock/pipe lock joining methods is restricted to 2" W.G. pressure class only.

E. Button punch-snap lock seams are not to be used.

F. Concealed stainless steel ductwork shall have an ASTM mill rolled No. 1 or No. 2 D finish. Exposed stainless steel ductwork shall have an ASTM mill rolled No. 2 B finish, or higher grade as required by the Engineer, with all welds ground smooth and final brushed with stainless steel wire brushes. All welds on exposed stainless steel ductwork shall be free of stain, burn-through, or discoloration to the satisfaction of the Engineer.

G. Tie rods shall not be used in any plenum or large duct requiring internal access or use as an access pathway.

H. All ductwork required to be removable shall be companion flanged SMACNA Type T-22 for ductwork constructed to SMACNA Metal Duct Standard and companion flanged in accordance with Industrial Standards for ductwork required to be constructed to Industrial Standards.

I. Elbows

1. All dust collection ductwork elbows shall be a centerline radius equal to (2) duct widths or diameters. No reduction shall be allowed.

2. Radius elbows shall be used wherever possible. Where it is impossible or impractical to install a 1.5 times width to centerline radius of elbow (full radius elbow) lesser radii configurations shall be used, each with "radius-proportional" splitter vanes permanently installed within. No radius shall be less than 1.0 times the width. Provide square elbows in rectangular ducts with double thickness vanes with a minimum radius of 4 1/2". Square elbows may only be used when radius elbows will not fit and where specifically approved by the Engineer prior to fabrication and/or as required by coordination shop drawings. All offsets shall be of the radium type.

J. Auxiliary drain pans.

1. Provide 1 ½: deep auxiliary drain pans under any units with cooling coils located above hung ceilings.

2. Pans shall be 6” larger then equipment in all directions.

3. This includes but not limited to all fan coil units.

4. Drains shall be piped to floor drains or utility sinks.

K. Ducts Exposed to Weather

1. For all ducts exposed to weather, after all ducts and joints are sealed and tested as specified herein, apply all over and around the same areas of possible leakage (joints), an approved sealer system, so that ductwork outside the building shall be installed in a manner to result in less then 0.5 leakage class.

2. Exposed ductwork shall be insulated and weather-protected by the Insulation Contractor after the installation is completed and tested.

L. Provide baffles and/or diffusion plates as required in all air handling units, to ensure proper air mixing, coil velocities and air distribution across filters or coils as determined in the field by the Engineer, at no additional cost to the Owner.

M. It is the intent of this specification to provide a duct system with minimum resistance to airflow. All take-offs shall be throated and transitions made as gradually as possible. "Bullhead" or sharp take-offs shall not be acceptable.

N. In addition to SMACNA requirements, ductwork in return systems without boxes, ductwork in supply systems without boxes, ductwork in exhaust systems without boxes, ductwork in any Constant Volume System and/or ductwork downstream of VAV Boxes shall be provided with:

1. Volume dampers in all branch takeoffs and in all main branches and ducts of all ductwork systems (supply, return and exhaust) for properly regulating and balancing airflow to all terminal outlets, for all duct sizes, whether shown on the drawings or not. The above requirement is mandatory.

O. All rectangular dampers shall be opposed blade and each shall be controlled by an approved galvanized locking quadrant indicating the damper position, as detailed on the drawings.

1. Volume dampers installed into ductwork that is specified to be externally insulated shall have extended activator/handle rods with extension bracket such that adjustment of the damper handle will not disturb the insulation.

P. Submit the sheet metal shop drawings to the Balancing Contractor of the project for his review and placement of dampers with the final balancing procedures and requirements in mind.

1. Coordinate the location and areas with the Balancing Contractor, and fabricate the ductwork system accordingly.

2. Provide any and all balancing dampers required by the balancing contractor at no additional cost.

Q. In addition to SMACNA requirements, all round ductwork, if used in lieu of rectangular supply and/or return/exhaust systems shall conform to SMACNA.

1. The use of flat oval ductwork shall be acceptable only with prior written approval of the Engineer. Note: Flat oval shall not be used under negative pressure.

2. Round duct shall be manufactured of spiral lock seam. Ductwork up to 12"ø and 2" w.g. pressure class can be manufactured with longitudinal lock seams.

3. All tees shall be conical.

4. All laterals shall be straight.

5. All taps through 10" diameter in size shall have a machine drawn entrance and all fittings shall have longitudinal seams, continuous-welded. Both sides of all welds shall be primed with zinc chromate.

6. All tap entrances shall be free of weld build-up.

7. Elbows in diameters 3" through 10" shall be 2-section stamped or pleated elbows. Larger elbows shall be gored construction. Elbows shall be fabricated to a centerline radius of 1.5 times the diameter. All gored elbows shall be fabricated according to the following schedule:

Elbows	# of Gores
Up to 35°	2
36° to 71°	3
Over 71°	5

8. All field joints in diameters through 48" shall be made with a 2" long slip-fit or sleeve coupling provided assembly is not hindered. Ductwork over 48", and for all sizes where disassembly and removal is required, shall be joined with Vanstone or shop fabricated flanges.

9. All flanges and taps into spiral ducts shall be factory or shop fabricated and installed as hereinbefore specified. Shipment of loose flanges or taps for field installation shall be avoided.

10. All access doors for round duct shall be furnished by the access door manufacturer. Round duct access doors shall be of low leakage sandwich type suitable for systems up to 8” pressure, positive or negative. Round duct access doors shall be insulated and shall be equivalent to Ruskin model ARDD.

11. Unless specifically noted otherwise or required by special constraints, all elbows on ductwork changing direction from vertical to horizontal shall be 1.5 times radius.

2.04 SHOP APPLIED DUCT LINER

A. Interior supply and return ducts and plenums (other than outside air plenums), as hereinbefore specified to have internal duct insulation shall be lined with 1" thick fiberglass duct liner equal to Manville Permacote Linacoustic R300.

B. Liner shall meet the requirements of UL 181, ASTM C665 Bacteriological Standards, UL 723 Flamespread and NFPA 90A for flamespread and smoke developed ratings as borne out by tests and ratings of UL. Liner shall have an NRC no less than 0.80, based on Type A mounting as tested in accordance with ASTM C423-90 "k" factor not to exceed 0.25 (1") at 75°F mean temperature in accordance with ASTM C-518.

C. Maximum air friction in straight 24" diameter duct conveying 6200 cfm airflow at 2000 fpm velocity shall be 0.36" per 100'-0"

D. No erosion of insulation material shall occur below 5000 fpm duct velocity. Rigid board liner shall be constructed of strong glass fibers bonded with thermosetting resin.

E. All surfaces shall be protected with an acrylic coating.

F. Liner shall be applied with 100% coverage of approved fire resistant adhesive. Ducts over 20" in size in any direction shall be secured with mechanical fasteners ("stick-clips") on 12" centers and within 3" of ends.

G. Leading and exposed edges of liner joints shall be coated with fire resistant adhesive. Permacote-coated surface shall face the airstream.

H. The ductwork system shall be lined/sealed and installed in a manner to allow for low temperature air operation.

I. Care shall be exercised to ensure that no gaps or bare sheet metal exist, which might create condensation.

J. Acoustical liner installed in medium pressure ductwork and wherever lining starts abruptly from unlined ductwork shall be "nosed" with sheet metal flanging at all joints in accordance with SMACNA liner nosing details.

K. Liner shall be coated with a surface coating that does not support the growth of fungus or bacteria as determined by tests in accordance with ASTM C1071 and ASTM G21 and G22. Liner shall be sound absorptive.

L. The smooth black surface of the liner shall face the airstream and top pieces shall support the side pieces.

M. Lining on double wall duct systems may be completely covered with a layer of perforated minimum 24 gauge sheet metal (3/16 sq.in. holes on 7/16" staggered centers). The perforated sheet metal inner liner shall be secured with rivets and washers at intermediary points maximum 12" on center on all spans greater than 12" in width or height. Sheet metal nosing shall be provided to cover all insulation exposed-to-airstream edges, by bending of the sheet metal liner. Other methods of nosing, if different than the one specified, shall be submitted for review by the Engineer prior to installation.

2.05 ACCESS DOORS

A. Provide access doors and frames in all supply, exhaust and return ductwork as required, to permit access to:

1. Automatic dampers

2. In-box heating coils

3. Fire dampers

4. In-duct coils

5. All plenums
6. In-duct humidifiers
    a. Provide sight doors
7. Other similar equipment
8. Fan Bearings enclosed in ducts.
9. Duct smoke Detectors
    a. Provide sight doors
10. For cleaning and inspection purposes
11. Where indicated on the drawings

B. Door construction

1. Door size
    a. Ductwork
        1) Minimum 20” x 16”
        2) In ducts smaller then 16” they shall be 20” x 2” less then duct width except:
            a) Terminal Box heating coil door may be 12” x 6”
    b. Plenums
        1) Shall be 20” x 56”
            a) 18” x 45” door may be used only when 20” x 56” will not fit.
        2) Larger door shall be provided if required for equipment removal. Coordinate with equipment.
2. Doors shall match material type and gauge of the duct system in which they are installed.
3. Minimum gauge shall be 22.
4. Provide a neoprene gasketed around their entire perimeter.
5. Where sight doors are required, a wire reinforced safety glass shall be utilized.

6. Insulated or lined ductwork shall have insulated door

7. Insulated plenums shall have insulated door

8. Insulated doors shall be double wall.

9. Insulation between the metal panels shall be of the same thickness as the duct or panel adjacent to the access doors.

10. All access doors shall be hung on heavy hinges and shall be secured in the closed position by means of cast zinc clinching type cam latches

11. Hinged doors shall be similar to Greenheck model HAD-10.

12. Where space conditions preclude hinges, a minimum of (2) cams shall be utilized in low pressure ductwork and a minimum of (4) heavy window type latches shall be utilized in ductwork over 2" pressure class. In all cases where hinged doors are not utilized, a safety retainer chain shall be provided.

13. Cammed doors shall be equivalent to Greenheck model CAD-10.

14. All fire damper access doors in all positive pressure supply ductwork of +3" w.g. or greater construction:

    a. Shall be of the pressure relief (negative pressure) spring loaded type. Design shall incorporate self-closing spring latch or be complete with secure retainer chain and "D" handle.

    b. These doors shall be mounted downstream (after shutoff) of fire dampers, fire/smoke dampers or smoke dampers or similar automatic shutting devices.

    c. These doors shall be of the automatic reset type and similar to Ruskin model ADHP-3.

2.06 FLEXIBLE CONNECTIONS (AHUS, FANS)

A. Provide flexible connections of 4" minimum fabric width

1. Between ductwork and the inlets and outlets of all fans except:

    a. Hazardous exhausts

    b. Lab exhaust fans located indoors.

2. Equipment equipped with fans

3. All ductwork that crosses building expansion joints

B. The connections shall be placed as close to the equipment as practical except at fan suction connections and the clear gap at rest shall be not less than 3". At fan suction connections, locate flexible duct connection at least 3 duct diameters away from fan inlet connection.

C. There shall be no tension of the fabric under static or dynamic loads

D. All fabric for flexible duct connections to equipment shall be a minimum of 22 oz. glass fabric, double coated with neoprene, fire retardant, waterproof, airtight, and approved by UL, similar to Ventfabrics or Ventglass.

E. Exterior flexible connection shall be insulated type similar to Duro Dyne.

F. Flexible connections shall be fabricated from approved flameproofed fabric conforming to NFPA 90A. Asbestos shall not be acceptable.

G. Flexible connections shall be installed further upstream from fan powered equipment (in the main duct size) to prevent obstruction of the fan inlet due to suction of the fabric into the airstream.

H. Ductwork shall be increased in size where the flexible connections are located to prevent fully drawn in connections from blocking any duct area. Submit detail for review.

2.07 BLANK OFF PANELS FOR UNUSED LOUVER AREAS

A. Provide minimum 20 gauge sheet metal blank off panels for all unused louver areas:

1. All louver areas not enjoined or connected to an active plenum.

B. Exterior/visible face of blank off panel shall be cleaned and painted flat black, prior to installation.

C. Panels shall be screwed to louver frames and caulked to provide a weathertight seal.

D. Provide insulation of blank off panels. See specification Section 15081 - Ductwork insulation.

2.08 FLEXIBLE DUCTWORK (USE FOR TEMPORARY DUCTWORK ONLY. ALL PERMANENT DUCTS RIGID TYPE ONLY)

A. General

1. Flexible ductwork shall be supported at a maximum spacing of 2'-6", and as detailed on the drawings. Ductwork must not be compressed. Duct elbows must not exceed 45°.

B. Flexible Duct (Rigid)

1. Flexible duct shall be similar to Flexmaster Triple Lock Buck Duct Flexible Air Duct. Flexible duct (insulated) shall be UL 181, Class 0 listed air duct and

constructed in accordance with NFPA 90A and 90B. It shall have a smoke/flame spread rating of 50/25.

2. Triple Lock Buck Duct shall be made from a tape of dead soft aluminum sheet, spiral wound into a tube and spiral corrugated to provide strength and stability. The joint shall consist of a triple lock that is mechanically performed without the use of adhesives to make a durable airtight seam. A double lock is not acceptable.

3. Insulated flex shall have a gray fire retardant polyethylene outer jacket with an 8 oz. density, 1 1/2" thick fiberglass insulation blanket, factory wrapped.

4. The flexible duct shall be supported as required.

5. Flexible ductwork shall be rated at 12" positive pressure. Duct from 3" to 16" shall have a negative pressure 12" and duct from 18" to 20" shall have a negative pressure of 8".

6. All flexible ducts shall be individually cartooned and labeled for delivery to the job site for maximum protection.

7. Provide, where indicated in construction greater then +2” or less then –2”, and upstream of supply boxes or downstream of exhaust boxes.

C. Flexible Duct (Fabric)

1. Flexible duct shall be similar to Flexmaster Type 2. Flexible duct (insulated) shall be UL 181, Class 1 listed air duct and constructed in accordance with NFPA 90A and 90B. It shall have a smoke/flame spread rating of 50/25.

2. Duct fabric shall be of a heavy duty coated fiberglass cloth fabric. The fabric material shall be mechanically locked to the outside helix. (Use of adhesives to lock fabric in place is unacceptable.) The helix is constructed of a corrosive resistant galvanized steel, formed and mechanically locked to the duct fabric on the outside to prevent tearing of the flexible duct.

3. Insulated flex shall have a gray fire retardant polyethylene outer jacket with an 8 oz. density, 1 1/2" thick fiberglass insulation blanket, factory wrapped.

4. The flexible duct shall be supported as required to prevent sagging. Flexible duct with excessive sagging will not be approved.

5. Flexible ductwork shall be rated at 12" positive pressure and 10" negative pressure. Negative pressure for 14"R and 16"R shall be 5" and negative pressure for 18"R shall be 1".

6. All flexible ducts shall be individually cartooned and labeled for delivery to the job site for maximum protection.

7. Provide, where indicated in ±2” duct construction, downstream of supply boxes or upstream of exhaust boxes.

2.09 DAMPERS

A. General

1. The minimum damper requirements shall be as indicated in the following table:

Damper Construction Table						
Type	Approach Velocity (FPM)	Pressure Rating	Instantaneous Pressure Rating	UL555S Leakage Class	Blade Type	Listing
Fire dampers in ducts greater than +2" w.g. or less than -2" w.g. (FD)	2000	4”w.g.	10” w.g.	N/A	OBD 3V	UL555 Dynamic
Other fire dampers (FD)	2,000	4" w.g.	8" w.g.	N/A	Curtain or OBD	UL555 Dynamic
Fire smoke dampers in ducts greater than +2" w.g. or less than -2" w.g. and at all shafts (FSD)	3,000	4" w.g.	14" w.g.	I	Air Foil	UL555, UL555S Dynamic
Other fire smoke dampers (FSD or HFD)	2,000	4" w.g.	8" w.g.	I	OBD 3V	UL555, UL555S Dynamic
Smoke dampers (SD)	3,000	4" w.g.	14" w.g.	I	Air Foil	UL555S Dynamic
Isolation dampers (at units)	4.500	8" w.g.	20" w.g.	I	Air Foil	
Automatic dampers (AD)	4.500	6" w.g.	14" w.g.	I	Air Foil	N/A
Balancing dampers in ducts wider than 48" and/or deeper than 12" (VD or as specified)	2,500	4" w.g.	N/A	N/A	OBD	N/A
Balancing damper in ducts less than 48" by 12" (VD or as specified)	2,500	2”	N/A	N/A	OBD	N/A
Smoke control damper (SCD)	3,000	4"	8"		OBD	UL555S Dynamic

2. Dampers in stainless steel ducts shall be stainless steel.

B. Automatic Dampers

1. See Automatic Temperature Control Specification.

C. Fire Dampers, Ceiling Radiation Dampers, Smoke Dampers, and Combination Smoke/Fire Dampers

1. Fire dampers, smoke dampers and combination smoke/fire dampers shall be provided as shown on the drawings and wherever Engineerural drawings indicate

fire and/or smoke rated partitions. Devices shall be of the appropriate service for the partition class into which they are installed. Exact requirements and type of partition shall be coordinated with the Engineer.

2. All dampers shall meet the requirements of NFPA 90A and further shall be tested, rated and labeled in accordance with UL 555 (6th Edition), UL555S (4th Edition) and UL555C (1st Edition).

3. All dampers shall be tested, rated and labeled as "Dynamic Rated" for closure against airflow in the following configuration:

   a. Vertical mount (horizontal airflow): Ducted and unducted.

   b. Horizontal mount (airflow up): Ducted and unducted.

   c. Horizontal mount (airflow down): Ducted and unducted.

   Note: Static rated dampers shall not be allowed.

4. Each damper shall be rated to close against maximum design airflow at its installed location, with 400 fpm and .5 in wg. safety factors and against 4" w.g. maximum pressure across the closed damper.

5. All dampers of all ratings and types shall be of the nominal 100% face area type, with blade package and all frame components out of the airstream. These dampers shall include the required oversize enclosures which shall be sealed by the damper manufacturer for the appropriate duct pressure class into which they are installed. All such dampers shall have appropriate rectangular, flat oval or round duct collars to facilitate connection of mating ductwork. The Contractor shall be responsible for any additional sealing of duct collars and connections required to maintain the duct seal class requirements but shall not jeopardize the UL breakaway connection when utilized.

6. The Contractor shall indicate the location and rating of all dampers on his shop drawings and shall provide access doors at each location of sufficient size and type to permit access to the damper components. A list of fire dampers shall be provided for review. The Contractor shall be solely responsible to coordinate all locations of duct access doors and dampers of all types.

7. Contractor shall include damper manufacturer's installation instructions as part of the damper submittal. These instructions shall describe the applicable requirements for damper sleeve thickness; retaining angles; sealing; duct-to-sleeve connections; preparation of wall, floor or ceiling openings; and all other requirements to provide an installation equivalent to that tested by the damper manufacturer during the UL 555, UL555S and UL555C qualification procedures. Contractor shall detail any proposed installations that deviate from these manufacturer's instructions and explain the needed deviations. All fire, smoke and ceiling radiation damper installations shall comply with the manufacturer's installation instructions. Any

submitted deviations must be acceptable to the appropriate authority having jurisdiction.

8. Fire Dampers

a. Fire dampers shall be provided as shown on the drawings and wherever Engineerural drawings indicate fire-rated partitions to the following schedule:

Partition Assembly Fire Rating	Penetration Type	Damper Rating
1 Hour	Ducted and Sprinklered	No damper; duct sleeved and packed only
1 Hour	Ducted and Non-Sprinklered	1.5 Hour
1 Hour	Open (Transfer)	1.5 Hour
1.5 to 2 Hours	Ducted or Open	1.5 Hour
3 Hour	Ducted *	3.0 Hour
4 Hour	Ducted *	3.0 Hour
*No open transfer will be permitted through these partitions.		

b. Fire damper sleeves shall be manufactured with a metal sleeve of appropriate length and thickness for the required damper installation as shown in the table below:

Maximum Duct I.D.	Sleeve Gauge (U.S.)
Up to 84”	20 gauge
85” & Up	18 gauge

c. Fusible link temperature rating for all fire dampers shall be 212°F or 50°F above the highest system temperature, whichever is greater.

d. Dampers in stainless steel ducts shall be stainless steel.

e. Dampers located in welded systems shall be rigidly connected with welded connections (not breakaway).

9. Smoke Dampers and Combination Fire/Smoke Dampers

a. Smoke dampers and combination fire/smoke dampers shall be provided as shown on the drawings and wherever Engineerural drawings indicate smoke/fire rated partitions. Combination fire/smoke dampers shall be dynamically rated for 1.5 or 3 hours as determined by the Engineer.

b. Smoke dampers and combination fire/smoke dampers and actuators shall meet the requirements of NFPA 92A and NFPA 92B and further shall be tested, rated and labeled as a "Leakage Rated Damper for Use in Smoke Control Systems" in accordance with the 4th edition of UL 555S. All smoke dampers shall be of low leakage design qualified to UL 555S Leakage Class I (maximum leakage of 4 cfm/sq.ft. at 1" w.g. and 8

cfm/sq.ft. at 4" w.g.) and shall have a UL 555S elevated temperature rating of 350°F.

1) Each smoke damper/actuator combination shall be UL 555S rated to operate at maximum design airflow at its installed location with 400 fpm and .5 in wg. safety factors.

c. Each smoke damper and combination fire/smoke damper shall be supplied with an appropriate damper actuator installed by the damper manufacturer at the time of damper fabrication. Combination fire/smoke dampers shall be manufactured with a metal sleeve of appropriate length and thickness for the required damper installation, and the damper actuator shall be installed on the sleeve exterior. Smoke dampers may be installed in ductwork up to 24" from wall with no openings between the wall and the smoke damper.

1) Damper actuators shall be electric type for 120 volt operation.

2) Power wiring, including interlocking to smoke detectors and fire alarm system, and panels to effect the sequence of operation shall be by the Electrical Contractor.

3) Dampers shall be fail closed as follows:

a) Power to Damper: Open

b) No Power to Damper: Closed

d. Damper frame shall be galvanized steel formed into a structural hat channel shape with reinforced corners. The smoke and combination fire/smoke damper blades shall be airfoil type with Class 1 leakage rating. Bearings shall be stainless steel sleeve turning in an extruded hole in the frame. Blade edge seals shall be silicone rubber designed to withstand 450ºF (232ºC) and jamb seals shall be stainless steel flexible metal compression type.

e. Each damper shall be equipped with a remote open or closed position indication switch. The switch shall be over the shaft type using two independent rotary cams and adjustable switch points indicating open and closed positions. Switch can be factory or field applied to manufacturer's damper.

1) These switches shall be furnished by the damper manufacturer and wired by the Electrical Contractor, in a location approved by the Engineer.

2) Spare contacts shall be provided for additional remote (fire panel) operation.

f. Each combination fire/smoke damper shall also be equipped with a temperature limited re-openable feature equivalent to Greenheck model TOR providing the following operational sequence:

1) Temperature at damper fusible device reaches 165°F or 50°F above highest system temperature, whichever is greatest, and primary heat sensing device closes damper. Remote or local override command panel can then re-open damper.

2) If temperature at damper fusible device reaches 250°F, secondary heat sensing device will close the damper. Override and re-opening above this secondary temperature is not permitted. Both primary and secondary heat responsive devices shall incorporate a manual reset feature allowing restoration of normal operation after fire emergency has been cleared.

g. If utilizing system operation for smoke control purposes during the early phase of a fire emergency, each combination fire/smoke damper shall be equipped with a 286°F primary fusible device and 350°F minimum rated damper actuator. .

h. Dampers in stainless steel ducts shall be stainless steel.

i. Dampers located in welded systems shall be rigidly connected with welded connections (not breakaway).

10. Smoke Isolation Dampers at Air Handling Units

a. Provide smoke isolation dampers at air handling units as shown on drawings. Smoke dampers shall comply with NFPA 90A, UL 555S and the aforementioned requirements, except that dampers shall be pneumatically operated, with a minimum of (1) actuator for every 16 sq.ft. of damper or portion thereof.

1) Air to Damper: Open

2) No Air to Damper: Closed

b. The ATC Contractor shall provide all PE and EP switches, relays, etc., for ready wiring to the following schedule:

Device	Furnished By	Installed By	Actuator By	Actuator Type	End Switches	Control Air	Control Wires	Power	UL Assembly
Automatic Damper (AD) (When noted to be electric)	ATC	HVAC	ATC	Electric	ATC	N/A	ATC	ATC	No
Fire Smoke Damper (FSD)	HVAC	HVAC	Damper Manufacturer	Electric	ATC	N/A	ATC	Div 16	Yes
Smoke Damper (SD)	HVAC	HVAC	Damper Manufacturer	Electric	Damper Manufacturer	N/A	ATC	Div 16	Yes

Device	Furnished By	Installed By	Actuator By	Actuator Type	End Switches	Control Air	Control Wires	Power	UL Assembly
Smoke Isolation Damper (SD)	HVAC	HVAC	Damper Manufacturer	Electric	Damper Manufacturer	N/A	ATC	Div 16	Yes
Fire Damper (FD)	HVAC	HVAC	N/A	N/A	N/A	N/A	N/A	N/A	Yes
Smoke Control Damper (SCD)	HVAC	HVAC	Damper Manufacturer	Electric	N/A	N/A	ATC	Div 16	Yes

11. Smoke Control Dampers shall be the same as specified for smoke dampers only without end switches and alarm.

2.10 **INFLATABLE DAMPER SYSTEM**

A. General Requirements

1. The temperature control system shall automatically monitor and regulate indoor temperature by means of HVAC equipment control and control of air distribution.

B. Description

1. Indoor temperatures shall be achieved by controlling HVAC equipment including but not limited to; furnaces, air handlers, condensers, heat pumps, unit heaters, etc.
2. The temperature control system shall have the ability to manage and schedule set points.
3. The system shall control each room/area as its own zone.
4. Every supply run shall utilize an inflatable damper/zone valve as means of zoning and dynamic balancing.
5. Every zone shall have at least one temperature sensor installed for dynamic feedback.
6. Every supply duct in a room shall be individually controlled based on that room's temperature sensor.
7. The controls shall be Wi-Fi capable and allow remote access.
8. The controls shall be able to generate email alerts.
9. Controls shall be capable of controlling 3 stages of heat and two stages of cooling.
10. Controls shall be capable of controlling humidifier equipment.
11. Controls shall be capable of controlling fresh air introduction and/or related equipment.
12. Automated temperature control system shall comply with ASHRAE 62.1.

C. Work By Others

1. Division 26 (Electrical contractor) shall provide a 120-60-1 circuit with receptacle for each control system OR provide a hardwired connection with service switch where applicable.

D. Submittals

1. **Shop drawings shall layout location of all system components including HVAC equipment, inflatable dampers and sizes, proposed routing of air tubing, zoning layout, sensor locations and equipment mounting locations.**
2. **System wiring diagrams to include field connections as well as proposed wire routing.**
3. **Product specific cut sheets to include electrical, mechanical, dimensional and relevant certification data.**
4. **Product specific manufacturer installation and operation manuals.**

E. Closeout Submittals

1. **Record of installed components to include physical hardware locations, wiring and tubing routes, damper sizes and locations, installation and commissioning dates.**
2. **Record of programmed data to include zoning schedule, climate schedule, system settings and password information.**

F. Operation And Maintenance

1. **Include product specific manufacturer literature covering operation and maintenance.**
2. **Repair and/or replacement parts must be readily available for installed system.**
3. **Installing contractor shall provide maintenance and repair of installed system for a period of no less than one year from commissioning date.**
4. **Maintenance by installing contractor shall adhere to the written practices covered in the manufacturer's operation and maintenance manual.**
5. **Repair by installing contractor shall include 24 hour emergency service.**
6. **Maintenance and repair work must be performed by installing contractor unless written notice of subcontractor has been previously agreed upon by building owner and/or system administrator.**

G. Quality Assurance

1. **Product manufacturer shall have a minimum of 4 years documented experience in manufacturing industry specific products.**

H. System Responsibility

1. **The automated temperature controls and all components of the system are to be furnished by a single manufacturer who shall be responsible for the entire system.**

I. Warranty

1. **The automated temperature controls manufacturer shall provide a minimum of two years warranty on all installed components provided by said manufacturer.**

J. Manufacturers

1. **The preferred manufacturer of inflatable damper controls shall be Emme Controls Inc., Bristol, CT.**
2. **Mechanical dampers and controls as manufactured by Honeywell, Belimo, Trox or approved equal.**
3. **Comparable systems manufacturers and methods must be approved and accepted for substitution by owner.**

K. Main Display

1. **Main display shall utilize a 7” high definition color touchscreen.**
2. **Configuration information for the HVAC equipment shall be accessible from the main display.**
3. **The main display shall have the ability to be password protected.**
4. **The main display shall be hardwired to the backend.**
5. **The main display shall be powered by the backend.**
6. **The main display shall have the ability to be securely connected to the network via Wi-Fi or Ethernet connection.**

L. Master Unit

1. **The master unit shall serve as the system backend.**
2. **A wired connection between the master unit and HVAC equipment shall be made.**
3. **A wired connection shall be made between the master unit and main display.**
4. **The master unit shall house the air control mechanism.**
5. **Air control shall be achieved via electro mechanical solenoid valves.**
6. **The master unit shall provide female RJ-45 terminals for the connection of peripheral equipment.**
7. **The master unit shall be wired to the air pump and power supply unit.**
8. **The master unit shall be low voltage and powered by 12VDC from the air pump and power supply unit.**

M. Air Pump and Power Supply Unit

1. **The air pump and power supply unit shall house the air pump and power supply.**
2. **The primary side of the power supply transformer shall be supplied 120V/60Hz via grounded, corded 3 prong plug OR hardwired for applications where necessary to meet electrical code.**

3. **The secondary side of the power supply shall provide 12VDC.**
4. **The air pump shall be able to simultaneously produce pressure and vacuum to .5 PSI.**

N. Smart Sensors/Controllers

1. **Smart sensors/controllers shall be hard wired and communicate via RF.**
2. **Smart sensors/controllers shall obtain power through the hard wired connection.**
3. **Smart sensors/controller communications shall conform to FCC ID RU7-HCZ-SC-02 standard.**

O. Hard Wired Receivers

1. **Hard wired receivers shall be hardwired to the master unit via CAT-5 cable and 24 volt twisted pair cables.**
2. **Receivers shall receive data from smart sensors/controllers and relay data back to the master unit.**

P. Supply Plenum Sensor

1. **The supply plenum sensor shall be installed in the supply plenum.**
2. **The supply plenum sensor shall be hardwired to the master unit OR daisy chained to a nearby wireless receiver via CAT-5 cable.**
3. **The supply plenum sensor shall measure and relay supply plenum temperature and pressure.**

Q. Inflatable Dampers

1. **Inflatable dampers shall be installed in every supply run between takeoff and diffuser for intended area of control.**
2. **Inflatable dampers shall be installed in accordance manufacturer's install specification.**
3. **Every inflatable damper shall be connected to the master units' air control mechanism via ¼" copper tubing. Maximum 18" pig tail consisting of plenum rated ¼" non-metallic pneumatic tubing shall be allowable at end connection only and only inside ductwork.**

R **Plenum Rated Non-Metallic Air Tubing**

1. **Plenum rated non-metallic air tubing may be installed inside of the ductwork for maximum 18" pigtail termination only.**
2. **Tubing is to be properly supported.**
3. **Use of any tubing other than the tubing specified and sold by control manufacturer is prohibited.**
4. **Plenum rated tubing shall conform to the UL 1820 standard.**

S Copper Air Tubing

1. **Copper tubing shall be installed outside of ductwork.**
2. **Copper tubing is to be properly supported.**
3. **Copper tubing raceway/tray shall be provide to support multiple copper tubing runs.**
4. **Copper tubing shall be Type L Hard-Drawn Temper per ASTM B88 as manufactured by Mueller Industries, NIBCO Inc., Phelps-Dodge Copper Products Corp., Revere Copper and Brass Inc. or approved equal**
5. **Fittings shall be wrought copper solder joint fittings suitable for brazing and shall be in accordance with ANSI B16.22. Type "L" fittings shall have a minimum working water pressure of 150 p.s.i.**
6. **Flux for brazing Type L shall be equal to "Handy Flux" and shall comply with Navy Dept. Spec. 51F 4a.**
7. **The silver brazing alloy for brazed Type L joints shall be similar to Handy & Harmon Sil-Fos brazing alloy having a silver content of not less than 15% and a flow point of 1300oF.**
8. **Fittings shall be manufactured by Mueller Industries, NIBCO Inc., Elkhart Products Corp. or approved equal**

PART 3 - EXECUTION

3.01 SHEET METAL INSTALLATION

A. All ductwork shall be installed to true alignment, generally parallel or perpendicular to adjacent building walls, floors and ceilings, so as to present a neat and workmanlike appearance. All fabricated, stored and installed ductwork shall be protected with removable caps, plastic or other means to prevent dirt, water and debris from entering duct system. The Sheet Metal Contractor shall be responsible for maintaining a clean duct system and shall clean and/or replace any ductwork identified by the Owner or Engineer as being deficient or dirty. The Sheet Metal Contractor shall be responsible for all costs associated with the temporary protection cleaning and/or replacement of ductwork. All fabrication labels shall be applied to the exterior of the duct. The Sheet Metal Contractor shall be responsible for the removal of all internal labels if such labels were incorrectly applied.

B. Care shall be paid to the exact locations of all sheet metal work with respect to equipment, ducts, conduits, piping, slabs, beams, columns, ceiling suspension systems, lighting fixtures and electrical, plumbing and fire protection systems in the building. Close coordination and cooperation shall be exercised with other Trades in locating the piping and equipment in the best interests of the Owner. The drawings and specifications covering other work to be done in the building shall be carefully studied and arrangements shall be made to avoid conflict.

C. The drawings shall be followed where they are definite and provided such procedures do not cause objectionable conditions for equipment provided installed under this Contract.

The drawings are intended to indicate the sizes of ductwork and if certain sizes are omitted or unclear, obtain additional information before proceeding.

D. Locate and size all openings for ductwork in the building construction. Provide all sleeves as hereinbefore specified.

E. Provide access doors in ductwork at the following locations:

1. Both sides of all coils
2. Fire dampers
3. Smoke dampers
4. Fire/Smoke dampers
5. Both sides of automatic dampers
6. Both sides of filters
7. At a maximum of 20'-0" and at every change in direction in kitchen exhaust system and/or as required by code.
8. At all exhaust and intake plenums, doors shall allow full body access in all plenums over 4'-0" tall.
9. Otherwise indicated or specified

F. Provide labels with a minimum of 1" high red letters on white background. Each access door shall be labeled as follows (or worded as required by Code):

1. Fire Damper
2. Fire/Smoke Damper
3. Smoke Damper
4. Automatic Damper
5. Filter Access
6. Coil Access

G. The installation of special items of equipment in the duct systems, including automatic dampers, thermostats, thermometers, duct airflow measuring devices and other related controls, shall be done by this Contractor under the direct supervision of the manufacturer of such controls.

H. All elbows, tees and branch takeoffs in round ductwork shall be made of the same materials as the ductwork.

I. Duct connections to equipment shall be in no case smaller than the equipment openings.

J. All openings for pitot tube traverses shall be fitted with neat removable plugs or caps. As a minimum, such openings shall be provided at every fan inlet and at such other points as may be required for airflow measuring and balancing. Coordinate the location of plugs and caps with the Balancing Contractor.

K. All internally lined duct sections and joints shall be closely inspected by the contractor before and after each piece is erected. Loose edges, open joints, damaged areas and other defects shall be sealed securely so as to insulate all metal surfaces and so as to endure without falling in the presence of moving air. All liner applications shall comply with SMACNA "Duct Liner Application Standard".

L. Provide other miscellaneous sheet metal work shown on the drawings including blanking off portions of louvers not required for the specific usage and diffusion plates or mixing air scoops to allow for air mixing where job conditions require the provision of same. All above work shall be provided as part of this Contract at no extra cost to the Owner.

M. Where applicable and as approved by the Engineer, all exposed ductwork shall be installed in a workmanlike manner to result in a neat appearance with no visible penetrations, screws, or other sheet metal imperfections.

N. Install all UL classified devices in accordance with their UL approved installation sheets.

O. Counterflashing of duct penetrations through roof shall be provided under this Contract.

3.02 DUCT HANGERS AND SUPPORTS

A. Provide suitable angle iron/strap hangers and supports inside the mechanical shafts, mechanical rooms and in ceilings of the buildings, and on the roof(s) as shown on the drawings. This work shall be performed as required by job conditions and as instructed by the Engineer in the field to support all air distribution ductwork and devices in both horizontal and vertical planes.

B. When hanging and supporting the ductwork, the following shall be complied with:

1. Except as otherwise noted, ductwork up to 42" in greatest dimension shall be hung by using sheet metal bands secured as a minimum at (2) locations to the vertical sides of the ductwork and at (1) location under the duct. All support systems shall be compatible with the building structure and roofing system as approved by the Engineer.

2. Where ductwork major axis dimension is larger than 42", ductwork shall be hung by using rods of not less than 3/8" soft steel secured to angle iron trapeze support frame around ductwork with threaded nuts for securement and adjustment. All rods used on ductwork exposed in finished spaces shall be plain smooth rods threaded only at the ends.

3. Ductwork shall be securely attached to the building construction. The hanger design and spacing shall be governed by the major duct dimension and shall be in accordance with SMACNA Duct Manual, except as modified hereinbefore. Vertical ductwork shall be supported at each floor level in an approved manner using angles or channels attached to the ducts. The installation, when complete and under operating conditions, shall be free from chatter or vibration. If necessary to achieve this, additional supports and/or bracing shall be furnished without extra cost to the Owner. Supports and bars and similar items shall be primed and painted structural steel. Touch up with aluminum paint any surfaces where galvanizing is destroyed on indoor ductwork, zinc primer on exposed ductwork with a final coat of aluminum paint. Provide vibration isolation hangers where specified under Vibration Isolation Section of these specifications.

4. The Sheet Metal Contractor shall provide all supplemental steel required to support the ductwork in shafts, mechanical rooms or on the floor where structural steel is not properly positioned. Beam clamps shall be double sided.

5. The maximum hanger spacing shall be 10'-0" on centers and additionally on each side of an elbow or change-in-direction fitting.

6. In addition to the above, provide supports on each side of any duct mounted device, fans, coils, flow measuring stations, framed dampers, etc., to permit removal of the device without disconnecting adjacent duct sections.

7. Provide angle sway bracing to the structure wherever lateral loads would be imposed on the ductwork, including but not limited to:

    a. Elbows downstream of fan discharges.

    b. Ductwork exposed to the weather subject to wind loads.

8. Ductwork mounted on the roof or otherwise exposed to the elements shall be supported with frames constructed of steel angles and channels regardless of duct size.

    a. Coordinate all roof supports with General Contractor.

    b. Provide diagonal cross bracing between supports as required to sustain maximum area wind loads as dictated by the Engineer.

9. The Sheet Metal Contractor shall provide expansion compensators, anchors and guides on all high temperature ductwork (breeching, high temperature supply/exhaust) as required.

3.03 SHEETMETAL TESTING

A. General

1. All ductwork that is required to be tested shall be tested on regular intervals as the job proceeds and shall be completed prior to enclosure in shafts, above ceilings or behind walls.

2. The Sheet Metal Contractor shall keep an up-to-date log of the ductwork tested for review by the Engineer. The Sheet Metal Contractor shall notify all other Contractors when the testing is completed and accepted to permit enclosure of ducts.

3. The Sheet Metal Contractor shall furnish and install all blank off plates, blind flanges, safing, etc., necessary to isolate each section of duct being tested for leakage.

4. The Sheet Metal Contractor shall submit for review all proposed testing procedures, sample report, and equipment to the Engineer prior to proceeding. Additionally, the Sheet Metal Contractor shall notify the Engineer when testing is to occur so that the test can be witnessed at the Engineer's option.

5. All test equipment shall be calibrated per ANSI Standards prior to testing. Certified test reports shall be submitted to the Engineer prior to commencement of the testing.

6. Testing Procedure

    a. The testing procedure shall be in accordance with SMACNA "HVAC Air Duct Leakage Test Manual".

    b. The test pressure shall be the specified construction pressure of the duct system.

7. Scope of Testing

    a. All ductwork (regardless of pressure class) that will be in inaccessible areas including, but not limited to, all ducts within shafts, above hard ceilings, and those that will be made inaccessible by the work of other Trades. (This shall include ±2" w.g. construction.)

    b. All ductwork constructed to greater than +2" w.g. or less than -2" w.g.

    c. All other sheet metal in duct systems constructed to ±2" w.g. shall be tested under normal fan pressure and shall not leak sufficiently to cause audible leaks or blowing detectable by hand. If, in the opinion of the Engineer, the ductwork does not appear to be constructed and/or sealed to the approved shop standards, the Engineer may request any or all of this ductwork to be tested at the specified construction pressure.

    d. Allowable Leakage

1) The total allowable leakage shall be less than specified leakage class with no audible leaks.

2) If no leakage class is listed elsewhere, the system shall meet leakage Class 4.

3.04 INFLATABLE DAMPER INSTALLATION

A. Installation

1. **System to be installed in accordance with supplied manufacturer's installation instructions.**

2. **System to be installed by qualified contractor and meet all applicable code requirements.**

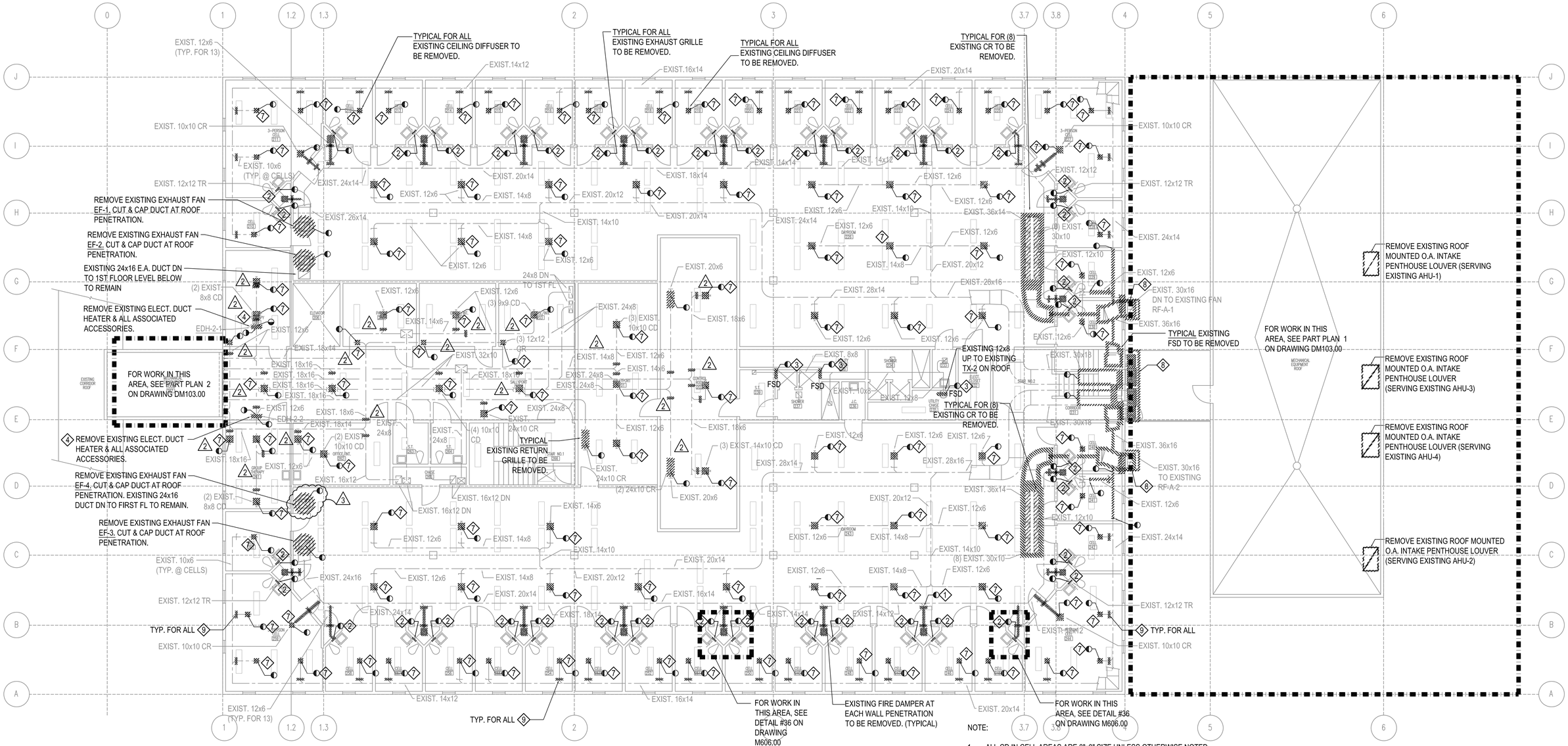
B. Commissioning

1. **System to be commissioned in accordance with manufacturer's instructions.**

2. **Contractor shall perform testing to ensure control of forced air at each supply register.**

3. **A representative from the control manufacturer shall be available for commissioning.**

END OF SECTION 23 31 00



1 2ND FLOOR - REMOVAL WORK

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

TAG NOTES:

1. REMOVE EXISTING DUCTWORK FROM MAIN TO POINT SHOWN INCLUDING FIRE DAMPER.
2. REMOVE EXISTING 12x6 RR UON. ALONG WITH SLEEVE, VOLUME DAMPER AND DUCT TO THE EXTENT SHOWN.
3. DISCONNECT EXISTING FSD FROM POWER/FIRE ALARM. REMOVE DAMPER WITH MIN. 4'-0" DUCT ON EITHER SIDE. TEMPORARILY CAP UNTIL REPLACEMENT.
4. DISCONNECT POWER AND CONTROL FROM DUCT HEATER AND MIN. 4'-0" DUCT ON EITHER SIDE OF HEATER. TEMPORARILY CAP UNTIL REPLACEMENT.
5. CEILING REGISTER.
6. DISCONNECT AND REMOVE EXISTING THERMOSTAT, ALL CONTROL WIRING IN ITS ENTIRELY. SEE M101 FOR NEW WORK. NOT ALL THERMOSTAT ARE SHOWN. VERIFY THERMOSTAT LOCATION IN FIELD. LOCATION SHOWN IS APPROXIMATE.
7. CLEAN AND WIRE BRUSH EXISTING AIR INLETS AND OUTLETS, COMB ALL APERTURES.
8. REMOVE EXISTING EXTERIOR ARCHITECTURAL DUCT ENCLOSURE IN ITS ENTIRELY CAREFULLY, STORED SAFELY AND REINSTALL UPON COMPLETION OF NEW WORK AS SHOWN ON CONSTRUCTION PLAN AND RESTORE TO ORIGINAL CONDITION.
9. REMOVE EXISTING VOLUME DAMPER AT ALL DUCT BRANCH LOCATIONS. RELOCATE LIGHT FIXTURE, GRILLES, OR OTHER COMPONENT AS REQUIRED TO PERFORM WORK.

NOTE:

1. ALL CD IN CELL AREAS ARE 8"x8" SIZE UNLESS OTHERWISE NOTED.
2. ALL CD IN DAYROOM AREAS ARE 10"x10" SIZE UNLESS OTHERWISE NOTED.
3. EXISTING FIRE DAMPER AT EACH WALL PENETRATION TO BE REMOVED TYP.
4. DISCONNECT ALL FIRE SMOKE DAMPERS AND POWER, CONTROL, FIRE ALARM CONNECTIONS AND REMOVE EXISTING SMOKE PURGE PANEL ALONG WITH SUPPORTS.
5. CLEAN ALL EXISTING DUCTWORK IN THEIR ENTIRETY AS PER SPECIFICATIONS PRIOR TO PROVISION OF ANY NEW COMPONENTS, SEE NOTES ON DRAWING M003.00.
6. DISCONNECT AND REMOVE LIGHTING FIXTURES AS REQUIRED, REINSTALL AND RECONNECT AFTER COMPLETION OF WORK AND RESTORE TO ORIGINAL WORKING CONDITION.
7. SEE PHASING PLAN FOR WORK TO BE PERFORMED IN PHASES. PROVIDE CONTINUOUS AIR QUALITY AND NOISE MONITORING AND TRACKING FOR DURATION OF CONTRACT. CONTRACTOR SHALL HIRE AN ACOUSTIC CONSULTANT TO ENSURE THE CODE ALLOWED NOISE LEVEL IS NOT EXCEEDED. CONTRACTOR SHALL PROVIDE ALL NECESSARY COMPONENTS TO ENSURE COMPLIANCE.

REMOVE ALL CEILING/LIGHT FIXTURES, OTHER COMPONENTS AS NECESSARY TO PERFORM ALL WORK AS SHOWN WHETHER SPECIFICALLY INDICATED OR OTHERWISE.

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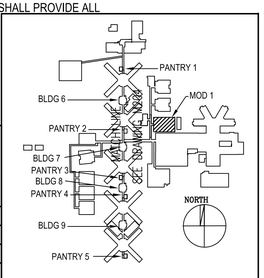


KEY PLAN

CITY OF NEW YORK DEPARTMENT OF CORRECTION

THE CITY OF NEW YORK
DEPARTMENT OF CORRECTION
DIVISION OF CAPITAL POLICY
AND DEVELOPMENT
ENGINEERING UNIT

DESIGNED BY:

IAQ SYSTEMS INC
Consulting Engineers
630 9th Avenue, Suite 1112
New York, New York 10036
Tel. 212.680.8945
www.iaqsys.com

Project:

AIR CONDITIONING SYSTEM REPLACEMENT

MODULAR BUILDING NUMBER 1
ANNA M. KROSS CENTER
18-18 HAZEN STREET, RIKERS ISLAND,
EAST ELMHURST, NEW YORK 11370

No.	Date	Revision
3	04-24-17	ADDENDUM 3
2	04-17-17	ADDENDUM 2
	01-30-17	ISSUED FOR BID

Director:	HARDEE SAINI
Project Manager:	BV
Project Engineer:	
Drawn By:	Checked By: SB
PIN # 072201723CPD	Date: 01/21/2015

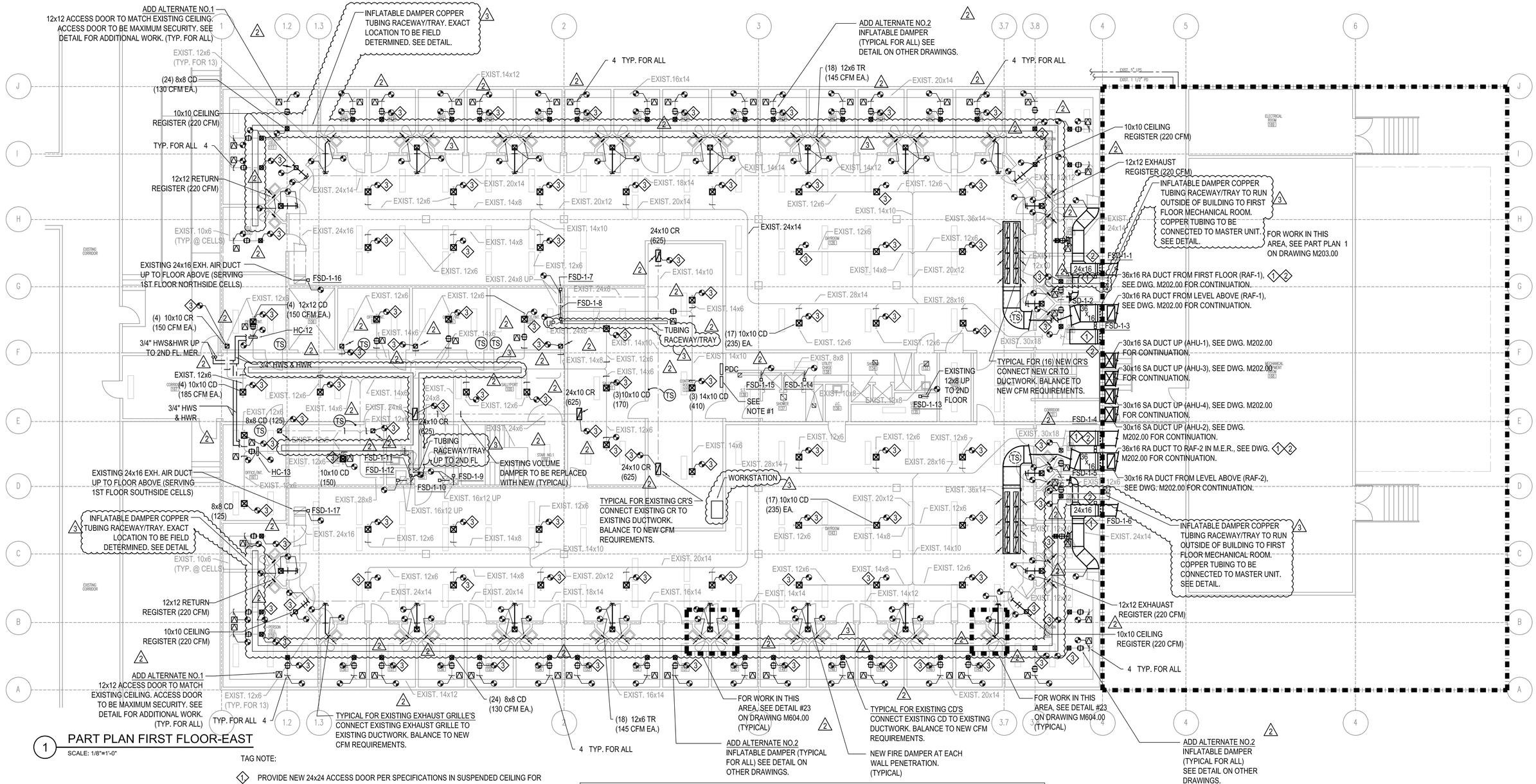
Drawing Title:
HVAC
SECOND FLOOR
REMOVAL WORK

Seal:

Drawing No.: DM102.00

Scale: 1/8" - 1'-0"

Sheet: 12 of 70



1 PART PLAN FIRST FLOOR-EAST

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

TAG NOTE:

1. PROVIDE NEW 24x24 ACCESS DOOR PER SPECIFICATIONS IN SUSPENDED CEILING FOR ACCESS TO ALL DAMPERS. ACCESS DOOR CONSTRUCTION AND INSTALLATION SHALL BE FOR MAXIMUM SECURITY AND SHALL MATCH THE CEILING CONSTRUCTION.
2. SEE DUCTWORK PENETRATION DETAIL ON DRAWING M202.00 (2) DETAIL.
3. CLEAN EXISTING AIR INLETS AND AIR OUTLETS IN PLACE THOROUGHLY. WIRE BRUSH AND COMB ALL APERTURES, PAINT AND FINISH RESTORE TO ORIGINAL CONDITION. PROVIDE SECURITY CAULKING AROUND THE AIR INLETS/OUTLET AND FLANGE ASSEMBLY FOR TIGHT SECURE INSTALLATION.
4. PROVIDE NEW VOLUME DAMPER AT ALL DUCT BRANCH LOCATIONS. RELOCATE LIGHT FIXTURES, GRILLES, OR OTHER COMPONENTS AS REQUIRED TO PERFORM WORKS. VOLUME DAMPERS SHALL BE INSTALLED IN CLOSE PROXIMITY TO INFLATABLE DAMPERS FOR ACCESS COMMON ACCESS DOOR.

NOTE:

1. PROVIDE NEW SMOKE PURGE PANEL TO BE INSTALLED IN CONTROL ROOM. SEE SEQUENCE ON SMOKE PURGE MATRIX AND SCHEDULE DWG. SMOKE PURGE PANEL TO BE INTERFACED WITH EXISTING FIRE ALARM SYSTEM. CONTRACTOR SHALL HIRE EXISTING FIRE ALARM SYSTEM VENDOR (SIMPLEX / GRINNELL) FOR INTERFACING SMOKE PURGE PANEL WITH EXISTING FIRE ALARM CONTROL PANEL.
2. PROVIDE FIRE SMOKE DAMPER AT EACH WALL PENETRATION (TYPICAL).
3. TYPICAL FOR EXISTING EXHAUST REGISTERS. CONNECT EXISTING EXHAUST REGISTERS TO EXISTING DUCTWORK. BALANCE TO CFM REQUIREMENTS. ENSURE TIGHT FIT WITH THE ARCHITECTURAL PORTION USING SECURITY FASTENERS. PROVIDE SECURITY CAULKING ON ALL SIDES OF THE REGISTER. OBTAIN APPROVAL FROM DOC.
4. PROVIDE NEW 12x12 ACCESS DOORS IN CEILING AS REQUIRED FOR ALL SERVICEABLE COMPONENTS SUCH AS DAMPERS, VALVES CONTROL ETC. FOR CONSTRUCTION ACCESS AND DUCT CLEANING CONTRACTOR.
5. ANY DUCT EXCEEDING 6" IN ANY DIMENSION SHALL BE PROVIDE WITH SECURITY BAR PER SPECIFICATION. MAXIMUM SECURITY AIR INLETS / AIR OUTLET SHALL BE EXCLUDED FOR HAVING SECURITY BARS.
6. CONTRACTOR TO PROVIDE CONSTRUCTION NOISE AND AIR QUALITY MONITORING DURING CONSTRUCTION WORK AS PER CODE.

1. REMOVE ALL CEILING/LIGHT FIXTURES, OTHER COMPONENTS AS NECESSARY TO PERFORM ALL WORK AS SHOWN WHETHER SPECIFICALLY INDICATED OR OTHERWISE.
2. ACCESS DOORS SHALL BE LOCATED FOR ACCESS TO BOTH INFLATABLE DAMPERS AND THE VOLUME DAMPERS. CUT CEILINGS AS REQUIRED TO INSTALL ALL DAMPERS AND RESTORE TO ORIGINAL CONDITION.

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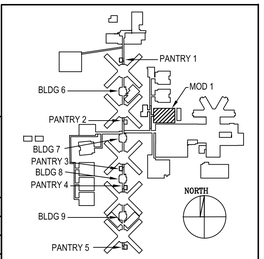

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	01-30-17	ISSUED FOR BID

Director:	HARDEE SAINI
Project Manager:	BV
Project Engineer:	
Drawn By:	Checked By: SB
PIN # 072201723CPD	Date: 01/21/2015

Drawing Title:

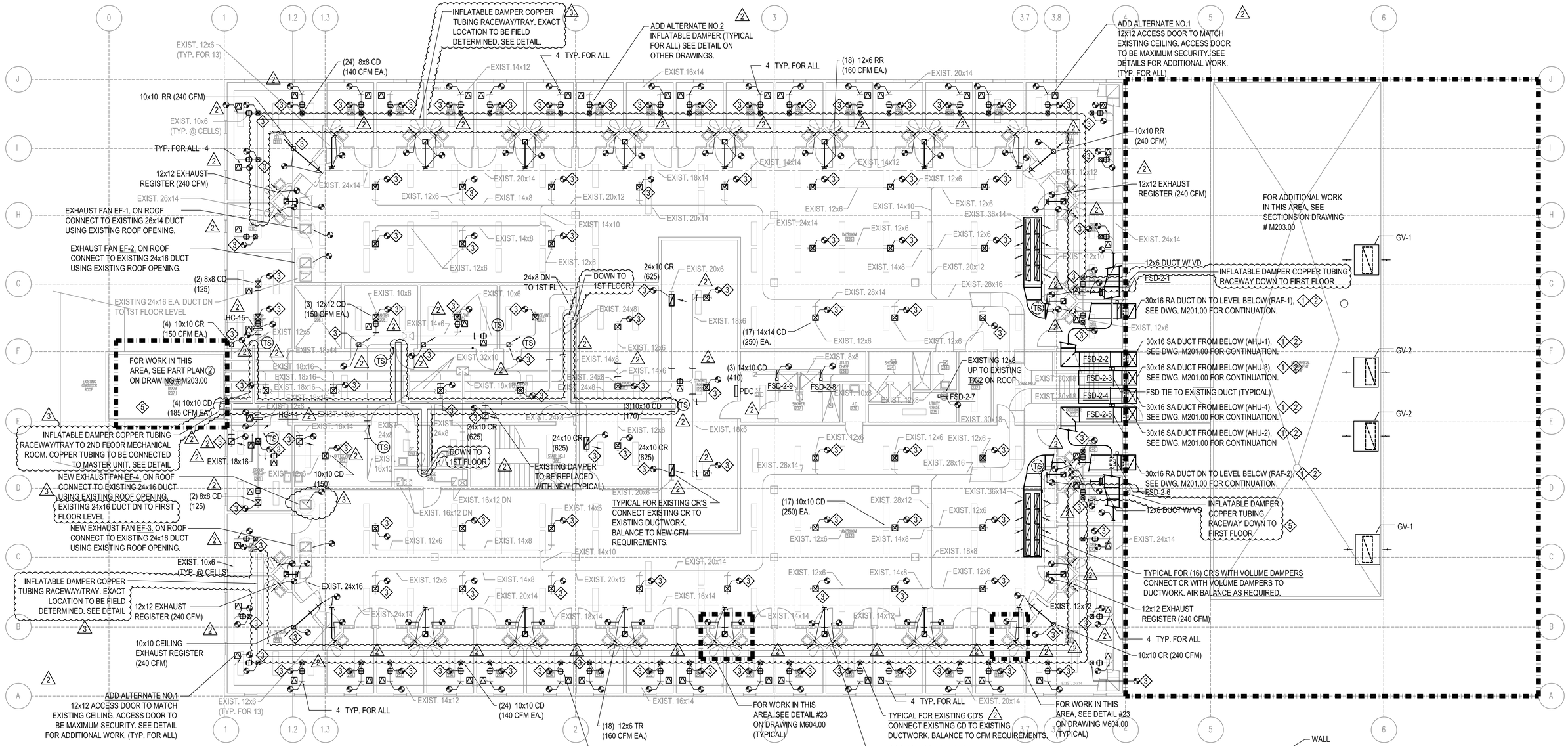
HVAC
FIRST FLOOR
CONSTRUCTION PLAN

Seal:

Drawing No.: M201.00

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

Sheet: 16 of 70



1 2ND FLOOR PLAN MODULE 1 - CONSTRUCTION WORK

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

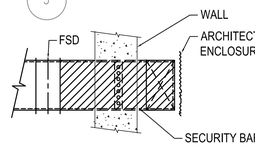
TAG NOTE:

1. PROVIDE NEW 24x24 ACCESS DOOR PER SPECIFICATIONS IN SUSPENDED CEILING FOR ACCESS TO ALL DAMPERS. ACCESS DOOR CONSTRUCTION AND INSTALLATION SHALL BE FOR MAXIMUM SECURITY AND SHALL MATCH THE CEILING CONSTRUCTION.
2. SEE DUCT WORK PENETRATION INSTALLATION DETAIL ② ON THIS DRAWING.
3. REINSTALL AND CLEAN EXISTING AIR INLETS AND AIR OUTLETS IN PLACE THOROUGHLY. WIRE BRUSH AND COMB ALL APERTURES, PAINT AND FINISH RESTORE TO ORIGINAL CONDITION. PROVIDE SECURITY CAULKING AROUND THE AIR INLETS/OUTLET AND FLANGE ASSEMBLY FOR TIGHT SECURE INSTALLATION.
4. PROVIDE NEW VOLUME DAMPER AT ALL DUCT BRANCH LOCATIONS. RELOCATE LIGHT FIXTURES / GRILLES / OTHER COMPONENTS AS REQUIRED TO PERFORM WALL
5. CONTRACTOR SHALL HIRE ROOFING CONTRACTOR TO PERFORM ALL ROOFING RELATED WORK TO ENSURE ROOF INTEGRITY IS MAINTAINED AFTER OTHER TRADE WORK IS INSTALLED.

1. REMOVE ALL CEILING/LIGHT FIXTURES, OTHER COMPONENTS AS NECESSARY TO PERFORM ALL WORK AS SHOWN WHETHER SPECIFICALLY INDICATED OR OTHERWISE.
2. ACCESS DOORS SHALL BE LOCATED FOR ACCESS TO BOTH INFLATABLE DAMPERS AND THE VOLUME DAMPERS. CUT CEILINGS AS REQUIRED TO INSTALL ALL DAMPERS AND RESTORE TO ORIGINAL CONDITION.

NOTE:

1. PROVIDE FIRE DAMPER AT EACH WALL PENETRATION (TYPICAL).
2. TYPICAL FOR EXISTING EXHAUST REGISTERS CONNECT EXISTING EXHAUST REGISTERS TO EXISTING DUCTWORK. BALANCE TO NEW CFM REQUIREMENTS. ENSURE TIGHT FIT WITH THE ARCHITECTURAL PORTION USING SECURITY FASTENERS. PROVIDE SECURITY CAULKING ON ALL SIDES OF THE REGISTER AND OBTAIN APPROVAL FROM DOC.
3. PROVIDE NEW 12x12 ACCESS DOORS IN CEILING AS REQUIRED FOR ALL SERVICEABLE COMPONENTS SUCH AS DAMPERS, VALVES CONTROL ETC. FOR CONSTRUCTION ACCESS AND DUCT CLEANING CONTRACTOR.
4. ANY DUCT EXCEEDING 6" IN ANY DIMENSION SHALL BE PROVIDE WITH SECURITY BAR PER SPECIFICATION. MAXIMUM SECURITY AIR INLETS / AIR OUTLET SHALL BE EXCLUDED FOR HAVING SECURITY BARS.
5. CONTRACTOR TO PROVIDE CONSTRUCTION NOISE AND AIR QUALITY MONITORING DURING CONSTRUCTION WORK AS PER CODE.



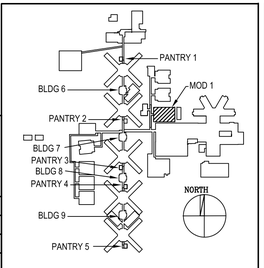
NOTE:

1. 2 HOURS RATED FIRE BARRIER (3M615+ OR APPROVED EQUAL) MIN. 24" INSIDE BUILDING. AND TOTAL MIN. LENGTH 8'-0"

2 DUCTWORK PENETRATION DETAIL

SCALE: N.T.S.

0 4 8 16



KEY PLAN

CITY OF NEW YORK DEPARTMENT OF CORRECTION

THE CITY OF NEW YORK
DEPARTMENT OF CORRECTION
DIVISION OF CAPITAL POLICY AND DEVELOPMENT ENGINEERING UNIT

DESIGNED BY:

IAQ SYSTEMS INC
Consulting Engineers
630 9th Avenue, Suite 1112
New York, New York 10036
Tel. 212.680.8945
www.iaqsys.com

Project:

AIR CONDITIONING SYSTEM REPLACEMENT

MODULAR BUILDING NUMBER 1
ANNA M. KROSS CENTER
18-18 HAZEN STREET, RIKERS ISLAND,
EAST ELMHURST, NEW YORK 11370

No.	Date	Revision
3	04-24-17	ADDENDUM 3
2	04-17-17	ADDENDUM 2
	01-30-17	ISSUED FOR BID

Director:	HARDEE SAINI
Project Manager:	BV
Project Engineer:	
Drawn By:	Checked By: SB
PIN # 072201723CPD	Date: 01/21/2015

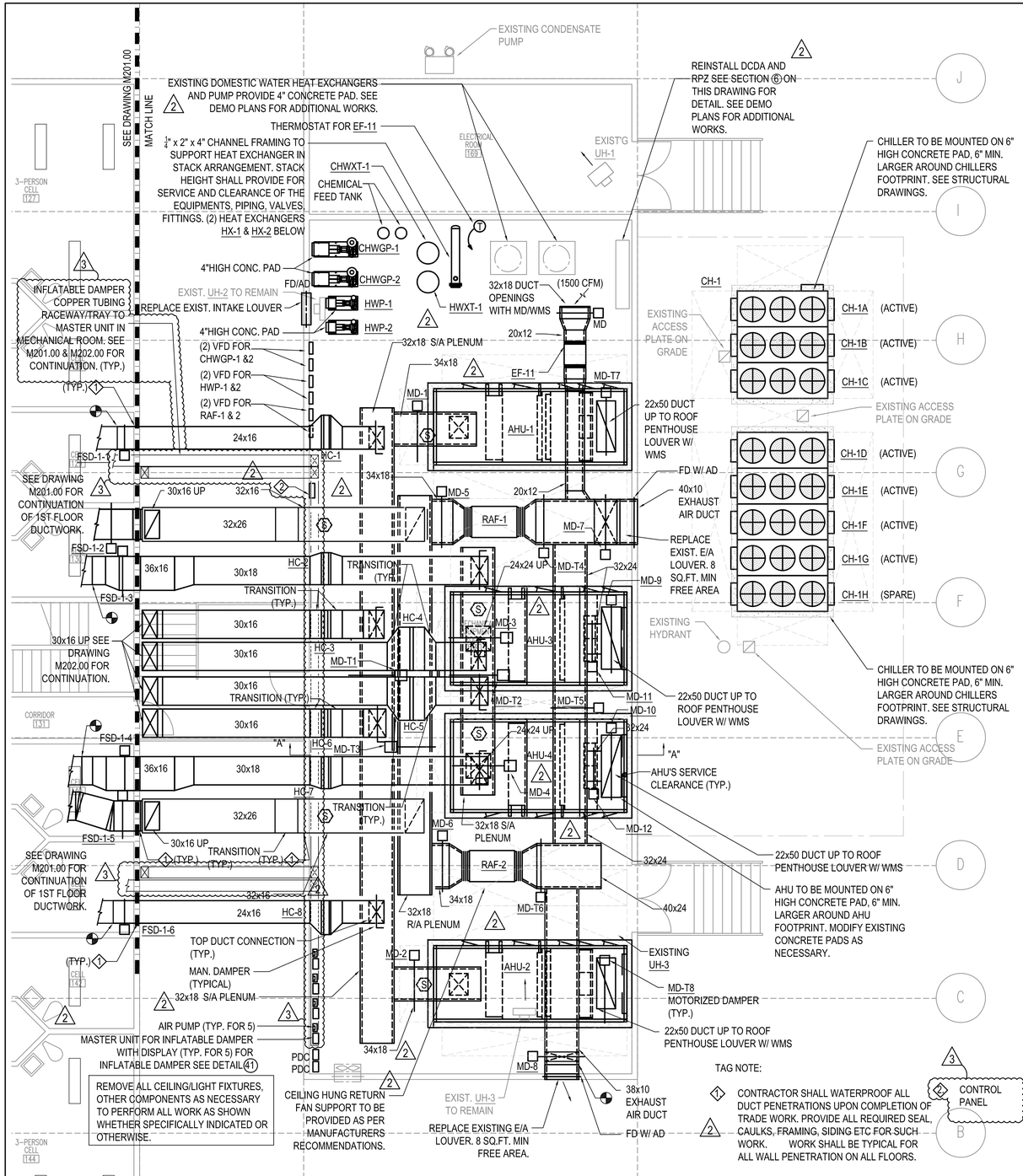
Drawing Title:
HVAC
SECOND FLOOR
CONSTRUCTION PLAN

Seal:

Drawing No.: M202.00

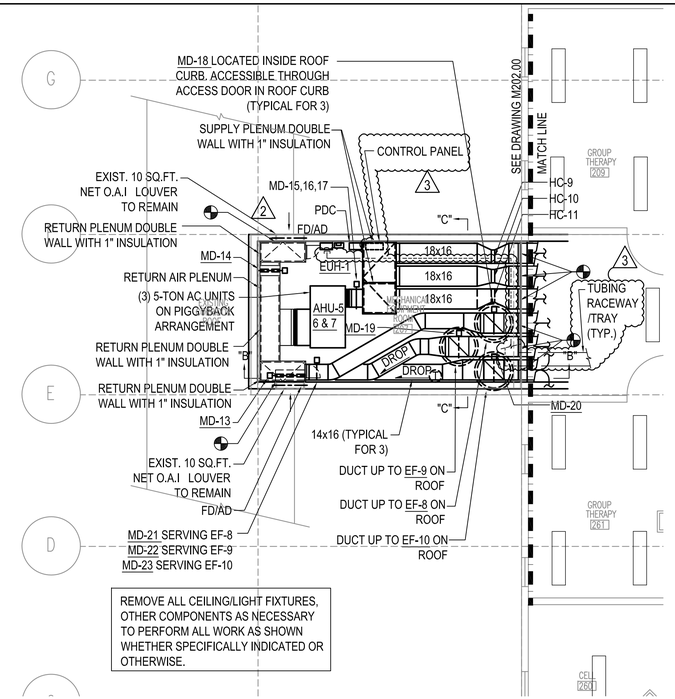
Scale: 1/8" = 1'-0"

Sheet: 17 of 70



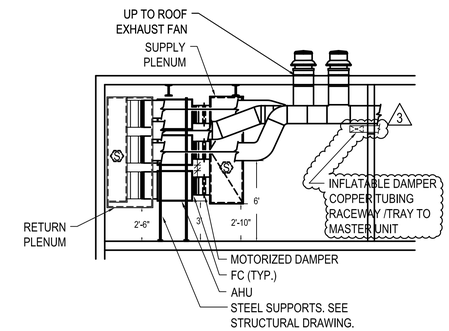
1 PART PLAN MECHANICAL ROOM - CONSTRUCTION WORK

SCALE: 3/16"=1'-0"



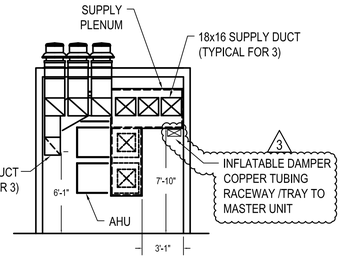
2 PART PLAN 2ND FLOOR M.E.R. - CONSTRUCTION WORK

SCALE: 3/16"=1'-0"



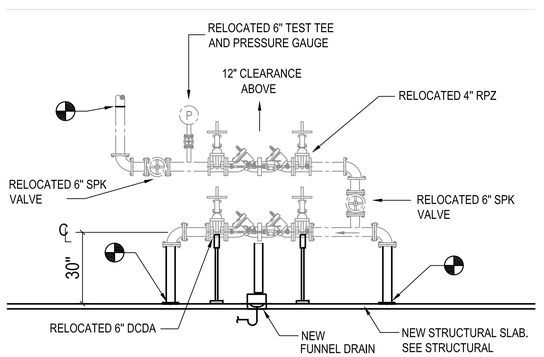
3 2ND FLOOR M.E.R. - ELEVATION "B-B"

SCALE: 3/16"=1'-0"



4 2ND FLOOR M.E.R. - ELEVATION "C-C"

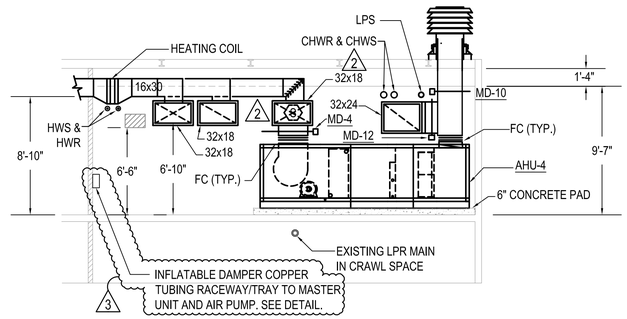
SCALE: 3/16"=1'-0"



1. REINSTALL DCDA-1 TO BE 30" ABOVE FLOOR LEVEL.
2. ELEVATION BETWEEN RPZ AND DCDA SHALL REMAIN
3. ALL VALVES, TEST TEE AND PRESSURE GAUGE SHALL RELOCATE ACCORDINGLY.
4. MINIMUM CLEARANCE TO FRONT OF DCDA & RPZ= 30"
5. MINIMUM CLEARANCE TO REAR OF DCDA & RPZ = 8"
6. SEE DISINFECTION NOTES ON GENERAL NOTES

6 MECHANICAL ROOM - ELEVATION "A-A"

SCALE: 3/16"=1'-0"

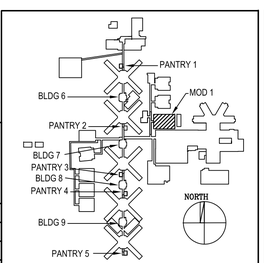


5 MECHANICAL ROOM - ELEVATION "A-A"

SCALE: 3/16"=1'-0"

GENERAL NOTE:
1. CONTRACTOR TO PROVIDE CONSTRUCTION NOISE AND AIR QUALITY MONITORING DURING CONSTRUCTION WORK AS PER CODE.

0 4 8 16



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Director:	HARDEE SAINI
Project Manager:	BV
Project Engineer:	
Drawn By:	Checked By: SB
PIN # 072201723CPD	Date: 01/21/2015

Drawing Title:

HVAC - PART PLAN
MECHANICAL ROOMS
CONSTRUCTION PLAN

Seal:

Drawing No.: M203.00

Scale: 1/4" = 1'-0"

Sheet: 18 of 70

		INPUT/OUTPUT (NOTE 1)														SOFTWARE/FIRMWARE FEATURES (NOTE 2, 3)											NOTES
"CONSTANT VOLUME AIR HANDLING UNIT"		SENSED				CALCULATED						CONTROL				ALARMS AND ADVISORIES (WITH INSTRUCTIONS)							MISC. FEATURES					
REFERENCE NO.	POINT NAME	ANALOG INPUT	ANALOG OUTPUT	DIGITAL INPUT	DIGITAL OUTPUT	RATE OF VARIABLE	TOTALIZE VARIABLE	TOTALIZED RUNTIME	DIFFERENTIAL CFM	DIFFERENTIAL CO2	OTHER CALCULATED	ANALOG CONTROL	DIGITAL CONTROL	SCHEDULED CONTROL	EVENT CONTROL	SUPERVISORY ALARM	CHANGE-OF-STATE	COS OFF-TO-ON	COS ON-TO-OFF	HIGH LIMIT ALARM	LOW LIMIT ALARM	RUNTIME LIMIT (HRS)	OTHER ALARM	MANUAL OVERRIDE	"DIRECT BACNET COMMUNICATION"	TRENDED VALUE	MISC. OTHER	NOTES
1	OUTSIDE AIR TEMP	B																									
2	OUTSIDE AIR HUMIDITY	B																									
3	OUTSIDE AIR CO2	B								C1																	6
4	MIXED AIR TEMP	X																		40.0F						X	
5	HEATING COIL DISCH TEMP	X																		40.0F						X	
6	SUPPLY AIR TEMP	X																								X	
7	RETURN AIR TEMP	X										X								55.0F							
8	RETURN AIR HUMIDITY	X										X															
9	SPACE TEMP	X										X								45.0F						X	
10	SPACE HUMIDITY	X										X							70.0%RH							X	8
11	SPACE CO2	X								C2									770ppm							X	6
12	DIRTY FILTER MONITOR	X															X		per Mfr								
13	FREEZESTAT ALARM			X													X			39.0F							
14	SF HIGH STATIC PRESSURE			X													X		[TBD]								5
15	RF LOW SUCTION PRESSURE			X									X				X			[TBD]							5
16	OUTSIDE AIR DAMPERS		X									X															
17	RETURN AIR DAMPERS		X									X															
18	SUPPLY AIR FLOW	X				cfm	CCF					X														X	NVO
19	COOLING COIL VALVE		X									X			X												
20	HEATING CONTROL		X									X			X												
21	OUTSIDE AIR FLOW	X				cfm	CCF					X							SP-10%	SP+10%						X	4, NVO
22	SUPPLY FAN STATUS			X				X								X					1,000						
23	SUPPLY FAN VFD																								X		7
24	SUPPLY FAN VFD S/S				X									X	X	X											
25	SUPPLY FAN VFD FAULT			X													X										
26	SUPPLY FAN VFD SPEED		X									X															
27	RETURN FAN STATUS			X				X								X					1,000						
28	RETURN FAN VFD																								X		7
29	RETURN FAN VFD FAULT			X													X										
30	RETURN FAN VFD SPEED		X									X															
31	COMMON FIRE ALARM (ONE/BLDG.)			X													X										
32	RETURN AIR FLOW	X				cfm	CCF					X														X	NVO
33	RETURN FAN VFD S/S				X									X	X	X											
34	HOA SWITCH NOT IN AUTO			X									X														
35	EXHAUST AIR DAMPERS		X									X															

LEGEND

X = PROVIDE QUANTITY AS REQUIRED TO INCLUDE ALL INSTANCES OF THE INDICATED FEATURE. INCLUDE MULTIPLE POINTS WITHIN EACH MECHANICAL SYSTEM AS NECESSARY. COORDINATE WITH EQUIPMENT VENDOR.

B = INFORMATION PROVIDED TO EACH SYSTEM VIA NETWORK BROADCAST.

TCC = TEMPERATURE CONTROLS CONTRACTOR

NOTES:

1. THE POINT LISTED HEREIN ARE THE MINIMUM POINTS REQUIRED FOR THE CONTROL AND MONITORING OF THIS EQUIPMENT. THIS POINT LIST IS TYPICAL FOR EACH MECHANICAL/ELECTRICAL SYSTEM OF THIS TYPE. IF THE SEQUENCE OF OPERATION REQUIRES ADDITIONAL OR DIFFERING INFORMATION, IT MUST BE PROVIDED BY THE RESPECTIVE PROVIDER OF THE CONTROLS FOR THIS TYPE OF EQUIPMENT AS COORDINATED BY THE GENERAL AND MECHANICAL CONTRACTORS.
2. THE TCC SHALL PROVIDE ALL DIGITAL ALARM LOGIC. ALL DIGITAL ALARMS SHALL BE PART OF THE LNS DATABASE.
3. THE TCC SHALL PROVIDE ALL TRENDING AND ANALOG ALARMING VIA THE WONDERWARE SOFTWARE.
4. PROVIDE ACCUMULATED AIR FLOW FOR VALIDATION OF PURGE-MODE AND FOR PERMANENT VALIDATION OF OCCUPANT VENTILATION.
5. PROVIDE MANUAL RESET DEVICE. NOTE THAT THIS DEVICE BOTH ALARMS IN THE BMS AND IS HARDWIRED TO THE VFDS FOR SHUTDOWN OF THE FANS IN ALL OPERATING CONDITIONS OF THE VFD.
6. PROVIDE THE ALARM INDICATED AT THE CALCULATED DIFFERENTIAL BETWEEN OUTSIDE AIR AND SPACE AIR CO2 VALUES.
7. PROVIDE BACNET COMMUNICATION CONNECTION TO THIS DEVICE MAPPING ALL REQUIRED POINTS INTO THE LNS DATABASE.
8. ALARM ONLY AFTER AN 8-HOUR CONSECUTIVE TIME PERIOD DURING WHICH THE RELATIVE HUMIDITY EXCEEDS ITS SETPOINT.

TYPICAL AHU SYSTEM CONTROL POINT SCHEDULE

		INPUT/OUTPUT (NOTE 1)														SOFTWARE/FIRMWARE ARE FEATURES (NOTE: 2, 3)											
LP STEAM / HOT WATER GLYCOL PLANT MONITORING		SENSED				CALCULATED							CONTROL			ALARM AND ADVISORIES (WITH INSTRUCTIONS)							MISC. FEATURES				
REFERENCE NO.	POINT NAME	ANALOG INPUT	ANALOG OUTPUT	DIGITAL INPUT	DIGITAL OUTPUT	RATE OF VARIABLE	TOTALIZE VARIABLE	TOTALIZE RUNTIME	DEWPOINT	DIFFERENTIAL CO2	THERMAL EFFICIENCY	ANALOG CONTROL	DIGITAL CONTROL	SCHEDULED CONTROL	EVENT CONTROL	SUPERVISORY ALARM	CHANGE OF STATE	COS OFF-TO-ON	COS ON-TO-OFF	HIGH LIMIT ALARM	LOW LIMIT ALARM	RUNTIME LIMIT (HRS)	OTHER ALARM	MANUAL OVERRIDE	DIRECT LON COMMUNICATION	TRENDED VALUE	MISC. OTHER	NOTES
1	DIFFERENTIAL WATER PRESSURE	X																										
2	DIFFERENTIAL PRESSURE VALVE		X																									
3	DIFFERENTIAL WATER PRESSURE SETPOINT		X																									
4	STEAM PRESSURE	X																		TBD	TBD					X		6
5	STEAM CONTROL VALVE % OPEN		X																							X		
6	HW (GLYCOL) SUPPLY TEMP	X									X															X		
7	HW (GLYCOL) RETURN TEMP	X									X															X		
8	HW SUPPLY TEMP-EACH CONVERTOR	X																								X		
9	HW RETURN TEMP-EACH CONVERTOR	X																								X		
10	(NOT USED)																											
11	HW (GLYCOL) PUMP VFD S/S				X							X		X														
12	HW (GLYCOL) PUMP VFD STATUS			X				X							X							1000						
13	(NOT USED)																											
14	HW (GLYCOL) PUMP VFD FAULT			X												X												
15	CONVERTOR CONTROLLER									X	X	X		X	X									X	X			4, 5
16	HW SUPPLY TEMP-EACH COIL	X																								X		
17	HW RETURN TEMP-EACH COIL	X																								X		
18	FLOW RATE	X				GPM				X																X		
19	CONVERTOR COMMOM ALARM			X																								

LEGEND:

X = PROVIDE QUANTITY AS REQUIRED TO INCLUDE ALL INSTANCES OF THE INDICATED FEATURE. INCLUDE MULTIPLE POINTS WITHIN EACH MECHANICAL SYSTEM AS NECESSARY. COORDINATE WITH EQUIPMENT VENDOR.

B = INFORMATION PROVIDED TO EACH SYSTEM VIA NETWORK BROADCAST.

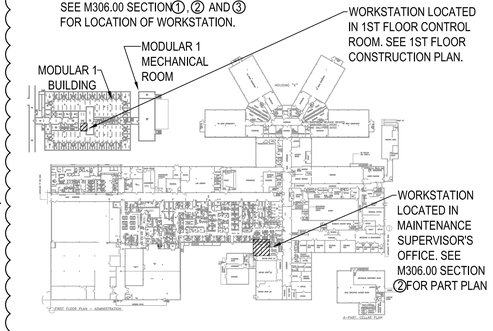
NOTES:

1. THE POINT LISTED HEREIN ARE THE MINIMUM POINTS REQUIRED FOR THE CONTROL AND MONITORING OF THIS EQUIPMENT. THIS POINT LIST IS TYPICAL FOR EACH MECHANICAL/ELECTRICAL SYSTEM OF THIS TYPE. IF THE SEQUENCE OF OPERATION REQUIRES ADDITIONAL OR DIFFERING INFORMATION IT MUST BE PROVIDED BY THE RESPECTIVE PROVIDER OF THE CONTROLS FOR THIS TYPE OF EQUIPMENT AS COORDINATED BY THE GENERAL AND MECHANICAL CONTRACTORS.
2. THE TCC SHALL PROVIDE ALL DIGITAL ALARM LOGIC. ALL DIGITAL ALARMS SHALL BE PART OF THE LNS DATABASE.
3. THE TCC SHALL PROVIDE ALL TRENDING AND ANALOG ALARMING VIA THE WONDERWARE SOFTWARE.
4. PROVIDE LON COMMUNICATION CONNECTION TO THIS DEVICE MAPPING ALL REQUIRED POINTS INTO THE LNS DATABASE.
5. PROVIDE REMOTE CHILLED WATER SETPOINT ADJUSTMENT.
6. WHEN USING THERMISTOR SENSORS USE MATCHED-PAIR ELEMENTS TO ELIMINATE INTER-SENSOR ERROR FACTOR.
7. INCLUDE ALL ADDITIONAL POINTS AS INCLUDED IN SPECIFICATIONS.

TYPICAL HEATING SYSTEM CONTROL POINT SCHEDULE

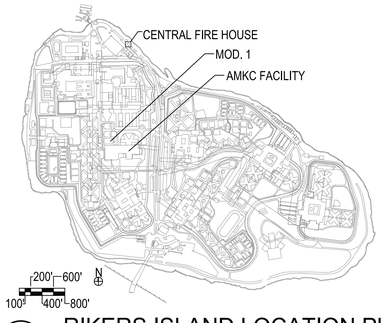
GENERAL NOTE:

1. WORKSTATION TO BE LOCATED IN MOD. 1 FIRST FLOOR CONTROL ROOM, CENTRAL FIRE HOUSE, AND MAINTENANCE SUPERVISOR'S OFFICE. SEE M306.00 SECTION ①, ② AND ③ FOR LOCATION OF WORKSTATION.
2. PROVIDE ALL REQUIRED WIRING AND CONNECTION FOR WORKSTATION.



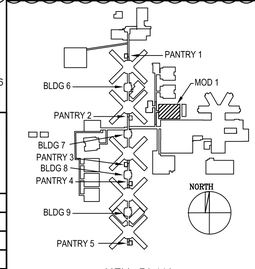
1 AMKC FIRST FLOOR PART PLAN
SCALE: 1/128"=1'-0"

2 MAINTENANCE OFFICE PART PLAN
SCALE: 1/8"=1'-0"



3 RIKERS ISLAND LOCATION PLAN
SCALE: SEE GRAPHIC SCALE

0 4 8 16



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Drawn By:	Checked By: SB
PIN # 072201723CPD	Date: 01/21/2015

Drawing Title:
HVAC
CONTROL TABLE

Seal:

Drawing No.:
M306.00

Scale: NONE

Sheet: 26 of 70

AIR HANDLING UNITS SCHEDULE

BASIS OF DESIGN: ENVIRO-TEC

GENERAL DATA					SUPPLY FAN DATA														TOTAL UNIT ELECTRICAL SUMMARY			CHILLED WATER COIL DATA										HEATING COIL DATA									FILTERS				
														MOTOR DATA									CHW. TEMP (F)	AIR SIDE (F)									AIR TEMP (°F)	H20 TEMP (°F)	GPM / LBS/HR									
UNIT NO.	SERVICE	LOCATIONS	TOTAL WIEGHT (LB)	MFR UNIT SIZE	TOTAL CFM	OA CFM	NORM. SUPPLY CFM	NORM. OA CFM	TOTAL R/A CFM	NORM. R/A CFM	EXT. S.P. W.G.	TOTAL S.P. W.G.	BHP	WHEEL DIA (IN)	TYPE	FAN SPEED (RPM)	H.P.	MOTOR (RPM)	VOLT	PH.	HZ.	FLA	MCA	MOP	C.C. GPM	ENT.	LVG.	EDB	EWB	LDB	LWB	TOTAL MBH	SENS. MBH	FACE AREA SQ.FT.	FACE VEL FPM	ROWS (TYPE)	FINS PER FT.	PD FT H20	CFM	ENT.	LVG.	ENT.	LVG.	LBS/HR	TOTAL MBH	FACE AREA SQ.FT.	NO. OF ROWS	FINS PER FT.	TYPE	P.D. IN W.G.	FILTER FACE VEL. (FPM)	FILTER AREA (SQ.FT.)	REMARKS
AHU-1	CELLS	MOD. D MER	5419	ENVIRO-TEC ESL-51x81	6500/9750	6500/9750	6500	6500	0	0	2.0	5.29/6.93	7.53/15.59	18.0	BELT-DRIVE	2126/2635	20	1800	460	3	60	28.6	35.8	50.0	128/175	40	48.6/49.1	95	75	49.4/50.6	49.4/50.6	510/735.5	312.1/455.3	20.0	312/488	12	144	10.6/19.7	6500/9750	0	70.0/70.2	5 PSI SAT. STEAM		563/871.5	632/738.8	14.2	1	168	PREFILTER: 2" PLEATED - MERV 8 FILTER: RIGID TYPE - MERV 14	0.14/0.26 0.31/0.56	325/488	20.0	NOTE ①②③④⑤⑥⑦⑩
AHU-2	CELLS	MOD. D MER	5419	ENVIRO-TEC ESL-51x81	6500/9750	6500/9750	6500	6500	0	0	2.0	5.29/6.93	7.53/15.59	18.0	BELT-DRIVE	2126/2635	20	1800	460	3	60	28.6	35.8	50.0	128/175	40	48.6/49.1	95	75	49.4/50.6	49.4/50.6	510/735.5	312.1/455.3	20.0	312/488	12	144	10.6/19.7	6500/9750	0	70.0/70.2			563/871.5	632/738.8	14.2	1	168	PREFILTER: 2" PLEATED - MERV 8 FILTER: RIGID TYPE - MERV 14	0.14/0.26 0.31/0.56	325/488	20.0	NOTE ①②③④⑤⑥⑦⑩
AHU-3	DAYROOM	MOD. D MER	4740	ENVIRO-TEC ESL-51x99	8250/12375	1650/3300	8250	1650	7870	7430	2.0	4.19/4.86	7.12/13.64	20.0	BELT-DRIVE	1697/2056	20	1800	460	3	60	28.6	35.8	50.0	106/123	40	48.5/49.2	79	65.7	47.6/51.0	47.6/50.9	413.3/524	277.7/372.8	25.7	321/482	12	144	8.7/10.6	8250/12375	56.0/51.3	70.0/79.7			139/208.5	127.7/380.2	17.9	1	72	PREFILTER: 2" PLEATED - MERV 8 FILTER: RIGID TYPE - MERV 14	0.15/0.28 0.33/0.59	338/507	24.4	NOTE ①②③④⑤⑥⑧⑩
AHU-4	DAYROOM	MOD. D MER	4740	ENVIRO-TEC ESL-51x99	8250/12375	1650/3300	8250	1650	7870	7430	2.0	4.19/4.86	7.12/13.64	20.0	BELT-DRIVE	1697/2056	20	1800	460	3	60	28.6	35.8	50.0	106/123	40	48.5/49.2	79	65.7	47.6/51.0	47.6/50.9	413.3/524	277.7/372.8	25.7	321/482	12	144	8.7/10.6	8250/12375	56.0/51.3	70.0/79.7			139/208.5	127.7/380.2	17.9	1	72	PREFILTER: 2" PLEATED - MERV 8 FILTER: RIGID TYPE - MERV 14	0.15/0.28 0.33/0.59	338/507	24.4	NOTE ①②③④⑤⑥⑧⑩
AHU-5	OFFICES	2ND FL MER	750	UNITED COOL AIR CCW8G-4T-X	2000/2500	300/375	2000	300	2125	1700	2.0	3.79/4.6	1.85/2.79	12.0	BELT-DRIVE	1564/1715	3	1800	460	3	60	4.3	5.4	15	7.5/11	40	57.6/55.3	77.9/78.5	65.0/65.5	55.1/55.5	54.9/55.3	60.5/76.8	49/62.6	4.6	435/543	4	168	18.8/22.2	2000/2500	59.5/57.4	65.1/65.0	165	140	1/1.2	12.2/20.8	5.3	1	144	PREFILTER: 2" PLEATED - MERV 8 FILTER: CARTRIDGE TYPE - MERV 13	0.53/0.39	413	18.89	NOTE ①②③④⑤⑥⑨⑩ ⑪
AHU-6	OFFICES	2ND FL MER	750	UNITED COOL AIR CCW8G-4T-X	2000/2500	300/375	2000	300	2125	1700	2.0	3.79/4.6	1.85/2.79	12.0	BELT-DRIVE	1564/1715	3	1800	460	3	60	4.3	5.4	15	7.5/11	40	57.6/55.3	77.9/78.5	65.0/65.5	55.1/55.5	54.9/55.3	60.5/76.8	49/62.6	4.6	435/543	4	168	18.8/22.2	2000/2500	59.5/57.4	65.1/65.0	165	140	1/1.2	12.2/20.8	5.3	1	144	PREFILTER: 2" PLEATED - MERV 8 FILTER: CARTRIDGE TYPE - MERV 13	0.53/0.39	413	18.89	NOTE ①②③④⑤⑥⑨⑩ ⑪
AHU-7	OFFICES	2ND FL MER	750	UNITED COOL AIR CCW8G-4T-X	2000/2500	300/375	2000	300	2125	1700	2.0	3.79/4.6	1.85/2.79	12.0	BELT-DRIVE	1564/1715	3	1800	460	3	60	4.3	5.4	15	7.5/11	40	57.6/55.3	77.9/78.5	65.0/65.5	55.1/55.5	54.9/55.3	60.5/76.8	49/62.6	4.6	435/543	4	168	18.8/22.2	2000/2500	59.5/57.4	65.1/65.0	165	140	1/1.2	12.2/20.8	5.3	1	144	PREFILTER: 2" PLEATED - MERV 8 FILTER: CARTRIDGE TYPE - MERV 13	0.53/0.39	413	18.89	NOTE ①②③④⑤⑥⑨⑩ ⑪

NOTES:

1. PROVIDE VARIABLE FREQUENCY DRIVE FOR ALL FANS. VFDS SHALL BE AS MANUFACTURED BY ABB MODEL, ACH550 WITH BY-PASS, AND DISCONNECT .
2. ALL VFDS SHALL BE INSTALLED IN THE RESPECTIVE MECHANICAL ROOMS AND ALL ELECTRICAL POWER SHALL BE PROVIDED TO THE VFDS AND FROM VFDS TO RESPECTIVE MOTORS. SEE CONTROL DIAGRAMS ON OTHER CONTRACT DOCUMENTS AND PROVIDE ALL REQUIRED CONTROLS AND LOGICS.
3. PROVIDE CHILLED WATER COIL TYPE UW.
4. AHU MODULE ARRANGEMENT: MIXING BOX, FILTER SECTION, HEATING COIL, ACCESS SECTION, COOLING COIL, 14" ACCESS SECTION, SUPPLY FAN
5. MOTORS TO BE PROVIDED WITH 2 BELTS (1 SPARE).
6. AC UNITS SHALL BE PROVIDED WITH BACK UP MODE FAN SWITCH TO JACK UP UNIT FANS TO HIGHER CFMS TO SERVE THE OTHER AREA IN CASE OF UNIT FAILURE OR UNIT SERVICE.
7. AIR HANDLING UNITS AHU-1 & AHU-2 SUPPLY FAN SHALL BE INTERLOCKED WITH EXHAUST FANS EF-1, EF-1A, EF-2A, EF-3, EF-3A, EF-4, EF-4A.
8. AIR HANDLING UNITS AHU-3 & AHU-4 SHALL BE INTERLOCKED WITH RAF-1 AND RAF-2.
9. AIR HANDLING UNITS AHU-5, 6 AND 7 SHALL BE INTERLOCKED WITH EF-8,9 & 10.
10. MWSK (NYC ENVIRO-TEC & UNITED COOL AIR REP) TEL:212-643-7700 TO PROVIDE FREE THE FOLLOWING:
    - 10.1. START-UP SUPERVISION.
    - 10.2. OPERATOR'S TRAINING
    - 10.3. INSTALLATION GUIDANCE IF NEEDED.
    - 10.4. LIFETIME TROUBLESHOOTING SUPERVISION (NO SERVICE, NO MAINTENANCE. CONTRACTOR TO PROVIDE ROUTINE MAINTENANCE AND SERVICE.)
    - 11. PROVIDE STAINLESS STEEL DRAIN PAN.
    - 12. ALL AIR HANDLING UNIT COOLING AND HEATING COILS TO BE SIZED FOR 40% PROPYLENE GLYCOL. (3)

FAN SCHEDULE

BASIS OF DESIGN: GREENHECK

NO.	LOCATION	SYSTEM SERVED	PERFORMANCE DATA		SELECTION DATA						MOTOR DATA						MANUFACTURER	REMARKS
			MIN/MAX CFM	TOTAL SP INCH W.C.	MODEL	TYPE	CLASS	DRIVE	FAN R.P.M.	ROOF OPENING	VOLT	PH	BHP	HP	WT. IN LBS	SONES		
RAF-1	MER	AHU-3	7430	1.5	QEID-24-85-B50	CENTRIFUGAL INLINE	-	DIRECT	1024	N/A	460	3	2.65	5	480	18.3	GREENHECK	SEE NOTE ① ② ③
RAF-2	MER	AHU-4	7430	1.5	QEID-24-85-B50	CENTRIFUGAL INLINE	-	DIRECT	1024	N/A	460	3	2.65	5	480	18.3	GREENHECK	SEE NOTE ① ② ③
EF-1	2ND FL ROOF	2ND FL CELLS	1920/2880	1.381	G-163-A	MUSHROOM	-	DIRECT	1471	18.5x18.5	460	3	1.24	2	128	18.8	GREENHECK	SEE NOTE ① ② ③
EF-2	2ND FL ROOF	1ST FL CELLS	1745/2610	1.607	G-163-A	MUSHROOM	-	DIRECT	1498	18.5x18.5	460	3	1.26	2	128	18.7	GREENHECK	SEE NOTE ① ② ③
EF-3	2ND FL ROOF	2ND FL CELLS	1920/2880	1.381	G-163-A	MUSHROOM	-	DIRECT	1471	18.5x18.5	460	3	1.24	2	128	18.8	GREENHECK	SEE NOTE ① ② ③
EF-4	2ND FL ROOF	1ST FL CELLS	1745/2610	1.607	G-163-A	MUSHROOM	-	DIRECT	1498	18.5x18.5	460	3	1.26	2	128	18.7	GREENHECK	SEE NOTE ① ② ③
EF-8	2ND FL ROOF	CONT. ROOM	300/2500	0.812	G-183-B	MUSHROOM	-	DIRECT	946	20.5x20.5	460	3	0.55	1	159	10.4	GREENHECK	SEE NOTE ① ② ③ ④
EF-9	2ND FL ROOF	SALLYPORT	300/2500	0.812	G-183-B	MUSHROOM	-	DIRECT	946	20.5x20.5	460	3	0.55	1	159	10.4	GREENHECK	SEE NOTE ① ② ③ ④
EF-10	2ND FL ROOF	OFFICES	300/2500	0.812	G-183-B	MUSHROOM	-	DIRECT	946	20.5x20.5	460	3	0.55	1	159	10.4	GREENHECK	SEE NOTE ① ② ③ ④
EF-11	MER	MER	1550	1.375	SQ-140	INCLINE	-	DIRECT	1550	-	460	3	0.69	1	104	13.7	GREENHECK	SEE NOTE ①

NOTES:

1. PROVIDE DISCONNECT SWITCHES FOR ALL FANS.
2. PROVIDE VARIABLE FREQUENCY DRIVE FOR ALL FANS.
3. SEE NOTES 7,8 AND 9 ABOVE ON INTERLOCKING WITH AHUS.
4. PROVIDE GPE ROOF CURB EXTENSION.

GRAVITY VENTILATOR SCHEDULE

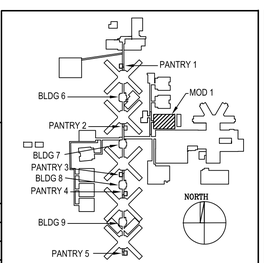
BASIS OF SELECTION : GREENHECK

TAG	SERVICE	LOCATION	THROAT WIDTH	THROAT LEGNTH	LOUVERS HIGH	LEGNTH	WIDTH	CURB CAP WIDTH	CURB CAP LEGNTH	FREE AREA FT. SQ	MODEL	MANUFACTURER	WEIGHT	REMARKS
GV-1	AHU-1 & 2	ROOF	36"	48"	6	62"	50"	44"	56"	12.54	WIH	GREENHECK	144 LBS	SEE NOTE ① ②
GV-2	AHU-3 & 4	ROOF	36"	48"	6	62"	50"	44"	56"	12.54	WIH	GREENHECK	144 LBS	SEE NOTE ① ②

NOTES:

1. INSTALL ACCORDING TO MANUFACTURER'S INSTRUCTIONS AND RECOMMENDATIONS ON 14" MANUFACTURER SUPPLIED ROOF CURB.
2. PROVIDE EQUIPMENT USE PERMIT AS REQUIRED BY NYC BUILDING DEPARTMENT.

0 4 8 16



KEY PLAN

CITY OF NEW YORK DEPARTMENT OF CORRECTION

THE CITY OF NEW YORK
DEPARTMENT OF CORRECTION
DIVISION OF CAPITAL POLICY
AND DEVELOPMENT
ENGINEERING UNIT

DESIGNED BY:

IAQ SYSTEMS INC
Consulting Engineers
630 9th Avenue, Suite 1112
New York, New York 10036
Tel. 212.680.8945
www.iaqsys.com

Project:

AIR CONDITIONING
SYSTEM REPLACEMENT
MODULAR BUILDING NUMBER 1
ANNA M. KROSS CENTER
18-18 HAZEN STREET, RIKERS ISLAND,
EAST ELMHURST, NEW YORK 11370

No.	Date	Revision
(3)	04-24-17	ADDENDUM 3
	01-30-17	ISSUED FOR BID

Director: HARDEE SAINI
Project Manager: BV
Project Engineer:
Drawn By: Checked By: SB
PIN # 072201723CPD Date: 01/21/2015

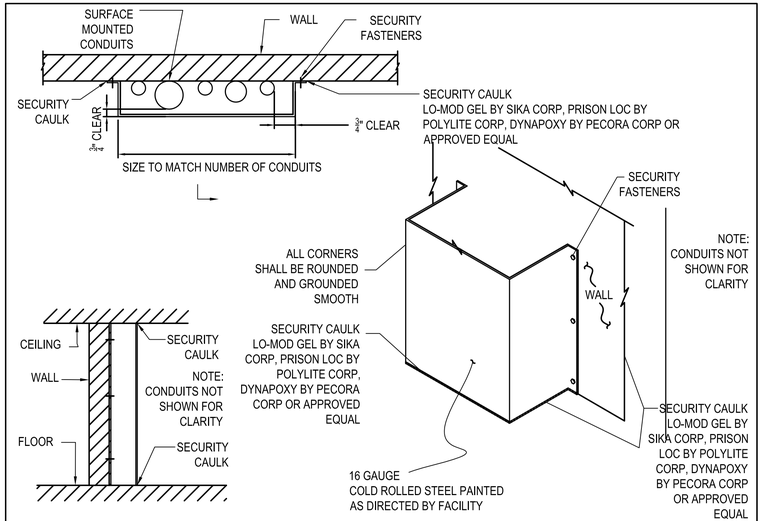
Drawing Title:
HVAC
SCHEDULE
SHEET 1 OF 2

Seal:

Drawing No.: M501.00

Scale: NONE

Sheet: 29 of 70



37
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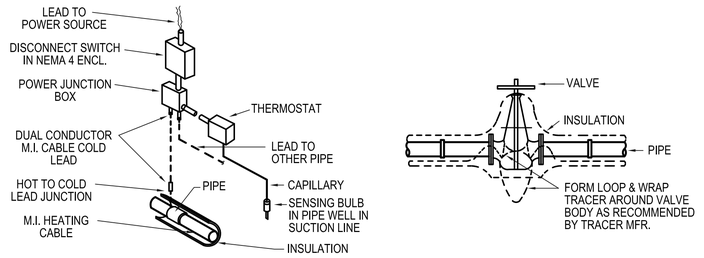
EXPOSED CONDUITS WITH SECURITY SHROUD/SECURITY CAULKING



CONTROL INSTALLATION

VALVE TRACING PATTERN

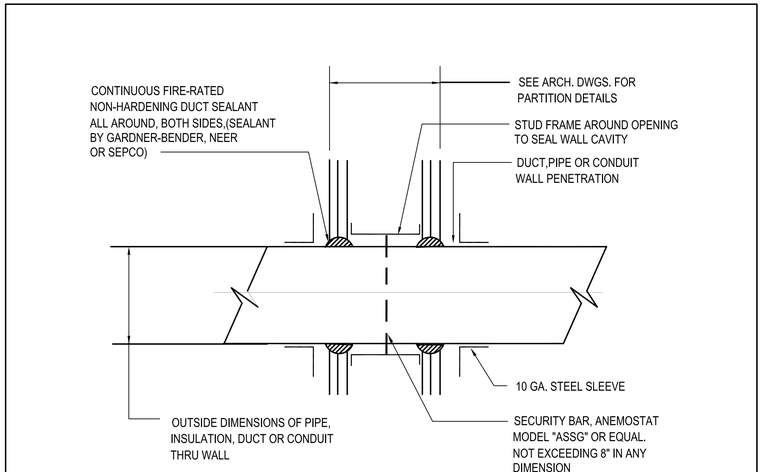
38
SCALE: NONE

PIPE HEAT TRACE

39
SCALE: NONE

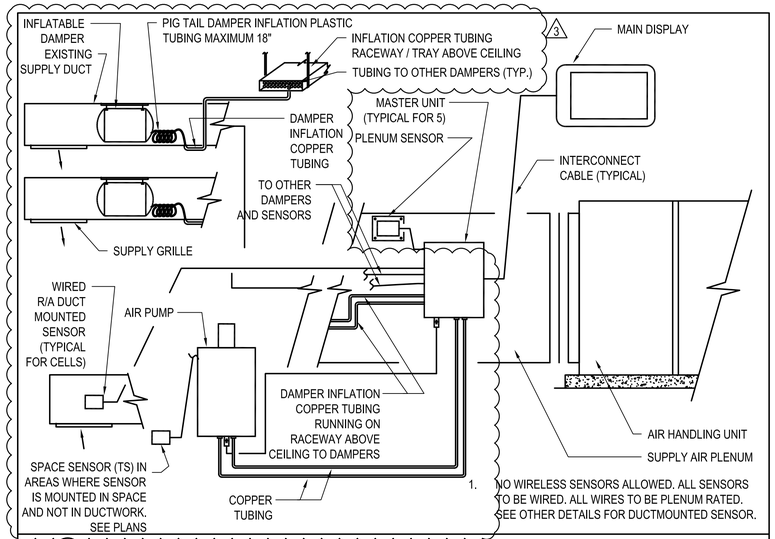
NOT USED

2



40
SCALE: NONE

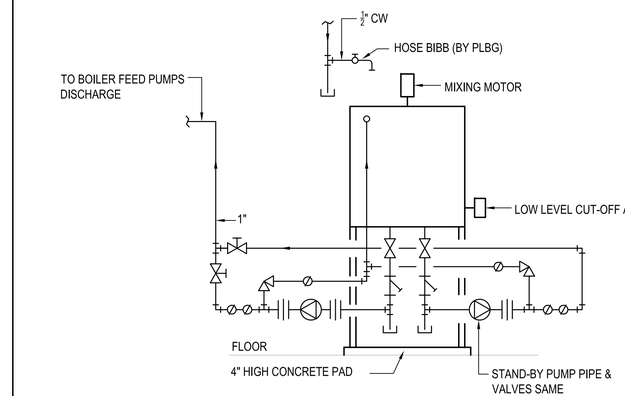
TYPICAL DUCT BARRIER DETAIL



1. NO WIRELESS SENSORS ALLOWED. ALL SENSORS TO BE WIRED. ALL WIRES TO BE PLENUM RATED. SEE OTHER DETAILS FOR DUCTMOUNTED SENSOR.

41
SCALE: NONE

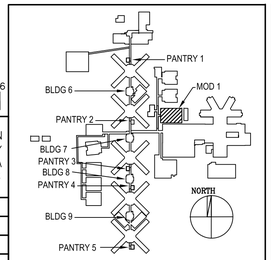
INFLATABLE DAMPER CONTROL SYSTEM SCHEMATIC



42
SCALE: NONE

CHEMICAL FEED SYSTEM

0 4 8 16



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Project Engineer:	
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PIN # 072201723CPD	Date: 01/21/2015

Drawing Title:
HVAC - DETAILS
SHEET 7 OF 8
2

Seal:

Drawing No.:
M607.00

Scale: NONE

Sheet: 37 of 70