

CHATHAM COUNTY PURCHASING DEPARTMENT

ADDENDUM NO. 1 TO BID # 17-0038-7

FOR: RALPH MARK GILBERT CIVIL RIGHTS MUSEUM – HVAC MODIFICATIONS AND REROOF

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PLEASE SEE THE FOLLOWING ADDITIONS, CLARIFICATIONS AND/OR CHANGES:

1.     **Question:**     Will the County consider a TPO roof?  
       **Response:**     Roofing material shall be PVC as noted in specifications (TPO or other roofing products shall not be an acceptable substitute).
  
2.     **Question:**     What is the voltage characteristics of all the equipment?  
       **Response:**     The voltage is 240 volts.
  
3.     **Question:**     The Scheduled capacity doesn't seem to line up with the scheduled AT. Do you want to meet capacity, LAT or both?  
       **Response:**     The scheduled amount must be met.
  
4.     **Question:**     The specifications call for the blower coils to have plastic drain pans. Are galvanized or stainless steel acceptable?  
       **Response:**     Yes to stainless.
  
5.     **Question:**     For the vertical blower coils, does the supply air out the top/vertical?  
       **Response:**     The supply air is out the top of the unit. The SCR heating coils may be in the unit or on top of the unit.
  
6.     **Question:**     Would the County consider another day/time for Contractors to come back and visit the site?  
       **Response:**     Staff will be available on-site at the Mark Gilbert Civil Rights Museum on May 25, 2:00p.m to provide access.
  
7.     **ADDITION:**    Section 230900 – DDC Instrumentation and Control for HVAC is listed in the table of contents in the specifications but were left out of the package. Included in Addendum 1 complete Section 230900.
  
8.     **ADDITION:**    Specifications for Additive Alternate #2 – Remove Existing skylight and provide a new skylight.
  - a. Wasco DDSS (or approved equal), curb mounted, 6'x6' acrylic dome, insulated.
  - b. PVC frame / aluminum frame (anodized finish, 1 year warranty).
  - c. 2 year warranty for watertight assembly and defects in the acrylic.
  - d. Outer dome to be bronze color, inner dome to be clear. With internal gutters and weeps and thermal break.
  - e. Units shall be tested to compliance with AAMA\WDMA\CSA\101\I.S.2\A440 as required by the International Building Code. Units shall be impact tested to 775 ft-lbs to comply with the intent of OSHA fall

protection regulation 29 CFR 1910.23 (e)(8).

f. Self-Ignition Temperature: 651 deg F or greater per ASTM D 1929.

Smoke density of 75 or less per ASTM D 2843. Relative- Burning Characteristics per ASTM D 635; burning rate of 2.5 inches per minute or less.

g. Installer shall have 5 years experience installing commercial skylights. Potential installer: Lewis Burton of the Joe Burton Company (770) 938-2730 x 25.

h. Installation shall comply with manufacturers written recommendations. Rebuild existing wood curb to accommodate new skylight.

9. **CHANGE:** Remove electrical plan sheet E1-01 and replace with revised electrical plan sheet E1-01.
10. **CHANGE:** Bid sheet has been revised. All bidders must use revised bid sheet.

## **THE BID OPENING HAS BEEN EXTENDED TO 2:00PM, JUNE 8, 2017.**

**PROPOSER IS RESPONSIBLE FOR MAKING THE NECESSARY CHANGES.**

May 22, 2017

DATE

  
MARGARET H. JOYNER  
PURCHASING DIRECTOR  
CHATHAM COUNTY

**REVISED BID SHEET**

CHATHAM COUNTY, GEORGIA

BID

**BID NO. 17-0038-7**

**RALPH MARK GILBERT CIVIL RIGHTS MUSEUM – HVAC MODIFICATIONS AND REROOF**

ALL WORK SHALL BE IN ACCORDANCE WITH THE BIDDING AND CONTRACT DOCUMENTS FOR THE FOLLOWING PRICE:

DESCRIPTION	BID
Reroof	\$
HVAC Modifications	\$
TOTAL BASE BID	

**ADDITIVE ALTERNATE:**

#1. - Control Tie into the J. Tom Coleman Judicial Courthouse –

Control System \$ \_\_\_\_\_

#2. - Remove Existing skylight and provide a new skylight - \$ \_\_\_\_\_

**The project is being bid based on the submitted Base Bid and will be awarded based on the Base Bid amount.** Chatham County reserves the right to select Alternates.

**UNIT PRICES**

The undersigned Bidder proposes the amounts below be added to or deducted from the Contract Sum on performance and measurement of the individual items of Work.

- A. Unit Price No. 1: Replacement of 2x4 studs - \$ \_\_\_\_\_ per 50 lf.
- B. Unit Price No. 2: Replacement of 2x8 rafters - \$ \_\_\_\_\_ per 50 lf.
- C. Unit Price No. 3: Replacement of 1x8 decking - \$ \_\_\_\_\_ per 50 lf.

**ALL FIRMS REQUESTING TO DO BUSINESS WITH CHATHAM COUNTY MUST**

**REGISTER ON-LINE AT [HTTP://PURCHASING.CHATHAMCOUNTY.ORG](http://PURCHASING.CHATHAMCOUNTY.ORG)**

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NAME/TITLE

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COMPANY NAME

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ADDRESS

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CITY/STATE/ZIP

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PHONE/FAX NUMBER

## SECTION 230900 – DDC INSTRUMENTATION AND CONTROL FOR HVAC

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.
- B. Related Sections include the following:
  - 1. Division 23 Section "Meters and Gages for HVAC Piping" for measuring equipment that relates to this Section.
  - 2. Division 23 Section "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

#### 1.3 DEFINITIONS

- A. Algorithm: A logical procedure for solving a recurrent mathematical problem. A prescribed set of well-defined rules or processes for solving a problem in a finite number of steps.
- B. Analog: A continuously varying signal value, such as current, flow, pressure, or temperature.
- C. BACnet Specific Definitions:
  - 1. BACnet: Building Automation Control Network Protocol, ASHRAE 135. A communications protocol allowing devices to communicate data over and services over a network.
  - 2. BACnet Interoperability Building Blocks (BIBBs): BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBs are combined to build the BACnet functional requirements for a device.
  - 3. BACnet/IP: Defines and allows using a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP subnetworks that share the same BACnet network number.
  - 4. BACnet Testing Laboratories (BTL): Organization responsible for testing products for compliance with ASHRAE 135, operated under direction of BACnet International.
  - 5. PICS (Protocol Implementation Conformance Statement): Written document that identifies the particular options specified by BACnet that are implemented in a device.
- D. Binary: Two-state signal where a high signal level represents "ON" or "OPEN" condition and a low signal level represents "OFF" or "CLOSED" condition. "Digital" is sometimes used interchangeably with "Binary" to indicate a two-state signal.
- E. Controller: Generic term for any standalone, microprocessor-based, digital controller residing on a network, used for local or global control. Three types of controllers are indicated: Network Controller, Programmable Application Controller, and Application-Specific Controller.
- F. Control System Integrator: An entity that assists in expansion of existing enterprise system and support of additional operator interfaces to I/O being added to existing enterprise system.

- G. COV: Changes of value.
- H. DDC System Provider: Authorized representative of, and trained by, DDC system manufacturer and responsible for execution of DDC system Work indicated.
- I. Distributed Control: Processing of system data is decentralized and control decisions are made at subsystem level. System operational programs and information are provided to remote subsystems and status is reported back. On loss of communication, subsystems shall be capable of operating in a standalone mode using the last best available data.
- J. DOCSIS: Data-OverCable Service Interface Specifications.
- K. E/P: Voltage to pneumatic.
- L. Gateway: Bidirectional protocol translator that connects control systems that use different communication protocols.
- M. HLC: Heavy load conditions.
- N. I/O: System through which information is received and transmitted. I/O refers to analog input (AI), binary input (BI), analog output (AO) and binary output (BO). Analog signals are continuous and represent control influences such as flow, level, moisture, pressure, and temperature. Binary signals convert electronic signals to digital pulses (values) and generally represent two-position operating and alarm status. "Digital," (DI and (DO), is sometimes used interchangeably with "Binary," (BI) and (BO), respectively.
- O. I/P: Current to pneumatic.
- P. LAN: Local area network.
- Q. LNS: LonWorks Network Services.
- R. LON Specific Definitions:
  - 1. FTT-10: Echelon Transmitter-Free Topology Transceiver.
  - 2. LonMark: Association comprising suppliers and installers of LonTalk products. Association provides guidelines for implementing LonTalk protocol to ensure interoperability through a standard or consistent implementation.
  - 3. LonTalk: An open standard protocol developed by the Echelon Corporation that uses a "Neuron Chip" for communication. LonTalk is a register trademark of Echelon.
  - 4. LonWorks: Network technology developed by Echelon.
  - 5. Node: Device that communicates using CEA-709.1-C protocol and that is connected to a CEA-709.1-C network.
  - 6. Node Address: The logical address of a node on the network, consisting of a Domain number, Subnet number, and Node number. "Node number" portion of an address is a number assigned to device during installation, is unique within a subnet, and is not a factory-set unique Node ID.
  - 7. Node ID: A unique 48-bit identifier assigned at factory to each CEA-709.1-C device. Sometimes called a "Neuron ID."
  - 8. Program ID: An identifier (number) stored in a device (usually EEPROM) that identifies node manufacturer, functionality of device (application and sequence), transceiver used, and intended device usage.
  - 9. Standard Configuration Property Type (SCPT): Pronounced "skip-it." A standard format type maintained by LonMark International for configuration properties.
  - 10. Standard Network Variable Type (SNVT): Pronounced "snivet." A standard format type maintained by LonMark used to define data information transmitted and received by individual

- nodes. "SNVT" is used in two ways. It is an acronym for "Standard Network Variable Type" and is often used to indicate a network variable itself (i.e., it can mean "a network variable of a standard network variable type").
11. Subnet: Consists of a logical grouping of up to 127 nodes, where logical grouping is defined by node addressing. Each subnet is assigned a number, which is unique within a Domain. See "Node Address."
  12. TP/FT-10: Free Topology Twisted Pair network defined by CEA-709.3 and is most common media type for a CEA-709.1-C control network.
  13. TP/XF-1250: High-speed, 1.25-Mbps, twisted-pair, doubly terminated bus network defined by "LonMark Interoperability Guidelines" typically used only to connect multiple TP/FT-10 networks.
  14. User-Defined Configuration Property Type (UCPT): Pronounced "U-Keep-It." A Configuration Property format type that is defined by device manufacturer.
  15. User-Defined Network Variable Type (UNVT): Network variable format defined by device manufacturer. UNVTs create non-standard communications that other vendors' devices may not correctly interpret and may negatively impact system operation. UNVTs are not allowed.
- S. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- T. Modbus TCP/IP: An open protocol for exchange of process data.
- U. MS/TP: Master-slave/token-passing, IEE 8802-3. Datalink protocol LAN option that uses twisted-pair wire for low-speed communication.
- V. MTBF: Mean time between failures.
- W. Network Controller: Digital controller, which supports a family of programmable application controllers and application-specific controllers, that communicates on peer-to-peer network for transmission of global data.
- X. Network Repeater: Device that receives data packet from one network and rebroadcasts it to another network. No routing information is added to protocol.
- Y. PDA: Personal digital assistant.
- Z. Peer to Peer: Networking architecture that treats all network stations as equal partners.
- AA. POT: Portable operator's terminal.
- BB. PUE: Performance usage effectiveness.
- CC. RAM: Random access memory.
- DD. RF: Radio frequency.
- EE. Router: Device connecting two or more networks at network layer.
- FF. Server: Computer used to maintain system configuration, historical and programming database.
- GG. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.
- HH. UPS: Uninterruptible power supply.
- II. USB: Universal Serial Bus.

- JJ. User Datagram Protocol (UDP): This protocol assumes that the IP is used as the underlying protocol.
- KK. VAV: Variable air volume.
- LL. WLED: White light emitting diode..

#### 1.4 SYSTEM PERFORMANCE

- A. Comply with the following performance requirements:
  - 1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
  - 2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
  - 3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
  - 4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
  - 5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
  - 6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
  - 7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
  - 8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
    - a. Water Temperature: Plus or minus 1 deg F (0.5 deg C).
    - b. Water Pressure: Plus or minus 2 percent of full scale.
    - c. Space Temperature: Plus or minus 1 deg F (0.5 deg C).
    - d. Ducted Air Temperature: Plus or minus 1 deg F (0.5 deg C).
    - e. Outside Air Temperature: Plus or minus 2 deg F (1.0 deg C).
    - f. Dew Point Temperature: Plus or minus 3 deg F (1.5 deg C).
    - g. Temperature Differential: Plus or minus 0.25 deg F (0.15 deg C).
    - h. Relative Humidity: Plus or minus 5 percent.
    - i. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
    - j. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
    - k. Airflow (Terminal): Plus or minus 10 percent of full scale.
    - l. Air Pressure (Space): Plus or minus 0.01-inch wg (2.5 Pa).
    - m. Air Pressure (Ducts): Plus or minus 0.1-inch wg (25 Pa).
    - n. Carbon Dioxide: Plus or minus 50 ppm.
    - o. Electrical: Plus or minus 5 percent of reading.

#### 1.5 SEQUENCE OF OPERATION

- A. A Sequences of operation and points list shall be as shown on the drawings.

#### 1.6 SUBMITTALS

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
  - 1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment,

- control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
  - 2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
  - 3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- 1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
  - 2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
  - 3. Wiring Diagrams: Power, signal, and control wiring.
  - 4. Details of control panel faces, including controls, instruments, and labeling.
  - 5. Written description of sequence of operation.
  - 6. Schedule of dampers including size, leakage, and flow characteristics.
  - 7. Schedule of valves including flow characteristics.
  - 8. DDC System Hardware:
    - a. Wiring diagrams for control units with termination numbers.
    - b. Schematic diagrams and floor plans for field sensors and control hardware.
    - c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
  - 9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
  - 10. Controlled Systems:
    - a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
    - b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
    - c. Written description of sequence of operation including schematic diagram.
    - d. Points list.
- C. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135 (BACNET).
- D. Samples for Initial Selection: For each color required, of each type of thermostat[ **or sensor**] cover with factory-applied color finishes.
- E. Samples for Verification: For each color required, of each type of thermostat[ **or sensor**] cover.
- F. Software and Firmware Operational Documentation: Include the following:
- 1. Software operating and upgrade manuals.
  - 2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
  - 3. Device address list.
  - 4. Printout of software application and graphic screens.
  - 5. Software license required by and installed for DDC workstations and control systems.
- G. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.
- H. Qualification Data: For **Installer and manufacturer**.
- I. Field quality-control test reports.

- J. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
  - 2. Interconnection wiring diagrams with identified and numbered system components and devices.
  - 3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
  - 4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
  - 5. Calibration records and list of set points.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with ASHRAE 135 for DDC system components.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.
- B. System Software: Update to latest version of software at Project completion.
- C. Control equipment received and stored on the job site shall be stored in environmentally controlled storage spaces, (e.g. building, trailer, or shed). Storage space shall be maintained at conditions acceptable to the equipment manufacturer. Equipment and materials shall be stored on wooden rails, wooden pallets, or shipping skids. Under no condition shall the equipment and materials be stored in such a way that metal components are in direct contact with the floor slabs
- D. Equipment shall be covered with 6 mil polyethylene sheet (taped in place) to protect the equipment from damage.
- E. Equipment shall not be stored for more than 3 months prior to installation

#### 1.9 COORDINATION

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

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
  - 2. The new control system shall be integrated into the current system in the Chatham County Court House by Trane **as an add alternate. The base bid control system shall interface through BAC NET to a remote system in the future.**

## 2.2 CONTROL SYSTEM

- A. Manufacturers:
1. Andover Controls Corporation.
  2. Automated Logic Corporation.
  3. Honeywell International Inc...
  4. Johnson Controls, Inc.; Controls Group.
  5. Siemens Building Technologies, Inc.
  6. Trane; Worldwide Applied Systems Group
- B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.
- C. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

## 2.3 DDC EQUIPMENT

- A. Operator Workstation: **One** PC-based microcomputer(s) with minimum configuration as follows:
1. Motherboard: With 8 integrated USB 2.0 ports, integrated Intel Pro 10/100 (Ethernet), integrated audio, bios, and hardware monitoring.
  2. Processor: **Intel 15 or greater**, 20 GHz or greater.
  3. Random-Access Memory: 4 GB.
  4. Graphics: Video adapter, minimum **1600 x 1200** pixels, **64** -MB video memory, with TV out.
  5. Monitor: **19 inches (480 mm)**, LCD color.
  6. Keyboard: QWERTY, 105 keys in ergonomic shape.
  7. Hard-Disk Drive: **500 GB or greater**.
  8. DVD Read/Write Drive.
  9. Mouse: Three button, optical.
  10. Uninterruptible Power Supply: **2 kVa**.
  11. Operating System: Manufacturer's standard with high-speed Internet access.
    - a. ASHRAE 135 Compliance: Workstation shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
  12. Printer: Color, ink-jet type as follows:
    - a. Print Head: **4800 x 120** dpi optimized color resolution.
    - b. Paper Handling: Minimum of **100** sheets.
    - c. Print Speed: Minimum of **17** ppm in black and **12** ppm in color.
  13. Application Software:
    - a. I/O capability from operator station.
    - b. System security for each operator via software password and access levels.
    - c. Automatic system diagnostics; monitor system and report failures.
    - d. Database creation and support.
    - e. Automatic and manual database save and restore.
    - f. Dynamic color graphic displays with up to **10** screen displays at once.
    - g. Custom graphics generation and graphics library of HVAC equipment and symbols.
    - h. Alarm processing, messages, and reactions.
    - i. Trend logs retrievable in spreadsheets and database programs.
    - j. Alarm and event processing.
    - k. Object and property status and control.
    - l. Automatic restart of field equipment on restoration of power.
    - m. Data collection, reports, and logs. Include standard reports for the following:
      - 1) Current values of all objects.
      - 2) Current alarm summary.

- 3) Disabled objects.
- 4) Alarm lockout objects.
- 5) Logs.
- n. Custom report development.
- o. Utility and weather reports.
- p. Workstation application editors for controllers and schedules.
- q. Maintenance management.
14. Custom Application Software:
  - a. English language oriented.
  - b. Full-screen character editor/programming environment.
  - c. Allow development of independently executing program modules with debugging/simulation capability.
  - d. Support conditional statements.
  - e. Support floating-point arithmetic with mathematic functions.
  - f. Contains predefined time variables.
- B. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
  1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
  2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
    - a. Discrete/digital, analog, and pulse I/O.
    - b. Monitoring, controlling, or addressing data points.
    - c. Software applications, scheduling, and alarm processing.
    - d. Testing and developing control algorithms without disrupting field hardware and controlled environment.
  3. Standard Application Programs:
    - a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.
    - b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
    - c. Chiller Control Programs: Control function of condenser-water reset, chilled-water reset, and equipment sequencing.
    - d. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
    - e. Remote communications.
    - f. Maintenance management.
    - g. Units of Measure: Inch-pound and SI (metric).
  4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
  5. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
- C. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
  1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
  2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
    - a. Global communications.
    - b. Discrete/digital, analog, and pulse I/O.
    - c. Monitoring, controlling, or addressing data points.

3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
  4. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
- D. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
1. Binary Inputs: Allow monitoring of on-off signals without external power.
  2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
  3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
  4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation **with three-position (on-off-auto) override switches and status lights.**
  5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) **with status lights, two-position (auto-manual) switch, and manually adjustable potentiometer.**
  6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
  7. Universal I/Os: Provide software selectable binary or analog outputs.
- E. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
1. Output ripple of 5.0 mV maximum peak to peak.
  2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
  3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.
- F. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
1. Minimum dielectric strength of 1000 V.
  2. Maximum response time of 10 nanoseconds.
  3. Minimum transverse-mode noise attenuation of 65 dB.
  4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

## 2.4 UNITARY CONTROLLERS

- A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
1. Configuration: Diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and **72-hour** battery backup.
  2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. **Perform scheduling with real-time clock.** Perform automatic system diagnostics; monitor system and report failures.
  3. ASHRAE 135 Compliance: Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135. Reside on network using MS/TP datalink/physical layer protocol and have service communication port for connection to diagnostic terminal unit.
  4. Enclosure: Dustproof rated for operation at 32 to 120 deg F (0 to 50 deg C).
  5. Enclosure: Waterproof rated for operation at 40 to 150 deg F (5 to 65 deg C).

## 2.5 ALARM PANELS

- A. Unitized cabinet with suitable brackets for wall or floor mounting. Fabricate of 0.06-inch- (1.5-mm-) thick, furniture-quality steel or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish. **Provide common keying for all panels.**
- B. Indicating light for each alarm point, single horn, acknowledge switch, and test switch, mounted on hinged cover.
  - 1. Alarm Condition: Indicating light flashes and horn sounds.
  - 2. Acknowledge Switch: Horn is silent and indicating light is steady.
  - 3. Second Alarm: Horn sounds and indicating light is steady.
  - 4. Alarm Condition Cleared: System is reset and indicating light is extinguished.
  - 5. Contacts in alarm panel allow remote monitoring by independent alarm company.

## 2.6 ANALOG CONTROLLERS

- A. Step Controllers: 6- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.
- B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F (minus 23 to plus 21 deg C), and single- or double-pole contacts.
- C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.
  - 1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.
- D. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.

## 2.7 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
- B. Thermistor Temperature Sensors and Transmitters:
  - 1. Manufacturers:
    - a. BEC Controls Corporation.
    - b. Ebtron, Inc.
    - c. Heat-Timer Corporation.
    - d. I.T.M. Instruments Inc.
    - e. MAMAC Systems, Inc.
    - f. RDF Corporation.
    - g. Siemens
    - h. Johnson Controls
    - i. Honeywell
  - 2. Accuracy: Plus or minus **0.5 deg F (0.3 deg C)** at calibration point.
  - 3. Wire: Twisted, shielded-pair cable.
  - 4. Insertion Elements in Ducts: Single point, **8 inches (200 mm)** long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).
  - 5. Averaging Elements in Ducts: **36 inches (915 mm) long, flexible**; use where prone to temperature stratification or where ducts are larger than 10 sq. ft. (1 sq. m).

6. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches (64 mm).
  7. Room Sensor Cover Construction: Manufacturer's standard locking covers.
    - a. Set-Point Adjustment: **Exposed**.
    - b. Set-Point Indication: **Exposed**.
    - c. Thermometer: **Exposed**.
    - d. Orientation: **Horizontal** or vertical.
  8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
- C. Humidity Sensors: Bulk polymer sensor element.
1. Manufacturers:
    - a. BEC Controls Corporation.
    - b. General Eastern Instruments.
    - c. MAMAC Systems, Inc.
    - d. ROTRONIC Instrument Corp.
    - e. TCS/Basys Controls.
    - f. Vaisala.
    - g. Siemens
    - h. Johnson Controls
    - i. Honeywell
  2. Accuracy: 2 percent full range with linear output.
  3. Room Sensor Range: 20 to 80 percent relative humidity.
  4. Room Sensor Cover Construction: Manufacturer's standard locking covers.
    - a. Set-Point Adjustment: **Exposed**.
    - b. Set-Point Indication: **Exposed**.
    - c. Thermometer: **Exposed**.
    - d. Orientation: **Vertical** or **Horizontal**.
  5. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
  6. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of **minus 22 to plus 185 deg F (minus 30 to plus 85 deg C)**.
  7. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.
- D. Pressure Transmitters/Transducers:
1. Manufacturers:
    - a. BEC Controls Corporation.
    - b. General Eastern Instruments.
    - c. MAMAC Systems, Inc.
    - d. ROTRONIC Instrument Corp.
    - e. TCS/Basys Controls.
    - f. Vaisala
    - g. Siemens
    - h. Johnson Controls
    - i. Honeywell
  2. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
    - a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
    - b. Output: 4 to 20 mA.
    - c. Building Static-Pressure Range: 0- to 0.25-inch wg (0 to 62 Pa).
    - d. Duct Static-Pressure Range: 0- to 5-inch wg (0 to 1240 Pa).
  3. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure; linear output 4 to 20 mA.
  4. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure and tested to 300-psig (2070-kPa); linear output 4 to 20 mA.

5. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
  6. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.
- E. Room Sensor Cover Construction: Manufacturer's standard locking covers.
1. Set-Point Adjustment: **Exposed**.
  2. Set-Point Indication: **Exposed**.
  3. Thermometer: **Exposed**.
  4. Orientation: **Vertical** or **Horizontal**.

## 2.8 STATUS SENSORS

- A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg (0 to 1240 Pa).
- B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig (55 to 414 kPa), piped across pump.
- C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
- D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.
- E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.
- F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
- G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
- H. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type I enclosure.
  1. Manufacturers:
    - a. BEC Controls Corporation.
    - b. I.T.M. Instruments Inc.
    - c. Siemens
    - d. Johnson Controls
    - e. Honeywell

## 2.9 GAS DETECTION EQUIPMENT

- A. Manufacturers:
  1. B. W. Technologies.
  2. CEA Instruments, Inc.
  3. Ebtron, Inc.
  4. Gems Sensors Inc.
  5. Greystone Energy Systems Inc.

6. Honeywell International Inc.; Home & Building Control.
7. INTEC Controls, Inc.
8. I.T.M. Instruments Inc.
9. Johnson Controls
10. MSA Canada Inc.
11. QEL/Quatrosense Environmental Limited.
12. Sauter Controls Corporation.
13. Siemens
14. Sensidyne, Inc.
15. TSI Incorporated.
16. Vaisala.
17. Vulcain Inc.

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

## 2.10 CONTROL VALVES

### A. Manufacturers:

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

- B. Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

### C. Hydronic system globe valves shall have the following characteristics:

1. NPS 2 (DN 50) and Smaller: Class **125** bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
2. NPS 2-1/2 (DN 65) and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.
  - a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
  - b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.
4. Sizing: **3-psig (21-kPa)** maximum pressure drop at design flow rate or the following:
  - a. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.
5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.

- D. Terminal Unit Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.

1. Rating: Class 125 for service at 125 psig (860 kPa) and 250 deg F (121 deg C) operating conditions.
2. Sizing: 3-psig (21-kPa) maximum pressure drop at design flow rate, to close against pump shutoff head.
3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

## 2.11 DAMPERS

### A. Manufacturers:

1. Air Balance Inc.
2. Don Park Inc.; Autodamp Div.
3. Ruskin
4. TAMCO (T. A. Morrison & Co. Inc.).
5. United Enertech Corp.
6. Vent Products Company, Inc.
7. Siemens
8. Johnson Controls
9. Honeywell

### B. Dampers: AMCA-rated, **opposed**-blade design; 0.108-inch- (2.8-mm-) minimum thick, galvanized-steel or 0.125-inch- (3.2-mm-) minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- (1.6-mm-) thick galvanized steel with maximum blade width of 8 inches (200 mm) and length of 48 inches (1220 mm).

1. Secure blades to 1/2-inch- (13-mm-) diameter, zinc-plated axles using zinc-plated hardware, with **nylon** blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).
3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. (50 L/s per sq. m) of damper area, at differential pressure of 4-inch wg (1000 Pa) when damper is held by torque of 50 in. x lbf (5.6 N x m); when tested according to AMCA 500D.

## 2.12 CONTROL CABLE

- ### A. Electronic and fiber-optic cables for control wiring shall be manufacturer's standard.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 INSTALLATION

- #### A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- #### B. Connect and configure equipment and software to achieve sequence of operation specified.
- #### C. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices **48 inches (1220 mm)** above the floor.
1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

- D. Install automatic dampers according to Division 23 Section "Air Duct Accessories."
- E. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- F. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."
- G. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."
- H. Install electronic and fiber-optic cables according to NEC and manufacturer's recommendations.

### 3.3 FIELD QUALITY CONTROL

- A. **Manufacturer's Field Service:** Engage a factory-authorized service representative to inspect, **test, and adjust** field-assembled components and equipment installation, including connection, **and to assist in field testing.** Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
  - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
  - 2. Test and adjust controls and safeties.
  - 3. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
  - 4. Test each point through its full operating range to verify that safety and operating control set points are as required.
  - 5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
  - 6. Test each system for compliance with sequence of operation.
  - 7. Test software and hardware interlocks.
- C. DDC Verification:
  - 1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
  - 2. Check instruments for proper location and accessibility.
  - 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
  - 4. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
  - 5. Check temperature instruments and material and length of sensing elements.
  - 6. Check control valves. Verify that they are in correct direction.
  - 7. Check DDC system as follows:
    - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
    - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
    - c. Verify that spare I/O capacity has been provided.
    - d. Verify that DDC controllers are protected from power supply surges.
- D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.
- E. Verify that all temporary software has been removed from the system.

### 3.4 ADJUSTING

- A. Calibrating and Adjusting:
  - 1. Calibrate instruments.

2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:
  - a. Check analog inputs at 0, 50, and 100 percent of span.
  - b. Check analog outputs using milliamper meter at 0, 50, and 100 percent output.
  - c. Check digital inputs using jumper wire.
  - d. Check digital outputs using ohmmeter to test for contact making or breaking.
  - e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
5. Flow:
  - a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
  - b. Manually operate flow switches to verify that they make or break contact.
6. Pressure:
  - a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
  - b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
7. Temperature:
  - a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
  - b. Calibrate temperature switches to make or break contacts.
8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
10. Provide diagnostic and test instruments for calibration and adjustment of system.
11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature and humidity set points.

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

### 3.5 DEMONSTRATION

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

### 3.6 SYSTEM CERTIFICATION

- A. The temperature control manufacturer shall calibrate, adjust, and approve the installation of the control system. A letter of certification from the manufacturer shall be submitted to certify the following:
1. That sensors and controllers have been checked, calibrated, and are working as specified.
  2. That all designated software has been loaded and diagnostic testing has been completed with all malfunctions corrected.
  3. That the sequence of operation has been checked and is as specified.
  4. All items called to be labeled are labeled.
  5. Permanent copy of the as-built control diagrams and schematics has been placed in the Operation & Maintenance Manual.

6. Owner's representatives have been instructed, verbally and in writing, in control operation.
7. That all sensors and controls are set to operating conditions.
8. That all temporary controls and software have been removed

**END OF SECTION**

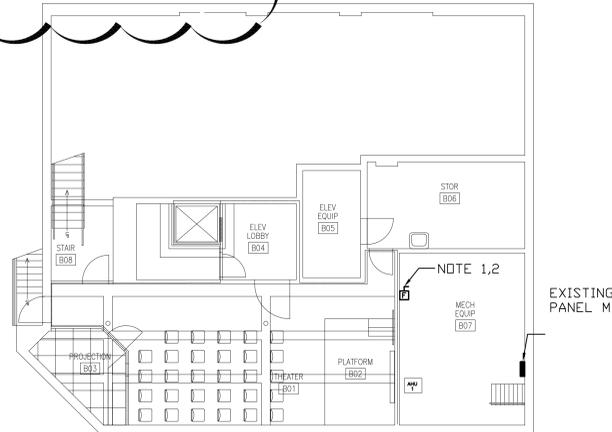
**GENERAL NOTES:**

1. NEW INDOOR UNITS WILL HAVE INTERNAL DISCONNECTING MEANS. MODIFY THE EXISTING CIRCUIT RACEWAY TO TERMINATE TO NEW UNIT.
2. IT IS PERMISSIBLE TO REUSE EXISTING RACEWAYS TO NEW AIR HANDLERS IF IN GOOD CONDITION AND OF PROPER SIZE PER NEC FOR CONDUCTORS PULLED.
3. DISCONNECT AND REMOVE CIRCUITS SERVING EXISTING CONDENSING UNITS SHOWN TO BE REMOVED IN THEIR ENTIRETY.
4. THE BUILDING SERVICE IS 240 VOLTS, 3 PHASE, DELTA. ALL NEW AIR UNITS SHALL BE RATED FOR 240 VOLTS. SINCE ELECTRICAL CHARACTERISTICS OF AIR UNITS CAN DIFFER BETWEEN MANUFACTURERS, CONTRACTOR SHALL COORDINATE THE CIRCUIT BREAKER AND BRANCH CIRCUIT REQUIREMENTS OF THE UNITS CHOSEN AND NOTIFY THE ENGINEER WHERE DIFFERENCES ARE FOUND COMPARED TO ELECTRICAL DESIGN PRIOR TO RELEASING UNITS FOR SHIPMENT.

**LEGEND:**

**ELECTRICAL EQUIPMENT:**

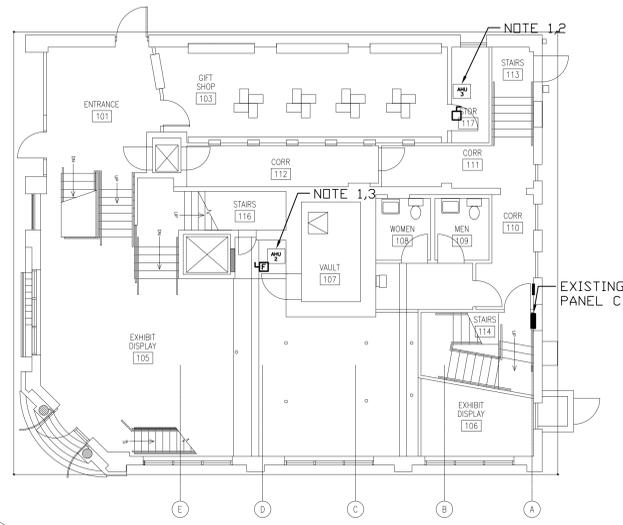
-  NON-FUSIBLE DISCONNECT SWITCH
-  FUSIBLE DISCONNECT SWITCH
-  PANELBOARD
-  NEMA 0 SIZE COMBINATION STARTER/DISCONNECT IN NEMA 3R ENCLOSURE



**1 BASEMENT NEW ELECTRICAL WORK PLAN**  
E1.01 SCALE: 1/8"=1'-0"

**NOTES:**

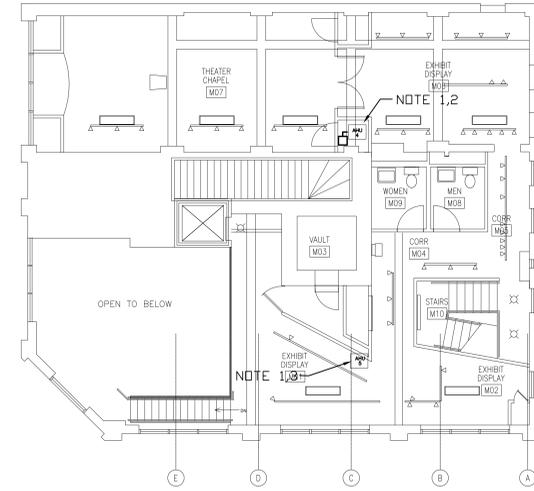
1. DISCONNECT CIRCUIT FROM EXISTING UNIT.
2. REPLACE DISCONNECT WITH NEW FUSIBLE 60/2/40F/NEMA 1. CONNECT TO EXISTING CIRCUIT AND MAKE FINAL CONNECTION TO NEW AIR HANDLER- (3) No. 8 AWG & (1) No. 10 AWG (G). UNIT RATING IS 230 VOLTS, 1 PH.



**2 FIRST FLOOR NEW ELECTRICAL WORK PLAN**  
E1.01 SCALE: 1/8"=1'-0"

**NOTES:**

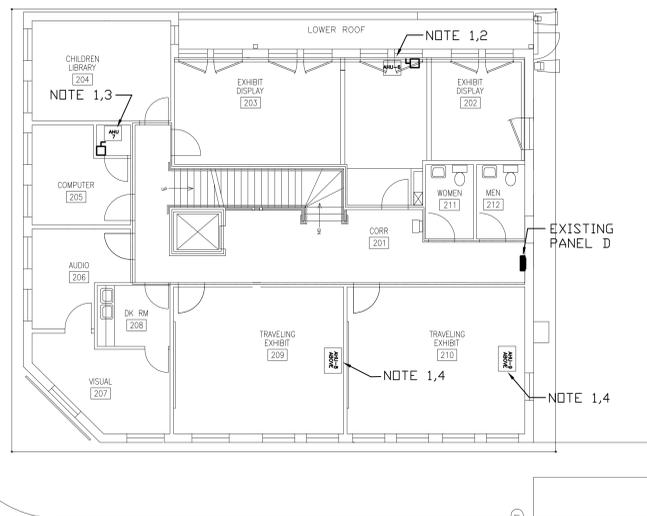
1. DISCONNECT CIRCUIT FROM EXISTING UNIT.
2. PULL NEW 3/4" (2) No. 8 & (1) No. 10 (G) FROM NEW 35/2 BREAKER IN PANEL C. REMOVE BREAKER SERVING EXISTING UNIT. CONNECT TO NEW AIR UNIT. UNIT RATING IS 230 VOLTS, 1 PH.
3. PULL NEW 1" C. W/ (3) No. 6 & (1) No. 10 (G) FROM NEW 45/3 BREAKER IN PANEL M IN BASEMENT. CONNECT TO NEW AIR UNIT. UNIT RATING IS 230 VOLTS, 3 PH.



**3 SECOND FLOOR NEW ELECTRICAL WORK PLAN**  
E1.01 SCALE: 1/8"=1'-0"

**NOTES:**

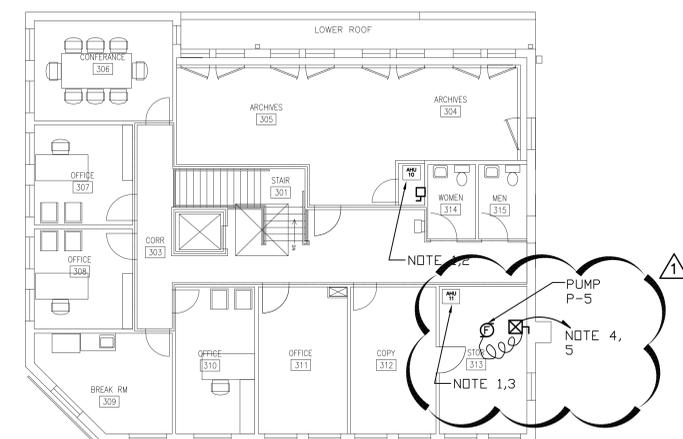
1. DISCONNECT CIRCUIT FROM EXISTING UNIT. REMOVE BREAKER SERVING EXISTING UNIT.
2. PULL NEW 1" C. W/ (2) No. 6 & (1) No. 10 (G) FROM NEW 60/2 BREAKER IN PANEL C. CONNECT TO NEW AIR UNIT. UNIT RATING IS 230 VOLTS, 1 PH.
3. EXTEND NEW 1" C. W/ (2) No. 4, & (1) No. 10 (G) FROM NEW 60/2 BREAKER IN PANEL C. CONNECT TO NEW UNIT. UNIT RATING IS 230 VOLTS, 1 PH.



**4 THIRD FLOOR NEW ELECTRICAL WORK PLAN**  
E1.01 SCALE: 1/8"=1'-0"

**NOTES:**

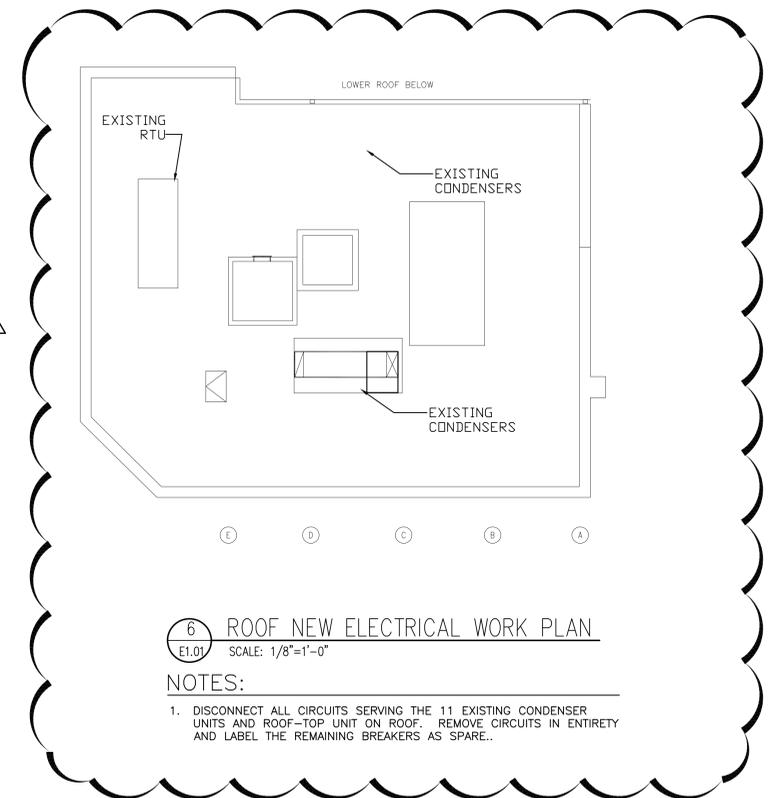
1. DISCONNECT CIRCUIT FROM EXISTING UNIT.
2. EXTEND NEW 1/2" C. W/ (2) No. 12 AWG & (1) No. 12 AWG (G) FROM PANEL D. REPLACE EXISTING 15/2 BREAKER WITH NEW 20/2 BREAKER. MAKE FINAL CONNECTION TO NEW AIR HANDLER. UNIT RATING IS 230 VOLTS, 1 PH.
3. EXTEND NEW 1 1/4" C. W/ (2) No. 4 & (1) No. 10 (G) FROM PANEL D. CONNECT TO SAME 60/2 BREAKER SERVING EXISTING UNIT. MAKE FINAL CONNECTION TO NEW AIR HANDLER. UNIT RATING IS 230 VOLTS, 1 PH. UNIT RATING IS 230 VOLTS, 1 PH.
4. MAINTAIN EXISTING CIRCUIT AND REPLACE FUSES IN DISCONNECT WITH 20 AMP FUSES (2). MAKE FINAL CONNECTION TO NEW AIR HANDLER- (2) No. 12 AWG & (1) No. 12 AWG (G). UNIT RATING IS 230 VOLTS, 1 PH.



**5 FOURTH FLOOR NEW ELECTRICAL WORK PLAN**  
E1.01 SCALE: 1/8"=1'-0"

**NOTES:**

1. DISCONNECT CIRCUIT FROM EXISTING UNIT.
2. EXTEND NEW 3/4" C. W/ (2) No. 8 AWG & (1) No. 10 AWG (G) FROM PANEL D. REPLACE EXISTING 35/2 BREAKER WITH NEW 40/2 BREAKER. MAKE FINAL CONNECTION TO NEW AIR HANDLER. UNIT RATING IS 230 VOLTS, 1 PH.
3. EXTEND NEW 1 1/4" C. W/ (2) No. 4 AWG & (1) No. 10 AWG (G) FROM PANEL D. REPLACE EXISTING 70/2 BREAKER WITH NEW 60/2 BREAKER. MAKE FINAL CONNECTION TO NEW AIR HANDLER.
4. EXTEND 1/2" C. FROM STARTER TO CHILLER FOR CONTROL CABLING.
5. EXTEND NEW 3/4" C. W/ (3) No. 12 AWG & (1) No. 12 AWG (G) FROM NEW STARTER TO EXISTING SERVICE SWITCHBOARD. PROVIDE NEW 15/3P BREAKER IN PANEL.



**6 ROOF NEW ELECTRICAL WORK PLAN**  
E1.01 SCALE: 1/8"=1'-0"

**NOTES:**

1. DISCONNECT ALL CIRCUITS SERVING THE 11 EXISTING CONDENSER UNITS AND ROOF-TOP UNIT ON ROOF. REMOVE CIRCUITS IN ENTIRETY AND LABEL THE REMAINING BREAKERS AS SPARE..

**ROSSER**

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CONSULTANTS

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HVAC MODIFICATIONS

PROJECT PHASE

KEY PLAN

PRINTING AND REVISIONS

5/22/17 - GEN REVISIONS

MARK, DATE, DESCRIPTION

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DRAWN BY	WLS
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DATE RELEASED FOR CONSTRUCTION	4-03-2017
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CADD SHEET FILE NAME	

SHEET TITLE

NEW ELECTRICAL  
WORK PLAN -  
MUSEUM

SHEET NUMBER

E1.01

SHEET XX OF XX