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**B0001676**

***ADDENDUM # 1***

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**FROM:** *Kim Sowell*

Campus Box 12

Ph: 316-978-3784

Fax: 316-978-3528

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**TO:** All Bidders

**DATE:** 9/10/2020

**CLOSING DATE AND TIME:** 9/16/2020 @ 2:00 PM

**SUBJECT:** B0001676 Addendum – NIAR ATLAS Phase 2

**CLARIFICATIONS TO BID:**

- See attachments for addendum details.

**NO. OF PAGES (including cover sheet):** 24

**Bid Responses must be emailed to [kim.sowell@wichita.edu](mailto:kim.sowell@wichita.edu) prior to the bid closing date and time! Hand delivered or mailed responses are not allowed to WSU Office of Purchasing.**

**Wichita State University**  
**Office of Purchasing**  
Kim Sowell  
1845 Fairmount, Campus Box 12  
Morrison Hall, Room 021  
Wichita, KS 67260-0012  
Phone: 316-978-3784

STATE OF KANSAS  
CONSTRUCTION PROJECT NO. A-014118

ADDENDUM NO. 1

September 10, 2020

ISSUED BY:

Wichita State University  
1845 Fairmount St.  
Wichita, Kansas 67260-0047

GLMV Architecture  
1525 E. Douglas  
Wichita, Kansas 67211  
Contact: Meredith Hampton, Project Manager  
Phone Number: 316-265-9367  
E-Mail: mcortez@glmv.com

ISSUED FOR ARCHITECT/ENGINEER  
NOTICE ALL BIDDERS FOR THE:

Wichita State University  
NIAR ATLAS Building Phase 2  
Wichita, Kansas

You are instructed to read and to note the following described changes, corrections, clarifications, omissions, deletions, additions, approvals and statements pertinent to the Contract Bid and Construction Documents.

The Addendum No. 1 is a part of the Contract Bid and Construction Documents and shall govern in the performance of the Work.

Article 1-1, Pre-Bid Conference: (Attachment)

- A. A pre-bid conference was held on Tuesday, September 1, 2020 at 10:00am. Attached is a list of attendees.

Article 1-2, Pre-Bid Jobsite Visit: (Attachment)

- A. A pre-bid jobsite visit was held on Tuesday, September 1, 2020 at 2:00pm, 3:00pm and Friday, September 4, 2020 at 2:00pm. Attached is a list of attendees.

Article 1-3, Specification Section 230900 INSTRUMENTATION AND CONTROL FOR HVAC:

- A. Specification Section shall be replaced with the attached revised section. The acceptable manufacturers shall be Sandifer Engineering and Controls – TAC to match the existing control system for the building.

Article 1-4, Clarification:

- A. Clarification: Glazing type shall be ¼" clear tempered glass.

Article 1-5, Clarification:

- A. Clarification: Owner provided vacuum pump is scheduled to ship on October 1 and shall be arriving 2-3 days after shipment. G.C. shall coordinate in receiving the equipment.

Article 1-6, Clarification:

- A. Clarification: Owner provided RTU to be delivered around October 14, 2020. G.C shall coordinate in receiving the equipment.

Article 1-7, Clarification:

- A. Clarification: G.C. shall provide a temporary partial height (minimum height of 12'-0") dust protection with no mechanical attachment to the floor to avoid permanent damage to the facility after removal to protect NIAR employees.

Article 1-8, Clarification:

- A. Clarification: G.C. shall utilize technique for drywall finishing work to ensure dust is minimized within the space for NIAR.

Article 1-9, Clarification:

- A. Clarification: To assist on tracking items within the construction schedule and submittals to meet the indicated completion date, G.C. shall provide a list of long-lead items (4 weeks or longer) within their bid information.

Article 1-10, Clarification:

- A. Clarification: The use of temporary doors for both the man door and the overhead coiling door necessary to pass inspections could be used to achieve the November 6, 2020 completion date. This door shall still maintain a secure space for the Slitter Room.

Article 1-11, Clarification:

- B. Clarification: The existing equipment east of the new Slitter Room shall be either protected or relocated by NIAR and not in the G.C.'s scope.

Article 1-12, Clarification:

- A. Clarification: NIAR shall continue to utilize the space during construction of the Phase II project. G.C.'s work hours can be outside of NIAR working hours, but shall be coordinated with NIAR and WSU.

Article 1-13, Clarification: (Attachment)

- A. Clarification: Coordinate with NIAR for work in Coriolis Lab for vacuum line installation throughout the west side of the building. See the attached photos for reference of the Coriolis Lab.

Article 1-14, Clarification:

- A. Clarification: Interior access to the west Coriolis Lab shall be kept clear as much as possible. G.C. access could occur at the north door. Keep access on the interior clear as much as possible for NIAR.

Article 1-15, Clarification:

- A. Question: 12 and 13 on M-200 show a service platform. The existing unit does not have a platform. Will a platform be required?
- B. Clarification: A platform is required to assist in keeping the ductwork from being stood on top of or create any issues in the future while the unit is being serviced.

Article 1-16, Clarification:

- A. Question: Will the sheetrock on top of the lid be required to be finished?
- B. Clarification: Yes, the sheetrock is intended to be finished on the lid to the Slitter Room.

Article 1-17, Clarification:

- A. Question: What company installed the existing fire sprinkler system?
- B. Clarification: Myers Automatic Fire Protection, LLC

Article 1-18, Product Substitutions:

- A. Subject to compliance with requirements, add the following to the list of acceptable manufacturers for each of the following Specification Sections:
  - 1. Section 081113 – Hollow Metal Doors and Frames – Mesker, Ceco

## B0001676

### (NIAR ATLAS Phase 2)

Pre-Bid Conference: Non-Mandatory

Date: September 1, 2020 at 10:00am

Place: Zoom Meeting

Name	Company	Phone	Email Address
Drew Wyss	Bauer & Son Construction Company, Inc.	(316) 214 - 2567	<a href="mailto:dwyss@bscconstruction.com">dwyss@bscconstruction.com</a>
DJ McClenny	Crossland Construction	(620) 210 - 0282	<a href="mailto:djmccclenny@crossland.com">djmccclenny@crossland.com</a>
Jeff Van Asdale	Van Asdale Construction	(316) 648 - 5931	<a href="mailto:vanasdaleconst@gmail.com">vanasdaleconst@gmail.com</a>
Travis DeForeest	Commerce Construction	(316) 516 – 8993	<a href="mailto:travis@ccswichita.com">travis@ccswichita.com</a>
Brandon Merritt	Eby Construction	(316) 250 - 4952	<a href="mailto:Bmerritt@ebycorp.com">Bmerritt@ebycorp.com</a>
Warren Way	Harman Huffman	(316) 744 - 2081	<a href="mailto:wway@harmanhuffman.com">wway@harmanhuffman.com</a>
Kim Sowell	WSU	(316) 978 - 3784	<a href="mailto:Kim.sowell@wichita.edu">Kim.sowell@wichita.edu</a>
Todd Woolsoncroft	WSU	(316) 978 - 5517	<a href="mailto:Todd.woolsoncroft@wichita.edu">Todd.woolsoncroft@wichita.edu</a>
Matt Cortez	GLMV	(316) 265-9367	<a href="mailto:Matt.cortez@glmv.com">Matt.cortez@glmv.com</a>
Meredith Hampton	GLMV	(316) 265-9367	<a href="mailto:Meredith.hampton@glmv.com">Meredith.hampton@glmv.com</a>

**B0001676****(NIAR ATLAS Phase 2)**

Site Visit Meeting: Non-Mandatory

Date: September 1, 2020 at 2:00 and 3:00 pm

Place: East side of ATLAS Building

<b>2:00</b>	<b>3:00</b>	
Travis DeForeest Commerce Construction <a href="mailto:travis@ccswichita.com">travis@ccswichita.com</a> 316-516-8993	Drew Wyss Bauer & Son Construction Company, Inc. 415 S. Zelta <u>Wichita, KS 67207</u> (316) 683-1492 Fax (316) 684-1372 Mobile (316) 214-2567 Email <a href="mailto:dwyss@bscconstruction.com">dwyss@bscconstruction.com</a> <a href="http://www.bscconstruction.com">www.bscconstruction.com</a>	
Brandon Merritt Superintendent Martin K. Eby Construction Co., Inc. 2525 E. 36 <sup>th</sup> Circle North Wichita, KS 67219 316-250-4952 (cell) <a href="http://www.ebycorp.com">www.ebycorp.com</a>	Jeff Van Asdale Van Asdale Construction <a href="mailto:vanasdaleconst@gmail.com">vanasdaleconst@gmail.com</a> (316) 648-5931	
Greg Anderson Dondlinger Construction 2656 S. Sheridan Ave. PO Box 398 Wichita, KS 67201 t: 316-945-0555 f: 316-945-9009 <a href="http://www.dondlinger.biz">www.dondlinger.biz</a>	James Sudduth <u>3017 N. Cypress Drive</u> <u>Wichita KS 67226</u> Phone: <u>316-942-9090</u> Fax: <u>316-944-0147</u> Cell: <u>620-210-0282</u> <a href="mailto:DJMcClenny@Crossland.com">DJMcClenny@Crossland.com</a> website: <a href="http://www.crosslandconstruction.com">www.crosslandconstruction.com</a>	
Armando Michel Michel Drywall LLC 1913 N Ohio Ave Wichita, KS 67214 <a href="http://www.micheldrywall.com">www.micheldrywall.com</a> Cell. 316-617-5812	Brad Bradford Phillips Southern Electric <a href="mailto:Brad@phillips-southern.org">Brad@phillips-southern.org</a> 316.259.0571	
Date: September 4, 2020 at 2:00		
Derek Dahm Chief Estimator <a href="mailto:derek@concoconstruction.com">derek@concoconstruction.com</a> 3051 N. Ohio · Wichita, KS 67219 p: 316-943-7111 · c: 316-364-8643	Andre Michaud Wichita Electric Company 2020 E. Douglas Wichita, KS 67214 <u>O:316-269-1962</u> <u>C:316-299-8015</u>	

SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 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. See Section 230993 "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

1.2 ACTION SUBMITTALS

- A. Product Data: For each control device indicated.
- B. Shop Drawings:
  - 1. Schematic flow diagrams.
  - 2. Power, signal, and control wiring diagrams.
  - 3. Details of control panel faces.
  - 4. Damper schedule.
  - 5. Valve schedule.
  - 6. DDC System Hardware: Wiring diagrams, schematic floor plans, and schematic control diagrams.
  - 7. Control System Software: Schematic diagrams, written descriptions, and points list.
- C. Where CAD files or Revit models are deemed beneficial by contractor for contractors use in coordination, a service charge will be assessed for file preparation.
- D. Request for electronic files shall be submitted to Architect/Engineer with signed Data Release form including listed sheet numbers requested.
- E. A service charge of \$100 per sheet for preparation of electronic drawing files or Revit files will be charged for requested construction document sheets.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
- B. Software and firmware operational documentation.

## 1.5 QUALITY ASSURANCE

- A. 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.

## 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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
  2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

## 2.2 CONTROL SYSTEM

- A. Manufacturers:
1. Sandifer Engineering and Controls - TAC.
- B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator 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: PC-based microcomputer with minimum configuration as follows:
1. Motherboard: With 8 integrated USB 3.0 ports, integrated Intel Pro 10/100/1000 (Ethernet), integrated audio, bios, and hardware monitoring.
  2. Processor: Intel Pentium I5-2320 Processor.
  3. Random-Access Memory: 8.00 GB DDR3 memory, 1333 MHz.
  4. Radeon HD 6450, 1 GB DDR3
  5. Monitor: 24 inches wide screen LED monitor color.
  6. Keyboard: Logitech K850 wireless keyboard QWERTY, 105 keys in ergonomic shape with unifying receiver.
  7. Hard-Disk Drives: QTY 2, 1 TB Hard Drives, SATA-6, Setup as RAID 1.
  8. CD/DVD Writer/Reader
  9. Mouse: Logitech MX Master 2S wireless unifying receiver.
  10. Standard Tower Case.
  11. 2 TB backup portable hard drive, USB 3.0 interface.



12. Uninterruptible Power Supply: 2 kVa.
  13. Operating System: Microsoft Windows 10 Premium 64 bit. Professional with high-speed Internet access.
  14. Printer: Color, ink-jet type as follows:
    - a. Print Head: 4800 x 1200 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.
    - d. Application Software.
- 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.
  2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
    - a. Global communications.
    - b. Discrete/digital, analog, and pulse I/O.
    - c. Monitoring, controlling, or addressing data points.
    - d. Software applications, scheduling, and alarm processing.
    - e. Testing and developing control algorithms without disrupting field hardware and controlled environment.
- 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.
- 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: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
  2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
  3. Enclosure: Dustproof rated for operation at 32 to 120 deg F (0 to 50 deg C).

## 2.5 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.

## 2.6 TIME CLOCKS

### A. Manufacturers:

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

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

- C. Solid-state, programmable time control with 8 separate programs each with up to 100 on-off operations; 1-second resolution; lithium battery backup; keyboard interface and manual override; individual on-off-auto switches for each program; 365-day calendar with 20 programmable holidays; choice of fail-safe operation for each program; system fault alarm; and communications package allowing networking of time controls and programming from PC.

## 2.7 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.

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. Color: As selected by Architect from manufacturer's standard color selection.
  - e. Orientation: Vertical.
8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
9. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

C. RTDs and Transmitters:

1. Manufacturers:
  - a. BEC Controls Corporation.
  - b. MAMAC Systems, Inc.
  - c. RDF Corporation.
2. Accuracy: Plus or minus 0.2 percent at calibration point.
3. Wire: Twisted, shielded-pair cable.
4. Insertion Elements in Ducts: Single point, 8 inches (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: 18 inches (460 mm) long, rigid; use where prone to temperature stratification or where ducts are larger than 9 sq. ft. (0.84 sq. m); length as required.
6. Insertion Elements for Liquids: Brass 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. Color: As selected by Architect from manufacturer's standard color selection.
  - e. Orientation: Vertical.
8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
9. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

D. Humidity Sensors: Bulk polymer sensor element.

1. Manufacturers:
  - a. BEC Controls Corporation.
  - b. General Eastern Instruments.
  - c. MAMAC Systems, Inc.
  - d. ROTRONIC Instrument Corp.
  - e. TCS/Basys Controls.
  - f. Vaisala.

2. Accuracy: 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. Color: As selected by Architect from manufacturer's standard color selection.
  - e. Orientation: Vertical.
5. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
6. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of 32 to 120 deg F (0 to 50 deg C).
7. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.

E. Pressure Transmitters/Transducers:

1. Manufacturers:
  - a. BEC Controls Corporation.
  - b. General Eastern Instruments.
  - c. MAMAC Systems, Inc.
  - d. ROTRONIC Instrument Corp.
  - e. TCS/Basys Controls.
  - f. Vaisala.
2. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
  - a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
  - b. Output: 4 to 20 mA.
  - c. Building Static-Pressure Range: 0- to 0.25-inch wg (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 or liquid service; range suitable for system; linear output 4 to 20 mA.

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

1. Set-Point Adjustment: Exposed.
2. Set-Point Indication: Exposed.
3. Thermometer: Exposed.
4. Color: As selected by Architect from manufacturer's standard color selection.
5. Orientation: Vertical.

- G. Room sensor accessories include the following:
1. Insulating Bases: For sensors located on exterior walls.
  2. Guards: Locking, solid metal, ventilated.
  3. Adjusting Key: As required for calibration and cover screws.

## 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 1 enclosure.
1. Manufacturers:
    - a. BEC Controls Corporation.
    - b. I.T.M. Instruments Inc.

## 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. MSA Canada Inc.
10. QEL/Quatrosense Environmental Limited.
11. Sauter Controls Corporation.
12. Sensidyne, Inc.
13. TSI Incorporated.
14. Vaisala.
15. Vulcain Inc.

- B. Carbon Monoxide Detectors: Single or multichannel, dual-level detectors using solid-state plug-in sensors with a 3-year minimum life; suitable over a temperature range of 32 to 104 deg F (0 to 40 deg C); with 2 factory-calibrated alarm levels at 35 and 200 ppm.
- C. 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.
- D. Occupancy Sensor: Passive infrared, with time delay, daylight sensor lockout, sensitivity control, and 180-degree field of view with vertical sensing adjustment; for flush mounting.

## 2.10 THERMOSTATS

### A. Manufacturers:

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

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

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

- f. Day of week.
  - g. System mode indications include "heating," "off," "fan auto," and "fan on."
- C. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F (13 to 30 deg C) set-point range, and 2 deg F (1 deg C) maximum differential.
- D. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F (13 to 30 deg C) set-point range, and 2 deg F (1 deg C) maximum differential.
- 1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.
  - 2. Selector Switch: Integral, manual on-off-auto.
- E. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.
- 1. Bulbs in water lines with separate wells of same material as bulb.
  - 2. Bulbs in air ducts with flanges and shields.
  - 3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.
  - 4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
  - 5. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.
  - 6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.
- F. Fire-Protection Thermostats: Listed and labeled by an NRTL acceptable to authorities having jurisdiction; with fixed or adjustable settings to operate at not less than 75 deg F (24 deg C) above normal maximum operating temperature, and the following:
- 1. Reset: Manual.
  - 2. Reset: Automatic, with control circuit arranged to require manual reset at central control panel; with pilot light and reset switch on panel labeled to indicate operation.
- G. Room Thermostat Cover Construction: Manufacturer's standard locking covers.
- 1. Set-Point Adjustment: Exposed.
  - 2. Set-Point Indication: Exposed.
  - 3. Thermometer: Exposed.
  - 4. Color: As selected by Architect from manufacturer's standard color selection.
  - 5. Orientation: Vertical.
- H. Room thermostat accessories include the following:
- 1. Insulating Bases: For thermostats located on exterior walls.
  - 2. Thermostat Guards: Locking, solid metal, ventilated.
  - 3. Adjusting Key: As required for calibration and cover screws.
  - 4. Set-Point Adjustment: ½-inch- (13-mm-) diameter, adjustment knob.



- I. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.
- J. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.
- K. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual-reset switch that trips if temperature sensed across any 12 inches (300 mm) of bulb length is equal to or below set point.
  - 1. Bulb Length: Minimum 20 feet (6 m).
  - 2. Quantity: One thermostat for every 20 sq. ft. (2 sq. m) of coil surface.
- L. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual-reset switch that trips if temperature sensed across any 12 inches (300 mm) of bulb length is equal to or above set point.
  - 1. Bulb Length: Minimum 20 feet (6 m).
  - 2. Quantity: One thermostat for every 20 sq. ft. (2 sq. m) of coil surface.
- M. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, with molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psig (172 kPa), and cast housing with position indicator and adjusting knob.

## 2.11 HUMIDISTATS

- A. Manufacturers:
  - 1. MAMAC Systems, Inc.
  - 2. ROTRONIC Instrument Corp.
- B. Duct-Mounting Humidistats: Electric insertion, 2-position type with adjustable, 2 percent throttling range, 20 to 80 percent operating range, and single- or double-pole contacts.

## 2.12 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
  - 1. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
  - 2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
  - 3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).
  - 4. Spring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).

5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).
6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).

B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

1. Manufacturers:

- a. Belimo Aircontrols (USA), Inc.
- b. IA Seriec T.A.C.
- c. Professional Series.

2. Valves: Size for torque required for valve close off at maximum pump differential pressure.

3. Dampers: Size for running torque calculated as follows:

- a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. (86.8 kg-cm/sq. m) of damper.
- b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. (62 kg-cm/sq. m) of damper.
- c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. (49.6 kg-cm/sq. m) of damper.
- d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. (37.2 kg-cm/sq. m) of damper.
- e. Dampers with 2- to 3-Inch wg (500 to 750 Pa) of Pressure Drop or Face Velocities of 1000 to 2500 fpm (5 to 13 m/s): Increase running torque by 1.5.
- f. Dampers with 3- to 4-Inch wg (750 to 1000 Pa) of Pressure Drop or Face Velocities of 2500 to 3000 fpm (13 to 15 m/s): Increase running torque by 2.0.

4. Coupling: V-bolt and V-shaped, toothed cradle.

5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.

6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.

7. Power Requirements (Two-Position Spring Return): 24-V ac.

8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.

9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.

10. Temperature Rating: Minus 22 to plus 122 deg F (Minus 30 to plus 50 deg C).

11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F (Minus 30 to plus 121 deg C).

12. Run Time: 30 seconds.

## 2.13 CONTROL VALVES

A. Manufacturers:

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

- B. Control Valves: Valves must be selected so that the minimum stabilized control valve authority is greater than or equal to 0.25. 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: 250-psig; DZR Brass (Ametal®) or bronze body, bronze trim, rising stem, DZR Brass (Ametal®) disc with EPDM seat or renewable composition disc, and screwed ends with backseating capacity repackable under pressure. Basis of Design: Victaulic Series 786.
  2. NPS 2-1/2 (DN 65) and Larger: 250-psig ductile iron body, DZR brass or bronze trim, rising stem, plug-type disc, flanged or grooved ends, and renewable seat and disc. Basis of Design: Victaulic Series 788 and 789.
  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. Two Position: Line size.
    - b. Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.
    - c. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.
  5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
  6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.
- D. Butterfly Valves: 300-psig (2065-kPa), maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable pressure-responsive EPDM or Buna N seat, sleeve and stem seals. Stem shall be offset from the disc centerline to provide complete 360-degree circumferential seating.
1. Body Style: Grooved.
  2. Disc Type: Electroless nickel-plated ductile iron, Aluminum bronze, Elastomer-coated ductile iron or Epoxy-coated ductile iron.
  3. Sizing: 1-psig (7-kPa) maximum pressure drop at design flow rate.
  4. Basis of Design: Victaulic Vic 300 Master Seal.
- E. Terminal Unit Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.
1. Rating: Class 125 for service at 125 psig (860 kPa) and 250 deg F (121 deg C) operating conditions.
  2. Sizing: 3-psig (21-kPa) maximum pressure drop at design flow rate, to close against pump shutoff head.

3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

F. Terminal Balancing Valve for Modulating Control: NPT female threaded ends, non-ferrous Ametal® DZR brass copper alloy body, PPS (polyphenylsulfide) plug, EPDM o-ring seat and spindle seal, stainless steel return spring, Nedox® coated Ametal® spindle, and 10-position setting dial. Suitable for working temperatures to +250°F (+120°C). Normally closed actuators shall be available factory installed. Victaulic Series TCM.

## 2.14 DAMPERS

### A. Manufacturers:

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

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 ½-inch- (13-mm-) diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).
3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
4. Edge Seals, Low-Leakage Applications: Use 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.

C. Temperature Control Contractor shall provide all control dampers and actuators unless damper is provided by unit manufacturer.

## 2.15 CONTROL CABLE

A. All DDC control wires shall be a minimum of two pairs, plenum rated, shielded, and with a drain wire. The LAN wire must be a 22-gauge wire conforming to the above standard as a minimum. All other wire must be eighteen- (18) or twenty- (20) gauge conforming to the above standard as a minimum. The wire cover shall be a bone or ivory color with orange or purple stripe. DDC wire must be installed in its own raceway and must be located 12" away from network and intercom wiring supported by D-rings, J-hooks, or in a cable tray.

- B. All conduit and wiring for low voltage HVAC controls shall be by Temperature Controls Contractor.
- C. All line voltage conduit and wiring for HVAC controls shall be by Electrical Contractor.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. 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.
- B. Install guards on thermostats in the following locations:
  - 1. Entrances.
  - 2. Public areas.
  - 3. Where indicated.
- C. Install automatic dampers according to Section 233300 "Air Duct Accessories."
- D. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- E. Install labels and nameplates to identify control components according to Section 230553 "Identification for HVAC Piping and Equipment."
- F. Install hydronic instrument wells, valves, and other accessories according to Section 232113 "Hydronic Piping."
- G. Install refrigerant instrument wells, valves, and other accessories according to Section 232300 "Refrigerant Piping."
- H. Install duct volume-control dampers according to Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts."
- I. Install electronic and fiber-optic cables according to Section 271500 "Communications Horizontal Cabling."

#### 3.2 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Electrical Specifications "Raceways and Boxes for Electrical Systems."
- B. Install building wire and cable according to Electrical Specifications "Low-Voltage Electrical Power Conductors and Cables."

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

### 3.3 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 connections and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
  - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
  - 2. Test and adjust controls and safeties.
  - 3. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
  - 4. Test each point through its full operating range to verify that safety and operating control set points are as required.
  - 5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
  - 6. Test each system for compliance with sequence of operation.
  - 7. Test software and hardware interlocks.
- C. DDC Verification:
  - 1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
  - 2. Check instruments for proper location and accessibility.
  - 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
  - 4. Check instrument tubing for proper fittings, slope, material, and support.
  - 5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.

6. Check temperature instruments and material and length of sensing elements.
  7. Check control valves. Verify that they are in correct direction.
  8. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
  9. Check DDC system as follows:
    - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
    - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
    - c. Verify that spare I/O capacity has been provided.
    - d. Verify that DDC controllers are protected from power supply surges.
- D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

### 3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls.
- B. Operational and Maintenance Training:
  1. On-Site building engineer.
  2. Minimum of three additional maintenance personnel.  
Note: Manufacturer shall provide services for (4) four hour training sessions to instruct Owner's personnel in operation and maintenance. Schedule training with owner. Provide minimum 14-day notice.

END OF SECTION 230900



