

INVITATION TO BID

INVITATION TO BID #10-08

BID DESCRIPTION: HVAC Building Automation Upgrade

ISSUE DATE: Thursday, August 26, 2010

BID OPENING DATE: Thursday, September 23, 2010

BID OPENING TIME: 10:00 AM

BID RESPONSES MUST BE RECEIVED NO LATER THAN THE PUBLIC BID OPENING DATE AND TIME (LOCAL TIME) SPECIFIED ABOVE. BIDS WILL BE OPENED AND READ ALOUD AT THAT TIME. LATE BIDS WILL NOT BE CONSIDERED.

TO ALL PROSPECTIVE CONTRACTORS/BIDDERS:

You are hereby invited to submit your bid for the item(s) to be furnished and delivered, shipped f.o.b. to the address specified herein.

All bids must be received in **DUPLICATE** in sealed envelopes.

All bids are subject to staff analysis and Board approval. The Greater Rockford Airport Authority (Authority) reserves the right to accept or reject any and all bids received and waive any and all technicalities.

Bids must be delivered prior to the public bid opening date and time to:

**Greater Rockford Airport Authority
60 Airport Drive
Rockford, IL 61109-2902**

Direct any and all inquiries about this bid to Matt Zinke, Operations & Facilities Manager, at 815-703-5331 or mzinke@flyrfd.com .

Instructions to Bidders

1.1 Bid Preparation

Bids must be submitted, in duplicate, on the blank Bid Form furnished with these contract documents and shall conform to the terms and conditions set forth in the “Instructions to Bidders,” “General Terms and Conditions” and “Special Terms and Conditions” of the contract. Bids submitted in any other manner, or which fail to furnish all information or certificates required, may be summarily rejected. Bids may be modified or withdrawn prior to the time specified for the opening of bids. Bids shall be filled out legibly in ink or typewritten with all erasures, strikeouts and corrections initialed in ink by the person signing the bid.

1.2 Bid Execution

If the Bidder is a corporation, the President shall execute the bid. In the event that the bid is executed by other than the President, a certified copy of that section of the corporate by-laws or other authorization by the corporation, which permits the person to execute the bid for the corporation, shall be submitted. If the Bidder is a partnership, all partners shall execute the bid, unless one partner has been authorized to sign for the partnership, in which case, evidence of such authority satisfactory to the Deputy Director/Finance & Administration shall be submitted. If the Bidder is a sole proprietor, the owner shall execute the bid. A “Partnership” or “Sole Proprietor” operating under an Assumed Name shall be registered with the Illinois County in which located, as provided in the Illinois Compiled Statutes, 805/ILCS 405/1.

1.3 Bid Submission

The Greater Rockford Airport Authority must receive all bids by the specified opening time of the bid. Bids arriving after the specified time will not be accepted and will be returned unopened. All bids shall be submitted in sealed envelopes with the following information explicitly shown (centered both vertically and horizontally on the envelope): name and address of bidder and bid number. Further, the sealed envelope must be clearly marked “SEALED BID.” The Bidder shall be responsible for the delivery of the bid before the date and hour set forth for the opening of bids.

1.4 Error in Bid

Bidders are cautioned to verify their bids before submission. Negligence on the part of the Bidder in preparing the bid confers no right for withdrawal or modifications of the bid after it has been opened. In case of error in the extension of prices in the bid, the unit price will prevail.

1.5 Variances and Deviations

Variances and deviations shall be described fully on the Bid Form. In the absence of such statement, the bid shall be considered as if submitted in strict compliance with all terms, conditions, and specifications; the Contractor shall be held liable. Contractors are cautioned to avoid making variances and deviations to the specifications, which may result in rejection of their bid.

1.6 Reserved Rights

Greater Rockford Airport Authority reserves the right at any time and for any reason to cancel this Invitation to Bid, accept or reject any or all bids or any portion thereof, or to accept an alternate bid. The Authority reserves the right to waive any immaterial defects or irregularities in any bid. The Authority may seek clarification from any Bidder at any time and failure to respond promptly is cause for rejection. The Authority has sixty (60) days to accept the bid.

1.7 Interpretation or Correction of Bidding Documents

Bidders shall promptly notify the Authority no later than one (1) week before bid opening of any ambiguity, inconsistency or error, which they may discover upon examination of the bidding documents. Interpretations, corrections and changes will be made by written addendum. Each bidder shall ascertain prior to submitting a bid that all addenda have been received and acknowledged in the bid. Oral explanations will not be binding.

1.8 Incurred Costs

The Authority will not be liable for any costs incurred by Bidders in replying to this Invitation to Bid.

1.9 No Bid Response

If your firm declines to bid on this invitation, but desires to remain on the Authority's Bidders' List for future invitations, please submit in a letter stating why you are declining to bid.

1.10 Basis of Award

It is the intent of the Authority to award a contract to the lowest responsible bidder meeting specifications. Further, the Authority reserves the right to determine the lowest responsible bidder in any way determined to be in the best interests of the Authority. Award will be based on the following factors (where applicable): (a) adherence to all conditions and requirements of the bid specifications; (b) price; (c) qualifications of the bidder, including past performance, financial responsibility, general reputation, experience, service capabilities, and facilities; (d) delivery or completion date; (e) product appearance, workmanship, finish, taste, feel, overall quality, and results of product testing; (f) maintenance costs and warranty provisions; and (g) repurchase or residual value.

1.11 Pre-Bid Conference

If a Pre-Bid Conference is a requirement of this contract, it will be shown on the Title Page.

End of Instructions to Bidders

General Terms and Conditions

2.1 Non-Discrimination

Contractor shall comply with the Illinois Human Rights Act, 775, ILCS 5/1-101 et seq., as amended and any rules and regulations promulgated in accordance therewith, including, but not limited to the Equal Opportunity Clause, Illinois Administrative Code, Title 44, Part 750 (Appendix A), which is incorporated herein by reference. Furthermore, the Contractor shall comply with the Public Works Employment Discrimination Act, 775 ILCS 10/0.01 et seq., as amended.

During the performance of this Contract, the Contractor agrees that it shall not discriminate against any worker, employee or applicant, or any member of the public, on the basis of race, color, religion, sex, national origin, ancestry, age, marital status, physical or mental handicap, or sexual orientation. Upon request of the Authority, the Contractor also agrees to submit in writing an affirmative action plan demonstrating compliance with equal employment opportunity laws and policies. Contractor further agrees that this clause will be incorporated by the Contractor in all contracts entered into with suppliers or materials or services, sub-contractors and all labor organizations furnishing skilled, unskilled and craft union skilled labor, or any other person or organization performing services in connection with this Contract.

2.2 Drug-Free Workplace

The Contractor agrees to provide a drug free workplace as provided for in the Drug Free Workplace Act, 30 ILCS 580/1, et seq.

2.3 Tax Exemption

The Greater Rockford Airport Authority is not subject to Federal Excise Tax. Per Illinois Compiled Statutes, 35 ILCS 120/2-5, the Greater Rockford Airport Authority is exempt from state and local taxes. Our exempt number is E9992-3521-05.

2.4 Warranties

Contractor warrants that all goods and services furnished hereunder will conform in all respects to the terms of this solicitation, including any drawings, specifications or standards incorporated herein, and that they will be free from latent and patent defects in materials, workmanship and title, and will be free from such defects in design. In addition, Contractor warrants that said goods and services are suitable for, and will perform in accordance with, the purposes for which they are purchased, fabricated, manufactured and designed or for such other purposes as are expressly specified in this solicitation. The Authority may return any nonconforming or defective items to the Contractor or require correction or replacement of the item at the time the defect is discovered, all at the Contractor's risk and expense. Acceptance shall not relieve the Contractor of its responsibility.

The Contractor further agrees, upon written notice from the Authority, to promptly and without charge, make changes, corrections and/or replacement, to the satisfaction of the Authority, which may be required to make good all defects in design and material under its intended use, for a period of one (1) year, with the one (1) year period commencing on the date of acceptance by the Authority. The Contractor shall receive no compensation for cost in replacement of goods or workmanship.

2.5 Indemnification

Contractor agrees to indemnify, save harmless and defend the Greater Rockford Airport Authority, its agents, servants, Commissioners, and employees, and each of them against and hold it and them harmless from any and all lawsuits, claims, demands, liabilities, losses or expenses, including court costs and attorneys' fees, for or on account of any injury to any person, or any death at any time resulting from such injury, or any damage to any property, which may arise or which may be alleged to have arisen, in whole or in part, out of or in connection with the work covered by this contract. The foregoing indemnity shall apply except if such injury, death or damage is caused directly and solely by the negligence or other fault of the Greater Rockford Airport Authority, its agents, servants, Commissioners, or employees or any other person indemnified hereunder. This indemnification obligation is not limited by, but is in addition to the insurance obligations, which may be contained in this contract. The provision of this paragraph shall not be waived.

General Terms and Conditions

2.6 Termination and Default

Time is of the essence of this contract and if delivery of acceptable items or rendering of services is not completed by the time promised, the Authority reserves the right, without liability, in addition to its other rights and remedies, to terminate the contract by notice effective when received by Contractor, as to stated items not yet shipped or services not yet rendered and to purchase substitute items or services elsewhere and charge the Contractor with any or all losses incurred. The Authority shall be entitled to recover its attorney's fees and expenses in any successful action by the Authority to enforce this contract.

2.7 Royalties and Patents

Contractor shall pay all royalties and license fees. Contractor shall defend all suits or claims for infringement of any patent, copyright or trademark rights and shall hold the Authority harmless from loss on account thereof.

2.8 Regulatory Compliance

Contractor represents and warrants that the goods or services furnished hereunder (including all labels, packages and containers for said goods) comply with all applicable standards, rules and regulations in effect under the requirements of all Federal, State and local laws, rules and regulations as applicable, including the Occupational Safety and Health Act as amended, with respect to design, construction, manufacture or use for their intended purpose of said goods or services. Contractor shall furnish "Material Safety Data Sheets" in compliance with the Illinois Toxic Substances Disclosure to Employees Act.

Pursuant to Illinois Municipal Code 65 ILCS 5/11-42.1-1, by signing this bid the Contractor certifies that it is not delinquent in the payment of any tax administered by the Department of Revenue.

All federal contractors and subcontractors, by signing this bid, agree to comply with the provisions of 29 CFR Part 470; the Beck notice requirement.

The Contractor certifies that they are not barred from bidding on this contract as a result of engaging in or being convicted of: (a) bid-rigging in violation of Section 3; or (b) bid-rotating in violation of Section 4, of the Illinois Criminal Code of 1961, as amended [720 ILCS 5/33E-3 and 4].

2.9 Discounts

Prices quoted must be net after deducting all trade and quantity discounts. Where cash discounts for prompt payment are offered, the discount period shall begin with the date of receipt of a correct invoice or receipt or final acceptance of goods, whichever is later.

2.10 Inspections

The Authority shall have the right to inspect any materials, components, equipment, supplies, services, or completed work specified herein. Any of said items not complying with these specifications are subject to rejection at the option of the Authority. Any items rejected shall be removed from the premises of the Authority and/or replaced at the entire expense of the Contractor.

2.11 References

To allow the Authority to evaluate the experience of the Contractor, as it relates to this purchase, the Contractor must submit a minimum of three (3) references of organizations that have purchased similar items. Failure to include references may result in bid disqualification. References must be submitted on the Bid Form.

General Terms and Conditions

2.12 Law Governing

This contract shall be governed by and construed according to the laws of the State of Illinois.

2.13 Prevailing Rate Wages

The awarded Contractor is required to pay all applicable wage rates as required and stipulated by Federal, State and Local laws. The Authority requires Prevailing Rate Wages in accordance with the Illinois Prevailing Wage Act, 820 ILCS 130/01 et seq. (“the Act”) to be paid as stipulated by the Authority’s annual Ordinance. The Act requires contractors and subcontractors to pay laborers, workers and mechanics performing services on public works projects no less than the “prevailing rate of wages” (hourly cash wages plus fringe benefits) in the county where the work is performed. For information regarding current prevailing wage rates, please refer to the Illinois Department of Labor’s website at <http://www.state.il.us/agency/idol/rates/rates.HTM>. All contractors and subcontractors rendering services under this contract must comply with all requirements of the Act, including but not limited to, all wage, notice and record keeping duties.

2.14 Prevailing Wage Reporting Burdens

Public Act 96-0437 requires all contractors and subcontractors working on a prevailing wage project to submit on a monthly basis a certified payroll to the public body in charge of the project. Any contractor or subcontractor who fails to submit a certified payroll or knowingly files a false certified payroll is guilty of a Class B misdemeanor. Such payroll records are public records subject to disclosure under the Freedom of Information Act.

End of General Terms and Conditions

Revised 9/05

Special Terms and Conditions

- 3.1 Pricing
The price quoted for each item is the full purchase price, including delivery to destination, and includes all transportation and handling charges, premiums on bonds, material or service costs, patent royalties and all other overhead charges of every kind and nature. Unless otherwise specified, prices shall remain firm for the contract period.
- 3.2 Specifications
See Exhibit A – HVAC Instrumentation and Controls and attached Point Charts.
- 3.3 Retainer
The Authority will retain 10% of the total bid package until final inspection is deemed full and complete.
- 3.4 Invoicing and Payment
The goal of the Authority is to pay properly submitted Contractor invoices within thirty (30) days of receipt, providing goods have been delivered and/or services have been performed, approved and accepted by the Greater Rockford Airport Authority. Original invoices must be presented for payment in accordance with instructions contained on the Purchase Order including reference to Purchase Order number and submitted to the correct address for processing.
- 3.5 Insurance
The Contractor shall maintain at all times a minimum commercial liability insurance policy in the amount of \$2,000,000.00 and must name the Greater Rockford Airport Authority as additional insured on Contractors policy. Proof of adequate insurance in the form of a Certificate of Insurance must be provided to the Authority upon contract acceptance.
- 3.6 Contractor Responsibility
The successful bidder/contractor is responsible for obtaining all necessary building permits including, but not limited to, the contractors drawings necessary for permitting requirements.

End of Special Terms and Conditions

Full Name of Bidder: _____

Business Address: _____

City, State, Zip: _____

Telephone Number: _____ FAX: _____

Email: _____

Contract Person: _____

FEIN: _____

The undersigned, being duly sworn, certifies that he/she is:

- The Owner/
Sole Proprietor a Member of the
Partnership an Officer of the
Corporation a Member of the
Joint Venture

Further, the Contractor declares that the only person or parties interested in this bid as principals are those named herein.

Further, the undersigned hereby certifies that they have read and understand the contents of this bid and agree to furnish at the prices shown any or all of the items above, subject to all instructions, conditions, specifications, warranties and attachments, including Addenda No. _____ and _____ issued thereto, except only to the extent that the Contractor has taken express written exception in this bid, hereto. Failure to have read all the provisions of this bid shall not be cause to alter any resulting contract or request additional compensations.

Further, by signing this bid document, the bidder hereby certifies that they are not barred from bidding on this contract as a result of a violation of either Section 33E-3 or 33E-4 of the Illinois Criminal Code of 1961, as amended.

Further, by signing this bid document, the Contractor hereby certifies that pursuant to Illinois Compiled Statutes, 65 ILCS 5/11-42-1, the Contractor is not delinquent in the payment of any tax administered by the Department of Revenue.

Our State of Illinois Certification Number under the Fair Employment Practices Law is _____.

(check if applicable) We do not have a State Pre-Qualification Statement. In lieu thereof, we will make an application at 312.814.2432 within thirty (30) days from the date of this bid opening.

Further, the Contractor agrees to provide a drug free workplace as provided for in the Drug Free Workplace Act, 30 ILCS 580.1 et seq.

Authorized Signature: _____

Typed/Printed Name: _____

Title: _____

Date: _____

Bidders Name _____

The following submittals shall be attached to this Bid Form:

- 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. Each control device labeled with setting or adjustable range of control.

- 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. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 - 2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
 - 3. Details of control panel faces, including controls, instruments, and labeling.
 - 4. Written description of sequence of operation.
 - 5. Trunk cable schematic showing programmable control unit locations and trunk data conductors.
 - 6. Listing of connected data points, including connected control unit and input device.
 - 7. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
 - 8. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.

- C. External Interface Files: XIF files or object diagrams for each DDC system component (Custom Application Controller and Application Specific Controller) proposed.

- D. PIC/BIBB statement clarifying which BACnet objects and services are supported by each controller.

- E. ANSI / ASHRAE™ Standard 135-2004, BACnet PIC/BIBB Statement: Proof of Compliance Level 3 or higher is required to protect building owner by reducing future maintenance and expansion costs.

- F. Samples: For each color required, of each type of thermostat cover.

- G. Software and Firmware Operational Documentation: Include the following:
 - 1. Engineering, Installation, Operation and Maintenance 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. Licenses, guarantee, and warranty documents for all equipment and systems.

H. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

I. Maintenance Data: For systems to include in maintenance manuals specified in Division 1. 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.

J. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

K. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise Shop Drawings to reflect actual installation and operating sequences.

Price \$_____

Prompt Payment_____

Manufacturer name and model number_____

Delivery or Completion Time_____

Warranty_____

Variances and Deviations

Variance 1: _____

Variance 2: _____

Variance 3: _____

Variance 4: _____

References

Company Name: _____

Address: _____

Contact Person: _____

Telephone #: _____

E-mail _____

Company Name: _____

Address: _____

Contact Person: _____

Telephone #: _____

E-mail _____

Company Name: _____

Address: _____

Contact Person: _____

Telephone #: _____

E-mail _____

Company Name: _____

Address: _____

Contact Person: _____

Telephone #: _____

E-mail _____

SECTION 15900 - HVAC INSTRUMENTATION AND CONTROLS.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the Building Management System (BMS) control equipment for HVAC systems and components
- B. The existing NETWORK 8000 system shall be upgraded to a networked based system as specified in the following document. All sequences of operation shall conform to the original Barber Colman sequences of operation as defined on the as built control drawings plus modifications as made over the years. The Enterprise Server software shall reside on the owner's server. The owner shall provide necessary network connection points plus IP addresses as required. Provide detailed graphic screens plus alarms via email and text message.
- C. The existing DDC system controls the AHUs, boilers, pumps, VAV boxes and exhaust fans.

1.3 DEFINITIONS

- A. Standard
 1. ASHRAE: American Society Heating, Refrigeration, Air Conditioning Engineers
 2. AHU: Air Handling Unit
 3. BACnet: Building Automation Controls Network
 4. BMS: Building Management System
 5. DDC: Direct Digital Control
 6. EIA: Electronic Industries Alliance
 7. GUI: Graphical User Interface
 8. HVAC: Heating, Ventilation, and Air Conditioning
 9. IEEE: Institute Electrical Electronic Engineers
 10. MER: Mechanical Equipment Room
 11. PID: Proportional, Integral, Derivative
 12. VAV: Variable Air Volume Box
- B. Communications and Protocols
 1. ARP: Address Resolution Protocol
 2. CORBA: Common Object Request Broker Architecture
 3. CSMA/CD: Carrier Sense Multiple Access/Collision Detect
 4. DDE: Dynamic Data Exchange
 5. FTT: Free Topology Tranceivers
 6. HRDB: Hierarchical Real-Time Database

7. HTTP: Hyper Text Transfer Protocol
8. IIOP: Internet Inter-ORB Protocol
9. LAN: Local Area Network
10. MS/TP: Master Slave Token Passing
11. ODBC: Open DataBase Connectivity
12. ORB: Object Request Broker
13. SNVT: Standard Network Variable Types
14. SQL: Structured Query Language
15. UDP: User Datagram Protocol
16. XML: exTensible Markup Language

C. Controllers

1. AAC: Advanced Application Controller
2. AHDC: Air Handler Digital Controller
3. ASC: Application Specific Controller
4. ASC: Application Specific Controller
5. ASD: Application Specific Device
6. CAC: Custom Application Controller
7. GCM: Global Control Module
8. LCM: Local Control Module
9. LNC: LON Network Controller
10. MN-FLO: Micronet 2000 Pressure Independent VAV Controller:
11. MSDC: Mechanical System Digital Controller
12. MZ-II: MICROZONE II Direct Digital Controller
13. NIM: Network Interface Module
14. UDC: Unitary Digital Controller
15. UEC: Unitary Equipment Controller
16. UNC: Universal Network Controller

D. Tools and Software

1. BPES: BACnet Portable Engineering Station
2. VAVDC: Variable Air Volume Digital Controller
3. CCDT: Configuration, Commissioning and Diagnostic Tool
4. CIM: Control Interface Module
5. HHOT: Hand Held Operators Tool
6. LPES: LON Portable Engineering Station
7. PES: Portable Engineering Station
8. POT: Portable Operator's Terminal
9. PSI: Personal System Interface

1.4 SYSTEM DESCRIPTION Ethernet (IEEE 802.3), peer-to-peer CSMA/CD

- A. Furnish all labor, materials, equipment, and service necessary for a complete and operating temperature control system, utilizing a high speed peer to peer network of interoperable Direct Digital Controls (DDC), Graphical User Interface (GUI) with color graphic displays available on at least 64 client computers, and electronic interfaces and actuation devices, as shown on the drawings and as described herein.
- B. The Local Area Network (LAN) shall be either a 10 or 100 Mbps Ethernet network supporting BACnet, Java, XML, HTTP, and CORBA IIOP for maximum flexibility for integration of

building data with enterprise information systems and providing support for multiple Universal Network Controllers (UNCs), user workstations and a local host computer system.

- C. The Enterprise Ethernet (IEEE 802.3) LAN shall utilize Carrier Sense Multiple/Access/Collision Detect (CSMA/CD), Address Resolution Protocol (ARP) and User Datagram Protocol (UDP) operating at 10 or 100 Mbps.
- D. The system will consist of an open architecture that utilizes EIA standard 709.1, the LonTalk™ protocol, as the common communication protocol between all controllers and integral ANSI / ASHRAE™ Standard 135-2004, BACnet functionality to assure interoperability between all system components. Both the LonTalk™ protocol and the ANSI / ASHRAE™ Standard 135-2004, BACnet protocol are required to assure that the project is fully supported by the leading HVAC open protocol to reduce future building maintenance, upgrade, and expansion costs.
- E. The system will consist of an architecture that utilizes a MS/TP selectable 9.6-76.8 K9600 Baud protocol, as the common communication protocol between all controllers and integral ANSI / ASHRAE™ Standard 135-2004, BACnet functionality to assure interoperability between all system components. The AAC shall be capable of communicating as a MS/TP device or as a BACnet IP device communicating at 10/100 Mbps on a TCP/IP trunk. The AAC shall have a MS/TP bus that is capable of supporting up to 127 UEC's or VAVDDC's without the addition of repeaters. The ANSI / ASHRAE™ Standard 135-2004, BACnet protocol is required to assure that the project is fully supported by the leading HVAC open protocol to reduce future building maintenance, upgrade, and expansion costs.
- F. The system will consist of an architecture that utilizes a RS-485 19.2/9600 Baud protocol, as the common communication protocol between all controllers and integral ANSI / ASHRAE™ Standard 135-2004, BACnet functionality to assure interoperability between all system components. The ANSI / ASHRAE™ Standard 135-2004, BACnet protocol is required to assure that the project is fully supported by the leading HVAC open protocol to reduce future building maintenance, upgrade, and expansion costs.
- G. Where necessary or desired, LonTalk™ packets may be encapsulated into TCP/IP messages to take advantage of existing infrastructure or to increase network bandwidth.
 - 1. Any such encapsulation of the LonTalk™ protocol into IP datagrams shall conform to existing LonMark™ guide-lines for such encapsulation and shall be based on industry standard protocols.
 - 2. The products used in constructing the BMS shall be LonMark™ compliant.
 - 3. In those instances in which Lon-Mark™ devices are not available, the BMS contractor shall provide LonWorks™ devices with application source code, device resource files, and external interface definitions.
- H. The software tools required to network manage both the LonTalk™ protocol and the ANSI / ASHRAE™ Standard 135-2004, BACnet protocol must be provided with the system. Drawings are diagrammatic only. Equipment and labor not specifically referred to herein or on the plans that are required to meet the functional intent, shall be provided without additional cost to the Owner. Minimum BACnet compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet/Ethernet IP or MS/TP.
- I. Complete temperature control system to be DDC with electronic sensors and electronic/electric actuation of Mechanical Equipment Room (MER) valves and dampers and electronic actuation

of terminal equipment valves and actuators as specified herein. The BMS is intended to seamlessly connect devices throughout the building regardless of subsystem type, i.e. variable frequency drives, low voltage lighting systems, electrical circuit breakers, power metering and card access should easily coexist on the same network channel.

1. The supplied system must incorporate the ability to access all data using Java enabled browsers without requiring proprietary operator interface and configuration programs.
 2. An Open DataBase Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage.
 - a. This data shall reside on a supplier-installed server for all database access.
 - b. Systems requiring proprietary database and user interface programs shall not be acceptable.
 - c. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network.
 - d. Systems employing a "flat" single tiered architecture shall not be acceptable.
- J. All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of Alpha Controls & Services. Alpha Controls & Services shall have a minimum of 5 years of installation experience with the manufacturer and shall provide documentation in the bid and submittal package verifying longevity of the installing company's relationship with the manufacturer when requested. Supervision, calibration and checkout of the system shall be by the employees of Alpha Controls & Services and shall not be subcontracted. The control contractor shall have an in place support facility within 10 miles of the site with factory certified technicians and engineers, spare parts inventory and all necessary test and diagnostic equipment for the installed system, and the control contractor shall have emergency service available.

1.5 SUBMITTALS.

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
 1. Each control device labeled with setting or adjustable range of control.
- 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. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
 3. Details of control panel faces, including controls, instruments, and labeling.
 4. Written description of sequence of operation.
 5. Trunk cable schematic showing programmable control unit locations and trunk data conductors.
 6. Listing of connected data points, including connected control unit and input device.
 7. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
 8. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.

- C. External Interface Files: XIF files or object diagrams for each DDC system component (Custom Application Controller and Application Specific Controller) proposed.
 - D. PIC/BIBB statement clarifying which BACnet objects and services are supported by each controller.
 - E. ANSI / ASHRAE™ Standard 135-2004, BACnet PIC/BIBB Statement: Proof of Compliance Level 3 or higher is required to protect building owner by reducing future maintenance and expansion costs.
 - F. Samples: For each color required, of each type of thermostat cover.
 - G. Software and Firmware Operational Documentation: Include the following:
 - 1. Engineering, Installation, Operation and Maintenance 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. Licenses, guarantee, and warranty documents for all equipment and systems.
 - H. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
 - I. Maintenance Data: For systems to include in maintenance manuals specified in Division 1. 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.
 - J. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
 - K. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise Shop Drawings to reflect actual installation and operating sequences.
- 1.6 QUALITY ASSURANCE.
- A. Bids by wholesalers, distributors, mechanical contractors, ABCS, ACS, and non-franchised contractors shall not be acceptable.
 - B. The system manufacturer shall, as a minimum, manufacture and supply the Custom Application Controller, Application Specific Controller, Air Handler Digital Controller, Unitary Digital Controller, Variable Air Volume Digital Controller, Variable Air Volume Direct Digital Controller, Unitary Equipment Controller, Advanced Application Controller, Graphical User Interface, damper actuators, and valve actuator assemblies.

- C. All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the temperature control system manufacturer's local field office.
- D. The Building Management System contractor shall have a full service facility within 10 miles of the project that is staffed with engineers trained in Integrating Interoperable Systems and technicians fully capable of providing LonWorks instructions and routine emergency maintenance service on all system components.
 - 1. Any installing contractor, not listed as prequalified in the Approved Manufacturer's section, shall submit credentials as detailed in the Prebid Submittal section for the engineers review 2 weeks prior to bid date. Failure to follow the attached formats shall disqualify potential alternate bidders. Credentials must attest that the contractor meets all requirements of the specification and the Engineers judgment regarding approval to bid as an acceptable installer after reviewing the data will be final.
- E. Mechanical equipment manufacturers that are listed as approved to provide DDC type controls may submit a bid with factory mounted controls, and shall also provide a separate bid for their products less all controls, actuators, valve assemblies and sensors, which are specified to be provided by the BMS contractor.
- F. 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.
- G. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."
- H. Comply with National Electric Code, UL-916 Energy Management Systems, LonMark™, ULC, FCC Part 15, subpart J, Class B Computing Devices.
- I. Comply with EIA Standard 709.1 LonTalk™ protocol for DDC system control components.

1.7 PRE-BID SUBMITTAL.

- A. Any installing contractors or manufacturers interested in participating as acceptable bidders for this project that are not pre-qualified shall furnish a detailed technical pre-bid submittal to the consulting engineer. All information must be submitted 2 weeks prior to the published bid date to allow the engineer adequate time to review the bidders credentials.
- B. The Pre-Bid submittal shall contain the following information as a minimum:
 - 1. A profile of the manufacturer and the local installation and service/organization.
 - 2. Description of how the system meets and achieves all the specified criteria in terms of configuration, operation, and control.
 - 3. System Architecture with single line riser diagram showing all major components (digital controllers, routers, hubs, etc.) that will be required for this project.
 - 4. Procedure for commissioning and time required to startup and commission each of the systems for this project.
 - 5. Contractors approach for the project planning and management.
 - 6. Product Data Sheets for all components, DDC panels, and all accessories listed per the appropriate spec sections herein.
 - 7. Examples of actual graphic screens for other similar projects.

8. Number and types of DDC panels required for this installation.
9. Number and types of spare points provided with the proposed system.
10. Recommended spare parts list for components with list price schedule and discount multiplier.
11. List of 5 similar systems in size, point capacity, total installed value, installed and commissioned by the local office with a list of the installers/manufacturers design team members for each project and the owners contact information.
12. Samples of service offerings and a list of current similar service contracts with contact information.
13. Resumes for the management team and all employees who will be involved with the project design, commissioning, project management, and after installation service. Resumes should include copies of manufacturer's certifications for the proposed product line for each employee.
14. Copy of this Control Specification in its entirety with a check mark beside each paragraph to signify that the manufacturer's equipment and software shall fully conform to the specified requirement. If the requirement cannot be met, indicate the reasons/limitations and the alternative proposed.
15. An interview may be conducted and the bidder will be requested to make a formal presentation concerning the proposed system and possibly provide an installed project tour prior to a final decision.

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 unit manufacturer.

1.9 COORDINATION.

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- B. Coordinate equipment from other divisions including "Intrusion Detection," "Lighting Controls," "Motor-Control Centers," "Panelboards," and "Fire Alarm" to achieve compatibility with equipment that interfaces with those systems.
- C. Coordinate supply of conditioned electrical circuits for control units and operator workstation.
- D. Coordinate location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete".
- E. Coordinate with the Owner's IT department on locations for UNC's, Ethernet communication cabling and TCP/IP addresses.

1.10 WARRANTY AND MAINTENANCE.

- A. All components, system software, and parts furnished and installed by the BMS contractor shall be guaranteed against defects in materials and workmanship for 1 year of substantial

completion. Labor to repair, reprogram, or replace these components shall be furnished by the BMS contractor at no charge during normal working hours during the warranty period. Materials furnished but not installed by the BMS contractor shall be covered to the extent of the product only. Installation labor shall be the responsibility of the trade contractor performing the installation. All corrective software modifications made during warranty periods shall be updated on all user documentation and on user and manufacturer archived software disks. The Contractor shall respond to the owner's request for warranty service within 24 standard working hours.

1.11 OWNERSHIP OF PROPRIETARY MATERIAL.

- A. The owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software. All project developed software and documentation shall become the property of the owner. These include, but are not limited to project graphic images, record drawings, project database, project specific application programming code, and all other associated documentation.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following pre-qualified manufacturers:
 - 1. Electric Components:
Schneider Electric
 - 2. Direct Digital Control Systems and Approved Installing Contractors:
Schneider electric I/A Series by Alpha Controls & Services

2.2 DDC EQUIPMENT

- A. Front End Hardware Station: PROVIDED BY OWNER: IBM-compatible microcomputer with minimum configuration as follows:
 - 1. Processor: Intel Pentium IV, 950 MHz., or faster.
 - 2. Random-Access Memory: 128 MB., minimum.
 - 3. Cache Memory: 256 kB.
 - 4. Graphics: Super video graphic adapter (SVGA), minimum 1024 x 768 pixels, 2.0-MB EDO video memory.
 - 5. Monitor: 17 inches (17.4 viewable, minimum), noninterlaced, color, with maximum 0.28-mm dot pitch.
 - 6. Keyboard: QWERTY, 105 keys in ergonomic shape.
 - 7. Floppy-Disk Drives: 1.44 MB.
 - 8. Hard-Disk Drive: 40.0 GB., minimum.
 - 9. DVD-ROM Drive: 12x max. variable DVD-ROM with software decoding.
 - 10. Mouse: Two button.
 - 11. Tape Backup: 8X RW-CD, minimum.
 - 12. Operating System: Microsoft Windows NT/2000

B. GUI Server Application Software: Include the following:

Input/output capability from operator station for monitoring and controlling all of the points listed in the input/output point list. The operator shall be able to monitor and access all points by means of clear concise English names without having to understand or reference hardware point locations or controller programs.

1. Operating System: The GUI shall run on Microsoft Windows NT Workstation 4.0, Service Pack 4, Windows 2000, or later.
2. The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimum knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.
3. Real-Time Displays. The GUI, shall at a minimum, support the following graphical features and functions:
 - a. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures.
 - b. Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.
 - c. Graphics shall support layering and each graphic object shall be configurable for assignment to one a layer. A minimum of six layers shall be supported.
 - d. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.
 - 1) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
 - 2) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
4. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
5. Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and using a graphical slider to adjust the value. No entry of text shall be required.
6. System Configuration. At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:
 - a. Create, delete or modify control strategies.
 - b. Add/delete objects to the system.
 - c. Tune control loops through the adjustment of control loop parameters.
 - d. Enable or disable control strategies.
 - e. Generate hard copy records or control strategies on a printer.
 - f. Select points to be alarmable and define the alarm state.

- b. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.
- c. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
- d. Storage of the graphical screens shall be in the Building Control Units (BC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
- e. Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.
- f. User’s shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
 - 1) Modify common application objects, such as schedules, calendars, and set points in a graphical manner.
 - a) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
 - b) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
 - 2) Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
 - 3) View logs and charts
 - 4) View and acknowledge alarms
- g. The system shall provide the capability to specify a user’s (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.
- h. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

D. Control Units General:

Provide an adequate number of control units to achieve monitoring and control of all data points specified and necessary to satisfy the sequence of operation for all mechanical systems shown on the plans. Provide a minimum of one separate controller for each AHU or other HVAC system. Multiple DDC controllers may control one system provided that all points associated with individual control loops are assigned to the same DDC controller. Points used for control loop reset such as outside air or space temperature are exempt from this requirement. Each of the following panel types shall meet the following requirements. Existing ASD devices will be reused and integrated into the new network level controller.

- 1. Controllers shall be suitable for the anticipated ambient conditions.
 - a. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures, and shall be rated for operation at -40°F to 140°F and 5 to 95% RH, non condensing.

- b. Controllers used in conditioned ambient space shall be mounted in dustproof enclosures, and shall be rated for operation at 32°F to 122°F and 5 to 95% RH, non condensing.
2. Serviceability: Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Memory: The Control Units shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
4. Diagnostics: The Building Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall assume a predetermined failure mode and generate an alarm notification.
5. Immunity to power and noise: Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 ft.
6. Automatic staggered restart of field equipment after restoration of power and short cycle protection.

E. Universal Network Controllers (UNC)

1. The Universal Network Controllers (UNC) shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the UNC. It shall be capable of executing application control programs to provide:
 - a. Calendar functions
 - b. Scheduling
 - c. Trending
 - d. Alarm monitoring and routing
 - e. Time synchronization by means of an Atomic Clock Internet site including automatic synchronization
 - f. Integration of LonWorks controller data and BACnet controller data
 - g. Network Management functions for all LonWorks based devices
2. The Universal Network Controller Type 2 must provide the following hardware features as a minimum:
 - a. One Ethernet Port – 10/100 Mbps
 - b. Two RS-232 ports
 - c. Four RS-RS485 ports electrically isolated
 - d. One LonWorks Interface Port – 78KB FTT-10A with Weidmuller connector
 - e. Power supply 24 VAC or 24 VDC
 - f. Battery Backup
 - g. Real-time clock
 - h. Processor @ 200 MHz or greater
 - i. 64 Mb flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
 - j. 128 Mb Ram or greater
3. The UNC shall provide multiple user access to the system and support for ODBC or SQL. A database resident on the UNC shall be an ODBC compliant database or must provide an ODBC data access mechanism to read and write data stored within it.
4. The UNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 64 simultaneous users.
5. Event Alarm Notification and Actions

- a. The UNC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
- b. The UNC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up telephone connection, or wide-area network.
- c. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:
 - 1) To alarm
 - 2) Return to normal
 - 3) To fault
- d. Provide for the creation of a minimum of eight of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.
- e. Provide timed (schedule) routing of alarms by class, object, group, or node.
- f. Provide alarm generation from binary object “runtime” and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.
- g. Control equipment and network failures shall be treated as alarms and annunciated.
- h. Alarms shall be annunciated in any of the following manners as defined by the user:
 - 1) Screen message text
 - 2) Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
 - a) Day of week
 - b) Time of day
 - c) Recipient
 - 3) Pagers via paging services that initiate a page on receipt of email message
 - 4) Graphic with flashing alarm object(s)
 - 5) Printed message, routed directly to a dedicated alarm printer
- i. The following shall be recorded by the UNC for each alarm (at a minimum):
 - 1) Time and date
 - 2) Location (building, floor, zone, office number, etc.)
 - 3) Equipment (air handler #, accessway, etc.)
 - 4) Acknowledge time, date, and user who issued acknowledgement.
 - 5) Number of occurrences since last acknowledgement.
- j. Alarm actions may be initiated by user defined programmable objects created for that purpose.
- k. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
- l. A log of all alarms shall be maintained by the UNC and/or a server (if configured in the system) and shall be available for review by the user.
- m. Provide a “query” feature to allow review of specific alarms by user defined parameters.
- n. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.

13. DATABASE BACKUP AND STORAGE

- a. The UNC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.
- b. Copies of the current database and, at the most recently saved database shall be stored in the UNC. The age of the most recently saved database is dependent on the user-defined database save interval.
- c. The UNC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

F. CAC Room Sensor

1. The CAC Sensor shall provide room temperature value to the CAC.
2. The CAC Sensor shall connect directly to the CAC and shall not utilize any of the I/O points of the controller.
3. The CAC Sensor shall provide a two-wire connection to the controller that is polarity and wire type insensitive.
4. There shall be one CAC Sensor per floor wired so that the communication jack will provide for a connection to the LON communication trunk to which the CAC controller is connected.
5. By connecting to this CAC Sensor, the connected controller, and all other devices on the LON bus shall be accessible by the Portable Engineering Station.
6. The CAC Sensor shall be provided in a modular configuration that allows for the rough in of all wiring without the presence of the electronics or esthetic covering.
7. The CAC Sensor shall be provided in a modular configuration that allows for the rough in of all wiring without the presence of the electronics or esthetic covering.
8. The CAC Sensor shall allow for the customization of the color on the esthetic covering as a standard offering.
9. The CAC Sensor shall be supplied in the following manner:
 - a. LCD display for showing (typically) the current temperature.
 - b. Tenant override to allow timed override of unoccupied to occupied mode of operation.
 - c. LED indication of override state.
 - d. Up/Down keys to allow adjustment of the current setpoint
 - e. User interface with the CAC Sensor shall be provided as a configurable function, and shall offer password protection for access to network variable editing.
 - f. ASHRAE 95 compliance (LCD display and sub-base functionality)
 - g. The room sensor shall provide access to additional diagnostic data from a sensor-user keypad request. This Diagnostic mode is displayed on the LCD screens and includes separate displays for the controllers:
 - 1) Subnet and Node Address
 - 2) Errors
 - 3) Alarms
 - 4) Temperature Offset

G. AAC Room Sensor

1. The AAC Sensor shall provide room temperature value to the controller.
2. Each AAC shall support a minimum of two sensors.
3. The AAC Sensor shall connect directly to the controller and shall not utilize any of the I/O points of the controller.

4. The AAC Sensor shall provide a two-wire connection to the controller that is polarity and wire type insensitive.
5. There shall be one AAC Sensor per floor wired so that the communication jack will provide for a connection to the LON communication trunk to which the AAC controller is connected.
6. By connecting to this AAC Sensor, the connected controller, and all other devices on the LON bus shall be accessible by the Portable Engineering Station.
7. The AAC Sensor shall be provided in a modular configuration that allows for the rough in of all wiring without the presence of the electronics or esthetic covering.
8. The AAC Sensor shall allow for the customization of the color on the esthetic covering as a standard offering.
9. The AAC Sensor shall be supplied in the following manner:
 - a. LCD display for showing (typically) the current temperature.
 - b. Tenant override to allow timed override of unoccupied to occupied mode of operation.
 - c. LED indication of override state.
 - d. Up/Down keys to allow adjustment of the current setpoint
 - e. User interface with the AAC Sensor shall be provided as a configurable function, and shall offer password protection for access to network variable editing.
 - f. ASHRAE 95 compliance (LCD display and sub-base functionality)
 - g. The room sensor shall provide access to additional diagnostic data from a sensor-user keypad request. This Diagnostic mode is displayed on the LCD screens and includes separate displays for the controllers:
 - 1) Subnet and Node Address
 - 2) Errors
 - 3) Alarms
 - 4) Temperature Offset

H. Unitary Equipment Controller Units:

Single board construction comprising processor board with programmable, nonvolatile, RAM/EEPROM memory for custom control and unitary applications. ASCs shall be provided for Unit Ventilators, Fan Coils, Heat Pumps, Rooftop Units, and other applications as shown on the drawings. To assure complete interoperability, all UEC's firmware shall support all BACnet objects and services as called out in the PIC and BIBBs statement.

1. The Unitary Equipment Controller shall have the following point count as a minimum.
 - a. 6 Universal Inputs
 - 1) 0-20mA
 - 2) 0-5 VDC
 - 3) Balco Sensors
 - 4) Platinum Sensor
 - 5) 10K thermistor
 - b. 4 Analog Outputs
 - 1) 0-20 mA

- 2) 0-5/10 VDC
- 3) Individually short circuit protected
- c. 8 Digital Outputs
 - 1) Triacs
 - 2) LED indication
2. Units monitor or control each input/output point; process information; and download from the operator station.
3. The controller shall have removable terminals for:
 - a. 24 VAC Power inputs
 - b. MS/TP Communication terminals
4. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Peer to peer primary network level communications with automatic communications loss detection to maintain normal control functionality regardless of available network communications.
 - b. Discrete/digital, analog, and pulse input/output.
 - c. Monitoring, controlling, or addressing data points.
 - d. Appropriate BACnet Objects for specific unitary applications.
5. Local operator interface port located on UEC and UEC sensor provides for download from or upload to portable workstation. All bus devices shall be accessible from either port.
6. Communication: UEC's shall communicate with the UNC and ACC at a baud rate selectable of 9.6-76.8 Kbaud utilizing MS/TP.
7. UEC units monitor or control each input/output point; process information; and at least 50 expressions for customized HVAC control including mathematical equations, Boolean logic, PID control loops with anti-windup, sequencers, timers, interlocks, thermostats, counters, interlocks, compare, limit, and alarms.
8. All UEC Controller setpoints shall be digital display setpoints with dual setpoint limits (integral hard limits which the user cannot exceed above and below and independent soft limits which are hidden from the user). All digital setpoints shall be network retentive after power outages and after replacement of sensor.

I. LANs:

Capacity for a minimum of 64 client workstations connected to multi-user, multitasking environment with concurrent capability to access DDC network or control units.

1. Enterprise Network LAN
 - a. Media: Ethernet (IEEE 802.3), peer-to-peer CSMA/CD, operating at 10 or 100 Mbps, cable 10 Base-T, UTP-8 wire, category 5
2. Primary Controller Network LAN
 - a. Media: LonTalk™ (EIA 709.1), peer to peer, FTT-10 operating at 78.8K.
3. Secondary Network LAN (If Required)
 - a. Media: LonTalk™ (EIA 709.1), peer to peer, FTT-10 operating at 78.8K
4. Remote Connection
 - a. ISDN, ADSL, T1 or dial-up connection, monthly charges paid by building owner

J. Software:

1. Controller and System HVAC Applications

- a. Update to latest version of software at Project completion. Include and implement the following capabilities from the control units if documented by the specified sequence of operations:
 - 1) Load Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, occupied/unoccupied setback/setup, DDC with PID, and trend logging.
 - 2) HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy/economizer switchover.
 - 3) Chiller Control Programs: Chilled water plant optimization with condenser water reset, chilled-water reset, chiller and pump equipment selection and sequencing.
 - 4) Boiler Control Programs: Boiler plant optimization with hot water supply reset, boiler and pump equipment selection and sequencing.
 - 5) Programming Application Features: Include trend point, alarm reporting, alarm lockout, weekly scheduling, staggered start, sequencing, anti-short cycling and calculated point.
- 2. Controller and Network Setup Software
 - 1) Network managements tools for LonTalk™ protocol and the ANSI / ASHRAE™ Standard 135-1995, BACnet protocol shall be provided including a network learn function, LonMark bindings, service pins, winks, and diagnostics.

2.3 CONTROL PANELS

- A. Local Control Panels: Unitized NEMA 1 cabinet with suitable brackets for wall or floor mounting, located adjacent to each system under automatic control. Provide common keying for all panels.
 - 1. Fabricate panels 0.06-inch thick, furniture-quality steel, or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish.
 - 2. Interconnections between internal and face-mounted devices pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL Listed for 600 volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.
 - 3. Door-Mounted Equipment: Flush-mount (on hinged door) manual switches, including damper-positioning switches, changeover switches, thermometers, and gauges.
 - 4. Provide ON/OFF power switch with over-current protection for control power sources to each local panel.

2.4 SENSORS

- A. Electronic Temperature Sensors: Vibration and corrosion resistant for wall, immersion, or duct mounting as required.
 - 1. Resistance Temperature Detectors: Platinum, thermistor, or balco

- a. Accuracy: Plus or minus 0.2 percent at calibration point; thermistors shall have a maximum 5 year drift of no more than .225°F maximum error of no more than .36°F
 - b. Wire: Twisted, shielded-pair cable
 - c. Insertion Elements in Ducts: Single point, 6 inches long; use where not affected by temperature stratification or where ducts are smaller than 4 sq. ft.
 - d. Averaging Elements in Ducts: 60 inches, long, flexible for use where prone to temperature stratification or where ducts are larger than 4 sq. ft.; 264 inches long, flexible for use where prone to temperature stratification or where ducts are larger than 16 sq. ft; length as required.
 - e. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
 - f. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
 - g. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
2. Humidity Sensors: Bulk polymer sensor element.
 - a. Accuracy: 2 percent at 10-90% RH with linear output.
 - b. Room Sensors: Range of 0 to 100 percent relative humidity
 - c. Duct and Outside-Air Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.
 3. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
 - a. Accuracy: +/- 1 percent of full scale with repeatability of 0.5 percent.
 - b. Output: 4 to 20 mA, 0-5 vDC, 0-10 vDC.
 - c. Building Static-Pressure Range: -.1 to .1, -.25 to 0.25, -.5 to .5, -1.0 to 1.0 IN WC., jumper selectable.
 - d. Duct Static-Pressure Range: 0 to 1, 0 to 2.5, 0 to 5, 0 to 10 IN WC., jumper adjustable.
 4. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; proportional output 4 to 20 mA.
- B. Equipment operation sensors as follows:
1. Status Inputs for Fans: Differential-pressure switch with adjustable range of 0 to 5 IN WC.
 2. Status Inputs for Pumps: Differential-pressure switch piped across pump with adjustable pressure-differential range of 8 to 60 psig.
 3. Status Inputs for Electric Motors: Current-sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.
- C. Electronic Valve/Damper Position Indication: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
- D. Water-Flow Switches: Pressure-flow switches of bellows-actuated mercury or snap-acting type, with appropriate scale range and differential adjustment, with stainless-steel or bronze paddle. For chilled-water applications, provide vapor proof type.
- E. Carbon-Monoxide Detectors: Single or multi-channel, dual-level detectors, using solid-state sensors with 3-year minimum life, maximum 15-minute sensor replacement, suitable over a temperature range of 23°F to 130°F, calibrated for 50 and 100 ppm, with maximum 120-second response time to 100-ppm carbon monoxide.

- F. Carbon-Dioxide Sensor and Transmitter: Single detectors, using solid-state infrared sensors, suitable over a temperature range of 23°F to 130°F, calibrated for 0 to 2 percent, with continuous or averaged reading, 4 to 20 mA output, and wall mounted.
- G. Oxygen Sensor and Transmitter: Single detectors, using solid-state zircon cell sensing, suitable over a temperature range of -32°F to 1100°F, calibrated for 0 to 5 percent, with continuous or averaged reading, 4 to 20 mA output, and wall mounted.
- H. Refrigerant Detectors: Dual-level detectors, using solid-state sensors, with alarm preset for 300 ppm, alarm indicator light, alarm silence light and button, alarm test light and button, and trouble light. Provide auxiliary relay preset for 150 ppm.
- I. 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.

2.5 THERMOSTATS

- A. Combination Thermostat and Fan Switches: Line-voltage thermostat with two-, three-, or four-position, push-button or lever-operated fan switch.
 - 1. Label switches "FAN ON-OFF," "FAN HIGH-LOW-OFF," "FAN HIGH-MED-LOW-OFF." Provide unit for mounting on two-gang switch box.
- B. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater.
- C. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch type, or equivalent solid-state type, with heat anticipator, integral manual on-off-auto selector switch.
 - 1. Equip thermostats, which control electric heating loads directly, with off position on dial wired to break ungrounded conductors.
 - 2. Dead Band: Maximum 2°F.
- D. 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, 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.
- E. Fire-Protection Thermostats: UL listed with fixed or adjustable settings to operate at not less than 75°F above normal maximum operating temperature, with the following:
 - 1. Reset: Manual with control circuit arranged to directly shutdown appropriate equipment and provide remote annunciation at the GUI.

- F. Room Thermostat Cover Construction:
1. Set-Point Adjustment: Concealed or exposed
 2. Set-Point Indication: Concealed or exposed
 3. Thermometer: Optional
 4. Color: Neutral
 5. Orientation: Vertical or horizontal
- G. Room thermostat accessories include the following:
1. Insulating Bases: For thermostats located on exterior walls.
 2. Thermostat Guards: As specified in tamper prone areas
 3. Adjusting Key: As required for calibration and cover screws.
 4. Set-Point Adjustment: 1/2-inch diameter, adjustment knob.
- H. Electric Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.
1. Bulb Length: Minimum 20 feet
 2. Quantity: One thermostat for every 20 sq. ft. of coil surface.
- I. Electric High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above set point.
1. Bulb Length: Minimum 20 feet.
 2. Quantity: One thermostat for every 20 sq. ft. of coil surface.
- J. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psig., and cast housing with position indicator and adjusting knob.

2.6 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action under all environmental conditions (temperature, low power voltage fluctuations, tight seal damper design, maximum air and water flow forces).
1. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 2. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2": Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 3. Spring-Return Motors for Valves Larger Than NPS 2-1/2": Size for running and breakaway torque of 150 in. x lbf.
 4. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 5. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.
- B. Electronic Damper and Valve Actuators: Direct-coupled type non-hydraulic designed for minimum 100,000 full-stroke cycles at rated torque. The actuator shall have rating of not less than twice the thrust needed for actual operation of the damper or valve

1. Coupling: V-bolt and V-shaped, toothed cradle.
2. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
3. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on non-spring-return actuators.
4. Actuators shall have the ability to be tandem mounted.
5. All spring-return actuators shall have a manual override. Complete manual override shall take no more than 10 turns.
6. Power Requirements (Two-Position Spring Return): 24V ac or dc, Maximum 10VA.
7. Power Requirements (Modulating): Maximum 15 VA at 24V ac.
8. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
9. Temperature Rating: -22°F to 140°F.
10. Run Time: 200 seconds open, 40 seconds closed.
11. All actuators shall have a 5-year warranty.
12. Valves:
 - a. Size for torque required for valve close-off at maximum pump differential pressure (regardless of water loop system pressures).
 - b. Valve and Actuators shall come from the factory fully assembled.
 - c. Spring Return Manual Override shall come with a 10 Degree Valve Preload to assure tight close off.
13. Dampers:
 - a. Size for running torque calculated as follows:
 - 1) Parallel-Blade Damper with Edge Seals: 7 inch-pounds/sq. ft. of damper.
 - 2) Opposed-Blade Damper with Edge Seals: 5 inch-pounds/sq. ft. of damper.
 - 3) Parallel-Blade Damper without Edge Seals: 4 inch-pounds/sq. ft. damper.
 - 4) Opposed-Blade Damper without Edge Seals: 3 inch-pounds/sq. ft. of damper.
 - 5) Dampers with 2 to 3 Inches wg. of Pressure Drop or Face Velocities of 1000 to 2500 FPM Multiply the minimum full-stroke cycles above by 1.5.
 - 6) Dampers with 3 to 4 Inches wg. of Pressure Drop or Face Velocities of 2500 to 3000 FPM Multiply the minimum full-stroke cycles above by 2.0.
 - b. Spring Return Manual Override actuators shall have a factory set 5 Degree Damper Preload.

2.7 CONTROL CABLE

- A. Electronic and Fiber-Optic Cable for Control Wiring: As specified in Division 16 Section "Control/Signal Transmission Media."
- B. LON communication cable shall be category 4.

PART 3 - EXECUTION

3.1 EXAMINATION

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

- B. Verify that duct, pipe, and equipment mounted devices and wiring are installed before proceeding with installation.

3.2 INSTALLATION

- A. Install equipment level and plumb.
- B. Install software in control units and operator workstation. Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- C. Connect and configure equipment and software to achieve sequence of operation specified.
- D. Verify location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. Locate all 60 inches above the floor.
 - 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- E. Install guards or tamper proof enclosures on thermostats in the following locations:
 - 1. Entrances.
 - 2. Public areas.
 - 3. Where indicated.
- F. Install automatic dampers according to Division 15 Section "Duct Accessories.
- G. Install damper actuators on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- H. Install labels and nameplates to identify control components according to Division 15 Section "Basic Mechanical Materials and Methods."
- I. Install labels and nameplates to identify control components according to Division 15 Section "Mechanical Identification."
- J. Install hydronic instrument wells, valves, and other accessories according to Division 15 Section "Hydronic Piping."
- K. Install steam and condensate instrument wells, valves, and other accessories according to Division 15 Section "Steam and Condensate Piping."
- L. Install refrigerant instrument wells, valves, and other accessories according to Division 15 Section "Refrigerant Piping."
- M. Install duct volume-control dampers according to Division 15 Sections specifying air ducts.
- N. Install electronic and fiber-optic cables according to Division 16 Section "Control/Signal Transmission Media."

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Division 16 Section "Raceways and Boxes."

- B. Install building wire and cable according to Division 16 Section "Conductors and Cables."
- C. Install signal and communication cable according to Division 16 Section "Control/Signal Transmission Media."
 - 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.
- D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
 - 1. Install piping adjacent to machine to allow service and maintenance.
- B. Ground equipment.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
 - 1. Leak Test: After installation, fill system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment, and retest.
 - 4. Pressure test control for air piping:
 - a. Pressure test control air piping at 30 psig. or 1.5 times the operating pressure for 24 hours, with maximum 5 psig. loss.
 - b. Pressure test high-pressure control air piping at 150 psig. and low-pressure control air piping at 30 psig. for 2 hours, with maximum 1 psig.

5. Calibration and test electric/electronic thermostats by disconnecting input sensors and stimulating operation with compatible signal generator.
- B. Replace damaged or malfunctioning controls and equipment.
1. Start, test, and adjust control systems.
 2. Demonstrate compliance with requirements, including calibration and testing, and control sequences.
 3. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.
- C. Verify DDC as follows:
1. Verify software including automatic restart, control sequences, scheduling, reset controls, and occupied/unoccupied cycles.
 2. Verify operation of operator workstation.
 3. Verify local control units including self-diagnostics.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain control systems and components.
1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
 2. Provide operator training on data display, alarm and status descriptors, requesting data, executing commands, calibrating and adjusting devices, resetting default values, and requesting logs. Include a minimum of 8 hours dedicated instructor time on-site.
 3. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."
 4. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
 5. Schedule training with Owner with at least seven days advance notice.

3.7 ON-SITE ASSISTANCE

- A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to three Project site visits, when requested by Owner, to adjust and calibrate components and to assist Owner's personnel in making program changes and in adjusting sensors and controls to suit actual conditions.

3.8 TRAINING

- A. Provide a minimum of 8 hours of on-site or classroom training throughout the contract period for personnel designated by the Owner. Each session shall be a minimum of four hours in length and must be coordinated with the building Owner. Train the designated staff of Owners Representative and Owner to enable them to:
1. Proficiently operate the system
 2. Understand control system architecture and configuration
 3. Understand DDC system components
 4. Understand system operation, including DDC system control and optimizing routines (algorithms)

8/25/2010

5. Operate the workstation and peripherals
6. Log on and off the system
7. Access graphics, point reports, and logs
8. Adjust and change system set points, time schedules, and holiday schedules
9. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals
10. Understand system drawings, and Operation and Maintenance manual
11. Understand the job layout and location of control components
12. Access data from DDC controllers

END OF SECTION 15900 - HVAC INSTRUMENTATION AND CONTROLS

