AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. Contract Number	Page of Pages	
	1	41

2. Amendment/Modification Number	3. Effective Date	4. Requisition/Purchase Request No.	Replace Energy Management System, Campus Wide Controls Infrastructure Upgrade
GF-2013-B-0067-003	December 5, 2012		

6. Issued By: Code	7. Administered By (If other than line 6)
University of the District of Columbia Capital Procurement Division 4200 Connecticut Avenue, NW, Room C03 Building 38 Washington. DC 20008	University of the District of Columbia Capital Procurement Division 4200 Connecticut Avenue, NW, Room C03 Building 38 Washington,. DC 20008

8. Name and Address of Contractor (No. Street, city, country, state and ZIP Code)	(X)	9A. Amendment of Solicitation No.
		GF-2013-B-0067
		9B. Dated (See Item 11)
		November 13, 2012
		10A. Modification of Contract/Order No.
		10B. Dated (See Item 13)

Code	Facility

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of ☐ is ☒ is not extended. Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing Items 8 and 15, and returning ☐ 0 ☐ copy of the amendment: (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or fax which includes a reference to the solicitation and amendment number. FAILURE OF YOUR ACKNOWLEDGEMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by letter or fax, provided each letter or telegram makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. Accounting and Appropriation Data (If Required)

13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS,
IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14

A. This change order is issued pursuant to: (Specify Authority) The changes set forth in Item 14 are made in the contract/order no. in item 10A.	
B. The above numbered contract/order is modified to reflect the administrative changes (such as changes in paying office, appropriation date, etc.) set forth in item 14, pursuant to the authority of 27 DCMR, Chapter 36, Section 3601.2.	
C. This supplemental agreement is entered into pursuant to authority of:	
D. Other (Specify type of modification and authority)	

E. IMPORTANT: Contractor ☒ is not, ☐ is required to sign this document and return 1 copy to the issuing office.

14. Description of amendment/modification (Organized by UCF Section headings, including solicitation/contract subject matter where feasible.)

Solicitation No. GF-2013-B-0067 for the Repalce Energy Management System Campus Wide Controls Infrastructure Upgrade is hereby amended as follows:

  1) Pre-Proposal Conference Sign-in Sheet (Attachment A)

  2) Questions and Answers (Attachment B)

  3) Replacement of Section 230900 of Specification - Instrumentation and Control for HVAC (Attachement C)

  4) Plan Holders List (Attachment D)

  5) All other Terms and Conditions remain unchanged.

Except as provided herein, all terms and conditions of the document referenced in Item (9A or 10A) remain unchanged and in full force and effect

15A. Name and Title of Signer (Type or print)		16A. Name of Contracting Officer SHERRY JONES-QUASHIE	
15B. Name of Contractor	15C. Date Signed	16B. District of Columbia	16C. Date Signed
(Signature of person authorized to sign)		*Sherry Jones-Quashie* (Signature of Contracting Officer)	12/5/12

ATTACHMENT A

PRE-PROPOSAL

SIGN-IN SHEET

Date: Novemeber 20, 2012   Time: 1:00pm
Solicitation # : GF-2013-B-0067
Capition: Replace Energy Management System, Campus Wide Controls Infrastructure Upgrade

University Of The District Of Columbia
Capital Procurement Division
SIGN-IN SHEET

NAME	COMPANY	TELEPHONE NO.	EMAIL ADDRESS
Rosalyn Lindsay	Lindsay Company LLC	2/461-6060	lindsaycompany4402@verizon.net
Roel Bileeky	Pritchett Controls	301 420-7300	c.bilecky@pitchettcontrols.com
Clifford Reeves	UDC	540-421-1012	clifford.reeves@udc.edu
Eric Ball	Honeywell	703-793-4461	eric.ball@honeywell.com
Vetch Mash	VERTUETT Controls	301-346-5585	V.Maher@pritchett controls on
Philip Grotheer	Grotheer & Co.	202.223.5752	phil@grotheer.com
Patrice Logan	UDC	202.274.6491	Patrice.logan@udc.edu
Alex Garrett	UDC	202 274-5353	algarrett@udc.edu
Michila McGran	UC	000-274-5091	mmadson@udc.edu
Casayla S Moody	UDC	202 274-5774	c.moody@udc.edu

ATTACHMENT B

QUESTIONS AND ANSWERS

ANSWERS TO OFFERORS QUESTIONS

Quest. No.	Question	Answer
1.	Will Bid date be extended due to the addendum?	The submission date is extended to Tuesday, December 4, 2012, at 2:00 pm.
2.	Where can we get plans and specs?	Drawings and specs can be purchased in t.
3.	Are there any pre-bid site inspections for this project?	The site inspection as held on November 20, 2012.
4.	The Project manual for the project mentioned above includes as the last pages a STI Thermostat Protector. There does not appear to be guidance in the specification when to use this protector. Is it to be used in every case for a wall mounted wireless temp or humidity sensor, only those public spaces not behind locked doors, or some other installation criterion?	The basis for this project is to have a protective cover over each wall-mounted sensor (Temp + Humidity) throughout the project. This also includes the devices inside locked "non-public" spaces. - P. Grotheer, 11/28/12.
5.	Is there the possibility for a walk through of the campus buildings to examine the installation conditions for the new EMS network? BAS would need to walk the halls per floor of each effected building, and visit the Mechanical Rooms in the effected buildings. We would expect this visit to take no more than 2 hours.	Please contact Alex Garrett at 202-274-5353.
6.	How will the add-alternatives for pricing be evaluated?	Add alternates should not be priced at this time. Any additional work required will be negotiated via change order.
7.	It appears that bidders are only required to submit one lump sum price. Are we to include the add-alternatives in our bid?	See response to question 6.
8.	What are the requirements for the cabling from the wireless access points back to the central router and touch pad located in the mechanical room? Will unshielded CAT5 copper be sufficient?	Network wiring and cabling requirements are included in spec section 3.15 C. There are exceptions to the shielding requirement per 3.15 C - 2, 3, 4 & 5

Dated: 12/5/2012

ANSWERS TO OFFERORS QUESTIONS

	Question	Answer
9.	Is there existing cable tray that we can use to rub communication cabling throughout the facility?	There is not sufficient cable tray throughout the facility to run communication cabling.
10.	Is it correct to assume that each facility already has internet connectivity that we can use to connect each building into the centralized BAS? And that the internet connectivity will be provided by the client?	The premise for this project is that the campus WAN (internet connection) is available for the contractor to tie into.
11.	Will all locations for the Wireless Access Points and Temperature sensors have power already available at the unit? If not, please specify how many units will require power delivered by the contractor?	Contractor is responsible for providing power to new devices requiring it per spec 230900 using available spare circuits in the building. Temperature and humidity sensors are energy harvesting wireless devices and do not require local power. Quantity takeoffs for centrally located devices requiring power will need to be determined by the bidders using the quantities of sensors shown on the plans as a basis.
12	Spec section 230900 page 1 describes existing BACnet infrastructure in various buildings. During the site visit to the central plant it was mentioned that the only existing BACnet infrastructure in the entire campus was one control panel for the boilers and one operator workstation which only had graphics for just the boilers. This section describe a significant amount of additional existing controls. Does this other BACnet existing infrastructure exist today?	The Bacnet infrastructure briefly described on-site only included Plant Building 43 equipment. There are significant exiting DDC controls in building 52 as well. Please note spec 230900 sections A- 2 & 3 have been revised to accurately list existing mapped points in buildings 43 and 52. Other buildings which are encountering ongoing construction are buildings 38/39, 42 and 47. Please follow drawings and spec 230900 which includes point schedules and equipment to incorporate for bidding purposes.
13	Can you please provide the brand of existing system manufacturer, model/version of hardware and software, system wiring diagrams, cut sheets, sequence of operations, and riser diagrams for the existing BACnet infrastructure in buildings 43, 52, 38, 38, 42, and 47 that are described on spec section 230900 1.1 A.2, 3 and 4 (page 1 of spec section 230900) and are associated with the points list on the contract drawings.	See response to question 12. Buildings 43 and 52 (existing) mapped points and equipment information are included in revised spec 230900. Reliable is the existing manufacturer. For bidding purposes only information on drawings is available since much of the work is ongoing for the other buildings. Upon execution of contract the assumption is that shop drawings will become available for any respective Add-Alternate area of work.

ANSWERS TO OFFERORS QUESTIONS

14	Does UDC have any special or technical requirements for the IT hardware described on page 15 of specification section 230900.2.10.C? Since these devices are to be integral to the UDC campus IT network please provide all pertinent technical requirement.	Yes. See attached list.
		• Cisco 1841
		○ Cisco 1841 Modular Router w/2xFE, 2 WAN Slots, 32 FL/128DR
		• CAB-AC Power Cord, 110v
		• S1841PB-12415T
		○ Cisco 1841 IOS IP Base w/o Crypto
		• HWIC-8A
		○ 8-port Async HWIC
		• CAB-HD8-ASYNC
		○ High Density 8-port EIA-232 Async Cable
		• Router-SDM-CD
		○ CD for SDM Software
		• MEM1800-32CF
		○ 32MB Cisco 1800 Compact Flash
		• Cisco WS-2960G-24TC-L
		○ Catalyst 2960 24 10/100/1000, 4T/SFP LAN Base Image
		• CAB-AC Power Cord, 110v
		• WS-C3560X-48PF-S
		○ Catalyst 3560X 48 Port Full PoE IP Base
		• C3KX-PWR-1100WAC
		○ Catalyst 3K-X 1100W AC Power Supply
		• S356XVK9T-12255SE
		○ CAT 3560X IOS UNIVERSAL WITH WEB BASED DEV MGR
		• C3KX-NM-1G
		○ Catalyst 3K-X 1G Network Module option PID
		• C3KX-PWR-1100WAC/2
		○ Catalyst 3K-X 1100W AC Secondary Power Supply
		• CAB-3KX-AC
		○ AC Power Cord for Catalyst 3K-X (North America)

Dated: 12/5/2012

ANSWERS TO OFFERORS QUESTIONS

		• SFP-GE-L ○ 1000BASE-LX/LH SFP (DOM)
15	Spec section 230900.2.16.F says the wireless temperature sensors must be manufactured by the same company as the BAS components and the WEB Based area controller (WBAC). Would a BACnet wireless temperature sensor the meets the technical requirements of the specification but is manufactured by a different supplier be acceptable?	GROTHEER, PC RESPONSE: It is acceptable for the wireless temperature sensors to be by different manufacturer provided they are supported by the manufacturer of the main BAS components and integration is as seamless as the Basis-of-Design Reliable.
16	Please confirm that UDC will provide all IT internetworking between all buildings and provide all the necessary IT network infrastructure to allow for a single point of connection for each building for the Instrumentation and Control vendor to connect to the UDC network?	Yes, the existing fiber infrastructure on campus can be utilized and does not need to be duplicated by this contract. Data can be sent over the existing VLAN which is on the general campus network. However the Contractor will provide the following items below. • The Contractor will provide and install all Ethernet switches, patch panels, blades and applicable equipment at no less than (1) location in each building, totaling 11 locations. Contractor shall coordinate with UDC to ensure there is space in the existing equipment rack. If no space exists, the Contractor will provide a new equipment rack and any such infrastructure to fully connect the control panel to the network infrastructure. • The Contractor will provide tie in fiber on the campus network side of the switch and to the local network side of the switch. • The Contractor will provide install all raceway and conduit between the Ethernet Switch and the control panel. • Install all Ethernet homeruns from each control point. Each line will be installed, labeled at both ends, tested, and certified by the Contractor. • Install all patch cabling from each control point. Each patch cable will be installed, labeled at both ends, tested, and certified by the Contractor. • The Contractor will install a battery back-up for each control panel and switch device.

ATTACHMENT C

SPECIFICATION

SECTION 230900

INSTRUMENTATION AND CONTROL FOR HVAC

SECTION 230900 – INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1   SUMMARY

A.   Work Includes:

1.   This project creates a BACnet/IP Internetwork backbone throughout the noted buildings within this campus. This includes integrating the two separate Reliable Controls temperature control systems in Buildings 43 and 52 onto this backbone and extending the backbone into all buildings denoted as new to the backbone. Typically each new building will have at least one Touch Screen PC Operator Workstation for local Human machine interface. Each new building will also have new wireless temperature sensors throughout each building.

2.   (Add-Alternate 5) Building 43 is considered the Central Plant including central steam boilers and water chillers which serve the entire campus. The BACnet Internetwork within that building is to be combined with and integrated into this campus system. The BACnet internetwork within that building consists of the following:
       a.   A desktop B-OWS with the following graphical displays. 1) 2 building floor plans 2) 4 system schematics with a total of 240 mapped points
       b.   1 B-BC controller with points
       c.   1 B-AAC controller with points
       d.   3 B-ASC controllers with points

3.   (Add-Alternate 7) Building 52 is an office building. The BACnet Internetwork within that building is to be combined and integrated into this campus system. The BACnet Internetwork within that building consists of the following:
       a.   A desktop B-OWS with the following graphical displays. 1) 9 building floor plans 2) 216 system schematics with 4800 mapped points
       b.   3 BACnet IP Networks
       c.   9 BACnet MS/TP Networks
       d.   2 B-BC controllers with points
       e.   7 B-AAC controllers with points
       f.   210 B-ASC controllers with points

4.   (Add-Alternates 2, 3, 4, 6) Buildings 38, 39, 42, and 47 are office buildings with partial DDC systems as described in drawings. These areas are to be combined and integrated into this campus system. The BACnet internetworks and related control points are depicted on sheets M-17 and M-18.

5.   Typical Buildings without a BACnet Internetwork that are to be combined and integrated into this campus system will consist in general of the following:
       a.   A Touch Screen B-OWS with the following graphical displays. 1) building floor plans meant to depict number of levels and floors. 2) system schematics with mapped points.
       b.   1 B-BC controller

        c.   Wireless temperature sensors as shown

6. Furnish all labor, materials, tools, equipment and services to install a BACnet Internetwork and control system as indicated, in accordance with provisions of the Contract Documents.

7. The System Contractor shall coordinate the requirements of all mechanical and electrical equipment that will be controlled and shall be responsible for the coordination and interface requirements between the Control System, the Mechanical and Electrical Systems, the Fire Alarm System and existing conditions.

8. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

9. See Division 1 for General Requirements.

B. System Description

    1. General Requirements

        a.   The Control System shall be an on-line network of distributed, communicating microprocessor based stand-alone controllers, including PC and touch screen based operator workstation interfaces and programming software applications, wireless and hardwired field sensors, control devices, enclosures and interconnecting conduit and wire.

        b.   The networked components of the system shall make up a BACnet Internetwork including at least a high speed and/or other LAN's interconnecting BACnet devices. Those devices on the BACnet Internetwork shall communicate exclusively utilizing the BACnet protocol on BACnet LAN types. Communications between buildings and PC and Touch Screen based PC shall be IP on owner provided LAN utilizing Owner provided IP addresses.

        c.   Communications within buildings shall be a minimum of BACnet MS/TP.

        d.   The Operator Workstation software, other components of the networked system and wireless sensors shall all be manufactured by the same manufacturer and offer a manufacturer warranty as per section 1.8 Warranty.

        e.   Actuation of control devices shall be electronic. Spring return fail-safe actuation shall be provided when loss of property is possible without spring return fail-safe.

    2. Basic System Architecture

        a.   The system components shall include but not be limited to:
            (1)   Control System Application Software
            (2)   3rd Party Software
            (3)   Owner provided Building to Building WAN.
            (4)   Server (B-OWS) (if more than one B-OWS provided)
            (5)   Touch Screen (B-OWS) one for each building..
            (6)   Portable Operator Workstation (B-OWS)

        (7)   Building Controllers (B-BC)
        (8)   Advanced Application Controllers (B-AAC)
        (9)   Application Specific Controllers (B-ASC)
        (10)   Enclosures
        (11)   Wireless field sensors.
        (12)   Hardwired field sensors
        (13)   Controlled Devices
        (14)   Interconnecting Wire and Cabling
        (15)   Service Tools
        (16)   Network LAN's and Communication Protocols

b.   Wireless field sensors shall connect up to sensor manufacturer interface device. Sensor manufacturer interface device shall then connect directly to a stand-alone B-AAC or B-ASC BACnet control device. Connection between the wireless sensor manufacturer interface device is not required to be BACnet communication protocol.

c.   Hardwired field sensors and control devices shall connect to stand-alone B-AAC and B-ASC as required to achieve the point monitoring and control sequences specified. In general all mechanical systems, except those so noted, are to be digitally controlled by B-AAC and B-ASC, monitored by B-OWS or B-BC and are to be electronically actuated. Each mechanical system shall have a dedicated B-AAC or B-ASC that shall be connected to all field sensors and control devices for that system. Sensors and Control devices shall be UL listed.

1.2   WORK FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A.   Automatic control valves, thermo-wells, liquid flow switches, and liquid flow sensors are to be installed under applicable piping section.

    1.   Automatic dampers, smoke dampers, airflow measuring devices and combination fire/ smoke dampers are to be installed under Division 15 Section "Air Distribution System".

    2.   Terminal Unit B-ASC and damper operators are to be factory installed under Division 15 Section "Air Terminal Units and Induction Units".

1.3   QUALITY ASSURANCE

A.   Control System components shall be manufactured by firms regularly engaged in manufacture of equipment, of the types and sizes required

B.   System Contractor shall be a licensed contractor specializing and experienced in control system installations for not less than 5-years and with 3-years experience in networked "NATIVE" BACnet microprocessor based commercial HVAC control system installations and be able to demonstrate direct experience with a single "NATIVE" BACnet control system installation that includes Ethernet and MS/TP LAN type Internetwork, chilled and hot water plant pumping systems, 3 AHUs, 25 terminal units. Being listed as a manufacturer or an installing contractor does not imply that those contractors have such experience only that if they can demonstrate experience they can be qualified.

C. The System Contractor shall have successfully completed Control System Manufacturer's classes on the control system.

D. The BACnet Internetwork System shall be based on Manufacturer's standard integrated hardware and software product offering, which has been installed and fully operational in similar service for not less than 2-years.

E. To the extent practical, all equipment of the same type serving the same function shall be identical and from the same manufacturer.

F. Meet requirements of all governing and/or applicable local or national standards and codes, except when more detailed or stringent requirements are indicated by the Contract Documents, including requirements of this Section and the following:
1. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
    d. ASHRAE 135-2010: BACnet- Building Automation and Control Networking Protocol.
2. National Institute of Standards And Technology:
    a. NIST IR 6392 Annex B Profiles of Standard BACnet Devices.
3. Underwriters Laboratories:
    a. UL 916PAZX: Energy Management Systems.
4. NEMA Compliance:
    a. NEMA 250 Enclosure for Electrical Equipment.
    b. NEMA ICS 1: General Standards for Industrial Controls.
5. NFPA Compliance:
    a. NFPA 70 National Electrical Code (NEC).
6. Institute of Electrical and Electronic Engineers (EEE):
    a. IEEE 142 Recommended Practice for Grounding of Industrial and Commercial Power Systems.
7. Electronics Industries Associations (EIA):
    a. EIA 232 Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.
    b. EIA-485 Standard for Electrical Characteristics of Generator and Receivers for use in Balanced Digital Multi-point Systems.
8. Federal Communications Commission- Part J for class "A" application.

1.4 SYSTEM PERFORMANCE

A. The system shall conform to the following performance standards:
1. Graphics shall display with a minimum of 20 dynamic current data points and within 10-seconds of the request.
2. The maximum time between the command of a binary object by the operator and the reaction by the device shall be 10-seconds. Analog objects shall start to adjust within 10-seconds of being commanded to change.
3. All changes of state or change of analog values shall be transmitted such that no reporting of a value is more than 15-seconds old.
4. The maximum time from when an object goes into alarm to when it is annunciated at the B-OWS shall not exceed 20-seconds. Those points denoted as critical shall be annunciated in 2-seconds.

5. B-BC, B-AAC, and B-ASC shall be able to execute control loops at a selectable frequency at least 5 times every second. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
6. All B-OWS on the network shall receive alarms within 5-seconds of each other.
    a. Each controller/sensor combination shall be selected and designed to perform within the accuracy and repeatability limits specified herein.
    b. Unless noted otherwise in these Specifications the overall combined system accuracy of sensors, controllers and readout devices shall be noted in Table 1.
    c. Overall combined system repeatability of sensors, controllers and readout devices for a particular application shall be +/-2-percent of full scale of the operating range. Repeatability of overall combined system of sensor, controller and readout device in a control loop application will be +/-0.5percent of full scale of the operating range.
    d. Long term electronic drift shall not exceed 0.4-percent per year.

7. The system to have an ultimate capacity of not less than 10,000 points.
8. All components provided as part of this system shall operate under indoor ambient environmental conditions of 35 to 122 degF dry bulb and 10 to 95-percent relative humidity, non-condensing as a minimum. Outdoor conditions shall be -30 degF to 150 degF and 0 to 100-percent relative humidity. Sensors and control elements shall operate under the ambient environmental temperature, pressure, humidity, and vibration conditions encountered for the installed location. B-OWS equipment, such as CRTs and printers, shall, unless designated otherwise, operate properly under ambient environmental conditions of 45 to 90 degF and a relative humidity of 10 to 90-percent.
9. Networked components of the system shall be able to operate at 90 to 110-percent of nominal voltage rating and shall perform an orderly shutdown below 80-percent.
10. All sensors and control devices exposed directly to a controlled media shall be rated to withstand 150-percent of maximum conditions found where in contact with the controlled media, and shall be constructed of material suitable for the media sensed.

Table 1 – System Accuracy

Measured Variable	Reported Accuracy
Space temperature	+/-0.5 degC (+/-1 degF)
Ducted air	+/-1.0 degC (+/-2 degF)
Outside air	+/-1.0 degC (+/-2 degF)
Water temperature	+/-0.5 degC (+/-1 degF)
Delta-T	+/-0.15 degC (+/-0.25 degF)
Relative humidity	+/-3% RH 10-95% RH
Water flow	+/-2% of actual valve
Air flow (terminal)	+/-10% of actual valve (Note 1)
Air flow (measuring stations)	+/-2% for calibrated range.
Air pressure (ducts)	+/-25 Pa (+/-0.1 WG)
Air pressure (space)	+/-3 Pa (+/-0.01 WG)
Water pressure	+/-1PSI (Note 2)
Measured Variable	Reported Accuracy
Electrical Power	□2% of Range (Note 3)
Carbon Monoxide (CO)	+/-50 PPM
Carbon Dioxide (CO2)	+/-50 PPM

Note 1: (10% to100% of scale) (cannot read accurately below 10%)

| Note 2: for both absolute and differential pressure |
| Note 3: * not including utility supplied meters |

1.5   SUBMITTALS

A.   Submit under provisions of Division 15 Section "Special Mechanical Requirements" and Division 1.

B.   Submit in writing and so delineated at the beginning of each submittal, known substitutions and deviations from requirements of Contract Documents.

C.   Submit the following within 60-days of Contract award:
1.   A complete bill of materials of equipment to be used indicating manufacturer and model number.
2.   A schedule of all control valves including the valve size, dimensions, model number (including pattern and connections), close-off rating, flow, CV, pressure rating and location.
3.   A schedule of all control dampers. This shall include the damper size, pressure drop, and manufacturer and model number.
4.   Provide manufacturer's cut sheets for major system components. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Include:
a.   PC and Touch Screen Based Operator Workstations (B-OWS).
b.   Building Controllers (B-BC).
c.   Advanced Application Controllers (B-AAC).
d.   Application Specific Controllers (B-ASC).
e.   Proposed Control System architecture riser diagram.
f.   Provide a BACnet Product Implementation Conformance Statement (PICS) or BIBB table for each BACnet device type in the submittal.
g.   Color prints of similar graphics with a list of points for display.

D.   Contractor shall submit shop drawings and manufacturer's standard specification data sheets on all hardware and software to be provided. Submittals shall contain the following information:
1.   Bill of materials showing manufacturer, model number, and description for each control component.
2.   System architecture one-line diagram.
3.   Schematic flow diagram of each air and water system showing fans, coils, dampers, valves, pumps, heat exchange equipment and control devices. Include sequence of operation including alarm and emergency sequences, equipment interlocks, and manual override capabilities.
4.   Indicate all required electrical wiring. Identify sources for all power to each device.
5.   Details of control panels, including controls instruments and labeling.
6.   Application Programming:
a.   Complete input output point schedule identifying, function, type, location, and identification code.
b.   Description of system operation under failure conditions.

E. Project Record Documents: Upon completion of installation submit owner's manual for review. The "As- Built Documents" should include:
1. Project Record Application Engineering Drawings.
2. Operating and Maintenance (O and M) Manual including:
    a. Operators' Manual with system manufacturer's complete operations manual.
    b. Programming Manual including:
        (1) Documentation on application and DDC programs.
        (2) Information required for independent programming of system.
        (3) Point schedules; include all points, real and virtual.
        (4) Software troubleshooting procedures.
    c. Maintenance Manual including the following:
        (1) Routine preventive maintenance procedures, corrective diagnostic troubleshooting procedures, and calibration procedures.
        (2) Parts lists with manufacturer's catalog numbers and ordering information.
        (3) One set of magnetic media containing files of all color-graphic screens created for the project.
        (4) A list of recommended spare parts with part numbers and supplier.
    d. Training manuals as described in Paragraph "Training".

1.6   CALIBRATION, COMMISSIONING DEMONSTRATION AND ACCEPTANCE

A. Calibration and Commissioning
1. Commission the control system. Document the commissioning and submit documentation prior to acceptance testing. Commissioning shall include the following:
    a. Verify that each control panel has been installed according to the shop drawings and test, calibrate, and bring on-line each control device.
    b. Each control program shall be put on-line and commissioned.
    c. Verify the overall networked system performs as specified.
    d. Subsystems not controlled by electronically shall also be tested and commissioned.

B. Demonstration and Acceptance Testing
1. Using the documented calibration and commissioning test data the Owner and /or his representative shall select, at random, results to be demonstrated. At least 95-percent of the results demonstrated must perform as specified and documented on commissioning data sheets or the system must be re-calibrated and re-commissioned before being re-tested
2. After the acceptance tests are complete a 14-day endurance test period shall begin. If the system functions as specified throughout the endurance test period requiring only routine maintenance and adjustment, the system shall be accepted. If during the endurance test period the system fails to perform as specified and cannot be corrected within 8-hours, the Owner may request that the endurance tests be repeated after problems have been corrected.

1.7   TRAINING

A.   Operational Training Program
1.   The Contractor shall furnish the services of competent instructors who will give instruction on the adjustment, and operation and maintenance of the control system provided. The System Contractor shall provide all equipment and material required for classroom training.
2.   This Contractor shall conduct a 5-day operational training program for the building operating crew. A day shall be defined as an 8-hour day with qualified instructions that shall be exclusive of travel time.
3.   2-days shall consist of off-site training provided at a factory authorized local training center. Schedule within 1-month of system acceptance. Training shall be done on a BACnet Internetwork of working controllers representative of the installed network or the Owner's site and shall include:
a.   Review of the installed system.
b.   Architecture of the Control System.
c.   Database design and modification.
d.   Applications software.
e.   Color graphics operation.
f.   Operator control function.
g.   Operation of PC computers and peripherals.
4.   3-days shall consist of on-site training covering the complete system and components. Schedule within 1-month of system acceptance. Training shall be done on the Owner's Control System and shall include:
a.   General equipment layout.
b.   Sequences of operation.
c.   Maintenance and repair.
d.   Troubleshooting.
e.   Preventative maintenance.
f.   Sensor calibration.
g.   Proper use of service material, and tools.
5.   The instructor shall provide one copy of training material per student. Training sessions shall be videotaped at the discretion of the Owner's Representative for future use by the building staff.

B.   Ongoing Support
1.   In addition to the initial 40-hours of operator and supervisor training, the Contractor shall provide an additional 24-hours training during the first year of operation.

1.8   WARRANTY, MAINTENANCE, NORMAL AND EMERGENCY SERVICE

A.   The Contractor shall warranty the Control System to be free from defects in workmanship and material under normal expected service and use for a period of 1-year from the date of acceptance by the Owner. During this period, the Contractor shall furnish all labor to repair or replace all items or components that fail due to defects in workmanship or material at no charge or reduction in service to the owner.

B.   The Manufacturer shall warranty the Operator Workstation software, the networked components of the system, the wireless interface devices and the wireless sensors themselves for a period of 4 years from the date of acceptance by the Owner.

INSTRUMENTATION AND CONTROL FOR HVAC   230900 - 8

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. The Basis of Design is Reliable Controls, Inc. installed by Building Automation Services, Inc. The BACnet Internetwork components of the control system shall be of one manufacture. If they comply completely with B-OWS, B-BC, B-AAC and B-ASC parts of these specifications, other manufacturers networked systems will be acceptable including:
   1. Automated Logic
   2. Reliable Controls
   3. Honeywell

B. Sensors and Control Devices may be of manufacturers other than those mentioned above whose products comply with these specifications.

2.2 ACCEPTABLE CONTRACTORS

A. The basis of design is Reliable Controls, Inc installed by Building Automation Services, Inc. If the installing contractor can demonstrate direct experience as noted in the Quality Assurance portion of this section of the specification, then the control system may be installed by other contractors including the following:
   1. Building Automation Service, Inc.
   2. EMS.
   3. Honeywell.

2.3 CONTROL SYSTEM APPLICATION SOFTWARE

A. The Control System Application software and database is to be stored on B-OWS hard disk drive.

B. Password Protection
   1. Multiple-level password access protection shall be provided.
   2. Passwords shall be exactly the same for all operator devices, including portable or panel mounted network terminals.
   3. A minimum of five levels of access shall be supported:
   4. A minimum of 50 passwords shall be supported at each B-OWS and B-BC.
   5. Operators will be able to perform only those commands available for their respective passwords.
   6. User-definable, automatic log-off timers of from 1 to 60-minutes shall be provided to prevent operators from inadvertently leaving devices on-line.
   7. All system security data shall be stored in an encrypted format.

C. Alarming and Event Notification
   1. B-OWS terminal shall provide audible, visual, and printed means of alarm and event notification.
   2. System shall provide log of notification messages. Alarm log shall be archived to the hard disk of the system B-OWS.

3. Alarm messages shall be in user-definable text (English or other specified language) and shall be entered either at the B-OWS terminal or via remote communication.
4. An alarm summary shall be available to show all alarms whether or not they have been acknowledged.
5. Alarm programming shall include level, message, notification locator, routing, C.O.S. value, and de-bounce.
6. Each defined point shall have assignable alarm states.

D. Provide the capability to schedule each object or group of objects in the system. Each schedule could consist of the following:
1. Provide separate schedules for each day of the week.
2. Provide the ability for the operator to designate any day of the year as an exception schedule.
3. Provide the capability for the operator to define up to special or holiday schedules.
4. There shall be a provision with proper password access to manually override each schedule.
5. B-OWS shall be able of synchronize the Time and Date of any BACnet device on the BACnet internetwork that supports the Time of Day functionality. It shall be possible to command a single device of groups of devices simultaneously across the internetwork.

E. The system shall include a software program to perform optimized start-up and shutdown of selected equipment. The SSTO program shall operate on outside weather conditions as well as inside zone condition, and empirical factors. The SSTO program shall operate in both the heating and cooling seasons. The system operator shall be able to, for each system under control of the SSTO program, establish and modify the following parameters:
1. Occupancy period
2. Heating/cooling transfer coefficients
3. Desired occupancy temperature
4. Primary equipment lag time
5. Heating/cooling retention coefficients

F. Electrical Demand Limiting
1. The system shall include a software program to perform electrical demand limiting (EDL) by resetting HVAC system set points to reduce load while maintaining Indoor Air Quality (humidity, VOC, CO_2) and comfort control in the space. The program shall automatically shed and restore loads to prevent the electrical demand from exceeding and operator set level
2. Each load shall be programmed with maximum off time, minimum on time and minimum off time.
3. When maximum target is exceeded alarm shall sound; current demand in kW displayed and printed out with time of occurrence on alarm printer.

G. Trendlog Information
1. Any system point either real or calculated shall be assignable to the historical trending program by periodically gathering historical samples of object data stored in the field equipment (global controllers, field controllers) and archive the information on the B-OWS terminal (server) hard disk.

H. The system shall monitor equipment status and generate maintenance messages based upon user designated run time, date of last PM, number of failures since last PM, date and time of last failure, starts and/or calendar date limits.

I. This application shall prevent all controlled equipment from simultaneously restarting after a power outage. The order in which equipment (or groups of equipment) is started, along with the time delay between starts shall be user-selectable.

J. All binary output points shall be protected from short cycling. This feature shall allow minimum on-time and off-time to be selected.

K. System Configuration, Set-Up and Definition
    1. Device and network status shall be displayed for any device on the BACnet internetwork.
    2. B-OWS shall be able to stop any BACnet object on the BACnet internetwork from transmitting event or alarm notifications until a subsequent command is issued.
    3. All control strategies and energy management routines shall be definable by the operator.
    4. B-OWS shall be able to back-up and restore the programming and data for any BACnet device on the BACnet internetwork. Users shall also have the ability to manually execute downloads of any or all portions of a device database.
    5. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system.
        a. Provide the tools to create, modify and debug custom application programming.

L. Color Graphics:
    1. Provide a color graphics package to allow the user to generate custom dynamic graphics for graphical representation of system design and system parameters.
        a. A listed set of symbols and graphic slides shall be provided to allow operators to select from the graphics table to assist in graphic generation.
            1) All color graphic display shall be dynamic with current point data automatically updated from the BACnet internetwork to the B-OWS workstation without operator intervention.
            2) The operator shall be able to manually adjust digital, analog or calculated values in the system, adjust values of control loops, and command points to local mode or release points to automatic mode.
        b. The windowing environment of the B-OWS shall allow the user to simultaneously view several graphics at the same time to analyze total building operation, and/or to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.
        c. Graphic generation software shall be provided to allow the user to add, modify, or delete system graphic displays. The system shall provide libraries of pre-engineered screens and symbols depicting mechanical system components.
    2. The system shall be provided with fully automatic diagnostic procedures for verification of field communication. In the event of communications failure, the system shall AutoDial the condition to a remote operator. AutoDial out will repeat alarms while the situation remains unacknowledged.
    3. Control Summaries, Reports and Logging
        a. The system shall provide self-documentation reporting to summarize control strategies for any point or any user selected group of points within the Control System.
        b. The B-OWS shall provide reporting and logging functions for user defined point value and status information.

          c.   The B-OWS reporting package shall allow the user to configure the point information display in custom format.

    M.   BACnet Conformance: B-OWS terminal shall comply with the requirements of a BACnet profile for B-OWS.

2.4   SERVER (Provide as required for systems with more than one B-OWS)

    A.   Hardware and Operating System: B-OWS common database and graphic files shall be stored on a PC based operators workstation designated and acting as the system server consisting of the following:

1.   1. 500-MHz Pentium III processor.
2.   128-MB RAM.
3.   3.5-inch 1.44-MB 3.5-inch diskette drive.
4.   20-Gigabyte or larger hard disc drive with 12-millisecond access time.
5.   A high-density removable storage device capable of 10-MB storage on a removable cartridge. Acceptable devices include Iomega Zip or JAZ drives, tape storage or CD-RW.
6.   Enhanced style keyboard with 101 key layout, 10 function keys, operate numeric keypad and separate cursor control pads.
7.   Tower case with at least two spare drive slots and three spare board slots.
8.   A 17-inch diagonal screen non-interlaced SVGA monitor with 0.28-mm minimum dot pitch and at least 1024*768 resolution, a fully adjustable tilting base, separate control for color, contrast and brightness and non-reflective screen.
9.   SVGA video output with 4-MB video RAM.
10.   Two button mouse with adjustable sensitivity and desk pad.
11.   CD-RW drive.
12.   Internal 56 K BPS modem.
13.   All required cables.
14.   At least one spare serial port.
15.   A combination surge suppressor/ UPS dedicated to this server and printer.
16.   All communication ports to connect all devices here and networked communications from the control system.
17.   Provide an integral audio tone generator to activate on detection of an alarm. Audio tone shall be capable of being enabled or disabled on operator command.
18.   Microsoft Windows 2000 or NTv4.0 including Internet Explorer.
19.   Microsoft Office 2000 Professional.
20.   Microsoft Active X.
21.   Database: Server software shall utilize an industry standard database engine compatible with Microsoft Access. The system database shall comprise a logical grouping of points, a building, multiple buildings or end-user sites as specified herein and an I/O summary. The system must have the capability of scaling up to an industrial strength database. Acceptable ODBC/JDBC compatible databases are MS SQL 7.0, Oracle 8I and IBM DB2. Vendors must identify proposed database in their bid.

    B.   Control System Application Software: Provide licensed copy of Control System Application Software described in Paragraph "Control System Application Software".

    C.   Communications and Protocols

1. B-OWS information access for the control system shall utilize the BACnet protocol exclusively.
2. B-OWS shall reside on the same LAN as B-BC's. B-OWS shall as a minimum support point-to-point (PTP) and either ARCnet ASTM751 or Ethernet ISO 8802-3. Physical/data link layer protocols.
3. The system shall have the ability to dial out in the event of an alarm.

2.5 OPERATORS WORKSTATION (B-OWS)

A. Hardware and Operating System: Desktop PC workstation of the same hardware and software configuration of the operators workstation without the server database.

B. Control System Application Software: Provide licensed copy of Control System Application Software described in Paragraph "Control System Application Software".

C. Communications and Protocols
    1. B-OWS information access for the control system shall utilize the BACnet protocol exclusively.
    2. B-OWS shall reside on the same LAN as B-BC's. B-OWS shall as a minimum support point-to-point (PTP) and either ARCnet ASTM751 or Ethernet ISO 8802-3. Physical/data link layer protocols.
    3. The B-OWS specified here may, at the Owner's option, be located remote from the BACnet internetwork. Other than the difference in B-OWS communication speed, the system shall be capable of remote operation via BACnet LAN types with no degradation in application performance.

2.6 PORTABLE OPERATORS WORKSTATION (Portable B-OWS)

A. Hardware and Operating System
    1. Provide at least one PC compatible notebook of the following minimum configuration:
        a. 2.8 GHz processor.
        b. 4 GB RAM.
        c. 100-Gigabyte hard disk storage.
        d. CD-RW.
        e. 14.1-inch TFT SVGA screen.
        f. On board mouse.
        g. On board modem 56.6-K.
        h. On board LAN connection to B-OWS BACnet LAN type.
        i. Rechargeable battery.
        j. 120-volts AC power supply and cord.
        k. Carrying case.
        l. Rechargeable extra battery.

    2. Provide identical OS and 3rd party application software as provided for the B-OWS.

B. Control System Application Software: Provide licensed copy of Control System Application Software described in Paragraph "Control System Application Software".

C. Communications and Protocols

INSTRUMENTATION AND CONTROL FOR HVAC

1. Portable B-OWS information access shall utilize the BACnet protocol exclusively.
2. Portable B-OWS shall as a minimum support point-to-point (PTP) and either ARCnet ASTM751 or Ethernet ISO 8802-3. Physical/data link layer protocols.
3. Remote LAN communications package shall be possible allowing offsite reporting and control through standard BACnet LAN types. Provide the connection devices for each Portable B-OWS to connect with LAN.

2.7   LOCAL TOUCH SCREEN OWS (B-OWS)

A. Hardware and Operating System:
1. Local Touch Screen Operator Workstation is to be provided in each building as indicated. Touch Screen shall be provided for interrogating and editing data real time on the network. An optional system security password shall be available to prevent unauthorized use of the keypad and display.
    a. 2.8 GHz processor.
    b. 4GB RAM.
    c. 100-Gigabyte hard disk storage.
    d. 8x CD-RW.
    e. 23-inch LCD or TFT screen w 1080p resolution of 1920 x 1080.
    f. On board LAN connection to B-OWS BACnet LAN type.

2. Provide identical OS and 3rd party application software as provided for the BOWS.

B. Control System Application Software: Provide licensed copy of Control System Application Software described in Paragraph "Control System Application Software".

C. Communications and Protocols
1. Touch Screen B-OWS information access shall utilize the BACnet protocol exclusively.
2. Touch Screen B-OWS shall as a minimum support point-to-point (PTP) and either ARCnet ASTM751 or Ethernet ISO 8802-3. Physical/data link layer protocols.
3. Remote LAN communications package shall be possible allowing offsite reporting and control through standard BACnet LAN types. Provide the connection devices for each Touch Screen B-OWS to connect with LAN.

2.8   PRINTERS

A. The system shall accept line printers with a serial interface for offsite alarming and reporting, and either serial or parallel interface for on-site alarming and reporting.

B. Display and report printer shall be 600 x 600 dpi [236 x 236 dots per cm], minimum four sheets per minute b/w laser printer with 8-1/2 x 11-inch [A4, A5] and legal sized 8-1/2 x 14-inch paper trays. Provide 2,000 sheets 8-1/2 x 11-inch pager/printer at time of acceptance.

C. Alarm printer shall be one dot matrix or equivalent line printer 8-1/2 x 11-inches with either fan feed or standard 8-1/2 x 11-inch individual feed and 240-characters/second printer speed.

2.9   SERVICE TOOLS

    A.   A. Hardware and Operating System
        1.   Provide, at a minimum, one of each proprietary hardware and/or software tools required to service the system, including all manuals and licenses. In the case of multiple type service tools, one of each type shall be provided.
        2.   Provide 1-year supply of all required lubricants for components of the system including valves and dampers.

    B.   Communication and Protocols
        1.   Universal, two-way, hand held service tool shall communicate with all microprocessor based controllers in the Control System. When connected the service tool may connect to multiple controllers simultaneously via the BACnet internetwork.

2.10   LAN TYPES AND COMMUNICATIONS

    A.   This Control System shall comprise a BACnet inter-network, as described in Section 1.

    B.   Each BACnet device shall operate on the BACnet physical/data link protocols specified for that device. Physical/data link protocol types utilized for communications exchange throughout the system will be limited to those LAN types described in the ANSI/ASHRAE Standard 135-1995, BACnet. BACnet LAN types are the following:
        1.   BACnet IP.
        2.   Ethernet (10Mps/100 Mps)(IEEE 802.3) via 10BASE-T, 10BASE-2, 10BASE-5, and 10BASE-F.
        3.   ARCnet (ANSI/ATA 878.1) via COAX, Fiber or RS-485.
        4.   Master Slave/Token Passing (MS/TP) via RS-485.
        5.   LONTalk (EIA-709.1).
        6.   Point-to-Point via RS-232 or Modern connection.

    C.   The Controls Contractor shall provide all communication media, connectors, repeaters, modems, switches, hubs, bridges and routers and half-routers necessary for the BACnet Internetwork.

2.11   BACnet PROTOCOL VERIFICATION SOFTWARE

    A.   The System contractor shall as part of this contract provide a licensed copy of a BACnet Protocol Analyzer. This software shall be installed on at least one of the owners Ethernet or ARCNET connected BACnet Operator Workstations (B-OWS). Should no BACnet Protocol packets be visible on the BACnet Internetwork then the system as installed will be rejected. Known BACnet Protocol Analyzers are available from Cimetrics Inc, Polarsoft, Inc. or Etherreal

2.12   WEB BASED AREA CONTROLLER (B-BC & B-OWS)

    A.   The Web Based Area Controller (NAC) shall provide a thin-client, Graphical User Interface (GUI) to the Building Automation System (BAS).

        1.   Local Access. The WBAC shall be installed upon the owner's Local Area Network (LAN) and shall support local operator access using standard web browsers including at a minimum Microsoft Internet Explorer 8, Mozilla Firefox 3, Google Chrome 7, and Apple Safari 6.

        2.   Remote Access. A high-speed connection from the WBAC to the Wide Area Network (WAN) shall be provided and maintained by the owner to facilitate remote operator access to the BAS using the standard web browsers including at a minimum Microsoft Internet Explorer 8, Mozilla Firefox 3, Google Chrome 7, and Apple Safari 6.

    B.   The WBAC(s) shall meet or exceed the requirements of a BACnet® Operator Workstation (B-OWS) and a BACnet® Building Controller (B-BC).

    C.   The WBAC(s) shall support the following hardware characteristics as a minimum:

        1.   One (1) ISO-8802.3 Ethernet Port – 10/100 Mbps

        2.   One EIA-232 Port – 115.2 Kbps maximum

        3.   Two EIA-485 Ports – 76.8 Kbps maximum

        4.   Local onboard and/or expandable hardware inputs/outputs (I/O), Expandable to a minimum of 96 Inputs and 64 Outputs

        5.   8 MB operating RAM

        6.   1 MB non-volatile RAM

        7.   128 MB Flash EEPROM

    D.   Real-time values displayed on the web browser shall update automatically without requiring a manual "refresh" of the web page.

    E.   HTML programming shall not be required to create or display system graphics or data on a web page.

    F.   A new point displayed on a B-OWS graphic screen shall appear automatically on the identical graphic screen served by the WBAC with no further programming or file transfer required.

    G.   The WBAC shall be capable of automatically uploading any changes to existing GUI images or animations.

    H.   The WBAC shall support operator interface via the web browser the following at a minimum:

        1.   Password Protection

            a.   The WBAC shall be configurable to provide read-only access without requiring log-on

            b.   Multiple-level password access protection shall be provided.

            c.   A minimum of 128 passwords shall be supported at each NAC

            d.   Operators will be able to perform only those commands available for their respective passwords.

            e.   User-definable, automatic log-off timers of from 1 to 60 minutes shall be provided to prevent operators from inadvertently leaving an NAC browser interface in an unsupervised logged-in state.

            f.   Unencrypted passwords shall not be transmitted between the NAC and the client browser

2. Alarming and Event Notification
   a. Each WBAC shall support BACnet® Event Enrollment, BACnet® Algorithmic Alarms and BACnet® Intrinsic Alarms
   b. Each WBAC shall be capable of generating configurable dynamic alarm notification that is presented on-top of any current browsing screens in the form of a configurable pop-up message
   c. Each WBAC shall be capable of e-mail notification of system alarms configurable to include notification class, recipient, inclusive and exclusive times and days as well as transition states (to alarm, to fault, return to normal)
   d. System shall provide log of notification messages
   e. Alarm messages shall be in user-definable text
   f. An alarm summary shall be available to show all alarms including but not limited to whether or not they have been acknowledged
   g. Alarm messages shall be fully customizable in size, content, behavior and sound.

3. Weekly, Annual and Special Event Exception Scheduling
   a. Provide the ability to view and modify the schedule for the calendar week and up to 255 special events in a graphical format. Each calendar day and special event shall provide at least six time/value entries per day.
   b. Provide the ability for the operator to select scheduling for binary, analog, or multi-state object values.
   c. Provide the ability for the operator to designate days, date ranges, or repeating date patterns as exception schedules.
   d. Provide the capability for the operator to define special or holiday schedules and to link the BACnet® schedule to a BACnet® calendar, thereby over-riding weekly schedule programming on holidays defined in the BACnet® calendar.
   e. There shall be a provision with proper password access to manually override each schedule.
   f. Provide the capability to designate any exception schedule to be "Executed Once" then automatically cleared.
   g. Provide the ability to name each exception schedule with a user defined term to describe each special event.

4. Trend Log Graphing
   a. Each WBAC must support the BACnet® Trend Log Object and the BACnet® Multi-Point Trend Log Object
   b. All data points (both hardware and software) system-wide shall be assignable to a historical trending program by gathering configurable historical samples of object data stored in the local controller (B-BC, BAAC, B-ASC).
   c. All trend log information shall be displayable in text or graphic format. All information shall be able to be printed in black & white or color and exported directly to a Microsoft Excel Spreadsheet.

5. Runtime Log Information
   a. B-OWS Software shall be capable of displaying Runtime and On/Off Cycle data of all Binary data points (both hardware and software) system-wide. Runtime logs shall provide the following at a minimum:
      1) Total Accumulated Runtime
      2) Accumulated Starts Today
      3) Total Accumulated Starts
      4) Timestamp each Start/Stop and duration of each on/off cycle

        5)   Monitor equipment status and generate maintenance messages based upon user designated run time

    6.   Ability to Manually Override any Database point

        a.   All hardware and software points may be temporarily overridden for a user adjustable configured time period.

    7.   Color Graphical User Interface (GUI)

        a.   All color graphic displays shall be dynamic with current point data automatically updated from the BACnet internetwork to the browser without operator intervention. Manual operator intervention shall use the same methodology as on the B-OWS application.

        b.   Depending upon configured access level; the operator shall be able to manually adjust digital, analog or calculated values in the system, adjust values of control loops, override points or release points to automatic mode.

I.   The WBAC shall provide the capability to create individual user (as determined by the log-on user identification) home pages. Provide the ability to limit a specific user to a 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.

J.   The WBAC shall include an Audit Trail feature that automatically records the time, date, and user, and action associated with all user changes made via Web Browser clients.

K.   The WBAC shall store complete help files describing system configuration, and use of the browser interface, the help files shall be served on-line as part of the browser interface.

    1.   The web browser interface shall include tool tips to describe the functionality of the interface.

2.13   BUILDING CONTROLLERS (B-BC)

A.   Hardware and Operating System

    1.   B-BC shall provide battery-backed distributed processing unit and shall monitor and manage input and output communication signals allowing B-AACs and B-ASCs to share real and virtual information and allow for central monitor and control. B-BC shall provide real-time (hardware) clock functions and perform scheduling.

    2.   B-BC shall be capable of deciding global strategies for the system based on information from any objects in the system. Control Systems that require a higher-level host processor for update, time stamps, global point data, COS transfer, on-line control instruction, or communications control between B-BC panels shall not be acceptable.

    3.   B-BC shall be capable of either discriminating or indiscriminately sharing global data with other B-BC and B-OWS on the BACnet internetwork.

    4.   Provide means to graphically simulate inputs and outputs to each program in real-time as program is executing. This function may be performed via any B-OWS.

    5.   B-BCs shall have sufficient memory to support its operating system, database, and programming requirements. Battery shall retain static RAM memory and clock functions for a minimum of 72-hours. B-BC operating system, field database, and application programs shall reside in on-board memory or EEPROM.

    6.   Provide diagnostic LEDs for power, communications and processor. The B-BC shall continually check the status of its processor and memory circuits.

B. Control System Application Software

1. The controller software shall reside in a real time, multi-tasking, networking operating environment. Database definition shall be accomplished through the BOWS online with the B-BC. The complete database and application program shall reside in the B-BC. The System Contractor shall configure the software to attain the proper sequence of control and to accomplish all other control system functions indicated in the Contract Documents. The user shall be able to add, delete, or objects on-line as required. The programming shall provide all the necessary mathematics, logic, utility and control functions necessary for proper sequence of control.

2. The software defined within the B-BC, in conjunction with the stand alone control loops residing within the B-AAC and B-ASC shall provide all required application programming.

3. Alarm management shall be provided. Each B-BC panel shall perform distributed, independent alarm analysis and filtering. At no time shall the B-BC panel's ability to report alarms be affected by either operator activity at a B-OWS or local I/O device, or communications with other B-BC on the network.

   a. B-BCs shall have capability to call out alarm conditions automatically. Alarm message and site description shall be sent to off-site computer or serial printer. If desired, controller may also send encoded message to digital pager.

   b. Alarms log viewable on site or remotely shall be provided.

   c. All alarm or point change reports shall include the point's English language description, and the time and date of occurrence.

   d. The user shall be able to define the specific system reaction for each point alarm and shall be able to customize reaction and filtering to minimize nuisance reporting. Each B-BC panel shall automatically inhibit the reporting of selected alarms during the standby power modes of operation, loss of power, fire alarm mode, and normal system shutdown and start-up. Users shall have the ability to manually inhibit alarm reporting for each point.

   e. Alarm reports, messages, and files can be directed to a user-defined list of operator devices, or PCs used for archiving alarm information.

4. A variety of historical data collection utilities shall be provided. Minimum sampling time shall be programmable with a minimum programmable time of 1-second.

   a. B-BC panels shall store point history files for all analog and binary inputs and outputs.

   b. Measure and calculated analog and binary data shall also be assignable to user-definable trends.

   c. Trend data shall be stored at the stand-alone B-BC panels, and uploaded to hard disk storage when archival is desired.

5. Stand-alone B-BC panels shall automatically accumulate and store runtime hours for binary input and output points.

6. B-BC panels shall automatically sample, calculate and store consumption totals on a daily, weekly, or monthly basis for user-selected analog and binary pulse input-type points.

7. B-BC panels shall have the ability to count events on a daily, weekly, or monthly basis.

8. Demand Limiting

   a. System shall monitor energy demand from any type of energy source. Networked B-BC shall provide a demand-limiting routine that shall shed appropriate system objects to prevent the demand from exceeding preset limits.

   b. Zone shed method shall be by either preventing zone heating and cooling operations, or by shifting zone heating and cooling set points.

9. The B-BC shall meet BACnet profile for Building Controllers.

INSTRUMENTATION AND CONTROL FOR HVAC

C.   Communication and Protocols:
1.   Each B-BC shall reside the same BACnet LAN type as B-OWS.
2.   The B-BC shall continuously scan the BACnet Internetwork and maintain a current database of field data in on board battery backed RAM or EEPROM. The B-BC shall coordinate transfer of data between B-OWS and/or B-BC.
3.   The B-BC shall provide a communications port for connection of the Portable Operators Terminal using Point to Point BACnet physical/data link layer protocol or a connection to the inter-network.
4.   The B-BC shall provide a communication port for connection of a portable (B-OWS) using either ISO 8801-3 internet or ARCnet (ASTM878.1).
5.   Provide all functions that will allow remote communications via modem to off-site locations. Include modem along with all cabling necessary for installation.

2.14   ADVANCED APPLICATION CONTROLLER (B-AAC)

A.   Hardware and Operating System:
1.   The primary device for input/output connection to the field sensors, and control devices shall be a B-AAC. Each B-AAC shall acquire process and store point input data on a real time basis for internal use and for upload to the B-BC. Each B-AAC shall also maintain and supervise digital and analog output signals to the control devices and have a real time operating system capable of time of day scheduling and other time based functions.
2.   B-AAC shall provide microprocessor based self-contained stand-alone fully programmable operation of local process control loops. All local level application programs shall be installed on individual controllers in non-volatile memory. Each B-AAC shall be capable of sharing point information with other B-BC, B-AAC, or B-ASC on the BACnet Internetwork.
3.   Control systems that require communication between B-AAC or B-ASC and a B-OWS or B-BC for normal control functions, or which operate in a degraded mode without those level communications, or which require programmable read only memory (PROM) level application programming are not acceptable.
4.   Once downloaded, a B-AAC shall not require further communication with the B-OWS except for data base changes, operator commands, and requests from the BOWS for B-AAC data. Programming of B-AACs shall be completely modifiable in the field, over installed BACnet Internetwork or remotely via modem.
5.   The B-AAC to be expandable by adding Input/Output logic modules or Input/Output expansion modules.
6.   All wiring shall be connected to padded screw terminals or labeled spade connections.
7.   Input/Output Configuration
     a.   Analog Inputs: Industry standard 4 to 20-mA, 0 to 5-volts, 0 to 10-volts, 3 to 15 psi and thermistor or RTD analog sensors. A/D conversion to be a minimum of 10 bit resolution. AI circuits will be electrically isolated.
     b.   Analog Outputs: Provide modulating signal to industry standard 3 to 15 psi, 4 to 20-mA, 0 to 5-volt and 0 to 10-volt analog control devices. Digital to analog conversion with a minimum of 8 bit resolution. All AOs shall have physical hand-off-auto switched located within the B-AAC control enclosure. Provide Potentiometer for manual positional of H-O-A when in hand. H-O-A switch shall be hardware monitored by the B-AAC for switch position.

> c. Digital Inputs: Accept non-powered, binary contact closure signals. DI circuit shall be electrically isolated.
>
> d. Digital Outputs: Electrically isolated maintained or momentary electrical relay. All DOs shall have physical hand-off-auto switched located within the B-AAC control enclosure. H-O-A switch shall be hardware monitored by the B-AAC for switch position.
>
> e. Pulse accumulation input points shall conform to all the requirements of Binary Input points, accept up to ten pulses per second for pulse accumulation, and shall be protected against effects of contact bounce and noise.

8. Provide diagnostic LEDs for power, communications and processor.
9. Each B-AAC shall be provided with the ability to prevent unauthorized access to its software program.
10. Each controller shall be addressable.
11. The B-AAC shall meet BACnet profile for Advanced Application Controller.

B. Control System Application Software: Shall be the same as B-AAC with the exception that BACnet profile is changed to B-ASC instead of B-AAC, and B-AAC may have firmware specifically dedicated to control a specific piece of mechanical equipment.

C. Communications and Protocols: B-AAC shall as a minimum support one BACnet LAN type communicating at a minimum of 9,600 baud as native BACnet device.

2.15 APPLICATION SPECIFIC CONTROLLER (B-ASC)

A. Hardware: B-ASC hardware shall be the same as B-AAC and indistinguishable with the exception that there is no requirement to have expansion I/O modules, 10 bit A/D conversion on inputs, or H-O-A overrides on outputs within the control enclosure.

B. Control System Application Software: Shall be the same as B-AAC with the exception that BACnet profile is changed to B-ASC instead of B-AAC, and B-AAC may have firmware specifically dedicated to control a specific piece of mechanical equipment.

C. Communication and Protocols: Shall be the same as B-AAC.

2.16 WIRELESS TEMPERATURE & HUMIDITY SENSORS & INTERFACE DEVICES

A. Wireless, communicating temperature sensors shall provided as indicated on project drawings and shall be available with the following options as required:
1. Temperature
2. Setpoint Slider
3. Occupancy Bypass

B. All wireless components shall comply with the following communication specifications:
1. Transceiver frequency: 315 MHz (TCM 300C)
2. Data rate/modulation type: 125 kbps/ASK
3. Receiver sensitivity (@ 25°C): -98 dBm (315 MHz)

C. All wireless components shall comply with FCC CFR-47 Part 15 Class B (TCM 300C)

D. All wireless components shall incorporate the EnOcean® interoperable communication protocol and be manufactured by a member of the EnOcean® Alliance.
    1. Wireless components that utilize proprietary communication protocols shall not be acceptable.

E. All wireless sensors shall comply with the following temperature specifications:
    1. Minimum 10-bit linear active thermistor
    2. Minimum sensing range: -8°C – 39°C (18°F – 102°F)
    3. Resolution: +/- 0.05°C (0.09°F)
    4. Accuracy: +/- 0.1°C (0.18°F)

F. Wireless temperature sensors shall be developed, manufactured and supported by the same manufacturer of the Building Automation System (BAS) components and the WEB Based Area Controllers (WBAC) specified herein.

G. Wireless access points, transmitters and receivers shall be designed and appropriate for space mounting.

H. Wireless sensors shall utilize energy harvesting technology providing maintenance-free wireless operation utilizing a solar-powered photovoltaic cell. Batteries shall not be required nor allowed.

I. All wireless components shall carry a documented five (5) year warranty from the manufacturer.

J. Access point/receiver shall be capable of confirming wireless sensor bindings visually (e.g. LEDs) and audibly (e.g., Piezo).

2.17   BACnet GATEWAY (B-GW)

The BACnet interface between the VFD and the BACnet internetwork shall conform with the requirements of the BACnet GATEWAY (B-GW) as identified in Annex B of NISTIR6392. The interface to the internetwork shall be trough 10-Base2 Ethernet, 10BaseY+T Ethernet, 100-BaseT Ethernet, MS/TP or an ARCnet LAN type

2.18   CONTROL ENCLOSURES AND SUB-PANELS

A. Provide pedestal base or wall mounted local control enclosure to house all control components associated with each area, system or mechanical equipment room. The enclosures shall be minimum 16-gauge steel or aluminum bonded on both sides to a plywood core, totally enclosed on all sides and painted with a baked enamel finish. Provide a continuous piano hinged door, keyed locking latch and removable sub-panel. A single key shall be common to all control enclosures. Enclosures shall be the same NEMA classification as all other enclosures located in the same environment, except if location requires additional protection due to potential vandalism or environmental conditions. At a minimum, enclosures located in dry indoor conditions shall conform to NEMA 1 standards. Enclosures located in wet indoor conditions

such as garages or located outdoors shall be fully gasketed and shall conform to NEMA 3R standards, and enclosures located outside for cooling tower condenser water controls shall be constructed of stainless steel.

B. Provide laminated nameplates for all control system components. Nameplates shall be 1/8inch [0.32-cm] thick, black, with white-center core, and shall be minimum 1 x 3-inches [2.5-cm x 7.5-cm], with minimum 1/4-inch high block lettering. Nameplates for devices smaller than 1 x 3-inches [2.5-cm x 7.5-cm] shall be attached to adjacent surface.

2.19   GENERAL FIELD DEVICES

A. Electric Solenoid Pneumatic Valves shall be sized for minimum pressure drop and shall be UL and CSA listed.
    1. High volume EP valves shall be manufactured with high temperature coil.
    2. Standard EP valves shall be Johnson Controls V11 series or approved equal.

B. All control relays shall be UL listed plug-in type with dust cover and with contacts and coils rated for the application.
    1. Control relays of 120-volts or less shall have 8 or 11 pin type plug and Pilot light indication of power-to-coil.
    2. Relays used for in-line control start/stop of line voltage motors and shall have a current rating at least 1.5 times full load amps.
    3. Relays used in lighting circuits shall be GE RRx type.
    4. Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay.

C. Control transformers shall be CSA and US listed. Primary and secondary sides shall be fused in accordance with the NEC or shall be class 2 current limiting type.

D. Panel-mounted electric push button switch pilot light shall be oil tight, transformer type, with screw terminals.

E. Voltage/Current to Pneumatic Transducer shall be non-bleed type 0 to 5-volt or 0 to 10-volt input and output pressure to match spring range of controlled device.

F. Emergency shut-off switches shall be heavy duty, two-position push-pull, maintained contact, illuminated 1-3/8-inches in diameter mushroom style push button switch. Provide hinged easy open protective clear cover to prevent accidental operation of switch.

2.20   INTERCONNECTING WIRE AND CABLE

A. Wire and cable for power, interlock, communications, sensor, and control device wiring shall be as specified in Division 16, with the voltage rating limited to 300V, the National Electric Code, Network Standards, control system manufacturer recommendations, and applicable local codes.

PART 3 - EXECUTION

3.1   GENERAL

A.   Control System component locations are the responsibility of the System Contractor. All control system components shall be installed in locations as required to properly sense the controlled medium and shall be easily accessible for adjustment and service. All components shall be installed in accordance with the component manufacturer's recommendations.

B.   The system shall be installed such that all wiring, communication, analog or digital, input or output shall be capable of sharing single conduit runs without affecting signal performance.

C.   The Contractor shall protect all work and material from damage by his/her work or workers, and shall be liable for all damage thus caused.

D.   The Contractor shall be responsible for his/her work and equipment until finally inspected, tested and accepted. The Contractor shall protect his/her work against theft or damage, and shall carefully store material and equipment received on site that is not immediately installed.

E.   After completion of installation, calibrate and commission all components provided as part of the Control System and demonstrate proper sequence of operation in compliance with Paragraph "Calibration, Commissioning, Demonstration and Acceptance". Equipment not operating correctly shall be field corrected or replaced.

3.2   CONTROL SYSTEM APPLICATION SOFTWARE

A.   At time of acceptance all operating system, third party and Control System Application software shall be at least the latest version available.

B.   Software programs are described to their general intent. It is recognized that Networked System manufacturer's software differ; however, the Application software provided shall incorporate the feature described fully implemented and optimized to provide the sequences described, minimize energy consumption and prolong equipment life.

C.   The following naming convention shall be standards for the naming of BACnet Devices on the BACnet internetwork. The convention for object names viewed by B-OWS shall consist of a string made up of components indicating, as appropriate, the building location, the building, the system, the subsystem, and point function of the object.

D.   When programming the system BACnet addressing rules will be strictly adhered to. All addressing strategies will have to be approved by the Owner's representative prior to terminating any LAN types.

E.   All analog and binary values shall be programmed with appropriate alarms.

F.   Except as specified otherwise, throttling ranges, proportional bands, and cycle differentials be centered on the associated set point.

G.   All set points unless otherwise indicated are adjustable and shall be programmed for all control loops.

H.   Each control loop or interlock for all mechanical system including terminal unit systems shall be programmed with a control loop specific graphical trend to trend all values associated with each specific control loop or system interlock.

I.   Where any sequence or occupancy schedule calls for more that one motorized unit to start simultaneously, the system shall start commands shall be staggered by 60-second (adj.) intervals to minimize inrush current.

J.   Scheduling shall be developed for each mechanical system, unless indicated otherwise the following schedule shall be used:
1.   Occupied: Consult Owner's Technical Representative (COTR) for these times in each particular building.
2.   Unoccupied: All other times and all Federal holidays.

K.   Optimal start/stop programs shall be applied to all regularly scheduled mechanical systems.

L.   Demand limit/load shed programs shall be applied to all mechanical systems greater than 5HP.

M.   Trend log/historical data shall be implemented for every point on the system. Point trends shall be grouped into logically interrelated points for individual mechanical systems. Initial set-up shall be to log values once every 5-minutes.

N.   B-OWS Graphics
1.   All sensors, control devices and set points shall be visible on a B-OWS in graphical form.
2.   All mechanical systems shall have a programmed real time color graphic for primary graphical user interface. The only exception allowed will be unit heaters or finned tube which require a tabular summary for the points associated with these systems.
3.   Individual floor plan graphics will be programmed for each floor or area of the building. All space sensors will be visible on floor plan graphics and system graphic.

O.   The system shall observe the following command priorities (from highest to lowest):
1.   Smoke Control and Life Safety
2.   Manual Operator Command
3.   Energy Management
4.   Automatic Control

3.3   PRINTERS

A.   Set-up and connect printers as required.

B.   Printer will only be accepted after demonstrating that the most complicated graphic prints with amount of RAM in printer.

3.4   SERVICE TOOL

A.   Provide to Owner at time of acceptance. Do not use Service Tools for commissioning of the system.

3.5   LAN TYPES

A.   The control system shall be configured so that any individual network shall not exceed 80-percent of its total design capacity. The system shall have a reserve of 20-percent point capacity.

B.   Where possible all hubs, switches, half and full routers will be from the same manufacturer. Switches will be all "Store and Forward" type and will be installed in accordance with manufacturer specifications.

C.   Inverted networks will not be allowed. Networks with minimum packet sizes smaller than those it connects to will not interconnect networks with larger minimum packet sizes. If three or more networks are interconnected the network with the highest speed and minimum packet size will be utilized to interconnect the slower networks.

D.   Where BACnet/IP LAN type is used with non-IP devices tunneling routers shall be used to maintain complete connectivity. Where BACnet/IP is provided new then the hardware provided for the project will meet Addendum a to ANSI/ASHRAE 135-1995 BACnet/IP.

3.6   VERIFICATION SOFTWARE

A.   Demonstrate exclusive communication utilizing the BACnet Protocol on all segments of the BACnet Internetwork.

3.7   WEB BASED AREA CONTROLLER (B-OWS & B-BC)

A.   The owner shall have full control and ownership of each WBAC without requiring any hardware, software or firmware license or licensing agreement

B.   Each WBAC shall provide integration support for the following physical networks and data links at a minimum at time of delivery without any additional cost to the owner.
    1.   ASHRAE 135-2010 BACnet®
        a.   Point-to-Point (PTP)
        b.   Master Slave/Token Passing (MS/TP)
        c.   Ethernet
        d.   BACnet® IP (B/IP)
    2.   Modbus
        a.   RTU (master or slave)
        b.   TCP (master or slave)
    3.   Simple Mail Transfer Protocol (SMTP)
    4.   Simple Network Management Protocol (SNMP)
    5.   Hyper Text Transfer Protocol (HTTP)

If any additional hardware including communication cards, ports, licenses or gateways are required to support these networks, they must be provided as a part of this contract. If gateways are required, configuration software must be provided as a part of this contract. Any additional hardware must be warranted by the manufacturer as proven by a certificate from the manufacturer for a period of five (5) years at a minimum.

C. The WBAC database and all necessary Graphical User Interface (GUI) resources including images, animations, credentials, etc. are to be stored on the WBAC. Web-enabled applications that require system graphics to be stored on the client machines will not be acceptable.

D. Multiple WBAC devices shall be capable of being installed on the same BACnet® internetwork without any separate server applications, separate network management or additional licensing.
    1. Browser clients shall have the ability to access any WBAC on the internetwork directly.

E. The WBAC shall provide native BACnet® communications directly with all BACnet® devices on the BACnet® internetwork.
    1. The WBAC shall provide BACnet® client and server functionality on all data links without any additional modules or licensing
    2. Applications that require translation of data, gateways, or mapping of any kind shall not be acceptable.
    3. Proprietary protocol communication between WBACs shall not be acceptable.

F. If any WBAC functionality as specified herein requires a server or B-OWS software; an individual PC or laptop workstation must be provided for each WBAC together with all necessary configuration software.

G. Where PCs, laptops or servers must be provided; each shall be warranted by the manufacturer as proven by a certificate from the manufacturer for a period of five (5) years at a minimum.

3.8 BUILDING CONTROLLERS (B-BC)

A. Provide as required to meet performance requirements of the system with a 20-percent increase in connected B-AAC and B-ASC on any individual network.

B. Locate strategically such that B-BC locations are as equally distributed throughout the project as possible.

3.9 ADVANCED APPLICATION CONTROLLER (B-AAC)

A. Provide a dedicated B-AAC for each major mechanical system.

B. All points used for a single mechanical system shall be connected to the same B-AAC. Points used for control loop reset based on outside air, or space/zone temperature, or extremely remote differential pressure sensors on slow acting control loops are exempt from this requirement.

C. Provide minimum of 15-percent spare I/O point capacity for each point type found at each B-AAC. If input points are not universal, 15-percent of each type is required. A minimum of one spare is required for each type of point used. Future use of spare capacity shall require

providing only the field device, field wiring, point database definition and custom software. Additional point modules may be required to implement use of these spare points.

3.10   APPLICATION SPECIFIC CONTROLLERS (B-ASC)

A.   Provide a dedicated B-ASC for each Terminal Unit Mechanical Device on the project. Those include VAV and fan powered terminal units, fan coil units, unit ventilators, unit heaters, individual fans, and finned tube. Terminal units specifically called out in the sequence of operation as "Non-DDC" shall be excluded from this requirement.

B.   All points used for a single Terminal Unit Mechanical Device shall be connected to a dedicated B-ASC. Points used for control loop reset based on outside air, or space/zone temperature, or extremely remote differential pressure sensors on slow acting control loops are exempt from this requirement.

C.   VAV and Fan Powered Terminal Unit Controllers
   1.   Provide Networked System Controllers for each VAV and fan powered terminal unit consisting of a B-ASC, damper actuator, velocity transducer and room temperature sensor.
   2.   The terminal unit manufacturer shall provide a transformer and factory wired to the B-ASC and other control devices such as actuators.
   3.   The terminal unit shall be provided with multi-point averaging type flow sensor factory piped to the velocity transducer.
   4.   Provide a space temperature sensor for each terminal unit that shall be field mounted and wired. Incorporate the plug-in connection for the Service Tool of Portable BOWS.

3.11   BACnet GATEWAY (B-GW)

A.   Implement the complete list on "Native" points from the VFD to the BACnet Internetwork.

3.12   LOCAL I/O

A.   At a minimum the Portable B-OWS shall be able to connect to the BACnet Internetwork within each mechanical equipment space within the project. For manufacturers systems that do not allow direct portable B-OWS connections to B-AAC and B-ASC, this may require that a higher level LAN be routed to each mechanical equipment space with a jack.

3.13   CONTROL ENCLOSURES AND SUB-PANELS

A.   All system components not designed for or required to be field installed shall be mounted in a control enclosure. Those components shall be sub-panel mounted except components that are mounted on the panel face. Provide on/off power switch with over-current protection for control power sources in each local enclosure.

B.   All control enclosures shall be located so visual observation and adjustment can be accomplished while standing flat footed on the floor in a convenient location adjacent to the

equipment served. Install all equipment in readily accessible location as defined by Chapter1 Article 100 Part A of the NEC.

C.   Label all control system components.

D.   A copy of the "As-built" application engineering for the system served shall be laminated in clear plastic; be legible and temporarily suspended within enclosure.

E.   All B-BC, B-AAC and B-ASC shall be mounted in an enclosure unless they are utilized for terminal units.

3.14   WIRELESS TEMP SENSORS & INTERFACE DEVICES

A.   Wireless sensors shall not be installed further than 30m (100 ft) line of sight from the access point/receiver

B.   If the Building Automation System (BAS) and the WEB Based Area Controller (WBAC) Graphical User Interface (GUI) is not capable of intrinsically monitoring, displaying and alarming signal strength and diagnostics then a signal strength monitoring and diagnosis tool must be provided for each wireless sensing receiver, each WBAC or each building – whichever is greater.

C.   If any signal repeaters and/or amplifiers are required by the manufacturer's installation documentation and/or for normal day-to-day operation; a spare repeater and/or amplifier shall be provided for every repeater and/or amplifier installed providing the owner 100% replacement/redundancy.

D.   Where batteries are required by the manufacturer's installation documentation and/or for normal day-to-day operation; one (1) new battery shall be provided for each wireless sensor per year for the first five (5) years. Additionally, this contractor shall replace the battery for each wireless sensor annually at a minimum. Where installed batteries have a documented and certified minimum operational life-cycle of five (5) years; this contract shall test each battery a minimum of two (2) times in the first year and at least twice for each remaining years of the four (4) year warranty at no additional cost to the owner.

E.   Where access points, transmitters and receivers cannot be installed directly in the space, necessary accessories, cabling and/or antennae must be provided for mounting within the space where the wireless sensors are mounted.

F.   If wireless device binding requires configuration tools or a software application; a spare configuration tool or software application must be provided for each wireless sensing receiver, each WBAC or each building – whichever is greater.

G.   If a configuration tool or software is required to confirm sensor binding; a spare configuration tool or software application must be provided for each wireless sensing receiver, each NAC or each building – whichever is greater. Additionally, as a part of this contract, bindings shall have to verified by this contractor a minimum of four (4) times in the first year and at least twice for each remaining year of the five (5) year warranty.

H.   Space mounted wireless components shall not be mounted using metal device boxes, plaster rings or mounting brackets.

3.15   INTERCONNECTING WIRE AND CABLE

A.   General
  1.   It shall be the System Contractor's responsibility to provide all wiring required for a complete Control System.
  2.   Control system wiring and cabling installed for this project shall include but may not be limited to the following:
      a.   Include all power wiring required not indicated on the electrical plans and specifications.
      b.   Power to all actuators and, where required, sensors.
      c.   Provide all wiring and cabling for network communications except for Owner provided LANs/WANs.
      d.   All sensor and control device input and output wiring.
      e.   All interconnecting cabling between and amongst network devices, PCs printers, modems, etc.
      f.   Interlock wiring between devices, and between motor starters.
      g.   All other necessary wiring for fully complete and functional system as specified.
      h.   Field mounting and wiring of control devices applicable to the Control System but specified elsewhere to be field installed by System Contractor including, but not limited to:
          1)   Wiring of unit heater thermostats.
          2)   Cooling tower basin heater, water level and vibration control wiring.
      i.   Smoke control wiring between contacts provided by the fire alarm system and the control system.
  3.   Install piping, wiring/cabling parallel to building lines.
  4.   Maximum allowable voltage for control wiring shall be 120-volts.
  5.   All wiring shall be installed as continuous links, where possible. Any required splices shall be made only within an approved junction box or other approved protective device.
  6.   Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
  7.   This Contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.

B.   Power Wiring and Cabling
  1.   If available, all power wiring for the entire control system shall be from spare circuits on emergency power panels. If available, at a minimum, only those enclosures serving mechanical equipment on emergency power shall be feed from spare circuits on emergency power panels.
  2.   Power wiring for all enclosures and equipment, including branch circuit wiring from circuit breaker panels shall be the responsibility of the System Contractor unless specifically shown on the Plans or Specifications to be provided under Division 16.
  3.   All B-OWS equipment shall be served from isolated ground receptacles via UPS by dedicated branch circuits.
  4.   All other enclosures, sensor and control devices shall be fed from separate circuits in the electrical distribution panels and shall not be served from the typical floor receptacle or lighting circuits.

C.   Network Wiring and Cabling

1. Network installation shall conform to standards for the LAN types and cabling types selected. Specific network rules inherent to the ANSI/ASHRAE Standard 135-1995, BACnet will be followed. Those include but are not limited to:
    a. Only one path can exist from any BACnet device to another.
    b. Each BACnet device connected to an Internetwork LAN must have a unique device instance (0-4,194,303).
    c. Each internetwork LAN must have a unique Network Number (1-65,545).
2. Primary LAN Network wire and cable shall be run in metallic conduit separately from all other wiring.
3. Other LAN Network wire and cabling shall be installed separate from any wiring over 30-volts.
4. All communications shielding shall be grounded as per Networked System manufacturer's recommendations.
5. Contractor may elect to run unshielded cable if noise immunity is ensured by other means. Contractor will be fully responsible for noise immunity and rewire with shielded cable if electrical or RF noise affects performance.

D. Installation
    1. Except in mechanical and electrical spaces where other conduits or piping is exposed, conceal wiring and cabling as much as possible and install as follows:
        a. In Enclosures: Panduit.
        b. Exposed in mechanical spaces above 8-feet: In EMT.
        c. Exposed in mechanical spaces below 8-feet. In EMT.
        d. LANs concealed above accessible ceilings: Cable.
        e. Other concealed above accessible ceilings: Cable.
        f. Above hard ceilings: In EMT.
        g. In hollow core partition walls: Cable.
        h. In block walls: In EMT.
        i. In poured concrete walls and deck: In EMT.
        j. Primary LAN: In EMT.
        k. In Plenums: Rated Cable.
        l. Other network: Maintain noise immunity.
        m. Exposed above 8-feet in service areas: Cable.

3.16   SEQUENCE OF OPERATION - GENERAL

The sequence of operations for any part of this project shall only apply for existing DDC type equipment installed by others in areas indicated on the drawings. This project includes the migration of these controls which are considered operational and are of DDC Bacnet protocol to the new campus wide system. The owner will attempt to provide documentation, including but not limited to controls shop drawings for these areas. If shop drawing information is not provided, the contractor must investigate those systems to define existing sequences and verify all available control points that can be integrated.

Contractor is responsible for maintaining functionality of all existing controls sequences throughout the process of migration onto the new parallel system.

END OF SECTION 230900

mgadson

User Name :

Date & Time : 12/06/2012 2:06 PM

Xerox WorkCentre 7425
Banner Sheet   mgadson

ATTACHMENT D

Plan Holders List

Opening Date: 11 13 12	Closing Date: 12 4 12
Opening Time:	Closing Date: 2pm

Issue Date:

Solicitation Number: GF-2013-B-0067

Caption Replace Energy Management System, Campus Wide Controls, Infrastructure Upgrade

---

Date: 11 26 12

Company Name: B.A.S. INC.

Contact Person: BRAD SKOREPA

Address: 7964-B Conell Ct.
LORTON VA 22079

Phone No: (703) 550-0090

Fax No: (703) 550-0217

Email Address: brads@bas-dc.com

Date: 11-30-2012

Company Name: RSC Electrical & Mechanical

Contact Person: Johnathan Bolden

Address: 6035 Dix St N.E.
Washington. D.C. 20019

Phone No: 202-398-7957   CELL 202.905.3422

Fax No:

Email Address:

Date: 11/26/2012

Company Name: Access Green LLC
Washington DC, 20003

Contact Person: Grot D. Timey

Address: 808, L Street SE
Washington DC. 20003

Phone No: 202 280-2384

Fax No:

Email Address: Grot@accessgreen.com

Date: 11/28/2012

Company Name: RUSH TECHNOLOGIES, INC.

Contact Person: LEWIS KELLEY

Address: 1420 K STREET NW SUITE 500
WASHINGTON DC 20005

Phone No: 202-591-8751

Fax No:

Email Address: KELLEYL@RUSHTECHNOLOGIES.COM

BG BENNETT GROUP

Hamilton Court   Emma L. Pfefferkorn
1230 31st Street, NW
Washington, DC 20007

Tel: 202-625-3330
Fax: 202-337-0475
Cell: 443-994-4035
emmap@bennettgroupdc.com

Email Address:

Date:

Company Name:

Contact Person:

Address:

Phone No:

Fax No:

Email Address: