Addendum Number 1

Project: South Campus, Building 1000, AHU Replacement
Rowan Cabarrus Community College
Concord, North Carolina

Date: August 26, 2021

Owner: Rowan Cabarrus Community College

Designer: CMTA, Inc.

NOTICE TO BIDDERS

This addendum is issued prior to receipt of bids, proposals, and its contents do hereby become a part of the pricing documents for the above referenced project.

All trade contractor bidders are responsible for assuring that their subcontractors and vendors are properly apprised of the contents of this Addendum.

All information contained in this Addendum supersedes and takes precedence over any conflicting information in the original pricing documents.

All bidders must acknowledge receipt of this Addendum in the space provided on the Bid Form for their bid package.

GENERAL INFORMATION

The bid date is September 7, 2021.

CHANGES TO THE SPECIFICATIONS AND BID DOCUMENTS

1. Form of Bid Bond is being issued as part of this Addendum. This form is to be submitted with contractor's Bid.
2. Form of Performance Bond is being issued as part of this Addendum. This form is to be submitted with the Contractor's Bid.
3. Section 23 09 00 – Automatic Temperature Controls and Instrumentation: Replace this section in its entirety with the section being issued as part of this addendum.

ATTACHMENTS

1. Pre-Bid Meeting Agenda
2. Pre-Bid Meeting Minutes
3. Pre-Bid Meeting Sign In Sheet
4. Form of Bid Bond
5. Form of Performance Bond
6. Section 23 09 00 – Automatic Temperature Controls and Instrumentation

End of Addendum 1 Narrative

CMTA
8801 J.M. Keynes Drive Suite 240
Charlotte, NC 28262

Pre-Bid Meeting Agenda
August 24, 2021
RCCC South Campus – 1000 Building HVAC Renovation
CMTA Project No. 221.040

Date: August 24, 2021

1. Opening Comments

2. Introduction of Team Members

   James Currie – CMTA – Principal – jcurrie@cmta.com
   Anthony Cortina – CMTA – Construction Administration – acortina@cmta.com
   Alan Culp – CMTA – Design Engineer - aculp@cmta.com
   Rowan Cabarrus Community College

3. Scope of Work

   Project is for the replacement of AHU-1 in building 1000. This is the primary AHU for the main building. Overall scope includes a multiphase replacement with the intent of maintaining comfort conditions in the building. Phases 1-3 address installation of temporary equipment and preliminary installation of new plenum. Phases 4-7 Include the installation of the permanent equipment as well as pipe, electrical and controls. The contractor shall provide temporary ventilation equipment and screen equipment with mesh fencing around. All work must be tightly coordinated with College. All dates in schedule are based upon a 12 week lead time of equipment. Recent lead time changes have pushed the project to a modular/catalog unit shipped to site and disassembled/reassembled in place to fit the tight access conditions.

4. Bidding Phase Schedule

   - Prebid: August 24, 2021
   - Bid Date: September 7, 2021
   - Contractor Walkthroughs Onsite:
     - Opportunity #1: 08/26/2021 10:00 AM
     - Opportunity #2: 08/27/2021 10:00 AM
   - **Questions from contractor due August 30, by 5:00pm.**
   - **Final Addendum date August 31, by end of day.**

5. General

   - Inspections
   - Construction Administration
   - Addenda
   - Delivery method

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- Construction schedule
- Construction work days / hours
- Contractor laydown / parking / use of facilities
- Crane / equipment staging
- Safety Requirements – Non-Smoking Policy
- Required bid submittals / forms

6. Tour / Questions

From 013200 – Construction Schedule (Pending Delivery)

A. Each contractor's bid pricing is to be based on meeting the Project Milestone Dates below.

DESCRIPTION	DATE(S)
1. "Intent to Award" letter issued in order to facilitate AHU shop drawing submittals to expedite review.	10 days post bid.
2. Anticipated Notice to Proceed.	September 28, 2021
3. Temporary AHU Installation	2 weeks prior to AHU Delivery to Site
4. Demolition of old AHU	1 week prior to AHU Delivery to Site
5. AHU Delivery (Based 12 weeks post NTP)	December 21, 2021
6. AHU Installation and Startup	2 weeks following delivery of AHU to Site
8. Substantial completion.	3 weeks following delivery of AHU to site.

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8801 J.M. Keynes Drive
Suite 240
Charlotte, NC 28262

Pre-Bid Meeting Minutes

Date: August 24, 2021

Meeting Date: August 24, 2021

Project No.: 221.040.00

Project Name: RCCC 1000 Building HVAC Renovation

General Notes:

1. The main emphasis in this project shall be maintaining acceptable air conditioning and air quality inside the building throughout the project.
2. Contractor shall be expected to submit for permit review and obtain a permit prior to beginning of work.
3. Pre-Construction meetings will occur weekly before work starts after the notice to proceed.
4. Delivery method shall be a single prime contract with the mechanical or general contractor as prime.
5. All work in the project shall be coordinated with the college. No loud work shall be permitted during regular hours.
6. RCCC is a non-smoking zone. Interaction with students shall not be permitted.

Questions:

1. Are the temporary air handlers being provided by the college?
    a. Yes, they are.
2. Is the Jace being updated on this project?
    a. No, it is not.
3. Who is the existing controls contractor?
    a. Jace is Distech.
    b. Recent work in building has been performed by United Automation, Platinum, and Brady Trane.

RCCC Building 1000 HVAC Renovations
Sign-In Sheet - August 24, 2021

Name	Company	Email	Phone
Anthony Cortina	CMTA	acortina@cmta.com	704.376.7072
Alan Culp	CMTA	aculp@cmta.com	704.376.7072
Dennis Armstrong	AMS	paularmstrong.amsi@outlook.com	704.455.2677
Jacob Unell	UAC	junell@uaccontrols.com	704.301.5931
Andy Fields	SMS	andy@superiormechserv.com	336.501.1024
Brian Mathews	MMI	brian@mmihvacnc.com	951.284.5542
Sharon Nokovich	Envirotrol	sharon.nokovich@etrol.net	704.412.0588
AJ Oldham	Piedmont Service Group	ajoldham@piedmontsg.com	919.215.0158
Kenneth Long	RCCC	kenneth.long@rccc.edu	704.298.2781
Dennis Davidson	RCCC	dennis.davidson@rccc.edu	704.640.5901

FORM OF BID BOND

KNOW ALL MEN BY THESE PRESENTS THAT _____ _____ as principal, and _____, as surety, who is duly licensed to act as surety in North Carolina, are held and firmly bound unto the Rowan Cabarrus Community College as obligee, in the penal sum of _____ DOLLARS, lawful money of the United States of America, for the payment of which, well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

Signed, sealed and dated this ____ day of _____ 20__

WHEREAS, the said principal is herewith submitting proposal for _____ and the principal desires to file this bid bond in lieu of making the cash deposit as required by G.S. 143-129.

NOW, THEREFORE, THE CONDITION OF THE ABOVE OBLIGATION is such, that if the principal shall be awarded the contract for which the bid is submitted and shall execute the contract and give bond for the faithful performance thereof within ten days after the award of same to the principal, then this obligation shall be null and void; but if the principal fails to so execute such contract and give performance bond as required by G.S. 143-129, the surety shall, upon demand, forthwith pay to the obligee the amount set forth in the first paragraph hereof. Provided further, that the bid may be withdrawn as provided by G.S. 143-129.1

_____(SEAL)

_____(SEAL)

_____(SEAL)

_____(SEAL)

_____(SEAL)

FORM OF PERFORMANCE BOND

Date of Contract: _____

Date of Execution: _____

Name of Principal (Contractor) _____

Name of Surety: _____

Name of Contracting Body: _____

Amount of Bond: _____

Project

KNOW ALL MEN BY THESE PRESENTS, that we, the principal and surety above named, are held and firmly bound unto the above-named contracting body, hereinafter called the contracting body, in the penal sum of the amount stated above for the payment of which sum well and truly to be made, we bind, ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the principal entered into a certain contract with the contracting body, identified as shown above and hereto attached:

NOW, THEREFORE, if the principal shall well and truly perform and fulfill all the undertakings, covenants, terms, conditions and agreements of said contract during the original term of said contract and any extensions thereof that may be granted by the contracting body, with or without notice to the surety, and during the life of any guaranty required under the contract, and shall also well and truly perform and fulfill all the undertakings, covenants, terms, conditions and agreements of any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the surety being hereby waived, then, this obligation to be void; otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above-bounden parties have executed this instrument under their several seals on the date indicated above, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

Executed in _____ counterparts.

Witness:

_____
Contractor: (Trade or Corporate Name)

_____
(Proprietorship or Partnership)

By: _____

Attest: (Corporation)

Title: _____
(Owner, Partner, or Corp. Pres. or Vice Pres. only)

By: _____

Title: _____
(Corp. Sec. or Asst. Sec. only)

(Corporate Seal)

_____
(Surety Company)

Witness:

By: _____

_____

Title: _____
(Attorney in Fact)

Countersigned:

_____

(Surety Corporate Seal)

_____
(N.C. Licensed Resident Agent)

_____

_____
Name and Address-Surety Agency

_____

_____
Surety Company Name and N.C.
Regional or Branch Office Address

SECTION 23 09 00 - AUTOMATIC TEMPERATURE CONTROLS AND INSTRUMENTATION

GENERAL

1.1 OVERVIEW:

A. Furnish all labor, materials, equipment, and service necessary for a complete and operating electric/ electronic temperature control system utilizing Direct Digital Controls as shown on the drawings and as described herein.

B. All labor, material, equipment and software necessary to meet the functional intent of the system as specified herein and as shown on the drawings shall be included. Drawings are diagrammatic only. Equipment and labor not specifically referred to herein or on the plans, that are required to meet the functional intent, shall be provided without additional cost to the Owner.

1.2 DESCRIPTION:

A. All work specified is governed by the Mechanical General Section 23 00 10.

B. This section and the accompanying drawings cover the provisions of all labor, equipment, appliances and materials and performing all operations in connection with the construction and installation of the Direct Digital Controls as specified herein and as shown. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with hardware, software, and interconnecting wire and conduit. Include installation and calibration, supervision, adjustments, and fine-tuning necessary for complete and fully operational system. This work includes, but is not limited to the following:

1. Direct Digital Controllers
2. Interface with Campus Automation System (CAS or BAS) as specified or shown on drawings
3. Control panels *(main and remote)
4. Thermostats
5. Temperature and pressure sensors
6. Control valves and dampers with actuators
7. Life safety shutdowns and interlock wiring
8. Relays, contactors, and transformers
9. Controls Wiring and Installation (24 and 120 volt)
10. Any additional line power (120 volts, AC) wiring required over and above of what is shown to be provided under Division 26 – Electrical.
11. Integration of power meters, emergency generator set, water and gas meters, and automatic transfer switches (as defined in other specification section or drawings)
12. Critical functions and integration of lighting control system specified under Division 26 – Electrical or shown on drawings
13. Each VFD speed control shall be hard wired 4-20 MA signal and shall communicate via BACNET.

1.3 RELATED WORK:

A. See the following related sections
   1. General Requirements: Division 01

2. Related Mechanical Work: Division 23
3. Related Electrical Work: Division 26, Division 27 and Division 28
4. Related Integration Work: Division 26, Division 27 and Division 28

1.4 SYSTEM FEATURES AND ARCHITECTURE:

A. The Owner currently has installed a Niagara/Tridium based campus management system and intends to monitor and control the entire system from a future browser-based Facility Management System (FMS). A Niagara server will be located at the main campus. It is the intent of the College to integrate this project and all future campus direct digital control systems to this Niagara server at some point in the future. The entire FMS system including the products and labor detailed in specifications shall be provided by one of the acceptable control system integrators. Provide the appropriate number of open protocol NAC(s) to integrate DDC system as necessary. Hard drive NAC(s) are not acceptable.

B. As part of this project, the subcontractor shall integrate all points to a central Jace 8000 system to allow future tie-in to a Niagara based campus system. A separate Tridium Integrator shall carry all points up to the Web-Server for final graphical interface. **Contractor to carry $4,000 Allowance in bid for cost of Tridium integration by Owner's third party company.**

C. The FMS shall be capable of total integration of the facility infrastructure systems with browser access to all system data either locally over a secure Intranet within the campus and by remote access by a standard Web Browser over the Internet. The scope shall include HVAC control and tuning, electrical, gas and water metering, energy management, alarm monitoring, and all trending, reporting and maintenance management functions related to normal building operations all as indicated on the drawings or elsewhere in this specification.

D. Graphical Updates – NAC(s) must provide data change updates within 5 seconds of change.

E. Power Fail Protection - All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the ASC or FPC.

F. The entire Facility Management System (FMS) shall be comprised of a network of interoperable, stand-alone digital controllers capable of communicating via an open protocol communication network to a future Niagara based the workstation (server). The communication from a building to the workstation shall be standardized for maintenance and trouble-shooting considerations and shall be via a Network Area Controller (NAC).

G. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate both the ANSI/ASHRAE Standard 135-2010 BACnet, LonWorks and Modbus RTU technology communication protocols in one open, interoperable system. TCP/IP can not be used.

H. The Niagara software system shall employ component-oriented technology (COT) for representation of all data and control devices within the system. In addition, adherence to industry standards including ANSI / ASHRAE™ Standard 135-2010 BACnet, LonWorks and Modbus RTU to assure interoperability between all system components is required. The system supplier must provide a PICS document showing the installed systems compliance level. Minimum compliance is Level 3.

I. The supplied system must incorporate the ability to access all data using Java enabled browsers without requiring proprietary operator interface and configuration programs. An Open DataBase Connectivity (ODBC) or Structured Query Language (SQL) compliant server

database is required for all system database parameter storage. This data shall reside on the existing workstation for all database access.

J. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.

K. The Campus LAN is an existing fiber optic, 10/100 MegabitsThe new FMS shall utilize the network infrastructure to support Modbus, LonWorks, BACnet, Java, XML, and HTTP for mN4imum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Area Controllers (NACs), and user workstations. The Ethernet communication protocols must be fully compatible with the Campus Wide Ethernet communication specifications. The Systems Integrator must coordinate with the Campus Telecommunications Group to attain written approval from the Group to operate on the Campus Wide Network.

L. The College's access to the FMS shall be via a standard Internet browser from a remote location, from a standard browser within the campus network or from a local workstation by direct connection to the Campus LAN. The Control Systems Integrator must provide a connection from every Network Area Controller (NAC) to the campus network to enable this access

M. The Systems Integrator shall include installation of conduit and thin-wire Ethernet cable from the building's NAC to the closest telecommunications uniform wiring closet in the building. The BAS subcontractor shall provide for four Ethernet connections to be installed and made available at a hub within the closest wiring closet. Any material or hardware required for the Ethernet connection at the NAC shall be the responsibility of the Systems Integrator.

N. Provide integration of the Variable Speed Drives and Variable Speed Pumping Systems via a Modbus RTU, LonWorks or BACnet interface provided by the equipment manufacturer. Provide graphics at the FMS to visualize the appropriate information from these systems at the FMS.

O. The Variable Speed Drive systems manufacturer shall provide a Modbus, BACnet or LonWorks Interface to the NAC.

P. The Division 26 meters, electrical equipment and systems specified to be monitored and integrated under this section into the FMS will be furnished with dry contacts or interface to NAC. Required NAC's shall be provided under this section along with all required wiring between dry contactors, or interface cards and NAC.

1.5 SYSTEM PROGRAMMING:

A. The system supplied by the systems integrator must be programmed using a palette of control, application, and graphical components provided to enable the creation of all applications and user interface screens. Applications are to be created by selecting the desired control components from the palette, dragging or pasting them on the screen, and "wiring" them together using a built in graphical connection tool. All completed applications must be provided to the College for future use by any future Systems Integrators. Graphical User screens are created in the same fashion. Data for the user screens is obtained by graphically linking the graphical components to the application components to provide "real-time" data updates. Any real-time data value or component property may be connected to display its current value on a user screen. Systems requiring separate software tools or processes to create applications and user interface screens shall not be acceptable.

B. Programming Methods:
   1. Provide the capability to copy components from the supplied palette, or from a user-defined palette to the user's application. Components shall be linked by a graphical linking scheme by dragging a link from one component to another. Component links will support one-to-one, many-to-one, or one-to-many relationships. Linked components shall maintain their connections to other components regardless of where they are positioned on the page and shall show link identification for links to components on other pages for easy identification. Links will vary in color depending on the type of link; i.e., internal, external, hardware, etc.
   2. Configuration of each component will be done through the component's property sheet using fill-in the blank fields, list boxes, and selection buttons. Requiring the use of custom programming, scripting language, or a manufacturer-specific procedural language for every component configuration will not be accepted.
   3. The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.
   4. All programming shall be done in real-time. Systems requiring the uploading, editing, and downloading of database component s shall not be allowed.
   5. The system shall support component duplication within a customer's database. An application, once configured, can be copied and pasted for easy re-use and duplication. All links, other than to the hardware, shall be maintained during duplication.

1.6 GRAPHICAL USER INTERFACE SOFTWARE

A. The College intends to, at some point in the future, license Niagara ^{N4} Supervisor for the development of their FMS logic and graphics and will integrate this system to it. As such, all companies shall be capable of communicating to this.

B. This user interface shall allow, with proper password access, full interaction with the system including, but not limited to, viewing and modifying data, database administration, configuration of communications parameters, password and security administration, programming and configuration of components, receipt, routing and acknowledgement of alarms, and development of graphic screens. The NAC system provided shall be fully capable of standalone interface with graphics.

C. The user interface shall employ browser-like functionality for ease of navigation. It shall include a tree view for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation techniques similar to those in a commercially available Web Browser. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected component identification.

D. Graphic screens shall be developed using any drawing package capable of generating a .GIF, .BMP, or .JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of, a graphic background, the user interface shall support the use of scanned pictures.

E. Graphics developed for the user interface shall be capable of being used by a standard Web Browser client, without the need to develop additional graphic screens specifically for the Web Browser.

F. Graphic screens shall have the capability to be overlaid with text, real-time values, command and adjust, animation, color spectrum, logs, graphs, HTML document links, and schedule graphic components, as well as links to other graphic screens.

G. Modifying common application components, such as schedules, calendars, and set points shall be accomplished in a graphical manner.

H. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.

I. Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.

J. Commands issued to start and stop binary components shall be done by right-clicking the selected component and selecting the appropriate command from the pop-up menu. No entry of text shall be required.

K. Adjustments to analog components, such as set points, shall be done by right-clicking the selected component and inserting text or by using a graphical slider to adjust the value.

1.7 FMS GRAPHICS

A. The successful Systems Integrator (SI) will be responsible for building graphics templates. The graphics template shall be coordinated with College staff and shall be created as standards for future Niagara systems The Integrator will be responsible for creating web pages within the supplied system with new information, links, etc. as buildings or systems are added. It is the SI's responsibility to review and record the Owner's FMS preferences for future integration with respect to web page style and palette of components.

B. This template shall not include all of the various scenarios or equipment that may be present on every project rather it provides a general overview of how each system shall look and how the data shall be displayed. A pre-engineering meeting shall be arranged between the systems integrator and the owner to discuss each project specifically before engineering and graphics developments begin. The following are mandatory requirements for each site.

C. Each graphics screen shall include the pre-approved College look and links across the top per the graphics template. Approval of all base graphics shall e the responsibility of this winning bidder within 120 days of notice to proceed.

D. The systems integrator is responsible for providing a link to the control drawings (.dwf format) for each associated piece of equipment. A button for control drawings shall be located on the Owner's frame navigation bar. On integration projects, where existing controls exist, the Owner shall be responsible for providing the control drawings (.dwf format) to the systems integrator. On new projects the systems integrator shall be responsible for providing the as-built control drawings. Note the system shall be engineered in such a way that the control drawings will be accessible with a standard browser-utilizing WHIP! or Volo View Express (Auto-Cad will not be required).

E. The systems integrator is responsible for providing a direct link from the equipment screen to the operating and maintenance manuals and approved shop drawing for each major piece of equipment (Chiller, Boiler, Pumps, VFDs). This link shall be located on the graphic for each piece of equipment, per the template. The mechanical contractor will provide the O&M data (.pdf format) and the Systems Integrator shall install it on the Owner's FMS network server for use.

F. All graphics shall have a resolution of 1280 by 1024 pixels. (Verify with owner.)

G. All graphics shall be designed for viewing using Internet Explorer 8.0(or whatever may be the College's standard at the time of deployment (not at time of submittals))

H. All graphics may be standard from the Owner's FMS graphics palette.

I. Any custom graphics that do not originate from the Owner's FMS graphics palette will require Owner's approval prior to deployment. The Owner approved graphics will be installed in the Owner's FMS graphics palette located on the hard drive of the Owner's server by the systems integrator for future College use as needed.

J. Any graphics work developed and provided by the Systems Integrator for any Owner project shall become the property of the Owner and shall be available for use by any other Systems Integrator. (The Owner wishes to reuse and standardize on graphics and ideas that work well.)

K. The systems integrator shall submit to Owner (2) copies of a graphical proposal within 120 days of Notice to Proceed. The graphical proposal shall include written and graphical representation of proposed Web- based, FMS navigational user interface including screen shots to be used for the actual proposed project. Software graphical proposals viewable with a browser, delivered on compact disc or available via the Internet are acceptable.

1.8 WEB BROWSER CLIENTS

A. The system shall be capable of supporting an unlimited number of clients using a standard Web Browser such as Internet Explorer™, Safari™ or Netscape Navigator™. Systems requiring additional software resident on the client machine or manufacture-specific browsers shall not be acceptable.

B. The Web Browser client shall support at a minimum, the following functions:

C. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication techniques to prevent unauthorized access shall be implemented.

D. Graphical screens developed for the GUI shall be the same screens used for the Web Browser client. Storage of the graphical screens shall be in the system, without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.

E. Depending on user access privileges, the user shall be able to view data, modify and command components such as start/stop, and adjust set points. In addition, users can be provided with the ability to view logs and view and acknowledge alarms.

F. The system shall provide the capability to specify a user's (as determined by the log-on user identification) home page. The capability to limit the user to just their home page shall be provided. From the home page, links to other views, or pages in the system shall be possible.

G. Graphic screens on the Web Browser client shall support hypertext links to other Web pages on other Internet or Intranet sites.

1.9 COMPONENT LIBRARIES

A. A standard palette of components shall be included by Owner for development and setup of application logic, user interface displays, system services, and communication networks. The successful Systems Integrator may be required to develop new components to meet the intent of this specification. Any new components created must be stored in the Owner's component palette for future use. It is the responsibility of the Systems Integrator to verify what components exist in the Owner's palette prior to bidding this project.

B. The components in this palette shall be capable of being copied and pasted into the user's database and shall be organized according to their function. In addition, the user shall have the capability to group components created in their application and store the new instances of these components in a user-defined palette.

C. The successful systems integrator shall update the Owner's standard palette specified here to provide new or updated components and applications as they are developed by the software manufacturer.

D. The Systems Integrator shall be responsible for timely verification that the Owner's palette includes services and components to support the particular Modbus, LonWorks and BACnet devices that the SI proposes to bid and install. If the components do not exist or will not exist in time to install this particular project, the SI must utilize a component that does exist.

1.10 LOAD CONTROL PROGRAMS

A. General: Support inch-pounds and S.I. metric units of measurement.

B. Automatic Time Scheduling:
1. Self-contained programs for automatic start/stop.
2. Support up to seven (7) normal day schedules, seven (7) "special day" schedules and two (2) temporary day schedules.
3. Special days schedule shall support up to 30 unique date/duration combinations.
4. Any number of loads assigned to any time program; each load can have individual time program.
5. Each load assigned up to 8 time schedules per day with 1 minute resolution.
6. Time schedule operations may be:
7. Start
8. Optimized Start
9. Stop
10. Optimized Stop
11. Minimum of 30 holiday periods up to 365 days in length may be specified for the year.
12. Controller shall be able to account for daylight savings time.

C. Start/Stop Time Optimization:
1. Perform optimized start/stop as function of outside conditions, inside conditions, or both.
2. Adaptive and self-tuning, adjusting to changing conditions unattended. Set Inactive.
3. For each point under control, establish and modify:
4. Occupancy period.

D. Calculated Points: Define calculations and totalization computed from monitored points (analog/digital points), constants, or other calculated points.

E. Employ arithmetic, algebraic, Boolean, and special function operations.

F. Treat calculated values like any other analog value, use for any function that a "hard wired point" might be used.

G. Event Initiated Programming: Event may be initiated by any data point, causing series of controls in a sequence.
1. Define time interval between each control action.
2. Output may be analog value.
3. Provide for "skip" logic.
4. Verify completion of each action.

H. Direct Digital Control: Each control unit shall provide Direct Digital Control software so that the operator may customize control strategies and sequences of operation by defining the appropriate control loop algorithms and choosing the optimum loop parameters.

I. Control loops: Defined using "modules" that are analogous to standard control devices.

J. Output: Paired or individual digital outputs for pulse-width modulation, and analog outputs, as required.

K. Firmware:
1. PID with analog or pulse-width modulation output.
2. Floating control with pulse-width modulated outputs.
3. Two-position control.
4. Primary and secondary reset schedule selector.
5. Hi/Lo signal selector.
6. Digital output.
7. Time delay function with delay before break, delay before make and interval time capabilities.
8. Direct Digital Control loops: Downloaded upon creation or on operator request. On sensor failure, program shall execute user defined failsafe output.
9. Display: LCD type.

L. Fine Tuning Direct Digital Control PID or floating loops:
1. Display information:
2. Control loop being tuned
3. Input (process) variable
4. Output (control) variable
5. Setpoint of loop
6. Proportional band
7. Integral (reset) Interval
8. Derivative (rate) Interval
9. Display format: LCD type.

1.11 HVAC CONTROL PROGRAMS

A. General: Identify each HVAC Control system.

B. Optimal Run Time:
1. Control start-up and shutdown times of HVAC equipment for cooling.
2. Base on occupancy schedules, outside air temperature, seasonal requirements.

C. Operator commands:
1. Define term schedule
2. Lock/unlock program.

D. Control Summary:
   1. HVAC Control system begin/end status.
   2. Optimal run time lock/unlock control status.
   3. Cooling mode status.
   4. Optimal run time schedule.
   5. Start/Stop times.
   6. Optimal run time system normal start times.
   7. Occupancy and vacancy times.
   8. Optimal run time system cooling mode parameters.

E. HVAC point summary:
   1. Control system identifier and status.
   2. Point ID and status.
   3. Outside air temperature point ID and status.
   4. Period start.

1.12 PROGRAMMING APPLICATION FEATURES

A. Alarm Messages:
   1. Output assigned alarm on LCD display; low/high and status alarms.

B. Weekly Scheduling:
   1. Automatically initiate equipment or system commands, based on preselected time schedule for points specified.
   2. Provide program times for each day of week, per point.
   3. Automatically generate alarm output for points not responding to command.
   4. Provide for holidays.

C. Operator commands:
   1. System logs and summaries.
   2. Start/stop point.
   3. Add, delete, or modify analog limits and differentials.
   4. Adjust point operation position.
   5. Change point operational mode.
   6. Open or close point.
   7. Begin or end point totalization.
   8. Modify totalization values and limits.
   9. Access or secure point.
   10. Begin or end HVAC or load control system.
   11. Modify load parameter.
   12. Modify demand limiting and duty cycle targets.

D. Output summary: Listing of programmed function points, associated program times, and respective day of week programmed points by software groups or time of day.

E. Interlocking:
   1. Permit events to occur, based on changing condition of one or more associated master points.
   2. Binary contact, high/low limit of analog point or computed point shall be capable of being utilized as master. Same master may monitor or command multiple slaves.

F. Operator commands:
   1. Define single master/multiple master interlock process.
   2. Define logic interlock process.

3. Lock/unlock program.
4. Enable/disable interlock process.

1.13 UTILITY MONITORING SOFTWARE INTEGRATION

A. The College will use the proposed FMS as its energy profiling/analysis software tool. The SI is responsible for all trend energy profiling/analysis software programming associated with this project.

B. System shall provide browser access to unit controllers and associated setpoints and tuning parameters. The Building Automation System shall be comprised of BACnet or LonMark/LonTalk controllers. Should the NAC network connection be interrupted, the DDC components shall continue to provide local control using the last known state of any global variables (OA temperature, Demand Value, Price of Energy, etc.)

C. It shall be the DDC contractor's responsibility to effectively design and program standalone control while coordinating the required DDC integration and communication to the NAC.

1.14 SOFTWARE LICENSE AGREEMENT

A. The Owner will be provided a software and firmware licensing agreement for the FMS software. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software. System Providers of the College's direct digital control systems must:

B. Be certified in the use, application and service of proposed software with 10-years experience and shall provide documentation from the manufacturer's training center as such. However, certification in the above does not automatically qualify an integrator to bid on proposed College projects. Only approved integrators listed in this specification are eligible to participate in the project.

C. Agree to use on any College project any application standards, html pages, graphics templates, etc. developed by or for the College for the purpose of digital control, scheduling, alarming, graphics, etc.

D. Agree that the application standards, html pages, graphics templates, etc. developed by or for the College are the property of the College (subject to the manufacturer's license agreement) and shall not be reproduced, etc. for use on any other customer, project, etc. without the expressed written permission of the College's facilities staff.

E. Agree that certification on the manufacturer's software does not guarantee continued participation in the College's FMS projects.

F. Agree to provide College's staff with the highest level of administrative password.

G. Agree that College staff and other Systems Integrators can use the onsite College software tools to modify NACs, license files, passwords, provide software maintenance, etc after warranty period expires.

1.15 ACCEPTABLE CONTROL SYSTEM INTEGRATORS/CONTROL SYSTEM MANUFACTURERS

A. Environmental Control and Mechanical (Honeywell BACNET)

B. Platinum Energy (Honeywell BACNET)

C. United Automation (Honeywell BACNET)

D. Application engineers working on this project shall be required to be certified in Niagara and certified by the DDC controls manufacturer to perform all engineering services. The Systems shall be installed by trained mechanics with 10-years experience and either in direct employ of Systems Integrator or by subcontractors who are under direct supervision of Systems Integrator's field representative. Submit resumes of application engineers and field supervisors to be assigned to this project within 30 days after contract award. Application engineers and supervisors shall have 5-years prior experience with at least 5 similar types, scale and complexity of projects. Engineer reserves right to exclude any engineers or field supervisors whose past experience is not sufficient to meet the needs of the project. Should there be doubt of acceptance by the Engineer, with respect to experience, the subcontractor shall submit proposed team resumes prior to Bid.

E. Application Engineers labor shall include, but is not limited to:
1. Engineering services to size all valve and dampers based on design criteria specified.
2. Engineering services to produce all submittals requested and working construction drawings and record drawings as specified here within.
3. Engineering services for all software programming specified except for NAC.
4. Project management services with single point contact to coordinate all construction related activities.
5. Field mechanics for installation of control wiring and related control devices.
6. Field technicians to start-up, calibrate, adjust and tune all control loops per specifications.
7. Field technicians to perform system checkout, testing and complete required reports.
8. Full time field supervisor during controls installation and start-up.
9. Field technicians to assist testing and balancing contractor in adjusting controls and determining set points related to his scope of work.
10. Field representatives and/or classroom instructors to provide Owner training as specified.
11. Complete installation of all control devices, except as noted, wiring terminations at panel locations to accomplish control sequences specified in this project manual or on drawings.
12. Responsible for any additional instrumentation described in any point schedules found in this contract document, which may not be directly related to any specified control sequences.

F. The certified Tridium systems integrator is responsible for providing interface of NAC(s) to the control system and total integration of the facility infrastructure systems with browser access to all system data both locally and over a secure Intranet within the campus, and by remote access by a standard Web Browser over the Internet. The scope shall include HVAC control and tuning, electrical, gas and water metering, energy management, alarm monitoring, and all trending, reporting and maintenance management functions related to normal building operations all as indicated on the drawings or elsewhere in this specification.

1.16 SUBMITTALS:

A. Submittals shall be coordinated through the control systems integrator provided as a part of this controls contract. This contractor shall incorporate DDC submittals and all other associated

Ethernet or serial communication devices not provided by this contractor into the electronic submittals. This contractor shall be responsible for verification that the sequence of operations is inclusive of all requirements and properly coordinates the division of work. Submittal requirements include:

B. Product Data:
   1. Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

C. Shop Drawings:
   1. Submit manufacturer's printed product data sheets for all control devices and all materials listed in bill of material in control drawings. Organize sheets in order of model number, alphabetically, then numerically. If more than 20 product data sheets are submitted, provide front index and tabs for logical groups of devices.
   2. Submit control drawings with a front sheet index for projects with more than 5 control drawing sheets.
   3. Overall system/network architecture drawings: Provide schematic drawing showing relationship of each controller, control panel or other network devices relative to each other, label room location of each device, number and indicate model number of each device, indicate network types and general cabling routing.
   4. Schematic Control Drawings: Include graphic representation of systems with all major inline components to properly locate all control devices. Identify controlled devices with their software designation on drawings, including unique valve and damper tag numbers.
   5. Control Logic Drawings: Include graphical programming logic drawings with all controllers and associated parameters, logic, inputs, outputs and control loops.
   6. Control Points List: As part of Schematic Control Drawings (see #4 above), include tabular representation of all points associated with a given DDC controller (hardware and software points) and provide the following information about each point:
      a. Is point exposed on graphic page?
      b. Is point commandable/adjustable by College from graphic?
      c. Is point scheduled?
      d. Is point trended? How many samples ? Is trend archived to server? Is trend archived to Vykon Energy Suite (VES)?
      e. Is point alarmed? What are high/low alarm limits?
      f. What are point units (i.e. DEG F, etc)?
   7. Detailed wiring and piping diagrams showing point to point hookup details of all transducers, relays, outputs, inputs and subsystem components. Label all lines and control wires with field ID numbers/colors.
   8. Bill of material identifying actual product model number used for each control device for each schematic control drawing.
   9. Sequence of Operation: Verbally describe each control sequence indicating method of control. Identify sensors, controllers and actuators used with references to tag number of the controlled device. Include set points and offsets of each control loop.
   10. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
   11. Schedule of dampers and valves including size, leakage, and flow characteristics.
   12. Details of control panel faces, including controls, instruments and labeling.
   13. Trunk cable schematic showing direct digital control unit locations and trunk data conductors.
   14. Listing of connected data points, indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
   15. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.

16. A graphics package displayed on a flat screen of all items of mechanical equipment and systems. All sensors, location description, operating and reset control points shall be indicated. Keyboard access shall be provided.

1.17 COMPLETION CHECK LIST

A. Submit with shop drawings a detailed completion checklist including written procedures for adjusting and calibrating each type of controller, instrument and sensor. Checklist shall also include step-by-step written procedure to functionally test each type of control loop or logic sequence. The Engineer reserves right to request modifications to any procedure which is incomplete or not adequate to prove system performance.

B. Check list to include references to the following additional requirements:
   1. Instruments and sensors shall be calibrated by comparison to known device, which is traceable to National Institute of Standards and Testing. Field calibration is not required if device readings can be fine tuned using software offset in the building automation system. Field calibration not required if device has manufacturer factory calibration sheet.
   2. Check each point for calibration, connection to correct control loop and that limit and alarm values are properly set.
   3. Transducers and other output devices shall be properly zeroed, and calibrated at both minimum and mN4imum output. Control contractor shall coordinate with testing, adjusting and balancing contractor to determine flows at minimum and mN4imum conditions for each device.
   4. Tune control loops to maintain controlled process variable at set point throughout the year without cycling or requiring modifications to control system. Auto tuning is not acceptable.
   5. Performance tests of all analog control loops shall be performed by changing set point and verify that sequence can come into stable equilibrium within reasonable time period which is appropriate for that sequence. Use load changes for all pressure and flow control loops.
   6. System performance shall be documented via 48 hour printed trend log report of actual output performance versus set point.
   7. Perform tests of discrete control loops by adjusting set point and verifying sequence action.
   8. All alarms, including network failures, to be tested for each controller and device connected to network, and ensure that alarms are properly acknowledged at control panel.

1.18 EXTENDED SERVICED AGREEMENT:

A. Control manufacturer shall, upon completion of warranty period, make available to Owner annual service agreement covering all labor and material required to effectively maintain control system after warranty period. Owner reserves rights to accept or reject any such offers and to cancel ongoing agreement with 30 day written notice.

1.19 SUBMITTALS FOR INFORMATION

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

1.20 SUBMITTALS AT PROJECT CLOSEOUT

A. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.
   1. Revise shop drawings to reflect actual installation and operating sequences.
   2. Include data specified in "Submittals" in final "Record Documents" form.

B. Provide 2 hard copies and 2 electronic copies (pdf format) of O & M manuals. Provide drawings in ACAD format. Provide copy of final controls and schematics posted in penthouse behind plexiglass frame on wall.

C. Operation and Maintenance Data:
   1. Include interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.
   2. Include step-by-step procedures indexed for each operator function.
   3. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
   4. Calibration records and list of set points.
   5. Maintenance instructions and lists of spare parts for each type of control device.

1.21 QUALITY ASSURANCE

A. The Manufacturer of the interoperable controllers shall provide documentation supporting compliance with ISO-9001 (Model for Quality Assurance in Design/Development, Production, Installation and Servicing). Product literature provided by the interoperable controller manufacturer shall contain the ISO-9001 Certification Mark from the applicable registrar.

1.22 WARRANTY AND SERVICE:

A. The HVAC contractor shall warrant the system to be free from defects in material and workmanship for a period of two (2) years from the date of completion and acceptance of the work by the owner. Any defects shall be repaired or replaced, including materials and labor at no cost to the owner.

B. The controls contractor shall provide two (2) years of maintenance service for the controls system to begin at the time of substantial completion. Service shall include inspection and adjustment of all operating controls and components. The service shall be performed every 6 months and documentation of service shall be provided to Facilities Operations.

1.23 EXTRA MATERIALS:

A. Furnish the following extra materials to Facilities Operations at completion:
   1. 2 water temperature sensors
   2. 1 space humidity type sensor
   3. 1 dP sensor (used in the water system)
   4. 2 zone sensors

1.24 COORDINATION:

A. This contractor shall coordinate with the other contractors as required to produce workable, controllable systems. Generally, all control and monitoring equipment shall be furnished and installed by this contractor unless otherwise noted. The controls contractor may subcontract the wiring of direct digital controls system. Specific examples of coordination and cooperation include:

B. Smoke detection system shall be furnished and wired to the fire alarm system by the electrical subcontractor.

C. Duct mounted smoke detectors shall be installed by the mechanical subcontractor. The electrical contractor shall provide contacts for air handler shut down at the fire alarm panel. This DDC contractor shall wire from these contacts and incorporate into the air handler controls.

1.25 APPLICATION SOFTWARE DOCUMENTATION:

A. Contractor shall provide a copy of all BACnet or Lonworks .xif files and system databases on Compact disk.

PRODUCTS:

1.26 MATERIALS:

A. All materials and equipment used shall be standard components and regularly manufactured for this application. All systems and components shall have been thoroughly tested and proven in actual use.

B. Bidders shall submit statement of compliance with the bid package, for review by the Owner's authorized representatives, a written line by line statement of compliance to the specifications related to the automatic control and building automation system.

1.27 EQUIPMENT:

A. NETWORK AREA CONTROLLER (NAC):
1. The NAC shall provide the interface between the Campus LAN and the field controllers. NACs shall be based on Niagara ^{N4} software and shall be provided with the OBIX driver.
2. The NAC shall provide multiple user access to the system and support for ODBC or SQL. An embedded database resident on the NAC must be an ODBC-compliant database or must provide an ODBC data access or must provide an ODBC data access mechanism to read and write data stored within it. A minimum offering would be the documentation of database schemes to allow users to read/write data into other applications using appropriate ODBC syntN4.
3. Provide an uninterruptible power supply for each NAC or central control panel.
4. The NAC must provide all tools for Java enabled Web browser access via the Intranet/Internet

B. Event Alarm Notification and Actions:
1. The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.

Object alarm properties shall conform to the alarm properties as defined in the BACnet specification.

2. The NAC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up, telephone connection, or wide-area network.
3. Alarms shall have the capability to be routed to e-mail messages and paging services that support receipt of e-mail messages.
4. The NAC shall provide a timed (scheduled) routing of alarms by component, group or code.
5. The NAC shall include a master clock service for its subsystems and provide time synchronization for all distributed controllers. The NAC shall also be programmed to accept time synchronization messages from trusted precision Atomic Internet Clock sites to update its master clock time.

C. Data Collection and Storage:
1. The NAC shall be provided with the ability to collect data for any property of any component and store this data for future use.

D. The data collection shall be performed by a log component that shall have, at a minimum, the following configurable properties:
1. Designating the log as interval or deviation.
2. For interval logs, the component shall be configured for time of day, day of week and the sample collection interval.
3. For deviation logs, the component shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the component.
4. For all logs, provide the ability to set the mN4imum number of data stores and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.

E. PC BASED NAC'S ARE NOT ACCEPTABLE. NAC(s) must provide data change updates within 5 seconds of change.

1.28 INTEROPERABLE LONMARK CONTROLLER (ILC):

A. Controls shall be microprocessor based Interoperable LONMARK Controllers (ILC), bearing the applicable LONMARK interoperability logo on each product delivered. ILCs shall be provided. ILCs shall be based on the Echelon Neuron 3150 microprocessor working from software program memory, which is physically located in the ILC. The application control program shall be resident within the same enclosure as the input/output circuitry, which translates the sensor signals.

B. To simplify controls and mechanical service troubleshooting, the ILC shall be mounted directly in the control compartment of the unitary system. The ILC shall be provided with a sheet metal or polymeric enclosure that is constructed of material allowing for the direct mounting within the primary air stream, as defined by UL-465. The direct mounting shall allow all controls maintenance and troubleshooting to be made while at the unitary equipment.

C. The ILCs shall communicate with the NAC at a baud rate of not less than 78.8K baud. The ILC shall provide LED indication of communication and controller performance to the technician, without cover removal.

D. The ILCs shall be fully supported and communicate with the FMS Graphical User Interface (GUI).

E. The ILC Sensor shall connect directly to the ILC and shall not utilize any of the I/O points of the controller. The ILC Sensor shall provide a two-wire connection to the controller that is polarity and wire type insensitive. The connected controller, and all other devices on the LON bus shall be accessible by the POT.

F. All input/output signals shall be directly hardwired to the ILC. For all non-VAV terminal applications, a minimum of two input points of the ILC shall employ a universal configuration that allows for flexibility in application ranging from dry contact, resistive, to voltage/current sourced inputs. If universal points are not available, a minimum of two input points (each) of the dry contact, resistive and analog voltage/current types must be provided on every controller. The outputs of the ILC shall be of the relay and universal analog form. All digital outputs shall be relay type. ILC devices utilizing non-relay outputs shall provide an interface relay for all points. All analog outputs shall be programmable for their start points and span to accommodate the control devices. Configuration of all I/O points shall be accomplished without physical hardware jumpers, switches or settings. Troubleshooting of input/output signals shall be easily executed with the POT or a volt-ohm meter (VOM). All I/O points shall be utilized by the local ILC or shall be available as I/O points for other controllers throughout the network.

G. All ILCs shall be fully application programmable and shall at all times maintain their LONMARK certification. Controllers offering application selection only (non-programmable), require a 10% spare point capacity to be provided for all applications. All control sequences within or programmed into the ILC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained. The ILC shall be provided with the ability to interface with the POT. The interface port shall be provided at the wall sensor or within the unitary equipment, as specified on the plans. The interface port shall allow the POT to have full functionality as described in POT section of this specification.

1.29 INTEROPERABLE DIGITAL CONTROLLER (IDC):

A. Controls shall be microprocessor based Interoperable LonWorks Digital Controllers (IDC), providing interoperability with all LONMARK and LonWorks devices. IDCs shall be provided for any equipment applications as required, as shown on the drawings. IDCs shall be based on the Echelon Neuron Hosted microprocessor architecture, working from software program memory that is physically located in the IDC. The application control program shall be resident within the same enclosure as the input/output circuitry, which translates the sensor signals.

B. All IDCs shall be fully application programmable utilizing graphical components. All control sequences programmed into the IDC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained. Systems that only allow selection of sequences from a palette or table are not acceptable.

C. The IDC shall be provided with the ability to interface with the POT. The interface port shall allow the POT to have full functionality as described in POT section of this specification. Through the interface port all IDC devices on the LON bus shall be accessible by the POT.

D. The IDCs shall communicate with the NAC at a baud rate of not less than 78.8K baud. The IDC shall have as a minimum ambient operating temperature range of 32 to 122 degrees Fahrenheit.

E. The IDC shall be fully supported by the Graphical User Interface (GUI).

F. All input/output signals shall be directly hardwired to the IDC. All controllers shall employ a universal input configuration that allows for flexibility in application ranging from dry contact, resistive and voltage/current-source inputs. If universal points are not available, a minimum of

one spare input point (each) of the dry contact, resistive and analog voltage/current types must be provided for each input point utilized.

G. IDC devices shall provide digital and analog output types and quantities consistent with the requirements of the application requirements. Troubleshooting of input/output signals shall be easily executed with the POT or a volt-ohm meter (VOM). All I/O points shall be utilized by the local ILC or shall be available as I/O points for other controllers throughout the network.

1.30 INTEROPERABLE BACNET CONTROLLER (IBACC)

A. Controls shall be microprocessor based Interoperable BACnet Controllers (IBACC) in accordance with the ANSI/ASHRAE Standard 135-2010. The application control program shall be resident within the same enclosure as the input/output circuitry, which translates the sensor signals. The system supplier must provide a PICS document showing the installed systems compliance level to the ANSI/ASHRAE Standard 135-2010. Minimum compliance is Level 3.

B. To simplify controls and mechanical service troubleshooting, the IBACC shall be mounted directly in the control compartment of the unitary system. The IBACC shall be provided with a sheet metal or polymeric enclosure that is constructed of material allowing for the direct mounting within the primary air stream, as defined by UL-465. The direct mounting shall allow all controls maintenance and troubleshooting to be made while at the unitary equipment.

C. The IBACCs shall communicate with the NAC at a baud rate of not less than 158K baud. The IBACC shall provide LED indication of communication and controller performance to the technician, without cover removal.

D. The IBACCs shall be fully supported and communicate with the FMS Graphical User Interface (GUI).

E. The IBACC Sensor shall connect directly to the IBACC and shall not utilize any of the I/O points of the controller. The IBACC Sensor shall provide a two-wire connection to the controller that is polarity and wire type insensitive. The IBACC Sensor shall provide a communications jack for connection to the BACnet communication trunk to which the IBACC controller is connected. The IBACC Sensor, the connected controller, and all other devices on the BACnet bus shall be accessible by the POT.

F. All input/output signals shall be directly hardwired to the IBACC. For all non-VAV terminal applications, a minimum of two input points of the IBACC shall employ a universal configuration that allows for flexibility in application ranging from dry contact, resistive, to voltage/current sourced inputs. If universal points are not available, a minimum of two input points (each) of the dry contact, resistive and analog voltage/current types must be provided on every controller. The outputs of the IBACC shall be of the relay and universal analog form. All digital outputs shall be relay type. IBACC devices utilizing non-relay outputs shall provide an interface relay for all points. All analog outputs shall be programmable for their start points and span to accommodate the control devices. Configuration of all I/O points shall be accomplished without physical hardware jumpers, switches or settings. Troubleshooting of input/output signals shall be easily executed with the POT or a volt-ohm meter (VOM). All I/O points shall be utilized by the local IBACC or shall be available as I/O points for other controllers throughout the network.

G. All IBACCs shall be fully application programmable and shall at all times maintain their BACnet Level 3 compliance. Controllers offering application selection only (non-programmable), require a 10% spare point capacity to be provided for all applications. All control sequences within or programmed into the IBACC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.

H. The IBACC shall be provided with the ability to interface with the POT. The interface port shall be provided at the wall sensor or within the unitary equipment, as specified on the plans. The interface port shall allow the POT to have full functionality as described in POT section of this specification.

I. Application Specific Controllers (ASC):
1. ASC's shall be designed through its I/O configuration and configurable control logic to be used for a specific type mechanical equipment. Typical applications are VAV boxes, Fan Coil Units, Roof Top Units, Unit Ventilators, Split DX Systems, Heat Pumps, etc.
2. Performance: Inputs Provide software selectable universal inputs. Analog inputs - shall have the following minimum level of performance: 10 bit A to D resolution; manage thermistors with an accuracy of: ±0.9 deg. F, and a Potentiometer. For VAV Applications provide a differential pressure input sensor built in to the controller with a control range of .01" to 1.25" H20 velocity pressure.
3. Output – Analog outputs shall have the following minimum level of performance: Tri-mode Voltage of 0-10 VDC (linear), digital 0-12 VDC (off/on) or PWM. All analog outputs shall be equipped with an auto-reset fuse. Output Resolution shall be a minimum 8 bits digital / analog converter. Digital outputs shall be provided with a minimum of a triac output rated at 24VAC and 1 amp. All analog outputs and power supply shall be fuse protected.
4. The ASCs shall be provided with an optimum start program internal to its control logic. The optimum start shall be activated by a time of day event signal from its NAC on the network.

J. Freely Programmable Controllers (FPC):
1. Freely Programmable Controllers shall be a controller designed for more complex sequences of operations such as built up AHU's, central plant operations, electrical monitoring, and control and management for chillers, boilers and generators. These FPCs are to allow for the flexibility of custom control programming to meet the needed sequences of operation.
2. Performance – Each FPC shall have a minimum of 64K of Non-volatile Flash memory for control applications and 128K non-volatile flash memory for storage with an 8 bit processor at 10mhz. The FPC shall have a minimum ambient operating temperature range of -0 deg. C to 70 deg. C or 32 deg. F to 158 degrees F. All connected points are to be updated at a minimum of one-second intervals

K. Inputs – Analog inputs shall have the following minimum level of performance: 10 bit A to D resolution; manage thermistors with an accuracy of: ±0.9 deg. F, platinum sensors with an accuracy of ±1.8 deg. F, 0-10 VDC with Accuracy of ±0.5%, a 4-20 mA signal and a Potentiometer with an accuracy of ±0.5%.

L. Output – Analog outputs shall have the following minimum level of performance: Tri-mode Voltage of 0-10 VDC (linear), digital 0-12 VDC (off/on) or PWM. All outputs shall an auto reset fuse. Output Resolution shall be a minimum 8 bits digital / analog converter. Digital outputs shall be provided with a minimum of a 5 amp relay @ 14VDC-24VAC. Where required provide for a manual override of the digital outputs built into the controller. All individual outputs and power supply shall be fuse protected. There shall be an LED status indicator on each of the outputs.

M. The FPC shall have the ability to share over the network with other controllers a minimum of 8 variable inputs and 8 variable outputs.

N. The FPC shall be provided with a diagnostic indicator light that when flashing signifies that the application program is running correctly.

O. Minimum Points: The following commands, displays and data shall be available at the operator's terminal or NAC as applicable to the project:
   1. Hot Water System:
      a. Supply and return temperature
      b. Supply temperature reset
      c. Pump status (current sensor)
      d. High/low temperature alarms
   2. The following points are only required if required by control strategy
      a. Primary/Secondary supply and return temperature
      b. Primary/Secondary flow (GPM)
      c. Bridge flow (GPM)
      d. Primary/Secondary pump speed (% of full speed)
      e. Return water temperature control valve (% of full open)
      f. Primary/Secondary loop differential pressure
      g. BTUH from BTU/Flow Meters
   3. Chilled Water System: (for each of the open and closed systems)
      a. Supply and return temperature
      b. Supply temperature reset
      c. Pump status (current sensor)
      d. High/low temperature alarms
   4. The following points are only required if required by control strategy
      a. Primary/Secondary supply and return temperature
      b. Primary/Secondary flow (GPM)
      c. Bridge flow (GPM)
      d. Primary/Secondary pump speed (% of full speed)
      e. Return water temperature control valve (% of full open)
      f. Primary/Secondary loop differential pressure
      g. BUTH from BTU/Flow Meters

P. Metering – Chilled Water, Hot Water, Power, Gas, Domestic Water

Q. Laptop Computer:
   1. Laptop Hardware Requirements: Provide one (1) laptop hardware platform with the following requirements:
   2. The computer shall be an Intel Pentium or AMD based computer (minimum processing speed of 2.0 GHz with 1.0 GB RAM and a 80-gigabyte minimum hard drive). It shall include a CD/DVD-RW Combination Drive, 1-parallel ports, 1-asynchronous serial ports and 2-USB ports. A minimum 15" color monitor, 1280 x 1024 optimal preset resolution, shall also be included.
   3. The server operating system shall be Microsoft Windows 7.0 Professional. Include Microsoft Internet Explorer 8.0 or later.
   4. This contract will provide appropriate connectors and cables for communication connection to the LonWorks or BACnet networks. Provide a license of any software required to program or service the NAC, ILC, IDC or IBACC controllers being provided by the Systems Integrator. Provide WorkPlace^{N4} on laptop. Demonstrate and instruct College personnel in the use of engineering tools to develop trends and control loop tuning.. The laptop shall communicate with the DDC controls network through a wired or wireless Ethernet connection as well as via a jack at the controller.
   5. Locate laptop in lockable vented NEMA cabinet in main penthouse adjacent to framed schematics and data port.

1.31 CONTROLS INTRUMENTATION – SEE ALSO 23 0903

1.32 CONTROL PANELS:

A. Panels shall have hinged doors and be marked with engraved labels. Panels used as a location for mounting control devices shall have a document holder located on the inside of the door.

B. Provide common keying for all panels

C. Entrance and exit wiring should be on the panel sides.

D. All heat generating devices shall be located at the top of the panel.

1.33 THERMOSTATS:

A. Space Thermostats
1. All room thermostats shall have exposed setpoint adjustment with display of setpoint and space temperature and internal stops or software stops for minimum and mN4imum setting initially set between 70 degrees and 74 degrees
2. All room thermostats in public areas will have concealed setpoint adjustments with blank cover.
3. Insulated mounting bases on exterior walls
4. Accuracy to +/-0.5%
5. Each thermostat shall be capable of reporting the space temperature and setpoint.

B. Temperature sensors shall be capable of being replaced without the need for controller re-calibration. Temperature sensors shall accordingly have manufactured space temperature and setpoint signal precision tolerances of no greater than 1°F.

1.34 LABELS and TAGS:

A. Labels of field devices (both locally and software ID's) shall be associated with their respective air handler, boiler, pump, etc.

EXECUTION

1.35 ADDITIONAL CONTROL SEQUENCES:

A. For the variable air volume units and their associated hot water reheat coils shall be DDC controlled with proportional modulating electronic valve actuators, proportional modulating damper actuators with dual minimum cfm set points, feedback loops, thermistor room temperature sensors, and cfm and temperature status readout on the BAS. The control wiring for the control transformer shall be the responsibility of the controls contractor from a dedicated voltage source provided by the electrical contractor. In concealed accessible plenum space, plenum rated cabling is acceptable. In exposed space such as mechanical rooms, wiring shall be installed in EMT conduit with fittings. Flexible conduit will not be accepted.

B. All wiring, transformers and breakers shall be provided by the DDC Contractor.

1.36 BUILDING PRESSURIZATION CONTROL:

A. See sequence of operation for floor pressurization.

1.37 INSTALLATION AND SUPERVISION:

A. All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the temperature control system manufacturer or its exclusive factory authorized installing contracting field office (representative). The installing office shall have a minimum of five years of installation experience with direct digital control systems. Supervision, calibration and checkout of the system shall be by the employees of the local exclusive factory authorized temperature control contracting field office (branch or representative).

1.38 CONTROL WIRING:

A. Interlock control wiring shall be manufacturer minimum of No. 18 gauge. All electrical work performed in the installation of the BAS/ATC system as described in this specification shall be per the National Electrical Code (NEC) and per applicable state and local codes. All wiring shall be installed in conduit unless specified otherwise in other sections. Where exposed, conduit shall be run parallel to building lines properly supported and sized at a mN4imum of 40% fill. In no cases shall field installed conduit smaller than 1/2" trade size be allowed. All electrical work shall comply with Division 26 of these specifications

B. Where specified, Class 2 wires in approved cables not in raceway may be used provided that:
   1. Circuits meet NEC Class 2 (current-limited) requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.)
   2. All cables shall be UL listed for application, i.e., cables used in plenums shall be UL listed specifically for that purpose.
   3. Wiring shall be run parallel along a surface or perpendicular to it, and bundled, to achieve a neat and workmanlike result.

C. Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage may not be used for low voltage wiring except for the purpose of interfacing the two (e.g. relays and transformers).

D. All wire-to-device connections shall be made at a terminal blocks or terminal strip. All wire-to wire connections shall be at a terminal block, or with a crimped connector. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

E. All wiring shall be installed as continuous lengths, where possible. Any required splices shall be made only within an approved junction box or other approved protective device.

F. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations in accordance with other sections of this specification and local codes.

G. Size of conduit and size and type of wire shall be the design responsibility of the Control System Contractor, in keeping with the manufacturer's recommendation and NEC.

H. Follow manufacturer's installation recommendations for all communication and network cabling. Network or communication cabling shall be run separately from other wiring.

I. Flexible metal conduits and liquid-tight, flexible metal conduits shall not exceed 3' in length and shall be supported at each end. Flexible metal conduit less than 1/2" electrical trade size shall not be used.

J. Where power for controls are not specifically indicated on Electrical Drawings, BAS Contractor shall be responsible for programmable and panel controller power to a dedicated 120 volt breaker served from the emergency power system.

K. The control power wiring for the control transformers shall be the responsibility of the controls contractor from a spare circuit breaker in an electrical panelboard that is on emergency power supply system.

1.39 ON-SITE TESTING:

A. When installation is complete, the controls contractor shall perform the following:
1. A field verification of all sensors.
2. Verification of each control point by comparing the control command and the field device.
3. Documentation of results shall be provided to the Owner prior to final acceptance.

1.40 FUNCTIONAL TESTING:

A. The controls contractor shall perform functional test that controls are installed, adjusted and operate as required by the drawings and specifications. This functional test shall be documented and may be conducted in conjunction with the training of Owner's personnel. The documentation shall identify the item, the person performing the functional test, date. Provide adequate notice to Owner for optional witnessing of functional testing. Typical items to be tested as follows (the table below is example of functional testing and not a requirement to have Owner witness all aspect of functional testing):

Item Demonstrated	Controls Contractor (Name)	College (Signature)	Date
Disconnect one DDC device from the NAC to demonstrate that a single device failure will not disrupt peer-to-peer communication.			
Manually generate alarms at all points and demonstrate that the workstation(s) receive the alarms			
Calibration has been performed on at least sensors			
Point-to-point verification of all points. Include labeling of points.			
Sequence of operation for the self-contained units including economizer cycle, reset , start/stop,			
Additional Boxes: Fan Coil Units Laboratory Exhaust/Cleaning Systems Pre-Conditioning Unit System			

Item Demonstrated	Controls Contractor (Name)	College (Signature)	Date
Sequence of operation for the cooling tower and condenser water open/closed systems.			
Sequence of operation for all VAV terminal units including Min/mN4 air, reset, heating CFM			
Sequence of operation of the HVAC controls system during a fire alarm			
Fail safe operation of self-contained, pre-conditioning unit, condenser water systems, boiler system, hot water system, smoke control system for atrium and terminal units.			
Response to upset conditions and change of setpoint for selected systems			

1.41 ACCEPTANCE TESTING:

A. Point Verification:
1. To verify end-to-end operation of the system, the Contractor shall provide a hard copy of an All Points Summary Listing to the Owner of each part or system to be placed in warranty by the Owner.
2. Sequence Verification during acceptance testing period:
3. The Contractor shall notify the Owner's representative of systems which perform all specified sequences. The engineer shall have the option of verifying all sequences of operation and place the system into warranty acceptance test.
4. The warranty acceptance test shall be of 7 days duration and the system shall perform as follows:
5. During the seven days, the BAS system shall not report any system diagnostics from the subsystem under test.
6. The subsystem shall be performance verified as operating using temporary trends of each control loop.
7. During the occupied periods, BAS control loops under test shall maintain control of the process variable within the following scales:

Duct Static Pressure	+/- 0.3 WC
Pump Head Pressure	+/- 10% of control range
Duct Temperature Loops	+/- 2.0F
Room Temperature	+/- 1.0F
Pipe Temperature Loops	+/- 2.0F
Duct Humidity	+/- 2x rate error of Humidity Transmitter
Room Humidity	+/- 2x rate error of Humidity Transmitter
Carbon Dioxide PPM	+/- 100 ppm

1.42 OWNER TRAINING:

A. Owner training shall be executed in four phases. The System Integrator will provide at no cost to the owner (include all reasonable and appropriate expenses), Phase I, Phase II, Phase III and Phase IV training classes. A proposed training agenda will be submitted to the College Facility Mechanical Engineer in writing, and approved by the Facility Mechanical Engineer before the training takes place.
   1. The first phase shall take place at the customer job site and will be scheduled at a time preceding owner acceptance. The purpose of the training is to provide an introduction and an overview of the FMS, and ensure POT is operational and functional with installed controllers.
   2. The second phase of training shall be a follow-up training to address specific building system and questions of the operators. Training shall take place at the customer job site and will include a site-specific walk through and hands on site-specific instruction. Completion of this training shall be a condition of system acceptance.
   3. The third phase of training shall be provided as a follow-up and enrichment to the introductory and site-specific training.

B. Points: The following commands, displays and data shall be available at the operator's terminal or NAC as applicable to the project:
   1. Laboratory Exhaust Systems
      a. Outside air temperature
      b. Mixed air temperature
      c. Supply air temperature
      d. Supply air temperature reset
      e. Return air temperature
      f. Fan status
      g. Cooling/heating valve position (% of full open)
   2. The following points are only required if required by control strategy.
      a. Calculated total outside air flow (cfm)
      b. Damper positions (% of full open)
      c. Duct static pressure
      d. Fan speed (% of full speed)
      e. Freeze protection status
      f. Alarms (temperature, flow)
      g. Outside air humidity
      h. Humidity valve position (% of full open)
   3. Atrium Exhaust Systems
      a. Outside air temperature
      b. Mixed air temperature
      c. Supply air temperature
      d. Supply air temperature reset
      e. Return air temperature
      f. Fan status
      g. Cooling/heating valve position (% of full open)
   4. The following points are only required if required by control strategy.
      a. Calculated total outside air flow (cfm)
      b. Damper positions (% of full open)
      c. Duct static pressure
      d. Fan speed (% of full speed)
      e. Freeze protection status
      f. Alarms (temperature, flow)
      g. Outside air humidity
      h. Humidity valve position (% of full open)
   5. Hot Water System:
      a. Supply and return temperature

b. Supply temperature reset
c. Pump status (current sensor)
d. High/low temperature alarms

6. The following points are only required if required by control strategy
   a. Primary/Secondary supply and return temperature
   b. Primary Secondary flow (GPM)
   c. Primary Secondary pump speed (% of full speed)
   d. Return water temperature control valve (% of full open)
   e. Primary Secondary loop differential pressure
7. Chilled Water System: (for both open and closed systems)
   a. Supply and return temperature
   b. Supply temperature reset
   c. Pump status (current sensor)
   d. High/low temperature alarms
8. The following points are only required if required by control strategy
   a. Primary/Secondary supply and return temperature
   b. Primary/Secondary flow (GPM)
   c. Primary/Secondary pump speed (% of full speed)
   d. Return water temperature control valve (% of full open)
   e. Primary/Secondary loop differential pressure
9. Air Terminals: (Including laboratory supply and exhaust air valves)
   a. Current space temperature
   b. Occupied setpoint
   c. Unoccupied setpoint
   d. Current status
   e. Minimum and MN4imum air flow setting (CFM)
   f. Current air flow reading (CFM)
   g. Reheat valve position (% of full open)
   h. High/low temperature alarm
   i. Current CO2 concentration (if CO2 monitor shown on plans)

C. Metering - Chilled Water, Hot Water, Gas, Water and Power:
   1. Output from building kilowatt-hour meter (kw, kwh, phase voltage and current)

1.43 APPLICATION SOFTWARE DOCUMENTATION:

A. Contractor shall provide a copy of all Lonworks .xif files and system databases on Compact disk.

1.44 ACCEPTANCE TESTING:

A. Point Verification:

B. To verify end-to-end operation of the system, the Contractor shall provide a hard copy of an All Points Summary Listing to the Owner of each part or system to be placed in warranty by the Owner. Sequence Verification during acceptance testing period.

C. The Contractor shall notify the Owner's representative of systems which perform all specified sequences. The engineer shall have the option of verifying all sequences of operation and place the system into warranty acceptance test.

D. The warranty acceptance test shall be of 7 days duration and the system shall perform as follows:

1. During the seven days, the BAS system shall not report any system diagnostics from the subsystem under test.
2. The subsystem shall be performance verified as operating using temporary trends of each control loop.
3. During the occupied periods, BAS control loops under test shall maintain control of the process variable within the following scales:

Duct Static Pressure	+/- 0.3 WC
Pump Head Pressure	+/- 10% of control range
Duct Temperature Loops	+/- 20F
Room Temperature	+/- 10F
Pipe Temperature Loops	+/- 20F
Duct Humidity	+/- 2x rate error of Humidity Transmitter
Room Humidity	+/- 2x rate error of Humidity Transmitter
Carbon Dioxide PPM	+/- 100 ppm

1.45 WARRANTY ACCESS:

A. The Owner shall grant the Contractor, reasonable access to the BAS system during the warranty period. The owner shall provide at no cost to the contractor, a dedicated, secure VPN connection for remote service and troubleshooting during this period.

B. PHASE I - ON SITE TRAINING: This training will give the operator with little or no experience with the FMS an introduction to:
1. Building automation fundamentals
2. System architecture and functions as they pertain to the site
3. System access using the Browser User Interface and FMS software
4. Basic software controller programming and tuning.
5. Editing parameters such as set points and schedules
6. Developing trends and day to day system monitoring
7. The complete range of hardware and software products
8. Building walk-thru.
9. This phase of training shall be a minimum of 8 hours

C. PHASE II - ON SITE TRAINING: The manufacturer and the controls contractor shall provide 8 hours of on-site training in the maintenance and operation of the installed system for up to (6) personnel. The training shall be documented and a syllabus and O&M manuals shall be submitted and approved by Facilities Operations 2 weeks prior to the training. The training should include the following:
1. HVAC systems layout including the locations of air handlers, DDC controllers, VAV boxes, pumps. This will include a walk-thru at the building.
2. Review of O&M manual and control system as-builts
3. Using As-Built documentation, Sequences of operation, control drawings, input/output summaries
4. Field sensor and actuator location and maintenance
5. Field controller location and maintenance
6. FMS hardware operation and maintenance
7. FMS software site specific capabilities
8. Troubleshooting tools.
9. Sequence of operations for each control loop.
10. Demonstration and turnover to owner of Laptop computer.
11. Logon procedure
12. Use of laptop Lonworks tools or NAC Plug-ins to configure ASCs or Program FPCs.
13. Password requirements
14. Operation and troubleshooting including:
15. Modification of ASC or FPC setpoints, parameters, etc.

16. Calibration and adjustment
17. Trending
18. Hands on training in the troubleshooting and replacement of components including sensors, transmitters, control valves and actuators. Contractor shall have examples of each component and demonstrate measurement of input and output signals, and any operator adjustments available.
19. DDC controller functions and operation
20. This phase of training shall be a minimum of 8 hours.

D. PHASE III – ON SITE TRAINING: No later than 6 months and no earlier than 4 months from building acceptance, the SI will repeat Phase I and Phase II training. Training to be consolidated into one 8 hour session.

E. PHASE IV – ONSITE TRAINING: No later than 12 months and no earlier than 10 months from building acceptance, the SI will repeat Phase I and Phase II training. Training to be consolidated into one 8 hour session.

1.46 WARRANTY ACCESS:

A. The Owner shall grant the Contractor, reasonable access to the BAS system during the warranty period. The owner shall provide at no cost to the contractor and to Engineer at their office web browser access for remote service and troubleshooting during warranty period. All required software and time to install systems shall be a part of this contract.

END OF SECTION 23 09 00