

UNIVERSITY OF CALIFORNIA, SANTA BARBARA

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SANTA BARBARA • SANTA CRUZ

OFFICE OF DESIGN & CONSTRUCTION SERVICES and PHYSICAL FACILITIES

CONTRACTING SERVICES  
Building 439  
Santa Barbara, California 93106-1030  
Telephone (805) 893-3356  
Fax (805) 893-8592

**SENT VIA:**  FAX ON THIS DATE  
 HAND DELIVERY ON THIS DATE  
 FEDERAL EXPRESS ON THIS DATE  
 UNITED PARCEL SERVICE ON THIS DATE

HOLDERS OF PLANS AND SPECIFICATIONS:

North Hall Data Center  
Project No. FM090222L/981610  
**Addendum No. One**

April 26, 2010

Enclosed is **ADDENDUM NO. ONE** to the Construction Documents on the above-captioned project.

Bid date is **Thursday, May 13, 2010 at 2:30 P.M.** to be held at:

CONTRACTING SERVICES  
Facilities Management, Bldg. 439,  
Door #E, Reception Counter  
University of California, Santa Barbara  
Santa Barbara, CA 93106-1030.

Late arrivals shall be disqualified. Please allow time for unforeseen traffic delays, securing a parking permit and potential parking problems.

Anna Galanis  
Director, Contracting Services

ADDENDUM NUMBER ONE

to the

CONSTRUCTION DOCUMENTS

April 26, 2010

GENERAL

The following changes, additions or deletions shall be made to the following document(s) as Indicated; all other conditions shall remain the same.

I. BID FORM

Item No.

- 1. BID FORM.: **REPLACE** in it's entirety with attached, "Revised Bid Form, Revised per Addendum One". Any Bids not submitted on the "Revised Bid Form, Revised per Addendum One", will be rejected.

II. SPECIFICATION

Item No.

- 1. TABLE OF CONTENTS, Division 1, General Requirements: ADD Section 01020, Allowances, pages 1-7.

Item No.

- 2. TABLE OF CONTENTS, Division 13, Special Construction: ADD Section 13810, Energy Monitoring and Controls System, pages 1-26.

Item No.

- 3. **ADD: Section 01020, Allowances, pages 1-7, Attached.**

Item No.

- 4. **ADD: Section 13810, Energy Monitoring and Controls System, pages 1-26, Attached.**

Item No.

5. Section 230900, Building Automation System, Part 1, General, 1.7, Start Up and Programmed Maintenance, "C". **CHANGE** to read in it's entirety as follows:

"C. Provide at least six (6) sets of training manuals for use by the operators."

Item No.

6. Section 230900, Building Automation System, Part 2, Products, 2.2, System Architecture, "B", **CHANGE** to read in it's entirety as follows:

"B. Johnson Controls will provide a lap top computer for local monitoring and control along with one printer.

Item No.

7. Section 230900, Building Automation System, Part 2, Products, 2.9, Automatic Control Damper Actuators, "B", **DELETE** in its entirety.

Item No.

8. Section 233300, Air Duct Accessories, Part 1, General, 1.1, Summary, "A", **ADD** "11 to read as follows:

"11. Control Dampers."

Item No.

9. Section 233300, Air Duct Accessories, Part 1, General, 1.1, Summary, "A", **ADD** "12" to read as follows:

"12. Automatic Insulation Dampers."

Item No.

- 10 Section 233300, Air Duct Accessories, Part 2, Products, **ADD** "2.12, Control Dampers, A and B" to read as follows:

"2.12 CONTROL DAMPERS  
A. Opposed blade 1% leakage.  
B. Manufacturer: 1. Ruskin Company or equal."

Item No.

11. Section 233300, Air Duct Accessories, Part 2, Products, ADD "2.13, Automatic Insulation Dampers, A and B" to read as follows:

"2.13 AUTOMATIC INSULATION DAMPERS  
A. Parallel blade, 1% leakage.  
B. Manufacturer: 1. Ruskin Company or equal."

END OF ADDENDUM NO. ONE

REVISED BID FORM  
Revised per Addendum One

FOR:

North Hall Data Center

FM090222L/981610

UNIVERSITY OF CALIFORNIA  
SANTA BARBARA  
SANTA BARBARA, CALIFORNIA

April 2010

BID TO:

University of California, Santa Barbara  
Facilities Management, Building 439  
Door E, Reception Counter  
Santa Barbara, CA 93106  
(805)893-3298

BID FROM:

\_\_\_\_\_  
(Name of Bidder)

\_\_\_\_\_  
(Address)

\_\_\_\_\_  
(City)

\_\_\_\_\_  
(State)

\_\_\_\_\_  
(Zip)

\_\_\_\_\_  
(Telephone Number)

\_\_\_\_\_  
(Fax Number)

\_\_\_\_\_  
(Email Address)

DATE BID SUBMITTED

\_\_\_\_\_  
(Date)

**Note: All portions of this Bid Form must be completed and the Bid Form must be signed before the Bid is submitted. Failure to do so may result in the BID being rejected as non-responsive.**

**1.0 BIDDER'S REPRESENTATIONS**

Bidder, represents that a) Bidder and all Subcontractors, regardless of tier, has the appropriate current and active Contractor's licenses required by the State of California and the Bidding Documents; b) it has carefully read and examined the Bidding Documents for the proposed Work on this Project; c) it has examined the site of the proposed Work and all Information Available to Bidders; d) it has become familiar with all the conditions related to the proposed Work, including the availability of labor, materials, and equipment. Bidder hereby offers to furnish all labor, materials, equipment, tools, transportation, and services necessary to complete the proposed Work on this Project in accordance with the Contract Documents for the sums quoted. Bidder further agrees that it will not withdraw its Bid within 60 days after the Bid Deadline, and that, if it is selected as the apparent lowest responsive and responsible Bidder, that it will, within 10 days after receipt of notice of selection, sign and deliver to University the Agreement in triplicate and furnish to University all items required by the Bidding Documents. If awarded the Contract, Bidder agrees to complete the proposed Work within Four Hundred (400) calendar days after the date of commencement specified in the Notice to Proceed.

**2.0 ADDENDA**

Bidder acknowledges that it is Bidder's responsibility to ascertain whether any Addenda have been issued and if so, to obtain copies of such Addenda from University's facility at the appropriate address stated on Page 1 of this Bid Form. Bidder therefore agrees to be bound by all Addenda that has been issued for this Bid.

**3.0 NOT USED****4.0 LUMP SUM BASE BID**

\$   ,    ,    .

(Place Figures in appropriate boxes)

Bidder includes in the Lump Sum Base Bid the following allowances:

**Allowance No. 1:**

**\$233,576.00** for fully completing the Scope of Work as defined in Section No. 01020 "Allowances".

**5.0 SELECTION OF APPARENT LOW BIDDER**

Refer to the Instructions to Bidders for selection of apparent low bidder.

**6.0 NOT USED****7.0 DAILY RATE OF COMPENSATION FOR COMPENSABLE DELAYS (Used As Basis For Award)**

Bidder shall determine and provide below the daily rate of compensation for any Compensable Delay caused by University at any time during the performance of the Work:

\$   ,    .   x 15 **MULTIPLIER**

(Place Amount in Figures in appropriate boxes)

University will perform the extension of the daily rate times the multiplier.

The daily rate shown above will be the total amount of Contractor entitlement for each day of Compensable Delay caused by University at any time during the performance of the Work and shall constitute payment in full for all delay costs, direct or indirect (including, without limitation, compensation for all extended home office overhead and extended general conditions), of the Contractor and all subcontractors, suppliers, persons, and entities under or claiming through Contractor on the Project. The number of days of Compensable Delay shown as a "multiplier" above is not intended as an estimate of the number of days of Compensable Delay anticipated by the University. The University will pay the daily rate of compensation only for the actual number of days of Compensable Delay, as defined in the General Conditions; the actual number of days of Compensable Delay may be greater or lesser than the "multiplier" shown above.

**8.0 NOT USED**





**10.0 NOT USED**

**11.0 BIDDER INFORMATION**

TYPE OF ORGANIZATION:

\_\_\_\_\_  
(Corporation, Partnership, Individual, Joint Venture, etc.)

- IF A CORPORATION, THE CORPORATION IS ORGANIZED UNDER THE LAWS OF THE STATE OF \_\_\_\_\_

NAME OF PRESIDENT OF THE CORPORATION:

\_\_\_\_\_  
(Insert Name)

NAME OF SECRETARY OF THE CORPORATION:

\_\_\_\_\_  
(Insert Name)

- IF A PARTNERSHIP, NAMES OF ALL GENERAL PARTNERS:

\_\_\_\_\_  
(Insert Names)

CALIFORNIA CONTRACTORS LICENSE(S):

\_\_\_\_\_  
(Classification)

\_\_\_\_\_  
(License Number)

\_\_\_\_\_  
(Expiration Date)

(For Joint Venture, list Joint Venture's license and licenses for all Joint Venture partners.)

EMPLOYER IDENTIFICATION NUMBER (EIN):

**12.0 REQUIRED COMPLETED ATTACHMENTS**

The following documents are submitted with and made a condition of this Bid:

1. Bid Security in the form of \_\_\_\_\_  
(Bid Bond or Certified Check)

**13.0 DECLARATION**

I, \_\_\_\_\_, hereby declare that I am  
(Printed Name)

the \_\_\_\_\_ of \_\_\_\_\_  
(Title) (Name of Bidder)

submitting this Bid Form; that I am duly authorized to execute this Bid Form on behalf of Bidder;  
and that all information set forth in this Bid Form and all attachments hereto are, to the best of my  
knowledge, true, accurate, and complete as of its submission date.

I declare, under penalty of perjury, that the foregoing is true and correct and that this declaration  
was

executed at: \_\_\_\_\_  
(Name of City if within a City, otherwise Name of County)

in the State of \_\_\_\_\_,

on \_\_\_\_\_  
(Date)

\_\_\_\_\_  
(Signature)

BID BOND

KNOW ALL PERSONS BY THESE PRESENTS:

That we, \_\_\_\_\_,  
as Principal, and \_\_\_\_\_, as Surety, are held and firmly bound unto THE REGENTS OF THE UNIVERSITY OF CALIFORNIA, hereinafter called THE REGENTS, in the sum of ten percent (10%) of the Lump Sum Base Bid amount for payment of which in lawful money of the United States, well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH THAT, WHEREAS, Principal has submitted a Bid for the work described as follows:

North Hall Data Center

FM090222L/981610

NOW, THEREFORE, if Principal shall not withdraw said Bid within the time period specified after the Bid Deadline, as defined in the Bidding Documents, or within sixty (60) days after the Bid Deadline if no time period be specified, and, if selected as the apparent lowest responsible Bidder, Principal shall, within the time period specified in the Bidding Documents, do the following:

- (1) Enter into a written agreement, in the prescribed form, in accordance with the Bid.
- (2) File two bonds with THE REGENTS, one to guarantee faithful performance and the other to guarantee payment for labor and materials, as required by the Bidding Documents.
- (3) Furnish certificates of insurance and all other items as required by the Bidding Documents.

In the event of the withdrawal of said Bid within the time period specified, or within sixty (60) days if no time period be specified, or the disqualification of said Bid due to failure of Principal to enter into such agreement and furnish such bonds, certificates of insurance, and all other items as required by the Bidding Documents, if Principal shall pay to THE REGENTS an amount equal to the difference, not to exceed the amount hereof, between the amount specified in said Bid and such larger amount for which THE REGENTS procure the required work covered by said Bid, if the latter be in excess of the former, then this obligation shall be null and void, otherwise to remain in full force and effect.

In the event suit is brought upon this bond by THE REGENTS, Surety shall pay reasonable attorneys' fees and costs incurred by THE REGENTS in such suit.

IN WITNESS WHEREOF, we have hereunto set our hands this \_\_\_\_ day of \_\_\_\_\_, 20

Principal

Surety

\_\_\_\_\_  
By: \_\_\_\_\_

\_\_\_\_\_  
By: \_\_\_\_\_

Title: \_\_\_\_\_

Title: \_\_\_\_\_

Address for Notices:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

NOTE: Notary acknowledgement for Surety and Surety's Power of Attorney must be attached.

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**SECTION 01020**

**ALLOWANCES**

**PART 1 - GENERAL**

**1.01 DESCRIPTION**

- A. Included in the Contract Sum are all Allowances stated in the Contract Documents. Items covered by Allowances shall be supplied for such amounts and by such persons or firms as University's Representative may direct.

**1.02 APPLICATION**

- A. The following shall apply, unless otherwise provided in the Contract Documents:
1. Allowances shall cover the cost to Contractor of: materials and equipment delivered at the Project site and all required taxes, less applicable trade discounts.
  2. Contractor's costs required for storage on and off the Project site; security; loading and unloading; handling at the Project site; labor; installation costs; overhead; profit; and other expenses necessary for the stated Allowance amounts shall be included in the Contract Sum and not in the Allowances.
  3. Whenever costs are more than or less than Allowances, the Contract sum shall be adjusted by Change Order based on (1) the difference between actual costs and the Allowances and (2) changes in Contractor's costs.
  4. At any time during the course of the Contract, the University's Representative may elect to delete any or all allowances via Change Order for the full amount listed below.

**PART 2 - DESCRIPTION OF ALLOWANCES**

**2.01 ALLOWANCE NO. 1:**

Include an Allowance of Two Hundred Thirty Three Thousand Five Hundred Seventy Six dollars (\$233,576) in the base bid for the cost of fully completing the Scope of Work as defined in "Section 13810 - Energy Monitoring and Controls System", and as defined on E and M sheets. The Contractor shall enter into a subcontract directly with the firm Johnson Controls, Inc. to furnish all labor, materials, and installation as specified inclusive of submittals, programming, panel terminations, coordination, start-up, as-built drawings, operations and maintenance manuals, and operational check-out, trending, commissioning and warranty. The Allowance has been pre-negotiated by the University and is non-negotiable by the Contractor or Johnson Controls, Inc. The basis for the pre-negotiated allowance is:

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I. SCOPE OF WORK-

**A. Local Work Station**

Included:

- Furnish and install new lap top computer for local monitoring and control
- Furnish and install a new printer
- Tie in new system to existing Metasys user workstation at UCSB facilities
- Generate operator work station graphics on exiting front end
- Furnish and install Johnson Controls supervisory controller – BACnet MS/TP NAE
- 60 man hours for all testing, training and commissioning of the system.

Clarifications:

- Any required gateways and/or interfaces for monitoring auxiliary control systems such as electrical, fire alarm, security and power is the responsibility of the respective subcontractor, not Johnson Controls. Johnson Controls will only provide the necessary I/O points described within the project documents to allow for the monitoring of such systems.

**B. BAS Monitoring**

Included:

- Furnish and install Johnson Controls field equipment controller in NEMA 1 enclosure
- Furnish and install outside air temperature and humidity sensor
- Furnish and install Qty (3) space temperature sensors
- Furnish and install Qty (2) space humidity sensors
- Furnish building chilled water differential pressure sensor
- Furnish building chilled water flow sensor
- Monitor the following points:
  - Utility power fail
  - Generator run
  - Chilled water high temperature

Not Included:

- Installation of flow sensor, pressure taps and tubing is by mechanical contractor

**C. Chilled Water System**

Included:

- Furnish and install Johnson Controls field equipment controller in NEMA 1 enclosure
- Furnish Qty (2) heat exchanger temperature sensor
- Furnish Qty (4) chilled water temperature sensors
- Furnish flow meter

Not Included:

- Installation of flow meter and thermowells by mechanical contractor

**D. Non- Critical System Chilled Water Pumps**

**P-1A & P-1B**

Included:

- Furnish and install Johnson Controls field equipment controller in NEMA 1 enclosure
- Furnish Qty (2) chilled water pump differential pressure sensor
- Qty (2) VFD commands, status and alarms
- Furnish Qty (2) chilled water temperature sensors

Not Included:

- Installation of thermowells, pressure taps and tubing by mechanical contractor

- Furnish or installation of VFD's

Clarifications:

- VFD's must be provided with BACnet MS/TP interface card by manufacturer

**E. Campus Chilled Water Booster Pump**

**P-4**

Included:

- Furnish and install Johnson Controls field equipment controller in NEMA 1 enclosure
- Furnish chilled water pump differential pressure sensor
- VFD commands, status and alarms
- Furnish campus chilled water loop differential pressure sensor

Not Included:

- Installation of pressure taps and tubing by mechanical contractor
- Furnish or installation of VFD's

Clarifications:

- VFD's must be provided with BACnet MS/TP interface card by manufacturer

**F. Heat Exchanger**

**HX-1A & HX-1B**

Included:

- Furnish Qty (2) 8" 2- position, 2-way chilled water isolation valve and actuator
- Furnish Qty (2) 8" 2-way modulating chilled water control valve and actuator

Not Included:

- Installation of valves and thermowells by mechanical contractor

**G. Critical System Primary Chilled Water Pumps**

**P-2A & P-2B**

Included:

- Furnish and install Johnson Controls field equipment controller in NEMA 1 enclosure
- Furnish Qty (2) chilled water pump differential pressure sensor
- Furnish Qty (2) chilled water temperature sensors
- Furnish and install Qty (2) current sensor to monitor pump status

Not Included:

- Installation of thermowells, pressure taps and tubing by mechanical contractor

**H. Critical System Secondary Chilled Water Pumps**

**P-3A & P-3B**

Included:

- Furnish and install Johnson Controls field equipment controller in NEMA 1 enclosure
- Furnish Qty (2) chilled water pump differential pressure sensor
- VFD commands, status and alarms
- Furnish Qty (2) chilled water temperature sensors
- Furnish and install Qty (2) current sensor to monitor pump status

Not Included:

- Installation of thermowells, pressure taps and tubing by mechanical contractor

- Furnish or installation of VFD's

Clarifications:

- VFD's must be provided with BACnet MS/TP interface card by manufacturer

**I. Computer Room Air Conditioning Unit**

**CRAH-1 THROUGH CRAH-5**

Included:

- Furnish and install Johnson Controls field equipment controller in NEMA 1 enclosure
- Map new points into system.
- Alarm monitoring
- Control wiring for (2) hardwired alarms to BMS per CRAH unit
- Low voltage wiring between condenser and evaporator if required.

Not Included:

- Icom microprocessor controls, interface card, disconnect switch, leak detector and smoke detectors will be provided with the unit
- Chilled water control valves are provided with the unit
- Temperature sensors are provided with in the return air intake of the unit
- Manual isolation valves
- Install valves isolation valves

Clarifications:

- The CRAH units will be provided with packaged, factory assembled, pre-wired, and pre-piped; consisting of cabinet, coil, fans, filters and controls per spec section 238123.
- The CRAH units operate through packaged, self-contained control systems to cool the space, based on temperature sensors located in their respective return air intakes per spec section 230900.
- Johnson Controls will monitor safety alarms and the status of each CRAH unit.
- Johnson Controls is not responsible for any modbus interface to CRAH units by specification section 230900.
- Icom controller must be BACnet MS/TP compatible

**J. Exhaust Fans**

**EF-1 & EF-2**

Included:

- Furnish and install Qty (2) current sensor for fan status
- Furnish and install a hydrogen sensor
- Furnish line voltage thermostat for EF-2

Not Included:

- Install and/or wire line voltage thermostat by base electrical contractor

**K. Air Cooled Chiller**

**CH-1 & CH-2**

Included:

- Furnish and install Johnson Controls field equipment controller in NEMA 1 enclosure
- Furnish Qty (2) chiller differential pressure sensors
- Furnish Qty (2) chilled water supply temperature sensors
- Furnish Qty (2) chilled water return temperature sensors

- Furnish Qty (2) 2-position chiller isolation valves
- Furnish and install Qty (2) current sensors

Not Included:

- Installation of thermowells, pressure taps and tubing by mechanical contractor

Clarifications:

- All existing points will be tied into new control system

**L. Roof Top Air Handling Unit**

**AHU-1**

Not Included:

- Furnish or install unit
- Starter, disconnect and/or smoke detector
- Installation of valves, thermowells, and pressure taps by mechanical contractor

Clarifications:

- All existing points will be tied into new control system
- Existing points include:
  - Pre-filter differential pressure sensor
  - Supply air temperature sensor
  - UPS room temperature sensor
  - Current sensor for supply fan status
  - Chilled water control valve output
  - Outside air damper output

**M. Roof Top Air Handling Unit**

**AHU-2**

Included:

- Furnish and install Johnson Controls field equipment controller in NEMA 3R enclosure
- Furnish supply air temperature sensor
- Furnish chilled water control valve and actuator
- Furnish outside air damper actuator
- Furnish exhaust air damper actuator
- Furnish return air damper actuator
- Furnish filter differential pressure switch
- Furnish and install UPS room space temperature sensor

Not Included:

- Furnish or install unit
- Installation of valves, thermowells, and pressure taps by mechanical contractor
- Starter, disconnect and/or smoke detector
- BACnet MS/TP interface card

Clarifications:

- The unit will be provided with integral, operating and safety controls per spec section 237413
- Factory provided unit controls:
- Operational and safety controls for space temperature control, air economizer operation, high and low unit discharge air temperature, and high static pressure per spec section 237413
- Contacts/ communication capability for BAS connection (BACnet MS/TP protocol) for monitoring, alarming, and start/stop/status per spec section 237413 will be provided with the unit.
- Control voltage transformers are provided by the unit manufacturer per specification section 237413.



- VFD's must be provided with BACnet MS/TP interface card by manufacturer
- There are no VFD's on this unit based on UCSB North Hall Data Center – Controls Scope Clarification dated 2/10/1010 from IDGROUP

**N. Indoor Air Handling Unit**

**AHU- 3**

Included:

- Furnish and install Johnson Controls field equipment controller in NEMA 1 enclosure
- Furnish supply air temperature sensor
- Furnish chilled water control valve and actuator
- Furnish outside air damper actuator
- Furnish exhaust air damper actuator
- Furnish return air damper actuator
- Furnish Qty (2) filter differential pressure switch
- 2 stage electric heat command

Not Included:

- Furnish or install unit
- Starter, disconnect, smoke detector, enthalpy economizer control, or fire/smoke dampers
- Controls for humidifier, including the humidifier control valve and actuator is factory supplied and mounted per specification section 237313.

Clarifications:

- The humidifier INTAC microprocessor controller will be factory installed and wired to perform self diagnostics and controls all water level, fill, drain, and safety circuit interlocks with fault indication per spec section 237313.
  - The INTAC microprocessor controller will also be provided with BAS communications

**O. Floor Fans**

**FF-1 THROUGH FF-10**

Included:

- Mount and wire factory supplied temperature sensors to associated floor fan controller

Not Included:

- Furnish or install floor fans
- Furnish or program any manufacturer supplied controls

Clarifications:

- Floor fans shall be furnished complete with stand-alone thermostatic controls to cycle fans on and off and vary fan speeds per specification section 230900
- Temperature sensors shall be furnished with the unit
- All floor fans will be furnished with speed controls

**P. Miscellaneous**

Included:

- Furnish and install a space temperature sensor to monitor space temperature while temporary cooling units are being used
- Furnish 3" isolation valves QTY (9)
- Furnish 4" isolation valve
- 24 additional digital input points for acceptance of status or alarm points from electrical infrastructure equipment

- Furnish and install UPS devices

Clarifications:

- Johnson Controls is not responsible for the interface to UPS, PDU's and the generators that are not BACnet MS/TP compatible.

III. CLARIFICATIONS

1.	The duct mounted smoke detector will be furnished and installed by the base electrical contractor. All fire alarm system devices and fan shutdown and power wiring to fire/smoke dampers is not included in this proposal per spec section 230900.
2.	Humidifier shall be factory mounted and installed by AHU manufacturer with INTAC microprocessor controls. INTAC microprocessor controls must be compatible with BACnet MS/TP and Johnson Controls Metasys for monitoring purposes.
3.	Johnson Controls will support the air/water balancing contractor for a maximum of 16 hours
4.	All valves, thermowells, pressure taps and tubing will be installed by mechanical contractor

IV. QUALIFICATIONS

1.	Installation labor is to be during normal business hours
2.	Johnson Controls warrants the equipment and services to be free of defects for a period of twelve (12) months from system <b>substantial</b> completion.

V. EXCLUSIONS

1.	Demolition (including pneumatic), permits, bonding or asbestos abatement
2.	Any required composite cleanup
3.	120 VAC Power, including power to control panels
4.	Furnish or installation of control, volume, fire, or combination fire smoke dampers
5.	Furnish or installation of any fire life safety systems, including smoke detectors
6.	Any required trenching for underground conduit and wire
7.	Furnish, wire, or terminate starters and disconnects
8.	Any required mechanical upgrades to existing HVAC control systems or equipment to working conditions
9.	Any required interfaces to lighting, fire, security or any other auxiliary low voltage system
10.	Tie in to any onboard packaged or terminal equipment units that are not factory supplied with a BACnet MS/TP interface card

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

**SECTION 13810**

**ENERGY MONITORING AND CONTROLS SYSTEM**

**PART 1 – GENERAL**

**1.01 RELATED DOCUMENTS**

- A. This section shall be procured directly in accordance with Section 01020 ALLOWANCES of this specification.
- B. All work of this section shall be coordinated by the Contractor and provided by the single Facilities Management System (FMS) subcontractor.
- C. The work of this section shall be scheduled, coordinated, and interfaced with the associated work of other trades. Reference the Division 15, 16 sections for details.
- D. The work of this division shall be as required by the Specifications, Point Schedules and Drawings.
- E. If the Contractor believes there are conflicts or missing information in the project documents, the Contractor shall promptly request clarification and instruction from the University Representative.

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**1.02 REFER TO SECTIONS**

- A. Division 15: Mechanical - Installation of wells, water and gas flow meters and other mechanical devices, etc., shall be by Division 15.
- B. Division 16: Electrical - Installation of devices integral to motor control centers, starters, disconnects, and power circuits for controls shall be by Division 16. Division 16 to supply all necessary 120V power wiring

**1.03 DEFINITIONS**

- A. Analog: A continuously variable system or value not having discrete levels. Typically exists within a defined range of limiting values.
- B. Binary: A two-state system where an "ON" condition is represented by one discrete signal level and an "OFF" condition is represented by a second discrete signal level each separated by a defined deadband. Digital Inputs and Digital Outputs are examples.
- C. Facility Management System (FMS): The total integrated system of fully operational and functional elements, including equipment, software, programming, and associated materials, to be provided and be interfaced to the associated work of other sections.
- D. FMS subcontractor: The single subcontractor to provide the work of this section. This subcontractor shall be the primary manufacturer, installer, commissioner and ongoing service provider for the FMS work.

- E. Control Sequence: An FMS pre-programmed arrangement of software algorithms, logical computation, target values and limits as required to attain the defined operational control objectives.
- F. Direct Digital Control: The digital algorithms and pre-defined arrangements included in the FMS software to provide direct closed-loop control for the designated equipment and controlled variables. Inclusive of Proportional, Derivative and Integral control algorithms together with target values, limits, logical functions, arithmetic functions, constant values, timing considerations and the like.
- G. FMS Network: The total digital on-line real-time interconnected configuration of FMS digital processing units, workstations, panels, sub-panels, controllers, devices and associated elements individually known as network nodes. May exist as one or more fully interfaced and integrated sub-networks, LAN, WAN or the like.
- H. Node: A digitally programmable entity existing on the FMS network.
- I. FMS Integration: The complete functional and operational interconnection and interfacing of all FMS work elements and nodes in compliance with all applicable codes, standards and ordinances so as to provide a single coherent FMS as required by this Division.
- J. Provide: The term "Provide" and its derivatives when used in this section shall mean to furnish, install in place, connect, calibrate, test, verify, warrant, document and supply the associated required services ready for operation.
- K. Furnish: The term "Furnish" and its derivatives when used in this section shall mean supply at the FMS subcontractor's cost to the designated third party trade contractor for installation. FMS subcontractor shall connect furnished items to the FMS, calibrate, test, verify, warrant and document.
- L. Wiring: The term "Wiring" and its derivatives when used in this section shall mean provide the FMS wiring and terminations.
- M. Install: The term "Install" and its derivatives when used in this section shall mean receive at the jobsite and mount.
- N. Protocol: The term "protocol" and its derivatives when used in this section shall mean a defined set of rules and standards governing the on-line exchange of data between FMS network nodes.
- O. Software: The term "software" and its derivatives when used in this section shall mean all of programmed digital processor software, preprogrammed firmware and project specific digital process programming and database entries and definitions as generally understood in the FMS industry for real-time, on-line, integrated FMS configurations.
- P. The use of words in the singular in these Division documents shall not be considered as limiting when other indications in these documents denote that more than one such item is being referenced.

Q. Headings, paragraph numbers, titles, shading, bolding, underscores, clouds and other symbolic interpretation aids included in the section documents are for general information only and are to assist in the reading and interpretation of this section. They do not form a formal part of the Documents and may not be consistent or complete in their use throughout the Documents.

R. The following abbreviations and acronyms may be used in describing the work of this section:

ADC	-	Analog to Digital Converter
AI	-	Analog Input
AN	-	Application Node
ANSI	-	American National Standards Institute
AO	-	Analog Output
ASCII	-	American Standard Code for Information Interchange
AWG	-	American Wire Gauge
CFM	-	Cubic Feet Per Minute
CPU	-	Central Processing Unit
CRT	-	Cathode Ray Tube
DAC	-	Digital to Analog Converter
DDC	-	Direct Digital Control
DI	-	(Binary) Digital Input
DO	-	(Binary) Digital Output
EEPROM	-	Electrically Erasable Programmable Read Only Memory
EMI	-	Electromagnetic Interference
FAS	-	Fire Alarm Detection and Annunciation System
GUI	-	Graphical User Interface
HOA	-	Hand-Off-Auto
ID	-	Identification
IEEE	-	Institute of Electrical and Electronics Engineers
I/O	-	Input/Output
LAN	-	Local Area Network
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
MCC	-	Motor Control Center
NC	-	Normally Closed
NIC	-	Not In Contract
NO	-	Normally Open
OWS	-	Operator Workstation
OAH	-	Outdoor Air Humidity
OAT	-	Outdoor Air Temperature
PC	-	Personal Computer
RAM	-	Random Access Memory
RF	-	Radio Frequency
RFI	-	Radio Frequency Interference
RH	-	Relative Humidity
ROM	-	Read Only Memory
RTD	-	Resistance Temperature Detector
SPDT	-	Single Pole Double Throw
SPST	-	Single Pole Single Throw
XVGA	-	Extended Video Graphics Adapter
TBA	-	To Be Advised
TCP/IP	-	Transmission Control Protocol/Internet Protocol
TTD	-	Thermistor Temperature Detector

UPS	-	Uninterruptible Power Supply
VAC	-	Volts, Alternating Current
VAV	-	Variable Air Volume
VDC	-	Volts, Direct Current
WAN	-	Wide Area Network

#### 1.04 FMS DESCRIPTION

- A. The FMS shall be a complete system designed for use on Intranets and the Internet. This functionality shall extend into the equipment rooms. Primary nodes located in equipment rooms and similar shall be fully IT compatible devices that mount and communicate directly on the IT infrastructure existing in the facility. Contractor shall be responsible for coordination with the University IT staff to ensure that the FMS will perform in the University environment without disruption to any of the other activities taking place on that LAN.
- B. All points of user interface shall be on standard PCs that do not require the purchase of any special software from the FMS manufacturer for use as a building operations terminal. The primary point of interface on these PCs will be a standard Web Browser such as Internet Explorer or Netscape.
- C. EXISTING server(s) shall be used for the purpose of providing a location for archiving system configuration data, and historical data such as trend data and operator transactions. All data stored will be through the use of a standard data base platform: Microsoft Data Engine (MSDE) or Microsoft SQL Server as dictated elsewhere in this specification.
- D. The work of the single FMS subcontractor shall be as defined individually and collectively in all Sections of this Division specifications together with the associated Point Sheets and Drawings and the associated interfacing work as referenced in the related documents as are listed in Part 1 of this Section.
- E. The FMS work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, verification, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items as Specified in these Division documents which are required for the complete, fully functional and commissioned FMS.
- F. Provide a complete, neat and workmanlike installation. Use only manufacturer employees who are skilled, experienced, trained, and familiar with the specific equipment, software and configurations to be provided for this Project.
- G. Manage and coordinate the FMS work in a timely manner in consideration of the Project schedules. Coordinate cooperatively with the associated work of other trades so as to assist the progress and not impede or delay the work specified in other sections.

- H. The FMS as provided shall incorporate, at minimum, the following integrated features, functions and services:
1. Operator information, alarm management and control functions at any Operator's console without the need to purchase special software from the FMS manufacturer for those consoles.
  2. Enterprise-level information and control functions.
  3. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
  4. Diagnostic monitoring and reporting of FMS functions.
  5. Offsite monitoring and management
  6. Energy management

1.05 QUALITY ASSURANCE

A. General

1. The contractor shall expand the existing Johnson Controls, Inc., "Metasys" Energy Management and Control System (EMCS) to provide monitoring, stand alone direct digital control (DDC) and effective and efficient operation of the project's HVAC system. EMCS shall be provided by Johnson Controls, Inc. (factory office), located at 5770 Warland Drive, Cypress, CA 90630. Please contact Drew Markway at 562-799-8882 with questions.
2. The Facility Management System subcontractor shall be the primary manufacturer-owned branch office that is regularly engaged in the engineering, programming, installation and service of total integrated Facility Management Systems of similar size, scope and complexity to the FMS specified in this Contract.
3. The FMS Contractor shall be a recognized national manufacturer, installer and service provider of FMS. Distributors, manufacturer's representatives and wholesalers will not be acceptable.
4. The FMS Contractor shall have a branch facility within a 150-mile radius of the job site supplying complete maintenance and support services on a 24 hour, 7-day-a-week basis. This branch facility shall provide the work for this project. This support facility shall have a spare parts and all necessary test and diagnostic equipment required to install, commission and service the specified FMS.
5. At the time of installation & as evidence and assurance of the contractor's ability to support the University's system with service and parts, the manufacturer/installer must have been in the FMS business for at least the last ten (10) years and have successfully completed total projects of at least 10 times the value of this contract in each of the preceding five years.

6. The system specified herein shall be supplied and installed by the factory offices of Johnson Controls, Inc. located at 5770 Warland Drive Cypress, CA 90630 to match existing Campus standard.
7. The FMS software residing in Nodes and servers shall be updated to the latest currently available revision at the start of Warranty.

B. Quality Management Program

1. Provide a competent and experienced FMS Project Manager employed by the manufacturer/installer. The Project Manager shall be supported as necessary by other manuf./installer employees in order to provide professional management service for the work. The Project Manger shall attend scheduled Project Meetings as required and shall be empowered to make technical, scheduling and related decisions on behalf of the FMS Contractor. At minimum, the Project Manager shall:
  - a. Manage the scheduling of the work to ensure that adequate materials, labor and other resources are available as needed.
  - b. Maintain the scheduling of the work and report monthly in writing to the University Representative on progress.
  - c. Coordinate with the FMS Site Supervisor and with the Univ. Rep. and work specified in other sections as necessary to maintain progress of the Contract.
2. Maintain a legible copy on-site, accessible to the University Representative upon request of, at minimum, the following documentation:
  - a. The FMS Contract Documents including all approved Change Orders.
  - b. All FMS related written Requests For Information and responses.
  - c. All approved Shop Drawings and other submittals.
  - d. A copy of the FMS Project Schedule.
  - e. Primary FMS related correspondence and minutes
  - f. A record of daily on-site manpower deployment
  - g. Other records as pertinent and required by the Contract Documents.

1.06 REFERENCES

- A. All work shall conform to the following Codes and Standards, as applicable:
  1. National Fire Protection Association (NFPA) Standards.
  2. National Electric Code (NEC) and applicable local Electric Code.
  3. Underwriters Laboratories (UL) listing and labels.



4. UL 864 UUKL Smoke Control
5. UL 268 Smoke Detectors.
6. UL 916 Energy Management
7. NFPA 70 - National Electrical Code.
8. NFPA 90A - Standard For The Installation Of Air Conditioning And Ventilating Systems.
9. NFPA 92A and 92B Smoke Purge/Control Equipment.
10. Factory Mutual (FM).
11. American National Standards Institute (ANSI).
12. National Electric Manufacturer's Association (NEMA).
13. American Society of Mechanical Engineers (ASME).
14. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
15. Air Movement and Control Association (AMCA).
16. Institute of Electrical and Electronic Engineers (IEEE).
17. American Standard Code for Information Interchange (ASCII).
18. Electronics Industries Association (EIA).
19. Occupational Safety and Health Administration (OSHA).
20. American Society for Testing and Materials (ASTM).
21. Federal Communications Commission (FCC) including Part 15, Radio Frequency Devices.
22. Americans Disability Act (ADA)

B. In the case of conflicts or discrepancies, the more stringent regulation shall apply.

C. All work shall meet the approval Applicable Code Requirements at the project site.

#### 1.07 SUBMITTALS

A. Shop Drawings, Product Data, and Samples

1. Submit a list of all shop drawings with submittal dates within 30 days of contract award.

2. Submittals shall be in defined packages. Each package shall be complete and shall only reference itself and previously submitted packages. The packages shall be as approved by the University Representative for Contract compliance.
3. Allow 15 working days for the review of each package by the University Representative in the scheduling of the total FMS work.
4. The Contractor shall correct any errors or omissions individually noted in the first review. The Contractor shall revise the submittal and resubmit for review.
5. At a minimum, submit the following:
  - a. FMS network architecture diagrams including all nodes and interconnections.
  - b. Schematics, sequences and flow diagrams.
  - c. Samples of Graphic Display screen types and associated menu penetrations to show hierarchy and functional interrelationships.
  - d. Detailed Bill of Material list for each Node, identifying quantity, part number, description, and optional features.
  - e. Control Valve Schedules including a separate line for each valve and a column for each of the valve attributes: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close off Pressure, Capacity, Valve CV, Calculated CV, Design Pressure, Actual Pressure, and Actuator Type.
  - f. Room Schedule including a separate line for each VAV box and terminal unit indicating minimum/maximum cfm, pickup gain, box area, and bias setting.
  - g. Product data sheets for all products including software.

#### 1.08 RECORD DOCUMENTATION

##### A. Operation and Maintenance Manuals

1. [Three (3)] copies of the Operation and Maintenance Manuals shall be provided to the Owner's Representative upon completion of the project. The entire Operation and Maintenance Manual shall be furnished on Compact Disc media, and include the following for the FMS provided:
  - a. Table of contents.
  - b. As-built system record drawings. Record drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal.
  - c. Manufacturers product data sheets for all products including software.
  - d. System Operator's manuals.

- e. Archive copy of all site-specific databases and sequences.
  - f. FMS network diagrams.
  - g. Wiring termination schedules.
  - h. Interfaces to all third-party products and work by other trades.
2. The Operation and Maintenance Manual CD shall be self-contained, and include all necessary software required to access the project record drawings and data sheets. A logically organized table of contents shall provide dynamic links to view and print all project record drawings and product data sheets. Viewer software shall provide the ability to display, zoom, and search all documents. The CD-ROM(s) shall contain adequate space for future system updates.

#### 1.09 WARRANTY

##### A. Standard Material and Labor Warranty:

1. Provide a one-year labor and material warranty on the FMS.
2. If within twelve (12) months from the date of acceptance of product, upon written notice from the owner, it is found to be defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted at the option of the FMS subcontractor at the cost of the FMS subcontractor.
3. Maintain an adequate supply of materials within 100 miles of the Project site such that replacement of key parts and labor support, including programming. Warranty work shall be done during FMS subcontractor's normal business hours.
4. Maintain an on-site record of all work done, all items removed from site, all items returned to site, all new replacement items installed and all remedial programming and database entry work undertaken including software revisions installed. Maintain a record of all re-calibrations required as a result of Warranty service.

#### PART 2 – PRODUCTS

##### 2.01 FMS ARCHITECTURE

##### A. Overall Conceptual Description

1. The FMS shall be designed entirely for use on intranets and internets. All networking technology used at the Tier 1 level shall be off the shelf, industry standard technology fully compatible with other owner provided networks in the facility.
2. All aspects of the user interface, whether to servers or to Tier 1 solid state devices, shall be via browsers. Any PCs used as operator interface points shall not require the purchase of any special software from the manufacturer in order to provide the complete user interface as described herein.
3. The user interface will be complete as described herein, providing complete tool sets, operational features, multi- panel displays, and other display features.

Systems which merely provide HTML based web pages as the operator interface will not be acceptable.

4. The primary components of the system will be the Primary Application Nodes and Servers located at the highest level of the network architecture. Both will use the same user interface and provide the same level of accessibility via the network. The only distinction between the user interface used on servers as compared to Primary Application Nodes will be select menu items used for accessing long term storage features on the servers or on their respective archive devices (CD/RW, etc.)

B. General

1. The FMS shall consist of a number of Nodes and associated equipment connected by industry standard network practices. All communication between Nodes shall be by digital means only.
2. The FMS network shall at minimum comprise of the following:
  - a. Operator PCs – fixed or portable.
  - b. Network processing, data storage and communication equipment including file servers.
  - c. Routers, bridges, switches, hubs, modems and like communications equipment.
  - d. Active processing Nodes including field panels.
  - e. Intelligent and addressable elements and end devices.
  - f. Third-party equipment interfaces.
  - g. Other components required for a complete and working FMS.
3. All FMS features shall be accessible via Enterprise Intranet and Internet browser with equivalent FMS access control for user access.
4. The FMS shall support auto-dial/auto-answer communications to allow FMS Nodes to communicate with other remote FMS Nodes via standard telephone lines. Refer to drawings for type of line to be used, DSL or voice grade. Where no preference is indicated, DSL is the preferred grade.
5. Provide licenses for all software residing in the FMS system and transfer these licenses to the Owner prior to completion.

C. Network

1. The FMS shall incorporate a primary Tier 1 network. At the Contractor's option, the FMS may also incorporate integrated secondary Tier 2 and tertiary Tier 3 networks.

2. The FMS Network shall utilize an open architecture capable of all of the following:
  - a. Utilizing standard Ethernet communications and operate at a minimum speed of 10/100 Mb/sec
  - b. Connecting via BACnet at the Tier 1 level in accordance with as per ANSI/ASHRAE Standard 135-2001.
  - c. Connecting via the N2 Protocol at the Tier 2 level.
  - d. Connecting via LonMark as per ANSI/EIA 709 (LonWorks) to LonMark FTT-10 transceivers at the Tier 2 level.
3. The FMS network shall support both copper and optical fiber communication media.

D. Work specified in other sections

1. The contractor supplying other systems will provide their necessary hardware and software and will cooperate fully with the FMS contractor in a timely manner at their cost to ensure complete data integration.

E. Power Fail / Auto Restart

1. Provide for the automatic orderly and predefined shutdown of parts or all of the FMS following total loss of power to parts or all of the FMS.
2. Provide for the automatic orderly and predefined startup of parts or all of the FMS following total loss of power to those parts or all of the FMS. Archive and annunciate time and details of restoration.
3. Provide for the orderly and predefined scheduling of controlled return to normal, automatically time scheduled, operation of controlled equipment as a result of the auto restart processes.

F. Downloading And Uploading

1. Provide the capability to generate FMS software-based sequences, database items and associated operational definition information and user-required revisions to same at any Operator PC, and the means to download same to the associated Application Node.
2. Application software tool used for the generation of custom logic sequences shall be resident in both the application node and the server(s) where indicated on the drawings.
3. Provide the capability to upload FMS operating software information, database items, sequences and alarms to the designated server.
4. The functions of this Part shall be governed by the codes, approvals and regulations applying to each individual FMS application.

## 2.02 OPERATOR INTERFACE

### A. General

1. The FMS Operator Interface shall be user friendly, readily understood and shall make maximum use of colors, graphics, icons, embedded images, animation, text based information and data visualization techniques to enhance and simplify the use and understanding of the FMS by authorized users at the OWS.
  2. It shall be possible to designate any PC on the Tier 1 network as an Operator Interface point. No special software will need to be purchased from the FMS manufacturer for any such PC.
  3. User access to the FMS shall be protected by a flexible and Owner redefinable software-based password access protection. Password protection shall be multi-level and partitionable to accommodate the varied access requirements of the different user groups. Provide the means to define unique access privileges for each individual authorized user. Also provide the means to establish general password groups to which an individual will then be assigned. Once assigned to the group each individual will assume all the capabilities and restrictions of that group. Provide the means to on-line manage password access control under the control of a Master Password.
  4. The user interface shall be able to combine data from any and all of the system components in a single browser window. This shall include historical data stored on a server.
  5. The Operator Interface shall incorporate comprehensive support for functions including, but not necessarily limited to, the following:
    - a. User access for selective information retrieval and control command execution
    - b. Monitoring and reporting
    - c. Alarm, non-normal, and return to normal condition annunciation
    - d. Selective operator override and other control actions
    - e. Information archiving, manipulation, formatting, display and reporting
    - f. FMS internal performance supervision and diagnostics
    - g. On-line access to user HELP menus
    - h. On-line access to current FMS as-built records and documentation
    - i. Means for the controlled re-programming, re-configuration of FMS operation and for the manipulation of FMS database information in compliance with the prevailing codes, approvals and regulations for individual FMS applications.
  6. Provide FMS reports and displays making maximized use of simple English language descriptions and readily understood acronyms, abbreviations and the
-

like to assist user understanding and interpretation. All text naming conventions shall be consistent in their use and application throughout the FMS.

7. All PC-based configurations shall operate on Microsoft® Windows 2000 or Windows XP.
8. Each fixed and portable PC shall be on-line configurable for specific applications, functions and groups of FMS points.

B. Navigation Trees

1. The system will have the capability to display multiple navigation trees that will aid the operator in navigating throughout all systems and points connected. At minimum provide a tree that identifies all systems on the networks.
2. Provide the ability for the operator add custom trees. The operator will be able to define any logical grouping of systems or points and arrange them on the tree in any order. It shall be possible to nest groups within other groups. Provide at minimum 5 levels of nesting.
3. The navigation trees shall be "dockable" to other displays in the user interface such as graphics. This means that the trees will appear as part of the display, but can be detached and then minimized to the Windows task bar or closed altogether. A simple keystroke will reattach the navigation to the primary display of the user interface.

C. Dividable display panels

1. It shall be possible for the operator to divide the display area within a single browser window into multiple display panels. The content of each display panel can be any of the standard summaries and graphics provided by the system.
2. Provide each display panel with minimize, maximize, and close icons.

D. Alarms

1. Alarms shall be routed directly from primary application nodes to PCs and servers. It shall be possible for specific alarms from specific points to be routed to specific PCs and servers. The alarm management portion of the OWS software shall, at the minimum, provide the following functions
  - a. Log date and time of alarm occurrence.
  - b. Generate a "Pop-Up" window, with audible alarm, informing a user that an alarm has been received.
  - c. Allow a user, with the appropriate security level, to acknowledge, temporarily silence, or discard an alarm.
  - d. Provide an audit trail on hard drive for alarms by recording user acknowledgment, deletion, or disabling of an alarm. The audit trail shall include the name of the user, the alarm, the action taken on the alarm, and a time/date stamp.

- e. Provide the ability to direct alarms to an e-mail address or alpha-numeric pager. This must be provided in addition to the pop up window described above. Systems which use e-mail and pagers as the exclusive means of annunciating alarms are not acceptable.
  - f. Any attribute of any object in the system may be designated to report an alarm.
2. The FMS shall annunciate diagnostic alarms indicating system failures and non-normal operating conditions
  3. The FMS shall annunciate application alarms at minimum, as required by Part 3.

E. Reports

1. Reports shall be generated and directed to one or more of the following: User interface displays, printers, or archive at the user's option. As a minimum , the system shall provide the following reports:
  - a. All points in the FMS.
  - b. All points in each FMS application.
  - c. All points in a specific AN.
  - d. All points in a user-defined group of points.
  - e. All points currently in alarm in an FMS application.
  - f. All points locked out in an FMS application.
  - g. All FMS schedules.
  - h. All user defined and adjustable variables, schedules, interlocks and the like.
  - i. FMS diagnostic and system status reports.
2. Provide all applicable standard reports of the FMS manufacturer.
3. Provide for the generation by the user of custom reports as specified in Part 3.

F. Dynamic Color Graphics

1. An unlimited number of graphic displays shall be able to be generated and executed.
2. Graphics shall be based on Scalar Vector Graphic (SVG) technology.
3. Values of real time attributes displayed on the graphics shall be dynamic and updated on the displays.



4. The graphic displays shall be able to display and provide animation based on real-time FMS data that is acquired, derived, or entered.
5. The user shall be able to change values (setpoints) and states in system controlled equipment directly from the graphic display.
6. FMS system shall be provided with a complete user expandable symbol library containing all of the basic symbols used to represent components of a typical FMS system. Implementing these symbols in a graphic shall involve dragging and dropping them from the library to the graphic.

G. Schedules

1. The system shall provide multiple schedule input forms for automatic FMS time-of-day scheduling and override scheduling of FMS operations. At a minimum, the following spreadsheet types shall be accommodated:
  - a. Weekly schedules.
  - b. Temporary override schedules.
  - c. Special "Only Active If Today Is A Holiday" schedules.
  - d. Monthly schedules.
2. Schedules shall be provided for each system or sub-system in the FMS. Each schedule shall include all commandable points residing within the system. Each point may have a unique schedule of operation relative to the system use schedule, allowing for sequential starting and control of equipment within the system. Scheduling and rescheduling of points shall be accomplished easily via the system schedule spreadsheets.
3. Monthly calendars for a 12-month period shall be provided that allow for simplified scheduling of holidays and special days in advance. Holidays and special days shall be user-selected with the pointing device or keyboard, and shall automatically reschedule equipment operation as previously defined on the weekly schedules.

H. Historical trending and data collection

1. Trend and store point history data for all FMS points and values as selected by the user.
2. The trend data shall be stored in a manner that allows custom queries and reports using industry-standard software tools.
3. At a minimum, provide the capability to perform statistical functions on the historical database:
  - a. Average.
  - b. Arithmetic mean.

- c. Maximum/minimum values.
- d. Range – difference between minimum and maximum values.
- e. Standard deviation.
- f. Sum of all values.
- g. Variance.

I. Paging:

- 1. Provide the means of automatic alphanumeric paging of personnel for user-defined FMS events.
  - a. System shall support both numeric and alpha-numeric pagers, using Alphanumeric, PET, or IXO Protocol at the owner's option.
  - b. Users shall have the ability to modify the phone number or message to be displayed on the pager through the system software.
  - c. System shall utilize pager schedules to send pages to the personnel that are "on-call".

2.03 APPLICATION NODES

A. Primary Application Nodes

- 1. The primary application node shall perform the function of monitoring all system variables, both from real hardware points, software variables, and controller parameters such as setpoints.
- 2. Application nodes shall be entirely solid state devices. No rigid disk drives will be permitted in the equipment rooms.
- 3. The primary application nodes shall manage and direct all information traffic on the Tier 1 network, between the Tier 1 and Tier2 networks, and to servers.
- 4. Any node on the Tier 1 network shall be equipped with all software necessary to drive the complete user interface including graphics on a browser connected to the node via the network or directly via a local port on the node.
- 5. The operating system of the application node shall support multi-user access. At minimum four users shall be able to access the same application node simultaneously.
- 6. Communication between nodes shall be per-to-peer via 10/100 Ethernet using the BACnet protocol.
- 7. The AN shall be capable of direct connection to multiple field busses using different protocols simultaneously as indicated below. Should the controller not support multiple field busses, install two primary nodes side by side.

- a. An RS-485 serial field bus such as MSTP or the manufacturer's proprietary field bus.
8. The primary nodes will integrate data from both field busses into a common object structure. Data from both field busses will appear in common displays throughout the user interface in exactly the same format. It shall not be possible to determine which field buss the data originated on without reviewing the system configuration data.
9. AN shall be programmable and governed by the requirements of their applicable codes, approvals and regulations.
10. The AN shall be designed, packaged, installed, programmed and commissioned in consideration of their specific service and prevailing operating conditions. They shall be proven standard product of their original manufacturer and not a custom product for this Project.
11. A failure at an AN shall not cause failures or non-normal operation at any other system AN other than the possible loss of active real-time information from the failed AN.
12. Ancillary AN equipment, including interfaces and power supplies, shall not be operated at more than 80% of their rated service capacity.
13. AN shall comply with FCC Part 15 subpart J class A emission requirements.

**B. HVAC Node**

1. HVAC Node shall provide both standalone and networked direct digital control of HVAC systems.
2. A dedicated HVAC Node shall be configured and provided for each primary HVAC system (air handler, chiller, boiler) and each terminal HVAC system (VAV Box, Unit Heater, Fan Coil Unit, Cabinet Heater, Heat Pump, Fan Powered Box, CV Box)
3. Each HVAC Node shall retain program, control algorithms, and setpoint information in non-volatile memory in the event of a power failure, and shall return to normal operation upon restoration of power.
4. Each HVAC Node shall report its communication status to the FMS. The FMS shall provide a system advisory upon communication failure and restoration.
5. For each primary HVAC system, provide means of indication of system performance and setpoints at, or adjacent to the HVAC Node.
6. For each primary HVAC system, provide a means to adjust setpoints and start/stop equipment at, or adjacent to the HVAC Node.
7. Provide a means to prevent unauthorized personnel from accessing setpoint adjustments and equipment control functions.
8. The HVAC Node shall provide the ability to download and upload configuration data, both locally at the Node and via the FMS communications network.

## 2.04 APPLICATION SOFTWARE

### A. HVAC Application Software

1. Event Messaging: Provide for the automatic execution of user-defined messages on the occurrence of each predefined FMS real-time event including equipment/point status change, approaching limit or alarm, time of day and the like. Direct messages to any number of operator PCs, e-mail destinations, and pagers.
2. Optimum Start/Stop: Provide software to start equipment on a sliding schedule based upon indoor and outdoor conditions, to determine the minimum time of HVAC system operation needed to satisfy the space environmental requirements. The program shall also determine the earliest possible time to stop the mechanical systems. The optimum start/stop program shall operate in conjunction with, and be coordinated with, the scheduled start/stop and night setback programs.
3. Auto Alarm Lockout: Provide for scheduled and automatic lockout of alarm annunciation from equipment during non-normal operating conditions including shutdown, emergency power operation, fire alarm and the like.
4. Energy monitoring: Provide software to monitor and totalize consumption as measured by pulse meters.
5. Event Initiated Programs and custom logic: Provide software to define custom logic sequences that will reside in the nodes. The definition software will also reside in the node and be accesible via the standard user interface via a browser.
6. System Restart: Upon restoration of the AC power to an HVAC Node, automatically restart all equipment and restore all loads to the state as required by the FMS. Provide appropriate time delays to prevent demand surges or overload trips.
7. Heavy Equipment Delays: The system shall provide protection against excessive demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.
8. Runtime Totalization: Automatically sample, calculate and store runtime hours for binary input and output points as listed in the point schedule of this specification.
9. Analog/Pulse Totalization: Sample, calculate and store consumption totals on a daily, weekly, or monthly basis for user-selected analog and binary pulse input-type points.

## 2.05 METERS

### A. All utility meters shall be JCI Metasys N2 network compatible

1. All utility meters shall be installed for easy bypassing and removal for maintenance without interrupting the flow of the primary utility.
2. All master utility meter installations shall be designed for convenient isolation and removal for maintenance without interrupting the flow of the primary utility.

3. The comprehensive metering systems shall be tested and commissioned by an approved commissioning agent.

#### 2.06 ELECTRICAL POWER METERING

##### A. MAIN BUILDING METER

1. To be provided and installed by Division 16. FMS subcontractor to be responsible for wiring and programming device into the FMS.

##### B. SUB METERING

1. "Hawkeye" meter shall be used for electrical utility sub-metering. Hawkeye meters to be provided and installed by FMS subcontractor. FMS subcontractor responsible for programming and wiring of meter.

#### 2.07 NATURAL GAS METERING

- ##### A.
- Natural Gas meter and monitoring devices to be provided and installed by Division 15 contractor. FMS subcontractor to provide necessary conduit, wiring and programming for incorporation into the FMS.

#### 2.08 DOMESTIC WATER METERING

- ##### A.
- Domestic Water meter and monitoring devices to be provided and installed by Division 15 contractor. FMS subcontractor to provide necessary conduit, wiring and programming for incorporation to FMS.

#### 2.09 CHILLED WATER BTU METERING

- ##### A.
- BTU meters shown on plans shall be Onicon System-10-N2 BTU meter(s). This BTU meter will include two Onicon matched temperature sensors and a bi-directional Onicon flow meter. Each BTU meter shall be connected to the Metasys system via the N2 Bus. Temperature, flow, BTUH and accumulated BTUs shall be mapped into the FMS system by FMS subcontractor.

- ##### B.
- This BTU meter is to be provided by FMS subcontractor and installed by Division 15 Contractor.

### PART 3 – PERFORMANCE / EXECUTION

#### 3.01 FMS SPECIFIC REQUIREMENTS

##### A. FMS Reports

1. Define custom reports required for this project here. Examples: tenant billing, chiller efficiency reports, alarm reports, run time summaries,

##### B. Graphic Displays

1. Provide a color graphic system flow diagram display for each system with all points as indicated on the point list. Provide Historical Data Viewer functionality.

2. User shall access the various system schematics and floor plans via a graphical penetration scheme and/or menu selection.

C. Data Visualization Displays

1. Display Requirements

- a. Binary Bar Chart: Provide a single binary bar chart that includes all points as indicated on the point list.
- b. Analog Bar Chart: Provide an individual analog bar chart for each system including all points as indicated on the point list. Provide Historical Data Viewer functionality.
- c. Color Gradient Chart: Provide an individual color gradient chart for each system indicated on the point list, including all points associated with that system as shown on the point list.
- d. Pattern Display: Provide a set of pattern displays. Each pattern display shall contain multiple systems and include all points as indicated on the point list. Provide Historical Data Viewer functionality.
- e. System Chart: Provide an individual system chart for each system indicated on the point list, including all points associated with that system as shown on the point list. Provide Historical Data Viewer functionality.

2. Provide two backup copies of the Data Visualization programming in Microsoft Excel or approved equal on CD-R.

D. Actuation / Control Type

1. Primary Equipment

- a. Controls shall be provided by equipment manufacturer as specified herein.
- b. All damper and valve actuation shall be electric.

2. Air Handling Equipment

- a. All air handlers shall be controlled with DDC controllers
- b. All damper and valve actuation shall be electric.

3. Terminal Equipment:

- a. Terminal Air Boxes (VAV, etc.) shall have electric damper and valve actuation.

### 3.02 INSTALLATION PRACTICES

A. FMS Wiring

1. Low Voltage conduit, wiring, accessories and wiring connections required for the installation of the Facility Management System, as herein specified, shall be provided by the FMS manufacturer/installer unless specifically shown on the Electrical Drawings under Division 16 Electrical. All wiring shall comply with the requirements of applicable portions of Division 16 and all local and national electric codes, unless specified otherwise in this section. All 120V wiring is to be by Division 16.
2. All FMS wiring materials and installation methods shall comply with FMS manufacturer recommendations.
3. The sizing type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the FMS manufacturer/installer. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the FMS subcontractor, the subcontractor shall be responsible for all costs incurred in replacing the selected components.
4. Class 2 Wiring
  - a. All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified.
  - b. Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5' from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements.
5. Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.
6. Perform circuit tests using qualified personnel only. Provide necessary instruments and equipment to demonstrate that:
  - a. All circuits are continuous and free from short circuits and grounds.
  - b. All circuits are free from unspecified grounds; that resistance to ground of all circuits is no less than 50 megohms.
  - c. All circuits are free from induced voltages.
7. Provide complete testing for all cables used under this Contract. Provide all equipment, tools, and personnel as necessary to conduct these tests.
8. Provide for complete grounding of all signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.

B. FMS Line Voltage Power Source

1. 120-volt AC circuits used for the Facility Management System shall be taken from panelboards and circuit breakers provided by Division 16.

2. Circuits used for the FMS shall be dedicated to the FMS and shall not be used for any other purposes.
3. DDC terminal unit controllers may use 120-volt AC power from motor power circuits.

C. FMS Raceway

1. All wiring shall be installed in conduit or raceway except as noted elsewhere in this specification. Minimum control wiring conduit size 1/2".
2. Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.
3. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.
4. Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls. Flexible Metal Conduit shall be UL listed.

D. Penetrations

1. Provide firestopping for all penetrations used by dedicated FMS conduits and raceways. All other project firestopping to be by other trade.
2. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.
3. All wiring passing through penetrations, including walls, shall be in conduit or enclosed raceway.
4. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.
5. No penetrations in structural elements shall be made before receipt of written approval from the architect.

E. FMS Identification Standards

1. Node Identification. All nodes shall be identified by a permanent label fastened to the outside of the enclosure. Labels shall be suitable for the node location.
2. Cable shall be labeled at a minimum of every 18" with the FMS System manufacturer's name and the type of signal carried within the cable, i.e. Analog Input, Analog Output, Binary Input, Binary Output, 24 VAC.
3. Each of the cable types specified in Item A shall be of a different color coding for easy identification and troubleshooting. Recommended color coding:
  - a. Analog Input Cable      Yellow



- b. Analog Output Cable Tan
- c. Binary Input Cable Orange
- d. Binary Output Cable Violet
- e. 24 VAC Cable Gray
- f. General Purpose Cable Natural
- g. Tier 1 Comm Cable Purple
- h. Other Tier Comm Cable Blue

- 4. Raceway Identification. All the covers to junction and pull boxes of the FMS raceways shall be painted with the appropriate color.
- 5. Wire Identification. All low and line voltage FMS wiring shall be identified by a number, as referenced to the associated shop drawing and as-built drawing, at each end of the conductor or cable. Identification number shall be permanently secured to the conductor or cable and shall be typed.

F. FMS Node Installation

- 1. The FMS panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.
- 2. The FMS subcontractor shall be responsible for coordinating panel locations with work specified in other sections including electrical and mechanical contractors.

G. Input Devices

- 1. All Input devices shall be installed per the manufacturer recommendation
- 2. Locate components of the FMS in accessible local control panels wherever possible.

H. HVAC Input Devices – General

- 1. All Input devices shall be installed per the manufacturer recommendation
- 2. Locate components of the FMS in accessible local control panels wherever possible.
- 3. The mechanical contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.
- 4. Input Flow Measuring Devices shall be installed in strict compliance with ASME guidelines affecting non-standard approach conditions.
- 5. Water Differential Pressure Sensors

- a. Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device.
  - b. Differential pressure transmitters shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.
  - c. The transmitters shall be installed in an accessible location wherever possible.
6. Medium to High Differential Water Pressure Applications (Over 21" w.c.):
- a. Air bleed units, bypass valves and compression fittings shall be provided.
7. Duct Temperature Sensors:
- a. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
  - b. The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
  - c. For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.
  - d. The sensor shall be mounted to suitable supports using factory approved element holders.
8. Space Sensors:
- a. Shall be mounted per ADA requirements.
  - b. Provide lockable tamper-proof covers in public areas and/or where indicated on the plans.
9. Air Differential Pressure Status Switches:
- a. Install with static pressure tips, tubing, fittings, and air filter.
10. Water Differential Pressure Status Switches:
- a. Install with shut off valves for isolation.
- I. HVAC Output Devices
1. All output devices shall be installed per the manufacturers recommendation. The mechanical contractor shall install all in-line devices such as control valves, dampers, etc.
  2. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke. When any pneumatic actuator is sequenced

with another device, pilot positioners shall be installed to allow for proper sequencing.

3. Control Valves: Shall be sized for proper flow control with equal percentage valve plugs. The maximum pressure drop for water applications shall be 5 PSI. The maximum pressure drop for steam applications shall be 7 PSI.
4. Electronic Signal Isolation Transducers: Whenever an analog output signal from the Facility Management System is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input a signal from a remote system, provide a signal isolation transducer. Signal isolation transducer shall provide ground plane isolation between systems. Signals shall provide optical isolation between systems

### 3.03 TRAINING

- A. The FMS subcontractor shall provide the following training services:
  1. One day of on-site orientation by a system technician who is fully knowledgeable of the specific installation details of the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings, the FMS software layout and naming conventions, and a walk through of the facility to identify panel and device locations.
  2. Site training for two owner representatives. This training shall be performed by a the site technician and, at a minimum, shall consist of:
    - a. One day training covering system reporting and alarm management.
    - b. One day training of scheduling and point trending

### 3.04 COMMISSIONING

- A Fully commission all aspects of the Facility Management System work.
- B. Acceptance Check Sheet
  1. Prepare a check sheet that includes all points for all functions of the FMS.
  2. Submit the check sheet to the University Representative for approval one month prior to testing.
  3. Complete the check sheet for all items and functions of the FMS and initial each entry with time/date as record of having fully calibrated and tested the FMS. Submit to University Representative.
  4. The Univ. Rep. will use the check sheet as the basis for acceptance testing with the FMS subcontractor.
- C. VAV box performance verification and documentation:

1. The FMS subcontractor shall test each VAV box for where the dampers in one half of a group of boxes are stepped towards full open while the other half are stepped towards full closed. At each step, after a settling time, box air flows and damper positions will be sampled. Following the cycle, a pass/fail report indicating results shall be produced. Possible results are Pass, No change in flow between full open and full close, Reverse operation or Maximum flow not achieved. The report shall be submitted as documentation of the installation.
  2. The FMS subcontractor shall issue a report based on a sampling of the VAV calculated loop performance metrics. The report shall indicate performance criteria, include the count of conforming and non-conforming boxes, list the non-conforming boxes along with their performance data, and shall also include graphical representations of performance. The sampling shall take place after completion of Test and Balance, when design cooling and heating media have been available and occupied conditions approximated for five consecutive days.
- D. Provide all necessary specialist labor, materials and tools to demonstrate to the Engineer that the FMS has been commissioned and is operating in compliance with the contract. Prepare a list of noted deficiencies signed by both the Engineer and the FMS subcontractor.
- E. Promptly rectify all listed deficiencies and submit to the University Representative that this has been completed.

END OF SECTION