PROJECT TITLE
CONTRACT TITLE
UNIVERSITY OF CALIFORNIA, DAVIS
CITY, CALIFORNIA

PROJECT NO: 0000000
GRANT NO: 0000000

SECTION 25 95 30 DDC EMS HARDWARE

PART 1 - GENERAL

1.1   SYSTEM ARCHITECTURE

A.   The system shall be configured as a distributed processing network(s) capable of expansion as specified below.

B.   The system architecture shall consist of a multi-level Local Area Network (LAN) which supports Control Units, Networked Servers, Operator Workstations, and LAN Interface Devices. The following indicates the functional description of the system structure.
1.   Inter-building LAN: Used for communication between Primary Controller LANs located in each building, DDC EMS server, and multiple networked DDC EMS operator workstations. This LAN will consist of using the existing campus Ethernet backbone with TCP/IP protocol. DDC EMS server and operator workstations shall employ native TCP/IP protocol with the Ethernet 10/100BaseT (IEEE802.3) physical layer standard for connection to existing University provided Ethernet routers. DDC EMS server and operator workstations shall not require third party routers, gateways or translators for TCP/IP protocol. The LAN Interface Device shall employ native TCP/IP on the Ethernet 10/100/1000BaseT (IEEE802.3) physical layer for connection to existing University provided Ethernet routers in each building. The LAN Interface Device shall not require third party routers, gateways or translators for TCP/IP protocol.
a.   System shall use the BACnet communication protocol for dynamic communication over an Ethernet based network.
b.   DDC EMS server(s) shall not impose a maximum constraint on the number of DDC EMS installations.
c.   Any PC on the Ethernet backbone shall have transparent communication with all control units/controllers on the building level networks connected via Ethernet. Any DDC EMS operator workstation or server shall be able to interrogate any control unit/controller on the building level network.
d.   Any controller/control unit residing on the peer-to-peer building level networks shall connect to Ethernet backbone without the use of a PC or a gateway with a hard drive.
e.   The standard client and server workstations on the Ethernet backbone shall reside on industry standard Ethernet utilizing standard TCP/IP (IEEE 802.3).
f.   Access to the DDC EMS database shall be available from any standard client workstation on the Ethernet backbone.
g.   Any break in Ethernet communication from the DDC EMS operator workstation to the controllers on the building level networks shall result in an alarm notification at the DDC EMS operator workstation.
h.   Client access to client-server workstation configurations over low-bandwidth network technologies shall be available optionally via Web browser interface. Remote client access via the Web browser interface shall provide multiple, independent sessions of the workstations software – Web browser interface clients shall have DDC EMS operator workstation software access, without the need to install the workstation software on the local hard drive.

       i.   Upon installation of the software, the software shall be hidden in a directory to protect the directory and its contents.

    2.   Primary Controller LAN: Used to connect Primary Control Units (Primary Control Units which generally control central plant equipment, air handlers) within a building. This LAN may be Ethernet 10/100BaseT (IEEE802.3) or a separate high speed peer-to-peer LAN used in conjunction with an Inter-building LAN Interface Device. The LAN Interface Device shall employ native TCP/IP on the Ethernet 10/100BaseT (IEEE802.3) physical layer for connection to existing University provided Ethernet routers in each building. The LAN Interface Device shall not require third party routers, gateways or translators for TCP/IP protocol.

    3.   Secondary Controller LAN: Polling or peer-to-peer LAN to support Terminal Control Units/application specific controllers and interfaces to other third party LANs. The Secondary Controller LAN shall interconnect with the Primary Controller LAN using a LAN Interface Device which may or may not be an integral part of a Primary Control Unit.

C.   Dynamic Data Access: Any data throughout any level of the network shall be available to and accessible by all other devices, Control Units, LAN Interface Devices, and DDC EMS operator workstations.

D.   Intranet/Internet access

    1.   Web Based Operator Interface
       a.   The DDC EMS shall provide a web based graphical interface that allows users to access the DDC EMS data via the Internet, extranet, or Intranet. Native Internet-based user interfaces (HTML, Java, XML, etc.), that do not require a plug-in, are acceptable. User interfaces that use an automatically downloaded and installed browser plug-in, or 'thick' client, that presents the user interface across the web are acceptable or equal, provided the plug-in is readily available at no additional cost to the University.
       b.   A rack-mounted web server and associated hardware shall be supplied by the Contractor (see DDC EMS Server requirements below). The DDC EMS server may not be used as the web server. The web server shall use Microsoft's IIS Server 6.0 (or newer) with Windows Server 2008 (or newer), and support web browser access via latest version of Microsoft Internet Explorer.
       c.   All information exchanged over Internet shall be optionally encrypted and secure via SSL.
       d.   Access to the web browser interface shall be password protected. A user's rights and privileges to points and graphics shall be the same as those assigned at the DDC EMS operator workstation.   An option shall exist to only allow users "read only" access via the web browser, while maintaining "command" privileges via the DDC EMS operator workstation.
       e.   All graphics available at the DDC EMS operator workstation shall be available to users via a web browser.
       f.   The web-based interface shall provide the following functionality to users, based on their access and privilege rights:
          1)   Logon Screen – allows the user to enter their user name, password and domain name for logging into the web server.
          2)   Alarm Display – a display of current EMS alarms to which the user has access shall be displayed. Users shall be able to acknowledge and erase active alarms, and link to additional alarm information including alarm messages, and informational and memo text. Any alarm acknowledgements initiated through the web interface shall be written to the EMS central workstation activity log.
          3)   Graphic Display – Display of system graphics available in the DDC EMS operator workstation shall be available for viewing over the web browser. Software that requires creation of dedicated "web" graphics in order to display them via the browser interface are not acceptable.   A graphic selector list shall allow users to select any graphics to which they have access. Graphic displays shall automatically

        refresh with the latest change of values. Users shall have the ability to command and override points from the graphic display as determined by their user accounts rights.

    4)   Point details – users shall have access to point detail information including operational status, operational priority, physical address, and alarm limits, for point objects to which they have access rights.

    5)   Point Commanding – users shall be able to override and command points they have access to via the web browser interface. Any commands or overrides initiated via the web browser interface shall be written to the EMS central workstation activity log.

    6)   Scheduling – allows users to create modify, override or delete existing schedule of reports, zones and trend collection depending on their current user privileges.

    7)   Run Reports – allows users to run and print a pre-configured report through a web interface client.

  g.   The web server licensing options shall not restrict the number of concurrent browser connections by users with valid credentials.

  h.   Internet connections, ISP services, as well as necessary firewalls or proxy servers shall be provided by the Contractor and configured by the University as required to support the web access feature.

E.   The system architecture and LAN nodal capacities shall accommodate expansion to an eventual maximum configuration as follows:
1.   150,000 system I/O points total.
2.   150 I/O buildings with a primary LAN in each building.
3.   Up to 500 I/O points on primary controllers in each building.
4.   Up to 1000 I/O points on secondary controllers in each building.

F.   The communication speed between the Control Units, LAN interface devices, and operator interface devices shall be sufficient to ensure fast system response time under the maximum future loading condition. In no case shall delay times between an event, request, or command initiation and its completion be greater than the following. Contractor shall reconfigure LAN as necessary to accomplish these performance requirements. Transmission time over University provided Ethernet backbone may be excluded from the response time.
1.   5 Seconds between and a Level 1 (critical) alarm occurrence and enunciation at operator workstation.
2.   10 Seconds between a Level 2 alarm occurrence and enunciation at operator workstation.
3.   20 Seconds between and a Level 3-5 alarm occurrence and enunciation at operator workstation.
4.   10 Seconds between an operator command via the operator interface to change a setpoint and the subsequent change in the controlling Control Unit.
5.   5 Seconds between an operator command via the operator interface to start/stop a device and the subsequent command to be received at the controlling Control Unit.
6.   10 Seconds between a change of value or state of an input and it being updated on the operator interface.
7.   10 Seconds between an operator selection of a graphic and it completely painting the screen and updating at least 10 points.

G.   Polling Secondary LANs shall operate at a minimum baud rate of 4800 baud. Application and node restrictions for polling LANs based on application and communication speed are specified below.

H.   The DDC EMS server and operator workstations shall provide for overall system supervision, operator interface, management report generation, alarm annunciation, remote monitoring and back-up and loading of software and data to be stored in control unit volatile memory.

PROJECT TITLE
CONTRACT TITLE
UNIVERSITY OF CALIFORNIA, DAVIS
CITY, CALIFORNIA

PROJECT NO: 0000000
GRANT NO: 0000000

I.   The primary and secondary control units shall monitor, control, and provide the field interface for all field points. Each Primary Control Unit or Secondary Control Unit shall be capable of performing energy management functions, and Distributed Digital Control (DDC) functions, independent of other Primary Control Units or Secondary Control Units and operator interface devices as more fully specified below.

J.   Interruptions or fault at any point in the primary LAN shall not interrupt communications between other nodes on the network. If a primary LAN is severed, 2 separate networks shall be formed and communications within each network shall continue uninterrupted.

K.   All gateways, modems, line drivers, signal boosters, and signal conditioners etc. shall be provided as necessary for proper data communication.

L.   Anytime any control unit's database or program is changed in the field, the controller shall either be capable of automatically uploading the new data to the system operator interface, or shall report an error condition on the graphic workstation screen if the workstation program or database does not match the control unit's program or database.

1.2   LISTING AND LABELING

A.   The DDC EMS and components shall be listed by Underwriters Laboratories (UL 916 PAZX).

PART 2 - PRODUCTS

2.1   MANUFACTURER

A.   The University has identified the following manufacturers as meeting the criteria listed above: Siemens/Siemens Apogee Controls (Basis of Design), Automated Logic Controls, and Johnson Controls, or equal.

B.   The Siemens Apogee Control System is the basis of design, or equal.

2.2   SURGE PROTECTION

A.   The Contractor shall furnish and install any power supply surge protection, filters, etc. as necessary for proper operation and protection of all Primary Control Units, Secondary Control Units, operator interfaces, printers, and other hardware and interface devices. All equipment shall be capable of handling voltage variations 10 percent above or below measured nominal value, with no affect on hardware, software, communications, and data storage.
   1.   Minimum power supply surge protection technical specification requirements shall be as follows:
       a.   On-line Input Voltage Range of 88-139VAC.
       b.   Automatic Voltage Regulation (AVR) of +/- 12 percent.
       c.   On-line Frequency Range of 47-63Hz.
       d.   Maximum Power Loading: 1000VA (600W min.); 1500VA (865W max.).
       e.   Ambient Operating Temperature Range of 32 to 104 degrees F (0 to 40 degrees C).
       f.   Operational Relative Humidity Range of 0 to 95 percent RH, non-condensing.
   2.   The Contractor shall provide a rack mountable Uninterrupted Power Supply (UPS) for each server for proper system operation and DDC EMS database protection during power outages.
   3.   The Contractor shall also provide a stand-up Uninterrupted Power Supply (UPS) in the main Temperature Control Panel (TCP) for each new DDC EMS installation for the proper operation of all PCUs, SCUs, and other control, hardware, and interface devices installed within the building. All equipment shall be capable of handling voltage variations 10 percent above or below measured nominal value, with no affect on hardware, software, communications, and data storage.

PROJECT TITLE
CONTRACT TITLE
UNIVERSITY OF CALIFORNIA, DAVIS
CITY, CALIFORNIA

PROJECT NO: 0000000
GRANT NO: 0000000

4. Minimum UPS technical specification requirements shall be as follows:
    a. On-line Input Voltage Range of 88-139VAC.
    b. Automatic Voltage Regulation (AVR) of +/- 12 percent.
    c. On-line Frequency Range of 47-63Hz.
    d. Typical Recharge Time: 8 hours.
    e. Maximum Power Loading: 1000VA (600W min.); 1500VA (865W max.).
    f. Ambient Operating Temperature Range of 32 to 104 degrees F (0 to 40 degrees C).
    g. Operational Relative Humidity Range of 0 to 95 percent RH, non-condensing.
    h. EMI Classification: FCC/DOC Class B Certified.

2.3   DDC EMS OPERATOR WORKSTATION

A. Provide personal computer (PC) with Intel® Pentium® Extreme Edition Dual Core Processor with HT Technology operating at 3.2GHz, 800FSB minimum speed. Include 2GB Dual Channel DDR2 SDRAM at 533MHz and minimum of two (2) 250 GB/7200 RPM hard disk drives. Provide a 16X max DVD+/-RW drives, 4 USB ports, 100/1000 Base-T network card. Provide a 24 inch Wide Screen Flat Panel monitor minimum 1900X1200 (WSXGA+) monitor or equal.

B. Provide detachable keyboard with standard typewriter layout, function keys, and separate numeric keypad. Provide a USB wireless optical mouse and mouse pad with the system.

C. Provide an UPS system providing battery backup for each DDC EMS operator workstation and peripheral devices. The UPS shall protect against blackouts, brownouts, surges and noise. The UPS shall include LAN port and modem line surge protection. The UPS shall be sized for a 7-minute full load runtime, 23-minute 1/2 load runtime, with a typical runtime of up to 60 minutes. Transfer time shall be 2-4 milliseconds. The UPS shall provide a 480-joule suppression rating and current suppression protection for 36,000 amps and provide 90% recharge capability in 2-4 hours. Suppression response time shall be instantaneous. The UPS low voltage switching shall occur when supply voltage is less than 94 volts. The UPS shall be provided with modem surge suppression and LAN port connections. Provide all software, cables, peripherals etc. for a complete system.

D. The DDC EMS operator workstation shall have the capability of changing serial port interrupt vectors and IOBASE addresses through software.

E. Operating system software shall be that required to operate the manufacturer's application software.

F. Provide network card approved by DDC EMS manufacturer to support Supervisory LAN communications (100/1000 Mbps Ethernet TCP/IP) for each DDC EMS operator workstations connected to the Local Supervisory LAN and network card or LANID where connected to the Primary Controller LAN.

G. Provide software, graphics and programming as specified in DDC EMS Software specification section.

H. Provide additional hardware, video drivers, network cards, etc., to facilitate all communications, control functions and software requirements specified for the automatic temperature control system.

I. The DDC EMS Operator Workstation shall be installed at the campus EMS Central Control Center.

2.4   PORTABLE OPERATOR'S TERMINAL / REMOTE DDC EMS OPERATOR WORKSTATION

A. The POT shall support system management either connected directly to the Control Units, LAN Interface Devices, intelligent thermostats, or via dial-up communications while serving as a remote DDC EMS operator workstation.

B. Provide a notebook personal computer (PC) with Intel® Pentium® M Processor 740 (minimum 2GHz) w/ATI RADEON X600 128MB. Include 2GB 800MHz, DDRII SDRAM, 2 DIMMS - Dual Channel memory and minimum 250GB/5400 RPM hard disk drive, 24X CD-RW/DVD Drive, and serial port. Provide a Wireless 802.11b/g/n internal WLAN, serial and parallel ports, Type II and Type III PCMCIA slots, touch pad, rechargeable battery, and 110V power supply/charger; or equal. Provide minimum 15.4 inch WXGA display.

C. Provide a 100/1000 LAN Card.

D. Provide carrying case and extra battery.

E. Operating system software shall be that required to operate the manufacturer's application software.

F. Provide software, graphics and programming as specified in DDC EMS Software section.

G. Provide additional hardware, video drivers, etc., to facilitate all control functions and software requirements specified for the automatic temperature control system.

2.5 HAND HELD OPERATOR'S TERMINAL

A. Provide manufacturers standard HHOT for connecting to controllers and thermostats. Capabilities of the HHOT shall include the following as a minimum:

1. Display of physical and virtual point values.
2. Adjustment of setpoints and adjustable parameters.
3. Temporary override of commands and point values.
4. Temporary override of time schedules.
5. Display of alarm conditions and CU diagnostics.

B. HHOTs shall be fully portable and shall not require external power connection. Read out shall be as a minimum 40 character LCD.

C. Provide all necessary cables for required connection to Primary Control Units, Secondary Control Units, gateways, enhanced zone sensors, etc.

D. Provide manufacturers standard battery charging device in same quantity as required for hand held device.

2.6 LAN INTERFACE DEVICES

A. LAN Interface Devices shall be microprocessor based communications devices which act as gateways between the Primary Controller LAN and the Inter-building LAN, and between the Primary Controller LAN and the Secondary Controller LAN. They may also function as a gateway between the Primary Controller LAN and a modem to support remote building operator interface or a printer. These may be provided within a Primary Control Unit or as a separate device.

B. The LAN Interface Device shall perform information translation between the Primary LAN, Inter-building LAN, and the Secondary LAN, supervise communications on a polling secondary LAN, and shall be applicable to systems in which the same functionality is not provided in the Primary Control Unit. In systems that the LAN Interface Devices are separate devices, they shall contain their own

microprocessor, RAM, battery, real time clock, communication ports and, power supply etc. as specified elsewhere for a primary control unit. Each LAN Interface Device shall be completely enclosed, secured, and locked within a panel.

C. Each LAN Interface Device shall support interrogation, full control, and all utilities associated with of all Primary Control Units on the Primary LAN, all Secondary Control Units connected to all secondary LANs under the Primary LAN, and all points connected to those Primary Control Units and Secondary Control Units.

D. LAN Interface Device shall support all operator interface operations without degrading the performance of the control functions and communications.

E. Upon loss of power to a LAN Interface Device, the battery shall provide for minimum 100 hour back-up of all programs and data in RAM. The battery shall be sealed and self charging.

F. LAN Interface Devices in remote buildings shall support auto answer/auto dial communications between remote building Primary Controller LAN (or standalone Primary Control Unit) and the Inter-building LAN. LAN Interface Device functionality shall support:
1. Automatic dial out to a single modem on the Inter-building LAN to report alarm conditions, download trend data, etc., as required elsewhere in these specifications, to any Operator Workstation(s) on the Inter-building LAN, including Operator Workstations on the Inter-building LAN which are not equipped with modems.
2. Multiple retries for unsuccessful connection.
3. Multiple number dial out.
4. Buffering of incoming and outgoing data.
5. Automatic answer.
6. Uploading and downloading of control unit programs.

G. The LAN Interface Device shall be transparent to control functions and shall not be required to control information routing on the Primary LAN.

2.7   LABORATORY AIRFLOW CONTROL SYSTEM INTERFACE DEVICE

A. Provide a microprocessor-based communications device that acts as a gateway between the DDC EMS and the Laboratory Airflow Control System. [Refer to Section 25 95 05 for Laboratory Airflow Controls.]

B. The interface device shall support full bi-directional communication between both systems using the BACnet protocol.

C. The interface device shall contain its own microprocessor, RAM, battery, communication ports, and power supply.

D. At a minimum, the following points shall be mapped to the DDC EMS:
1. The following set points shall be adjustable at the central EMS DDC station:
    a. Zone occupancy schedule for each laboratory zone.
    b. Zone occupied heating set-point.
    c. Zone occupied cooling set-point.
    d. Zone unoccupied cooling set-point.
    e. Zone occupied cooling set point.
    f. Position command for zone re-heat coil valves.
2. The following points shall be transferred for monitoring only:
    a. Supply terminal air volume for each valve (or valve position).
    b. General exhaust terminal air volume for each valve (or valve position).

PROJECT TITLE
CONTRACT TITLE
UNIVERSITY OF CALIFORNIA, DAVIS
CITY, CALIFORNIA

PROJECT NO: 0000000
GRANT NO: 0000000

    c.   Fume hood terminal air volume (or valve position).

    d.   d. Current laboratory air volume offset set-point.

    e.   Canopy hood terminal air volume (or valve position)

    f.   Zone temperature.

    g.   Zone occupancy status.

    h.   Re-heat coil valve position command.

    i.   Lab general Alarm.

2.8 PRIMARY CONTROL UNITS

A. Each Primary Control Units (PCU) shall have sufficient memory to support its own operating system and databases, including:

1. Control processes.
2. Energy management applications.
3. Alarm management applications.
4. Historical/trend data for points specified.
5. Maintenance support applications.
6. Custom processes.
7. Operator I/O.
8. Remote communications.

B. PCUs shall provide local LED status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device. All status indications must be visible at all times, scrolling displays area not acceptable.

C. Each PCU shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all components. PCUs shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failure to establish communication.

D. PCUs shall provide intelligent, standalone control of HVAC functions. PCUs shall be factory assembled, burned-in, tested and UL listed as one integral unit. PCUs shall be a 12-bit stand-alone, multi-tasking, multi-user, real-time digital control processors consisting of modular hardware with plug-in enclosed processors. Each PCU shall have its own internal RAM, nonvolatile memory, microprocessor, battery backup, A/D converters, regulated power supply, power conditioning equipment, wiring terminal strips, ports for connection of operating interface devices, and control enclosure. PCUs shall be programmable from any DDC EMS operator workstation, portable operators terminal, or hand held operating device. PCUs shall contain sufficient memory for specified global control strategies, user defined reports, communication programs, trending of all points, and central alarming.

E. PCUs communicate over a primary high speed, local area network. They perform overall system coordination, accept control programs, perform automated HVAC functions, control peripheral devices and perform all necessary mathematical and logical functions. PCUs share information with the entire network of PCUs and SCUs for full global control. Each controller shall permit multi user operation from multiple workstations and portable operator terminals connected either locally or over the Primary LAN.

F. Each PCU shall be capable of standalone direct digital operation utilizing its own processor, nonvolatile memory, input/output, A to D conversion, real time clock/calendar and voltage transient and lightning protection devices. All PCUs shall be protected from any memory loss due to a loss of power by one or a combination of the following:

1. Volatile RAM (32MB minimum) shall have a battery backup using a standard alkaline battery with a rated service life of 14 days, and a rated shelf life of at least 3 years. Self- diagnostic routine shall report an alarm for a low battery condition.

2. EEPROM, EPROM, or NOVROM nonvolatile memory.

G. The PCU shall provide for point mix flexibility and expandability. This requirement may be met via either a family of expander boards, modular input/output configuration, or a combination thereof. Any expansion devices shall connect directly to the microprocessor bus and receive the same functionality as that on the main board. Also, slave expansion panels may be used for point expansion provided they are located immediately adjacent to the PCUs and are designed as expansion devices. SCU's may not be used as expansion devices.
1. Each PCU shall have the capability of expanding to accept 500 I/O points through the use of I/O expansion modules on its microprocessor communication bus.

H. All PCU point data, algorithms, reporting, trends, messages, run time totalizations, and application software shall be modifiable from the DDC EMS operator workstation(s).

I. Each PCU shall execute application programs, calculations, and commands via a microprocessor resident in the PCU. The database and all application programs for each PCU shall be stored in nonvolatile or battery backed volatile memory within the PCU will be able to upload to, and download from, the DDC EMS operator workstation(s).
1. Each PCU used to control equipment serving the BSL-3 or Vivarium shall be capable of program changes, downloads and uploads without interfering with normal airflows and fan operation.

J. PCUs shall provide buffer for holding alarms, messages, trends, runtime totalizations, etc. for a minimum of 48 hours.

K. Each PCU shall be connected to the Primary LAN communicating to/from other PCUs. Each PCU shall include self test diagnostics which allow the PCU to automatically alarm any malfunctions or alarm conditions that exceed desired parameters as determined by programming input.

L. Each PCU shall contain both software and hardware to perform full DDC/PID control loops. Self-learning tuning loops softward such as "Adaptive Loop Control" shall be used for variable flow systems (CHW, HHW, Static Air Pressure, etc.).

M. Input-Output Processing:
1. Digital Outputs (DO): A minimum of 8 DOs shall be available on the PCU. Digital Outputs shall be a form C contact rated for a minimum 240VAC, 4A maximum current. Each DO shall have a supervised manual Hand-Off-Auto (HOA) switch to allow for override and a LED to indicate the operating mode of the DO. If these HOA switches are not provided on the main board they shall be provided via isolation relays within the control enclosure and shall be supervised. Each DO shall be discrete outputs from the PCU's PC board (multiplexing to a separate manufacturer's PC board is unacceptable). Provide suppression to limit transients to acceptable levels.
2. Analog Inputs (AI): A minimum of 8 AIs shall be available on the PCU. 0-5Vdc, 0-10Vdc, and 0 or 4-20mA. Provide signal conditioning, and zero and span calibration for each AI. Each AI shall be a discrete input to the PCU PC board (multiplexing to a separate manufacturer's PC board is unacceptable unless specifically indicated otherwise). A/D converters shall have a minimum resolution of 12 bits.
3. Digital Inputs (DI): A minimum of 8 DIs shall be available on the PCU. DIs monitor dry contact closures. Pulsed inputs of at least 25 per second with a minimum of a 20mS pulse duration are acceptable. Source voltage for sensing shall be supplied by the PCU and shall be isolated from the main PC board. Software multiplexing of an AI point and resistors is not acceptable.

4. Universal Inputs (UI-AI or DI): To serve as either AI or DI as specified above. If Universal Inputs are supplied, the overall minimum of 8 points of each type (AI, DI, AO, and DO) must still be available on the PCU.

5. Electronic Analog Outputs (AO): A minimum of 8 AOs shall be available on the PCU. Voltage mode, 0-5Vdc and 0-10Vdc; current mode 0 or 4-20mA. Provide zero and span calibration and circuit protection. Pulse Width Modulated (PWM) analog via a DO and transducer is acceptable unless stipulated otherwise for a given control loop. Transducer shall be programmable for normally open (NO), normally closed (NC), or hold last position and shall allow adjustable timing. Each AO shall be discrete outputs from the PCU's PC board (multiplexing to a separate manufacturer's PC board is unacceptable). D/A converters shall have a minimum resolution of 8 bits. Multiplexing of a single AO for control of both hot water valve and chilled water valve by using a changeover relay shall not be acceptable.

6. Analog Output Pneumatic (AOP), 0-20psi: Pneumatic outputs via digital to pneumatic transducers as a standard product and part of the PCU, with pressure feedback supplied. Pressure feedback shall monitor individual pressure outputs. Multiplexed pneumatic outputs are not acceptable. Pressure feedback of a separate manufacturer; I/P transducer, PWM/P transducer, or digital to pneumatic transducer of a separate manufacturer is acceptable.

7. Pulsed Inputs: Capable of counting up to 25 pulses per second with buffer to accumulate pulse count. Pulses shall be counted at all times.

N. A communication port for operator interface through a terminal shall be provided in each PCU. It shall be possible to perform all program and database backup, system monitoring, control functions, and PCU diagnostics through this port. Standalone PCUs (single PCUs in remote buildings, not on a Primary LAN) shall allow temporary use of portable devices without interrupting the normal operation of permanently connected printers, or workstations. Communication port shall be integral to the PCU, factory installed and tested. PCU field installation of communication ports is not acceptable.

O. Each PCU shall be equipped with loop tuning algorithm for precise, proportional, integral, derivative (PID) control. ADAPTIVE Loop Tunig, or "self learning" tuning should be used on all control loops for CHW, HHW Control, Supply Static Pressure and temperature, Bldg Pressure control and process Control loops.

P. Slope intercepts and gain adjustments shall be available on a per point basis.

Q. PCU Power Loss:
1. Upon a loss of power to any PCU, the other control units on the building level network shall not in any way be affected.
2. Upon a loss of power to any PCU, the battery backup shall ensure that the energy management control software, the DDC software, the EMS database parameters, and all other programs and data stored in the RAM are retained for a minimum of 50 hours. An alarm diagnostic message shall indicate that the PCU is under battery power.
3. Upon restoration of power within the specified battery backup period, the PCU shall resume full operation without operator intervention. The PCU shall automatically reset its clock such that proper operation of any time dependent function is possible without manual reset of the clock. All monitored functions shall be updated.
4. Should the duration of a loss of power exceed the specified battery backup period or PCU panel memory be lost for any reason, the panel shall automatically report the condition (upon resumption of power) and be capable of receiving a down load from any DDC EMS operator workstation via the EtherNet LAN. In addition, the University shall be able to upload the most current versions of all energy management control programs, DDC programs, EMS database parameters, and all other data and programs in the memory of each PCU to any DDC EMS operator workstation via the EtherNet LAN or to the laptop PC via the local RS-232C port.

R. PCU Failure:
    1. Primary LAN Data Transmission Failure: The PCU shall continue to operate in stand alone mode. The PCU shall store loss of communication alarm along with the time of the event. All control functions shall continue with the global values programmable to either last value or a specified value. Peer PCUs shall recognize the loss, report alarm and reconfigure the Primary LAN.
    2. PCU Hardware Failure: The PCU shall cease operation and terminate communication with other devices.

S. Each PCU shall be equipped with firmware resident self diagnostics for sensors and be capable of assessing an open or shorted sensor circuit, and sensor input signal out of range conditions, and taking an appropriate control action (close valve, damper, etc.).

T. PCUs may include LAN communications interface functions for controlling secondary controlling LANs.

U. A minimum of 4 levels of password protection shall be provided at each PCU.

2.9   SECONDARY CONTROL UNITS

A. Secondary Control Units shall include Unitary Controllers (UC), Terminal Equipment Controllers (TEC), and/or Application Specific Controllers (ASC) which provide intelligent, limited stand-alone control of HVAC equipment. Each unit shall have its own internal battery backed RAM and/or nonvolatile memory and will continue to operate all local control functions in the event of a loss of communications on the secondary LAN. Refer to stand alone requirements by application specified in Part 3 of this Section. In addition, it shall be able to share information with every other Primary Control Units and Secondary Control Units on the entire network.

B. Each SCU shall include self-test diagnostics which allow the SCU to automatically relay to the PCU, LAN Interface Device, or DDC EMS operator workstation any malfunctions or abnormal conditions within the SCU or alarm conditions of inputs that exceed desired parameters as determined by programming input.

C. SCUs shall include sufficient memory to perform the specific control functions required for its application and to communicate with other devices.

D. Each SCU must be capable of stand alone DDC operation utilizing its own processor, battery-backed or nonvolatile memory, input/output, minimum 10 bit A to D conversion, voltage transient and lightning protection devices. All volatile memory shall have a battery backup of at least 50 hours using a lithium battery with a rated shelf life of 5 years.

E. All point data, algorithms and application software within a SCU shall be modifiable from the DDC EMS operator workstation, POT, and HHOT.

F. SCU Input-Output Processing:
    1. Digital Outputs (DO): DOs shall be rated for a minimum 24VA/Vdc, 0.5A maximum current. Each DO shall be discrete outputs from the SCU's PC board (multiplexing to a separate manufacturer's PC board is unacceptable). Provide suppression to limit transients to acceptable levels.
    2. Analog Inputs (AI): 0-5Vdc, 0-10Vdc, 0 or 4-20mA, or temperature thermistor depending on application. Provide signal conditioning, and zero and span calibration for each input. Each AI shall be a discrete input to the SCU's PC board (multiplexing to a separate manufacturer's PC board is unacceptable unless specifically indicated otherwise). A/D converters shall have a minimum resolution of 10 bits.

3. Digital Inputs (DI): DI's monitor dry contact closures. Pulsed inputs of at least one per second are acceptable. Source voltage for sensing shall be supplied by the SCU and shall be isolated from the main PC board. Software multiplexing of an AI and resistors is not acceptable.
4. Universal Inputs (UI-AI or DI): To serve as either AI or DI as specified above.
5. Electronic Analog Outputs (AO) voltage mode, 0-5Vdc and 0-10Vdc; current mode (0 or 4-20mA). Provide zero and span calibration and circuit protection. Pulse Width Modulated (PWM) analog via a DO and transducer is acceptable unless stipulated otherwise for a given control loop. Transducer shall be programmable for normally open (NO), normally closed (NC), or hold last position and shall allow adjustable timing. Each AO shall be a discrete output from the SCU's PC board (multiplexing to a separate manufacturer's PC board is unacceptable). D/A converters shall have a minimum resolution of 8 bits. Multiplexing of a single AO for control of both hot water valve and chilled water valve by using a changeover relay shall not be acceptable.
6. Analog Output Pneumatic (AOP), 0-20psi: Pneumatic outputs via digital to pneumatic transducers as a standard product and part of the SCU, with pressure feedback supplied. Pressure feedback shall monitor individual pressure outputs. Multiplexed pneumatic outputs are not acceptable. Pressure feedback of a separate manufacturer; I/P transducer, PWM/P transducer, or digital to pneumatic transducer of a separate manufacturer is acceptable.

G. Each SCU shall be equipped with loop tuning algorithm for precise, proportional, integral, derivative (PID) control. Loop tuning tools provided with the DDC EMS operator workstation software is acceptable. In any case, tools to support loop tuning must be provided such that P, I, and D gains are automatically calculated.

H. Slope intercepts and gain adjustments shall be available on a per point basis.

I. SCU Power Loss:
1. Upon a loss of power to any SCU, the other control units on the building level network shall not in any way be affected.
2. Upon a loss of power to any SCU, the battery backup shall ensure that the energy management control software, the DDC software, the EMS database parameters, and all other programs and data stored in the RAM are retained for a minimum of 50 hours. An alarm diagnostic message shall indicate that the SCU is under battery power.
3. Upon restoration of power within the specified battery backup period, the SCU shall resume full operation without operator intervention. The SCU shall automatically reset its clock such that proper operation of any time dependent function is possible without manual reset of the clock. All monitored functions shall be updated.
4. Should the duration of a loss of power exceed the specified battery backup period or SCU panel memory be lost for any reason, the panel shall automatically report the condition (upon resumption of power) and be capable of receiving a down load from any DDC EMS operator workstation via the EtherNet LAN. In addition, the University's Representative shall be able to upload the most current versions of all database parameters to any DDC EMS operator workstation via the EtherNet LAN, or to the laptop PC via the local RS-232C port.

J. SCU Hardware Failure: SCU shall cease operation and terminate communication with other devices. All outputs shall go to their specified fail position.

K. A minimum of 1 level of password protection shall be provided at each SCU.

L. Terminal Box Controllers:
1. Terminal box controllers (in non-laboratory applications) controlling damper positions to maintain a quantity of supply or exhaust air serving a space shall have an automatically initiated function that resets the volume regulator damper to the fully closed position on a scheduled basis. The controllers shall initially be set up to perform this function once every 24

hours.   The purpose of this required function is to reset and synchronize the actual damper position with the calculated damper position and to assure the damper will completely close when commanded. The software shall select scheduled boxes randomly and shall not allow more than 5 percent of the total quantity of controllers in a building to perform this function at the same time. When possible the controllers shall perform this function when the supply or exhaust air system is not operating or is unoccupied.

2.10   DDC EMS SERVER

A.   The DDC EMS Server System shall consist of four (4) separate rack-mounted servers meeting the following requirements.

B.   Rack-Mounted Server 1 (Main Server): This server shall house the system configuration database and application programming. The basis of design is the PowerEdge Server by Dell. The server shall be equal to the following requirements:
1.   PowerEdge 2950: Quad Core Intel® Xeon® X5355, 2x4MB Cache, 2.66GHz, 1333MHz FSB 295C26 - [222-7342]
2.   Additional Processor: Quad Core Intel® Xeon® X5355 2x4MB Cache, 2.66GHz, 1333MHz FSB 2PC26 - [311-6968]
3.   Memory: 8GB 667MHz (4x2GB), Dual Ranked DIMMs 8G4D6D - [311-6197]
4.   Hard Drive Configuration: Integrated SAS/SATA RAID 10, PERC 5/i Integrated MSR10 - [341-3061]
5.   Backplane: 1x6 Backplane for 3.5-inch Hard Drives 1X635HD - [311-5747]
6.   Primary Controller: PERC 5/i, x6 Backplane, Integrated Controller Card PERC5I6 - [341-3066]
7.   Primary Hard Drive: 750GB 7.2K RPM Universal SATA 3Gbps 3.5-in HotPlug Hard Drive 750SU - [341-4430]
8.   2nd Hard Drive: 750GB 7.2K RPM Universal SATA 3Gbps 3.5-in HotPlug Hard Drive 750SU - [341-4430]
9.   3rd Hard Drive: 750GB 7.2K RPM Universal SATA 3Gbps 3.5-in HotPlug Hard Drive 750SU - [341-4430]
10. 4th Hard Drive: 750GB 7.2K RPM Universal SATA 3Gbps 3.5-in HotPlug Hard Drive 750SU - [341-4430]
11. CD/DVD Drive: 24X IDE CD-RW/DVD ROM Drive CDRWDVD - [313-3934]
12. Floppy Drive: No Floppy Drive for x6 Backplane NFDX6 - [341-3685]
13. Network Adapter: Dual Embedded Broadcom® NetXtreme II 5708 Gigabit Ethernet NIC OBNIC - [430-1764]
14. TCP/IP Offload Engine Enablement: Broadcom TCP/IP Offload Engine Not Enabled NTOEKEY - [430-1765]
15. Chassis Configuration: Rack Chassis w/Sliding Rapid/Versa Rails and Cable Management Arm,Universal RPVERSA - [310-7412]
16. Bezel: Rack Bezel BEZEL - [313-3920]
17. Open Manage Subscription: Open Manage Subscription (8 edition) OMSUB8 - [902-9887]
18. Power Supply: Redundant Power Supply with Dual Cords RPS - [310-7422]
19. Documentation: Electronic Documentation and Open Manage CD Kit EDOCS - [310-7415]
20. Hardware Support Services: 3Yr BASIC SUPPORT: 5x10 HW-Only, 5x10 NBD Onsite U3OS - [960-8162 960-8192 970-4070 984-1399 984-1417]
21. Installation Support Services: No Installation Assessment NOINSTL - [900-9997]
22. Riser Card: Riser with 3 PCIe Slots PCIE - [320-4607]
23. Mouse: Optical Two-Button Mouse, USB USBM - [310-8172]

C. Rack-Mounted Server 2 (Historical Archive Server): This server shall house historical trend data in SQL Server format. The basis of design is the PowerEdge Server by Dell, or equal. The server shall be equal to the following requirements:
   1. PowerEdge 2950: Quad Core Intel® Xeon® X5355, 2x4MB Cache, 2.66GHz, 1333MHz FSB 295C26 - [222-7342]
   2. Additional Processor: Quad Core Intel® Xeon® X5355 2x4MB Cache, 2.66GHz, 1333MHz FSB 2PC26 - [311-6968]
   3. Memory: 8GB 667MHz (4x2GB), Dual Ranked DIMMs 8G4D6D - [311-6197]
   4. Hard Drive Configuration: Integrated SAS/SATA RAID 10, PERC 5/i Integrated MSR10 - [341-3061]
   5. Backplane: 1x6 Backplane for 3.5-inch Hard Drives 1X635HD - [311-5747]
   6. Primary Controller: PERC 5/i, x6 Backplane, Integrated Controller Card PERC5I6 - [341-3066]
   7. Primary Hard Drive: 750GB 7.2K RPM Universal SATA 3Gbps 3.5-in HotPlug Hard Drive 750SU - [341-4430]
   8. 2nd Hard Drive: 750GB 7.2K RPM Universal SATA 3Gbps 3.5-in HotPlug Hard Drive 750SU - [341-4430]
   9. 3rd Hard Drive: 750GB 7.2K RPM Universal SATA 3Gbps 3.5-in HotPlug Hard Drive 750SU - [341-4430]
   10. 4th Hard Drive: 750GB 7.2K RPM Universal SATA 3Gbps 3.5-in HotPlug Hard Drive 750SU - [341-4430]
   11. 5th Hard Drive: 750GB 7.2K RPM Universal SATA 3Gbps 3.5-in HotPlug Hard Drive 750SU - [341-4430]
   12. 6th Hard Drive: 750GB 7.2K RPM Universal SATA 3Gbps 3.5-in HotPlug Hard Drive 750SU - [341-4430]
   13. CD/DVD Drive: 24X IDE CD-RW/DVD ROM Drive CDRWDVD - [313-3934]
   14. Floppy Drive: No Floppy Drive for x6 Backplane NFDX6 - [341-3685]
   15. Network Adapter: Dual Embedded Broadcom® NetXtreme II 5708 Gigabit Ethernet NIC OBNIC - [430-1764]
   16. TCP/IP Offload Engine Enablement: Broadcom TCP/IP Offload Engine Not Enabled NTOEKEY - [430-1765]
   17. Chassis Configuration: Rack Chassis w/Sliding Rapid/Versa Rails and Cable Management Arm,Universal RPVERSA - [310-7412]
   18. Bezel: Rack Bezel BEZEL - [313-3920]
   19. Open Manage Subscription: Open Manage Subscription (8 edition) OMSUB8 - [902-9887]
   20. Power Supply: Redundant Power Supply with Dual Cords RPS - [310-7422
   21. Documentation: Electronic Documentation and Open Manage CD Kit EDOCS - [310-7415]
   22. Hardware Support Services: 3Yr BASIC SUPPORT: 5x10 HW-Only, 5x10 NBD Onsite U3OS - [960-8162 960-8192 970-4070 984-1399 984-1417]
   23. Installation Support Services: No Installation Assessment NOINSTL - [900-9997]
   24. Riser Card: Riser with 3 PCIe Slots PCIE - [320-4607]
   25. Mouse: Optical Two-Button Mouse, USB USBM - [310-8172]

D. Rack-Mounted Server 3 (Integration Server): This server shall be used strictly to route mapped points between the DDC EMS and the existing Siemens system. The UCD Energy Management Team will program this server and map the points into the Siemens system. The Contractor is responsible to make all points available as BACnet standard analog, binary, schedule, alarm or trend objects as defined in Section 15955. The basis of design is the PowerEdge Server by Dell, or equal. The server shall be equal to the following requirements:
   1. PowerEdge 2950: Quad Core Intel® Xeon® X5355, 2x4MB Cache, 2.66GHz, 1333MHz FSB 295C26 - [222-7342]
   2. Additional Processor: Quad Core Intel® Xeon® X5355 2x4MB Cache, 2.66GHz, 1333MHz FSB 2PC26 - [311-6968]

PROJECT TITLE
CONTRACT TITLE
UNIVERSITY OF CALIFORNIA, DAVIS
CITY, CALIFORNIA

PROJECT NO: 0000000
GRANT NO: 0000000

3. Memory: 8GB 667MHz (4x2GB), Dual Ranked DIMMs 8G4D6D - [311-6197]
4. Hard Drive Configuration: Integrated SAS/SATA RAID 10, PERC 5/i Integrated MSR10 - [341-3061]
5. Backplane: 1x6 Backplane for 3.5-inch Hard Drives 1X635HD - [311-5747]
6. Primary Controller: PERC 5/i, x6 Backplane, Integrated Controller Card PERC5I6 - [341-3066]
7. Primary Hard Drive: 750GB 7.2K RPM UnIversal SATA 3Gbps 3.5-in HotPlug Hard Drive 750SU - [341-4430]
8. 2nd Hard Drive: 750GB 7.2K RPM Universal SATA 3Gbps 3.5-in HotPlug Hard Drive 750SU - [341-4430]
9. 3rd Hard Drive: 750GB 7.2K RPM Universal SATA 3Gbps 3.5-in HotPlug Hard Drive 750SU - [341-4430]
10. 4th Hard Drive: 750GB 7.2K RPM Universal SATA 3Gbps 3.5-in HotPlug Hard Drive 750SU - [341-4430]
11. CD/DVD Drive: 24X IDE CD-RW/DVD ROM Drive CDRWDVD - [313-3934]
12. Floppy Drive: No Floppy Drive for x6 Backplane NFDX6 - [341-3685]
13. Network Adapter: Dual Embedded Broadcom® NetXtreme II 5708 Gigabit Ethernet NIC OBNIC - [430-1764]
14. TCP/IP Offload Engine Enablement: Broadcom TCP/IP Offload Engine Not Enabled NTOEKEY - [430-1765]
15. Chassis Configuration: Rack Chassis w/Sliding Rapid/Versa Rails and Cable Management Arm,Universal RPVERSA - [310-7412]
16. Bezel: Rack Bezel BEZEL - [313-3920]
17. Open Manage Subscription: Open Manage Subscription (8 edition) OMSUB8 - [902-9887]
18. Power Supply: Redundant Power Supply with Dual Cords RPS - [310-7422]
19. Documentation: Electronic Documentation and Open Manage CD Kit EDOCS - [310-7415]
20. Hardware Support Services: 3Yr BASIC SUPPORT: 5x10 HW-Only, 5x10 NBD Onsite U3OS - [960-8162 960-8192 970-4070 984-1399 984-1417]
21. Installation Support Services: No Installation Assessment NOINSTL - [900-9997]
22. Riser Card: Riser with 3 PCIe Slots PCIE - [320-4607]
23. Mouse: Optical Two-Button Mouse, USB USBM - [310-8172]

E. Rack-Mounted Server 4 (Web Server): This server shall be used strictly to run the WEB based portion of the software for access to the web separate from the main server. The UCD Energy Management Team will assist in the setup and access through the existing firewalls. The basis of design is the PowerEdge Server by Dell, or equal. The server shall be equal to the following requirements:
1. PowerEdge 2950: Quad Core Intel® Xeon® X5355, 2x4MB Cache, 2.66GHz, 1333MHz FSB 295C26 - [222-7342]
2. Additional Processor: Quad Core Intel® Xeon® X5355 2x4MB Cache, 2.66GHz, 1333MHz FSB 2PC26 - [311-6968]
3. Memory: 8GB 667MHz (4x2GB), Dual Ranked DIMMs 8G4D6D - [311-6197]
4. Hard Drive Configuration: Integrated SAS/SATA RAID 10, PERC 5/i Integrated MSR10 - [341-3061]
5. Backplane: 1x6 Backplane for 3.5-inch Hard Drives 1X635HD - [311-5747]
6. Primary Controller: PERC 5/i, x6 Backplane, Integrated Controller Card PERC5I6 - [341-3066]
7. Primary Hard Drive: 750GB 7.2K RPM UnIversal SATA 3Gbps 3.5-in HotPlug Hard Drive 750SU - [341-4430]
8. 2nd Hard Drive: 750GB 7.2K RPM Universal SATA 3Gbps 3.5-in HotPlug Hard Drive 750SU - [341-4430]
9. 3rd Hard Drive: 750GB 7.2K RPM Universal SATA 3Gbps 3.5-in HotPlug Hard Drive 750SU - [341-4430]

PROJECT TITLE
CONTRACT TITLE
UNIVERSITY OF CALIFORNIA, DAVIS
CITY, CALIFORNIA

PROJECT NO: 0000000
GRANT NO: 0000000

10. 4th Hard Drive: 750GB 7.2K RPM Universal SATA 3Gbps 3.5-in HotPlug Hard Drive 750SU - [341-4430]
11. CD/DVD Drive: 24X IDE CD-RW/DVD ROM Drive CDRWDVD - [313-3934]
12. Floppy Drive: No Floppy Drive for x6 Backplane NFDX6 - [341-3685]
13. Network Adapter: Dual Embedded Broadcom® NetXtreme II 5708 Gigabit Ethernet NIC OBNIC - [430-1764]
14. TCP/IP Offload Engine Enablement: Broadcom TCP/IP Offload Engine Not Enabled NTOEKEY - [430-1765]
15. Chassis Configuration: Rack Chassis w/Sliding Rapid/Versa Rails and Cable Management Arm,Universal RPVERSA - [310-7412]
16. Bezel: Rack Bezel BEZEL - [313-3920]
17. Open Manage Subscription: Open Manage Subscription (8 edition) OMSUB8 - [902-9887]
18. Power Supply: Redundant Power Supply with Dual Cords RPS - [310-7422]
19. Documentation: Electronic Documentation and Open Manage CD Kit EDOCS - [310-7415]
20. Hardware Support Services: 3Yr BASIC SUPPORT: 5x10 HW-Only, 5x10 NBD Onsite U3OS - [960-8162 960-8192 970-4070 984-1399 984-1417]
21. Installation Support Services: No Installation Assessment NOINSTL - [900-9997]
22. Riser Card: Riser with 3 PCIe Slots PCIE - [320-4607]
23. Mouse: Optical Two-Button Mouse, USB USBM - [310-8172]

F. General Requirements for all DDC EMS Servers:
1. Operating system shall be Microsoft Windows Server 2008 R2 Standard Edition. Provide Microsoft Office 2008 Professional Software. All software shall be at least the latest version available as of the date of Substantial Completion.
2. Provide network configuration tool, all programming applications, graphic creation tools and all other software required to configure and operate the system.
3. For DDC EMS Web server, all web components and services shall be installed with required licensing.
4. Provide network card approved by DDC EMS manufacturer to support Supervisory LAN communications (10/100/1000 Mbps Ethernet TCP/IP)
5. Provide each server with a 24" flat-screen LCD monitor.
6. Provide additional hardware, video drivers, etc., to facilitate all control functions and software requirements specified for the DDC EMS.

G. Rack-Mounted UPS (one for each server): For each new rack-mounted server, provide a rack-mounted UPS. Each rack-mounted UPS shall be an APC SMART-UPS 1500VA or equal.

H. Conditioned Server Rack Enclosure (provide to house all servers listed above): Liebert MCR or equal.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which control systems are to be installed. Do not proceed with Work until the other Work is complete to the point that will allow controls to be installed in accordance with controls' manufacturers instructions.

3.2 INSTALLATION OF CONTROL SYSTEMS

A. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings.

B. Upgrade all controller firmware to the release (version) in effect at Substantial Completion.

PROJECT TITLE
CONTRACT TITLE
UNIVERSITY OF CALIFORNIA, DAVIS
CITY, CALIFORNIA

PROJECT NO: 0000000
GRANT NO: 0000000

3.3   DDC EMS OPERATOR WORKSTATION INSTALLATION

A.   Set up each DDC EMS operator workstation and printer where designated on drawings. Install all software and verify that the system is fully operational. Configure each DDC EMS operator workstation for direct connection to the Inter-building LAN. Configure each DDC EMS operator workstation as a remote DDC EMS operator workstation for each remote dial-up building, including remote buildings where this manufacturers DDC EMS is already installed.

B.   Set up POT and configure it as a remote DDC EMS operator workstation for all buildings included in this Contract as well as all buildings where this manufacturer's DDC EMS is already installed. Install all software and verify that the system is fully operational from a remote location, as well as directly connected at control units. All remote connections to the campus DDC EMS shall be approved by the DDC EMS Systems Administrator prior to construction.

C.   Install systems and materials in accordance with manufacturer's instructions.

D.   Deliver POTs and HHOTs to the University's Representative prior to specified University training.

3.4   CONTROL UNIT APPLICATION REQUIREMENTS

A.   General: The functional intent of this specification is to allow cost effective application of manufacturers standard products while maintaining the integrity and reliability of the control functions. A Primary Control Unit as specified above is generally fully featured and customizable. A Secondary Control Unit is generally designed for simpler, relatively standard applications. Specific requirements are specified below for each application. Contractor shall apply the most cost effective unit that meets the requirements of that application.

B.   Stand-Alone Functionality
   1.   Functional Boundary: Provide controllers so that all points associated with and common to one unit or other complete system/equipment shall reside within a single control unit. Systems specified for the Application Category will dictate the boundary of the standalone control functionality. See related restrictions below. When referring to the controller as pertains to the standalone functionality, reference is specifically made to the processor. One processor shall execute all the related I/O control logic via one operating system that uses a common programming and configuration tool.
   2.   The following configurations are considered acceptable with reference to a controller's standalone functionality:
      a.   Points packaged as integral to the controller such that the point configuration is listed as an essential piece of information for ordering the controller (having a unique ordering number).
      b.   Controllers with processors and modular back planes that allow plug in point modules as an integral part of the controller.
      c.   I/O point expander boards, plugged directly into the main controller board to expand the point capacity of the controller.
      d.   I/O point expansion devices connected to the main controller board via wiring and as such may be remote from the controller and that communicate via a sub LAN protocol. These arrangements to be considered standalone shall have a sub LAN that is dedicated to that controller and include no other controller devices (Secondary Control Units for other systems/equipment). All wiring to interconnect the I/O expander board shall be:
         1)   Contained in the control panel enclosure;
         2)   Or run in conduit. Wiring shall only be accessible at the terminations.
   3.   Multiple controllers enclosed in the same control panel to accomplish the point requirement are considered unacceptable with reference to a controller's standalone functionality.

C. Where associated control functions involve functions from different categories identified below, the requirements for the most restrictive category shall be met.

D. Application Category 1 (Terminal Units and Small Unitary Equipment)
    1. Applications in this category include the following:
        a. Fan Coil Units
        b. Airflow Terminal Units (VAV and Constant Volume Boxes)
        c. Miscellaneous Heaters
    2. Secondary Control Unit may be used in these applications.
    3. Standalone Capability: Provide ability to execute space temperature control functions for the application for a given setpoint or mode which shall generally be occupied mode control. Only the following data (as applicable) may be acquired from other Control Units via LANs. In the event of a loss of communications with any other Control Units, or any fault in any system hardware that interrupts the acquisition of any of these values, the Secondary Control Unit shall use the last value obtained before the fault occurred.
    4. Programmability: Operator shall be able to modify all setpoints, scheduling parameters associated with the unit, tuning and set up parameters, interstage timing parameters, and mode settings. Application specific block control algorithms may be used provided they meet the sequence of operations. The ability to customize the control algorithm is not required unless specifically indicated otherwise.
    5. An individual Control Unit shall be dedicated to each individual terminal unit that is located above ceilings.
    6. LAN Restrictions: Limit the number of nodes on the network to 90 percent of the maximum recommended by the manufacturer.

E. Application Category 2
    1. Applications in this category include the following:
        a. Miscellaneous Equipment Start/Stop
        b. Miscellaneous Monitoring (Not directly associated with a control sequence and where trending is not necessary.)
    2. Secondary Control Units may be used in these applications provided the Secondary Control Unit meets all requirements specified below. This category requires a general purpose Secondary Control Unit to which you can attach application specific control algorithms.
    3. Standalone Capability: Only the following data may be acquired from other Secondary Control Unit via LANs. In the event of a loss of communications with any other Secondary Control Unit, or any fault in any system hardware that interrupts the acquisition of any of these values, the Secondary Control Unit shall use the last value obtained before the fault occurred. The Control Unit shall continue to execute the specified sequence of operation with all parameters other than the following the same as with intact network communication. Control Units that revert to default programs that do not exactly perform the specified sequence are not acceptable.
    4. Programmability: Operator shall be able to modify all setpoints (temperature and airflow), scheduling parameters associated with the unit, tuning and set up parameters, interstage timing parameters, and mode settings. Operator shall be able to address and configure spare inputs for monitoring. Operator shall be able to address and configure spare outputs for simple single loop control actions or event initiated actions. Application specific block control algorithms may be used provided they meet the sequence of operations. The ability to customize the control algorithm is not required unless specifically indicated otherwise.
    5. LAN Restrictions: Limit the number of nodes on the network to 90 percent of the maximum recommended by the manufacturer.

F. Application Category 3 – Not Used

G. Application Category 4

1. Applications in this category include the following:
   a. AHUs 1-3
   b. Chilled Water System Control
   c. Heating Water System Control
   d. Laboratory, Vivarium and BSL-3 Exhaust Systems
   e. Any applications not listed in categories 1, 2, or 3.
2. Only Primary Control Units for each system or unit shall be used for these applications.
3. Standalone Capability: Only the following data (as applicable) may be acquired from other Control Units via LANs. In the event of a loss of communications with any other Control Unit, or any fault in any system hardware that interrupts the acquisition of any of these values, the Primary Control Unit shall use the last value obtained before the fault occurred. The Primary Control Unit shall continue to execute the specified sequence of operation with all parameters other than the following the same as with intact network communication.

3.5   CONTROL UNIT QUANTITY AND LOCATION REQUIREMENTS

A. Individual TCPs shall be referenced on project floor plans to indicate allocation of points to each TCPs and their location. TCPs shall consist of one or multiple Control Units to meet requirements of this specification. TCP enclosures shall be as specified in DDC EMS Basic Materials & I/F Devices section.

B. Unless otherwise noted on the Contract Documents, the Contractor is to provide Primary Control Units and/or Secondary Control Units so that all programming associated with and common to one air handling system or other complete stand alone system shall reside within a single control unit. Slave panels may be used to extend a Control Units point capacity provided such slave panels do not perform any logic, and provided the slave panel(s) are specifically designed as expansion devices and are located at the same TCP as the associated Control Unit. Secondary Control Units are not acceptable as expansion devices.

C. Contractor shall provide a minimum of the following:
   1. One TCP (including at least one Primary Control Unit) in the central mechanical room.
   2. One TCP for each mechanical room where air handlers are located.
   3. One controller shall be provided for each terminal unit unless indicated otherwise.

D. Provide sufficient spare space in each TCP to allow for future expansion, including space for additional control units, slave units, and expansion modules as required to accommodate an additional 10 percent of each point type.

3.6   DDC EMS SERVER INSTALLATION

A. Set up each DDC EMS server, Server UPS and Conditioned Rack Enclosure with the assistance of the University EMS administrator in the campus' DDC EMS server room. Install all DDC EMS server software and verify that the system is fully operational.

B. Install systems and materials in accordance with manufacturer's instructions.

END OF SECTION 25 95 30