

The following standard specification is intended to be edited according to the specifics of the project. Brackets [ ] and areas shaded in gray [e.g. format] indicate requirements that are optional depending upon the type of system being provided or per instructions associated with the [ ] and project requirements. Consult with University's Representative and campus stakeholders.

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## SECTION 25 95 50 - DDC EMS SOFTWARE

### PART 1 - GENERAL

#### 1.1 DESCRIPTION OF WORK

- A. Provide all software, programming and dynamic color graphics for a complete and fully functioning DDC EMS software package as specified herein.

#### 1.2 LICENSING

- A. Include licensing for all project-specific software and programming at all required DDC EMS servers and workstations.
- B. Include licensing for all DDC EMS server and workstation operating systems, and all required third party DDC EMS software.
- C. Provide licensing and original software copies for each specified DDC EMS server and workstation.
- D. Provide licensing and original software copies for each specified POT.
- E. Provide licensing and original software copies for each specified HHOT.
- F. Provide licensing and software copies for use during construction for the University's Representative only for the term of the Contract. This license shall be terminated upon conclusion of the Contract Warranty Period.
- G. Licenses for remote DDC EMS workstations shall allow for access to any site and shall not be restricted to accessing only the Primary Control Unit LAN's included in this Contract.
- H. Provide licensing and upgrade all software packages to the release (version) in effect at Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURER

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

#### 2.2 SYSTEM SOFTWARE-GENERAL

- A. Functionality and Completeness: The Contractor shall furnish and install all software and programming necessary to provide a complete and functioning system as specified. The Contractor shall include all software and programming not specifically itemized in these Specifications which is necessary to implement, maintain, operate, and diagnose the system in compliance with these Specifications.
- B. Configuration: The software shall support the system as a distributed processing network configuration.
- C. Server and workstation software shall employ native TCP/IP protocol with the Ethernet 10/100/1000 BaseT (IEEE802.3) physical layer standard.
- D. System Management and Supervision: The system software shall allow centralized overall system supervision, operator interface, management report generation, alarm annunciation, and

communication with control units. It shall allow system operators to perform the following functions from the Operator Interface, Portable Operator's Terminal, and Hand Held Operator's Terminal.

1. Monitor and supervise control of all points.
2. Add new points and edit the system database.
3. Change control setpoint, timing parameters, and loop-tuning constants in all control units.
4. Enter programmed start/stop time schedules.
5. View alarms and messages.
6. Modify existing control programs in all control units
7. Upload/Download programs, database, etc. as specified.

### 2.3 CONTROL UNIT SOFTWARE

- A. Primary Control Unit Software Residency: Each Primary Control Unit shall be capable of control and monitoring of all points physically connected to it. All software including the following shall reside and execute at the Primary Control Unit.
  1. Real Time Operating System software
  2. Real Time Clock/Calendar and network time synchronization
  3. Primary Control Unit diagnostic software
  4. LAN Communication software
  5. Direct Digital Control software
  6. Alarm Processing and Buffering software
  7. Energy Management software
  8. Data Trending, Reporting, and Buffering software
  9. I/O (physical and virtual) database
  10. Remote Communication Software unless its resident in a LAN Interface Device on the primary LAN.
  11. Adaptive Loop Tuning software
- B. Secondary Control Unit Software Residency: Each Secondary Control Unit shall be capable of control and monitoring of all points physically connected to it. As a minimum, the software including the following shall reside and execute at the Secondary Control Unit. Other software to support other required functions of the Secondary Control Unit may reside at the master Primary Control Unit or LAN Interface Device with the restrictions/exceptions per application provided in DDC EMS Hardware section.
  1. Real Time Operating System software
  2. Secondary Control Unit diagnostic software
  3. LAN Communication software
  4. Control software applicable to the unit it serves that will support a single mode of operation
  5. I/O (physical and virtual) database to support one mode of operation
- C. Stand Alone Capability: Primary Control Unit shall continue to perform all functions independent of a failure in other Primary Control Units/Secondary Control Units or other communication links to other Primary Control Units/Secondary Control Units. Trends and runtime totalization shall be retained in Primary Control Unit memory. Runtime totalization shall be available on all digital input points that monitor electric motor status.
- D. Operating System: Control Unit's shall include a real time operating system resident in ROM. This software shall execute independently from any other devices in the system. It shall support all specified functions including a real time clock that can be automatically synchronized with other devices on the LAN. It shall provide a command prioritization scheme to allow functional override of control functions.
- E. Network Communications: Each Control Unit shall include software that supports the networking of Control Units on a common communications trunk which forms the respective LAN. Network support shall include the following:

1. If a Primary LAN communications trunk is severed, Primary Control Units shall continue operations without interruption.
  2. Control Unit communication software shall include error detection, correction, and re-transmission to ensure data integrity.
  3. Operator/System communication software shall facilitate communications between other Primary Control Units, all subordinate Secondary Control Units, gateways and LAN Interface Devices or Operator Workstations. Software shall allow point interrogation, adjustment, addition/deletion, and programming while the Control Unit is on line and functioning without disruption to unaffected points. The software architecture shall allow networked Control Units to share selected physical and virtual point information throughout the entire system.
- F. Point/System Database: All points, trends, schedules, and alarms included in the typical equipment point list must be available via the DDC EMS Server to the University LAN. All points shall be provided as BACnet standard analog, binary, schedule, alarm or trend objects. Point/system database creation and modification shall be via a user friendly, menu driven program. System software shall support virtual or logic point (points not representing a physical I/O) creation. Software shall support virtual points with all services specified herein. Database software shall support definition of all parameters specified in Execution, of this Section for a given point type. If database does not support all of these parameters, a software module shall be created and attached to the points which accomplish the respective function.
- G. Diagnostic Software: Control Unit software shall include diagnostic software that checks memory and communications and reports any malfunctions
- H. Alarm/Messaging Software: Control Units software shall support alarm/message processing and buffering software as more fully specified in Alarm/Message Reporting Paragraph of this Section.
- I. Application Programs: Control Units shall support and execute application programs as more fully specified below. All Direct Digital Control software, Energy Management Control software, and application programming software shall be provided in a ready-to-use state, and shall not require but shall allow operator programming.
- J. Security: Control Unit software shall support multiple level password access restriction as more fully specified in Password Protection Paragraph of this Section.
- K. Direct Digital Control: Control Unit shall support application of Direct Digital Control Logic. All logic modules shall be provided pre-programmed with written documentation to support their application. Provide the following logic modules as a minimum:
1. Proportional-Integral-Derivative (PID) Control with analog, PWM and floating output PID algorithms shall automatically adjust for changes in Control Unit scanning frequency.
  2. Two Position control (Hi or Low crossing with deadband)
  3. Single Pole double throw relay
  4. Delay Timer (delay on make, delay on break, and interval)
  5. Hi/Low Selection
  6. Reset or Scaling Module
  7. Logical Operators (And, Or, Not, Xor)
- L. Updating/Storing Application Data: Site specific programming residing in volatile memory shall be uploadable/downloadable from an operator interface connected either locally, to the primary LAN or remotely via Ethernet. Initiation of an upload or download shall include all of the following methods; manually, scheduled, and automatically upon detection of a loss or change.
- M. Restart: System software shall provide for orderly shut down upon loss of power and automatic restart upon power restoration. Volatile memory shall be retained, outputs shall go to programmed fail (open, closed, or last) position. Equipment restart shall include a user definable time delay on each piece of equipment to stagger the restart. Loss of power shall be alarmed at operator interface indicating date and time.

- N. Psychrometric Parameters: Control Unit software shall be able to calculate and present psychrometric parameters, given temperature and relative humidity, including the following as a minimum: Enthalpy, Dew Point, Wet Bulb Temperature.
- O. Miscellaneous Calculations: System software shall automate calculation of psychrometric functions, calendar functions, and flow determination and totalization from pulsed or analog inputs, curve-fitting, look-up table, input/output scaling, and A/D conversion coefficients.
- P. PID Loop Tuning: Contractor shall provide a software tool for tuning PID loops. This tool shall preferably be provided as an integral part of the system software or graphic software package. Loop response trends shall be used to calculate suggested P, I, and D gains in the units used in the manufacturers PID algorithms. The following are acceptable:
  - 1. Manual Tuning that accepts either automatic or manual amplitude and response time inputs and calculates PID gains for automatic or manual entry into control module.
  - 2. Self Tuning algorithm that periodically upsets the process and automatically adjusts the PID gains.
  - 3. Adaptive Tuning that continuously monitors natural disturbances in the process and adjusts the PID gains accordingly. This algorithm must include a user definable noise band to inhibit adjustments.
- Q. Trending Software: Control Units software shall support alarm/message processing and buffering software as more fully specified in Alarm/Message Reporting Paragraph and Trending Paragraph of this Section.

#### 2.4 CONTROL UNIT PROGRAMMING METHOD

- A. Application software shall be user programmable.
- B. This specification generally requires a programming convention that is logical, easy to learn, use, and diagnose. Application programming shall be provided by the following conventions:
  - 1. Database Creation: provide templates customized for point type, to support input of individual point information.
  - 2. The method of programming must be able to accomplish sequences as specified. Both line-type programming and graphic block programming are acceptable, provided that programming can be annotated and follow standards that are consistent and supported by manufacturer's operational literature and training. The programming can be formatted using line-by-line text or graphical block representation.
  - 3. Line-by-line Text Programming: Programs shall contain comment lines that can exist without affecting the processing and command outputs of the programming. Provide a utility to compile programming language and indicate faults with the usage of the programming protocol. Line-type programming which uses text programming in a language similar to BASIC is acceptable.
  - 4. Graphical Block Programming: The method of programming shall be by manipulation of graphic icon blocks. Each block represents a subroutine containing the programming necessary to execute the function of the device that the block represents. The graphical programming software shall allow for interactive mouse-driven placement of block icons on the graphic screen and connection of block inputs to block outputs by means of drawing lines to form a graphic logic diagram. The user shall not have to manually input text to assign block input/output interconnections. Blocks shall allow entry of adjustable settings and parameters via pop-up windows. The clarity of the sequence shall be such that the user has the ability to verify that the system programming meets the specs without having to learn or interpret a manufacturer's unique programming language. Provide a utility that shall allow the graphic logic diagrams to be directly compiled into application programs. Logic diagrams shall be viewable either off-line, or on-line with real-time block output values.
- C. Contractor may provide a means for testing and debugging customized programming. However, no debugging program shall substitute for actual live verification of the program's ability to provide

actual on-line control. Commissioning checklists shall be utilized to determine the final effectiveness of programming to meet the intent of the Specifications and its sequences.

## 2.5 ENERGY MANAGEMENT APPLICATIONS

- A. System shall have the ability to perform all of the following energy management routines via preprogrammed function blocks or template programs. As a minimum provide the following whether or not required in the software:
1. Time of Day Scheduling
  2. Night Setback based on actual daily sunrise and sunset times with adjustable delays before sunrise and after sunset for darkness.
  3. Calendar Based Scheduling
  4. Holiday Scheduling
  5. Temporary Schedule Overrides
  6. Optimal Start/Optimal Stop-based on space temperature offset, outdoor air temperature, and building heating and cooling capacitance factors as a minimum
  7. Night Setback and Morning Recovery Control with ventilation only during occupancy.
  8. Night Purge ventilation cycle to use the cool night/morning air to pre-cool the space prior to occupancy.
  9. Economizer Control (enthalpy or dry bulb) with night purge
  10. Peak Demand Limiting
  11. Temperature Compensated Duty Cycling
  12. Dead Band Control
- B. All programs shall be executed automatically without the need for operator intervention, and shall be flexible enough to allow Operator customization.

## 2.6 PASSWORD PROTECTION

- A. Multiple-level password access protection shall be provided to allow the University's Representative to limit workstation control of operating, commissioning and programming software packages, display and database manipulation capabilities as deemed appropriate for each user, based upon an assigned user name with a unique password.
- B. Passwords shall restrict access to all control units
- C. Each user name shall be assigned to a discrete access level. A minimum of 5 levels of access shall be supported.
- D. A minimum of 200 user names shall be supported.
- E. Operators shall be able to perform only those commands available for the access level assigned to their user name.
- F. User-definable, automatic log-off timers of from 1 to 60 minutes shall be provided to prevent operators from inadvertently leaving interface device software on-line.

## 2.7 ALARM/MESSAGE REPORTING

- A. Alarm management shall be provided to monitor, buffer, and direct alarms and messages to operator devices and memory files. Each Primary Control Unit shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic, and prevent alarms from being lost. At no time shall a Primary Control Unit's ability to report alarms be affected by either Operator activity at an Operator Workstation or local handheld device, or by communications with other panels on the network.
1. Alarm Descriptor: Each alarm or point change shall include the point's English language description, and the time and date of occurrence. In addition to the alarm's descriptor and the time and date, the user shall be able to print, display and store an alarm message to more fully describe the alarm condition or direct Operator response.

2. Alarm Prioritization: The software shall allow users to define the handling and routing of each alarm by their assignment to discrete priority levels. A minimum of 5 priority levels shall be provided. For each priority level, users shall have the ability to enable or disable an audible tone whenever an alarm is reported and whenever an alarm returns to normal condition. Users shall have the ability to manually inhibit alarm reporting for each individual alarm and for each priority level.
3. Alarm Report Routing: Each alarm priority level shall be associated with a unique user-defined list of operator devices including any combination of local or remote workstations, printers and workstation disk files. All alarms associated with a given priority level shall be routed to all of the operator devices on the user-defined list associated with that priority level. For each priority level, alarms shall be automatically routed to a default operator device in the event that alarms are unable to be routed to any operator device assigned to the priority level.
4. Auto-Dial Alarm Routing: For alarm priority levels that include a remote workstation, accessed by modem, as one of the listed reporting destinations, the Primary Control Unit shall initiate a call to report the alarm, and shall terminate the call after alarm reporting is complete. System shall be capable of multiple retries and shall buffer alarms until a connection is made. If no connection is made, system shall attempt connection to an alternate station. System shall also be able to dial multiple pagers upon alarm activation.
5. Graphic Links: Each alarm shall be individually programmable to automatically display a selected graphic screen on a selected workstation when the alarm is reported.
6. Trend Log Links: Each alarm shall be individually programmable to automatically display a trend log of a pre-selected group of points.
7. Alarm Acknowledgment: For alarm priority levels that are directed to a workstation screen, an indication of alarm receipt shall be displayed immediately regardless of the application in use at the workstation, and shall remain on the screen until acknowledged by a user having a password that allows alarm acknowledgment. Upon acknowledgment, the complete alarm message string including date, time, and user name of acknowledging operator shall be stored in a selected file on the workstation hard disk.

## 2.8 TRENDING

- A. The software shall be capable of displaying historical data in both a tabular and graphical format. The requirements of this trending capability shall include the following:
  1. Any physical point or calculated variable shall be available for trending.
  2. In the graphical format, the trend shall plot at least 4 different values for a given time period superimposed on the same graph. The 4 values shall be distinguishable by using unique colors. In printed form the 4 lines shall be distinguishable by different line symbology. Displayed trend graphs shall indicate the engineering units for each trended value. Trends shall be able to be displayed in a dynamic mode using real time format.
  3. The time period for each trend shall be user selectable.
  4. The trended value range shall be user selectable.
- B. Control Loop Performance Trends: Control Units incorporating PID control loops shall also provide high resolution dynamic sampling capability in one-second increments for verification of control loop performance.
- C. Data Storage and Archiving: Trend data shall be stored at the Control Unit, and uploaded to server or hard disk storage when archival is desired. Uploads shall occur automatically based upon either user-defined interval or when the trend buffers become full. Uploads shall also have the ability to be initiated manually. Trended data shall include one row of descriptive column headings with all subsequent data in a contiguous stream. All trend data shall be available one of the following disk file formats:
  1. Quote and Comma separated text
  2. Microsoft ACCESS database
  3. SQL Database

4. Microsoft EXCEL spreadsheet (i.e. CSV)

## 2.9 TOTALIZATION

- A. The software shall support totalizing analog, digital, and pulsed inputs and be capable of accumulating, storing, and converting these totals to engineering units used in the documents. These values shall generally be accessible to the Operator Interfaces to support management reporting functions.

## 2.10 EQUIPMENT SCHEDULING

- A. Provide a graphic utility for user-friendly operator interface to adjust equipment operating schedules.
- B. Scheduling feature shall include multiple 7 day master schedules, plus holiday schedule, each with multiple start times and stop times. Master schedules shall be individually editable for each day and holiday.
- C. Scheduling feature shall allow for each individual equipment unit to be assigned to one of the master schedules.
- D. Timed override feature shall allow an Operator to temporarily change the state of scheduled equipment. An override command shall be selectable to apply to an individual unit, all units assigned to a given master schedule, or to all units in a building. Timed override shall terminate at the end of an operator selectable time, or at the end of the scheduled occupied/unoccupied period, whichever comes first. Timed override feature shall be allowed by a password level that does not allow assignment of master schedules.
- E. A yearly calendar feature shall allow assignment of holidays, and automatic reset of system real time clocks for transitions between daylight savings time and standard time.

## 2.11 OPERATOR INTERFACE GRAPHIC SOFTWARE

- A. Graphic software shall facilitate user friendly interface to all aspects of the System Software specified above. The intent of this specification is to require a graphic package that provides for intuitive operation of the systems without extensive training and experience. It shall facilitate logical and simple system interrogation, modification, configuration, and diagnosis.
- B. Graphic software shall support multiple simultaneous screens to be openable and resizable in a Windows type environment. All except text entry functions shall be executable with a mouse.
- C. Graphic software shall provide for multi-tasking such that third party programs can be used while the Operator Workstation Software is on line. Provide the ability to alarm graphically even when operator is in another software package.
- D. Operating system software shall be that required to operate the manufacturer's application software. Operating system must be industry-standard, as determined by the University.
- E. The software shall allow for operator creation of user defined, color graphic displays of geographic maps, building plans, floor plans, and mechanical and electrical system schematics. These graphics shall be capable of displaying all point information from the database including any attributes associated with each point (e.g., engineering units, etc.). In addition, operators shall be able to command equipment or change setpoints from a graphic through the use of the mouse. The user shall have the ability to directly import the latest version of AutoDesk AutoCAD generated files as background displays, without requiring third party file format conversion utilities.
- F. Screen Penetration: The operator interface shall allow users to access the various system graphic screens via a graphical penetration scheme by using the mouse to select from menus or button icons. Each graphic screen shall be capable of having a unique list of other graphic screens that are directly linked through the selection of a menu item or button icon.

- G. Dynamic Data Displays: Dynamic physical point values shall be automatically updated at a minimum frequency of 2 updates per minute without operator intervention. Point value fields shall be displayed with a color code depicting normal, abnormal, override and alarm conditions.
- H. Point Override Feature: Each displayed point shall be individually enabled/disabled to allow mouse driven override of digital points or changing of analog points for a user settable time. Such overrides or changes shall occur in the control unit, not just in the workstation software. When the override time has expired, the point value shall revert back to the normal value as otherwise sensed or calculated within the control unit. The graphic point override feature shall be subject to password level protection. Points that are overridden shall be reported as an alarm, and shall be displayed in a coded color. The alarm message shall include the operator's user name. A list of points that are currently in an override state shall be available through menu selection.
- I. Dynamic Symbols: Provide a selection of standard symbols which change in appearance based on the value of an associated point.
  - 1. Analog symbol: Provide a symbol that represents the value of an analog point as the length of a line or linear bar.
  - 2. Digital symbol: Provide symbols such as switches, pilot lights, rotating fan wheels, etc. to represent the value of digital input and output points.
  - 3. Point Status Color: Graphic presentations shall indicate different colors for different point status. (i.e., green = normal, red = alarm, etc.)
- J. Graphics Definition Package: Graphic generation software shall be provided to allow the user to add, modify, or delete system graphic displays.
  - 1. The Contractor shall provide libraries of pre-engineered screens and symbols depicting standard air handling unit components (e.g. fans, cooling coils, filters, dampers, etc.), mechanical system components (e.g., pumps, chillers, cooling towers, boilers, etc.), complete mechanical systems (e.g. constant volume-terminal reheat, VAV, etc.) and electrical symbols.
  - 2. The graphic development package shall use a mouse or similar pointing device in conjunction with the latest version of AutoCad to allow the user to perform the following:
    - a. Define symbols
    - b. Position items on graphic screens
    - c. Attach physical or virtual points to a graphic
    - d. Define background screens
    - e. Define connecting lines and curves
    - f. Locate, orient and size descriptive text
    - g. Define and display colors for all elements
    - h. Establish correlation between symbols or text and associated system points or other displays.
    - i. Create hot spots or link triggers to other graphic displays or other functions in the software.

## 2.12 REMOTE DDC EMS WORKSTATION GRAPHIC SOFTWARE

- A. Remote DDC EMS operator workstation software shall provide all the functionality specified for the local graphic software. It shall also provide for communications using the Internet.
- B. Graphic images shall reside on the remote operator workstation hard drive and all licenses shall be provided for the graphic software on the remote machine. Exceptions to this requirement include:
  - 1. System configuration uses an Internet server and presents web pages that can be pulled up using a standard browser.
  - 2. System configuration uses an Internet server and presents the standalone application running locally but controlled via a remote browser. Operator Interface Graphical Software application shall therefore support multi-instancing to allow multiple simultaneous remote connections and use of the graphic software.

- C. The combination of remote DDC EMS operator workstation software, Primary Control Unit software, and LAN Interface Device software shall provide the ability for seamless automatic upload of trend data and reports to the remote workstation. The feature shall allow for disk storage of continuous historical trend and report data without gaps or duplications.

#### 2.13 DDC EMS OPERATOR WORKSTATION DATA REPORTING AND STORAGE

- A. Workstation software shall support Microsoft Dynamic Data Exchange (DDE) and Object Linking and Embedding (OLE) to facilitate historical data access from popular spreadsheet and database programs (e.g., Microsoft EXCEL and ACCESS). Data storage format shall be directly importable to the application without manual parsing. Programs provided external to the graphic software are acceptable to meet this requirement or equal.
- B. Global Reporting Capability: Data reporting software shall be resident in the workstation. Reporting software shall not require an operator to log on to control units to access reports or reported information. Global reports shall include an All Points Report, and Subset Points Reports, user organized by wildcard, building, control unit, override status, alarm status, or point type.
- C. Workstation software shall include standard reports of totalized degree-days, kW-hours, ton-hours, MBtu, etc. on daily, monthly, and yearly bases.

### PART 3 - EXECUTION

#### 3.1 SYSTEM CONFIGURATION

- A. Thoroughly configure DDC EMS software, network communications, servers, operator workstations, portable operators terminals, printers, and remote communications.

#### 3.2 SITE SPECIFIC APPLICATION PROGRAMMING

- A. Provide all database creation and site specific application control programming as required by these Specifications, national and local standards and for a fully functioning system. Contractor shall provide all initial site specific application programming and thoroughly document programming. Meet the intent of the written sequences of operation. It is Contractor's responsibility to request clarification on sequence issues that require such clarification.
- B. All site specific programming shall be fully documented and submitted for review and approval, at the project submittal stage, prior to downloading into the panel, at the completion of functional performance testing, and at the end of the warranty period.
- C. All programming, graphics and data files shall be maintained in a logical system of directories with self-explanatory file names. All files developed for the project will be the property of the University and shall remain on the workstation(s)/server(s) at the completion of the project.

#### 3.3 PASSWORD SETUP

- A. Set up the following password levels to include the specified capabilities:
  - 1. Level 1: University's EMS Administrator
    - a. Level 2 capabilities
    - b. View, add, change and delete user names, passwords, password levels
  - 2. Level 2: Programmer
    - a. Level 3 capabilities
    - b. Configure system software
    - c. Modify control unit programs
    - d. Modify graphic software
    - e. Essentially unrestricted except for viewing or modifying user names, passwords, password levels
  - 3. Level 3: Senior HVAC Technician
    - a. Level 4 capabilities
    - b. Override output points

- c. Change setpoints
- d. Change equipment schedules
- e. Exit EMS software to use third party programs
- 4. Level 4: Junior HVAC Technician
  - a. Level 5 capabilities
  - b. Acknowledge alarms
  - c. Temporarily override equipment schedules
- 5. Level 5: HVAC Technician Trainee
  - a. Display all graphic data
  - b. Trend point data

B. Assist University's personnel with assigning user names, passwords and password levels.

C. Level 1, 2, and 3 passwords shall not be enabled until after record documents of all control unit databases have been submitted in accordance with DDC EMS General Requirements section. This is to prevent unauthorized adjustment of panel software before Contractor's record of final settings has been established.

### 3.4 POINT PARAMETERS

A. Provide the following minimum programming for each analog input:

- 1. Name
- 2. Address
- 3. Scanning frequency
- 4. Engineering units
- 5. Offset calibration and scaling factor for engineering units
- 6. High and low alarm values and alarm differentials for return to normal condition
- 7. High and low value reporting limits which shall prevent control logic from using shorted or open circuit values.
- 8. Default value to be used when the actual measured value is not reporting. This is required only for points that are transferred across the primary and secondary networks and used in control programs residing in control units other than the one in which the point resides. Events causing the default value to be used shall include failure of the control unit in which the point resides, or failure of any network over which the point value is transferred.
- 9. Selectable averaging function which shall average the measured value over a user selected number of scans for reporting.

B. Provide the following minimum programming for each analog output:

- 1. Name
- 2. Address
- 3. Output updating frequency
- 4. Engineering units
- 5. Offset calibration and scaling factor for engineering units
- 6. Output Range

C. Provide the following minimum programming for each digital input:

- 1. Name
- 2. Address
- 3. Scanning frequency
- 4. Engineering units (on/off, open/closed, freeze/normal, etc.)
- 5. Debounce time delay
- 6. Message and alarm reporting as specified.
- 7. Reporting of each change of state, and memory storage of the time of the last change of state.
- 8. Totalization of on time (for all motorized equipment status points), and accumulated number of off-to-on transitions.

- D. Provide the following minimum programming for each digital output:
1. Name
  2. Address
  3. Output updating frequency
  4. Engineering units (on/off, open/closed, freeze/normal, etc.)
  5. Direct or Reverse action selection
  6. Minimum on time
  7. Minimum off time
  8. Status association with a DI and failure alarming (as applicable)
  9. Reporting of each change of state, and memory storage of the time of the last change of state.
  10. Totalization of on time (for all motorized equipment status points), and accumulated number of off-to-on transitions.

### 3.5 ALARMS

- A. Alarm Priority Levels: Alarm messages specified below shall be assigned priority levels. Level 1 is the most critical. Level 5 is the least critical. Unless otherwise specified, alarm messages shall be assigned to priority Level 5. If the EMS does not have the capability of displaying the entire specified message, it shall condense the message as necessary; if the entire meaning of the message cannot be included, the message shall reference a code number that refers to an alarm code list. The alarm code list shall be provided by the Contractor with a third party database, spreadsheet, or word processor software package in a format that is searchable using the alarm code number. Return to normal conditions for all alarms shall be reported at the same priority level. For those alarm levels which include the POT as a reporting location, alarms shall be reported to the POT only during scheduled off-shift hours.
- B. Alarms and alarming requirements for each project specific HVAC system to be controlled are defined by the Points List found on the respective Contract Drawing and as specified as in this paragraph.
- C. Override alarms: Any point that is overridden through the override feature of the graphic workstation software shall be reported as a Level 3 alarm. Any point overridden through the use of Control Unit hardware HOA switches shall be reported as a Level 2 alarm.
- D. Analog Input Alarms: For each analog input, program an alarm message for reporting whenever the analog value is outside of the programmed alarm limits. Report a return to normal message after the analog value returns to the normal range, using a programmed alarm differential. Contractor to coordinate and implement required values and schedules acceptable for project specifics as directed by the University's Representative. Submit analog alarm limits for University's Representative's approval.
- E. Motorized Equipment Failure Alarms: Where "prove" operation is indicated in Sequence of Operations found on Drawings, it shall be defined as follows:
1. Monitor status of the associated device as indicated in the points list and on the Drawings. If status does not prove the device is operational at any time after 15 seconds following start command for constant speed devices, or 30 seconds for variable speed devices that accelerate to speed, remove and lock out the run command to that device and any other interlocked devices, and enunciate one of the following Level 2 alarm messages as applicable:
    - a. DEVICE XXXX FAILURE: Status has been lost on (the indicated device) when it was commanded to run. Determine cause of failure, correct it, and then acknowledge this alarm so the device can be restarted.
    - b. DEVICE XXXX FAILURE: Status has been lost on (the indicated device) when it was commanded to run. Standby pump has been started. Determine cause of failure, correct it, and then acknowledge this alarm so the device can be restarted.

- F. HOA Switch Tampering Alarms: For motorized equipment where the HOA switch is indicated to be monitored directly by a digital input point (as shown on control Drawings), EMS shall also enunciate the following Level 2 alarm message if the motorized device HOA switch is placed in HAND position. Whenever any device HOA switch is placed in HAND position, the EMS shall perform the remaining sequence as specified.
1. DEVICE XXXX HOA IN HAND: HOA switch is in HAND position. Acknowledge this alarm when the problem has been corrected.
- G. HOA Switch Tampering Alarms: Program this alarm for motorized equipment where the HOA switch is not indicated to be monitored directly by a digital input point. The sequences of operation are based on the presumption that motor starter Hand-Off-Auto (HOA) switches are in the auto position. If a motorized equipment unit starts without a prior start command from the EMS, (as sensed by status sensing device), then EMS shall perform the remaining sequence as specified. EMS shall also enunciate the following Level 2 alarm message if status indicates a unit is operational when the run command is not present.
1. DEVICE XXXX HOA IN HAND: Status is indicated on (the device) even though it has been commanded to stop. Check the HOA switch, control relay, status sensing device, contactors, etc. involved in starting the unit. Acknowledge this alarm when the problem has been corrected.

### 3.6 SITE SPECIFIC TRENDING

- A. As a minimum requirement of the Contract, establish trends for the following values:
1. Outside Air Temperature
  2. Outside Air Relative Humidity
  3. Outside Air Dewpoint
  4. CHW Loop Flow/BTU
  5. CHW Supply Temperature, Campus Loop, Building 40F Loop, Building 60F Loop
  6. CHW Return Temperature, Campus Loop, Building 40F Loop, Building 60F Loop, HHW Supply Temperature, Building 100F Loop, Building 180F Loop.
  7. HHW Return Temperature, Building 100F Loop, Building 180F Loop.
  8. HHW Flow
  9. KWH each VFD on pumps and fans
  10. OA Damper Output Signal on each air handler
  11. Cooling Coil Valve Output Signal on each air handler
  12. Heating Coil Valve Output Signal on each air handler
  13. Fan Volume Output Signal of VFD on pumps and fans
  14. Radiant heating/cooling floor temperature, each zone
  15. Airflow for each air handler
  16. Supply Air Temperature on each air handler
  17. Supply Air Dewpoint for AHU-1 and AHU-2
  18. Duct Static Pressure on each air handler
  19. Space Temperatures and Dewpoint for each space having active chilled beams, radiant heating/cooling panels or radiant heating/cooling floor.
  20. See M800 drawings for additional trending requirements.
- B. Trends and trending requirements for each project's specific HVAC systems to be controlled are defined by the Points List found on the respective Contract Drawing. Each specific project will require these trend points to be strictly defined on the Contract Drawings to define that project's particular operations and functionality.
- C. See additional trending requirements for commissioning purposes specified in DDC EMS Commissioning section.

### 3.7 EQUIPMENT SCHEDULES

- A. For each master schedule with the stated equipment assignments, Contractor shall coordinate and program required values and schedules acceptable for project specifics as directed by the University's Representative. Submit all programmed schedules for University's Representative approval.

### 3.8 GRAPHIC SCREENS

- A. Site Plan Screens: The Contract Drawing site plan will be made available to the Contractor in the latest version of AutoCad upon request. These Drawings may be used only for developing backgrounds for specified graphic screens; however the University does not guarantee the suitability of these Drawings for the Contractor's purpose.
  - 1. Provide a graphic site plan screen with link to the graphic screen for each building on the site with one or more control units. Show a north arrow, the building outline, and the location of significant features on the site plan such as roads and walks. Indicate the name of each building.
- B. Floor Plan Screens: The Contract Document Drawings will be made available to the Contractor in latest version of AutoCad upon request. These drawings may be used only for developing backgrounds for specified graphic screens; however the University does not guarantee the suitability of these Drawings for the Contractor's purpose.
  - 1. Provide graphic floor plan screens for each floor or wing of the building. Indicate the location of temperature sensors associated with each temperature controlled zone (i.e., VAV terminals, fan-coils, single-zone AHU's etc.) on the floor plan screens. Alternatively, change zone background color based on the temperature offset from setpoint. Display the space temperature point adjacent to each temperature sensor symbol. Use a distinct line symbol to demarcate each terminal unit zone boundary. Use distinct colors to demarcate each air handling unit zone and fan-coil hydronic zone. Indicate room numbers as provided by the University's Representative. Provide a drawing link from each terminal unit temperature sensor symbol shown on the graphic floor plan screens to each corresponding equipment schematic graphic screen.
  - 2. Provide graphic floor plan screens for each mechanical equipment room and a plan screen of the roof. Indicate the location of each item of mechanical equipment. Provide a drawing link from each equipment symbol shown on the graphic plan view screen to each corresponding mechanical system schematic graphic screen.
  - 3. If multiple floor plans are necessary to show all areas, provide a graphic building key plan. Use plan views as necessary to graphically indicate the location of all of the larger scale floor plans. Link graphic building key plan to larger scale partial floor plans. Provide links from each larger scale graphic floor plan screen to the building key plan and to each of the other graphic floor plan screens.
  - 4. Provide a graphic site plan with links to and from each building plan. If multiple site plans are necessary to show all areas, provide a graphic site key plan. Provide links from each site plan screen to the site key plan and to each of the other site plan screens.
- C. System Schematic Screens: Provide graphic system schematic screen for each HVAC subsystem controlled with each I/O point in the project appearing on at least one graphic screen. System graphics shall include flow diagrams with status, setpoints, current analog input and output values, operator commands, etc. as applicable. General layout of the system shall be schematically correct. Input/output devices shall be shown in their schematically correct locations. Include appropriate engineering units for each displayed point value. Written names (English language descriptors) shall be included for each point on all graphics; this may be accomplished by the use of a pop-up window accessed by selecting the displayed point with the mouse. Indicate all adjustable setpoints on the applicable system schematic graphic screen or, if space does not allow, on a supplemental linked setpoint screen.

1. Provide graphic screens for each air handling system. Indicate outside air temperature and enthalpy, and mode of operation as applicable (i.e., occupied, unoccupied, warm-up, cool-down). Link screens for air handlers to the heating and cooling plant graphics and associated fan-coil hydronic loop graphic. Link screens for supply and exhaust systems if they are not combined onto one screen.
  2. Provide a graphic screen for each fan-coil hydronic zone. Provide links to graphic system schematic screens of air handling units that serve the corresponding zone.
  3. Provide a graphic screen for air terminal unit controllers. In addition to points associated with the unit, indicate mode of operation as applicable (i.e., normal occupied, unoccupied, warm-up, maximum heating, maximum cooling). Provide links between the applicable floor plan screen and this screen. Provide links to the associated graphic air handling unit screen.
  4. Provide a cooling system graphic screen showing all points associated with the building chilled water system and pumps. Indicate outside air dry-bulb temperature, calculated wet-bulb temperature and calculated dew point.
  5. Provide a heating system graphic screen showing all points associated with the heat exchangers, and pumps. Indicate outside air dry-bulb temperature and relative humidity.
- D. Bar Chart Screens: On each graphic Bar Chart Screen, provide drawing links to the graphic air handling unit schematic screens.
1. Provide a graphic air handling unit status screen showing the current start or stop command and the status of all supply and return fans.
  2. Provide a graphic VAV fan screen showing the supply and return fan status of each VAV fan, the supply duct static pressure and setpoint of each VAV air handling unit expressed in inches w.g., supply and return fan output signals expressed in percentage maximum flow, and the supply and return air volumes of each VAV fan expressed in CFM if flow transmitters are provided. Analog values shall be indicated in bar chart format. If multiple screens are necessary, provide links between screens.
  3. Provide a graphic AHU damper screen showing, for each AHU, the economizer damper output signals in a bar chart format with signals expressed as percentage of fully open outside air damper, return temperature, and mixed air temperature. Indicate outside air temperature and enthalpy.
  4. Provide a graphic chilled water valve screen showing the analog output signal of all chilled water valves in a bar chart format, with signals expressed as percentage of fully open valve (percentage of full cooling). Indicate the discharge air temperature and setpoint of each air handling unit, cooling plant chilled water supply and return temperatures and the outside air temperature and humidity on this graphic. Provide drawing links between the graphic cooling system screen and this graphic screen.
  5. Provide a graphic heating water valve screen showing the analog output signal of all air handling unit and fan-coil zone heating water valves in a bar chart format, with signals expressed as percentage of fully open valve (percentage of full heating). Indicate the temperature of the controlled medium (i.e., AHU discharge air temperature or zone hot water supply temperature) and the associated setpoint, heating plant hot water supply and return temperatures and flow and the outside air temperature and humidity. Provide drawing links between the graphic heating system screen and this graphic screen. Provide drawing links from this graphic screen to the graphic fan-coil schematic screens.
- E. Alarms: Each programmed alarm shall appear on at least one graphic screen. In general, alarms shall be displayed on the graphic system schematic screen for the system that the alarm is associated with (e.g., chiller alarm shall be shown on graphic cooling plant schematic screen). For all graphic screens, display analog values that are in a "high alarm" condition in a red color, "low alarm" condition in a blue color. Indicate digital values that are in alarm condition in a red color.

END OF SECTION 25 95 50