DRAFT

SECTION 25 15 00 – BAS SOFTWARE AND PROGRAMMING

Consult BMS Project Manager re: **2.13: POINT STRUCTURING AND NAMING convention**

PART 1 - GENERAL

1.01   RELATED DOCUMENTS

   A.   Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

   B.   Although Specifications throughout the Mechanical, Electrical, Communications, Electronic Safety and Security divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them; additional Divisions also may be reciprocally applicable to this Section.

1.02   SUMMARY

   A.   Section Includes:

      1.   System Software.

      2.   Programming Description.

      3.   Control Algorithms.

      4.   Energy Management Applications.

      5.   Password Protection.

      6.   Alarm Reporting.

      7.   Trending.

      8.   Data Acquisition and Storage.

      9.   Point Structuring.

      10.   Dynamic Color Graphics.

   B.   Fully configure systems and furnish and install all software, programming and dynamic color graphics for a complete and fully functioning system as specified.

   C.   Refer to Section 25 00 00 - Building Automation System (BAS) General for general requirements as well as requirements for interface with Owner's WAN.

1.03   REFERENCE STANDARDS

   A.   The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B.   All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C.   All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within all references.

1.04   LICENSING

A.   Provide or upgrade all licensing for all software packages at all required workstations. BAS licensing shall allow unlimited simultaneous users for access to all aspects of the system including system access, workstations, points, programming, database management, graphics etc. No restrictions shall be placed on the licensing. All operator interface, programming environment, networking, database management and any other software used by the Contractor to install the system or needed to operate the system to its full capabilities shall be licensed and provided to the Owner.

B.   All software should be available on all Operator Workstations or CSSs provided, and on all Portable Operator Terminals. Hardware and software keys to provide all rights shall be installed on all workstations. At least two (2) sets of CDs shall be provided with backup software for all software provided, so that the Owner may reinstall any software as necessary. Include all licensing for workstation operating systems, and all required third-party software licenses.

C.   Provide licensing and original software copies for each OWS or CSS.

D.   Provide licensing and original software copies for each remote graphic workstation. Licenses for remote graphic workstations shall allow for access to any Site and shall not be restricted to accessing only the LANs included in this Project.

E.   In the last month of the Warranty Period, upgrade all software and firmware packages to the latest release (version) in effect at the end of the Warranty Period.

F.   Refer to Section 25 00 00 - Building Automation System (BAS) General for further requirements.

PART 2 - PRODUCTS

2.01   GENERAL

A.   All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02   SYSTEM SOFTWARE-GENERAL

A.   Functionality and Completeness: Contractor shall furnish and install all software and programming necessary to provide a complete and functioning system as specified. 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.

2.03   CONTROLLER SOFTWARE

A.   BC Software Residency: Each BC as defined below 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 BC:

1.   Real-Time Operating System software.

2.   Real-Time Clock/Calendar and network time synchronization.

3.   BC diagnostic software.

4.   LAN Communication software/firmware.

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.

B.   AAC/ASC Software Residency: Each AAC/ASC as defined below shall be capable of control and monitoring of all points physically connected to it. As a minimum, software including the following shall reside and execute at the AAC/ASC. Other software to support other required functions of the AAC/ASC may reside at the BC or LAN interface device (specified in Section 25 30 00) with the restrictions/exceptions per application provided in Section 25 14 00:

1.   Real-Time Operating System software.

2.   AAC/ASC 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: BC shall continue to perform all functions independent of a failure in other BC/AAC/ASC or other communication links to other BCs/AACs/ASCs. Trends and runtime totalization shall be retained in memory. Runtime totalization shall be available on all digital input points that monitor electric motor status. Refer also to Section 25 14 00 for other aspects of stand alone functionality.

D.   Operating System: Controllers 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. It shall provide a command prioritization scheme to allow functional override of control functions. Refer also to Section 25 14 00 for other aspects of the controller's operating system.

E.   Network Communications: Each controller shall include software/firmware that supports the networking of CUs on a common communications trunk that forms the respective LAN. Network support shall include the following:

1.   Building Controller/Primary LAN shall be a high-speed network designed and optimized for control system communication. If a Primary LAN communications trunk is severed, BCs shall reconfigure into two separate LANs and continue operations without interruption or Operator intervention.

2.   Controller communication software shall include error detection, correction, and re-transmission to ensure data integrity.

3.   Operator/System communication software shall facilitate communications between other BCs, all subordinate AACs/ASCs (including CIDs—Chiller Controls Interface Device), Gateways and LAN Interface Devices or Operator Workstations.   Software shall allow point interrogation, adjustment, addition/deletion, and programming while the controller is on line and functioning without disruption to unaffected points. The software architecture shall allow networked controllers to share selected physical and virtual point information throughout the entire system.

F.   Point Database/Summary Table:

1.   All points included in the typical equipment point list must be represented to Owner's WAN in a common, open protocol format. All points should be provided as BACnet standard analog, binary, schedule, or trend objects. Naming conventions for these points and network addressing are discussed in Part Three of this Section.

2.   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 Part Three of this Section for a given point type. If database does not support all these parameters, software module shall be created and attached to the points which accomplish the respective function.

G.   Diagnostic Software: Controller software shall include diagnostic software that checks memory and communications and reports any malfunctions

H.   Alarm/Messaging Software: Controller software shall support alarm/message processing and buffering software as more fully specified below.

I.   Application Programs: CUs shall support and execute application programs as more fully specified below:

     1.   All Direct Digital Control software, Energy Management Control software, and functional block application programming software templates shall be provided in a 'ready-to-use' state, and shall not require (but shall allow) Owner programming.

     2.   Line programs shall supply preprogrammed functions to support these energy management and functional block application algorithms. All functions shall be provided with printed narratives and/or flow diagrams to document algorithms and how to modify and use them.

J.   Security: Controller software shall support multiple level password access restriction as more fully specified below.

K.   Direct Digital Control: Controller 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.

     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.   Psychrometric Parameters: Controller software shall provide preprogrammed functions to calculated and present psychrometric parameters (given temperature and relative humidity) including the following as a minimum: Enthalpy, Wet Bulb Temperature.

M.   Updating/Storing Application Data: Site-specific programming residing in volatile memory shall be uploadable/downloadable from an OWS or CSS connected locally, to the Primary LAN, to the Local Supervisory LAN and remotely via the internet and modem and telephone lines as applicable but all must be available. Initiation of an upload or download shall include all of the following methods; Manually, Scheduled, and Automatically upon detection of a loss or change.

N.   Restart: System software shall provide for orderly shutdown 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.

O. Time Synchronization: Operators shall be able to set the time and date in any device on the network that supports time-of-day functionality. The operator shall be able to select to set the time and date for an individual device, devices on a single network, or all devices simultaneously. Automatic time synchronization shall be provided.

P. Miscellaneous Calculations: System software shall automate calculation of psychometric functions, calendar functions, kWh/kW, and flow determination and totalization from pulsed or analog inputs, curve-fitting, look-up table, input/output scaling, time averaging of inputs and A/D conversion coefficients.

2.04 APPLICATION PROGRAMMING DESCRIPTION

A. The application software shall be user programmable.

B. This Specification generally requires a programming convention that is logical, easy to learn, use, and diagnose. General approaches to application programming shall be provided by one, or a combination, of the following conventions:

1. Point Definition: provide templates customized for point type, to support input of individual point information. Use standard BACnet Objects as applicable.

2. Graphical Block Programming: Manipulation of graphic icon 'blocks', each of which represents a subroutine, in a functional/logical manner forming a control logic diagram. Blocks shall allow entry of adjustable settings and parameters via pop-up windows. 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.

3. Functional Application Programming: Pre-programmed application specific programs that allow/require limited customization via 'fill-in-the-blanks' edit fields. Typical values would be setpoints gains, associated point names, alarm limits, etc.

4. Line Programming: Textual syntax-based programming in a language similar to BASIC designed specifically for HVAC control. Subroutines or functions for energy management applications, setpoints, and adjustable parameters shall be customizable, but shall be provided preprogrammed and documented.

C. Provide a means for testing and/or debugging the control programs both off-line and on-line.

2.05 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. Calendar-Based Scheduling.

      3.   Holiday Scheduling.

      4.   Temporary Schedule Overrides.

      5.   Optimal Start/Optimal Stop-based on space temperature offset, outdoor air temperature, and building heating and cooling capacitance factors as a minimum.

      6.   Night Setback and Morning Recovery Control, with ventilation only during occupancy.

      7.   Economizer Control (enthalpy or dry-bulb).

      8.   Peak Demand Limiting / Load Shedding.

      9.   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.

2.06   PASSWORD PROTECTION

A.   Multiple-level password access protection shall be provided to allow the Owner's authorized BAS Administrator to limit workstation control, display and database manipulation capabilities as BAS Administrator deems appropriate for each user, based upon an assigned user name with a unique password.

B.   All passwords for the system shall be provided to the Owner including administrator, dealer, or factory level passwords for the systems provided under this Project.

C.   Passwords shall restrict access to all Control Units.

D.   Each user name shall be assigned to a discrete access level. A minimum of five (5) levels of access shall be supported. Alternately, a comprehensive list of accessibility/functionality items shall be provided, to be enabled or disabled for each user.

E.   A minimum of 250 user names shall be supported per Owner's direction.

F.   Operators shall be able to perform only those commands available for the access level assigned to their user name.

G.   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.

2.07   ALARM AND EVENT MANAGEMENT REPORTING

A.   Alarm management shall be provided to monitor, buffer, and direct alarms and messages to operator devices and memory files. Each BC 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 BCs 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 that 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:

a.   The software shall allow users to define the handling and routing of each alarm by their assignment to discrete priority levels.

b.   A minimum of ten (10) 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.

c.   All alarms shall display at the appropriate workstation alarm screen and each shall be assigned with the correct color and numeric value of priority.

d.   Attention needs to be considered where instantaneous on / off alarms may occur and defined as being nuisance alarms. These types of alarms that activate and deactivate in a short time period shall be delayed or enhanced in such a way to prevent them from becoming nuisance alarms.

e.   Users shall have the ability to manually inhibit alarm reporting for each individual alarm and for each priority level. Contractor shall coordinate with the Owner on establishing alarm priority definitions.

3.   Alarm Report Routing: Each alarm shall be associated with a priority level and unique user-defined list of operator devices including any combination of local or remote workstations, printers, workstation disk files, e-mail addresses, and pagers. All alarms associated with a given priority level shall be routed to all 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 BC 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 buffer alarms until a connection is made. If no connection is made, system shall attempt connection to an alternate dial-up workstation. System shall also be able to dial multiple pagers upon alarm activation.

5.   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.

B.   It shall be possible for any operator to receive a summary of all alarms regardless of acknowledgement status; for which a particular recipient is enrolled for notification; based on current event state; based on the particular event algorithm (e.g., change of value, change of state, out of range, and so on); alarm priority; and notification class.

C.   Alarming Services:

1.   All alarms and events shall be implemented using standard BACnet event detection and notification mechanisms. The workstation shall receive BACnet alarm and event notifications from any gateway or BACnet controller in the system and display them to an operator.

2.   The alarm shall be linked to the system graphic it corresponds to. Either intrinsic reporting or algorithmic change reporting may be used but the intrinsic reporting method is preferred.

3.   The workstation shall also log alarms and events, provide a way for an operator with sufficient privilege to acknowledge alarms, and log acknowledgements of alarms. It shall be possible for an operator to receive, at any time, a summary of all alarms that are currently in effect at any Site whether or not they have been acknowledged. Operators shall also be able to view and change alarm limits for any alarm at the appropriate password level

D.   Alarm Historical Database: The database shall store all alarms and events object occurrences in an ODBC or an OLE database-compliant relational database. Provide a commercially available ODBC driver or OLE database data provider, which would allow applications to access the data using standard Microsoft Windows Data Services.

E.   Submit all alarms per Section 25 00 00.

2.08   TRENDING

A.   The software shall display historical data in both a tabular and graphical format. The requirements of this trending shall include the following:

1. Provide trends for all physical points, virtual points and calculated variables.

2. BACnet Trend Objects are required and all trend data shall be stored in relational database format as specified in herein under Data Acquisition and Storage.

3. In the graphical format, the trend shall plot at least four (4) different values for a given time period superimposed on the same graph. The four (4) values shall be distinguishable by using unique colors. In printed form the four (4) lines shall be distinguishable by different line symbology. Displayed trend graphs shall indicate the engineering units for each trended value.

4. The sample rate and data selection shall be selectable by the operator.

5. The trended value range shall be selectable by the operator.

6. Where trended values on one table/graph are COV, software shall automatically fill the trend samples between COV entries.

B. Control Loop Performance Trends: Controllers incorporating PID control loops shall also provide high resolution sampling in less than six second increments for verification of control loop performance.

C. Data Buffering and Archiving: Trend data shall be buffered at the BC, and uploaded to hard disk storage when archival is desired. All archived trends shall be transmitted to the on-Site OWS or CSS as applicable. Uploads shall occur based upon a user-defined interval, manual command, or automatically when the trend buffers become full.

D. Time Synchronization: Provide a time master that is installed and configured to synchronize the clocks of all BACnet devices supporting time synchronization. Synchronization shall be done using Coordinated Universal Time (UTC). All trend sample times, both BACnet and LonTalk, shall be able to be synchronized. The frequency of time synchronization message transmission shall be selectable by the operator.

E. Submit all Trends per Section 25 00 00.

2.09 DYNAMIC PLOTTING

A. Provide a utility to dynamically plot in real-time at least four (4) values on a given 2-dimensional dynamic plot/graph with at least two Y-axes. At least five (5) dynamic plots shall be allowed simultaneously.

2.10 DATA ACQUISITION AND STORAGE

A. All points included in the typical equipment point list must be represented in a common, open or accessible format. All points should be provided as BACnet standard analog, binary, schedule, or trend objects. Naming conventions for these points and network addressing are discussed in the 'Point Naming Conventions' paragraph below.

B. Data from the BAS shall be stored in relational database format. The format and the naming convention used for storing the database files shall remain consistent across the database and across time. The relational structure shall allow for storage of any additional data points, which are added to the BAS in future. The metadata/schema or formal descriptions of the tables, columns, domains, and constraints shall be provided for each database.

C. The database shall allow applications to access the data while the database is running. The database shall not require shutting down in order to provide read-write access to the data. Data shall be able to be read from the database without interrupting the continuous storage of trend data being carried by the BAS.

D. The database shall be ODBC or OLE database compliant. Provide a commercially-available ODBC driver or OLE database data provider, which would allow applications to access the data via Microsoft Windows standard data access services.

2.11 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.

B. Totalization of electricity use/demand shall allow application of totals to different rate periods, which shall be user definable.

C. When specified to provide electrical or utility Use/Demand, the Contractor shall obtain from the local utility all information required to obtain meter data, including k factors, conversion constants, and the like.

2.12 EQUIPMENT SCHEDULING

A. Provide a graphic utility for user-friendly operator interface to adjust equipment-operating schedules.

B. All operators shall be able to view the entries for a schedule. Operators with sufficient privilege shall be able to modify schedule entries from any workstation.

C. Scheduling feature shall include multiple seven-day master schedules, plus holiday schedule, each with start time and stop time. Master schedules shall be individually editable for each day and holiday.

D. Scheduling feature shall allow for each individual equipment unit to be assigned to one of the master schedules.

E.   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. A password level that does not allow assignment of master schedules shall allow a timed override feature.

F.   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.

2.13   POINT STRUCTURING AND NAMING

A.   General:

1.   The intent of this Section is to require a consistent means of naming points across the Owner's WAN. Contractor shall configure the systems from the perspective of the Owner's WAN, not solely the local Project.

2.   The following requirement establishes a standard for naming points and addressing Buildings, Networks, Devices, Instances, and the like.

3.   The convention is tailored towards the Owner's WAN and as such, the interface shall always use this naming convention.

4.   Native BACnet systems shall also use this naming convention. For non-BACnet systems, the naming convention shall be implemented as much as practical, and any deviations from this naming convention shall be approved by the Owner.

5.   Each controller shall have English language descriptors for all system points, variables, parameters etc. located and accessible form the controller memory. All point naming shall match between all system files and record documents.

B.   Point Summary Table:

1.   The term 'Point' is a generic description for the class of object represented by analog and binary inputs, outputs, and values.

2.   With each schematic, Contractor shall provide a Point Summary Table listing:

a.   Building code (3 digit building acronym).

b.   Floor code.

c.   Room number.

d.   Sub room letter.

e.   Equipment type.

    f. Equipment number.

    g. Equipment code.

    h. Full point name (see Point Naming Convention paragraph).

    i. Point description.

    j. Ethernet backbone network number.

    k. Network number.

    l. Device ID.

    m. Device MAC address.

    n. Object ID (object type, instance number).

    o. Engineering units.

3. Additional fields for non-BACnet systems shall be appended to each row. Point Summary Table shall be provided in both hard copy and in electronic format (ODBC-compliant).

4. Point Summary Table shall also illustrate Network Variables/BACnet Data Links.

5. The BAS Provider shall coordinate with the Owner's representative to compile and submit a proposed Point Summary Table for review prior to any object programming or Project startup. The Contractor shall support and not impede direct negotiations between the BAS Provider and the Owner to allow the customizing necessary for structuring the BAS point names to meet the Owner's needs. The Owner shall grant approval of final point names to be verified through Commissioning by issuing the approved alarms to the Contractor.

6. The Point Summary Table shall be kept current throughout the duration of the Project by the Contractor as the Master List of all points for the Project. Project closeout documents shall include an up-to-date accurate Point Summary Table. The Contractor shall deliver to the Owner the final Point Summary Table prior to final acceptance of the system. The Point Summary Table shall be used as a reference and guide during the Commissioning process.

7. The Point Summary Table shall contain all data fields on a single row per point. The Point Summary Table is to have a single master source for all point information in the building that is easily sorted and kept up-to-date. Although a relational database of Device ID-to-point information would be more efficient, the single line format is required as a single master table that will reflect all point information for the building. The point description shall be an easily understandable English-language description of the point.

The Table below provides an example of the information to be described. Consult BMS Project Manager for current point summary table format.

Point Summary Table - Example	
(Transpose for a single point per row format)	
Building Number	
Floor Level	
Room Number	
Sub room letter	
Equipment Type	e.g. Air Handler (AH)
Equipment Number	
Equipment Code	
*POINT NAME (OBJECT NAME)	
*Point Description (Object Description)	
Ethernet Network Number	
Network Number	
Device ID	
Device MAC address	
Object Type	
Instance Number	
Engineering Units	e.g. KW
Network Variable?	e.g. True
Server Device	
Client Devices	
Included with Functional	
*Represents information that shall reside in the relevant property for the object	

C. Point Naming Convention:

1. All point names shall adhere to the Owner's format. Said objects shall include all physical I/O points, calculated points used for standard reports, and all application program parameters. For each BAS object, a specific and unique name shall be required.

2. For each point, seven (7) distinct descriptors shall be linked to form each unique object name: Building Code, Floor, Room Number, Equipment Type, Equipment Number or Letter, Equipment Code or Point Description. All keyboard characters except a space are allowable. Each of the four (4) descriptors must be bound by a period to form the entire object name. Reference the paragraphs below for an example of these descriptors.

3. The Owner shall designate the 'Building' descriptor. The 'Equipment Type' descriptor shall define the equipment category; e.g., Chiller, Air Handling Unit, or other equipment. The 'Equipment Code' descriptor shall define the hardware or software type or function associated with the equipment; e.g., supply temperature, water pressure, alarm, mixed air temperature setpoint, etc. and shall contain any numbering conventions for multiples of equipment; e.g., CHLR1KW, CHLR2KW, BLR2AL (Boiler 2 Alarm), HWP1ST (Hot Water Pump 1 Status).

4. A consistent object (point) naming convention shall be utilized to facilitate familiarity and operational ease across Owner's WAN. Inter-facility consistency shall be maintained to ensure transparent operability to the greatest degree possible. The table below details the object naming convention and general format of the descriptor string. A maximum of 30 characters shall be used.

The Table below provides an example of the point name convention. Consult BMS Project Manager for current format requirements.

Point / Object Name Requirements	
Sample: 585.02.1000a.AH31.SAT	
Building No.	3 (or 4) numeric characters
(02) - Floor Location	2 alpha or numeric characters - Must use two characters, such as, (02) for Second Floor
(.)	1 character - period; acts as a separator
(100) - Room Number	3 - 4 numeric characters
(a) - Sub Room Letter	(a-z) if no sub room DO NOT use space or a dash
(.)	1 character - period; acts as a separator
(AH) - Equipment Type	2 alpha characters
(31) - Equipment Number, Equipment Letter, or Combination	1-2 upper case alpha and/or numeric characters
(.)	1 character - period; acts as a separator
(SAT) - Equipment Code	1 - 4 alpha characters

D. Device Addressing Convention:

1. BACnet network numbers and Device Object IDs shall be unique throughout the network.

2. All assignment of network numbers and Device Object IDs shall be coordinated with the Owner.

3. Each Network number shall be unique throughout all facilities and shall be assigned in the following manner unless specified otherwise:

4. Each Device Object Identifier property shall be unique throughout the system and shall be assigned in the following manner unless specified otherwise:

5.   The Contractor shall coordinate with the Owner or a designated representative to ensure that no duplicate Device Object IDs occur.

6.   Alternative Device ID schemes or cross Project Device ID duplication if allowed shall be approved before Project commencement by the Owner.

2.14   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 displayed and resizable in a 'Windows'-like environment. All functions excepting text entry functions shall be executable with a mouse.

C.   Graphic software shall provide for multitasking such that third-party programs can be used while the OWS software is on line. Software shall provide the ability to alarm graphically even when operator is in another software package.

D.   Operating system software shall be [Microsoft Windows 2000 Professional].

E.   The software shall allow for Owner 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 (i.e., engineering units, etc.). In addition, operators shall be able to command equipment or change setpoints from a graphic through the use of the mouse

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 automatically updated at a minimum frequency of six (6) 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. Such overrides or changes shall occur in the control unit, not just in the workstation software. 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.   Submit all Graphics per Section 25 00 00.

J.   Dynamic Symbols: Provide a selection of standard symbols that 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 statuses. (For instance, green = normal, red = alarm, gray (or '???') for non-response.

K.   Graphics Development Package: Graphic development and 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 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.

2.15   REMOTE PERSONAL COMPUTER WORKSTATION GRAPHIC SOFTWARE

A.   Remote graphic operator software shall provide all the functionality specified for the local graphic software.   It shall also provide for dial-up communications using the specified modems via commercial telephone lines to connect to the Local Supervisory or Primary LAN, and using the Internet.

B.   Software shall not require graphic images to be sent across the phone lines or 56Kbps or slower Internet connection.   Graphic images shall reside on the remote operator workstation hard drive and all licenses must 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 must therefore support multi-instancing to allow multiple simultaneous remote connections and use of the graphic software.

C.   Software shall be capable of initiating communication to the any LAN, upon user command, to perform all specified functions.   Software shall be capable of initiating communication to the LANs in accordance with user-programmed time schedules to upload trend and report data.   Software shall be capable of communicating from the LAN in accordance with user-programmed time schedules to report alarms, upload trend, and report data.   Software shall automatically terminate the communication whenever all applications requiring modem connection are closed.

PART 3 - EXECUTION

3.01   SYSTEM CONFIGURATION

A.   Contractor shall thoroughly and completely configure BAS system software, supplemental software, network communications, CSS, OWS, remote operator workstation, portable operators terminal, printer, and remote communications.

3.02   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.   Provide all initial Site-specific application programming and thoroughly document programming.   Generally meet the intent of the written sequence of operation.   It is the 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, both 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 must be maintained in a logical system of directories. All file names shall adhere to the naming convention format as established in the Owner's Standard Acronyms documentation. All files developed for the Project will be the property of the Owner and shall remain on the workstation(s)/server(s) at the completion of the Project.

3.03 PASSWORD SETUP

A. Set up the following password levels to include the specified capabilities:

1. Level 1: (Owner's BAS Administrator):

a. Level 2 capabilities.

b. View, add, change and delete user names, passwords, password levels.

c. All unrestricted system capabilities including all network management functions.

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 BAS 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.   Contractor shall assist Owner's operators with assigning user names, passwords and password levels.

3.04   POINT PARAMETERS

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

1.   Name.

2.   Address.

3.   Scanning frequency or COV threshold.

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 (reasonableness values), 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/or secondary controlling 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 that 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.

7.   Default value to be used when the normal controlling value is not reporting.

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

1.   Name.

2.   Address.

3.   Engineering units (on/off, open/closed, freeze/normal, etc.).

4.   Debounce time delay.

5.   Message and alarm reporting as specified.

6.   Reporting of each change of state, and memory storage of the time of the last change of state.

7.   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.

11. Default value to be used when the normal controlling value is not reporting.

3.05   TRENDS

A.   Contractor shall establish and store trend logs. Trend logs shall be prepared for each physical input and output point, and all dynamic virtual points such as setpoints subject to a reset schedule, intermediate setpoint values for cascaded control loops, and the like as directed by the Owner.

B.   The Owner will analyze trend logs of the system operating parameters to evaluate normal system functionality. Contractor shall establish these trends and ensure they are being stored properly.

1.   Data shall include a single row of field headings and the data thereafter shall be contiguous. Each record shall include a date and time field or single date stamp. Recorded parameters for a given piece of equipment or component shall be trended at the same intervals and be presented in a maximum of two separate 2-dimensional formats with time being the row heading and field name being the column heading.

C.   Sample times indicated as COV (±) or change-of-value mean that the changed parameter only needs to be recorded after the value changes by the amount listed. When output to the trending file, the latest recorded value shall be listed with any given time increment record. The samples shall be filled with the latest values also if the points include different time intervals. If the BAS does not have the capability to record based on COV, the parameter shall be recorded based on the interval common to the unit.

D.   Trending intervals or COV thresholds shall be dictated by the Owner upon system start-up.

E.   The Contractor shall demonstrate functional trends as specified for a period of 30 days after successful system demonstration before final acceptance of the system.

3.06   TREND GRAPHS

A.   Prepare controller and workstation software to display graphical format trends. Trended values and intervals shall be the same as those specified

B.   Lines shall be labeled and shall be distinguishable from each other by using either different line types, or different line colors.

C.   Indicate engineering units of the y-axis values; e.g. degrees F., inches w.g., Btu/lb, percent open, etc.

D.   The y-axis scale shall be chosen so that all trended values are in a readable range. Do not mix trended values on one graph if their unit ranges are incompatible.

E.   Trend outside air temperature, humidity, and enthalpy during each period in which any other points are trended.

F.   All points trended for one HVAC subsystem (e.g. air handling unit, chilled water system, etc.) shall be trended during the same trend period.

G.   Each graph shall be clearly labeled with HVAC subsystem title, date, and times.

[Engineer must edit the following to be Project specific.]

3.07 ALARMS

A. This Section supersedes and over rules all references to building automation alarms in the Contract Documents, including all sequences of operations and other sections of the BAS Specification in regards to alarms. The Contractor shall support and not impede direct negotiations between the BAS Provider and the Owner to allow the customizing necessary for customizing alarms and alarm parameters to meet the Owner's needs.

B. The BAS Provider is required to submit a point summary to confirm building automation point names as specified herein The BAS Provider shall submit this point summary with the addition of identifying all alarms which includes detail information on the alarm parameters to the UNIVERSITY OF HOUSTON Manager of Building Automation for approval prior to the beginning of any Commissioning process of the building automation system.

C. The UNIVERSITY OF HOUSTON Manager of Building Automation will provide the format form to the BAS Provider upon request. The Owner shall grant approval of alarms to be verified through Commissioning by issuing the approved alarms to the Contractor. The approved alarms issued to the Contractor shall be used for the Functional Test Procedures alarms tested. The Contractor shall initiate the start of this process immediately after building automation submittal have been approved and monitor the progress to ensure the construction schedule is not delayed.

D. Analog Input Alarms:

    1. Duct Static Pressure:

        a. Alarm @ +(-) 0.3 inches from set point for 5 minutes @ Priority 3.

        b. Normal @ +(-) 0.2 inches from set point for 5 minutes.

        c. Alarm is active after fan is proven ON for the minimum time necessary to allow the sensor to be within the alarm parameter.

        d. Alarm is deactivated after fan is proven OFF.

    2. Duct Air Temperatures:

        a. Alarm @ +(-) 2.0 degrees F from set point for 5 minutes @ Priority 3.

        b. Normal @ +(-) 1.0 degrees F from set point for 5 minutes.

        c. Alarm is active after fan is proven ON for the minimum time necessary to allow the sensor to be within the alarm parameter.

        d. Alarm is deactivated after fan is proven OFF.

    3. Space or Room Temperature:

        a. Typically will not be alarmable.

        b.   Submit as not alarmable and Owner will confirm.

4.   Duct or Space Humidity:

        a.   Alarm @ (+) 15 percent from set point (60 percent) for 5 minutes @ Priority 3.

        b.   Alarm @ (-) 20 percent from set point (60 percent) for 5 minutes @ Priority 3.

        c.   Normal @ 5 percent from offset alarm parameters for 5 minutes.

        d.   Point is always ready to alarm.

5.   Water temperature sensors which are inputs to control loops:

        a.   Submit reasonable alarm parameter to prevent nuisance alarming Priority 3.

        b.   Owner will confirm alarm.

6.   All other Analog Inputs:

        a.   BAS Provider shall utilize their expertise and recommend not less than three (3) analog input alarms which protect the Owner's best interests.

        b.   Submit at Priority 3 with recommended alarm parameters.

        c.   Identify recommended alarms in submittal.

        d.   Owner will confirm alarm.

E.   Digital Inputs Alarms:

1.   Proofs (current sensor, air flow switches, water differential pressure switches etc).

        a.   Digital inputs paired with BAS digital output will have the ability to alarm at all times @ Priority 3.

        b.   Alarm will delay for the reason time needed when the state of the digital output changes to prevent nuisance alarms.

        c.   Point is in alarmed condition when the value of the digital input does not equal the value of the digital output after the time delay.

        d.   Point is in the Normal condition when the value of the digital input equals the value of the digital output after the time delay.

        e.   Digital input proofs without a paired digital output shall not alarm and be for monitoring purposes only.

      2.   Safeties (high static cutout, freeze condition, excessive vibration, high humidity cutout, VFD fault, etc.).

          a.   The digital input shall be always ready to alarm without delay.

          b.   The digital input shall display "ALARM" at Priority 3 at the Alarm screen when activated.

          c.   The digital input shall display "NORMAL" at the Alarm screen when deactivated.

      3.   Monitoring Digital Inputs (auxiliary drain pan alarm, Liebert Unit general alarm, water detector, etc) the exception is air filter differential pressure switch.

          a.   All digital inputs which "deactivated" is the normal state of planed operations shall alarm when the normal state of planed operation changes.

          b.   The digital input shall display "ALARM" at Priority 3 at the Alarm screen when activated.

          c.   The digital input shall display "NORMAL" at the Alarm screen when deactivated.

      4.   Air Filters:

          a.   Typically will not be alarmable.

          b.   Submit as not alarmable and Owner will confirm.

          c.   The digital input shall display "DIRTY" when activated.

          d.   The digital input shall display "CLEAN" when deactivated

F.   Analog Outputs Alarms:

    1.   All Analog Outputs:

        a.   BAS Provider shall utilize their expertise and recommend any analog output alarms which protect the Owner's best interests.

        b.   Identify recommended alarms in submittal.

        c.   Owner will confirm any alarms.

G.   Digital Outputs Alarms:

    1.   Refer to digital inputs paired with digital outputs as specified herein.

    2.   All Digital Outputs:

        a.   BAS Provider shall utilize their expertise and recommend any digital output alarms which protect the Owner's best interests.

   b. Identify recommended alarms in submittal.

   c. Owner will confirm any alarms.

 H. Nuisance Alarms: All alarms which have been identified by the Owner as a nuisance alarm due to numerous times in and out of alarm, shall be addressed and corrected by the Contractor in a manner that the Owner has approved.

 I. See requirements for additional equipment-specific alarms specified in the Contract Documents.

3.08 GRAPHIC SCREENS

  [Engineer must provide electronic control design floor plans.]

 A. Floor Plan Screens: The Contract Document Drawings will be made available to the Contractor in AutoCAD LT 2002 format upon request. These Drawings may be used only for developing backgrounds for specified graphic screens; however the Owner does not guarantee the suitability of these Drawings for the Contractor's purpose. Graphic Screens shall be submitted for approval.

  1. Provide graphic floor plan screens for each floor [wing] [tower] [other] of each building.

   a. Indicate the location of all equipment that is not located on the equipment room screens.

   b. Indicate the location of temperature sensors associated with each temperature-controlled zone (i.e., VAV terminals, fan-coils, single-zone AHUs, etc.) on the floor plan screens.

   c. 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.

   d. Mechanical floor plan Drawings will be made available to the Contractor upon request for the purpose of determining zone boundaries. Indicate room numbers as provided by the Owner.

   e. Provide a drawing link from each space temperature sensor symbol and equipment 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 elevation views and/or 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.

B.   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. Verbose 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 system and cooling system graphics. Link screens for supply and exhaust systems if they are not combined onto one screen.

2.   Provide a graphic screen for each zone. Provide links to graphic system schematic screens of air handling units that serve the corresponding zone.

3.   Provide a cooling system graphic screen showing all points associated with the chillers, cooling towers and pumps. Indicate outside air dry-bulb temperature and calculated wet-bulb temperature. Link screens for chilled water and condenser water systems if they cannot fit onto one cooling plant graphic screen.

4.   Link screens for heating and cooling system graphics to utility history reports showing current and monthly electric uses, demands, peak values, and other pertinent values.

C.   Bar Chart Screens: On each graphic Bar Chart Screen, provide drawing links to the graphic air handling unit schematic screens.

1.   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 system chilled water supply and return temperatures and the outside air temperature and humidity on this graphic. Provide drawing links between the graphic cooling plant screen and this graphic screen.

2. Provide a graphic heating water valve screen showing the analog output signal of all air handling unit 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 (such as AHU discharge air temperature or zone hot water supply temperature) and the associated setpoint and the outside air temperature and humidity.

D. 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 (for example, chiller alarm shall be shown on graphic cooling system 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 15 00