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## **PART 1 - GENERAL**

### **1.1 WORK OF THIS SECTION**

- A. This section of the Specifications details the components to be provided by the BMCS subcontractor relating to the following:
1. Monitoring and control software.
  2. Applications software packages.
  3. Programming software packages.
  4. PDA/Email Critical Alarm Notification.

### **1.2 OPERATOR INTERFACE SOFTWARE**

- A. This section details the operator interface. The operator interface portions of this section details those software requirements specifically related to the following:
1. BMCS operator password access control.
  2. The input by the operator of:
    - a. Requests for information.
    - b. Operator commands.
    - c. Databases and operating sequences
  3. The output by the BMCS of:
    - a. Alarms.
    - b. Reports.
    - c. VDU displays.

### **1.3 APPLICATIONS PACKAGES**

- A. The Applications Software Packages shall reside at the DCP and UC except that it shall be acceptable for the Applications Packages associated with the presentation of data, storage, analysis, and retrieval of data to reside at the OIW.
- B. Provide the following programs for the storage, analysis and retrieval of data:
1. Monitoring and control software.
  2. Setpoint and parameter software.
  3. Programming software
  4. PDA email and text alarm notification.
  5. Graphical displays.
  6. Dynamic graphical trending.
  7. Historical data trends.
- C. Provide the following programs for the presentation of data:
1. Psychometric properties.
  2. Equipment run-time totalization.
  3. Energy usage and demand.
  4. Thermal energy usage.
  5. Measurement and Verification data.
- D. Implement all applications programs such that the BMCS is fully functional and does not require input from the operator in order to be a fully commissioned turnkey system meeting all the requirements of these Specifications.
- E. Request any data required for the implementation of the application packages at least four weeks from the date the information is needed. Submit the request for information in the form of tables or forms for the Owner's personnel to complete and return.

## **PART 2 - PRODUCTS**

### **2.1 OPERATOR FUNCTIONS - WEB BASED BMCS**

- A. The BMCS shall utilize Secure Sockets Layer (SSL) HTTP to allow for access to the BMCS via the web without any additional software packages or system configuration.
- B. Operators shall have access to specific functions of the BMCS via a standard web browser interface, subject to password access assigned by the Owner. The web-based displays shall be XML based. A fixed IP address will be assigned for the remote access.
- C. Operators with the appropriate level a password shall be able to perform all specified functions specified in these documents, except for sequence of operation programming changes. The connection of a remote operator to the system via the web interface shall in no way hinder the local on-site NDS or OIW interface capabilities.
- D. All operator entries shall be coordinated with the BMCS to ensure seamless operations and tracking of all changes to history and archive databases.

## 2.2 BMCS USER PASSWORD ACCESS

- A. Access to the BMCS at any I/O device shall be protected by a password based access system. An operator shall not be able to access information and shall not be able to perform any tasks at the BMCS until a valid password has been entered. Access shall terminate when an operator signs off and after a predetermined time-out period, initially set at 10 minutes after the last operator access, whichever occurs first. The password shall not be echoed at any terminal when it is entered. Any operator functions, whether or not detailed within these specifications, shall be subject to the operator's password being of a sufficiently high level to enable the operator to perform the function.
- B. Each password shall have up to four alphanumeric characters and it shall be possible to have a minimum of twenty active passwords at any time.
- C. It shall be possible to define the following for each password:
  - 1. I/O terminals that can be used for access.
  - 2. Functions that can be performed.
  - 3. Points that can be accessed.
- D. If the system has fixed defined function levels then there shall be at least five levels. Only the highest level shall be able to undertake changes to the passwords.
- E. An operator with the highest level of password shall be able to make additions, deletions and changes to the passwords on-line using an interactive procedure including the changing of the time-out period. An operator with the highest level of password shall be able to obtain a report detailing the passwords assigned to each operator and all relevant details of the access privileges associated with each password.

## 2.3 PROGRAMMING SOFTWARE

- A. Provide programming software for each NDS, OIW, and ROW to allow the BMCS operator the ability to view/modify programming for the BMCS controllers. The programming software shall meet, at minimum, the following capabilities:
  - 1. Upload/download programming sequences to any CCP, DCP, or UC.
  - 2. Configure/modify inputs for each DCP or UC.
  - 3. Configure/modify all setpoints for the associated controller.
  - 4. Graphical programming software shall include all stencils and logic libraries available from the manufacturer.
  - 5. The software loaded on the ROW shall provide the above functionality through TCP/IP or by directly connecting to the associated controller.
  - 6. Separate software packages to meet the above functionality shall be permitted provided all required software packages are installed.

## 2.4 BMCS OPERATOR FUNCTIONS - GENERAL

- A. The operator shall be able to access the BMCS to perform the following functions:
  - 1. Observe values of BMCS monitored points, BMCS outputs and BMCS calculated values.
  - 2. Observe and change control modes for motors, i.e. BMCS manual control mode and

3. BMCS software control mode.
  3. Observe, add, delete and change databases including databases that define monitored, controlled and calculated points, databases that define schedules and databases that are created to meet any of the many functions detailed in these documents.
  4. Issue commands to change the status of a digital output and the value of an analog output.
  5. Observe and acknowledge BMCS determined alarm conditions.
  6. Initiate the output of, add, delete and change reports.
  7. Observe, add, delete and change operating sequences.
  8. Observe, add, delete and change VDU system diagram displays.
  9. Observe, add, delete and change control algorithms including PID control constants.
  10. Other functions as expressly detailed in the BMCS specifications and as required, even if not expressed, in order to meet the intent of these specifications.
- B. Operator access shall be by penetration through a hierarchy of menus and/or system displays on the VDU using cursor control. The menu selections shall be self-evident and shall easily guide the operator through the execution of any of the functions. It shall not be necessary for the operator to know the location, i.e. CCP, DCP and/or UC, at which a point is monitored/controlled in order to access any information concerning that point.
- C. Following the completion of all steps by the operator performing an operator access function, the function shall commence within two seconds and shall be completed within ten seconds apart from those functions, which are subject to the limitations of the output rate of the printers.
- D. An operator shall be able to edit his keyboard entries prior to attempted execution using standard keys such as "delete" and "backspace". However, if an operator makes an incorrect entry then the BMCS will display a message, which clearly details the nature of the error and identifies the appropriate "help" menu that will assist the operator to successfully complete the entry.
- E. All operator entries shall be echoed, except passwords, at the VDU at the OIW and on the screen on the ROW depending on where the operator entry is made.

## 2.5 OPERATOR REQUESTS FOR INFORMATION

- A. Each monitored, controlled and calculated point in the system shall be accessed via the menu and the alphanumeric approaches as detailed in these specifications.
- B. Access using the system displays, as detailed in the BMCS Software section of these specifications, with the addition that once the system display level is reached it shall be possible to progress to the individual monitored, controlled or calculated point. Once a menu or system display selection is made it shall take no more than five seconds before the next menu or display level appears on the VDU.
- C. Access using the alphanumeric approach shall enable an operator to access any point via a unique point name, which may be a short English language descriptor or a readily understandable mnemonic of the type used to identify points in the field termination schedules and system diagrams.
- D. Either approach shall enable the operator to observe or change any parameter associated with a point and to add and delete points.

## 2.6 OPERATOR COMMANDS

- A. An operator command at any operator terminal shall be completed within two seconds of entering the command at the terminal.
- B. The operator shall be able to place any output in the BMCS manual control mode and when in that mode the operator shall be able to place any output to any required value subject to any hardwired interlocks and any software interlocks, which are specified to apply in the BMCS manual control mode.
- C. The operator shall be able to place any setpoint that is determined by software into the manual

mode and to manually assign a value to the setpoint. This is considered an override condition.

- D. The operator shall be able to initiate the restart of equipment following a fire alarm and following a power failure. Refer to the paragraphs titled "Equipment restart following a fire alarm" and "Equipment restart following a power failure" in the BMCS Sequences of Operations in these specifications.

## 2.7 OIW AND ROW OPERATOR INTERFACE SOFTWARE - GENERAL

- A. Information shall be output from the BMCS when:
  - 1. Requested by the operator. This includes requests made by the operator for the immediate output of specific information and requests for information, which are optional and have been pre-programmed by the operator for display.
  - 2. Scheduled by the operator. An example of this might be the output of a report at an operator-defined time of day.
  - 3. An alarm condition has been detected by the BMCS. All alarm conditions detected by the BMCS shall be annunciated as detailed elsewhere in this section.
- B. The operator interfaces for the OIW and the ROW shall be the same.
- C. The operator interface shall be "user friendly". The interface shall be such that there is no need for the operator to reference documentation other than "help" menus on the system in order for the operator to perform his normal duties after the training has been received. The engineering units for the data displayed shall match the contract documents.
- D. The operator interface shall be English language with English units.
- E. Following a power failure, and BMCS microprocessor shall return to a fully operational status without operator intervention within two minutes of the return of mains power. Software changes, including modifications to database(s), shall not be lost in a power failure. Operator login shall be required to achieve access to the BMCS software after a power failure.
- F. Web based access to the BMCS shall provide monitoring and control specific to the user. The information displayed on the web pages shall be refreshed at least once every ten seconds. Where a web page provides for the operator to input changes or requests to the BMCS the activation of the changes shall require the operator to click on a "Submit" button or similar feature before the changes are sent. All web access actions shall be immediately echoed to all other OIW.

## 2.8 DATABASES AND OPERATING SEQUENCES

- A. The operator shall be able to make on-line modifications, additions and deletions to all databases at the PC, CCP, DCP, and UC using interactive procedures. Prior to the acceptance of the changes by the BMCS there shall be a restatement of the contemplated database modification, addition or deletion together with a question of the type "Do you wish to proceed?" which will require an affirmative answer before the change takes place.
- B. The operator shall be able to modify a sequence, add a sequence and delete a sequence on-line as detailed in the BMCS Software section of these specifications.

## 2.9 MONITORING AND CONTROL SOFTWARE - GENERAL

- A. Scan rates at the DCP and UC shall meet the following requirements:
  - 1. Each analog and digital input point shall be scanned at least once every five seconds.
  - 2. If a point is in alarm, then the alarm shall be annunciated at the OIW within two seconds of the termination of the time delay period following detection of the alarm condition.
- B. An operator command at any operator terminal shall be completed within two seconds of entering the command at the terminal.
- C. DDC outputs shall be updated at a frequency defined by the operator. The operator shall be able to select a frequency, at minimum, in the range of 2 seconds to 256 seconds.

- D. Define a minimum time delay between successive starts of each item of controlled equipment so that disturbances created on the building electrical system are minimized in frequency and amplitude. Time delays shall not exceed the manufacturer's rating. Time delays shall be changeable by the operator. This time delay shall be in effect for motors in the BMCS software control mode and for motors in the BMCS manual control mode.
- E. BMCS analog and digital outputs shall change as the result of either an operator entered command or a BMCS generated software command. These two modes of BMCS output are referred to as the BMCS MANUAL CONTROL mode and the BMCS SOFTWARE CONTROL mode and differ as follows:
1. In the BMCS manual control mode, the signal to a final control element such as a valve or a damper actuator and to a relay such as a motor control relay shall change as the result of a command manually entered at one of the operator terminals. When an output is in the BMCS manual control mode, there shall be no means by which it can switch to the BMCS software control mode or by which the value or state of the BMCS output can change without operator intervention. This is considered an override condition.
  2. In the BMCS software control mode, the signal to the final control element or relay shall be changed automatically as the result of software such as a schedule, operating sequence or Applications Package.

If an output remains in override for longer than one day, then a non-critical alarm shall be generated. The alarm shall continue to be generated each day as long as the output is in override.

- F. BMCS analog and digital inputs shall have two modes of operation; automatic and override.
1. In the BMCS automatic mode, the sensing element shall report directly to the BMCS controller and that value shall be displayed.
  2. In the BMCS override mode, the input value shall be fixed. The value shall be identified as being in the override mode.

If an input remains in override for longer than one day, then a non-critical alarm shall be generated. The alarm shall continue to be generated each day as long as the input is in override.

- G. BMCS software sequence setpoints and operating parameters shall have two modes of operation; automatic and override.
1. In the BMCS automatic mode, the defined setpoint or parameter shall be used as part of the operating sequence. The setpoint and parameter shall be changeable via an interactive procedure. Any setpoint and parameter changes in the automatic mode are not considered overrides.
  2. In the BMCS override mode, the setpoint or parameter value shall be set by the operator using the override function. This override setpoint or parameter shall be used as part of the operating sequence. The value shall be identified as being in the override mode.

If a setpoint or parameter remains in override for longer than one day, then a non-critical alarm shall be generated. The alarm shall continue to be generated each day as long as the setpoint or parameter is in override.

- H. The operator shall be able to select the mode of output control for each analog and digital output.
- I. If there is a discrepancy between the actual and BMCS commanded state of a motor then the motor control relay shall be set automatically to the OFF state and the motor shall be placed in the BMCS manual control mode. Generate an alarm unless the discrepancy arises because of control of the motor by the fire alarm system or because of a power failure. If the discrepancy has arisen because of override control by the fire alarm system, then the motor shall be restarted by the BMCS in accordance with the procedure detailed in the paragraph titled "Equipment Restart Following a Fire Alarm". If the discrepancy has arisen because of a power failure, then the motor shall be restarted by the BMCS in accordance with the procedure detailed in the paragraph titled "Equipment Restart Following a Power Failure". In all cases a motor shall only restart following an operator manually entered command.
- J. The BMCS shall not override any hardwired interlocks such as those provided at motor starters for overload protection, damper interlock, pressure interlock, etc. and those provided to facilitate control by the Fire Detection, Alarm and Communication System regardless of the BMCS output control mode.

- K. Software shall automatically inhibit the generating of an alarm on an analog input when the status of an associated digital input indicates that an alarm condition is to be expected. Such would be the case, for example, when an air handling unit is off as it would be expected that the supply air temperature would be outside the alarm limits established for the operating state. An interactive procedure shall enable the operator to link any analog value to a digital input so as to inhibit unnecessary alarms. Points with their alarms locked out shall continue to be displayed on reports and System graphics. The alarms shall remain locked out for an operator defined time delay following the start-up of the associated equipment
- L. If for any reason the operator wishes to terminate the monitoring of a particular digital or analog input, then it shall be possible to take the point out of service via an interactive procedure. If the point is the monitored variable in a control loop, then the control loop shall be disabled, any sequence dependent on the point shall also be disabled and all associated BMCS outputs shall go to the BMCS manual control mode.
- M. The operator shall be able to add, delete and modify points monitored and controlled by the BMCS via an interactive procedure.
- N. The operator shall be able to modify and configure control loops. Setpoints for control loops shall be as detailed in Part 3 of this Section and shall be changeable by the Operator via the associated graphic.

## 2.10 SYSTEM GRAPHICAL DISPLAYS

- A. Provide a graphical display package. Provide graphical displays for each system monitored and controlled by the BMCS. The operator shall be able to configure, modify and delete system graphics.
- B. System graphics shall appear on the VDU complete with all associated data within five seconds of the completion of the operator entry/ menu selection.
- C. Real-time data shall be superimposed on the system graphics and shall be updated at intervals between 10 and 20 seconds. The data shall be positioned on the display at points indicative of the instrumentation locations on the system.
- D. Provide a library of commonly used symbols based on ASHRAE and ISA standards.
- E. Each system graphic shall indicate real-time data including analog and digital input and output points, setpoints and calculated values of the associated system. The engineering units for the data displayed shall match the contract documents. Percentage of setpoint displays are not acceptable unless specifically noted.
- F. The BMCS Field Termination Schedules and associated flow diagram detailed in these Specifications shall provide a guideline for the selection of data to be displayed on a particular system diagram. Preferably the status of motors, e.g. on, off, failed, etc., shall be indicated by color changes such as green for on, blue for off and red for failed. The system graphics shall also distinguish between outputs in the BMCS manual control mode and in the BMCS software control mode. Where necessary to enhance the understanding of the data displayed use alphanumeric text.
- G. Provide system graphics for, at minimum, each of the following:
  - 1. Each system detailed in the Field Termination Schedules.
  - 2. A hierarchy of graphics including:
    - a. Site/main page.
    - b. Overall building diagram with main equipment status and AHU supply air temperature status.
    - b. Each floor/area of the building indicating mechanical equipment.
    - d. Each floor/area of the building indicating electrical equipment and lighting control.
    - c. Each AHU.
    - d. Each terminal unit.
    - e. Each fan coil unit.
    - f. Each fan.

- g. Lower Loop and Upper Loop CHW System.
  - h. Condenser water system.
  - i. Lower Loop and Upper Loop HHW System.
  - j. Building Pressure Totalization by systems.
  - k. Electrical systems. A one-line overall graphic of the building main electrical systems indicating status of main equipment and monitored points.
  - l. Fire alarm systems interfaces.
  - m. Plumbing system interfaces.
  - n. Fuel oil system.
  - o. Overall building diagram with system flowrates and pressures per floor.
  - p. Overall building diagram indicating LEED Measurement and Verification points.
  - 3. Each floor of the building shall indicate the terminal unit / tri-path AHU overhead zones. Separate the floor graphics into logical areas if the size of the floor is such that the presentation of data is not easily readable. Indicate the following for each zone:
    - a. Red background - space temperature above alarm limit.
    - b. Green background - space temperature within alarm limits.
    - c. Blue background - space temperature below alarm limit.
    - d. Space temperature superimposed on each zone area.
  - 4. Separate graphic for each terminal unit, which shall incorporate all operator changeable parameters and all input, output and calculated values.
- H. The hierarchy of system graphics shall enable an operator to progress from a diagram of the building, to a particular floor in the building and to a particular zone on the floor. The selection at each stage shall be by cursor control using a mouse or keyboard arrow buttons.
- I. Provide target boxes on displays to enable easy access from one display to a related display. For example, provide a target box on the system diagram for a group of terminal units that will enable one-step access to the associated air handling unit.
- J. The BMCS subcontractor shall submit a complete set of the proposed system graphics in color at the shop drawing stage of the project. The BMCS subcontractor shall modify the system graphics as requested by the Owner and Consultant following shop drawing review at no additional cost to the Owner.

## 2.11 ALARMS

- A. Provide configuration of appropriate alarm limits for all monitoring and control points. All features of the alarm annunciation and reporting package shall be configured by the BMCS subcontractor. If limits are not defined within these documents coordinate those limits with the Owner.
- B. Alarms shall be generated by the BMCS upon the occurrence of one of the following events:
- 1. Failure of a PC, CCP, DCP, UC, or any other BMCS hardware components.
  - 2. Failure of communications between nodes on the primary LAN.
  - 3. Failure of communications of devices on the secondary LAN.
  - 4. A monitored status indicates a discrepancy between the actual and the required value.
  - 5. A monitored value does not meet criteria established by the operator.
  - 6. The deviation of a variable from setpoint exceeds operator-established criteria.
  - 7. The output to a final control element is outside operator-established criteria.
  - 8. A digital input is in the state defined by the operator as indicating an alarm condition.
  - 9. Software failures and errors shall be diagnosed and annunciated by the BMCS.
- C. The failure of a BMCS hardware component, including communications failures, shall generate an alarm, which shall be differentiated from process alarms. If the failure of a PC cannot be annunciated at a printer or VDU at the OIW because of the BMCS topology then provide an alternative means such as a "watchdog timer" at a DCP. The alarm message generated by the BMCS shall clearly identify the component that has failed and the location of a communications failure shall also be clearly indicated.
- D. In the event that the BMCS detects a disparity between the actual and the required status of a digital input, the BMCS shall generate an alarm and shall set the control relay to the off state. This shall occur when the digital output is in both the BMCS manual control mode and the BMCS software control mode and shall automatically place the output in the BMCS manual control mode.

- E. The operator shall be able to define alarm conditions for each analog input, at minimum, as follows:
  - 1. The high limit above which the variable is in alarm.
  - 2. The low limit below which the variable is in alarm.
  - 3. An end or range alarm. This shall occur when the analog signal goes to zero or to its maximum value.
- F. The operator shall be able to assign deviation limits to setpoint values. An alarm shall be generated when a controlled variable deviates from setpoint by more than an operator-defined amount.
- G. The operator shall be able to assign alarm limits to analog outputs. The BMCS shall generate an alarm when an analog output reaches or exceeds an operator assigned high limit and reaches or goes below an operator assigned low limit.
- H. The operator shall be able to designate one state of a digital input as an alarm state.
- I. The operator shall be able to assign a time delay following detection by the BMCS of an alarm condition such that if there is a return to normal during the assigned time delays the alarm shall not be annunciated. If at the end of the time delay period the alarm condition still exists then the BMCS shall annunciate an alarm within two seconds (end to end time). The time delay shall be individually assignable to each alarm condition. All monitored points shall meet this alarm annunciation criterion regardless of type of panel used to monitor the point.
- J. The operator shall be able to assign a deadband to all analog high and low alarm limits so as to minimize the too frequent and unnecessary annunciation of alarms. An analog alarm limit shall not have returned to normal until it has returned beyond the alarm limit by a sufficient amount to have also cleared the deadband. The same shall also apply to analog output high and low alarms.
- K. A report shall be available to the operator detailing points in alarm and a further report shall be available to the operator detailing the alarm limits established for the monitored, controlled and calculated points.
- L. Designated alarms shall be output on the alarm printer.
- M. The occurrence of designated alarms shall initiate a visual alarm at the OIW. A switch, button or keyboard key shall be dedicated to the acknowledgment of alarms at the OIW. The visual alarm shall cease after acknowledgment of an alarm unless another alarm is awaiting acknowledgment. All alarms shall be acknowledged individually and the acknowledgment shall be recorded on the alarm printer. The alarm message shall uniquely identify the cause of the alarm together with the time of detection by the BMCS. The operator shall be able to associate an "event message" with any alarm occurrence. The operator shall be able to designate which alarms annunciate at the workstation within the security control center.
- N. Alarms shall be allocated priorities by the operator on-line using an interactive procedure. If there are concurrent alarms then they shall be annunciated in order of their priority. An icon shall appear on the VDU when there are alarms other than those displayed. The cursor and icon shall enable the operator to bring up an alarm report on the VDU at any time. There shall be at minimum, three levels of alarm priority. Alarms shall be prioritized in the following categories, with the following actions taking place:

	<u>Category</u>	<u>Action Taken</u>
	Critical	Printout on alarm printer, display on Engineering VDU, activate alarm annunciator in the Security Control Center, send PDA email alarm
	Non-critical BMCS component	Display on Engineering VDU Printout on alarm printer, display on Engineering VDU

- O. Alarms shall remain on the OIW VDU alarm queue until the operator has acknowledged the alarm



and return to normal state. If the alarm returns to normal before operator acknowledgment, then it shall be identified as such via different color designation on the alarm queue. If the alarm is acknowledged before it has returned to normal, then it shall also be identified via a different color designation.

- P. Alarms shall be acknowledged at any OIW with the appropriate password access.
- Q. Provide a web based automatic alarm display program to automatically display critical alarm descriptions on an Owner provided PC at the security console desk. It shall not be possible to acknowledge the alarm from this display.

## 2.12 SETPOINT AND PARAMETER CONFIGURATION

- A. Provide the ability to define each setpoint and operating parameter as required by the sequences of operations using an interactive procedure on the on-line system.
- B. All setpoints and operating parameters of the sequences of operation shall be easily changeable by any operator with the appropriate access level. Setpoints and operating parameter changes shall not be flagged as override states
- C. The term "interactive" is used to mean that the system shall operate in a conversational mode whereby the operator shall receive English language prompts in the form of:
  - 1. Tables into which data is entered by the operator.
  - 2. Questions which are responded to by the operator.
  - 3. Menu selections which are made by the operator.
  - 4. Controller configuration screens with data entry fields.
- D. Interactive procedures shall be such that a task can be readily executed by the operator without reference to instruction manuals and without knowledge of the BMCS control language.
- E. All setpoints, alarms limits, deadbands, software time delays, report configuration and requests, operating time limits, lead/lag designation, etc. shall be operator definable through an interactive procedure via the associated VDU system diagram or appropriate display.

## 2.13 DYNAMIC GRAPHICAL TRENDING

- A. Provide a software package that emulates, at minimum, a three-point strip chart recorder. This program shall concurrently display three or more (maximum of six) plots of variables in a graphical format. The graphs shall be plotted as the values are sampled in a similar fashion to a chart recorder and when the plot reaches the right hand side of the X-axis, the X-axis shall scroll to the left so as to accommodate newly sampled data.
- B. The variables to be plotted shall be selected by the operator from any input, output point, BMCS calculated value or any setpoint. It is envisaged that the primary use of this facility will be for the tuning of control loops and the observance of control loop performance. Typically this would require, for example, the concurrent plotting of the loop setpoint, the monitored variable and the BMCS output to the final control element.
- C. Each of the plotted variables shall be uniquely and clearly identified using a means of differentiation such as different colors for each variable or different symbol for the plotted points for each variable.
- D. The X-axis shall be the time axis and shall have a scale selected by the operator using an interactive procedure or shall be scaled automatically to accommodate a minimum of 30 plotted points for each variable. The plot rate shall be selected by the operator using an interactive procedure and shall have the following minimum ranges:
  - 1. Plot rates for monitored variables shall range from one second to 256 seconds.
  - 2. Setpoints shall be plotted at the same rate as the associated variable.
  - 3. Plot rates for BMCS outputs shall range from one second to 256 seconds.
  - 4. Plot rates for calculated points shall be the rate at which the calculation is performed.
- E. The Y-axis shall be the value of the plotted variable. If plotted variables have different ranges then

provide separate Y-axes. The Y-axis for each plotted variable shall be defined by the operator using an interactive procedure or shall be scaled automatically using a technique, which displays the data in an optimum manner.

#### 2.14 HISTORICAL DATA COLLECTION AND TRENDING

- A. Provide a software facility for the collection and storage of data and its subsequent retrieval and display in tabular and graphical form as selected by the operator.
- B. The operator shall be able to assign on-line, using an interactive procedure, any BMCS input or output point, calculated variable or setpoint to the historical data trend facility. It shall be possible to have data collection and storage concurrently, at minimum, for two hundred variables.
- C. Each variable shall be sampled at an operator-defined frequency using an interactive procedure. The sampling frequencies shall be in the following ranges at minimum:
  - 1. For BMCS monitored points the sample rate shall range from one second to once per day.
  - 2. Setpoints shall be sampled at the same rate as their associated variable.
  - 3. For BMCS outputs the sample rate shall range from one second to once per day.
  - 4. For calculated points the sample rate shall be in the range of the calculation rate to once per day.
- D. Storage shall be provided for at least two thousand pieces of sampled data for each variable assigned to this feature. Recall of data shall be in either a tabular form or in a graphical form and shall be displayed on the VDU or output on one of the printers as selected by the operator. It shall be possible to concurrently output data for a minimum of three variables. The time period to be covered by the data output shall be selected by the operator using an interactive procedure. When the storage capacity for a variable is full the newly sampled data shall over-write the data stored for that variable for the longest period of time.
- E. Data output in tabular form shall clearly distinguish between the variables and shall indicate the time and date at which each piece of data was sampled.
- F. Data output in graphical form shall meet the same requirements as detailed above for the real-time plotting of data.
- G. It shall be possible at any time to obtain a listing of which points have been assigned to this feature and their sampling rates.

#### 2.15 REPORTS

- A. Provide configuration of all reports specified in this part and other parts of the specification.
- B. Reports shall be output when requested by the operator and when scheduled by the operator.
- C. Reports shall be provided as detailed throughout these specifications and shall be output at the VDU at the OIW, the printer designated by the operator as the report printer or the screen at the ROW whichever is selected by the operator. The default output device for reports shall be the report printer at the OIW.
- D. The operator shall be able to select the following standards reports as follows:
  - 1. For a specific point.
  - 2. For a specific item(s) of equipment.
  - 3. For all points located on a specific floor or area of the building.
  - 4. For all equipment serving a particular floor.
  - 5. For all points monitored, controlled and calculated.
  - 6. For after hours operation of the AHU.
  - 7. For a specific schedule.
  - 8. For a specific or group of trended points.
  - 9. For a specific or group of totalized points.
  - 10. For all input points in override.
  - 11. For all output points in manual override.
  - 12. For all setpoints or operating parameters in override.

- E. Reports shall all have the time and date at which they were output recorded on them. Reports shall be formatted in such a manner as to make them easily understandable to the operator.
- F. A menu of reports shall enable the operator to access any report on the BMCS. Each report shall contain the date and time.
- G. The operator shall be able to configure customized reports. Standard reports shall be configured through the BMCS.

#### **2.16 PSYCHOMETRIC PROPERTIES**

- A. Provide a software package to determine the following properties of ambient air:
  - 1. Wet bulb temperature.
  - 2. Dewpoint temperature.
  - 3. Enthalpy.
  - 4. Dry bulb temperature.
  - 5. Relative humidity.
- B. Each of the parameters shall be calculated using the monitored values of any two of the parameters.
- C. These psychometric calculations shall be based on the ASHRAE sea level charts and shall cover the dry bulb temperature range of minus 30 Deg. C. (-22 Deg. F.) to plus 50 Deg. C. (+120 Deg. F.)

#### **2.17 EQUIPMENT RUN TIME TOTALIZATION**

- A. Provide a software package that will accumulate the operating times for motors as selected by the operator using an interactive procedure. Any piece of equipment that has its status monitored by the BMCS shall be selectable for inclusion in this feature. It shall be possible to concurrently monitor the accumulated operating time for every item of equipment monitored and/or controlled by the BMCS.
- B. The operator shall be able to establish on-line, using an interactive procedure, a value for the accumulated operating time at which a suitably worded message shall be output to the operator advising that the reporting limit has been reached for a specific motor. The message shall be output at the designated alarm printer.
- C. The operator shall be able to change the accumulated total for any motor to any value.
- D. The accumulated operating times shall be updated at least every 15 minutes.
- E. The operator shall be able to obtain on demand or on a scheduled basis a report detailing the accumulated operating times.
- F. Operating time software shall be used as the basis for equipment operating selection and stand-by status. Changeover of units based on operating times shall not take place more than an operator defined period, initially set at once per week.

#### **2.18 ELECTRICAL ENERGY USAGE AND DEMAND**

- A. Provide a software facility to monitor and report electrical energy usage and instantaneous energy demand. This feature shall also store data for recall via the historical data trend package.
- B. The BMCS shall monitor the demand kW, kVA and kWh at the main electrical equipment. The BMCS shall also monitor and provide reporting on kWh usage of all controlled equipment within the building based on equipment operating time and operator defined kW input for each piece of equipment.
- C. The BMCS shall provide a 15-minute interval counter for the electrical service metered inputs.
- D. This software feature shall generate a report available on demand and on a scheduled basis giving

the following information for each meter and the cumulative values for all meters:

1. Demand (at each meter) at time of report (kW and kVA).
2. Usage for present day to time of report (kWh).
3. Usage on previous day (kWh).
4. Usage for present week to time of report (kWh).
5. Usage for previous week (kWh).
6. Usage for preset month to time of report (kWh).
7. Usage for previous month (kWh).
8. Usage for year to time of report (kWh).
9. Usage for previous year (kWh).
10. Peak demand for the present day, week, month and year to time of report (kW and kVA).
11. Peak demand for the previous day, week, month and year (kW and kVA).

- E. In addition to the above reporting of data the operator shall be able to assign any monitored or calculated value to the real-time plotting and historical data trend features.

## 2.19 THERMAL ENERGY USAGE

- A. Provide a software facility to monitor and report thermal energy usage and instantaneous energy demand. This feature shall also store data for recall via the historical data trend package.
- B. The BMCS shall monitor the electrical and thermal properties of the chillers via software interface at each chiller control panel. The BMCS shall calculate the totalized BTUH, instantaneous BTUH, and KW/ton for each chiller, all operating chillers (as a group), and the entire plant.
- C. Provide the ability to set alarm limits and operator notification alarms as the building approaches peak setpoint levels.
- D. This software feature shall generate a report available on demand and on a scheduled basis:
1. KW/ton, at time of report.
  2. Usage for present day to time of report.
  3. Usage on previous day.
  4. Usage for present week to time of report.
  5. Usage for previous week.
  6. Usage for present month to time of report.
  7. Usage for previous month.
  8. Usage for year to time of report.
  9. Usage for previous year.
  10. Peak energy demand for the present day, week, month and year to time of report.
  11. Peak energy demand for the previous day, week, month and year.
- E. In addition to the above reporting of data the operator shall be able to assign any monitored or calculated value to the real-time plotting and historical data trend features.

## 2.20 MEASUREMENT AND VERIFICATION REPORTING

- A. Provide graphical display and reporting on the USGBC LEED monitored variables involved with the on-going Measurement and Verification process.
- B. Utilize the following specified packages as inputs to support the Measurement and Verification monitoring:
1. Historical data recording.
  2. Trending.
  3. Thermal energy monitoring.
  4. Electrical usage and demand.
- C. Provide reporting that emulates the reporting requirements of the Measurement and Verification Plan. The points required for the Measurement and Verification Plan are included with the Field Termination Schedules. The plan shall require the monitoring of the following systems:
1. Central chilled and condenser water systems – BTUH and energy consumption via software interfaces.
  2. Heating hot water systems - BTUH and energy consumption via software interfaces.

2. AHU – static pressure and VSD monitoring.
3. Electrical monitoring at VSD via the software interfaces.
4. Electrical monitoring at main electrical gear.
5. Electrical submeters throughout the building.
6. Water flow totalizers throughout the building.
7. Natural gas flow totalizers throughout the building.

#### 2.21 PDA/EMAIL CRITICAL ALARM NOTIFICATION

- A. Provide programming and associated hardware to annunciate critical alarms via SMS text messaging and emailing without the intervention of a BMCS operator. The alarm text interface shall have, at minimum, the following capabilities:
  1. A dedicated internet service provider connection.
  2. Each point within the BMCS shall be defined as to the critical level of the alarm.
  3. The system shall be capable of sending specific alarm messages to up to ten users via text message or e-mail.
  4. The operator texted shall be assignable on an operator, a point or event basis as well as a time scheduled basis.
  5. Alarm messages, 50 characters maximum, shall be user definable for specific event alarms. Messages shall conform to the format of "site-system-point identification-alarm type" for alarm notification.

**END OF SECTION**