Appendix C – Design Standards: BMS User Interface

Table of Contents

Scope

This design guide deals with aspects of the user interface to the Johnson Controls (JC) Metasys BMS System. From the date of its issue this guide should be followed as far as practicable accepting the need for existing work in progress to follow previous guides.

The design guide consists of six sections covering the following content.

- Userview Folder Structure
- Plant Naming and Numbering *(now superseded by a separate guide R1.1)*
- Object Names, Descriptions and Text
- Time Scheduling
- Trends and Trend Studies
- Graphics Design

Purpose

The purpose of this guide is to create a degree of uniformity in the development and presentation of user views and graphics so that users are able to quickly interpret air conditioning systems to identify abnormalities and troubleshoot problems. This will help to improve service delivery and reduce energy inefficiency. The guide is also aimed at creating a user friendly interface for new staff, interns and consultants so they can spend more time analysing problems and less time learning how to navigate the BMS.

Revision History

Revision	Release Date	Author	Review	Reason for Issue
V1	22 Jan 2014	NB	CC	Initial Document Release
V2	10 Mar 2014	NB	CC	Minor Edits
V3	10 Jun 2014	NB	CC	Multiple Floorplans, FCU logical grouping
V4	26 Feb 2015	NB	CC	Orientation symbol, Navigation bar changes
V5	03 Jun 2016	NB	NB	St. Lucia Weather Data
V6	04 Aug 2016	NB	NB/AL	Addition of Cold Rooms and Communications Cupboards identification
V7	31 Mar 2017	NB/AL	NB/AL	Userview graphics folder structure changes, Removal of section on plant numbering, New graphic header design

Related Guides and Standards

This guide should be used in conjunction with the following related guides:

- Appendix B - BMS Equipment Numbering, R1.1
- Appendix D - BMS Critical Alarms, R1.1
- BMS Categories and Priorities, R1.1

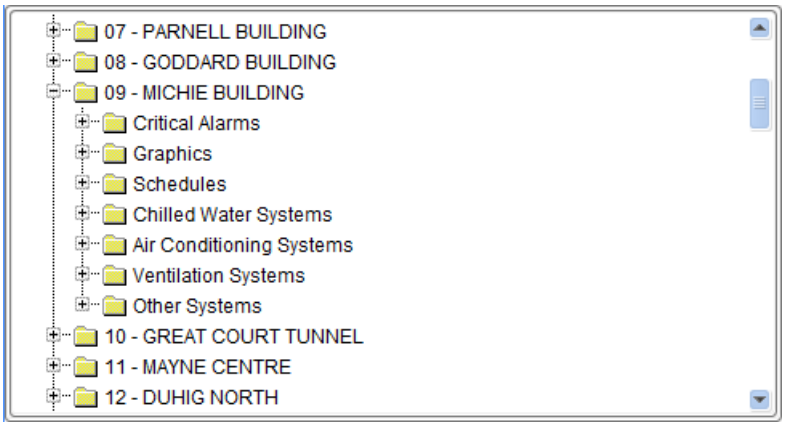
1. Userview Folder Structure

UQ St Lucia Campus Userview

Although this section deals specifically with the folder structure for the UQ St Lucia campus userview there are generic aspects to the design which can be applied equally to other campus and building userviews. The intent is to provide a uniformity of folder structure and naming to enhance navigation through the system.

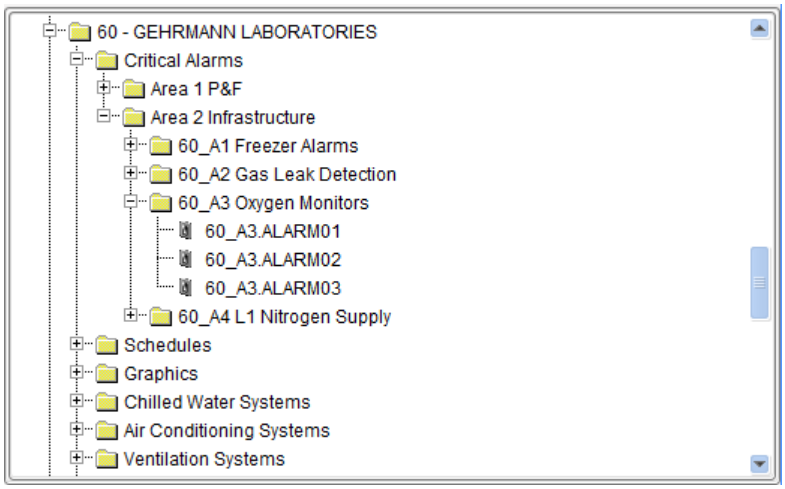
Building Folders

Each building represented in the userview has a top level folder which identifies the building by number and name separated by a hyphen. The building name is in uppercase characters as shown in the extract below taken from the St Lucia userview. Under the building folder are seven sub-folders identified in capitalised lower case. It is intended that all subsequent folders and data can be logically contained within these seven sub-folders.



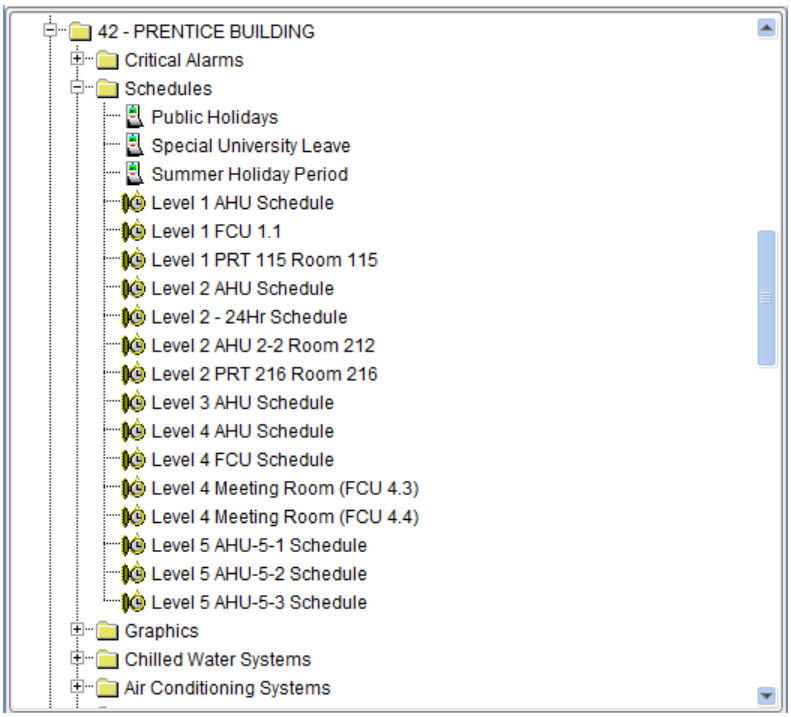
Critical alarms

This folder contains only alarms which are forwarded to the alarm callout system. Sub-folders are created to segregate the alarms into different groups such as P&F or building infrastructure alarms. Alarm objects are sorted by alarm number within each folder.



Time Schedules

This folder contains all time schedules pertaining to the building within a single folder. The first objects to be added are the central calendars from Metasys-42-1, Metasys-NIE-1 or Metasys-NIE-2 which are used to determine scheduled operation during holiday and leave days. The schedules are then added and sorted by floor and then plant number.



Graphics

The top level graphics folder contains the building home page followed by sub-folders for floorplans, chilled water graphics, air handling graphics, ventilation graphics and other systems graphics.

The floorplan sub-folder includes all floor plan graphics sorted by floor number (V7).

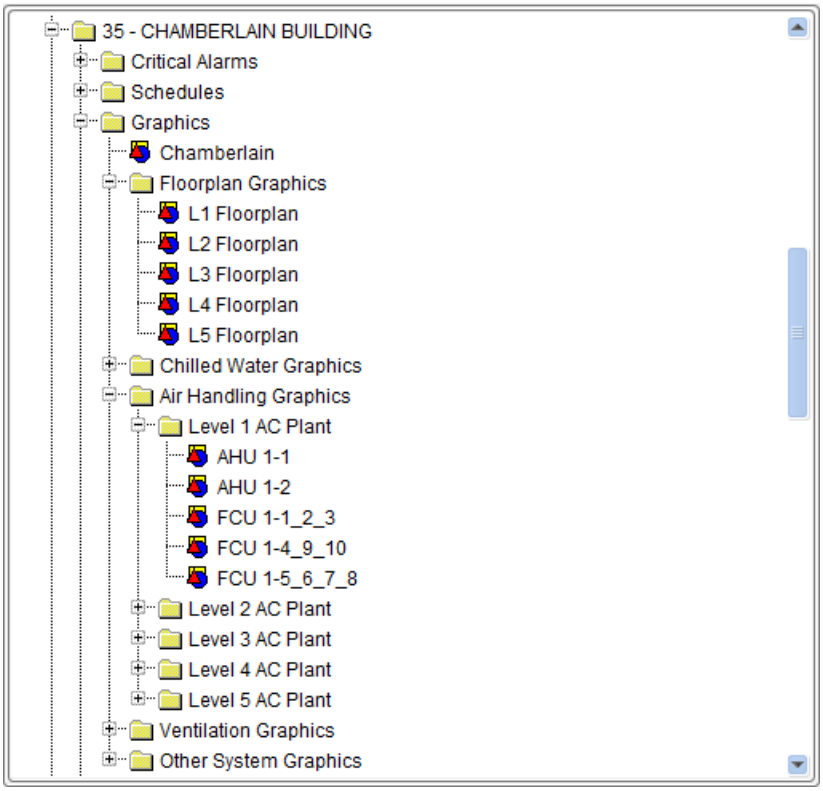
The chilled water graphic sub-folder includes all graphics related to chillers, primary and secondary chilled water, cooling towers and condenser water systems.

The air handling graphic folder has further sub-folders for each floor of the building sorted by floor number. All air handling unit, fan coil unit and VAV summary graphics are added to the corresponding floor sub-folder and sorted alphabetically.

The ventilation folder has no sub-folders and contains all floor and building ventilation summary graphics and any graphics related to natural ventilation systems.

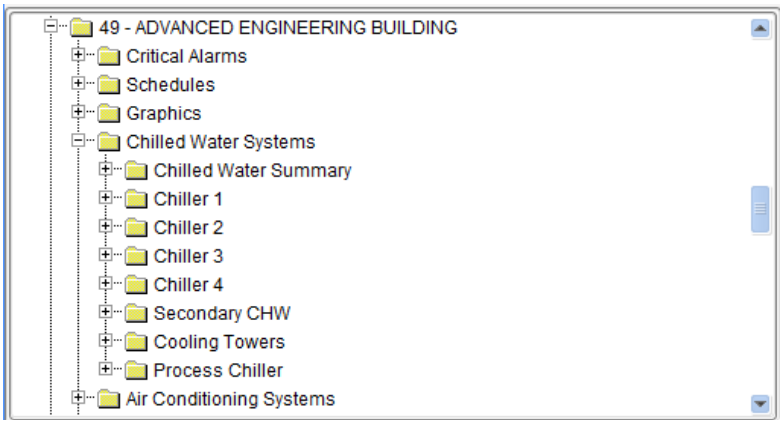
Any other systems monitored by the BMS appear under a single folder called Other System Graphics.

This folder is intended for any other BMS control and monitoring such as power and energy systems, water and gas systems, process air, process cooling water, vacuum plant and reverse osmosis water systems, lighting, lift and security systems. If there are no other system graphics then a blank folder titled “None” is used to convey this fact.



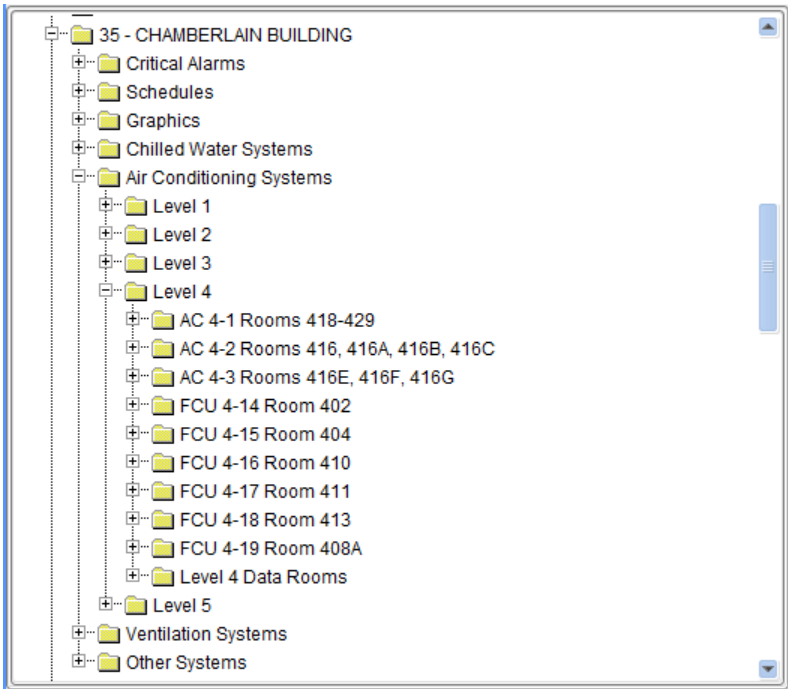
Chilled Water Systems

The chilled water systems folder contains sub-folders for each system being monitored including chillers, primary and secondary chilled water, cooling towers and condenser water systems. Only chilled water system equipment located in the building are included.



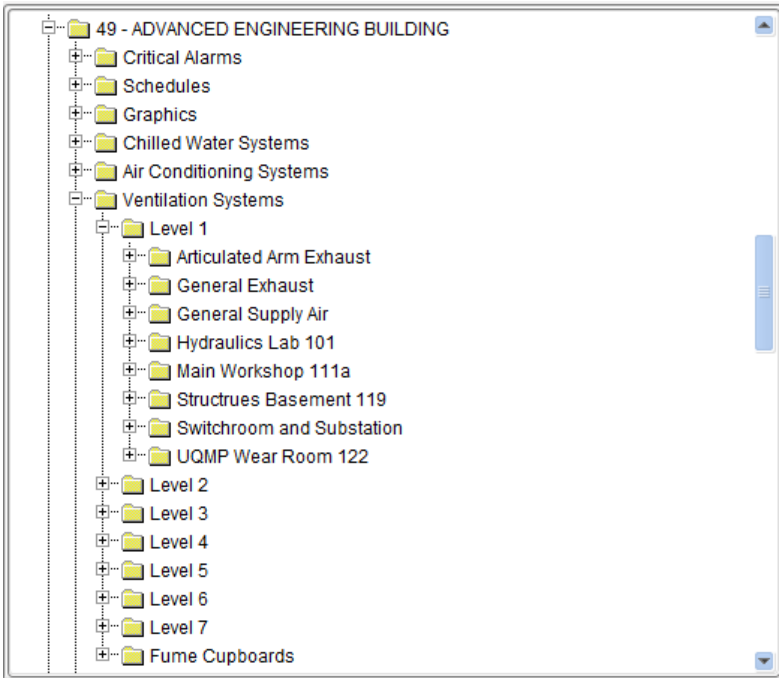
Air Handling Systems

The air handling systems folder contains sub-folders for each floor of the building with further folders for each air handling system. The air handling systems are titled with the plant number in uppercase followed by the rooms being served or a description of the plant duty such as Fresh Air Unit using capitalised lowercase. See section 2 Plant Naming and Numbering.



Ventilation Systems

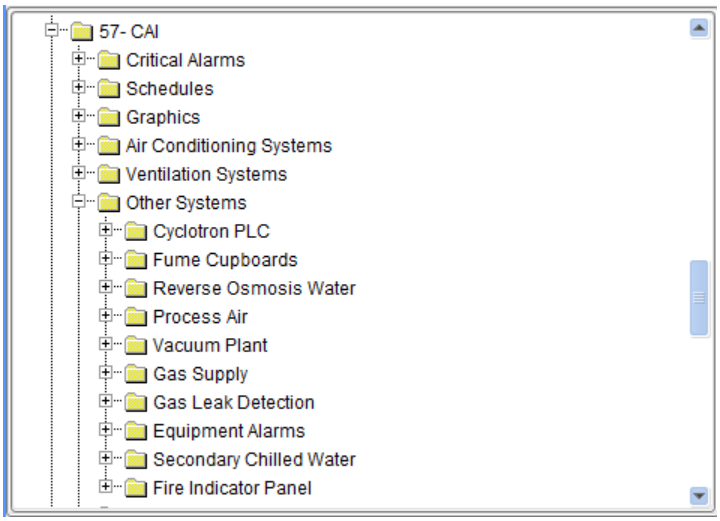
The ventilation systems for most buildings consist of a few outside air and exhaust fans which fit logically within a single folder. For buildings with more extensive systems a sub-folder is added for each floor with further folders to provide logical grouping of the fans. Fume cupboards and natural ventilation systems are included under their own sub-folder.



Other Systems

Any other systems monitored by the BMS appear under a sub-folder called Other Systems. This folder is intended for all other systems control or monitored by the BMS such as power and energy systems, heating hot water systems, water and gas systems, process air, process cooling water, vacuum plant

and reverse osmosis water systems, lighting, lift, fire and security systems. If there are no other systems monitored within the building then a blank folder titled “None” is used to convey this fact.



2. Plant Naming and Numbering

This Section has been superseded by a separate guide (V7)

3. Object Names, Descriptions and Text

Scope

During BMS object and graphic creation it is important to maintain a consistent approach to terminology to avoid unnecessary confusion in interpretation. This is especially apparent where there are different BMS technologies co-existing within the same system. This guide does not attempt to define every object name and text which may occur within the system but does provide a standard approach with examples provided for the more common objects.

Object Names

When an object is created within Metasys, an item reference is created within the database which cannot later be changed and is fundamental to any links to that object. At the same time, an object name is created which is initially the same as the item reference except that the object name can be changed without affecting the links within the databases. Whereas the item reference is inflexible and is to some extent dictated by the controller or system within which it was created, the object name can be changed to anything and can therefore be part of a consistent naming standard.

Example

An example of item reference, object name, description and state text for a fan status created within an FEC controller would be:-

Item Reference:	FAN-S
Object Name:	Fan Status
Description:	Supply Air Pressure Switch
States Text:	Off / On

Descriptions

The descriptions assigned to objects are restricted to 40 characters. Due to this imposed economy, object descriptions should not be used to duplicate detail already provided within the object name. Instead they should be utilized to provide additional information regarding the nature of the object in question. For instance, the field device which represents a fan run status might be an air pressure switch, a current sensor or a contactor status. This detail should be included in the object description to give a better appreciation of the physical installation and to aid with trouble shooting. The description can also be used to indicate where an annotation has been added by appending (Note) to the description.

States Text

Binary and multi-state objects created within Metasys have enumerated states text values which are assigned when the object is created. It is important that the same states text is allocated for like objects to provide a consistent user interface. Though there may be some legacy issues which prevent this being adhered to in all cases, wherever possible the standard states text listed later in this section should be adopted.

Air Handling Systems

Listed below are the more common object names for air handling plant.

Object name	States Text / Units	Example Description
Fan Status	Off: On	Supply Air Pressure Switch
Fan Command	Stop : Start	Supply Fan Start Relay
Fan Fault	Normal: Alarm	Supply Fan Overload
HPT Fault	Normal: Alarm	Heater Protection Thermostat
Scheduled Mode	Occupied: Standby: Unoccupied	Time Scheduled Occupancy
Effective Mode	Occupied: Standby: Unoccupied : Bypass	Effective Occupancy Mode
Cooling Enable	False: True	Cooling Control Permission
Heating Enable	False: True	Heating Control Permission
Fan Speed	%	Supply Fan VSD Reference
Cooling Output	%	Chilled Water Valve Output
Heating Output	%	Switched Solid State Relay
Zone Temp	deg C	Zone Temperature Room 123
Zone Temp Setpoint	deg C	Zone Cooling Setpoint
Zone Heating Bias	deg C	Zone Heating Offset
Supply Temp	deg C	Supply Air Temperature
Supply Pressure	deg C	Supply Air Pressure
Filter DP	Pa	Filter Differential Pressure

Variable Air Volume Systems

Listed below are the more common object names, descriptions and states text for VAV Boxes.

Object name	States Text / Units	Example Description
Zone Temp	deg C	Zone Temperature Room 123
Zone Temp SP	24.0 deg C	Zone Common Setpoint
Flow	L/s	Supply Air Flow
Flow SP	L/s	Controlled Flow Setpoint
Damper Position	% open	VAV Box Damper
Occupied Cooling Bias	0.0 deg C	Cooling Setpoint Bias Occupied
Occupied Heating Bias	-2.0 deg C	Heating Setpoint Bias Occupied
Standby Cooling Bias	2.0 deg C	Cooling Setpoint Bias Standby
Standby Heating Bias	-4.0 deg C	Heating Setpoint Bias Standby
Effective Cooling SP	deg C	Cooling Setpoint For Current Mode
Effective Heating SP	deg C	Heating Setpoint For Current Mode
Max Occupied Flow	L/s	Maximum Occupied Flow Setpoint
Min Occupied Flow	L/s	Minimum Occupied Flow Setpoint
Occupied Heating Flow	L/s	Occupied Heating Flow Setpoint
Unocc Cooling Flow	L/s	Unoccupied Cooling Flow Setpoint
Unocc Heating Flow	L/s	Unoccupied Heating Flow Setpoint
VAV Box Area	Sq meter	VAV Box Flow Area
Flow Coefficient		Flow Calibration Parameter
Scheduled Mode	Occupied: Unoccupied: Standby : Not Set	Time Scheduled Occupancy
Effective Mode	Occupied: Unoccupied: Bypass : Standby	Effective Occupancy Mode
Box mode	Cooling: Heating	Box operating Mode
Heating Command	No Htg Required: Box Heating	Heating Control Output
HPT Fault	Normal : Alarm	Heater Protection Thermostat

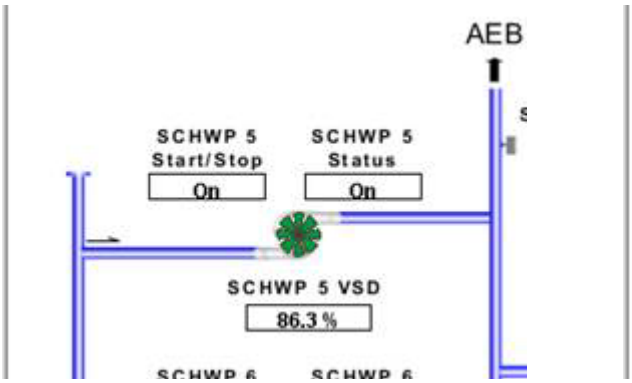
Chiller Systems

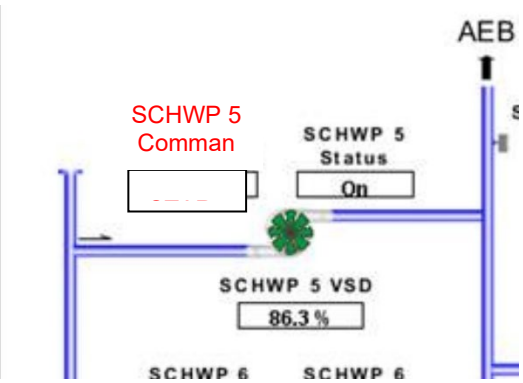
Listed below are the more common object names for chilled water systems.

Object name	States Text / Units	Example Description
Chiller Status	Off: On	Chiller Compressor Run Status
Chiller Command	Disable: Enable	Chiller Call To Operation
Chiller Fault	Normal: Alarm	Chiller Fault Requiring Reset
Chiller Available	Disable: Normal	Chiller Availability Flag
Chiller Amps	Amps	Chiller Total Current
Chiller Flow	L/s	Chilled Water Flow
Leaving Temp	deg C	Chilled Water Leaving Temperature
Entering Temp	deg C	Chilled Water Entering Temperature
System Enable	False: True	Chiller Sequence Enable
Chiller Rotation	False: True	Chiller Sequence Rotation Flag
Pump Status	Off: On	Pump VSD Run Status
Pump Command	Stop: Start	Pump VSD Run Command
Pump Fault	Normal: Alarm	Pump VSD Fault
Pump VSD	%	Pump VSD Speed Reference

Graphic Text

Descriptive text used in graphics should be consistent with the object names in the database. The corrected version on the right shows the changes required to match the required standard.





4. Time Schedules

The use of BMS time schedules on the St Lucia campus is extensive and varies considerably from building to building. While every building will function differently, a common approach to scheduling will allow a building's air conditioning operation to be quickly determined and energy saving strategies to be sensibly assessed and introduced.

There are 8 aspects to scheduling which can be used to provide consistency of operation.

1. Scheduled operating modes
2. Command priorities
3. Group Scheduling
4. Exception scheduling
5. Schedule object name and description
6. Schedule graphical interface
7. Userview schedule folders
8. Central Teaching Rooms

Scheduled Operating Modes

Air handling units which are controlled from the BMS have a scheduled operating mode.

Typically, this mode has 3 operating states: Occupied / Unoccupied / Standby. It is not necessary that an AHU utilises all three modes but as a minimum there will be two modes Occupied / Unoccupied.

These modes can be interpreted as follows.

Occupied:	Run the air conditioning and control conditions to normal set points
Standby:	Run the air conditioning with relaxed temperature set points to save energy
Unoccupied:	Stop the air conditioning

Standby operating mode is usually employed with some local occupancy determination such as motion detectors, control switches or calls for air conditioning from remote interfaces such as AMX systems or Syllabus Plus.

Legacy systems on the BMS may have different interfaces such as simple On / Off Modes or specific controller interfaces such as Night / Standby / Comfort (which equates to Unoccupied / Standby / Occupied). However, all new systems must adhere to the standard operating states above. It is important to avoid combining these in group schedules because the generic states will not always align. For instance, in BACNet Occupied is state 0 whereas Comfort mode is state 2).

Command Priority

The scheduled operating mode can be commanded at 16 different levels of priority where priority 1 is the highest and priority 16 is the lowest. The command priority can be used to filter different scheduling requirements and also allows for operator intervention and control interlocks.

If more than one source is commanding the operating mode then the greatest priority takes precedence. The default priority level is 16. Time schedules operate with command priority level 15. Any source which writes to the operating mode at priority 14 or less will take precedence over the time schedule. If two sources are writing at the same level of priority then the most recent command will prevail. If a command at a certain priority level is released then the mode changes to the command with the next highest priority.

The following table provides a list of common system command types with an associated priority. This dictates the precedence of each command type when multiple commands are present.

Command Priority	Command Type
16	Default Value
15	Time Schedule
14	Exception Schedule
13	Application logic – After Hours Call
12	Central Teaching Room Booking
11	Application Logic – AMX Call
10	Application Logic – Control Interlock Critical Alarms – Alarm Interlock
9	Critical Alarms – Unreliable Interlock
8	Operator Override

Group Scheduling

There is a trade-off between having individual time schedules for every item of plant or grouping items of plant together in a common time schedule. The former provides optimal flexibility in meeting the scheduling requirements for the building but requires additional configuration and management of the time schedules. The latter is easier to configure and maintain but may require some compromise on behalf of the building occupants.

The resolution of this trade off will be different for every building and can only be done with specific building knowledge. In general, plant should only be grouped on a building floor basis in order to retain a degree of flexibility and provide the following practical advantages:

1. Changes to scheduling will be more readily coordinated and communicated if dealing with the occupants of a single floor.

2. Time schedules are configured within BMS network devices which are allocated for floors within a building. It is intuitive that the time schedules for a particular floor of a building floor are resident on the network device which serves that floor. This also helps to minimise network traffic between devices.

3. The object name for the schedule needs to capture the extent of the plant being scheduled. This is straight forward for a schedule operating a single item of plant but is less straight forward for a group schedule. If the group schedule operates within a single floor then the naming of the schedule becomes more intuitive.

4. Holiday scheduling becomes easier to apply and communicate.

5. Group schedules are prevented from becoming inconveniently large.

Exception Scheduling

Each time schedule can have any number of exception schedules where the daily schedule defers to a schedule of higher priority. Holiday exception schedules should be allocated priority 14 so that they take precedence over normal time scheduled operation (15) but defer to other command calls.

Central Teaching Rooms scheduled from Syllabus Plus continue to function normally because they operate at a higher command priority (12) than the exception scheduling (14).

After-hours facilities continue to operate for the specified time period (usually 2 hours) and will need to be re-initiated several times to provide longer periods of air conditioning. Any after-hours logic which starts air handling units from a VAV box after-hours call should use priority 13.

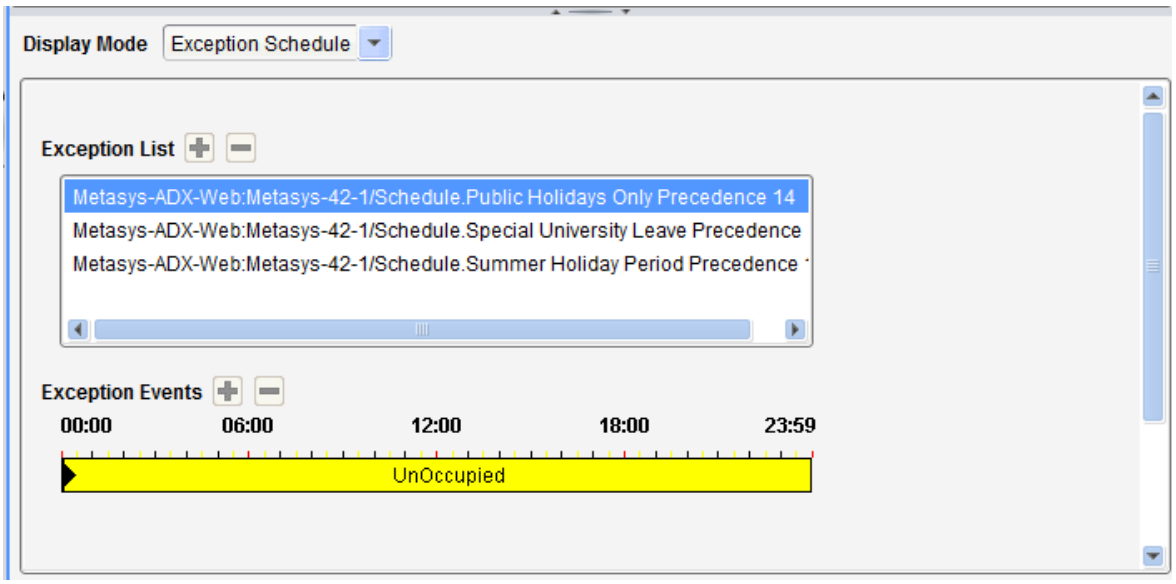
AMX Interfaces should be configured to operate at priority 11 and will continue operate.

Motion Detectors which instigate air conditioning continue to operate normally at a local level.

Exception schedules can refer to calendars to allocate the days when the alternative schedule is adopted. This provides the flexibility of having specific holiday time scheduling for individual plant but only having to maintain a common set of holiday calendars. Three calendars have been created on the Prentice network engine Metasys-42-1 to represent holiday days on the St Lucia campus:

Public Holidays
Special University Leave
Summer Holiday Period

The relevant calendars are added to the exception list for each time schedule. The required operation for those days is then specific to that time schedule only. This may be left blank (normal scheduling prevails), set to unoccupied (unit does not run all day) or set to run for, say, 2 hours to provide some turnover of air in spaces such as lecture theatres.



Five categories of holiday scheduling have been established with the following criterion being used to determine the appropriate category.

A. Exempt

Any plant that runs 7 days/week is exempt from holiday scheduling.

B. Public Holidays Only

Any areas which normally shut down for the weekend but would be adversely affected by an extended period without air conditioning are shutdown on public holidays only.

C. Public Holidays and Special University Leave

Any areas which are unoccupied for the public holiday and special university paid leave days but do not have after-hours push-buttons are shutdown on days set from the public holiday and the special university leave calendars.

D. Public Holidays and Summer Holiday Period

Any areas which are sparsely occupied for the entire Christmas holiday period and have local after hours push-buttons are shutdown on days set from the public holiday and the summer holiday calendars.

E. Legacy Scheduling

Time schedules which reside on the legacy Metasys PMI system have a single holiday calendar. For these schedules a balanced approach has been taken with the calendar set to include public holidays and special university leave days (equivalent to category C above). If this is not suitable for the area in question then it is made exempt, category A.

Schedule Name and Description

The name assigned to a time schedule should identify the plant that it controls and the floor space served by the plant. This is straight forward for a schedule which represents an individual item of plant serving a single room. For Example:

FCU 3-4 Room 327

If a single item of plant serves several rooms then all room numbers should be included in a list separated by commas or as a range of room numbers separated by a hyphen, or both. For example:

AHU 4-2 Rooms 412-415, 418

If there are too many room numbers to provide a practical list then an attempt should be made to describe the floor area being served. For example

AHU 5-1 Level 5 East

Group schedules which have few items of plant serving the same area should identify the plant numbers and the area served. For example:

FCU 1-1, 1-2 Room 128

All other group schedules do not identify the plant items and instead identify the floor and the area served or the scheduling being provided. Some examples:

Level 1 Northern Offices
Level 2 - 24 Hour Units
Level 3 Office Hours

Descriptions

The schedule description is used to summarise as much of the scheduling detail as possible using abbreviations and acronyms to fit the 40 character limit. There are 2 aspects to the description.

The first aspect captures the range of days in the week and the time period over which the scheduling occurs. The days of the week are abbreviated to 3 characters and separated by a hyphen. The time period provides the schedule start and stop times for each day. If the start and stop times vary significantly from day to day then this is represented by the text “Varied hours”. If the unit runs continuously then the text “24 Hours” is used. The following are typical examples.

<Day Range>	Mon-Fri
	Mon-Sun

<Time Range>	7am to 6pm 24 hours Varied hours

The second aspect uses a series of acronyms to capture other related components which impact on the scheduling. These may include any of the following:

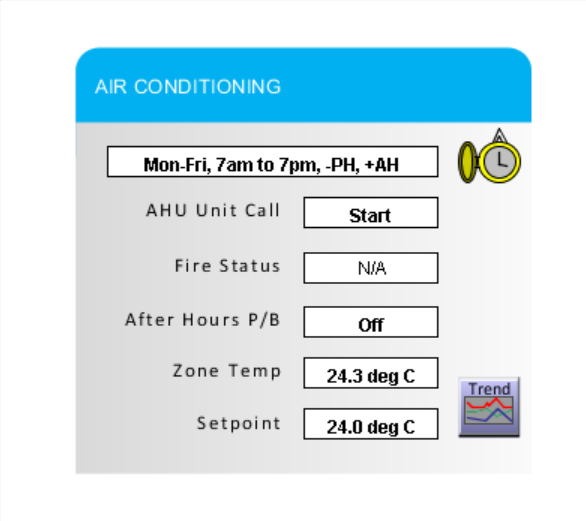
< Public Holiday schedule>	-PH	Unit does not run on public holidays
< University Leave schedule>	-UH	Unit does not run on special university leave days
< Summer Holiday schedule>	-SH	Unit does not run during extended holiday period
<After hours functionality>	+AH	After hours air conditioning available
<Motion Detectors>	+MD	Air conditioning activated by motion detectors
<Central Teaching Room>	+CTR	Room scheduling from Syllabus Plus system
< AMX Interface>	+AMX	Air conditioning initiated from AMX system

A typical schedule description might be “Mon-Fri, 7am to 6pm, -PH, +AH”

Schedule Graphical Interface

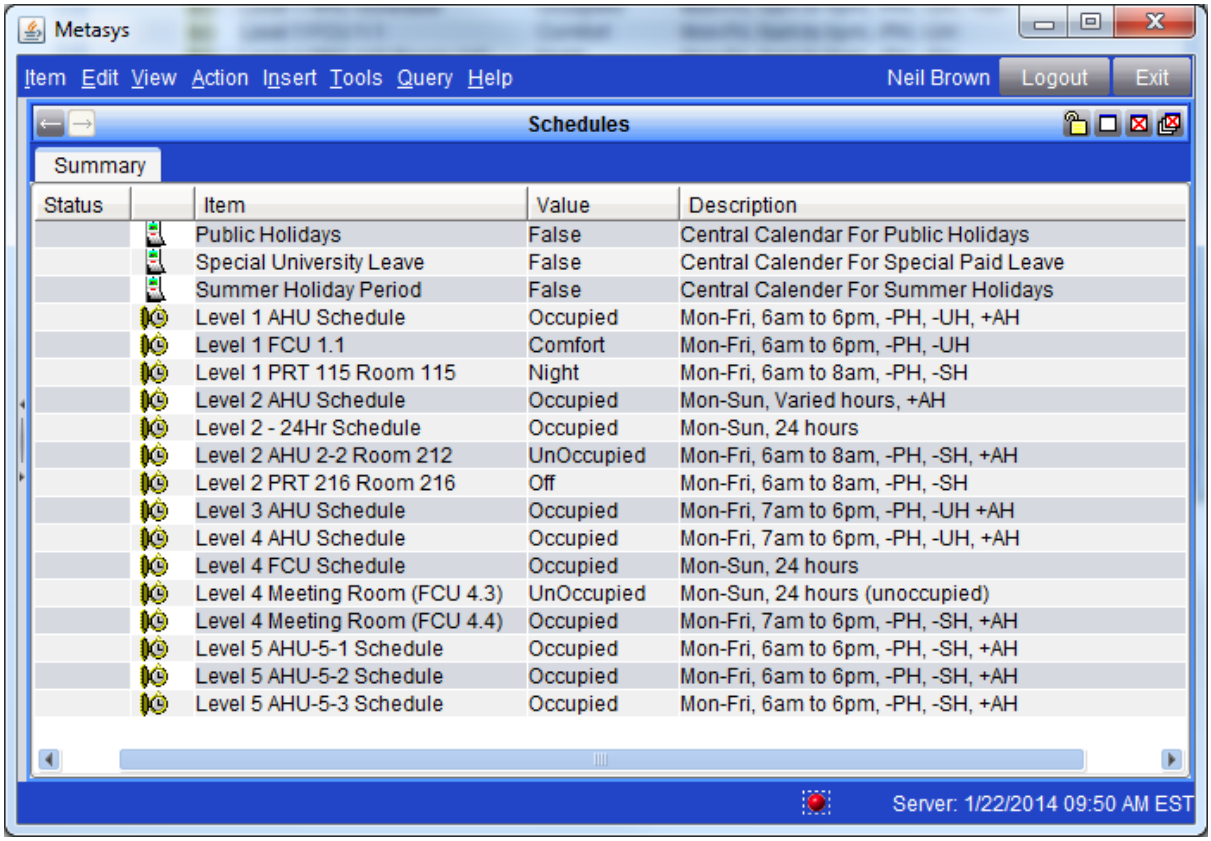
Time schedule page links are provided on floor plan, air handling unit and fan coil unit graphics. Additionally, the schedule description for a particular unit is displayed on the corresponding graphic.

Refer to section 6 for further details of the BMS graphical interface.



Userview Schedule folders

A dedicated schedules folder is created under each building folder within a userview. This folder contains all time schedules pertaining to the building. The first objects to be added are the central calendars from Metasys-42-1, Metasys-NIE-1 or Metasys-NIE-2 which are used to determine scheduled operation during holiday and leave days. The schedules are then added and sorted by floor and then plant number. The following example is the schedule folder for Prentice.

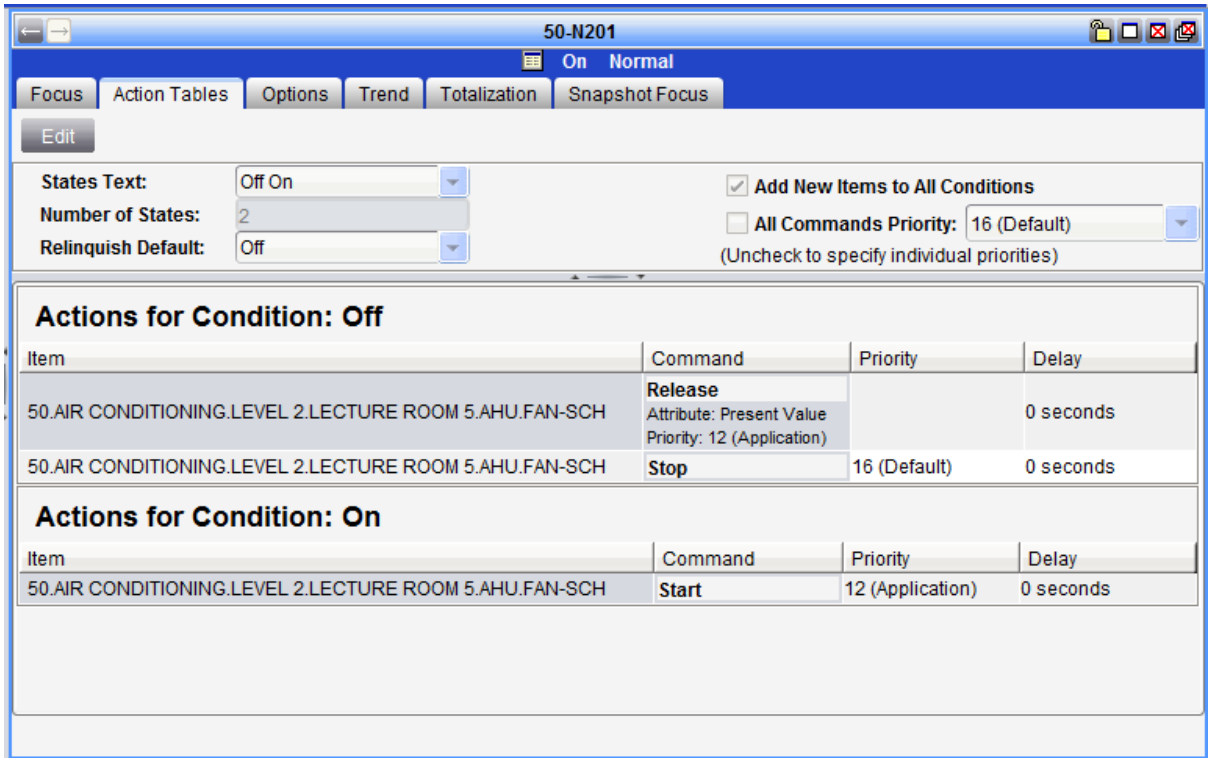


Central Teaching Room Scheduling

Seminar rooms and lecture theatres which are nominated as centrally controlled rooms are scheduled from a room booking system called Syllabus Plus. Room occupancy is conveyed to the BMS via a high level interface and writes to a command module in the NAE or NIE which hosts the central teaching room (CTR). The command module subsequently writes to the scheduled mode for the associated air handling unit at command priority level 12.

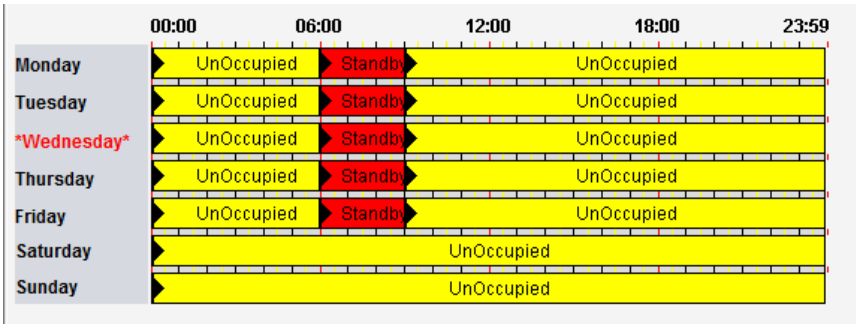
A BMS time schedule is also created for these spaces but the scheduling is left blank. In the event of a failure of the Syllabus Plus system or BMS interface then the schedule can be used to provide short term room scheduling. For this scheduling to work it is imperative that the room booking command module releases the priority 12 command when a scheduled room booking is complete. Otherwise the time scheduled priority 15 command cannot take precedence (see example below). However, it is prudent to also write a stop command at priority 16 in case the unit default is set to run.

The room booking command modules reside in a folder called “Room Bookings” which appears under the schedule folder of the NAE or NIE. The following example is for the Michie building teaching room 325.



Central Teaching Room Air Cycle

The BMS time schedule can also be used to provide a turnover of air in the space to avoid prolonged periods without air conditioning where no room bookings are received. The air cycle is best carried out early morning around 6am and should run for 0.5 or 1 hours. Ideally, the air handling unit control will be configured with standby setpoints and the scheduled operation set to standby mode. This will provide a turnover of the air without initiating full cooling or heating. However it will bring temperatures within proximity of occupied conditions so that when a room booking is received temperature conditions can be quickly recovered.



5. Trends and Trend Studies

Each point object can be designated a certain amount of trend data which is stored within the network automation engine. The rate of data accumulation and buffer size can be varied to determine the span of the trend data. For instance, 144 data points with a sample rate of 30 minutes will provide 3 days of trend data which is continually overwritten within the memory allocation of the network engine.

Trend data for binary points can be set to record a change of value only. The buffer size is normally set to 15 which would provide a week's worth of transitions for a typically scheduled fan status with after-hours operation.

Data which is of particular interest or critical in nature can also be nominated to be sent to the trend repository in the BMS ADX Server. The data that is overwritten in the network engine is thus preserved in the Server. As this data tends to be of higher importance it is recommended that the trend rate is set more frequently at 15 minutes. However, the number of points can be retained at 144 because older data is available from the server. This will avoid over allocation of the NAE memory space.

Some example trend settings are shown in the table below.

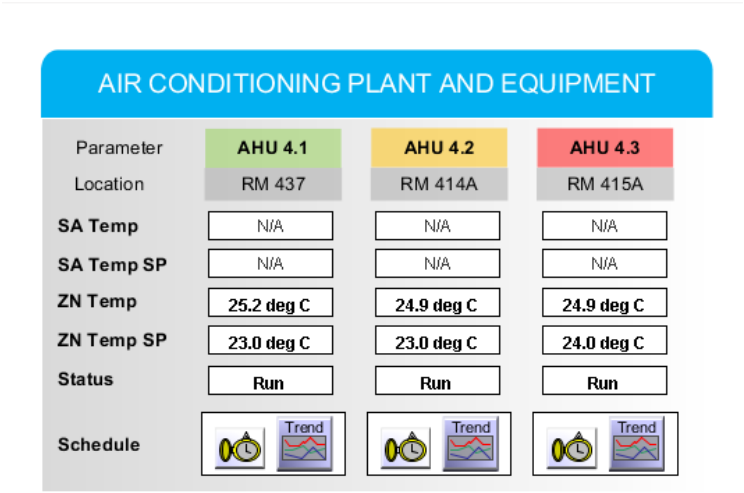
System	Trended Object	Sample Interval	Buffer Size	Repository Enabled
Chilled water and chiller plant	Temperatures	15 min	144	Yes
	Flows	15 min	144	Yes
	Differential Pressures	15 min	144	Yes
	Chiller amps	15 min	144	Yes
	Pump Speed	15 min	144	Yes
Chillers	Chiller enable	Change of Value	25	Yes
	Chiller run status	Change of Value	25	Yes
	Chiller fault	Change of Value	15	Yes
	kWr	15 min	144	Yes
	COP	15 min	144	Yes
Pumps	Pump command	Change of Value	25	Yes
	Pump status	Change of Value	25	Yes
	Pump fault	Change of Value	15	Yes
Computer and data rooms	Temperature	15 min	144	Yes
	Humidity	15 min	144	Yes
Critical rooms	Temperature	15 min	144	Yes
	Humidity	15 min	144	Yes
	Differential Pressure	15 min	144	Yes
	Chilled water valve	15 min	144	Yes
	Heater %	15 min	144	Yes
Normal air conditioning	Supply & Return Air Temperatures	15 min	144	Yes
	Supply Temperature Setpoint	Change of Value	25	No
	Supply air pressure	15 min	144	No
	Supply Air Pressure Setpoint	Change of Value	25	No
	Humidity	15 min	144	Yes
	Humidity Setpoint	Change of Value	25	No
	Zone Temperature	15 min	144	No
	Chilled water valve	15 min	144	Yes
	Heater %	15 min	144	Yes
	Dampers	15 min	144	No
	After hours	Change of Value	25	No
Fans	Fan speed	15 min	144	No
	Fan command	Change of Value	25	No
	Fan status	Change of Value	25	Yes

Operating Mode	Scheduled mode	Change of Value	25	No
	Effective mode	Change of Value	25	No

Trend Studies

Trend studies can be used to view data which is stored in the NAE or on the ADX server. The trend studies should be created in a separate folder of the NAE or the ADX server. The advantage of a trend study is that it can be used to view multiple items of data which can be selected and deselected from the trend view as required. It can also be set to display data from varying time periods when viewing data from the past. The default time setting should be set to display the previous 3 days of data.

Trend studies should be created for each air handling system with links provided to the study from the associated air handling graphic and floor-plan graphic. The trend study should include all analogue inputs and outputs relevant to the control of that unit. Likewise, chilled water systems have dedicated trend studies accessible from the associated chilled water system graphic. The following graphic extract is for Chamberlain level 4 showing the trend page links for each air handling unit.



6. BMS Graphics

Scope

This section of the design guide details the layout and content for the common types of graphic which represent the mechanical services infrastructure monitored by the BMS. The graphics provide a pictorial interpretation of the monitored systems with the specific purpose to accurately represent the physical installation and the control interface to the BMS. This facilitates a better understanding of the control of the plant and leads to improved performance analysis and troubleshooting.

The common types of graphic that are specifically covered by this guide are listed below. There will often be circumstances where graphics are required that differ from this standard suite. Any such customised graphics should adhere to the basic graphic structure, accurately reflect the installation and aid the interpretation of the system in question. Good examples are the solar PV monitoring at Gatton and the heat pump installation for the Mayne Centre at St Lucia.

- Floor plant layout graphic
- Air handling schematic graphic
- VAV summary graphic
- Fan coil unit graphic
- Ventilation summary graphic
- Secondary chilled water graphic
- Chiller system graphic

Purpose

The purpose of this guide is to create a degree of uniformity in the development and presentation of graphics so that users are able to quickly troubleshoot problems and identify abnormal operation. To this end it is imperative that all efforts are made to ensure that graphics are accurate in their representation and intuitive in their design.

Quality Assurance Procedure

A quality assurance procedure is essential to ensure that any graphics created on the BMS display the correct information and provide appropriate links to other graphics, trends and time schedules. All graphic development must incorporate the following checks as a minimum:

1. Verify that that all displayed field data is correct and matched to the right plant.
2. Verify that all page links connect to the correct graphic, schedule or trend study.
3. Verify that all plant labels and room numbering is correct.
4. Verify that all colour co-ordination matches the correct plant to the appropriate rooms.
5. Verify that the locations for mechanical plant and room sensors on the graphic accurately reflect the physical location in the building.
6. Verify that any plant not connected to the BMS is represented on the floor plan.

Graphic Design Principles

This design guide sets out the information to be conveyed and, to a degree, how to convey it but it cannot cover all the principles of good graphic design. Only general guidance can be given on matters such as layout as each case will raise its own challenges that in turn will steer the design.

The general requirement is to create a design that is relatively simple and intuitive; conveys information in an easy, unambiguous manner; and follows established graphic design principles. With a successful design the viewer will readily find the information they are looking for and not be distracted by clutter, visual clashes or cryptic elements. The principles of good graphical design are thoroughly documented elsewhere and are well known to graphic designers. A key element of graphic design and one quite relevant to the integration of plans with adjacent tables is "unity":

"*Visual unity is a main goal of graphic design. When all elements are in agreement, a design is considered unified. No individual part is viewed as more important than the whole design. A good balance between unity and variety must be established to avoid a chaotic or a lifeless design*"[1]

1. White, Alex (2011). *The Elements of Graphic Design*. New York, NY: Allworth Press. pp. 81–105. ISBN 978-1-58115-762-8.

Standard Graphic Layout

The following features form the back ground of all graphics within the system (V7).

Graphic Size

The graphics are intended to be viewed on a widescreen desktop or laptop monitor. A background image conforming to 400.5mm by 262.5mm will produce the correct relative scale.

Graphic Header

Each graphic has a banner or header at the top that contains the UQ Logo, the name and number of the building, the campus and the ambient weather conditions that are representative for that campus. The header colour is purple with the building name and number centred in white. The font size needs to be chosen so that the name occupies around 50% of the length of the header. If this results in a font height much less than half the height of the purple header then abbreviations can be used. Check with UQ to ensure that the proposed abbreviation is one in common use.

The ambient temperature and humidity would usually be taken from the central chiller station serving the campus or remoter site. For the St Lucia campus the weather data points provided in Metasys-42-2 should always be used.

This part of the header will be common for all graphics pertaining to that building. The following header represents building 1024, Elkhorn, which is part of the Long Pocket campus.

A black navigation bar is located below the header with navigation links to other relevant graphics. This may vary depending on the type of graphic. Common to all graphics will be a link to a Legend page containing standard symbols and nomenclature. This link will always be at the right hand side of the navigation bar and the link should be bound to the common legend graphic located in Metasys-adx-web under St Lucia Campus Graphics.

Graphic Footer

A narrow footer defines the bottom of the graphic and includes a date stamp on the right hand side to record the most recent update to the graphic. The date will be in the form dd-Mmm-yyyy to avoid confusion between US and Australian date formats.

Floor plan Graphics

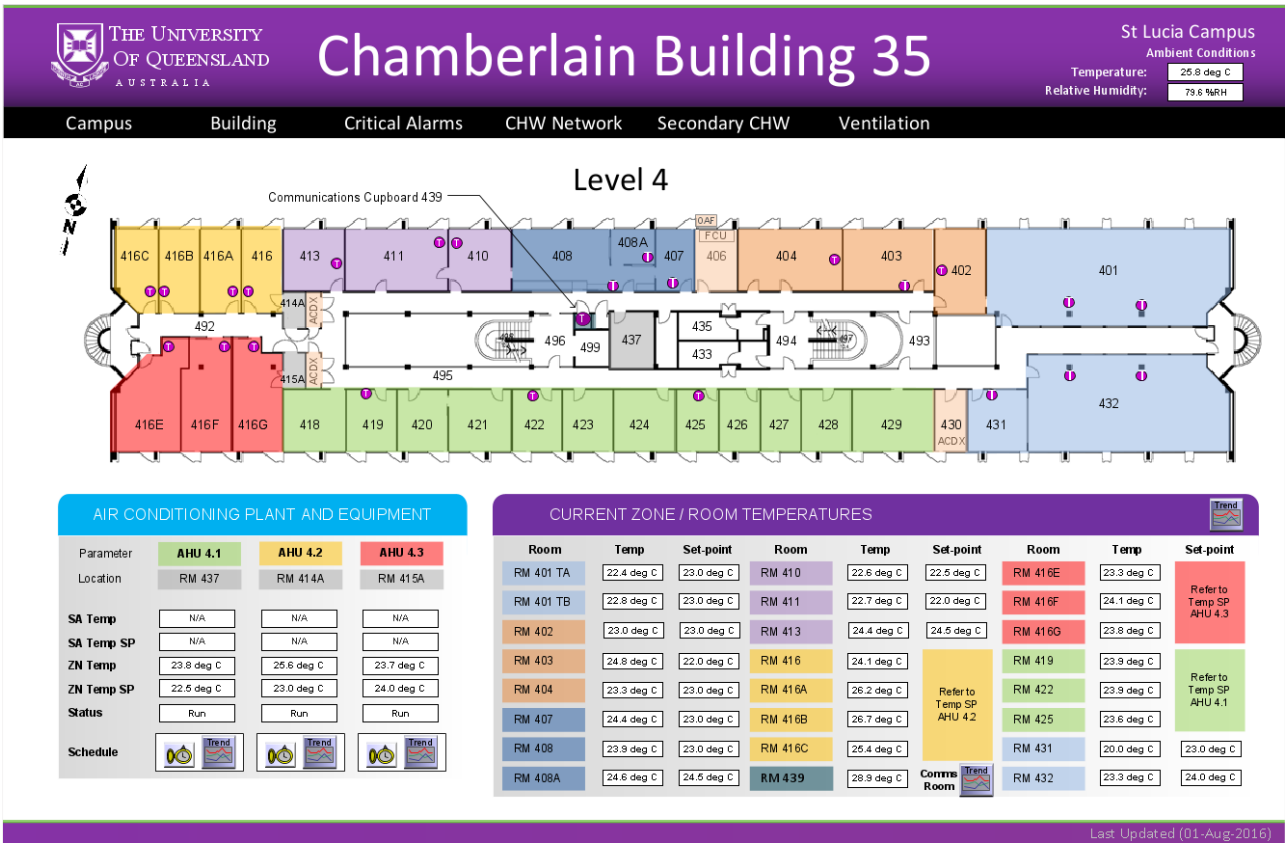
Floor Plan Purpose

The purpose of the floor plan graphic is to identify the plant that serves each space within the floor along with key information regarding the operating status of the main plant and temperatures within the space. From this graphic the user can delve further by selecting links to more detailed graphics showing the air handling plant or chilled water system, trend studies and time schedules. In this way the floor plan acts as a focal point for initial investigation with gateways to further relevant detail.

Floor Plan Graphic Overview

The floor plan graphic shows all or part of the floor plan of a building with rooms and corridors clearly delineated and room numbers distinctly labelled. It is imperative that the latest building layout is used in creating the background image to the graphic. Any air conditioning project which requires changes or additions to the floor plan graphics should consider the entire floor when creating the background image and not just the rooms directly affected by the works.

Figure 1

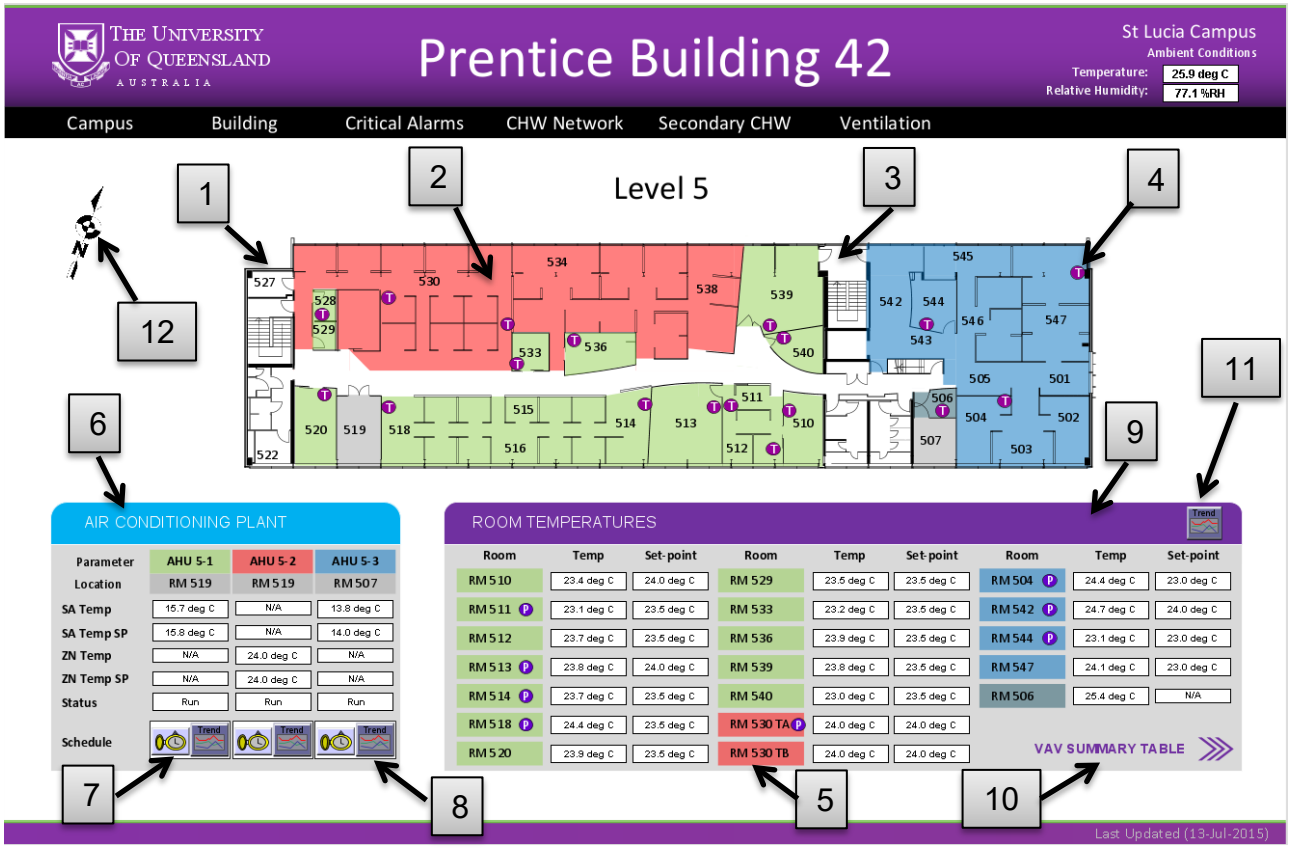


The overall layout of the graphic will depend on a range of factors such as:

- the size of the floor plate
- number of rooms
- number of plant items serving the floor

As a general guide the floor plan will occupy the top and left hand side of the graphic. It is important that the viewer can easily determine room details and displayed data. Typically the floorplan area should occupy 40% or more of the viewing space within the frame. Please see figure below. The numbered boxes relate to design details which are enumerated on the next page.

Figure 2



If more than one graphic is required to represent the entire floor of a building then a navigation symbol is required to show the position of the floor space relative to the remaining floor. This symbol will highlight the area captured by the graphic and include page links to the adjoining spaces.

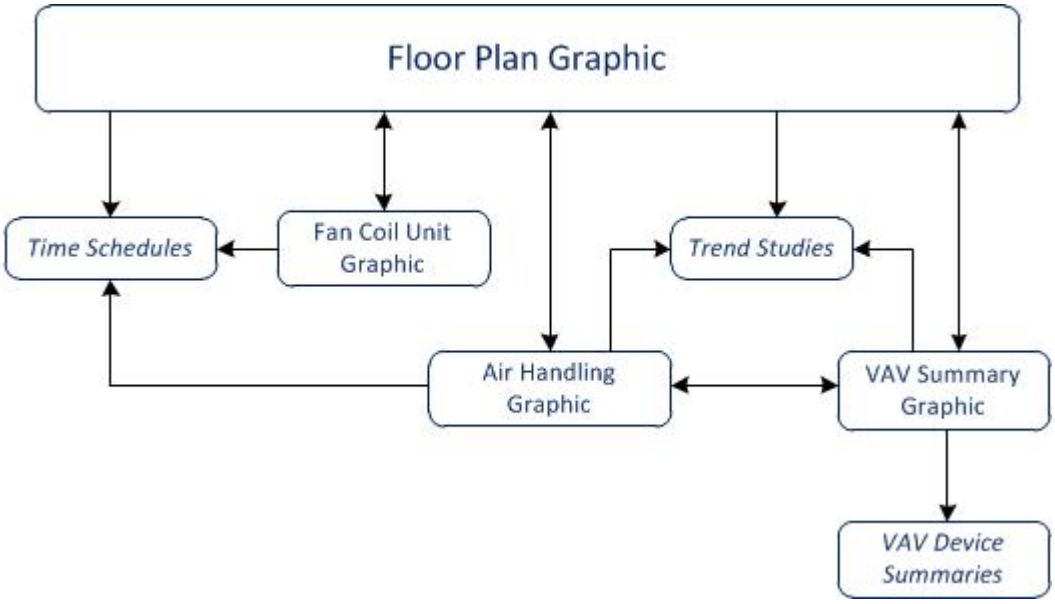
Where possible, two tables should be located under the floor plan: a plant and equipment table and a table showing the temperatures in the various rooms on the floor plan.

Where space is limited, information should be prioritised as follows:

1. Show the temperature table (or tables)
2. Show the plant and equipment table

Floor Plan Graphic Page Links

The floor plan graphic includes links to related graphics which in turn link back to the floor plan. There are also links to other BMS pages such as schedules and trend data. In this way the floor plan forms the nucleus for operator access as summarised in the following diagram.



Floor Plan Graphic Design Details

This section provides guidance on the detailed design of the graphic. The notes below are cross referenced to the numbers shown in grey boxes on Figure 2 above.

1. ***Floor Plan***

   Floor plans are usually available from UQ in CAD and PDF format. Regardless of source, any floor plan used should have strong bold lines to clearly delineated rooms, enclosed corridors, lift lobbies, stairs, toilets etc. Non-full-height open plan partitions should be rendered in a darker shade of the underlying colour or with grey lines to differentiate these from full height walls on the floor plan.

   It may be useful to render moveable internal partitions with a lighter zigzag line. Entrance doors should be shown and showing other doors is desirable, but otherwise extraneous rendering should be avoided. The resulting floor plan needs to be clear and easy to read. Viewers should have no problem discerning the floor entry and exits, gaining orientation and matching the plan to reality in the event, they have visited the floor.

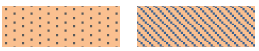
   Room numbers must be clearly visible. If this is not provided satisfactorily from the source CAD/PDF file then room numbers must be entered in as text using Arial 11pt font. The graphic should not become cluttered with room numbers squeezed into cupboards and stairwells. The extract below shows an example where the graphic could be improved by removing the cupboard and stairwell room numbering.

2. *Colour Coding*

Rooms should be colour coded to associate them with the air conditioning plant that serves the space. This means firstly assigning a colour to each item of plant serving the floor and then applying the same colour to corresponding floor space. The chosen colour should not be overly dominant within the graphic. The following pastel shades are appropriate.

This colour coding is common to the Air Conditioning Plant and Equipment table (Item 6) and the Room Temperatures table (Item 9). Colour shaded areas on the floor plan also constitute links to the air conditioning plant. Clicking on a coloured room, for example, takes the viewer to the graphic that shows the schematic for the item of plant that serves that room.

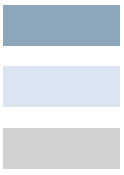
In some cases an air handling unit may provide pre-conditioned outside air to a room which is also served by an internal fan coil unit. In this situation the pre-conditioning unit is characterised by a speckled or hash pattern while the fill colour represents the fan coil unit.



The page link for the room will connect to the fan coil unit graphic. The link for the pre-conditioner will be present in the Air Conditioning Plant table.

It is important that the same colour be used for all spaces served by the same AHU including where the air handling unit serves spaces on more than one floor plan graphic.

A colour standard is also used to differentiate certain rooms of significance such as cold rooms, communications rooms, mechanical plant rooms and air conditioned spaces not monitored by the BMS. The designated colours for these rooms are listed below.



Communications or Data Room

Cold Room

Mechanical Plant Room

Air conditioned room not monitored by the BMS

Air conditioned spaces which are not monitored by the BMS should also display the type of the air conditioning provided in the space via a small text block. The text box should be positioned in the approximate location of the actual plant. Some examples are as follows:

FCU	Fan Coil unit	W	Window Mounted Unit
ACDX	Refrigeration Unit	C	Ceiling Mounted Cassette Unit
OAF	Outside Air Fan	EF	Exhaust Fan

3. ***Corridors and Non AC Areas***
Store rooms, toilets, stairwells etc. typically have no AC service. These areas should not be shaded but instead left as white. Corridors should reflect the colour of the plant serving the adjoining rooms as they will usually be directly or indirectly conditioned from this plant. However, for installations that are ambiguous in this regard then the corridor can remain white.

4. ***Temperature Sensors***
Temperature sensors should be shown as a white "T" within a small purple circle, as shown on Figure 2. The sensors should be located on the graphic as close as practical to their actual location. An easily made mistake is to locate the sensor on the wrong side of a wall partition. This completely throws out future troubleshooting and diagnostics. The QA process should check for this type of error.

5. ***Multiple Temperature Sensors***
The "Current Zone/Room Temperature" table (Item 9) references temperature sensors by room number. If a space or room has more than one temperature sensor then the graphic should differentiate the sensors using "TA", "TB", etc. These labels are carried over as an extension of the room number in the temperature table. They should also be consistent with any such labelling used in the BMS tag naming.

6. ***Air Conditioning Plant and Equipment Table***
Unless special conditions apply, such as a strange floor plate shape, this table should be located below the floor plan layout and on the LHS of the graphic. The table has a header as shown in Figure 2. The preference is for light blue background with white text.

The first row of the table has the Plant name and number with a colour coded background. This colour coded rectangle forms a link to a schematic of the actual item of plant. Where the number of plant items exceeds the space available, this table should reflect the major items of plant only. Minor plant, such as Fan Coil Units, should be logically grouped and represented on schematic graphics with page links from associated rooms on the floor plan and in the zone temperature table.

The second row shows the room location of the plant itself and not the rooms served. For ceiling or wall mounted FCUs this will be the same number.

The third and fourth rows show the supply air temperature and set point for the plant item. If not applicable then use N/A text in place of the displayed data.

The fifth and sixth rows show the zone temperatures and set points, data usually relevant to constant volume AHUs rather than AHUs serving a VAV system. Again, use N/A text if the field is not relevant for this particular plant.

The seventh row shows the operational state of the plant which is usually the supply fan run status and displayed as On or Off. The eighth row contains two linked icons that are discussed below.

7. ***Plant Schedules***

The clock icon provides a link to the associated operating time schedule for the plant, if one exists. From the schedules page, the viewer can return to the floorplan using the back arrow at the top left hand side of Metasys tool bar.

8. Plant Trends

The trend icon provides a link to a trend study set up for that item of plant. For AHUs units serving a VAV system this would normally include the supply air temperature, chilled water valve, supply duct pressure and fan speed. For constant volume units, it would include all one temperatures and the chilled water valve position. Again, the viewer can return to the floorplan using the back arrow at the top left hand side of Metasys tool bar.

9. Zone/Room Temperature Table

The table has a header as shown in Figure 2. The preference is for a purple background with white text. The table presents all the set-points and current temperatures for each zone on the displayed floor plan. The information is arranged as follows: rooms are arranged in blocks corresponding to the plant items that serves the room. Within each block, rooms are presented in ascending order. The blocks are also presented so that taken together the first room entry in each block represents an ascending sequence. The example in Figure 2 illustrates these "rules".

Each colour rectangle provides a link to the respective AHU/FCU/ACDX schematic that serves the room (unless no such schematic exists). Any communications or cold rooms should be highlighted using the designated room colour and additional text if there is space.

Where multiple sensors are averaged to provide a representative zone temperature, the set-point for each sensor listed in the table should reference the common zone temperature set-point listed in the Air Conditioning Plant and Equipment table (Item 6).

10. VAV Summary Table Link

For Variable Air Volume systems a link to VAV Summary Tables should be provided from the floor graphic. The preferred location is in or near the Current Zone Temperature Table but space and layout issues may dictate another position. Either way it should be clearly visible. The use of a purple font and chevron arrows should be used.

11. Temperature Trend Links

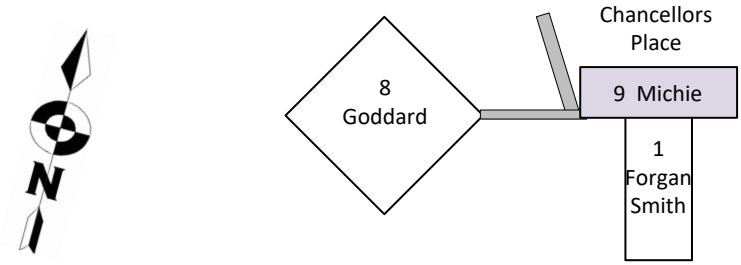
A trend icon located at the RH end of the "Current Zone/Room Temperature" header provides a link to trends for all the temperatures shown in the table. If space and layout issues dictate that temperatures are shown across two tables, then each header should have a trend icon and the link should only be to the temperatures shown in the respective table.

12. Ventilation Table

The ventilation table has a header as shown in Figure 2. The preference is for a green background with white text. The table lists the Outside Air, Toilet Exhaust and other ventilation fans serving the floor. The area served by the fan is listed opposite the fan name and number. This is a different approach to that adopted in the air conditioning plant and equipment table where the location of the unit is listed. Command and Status values are represented in the table. If the fan is variable speed then the table should be arrange to portray VSD data as well (% of Max Hz).

13. North Arrow

A north arrow assists the viewer with building orientation and also helps when assessing solar gain impacts. Generally it should be at the top left of the page. As far as practicable, the floor plan should be orientated such that north is towards the top of the page (item 12). If this is not possible then a locating diagram may be required to emphasize the orientation of the building. The following example is from the Michie building.



14. *Other Considerations*

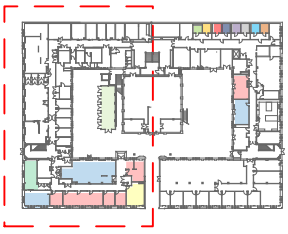
This section deals with a range of matters that may crop up when designing the layout of floor plan graphics.

a) Need to Split Floor Plates

This problem often arises with large floor plates, but it is not the size of the floor plate that creates the problem, but rather having too many rooms on a single floor and plant items serving the floor. The problem is that in order to accommodate the large number of plant items and temperature sensors into tables, the floor plan has to be made fairly small. You can get to the point where rooms are so small when rendered that it is hard to fit the room number in the space available using any reasonably sized font. The answer is to split the floor plate into multiple graphics.

The way in which air conditioning is delivered to a floor is an important consideration when deciding how to split a floor plate and create two or more floor plan graphics. In some cases it may make sense to split the floor plate geographically into an east and west wing, north and south and so on. However the split is achieved, it is desirable that no AHU has to be shown on both drawings. As far as practical we do not want the user to have to toggle back and forth between two graphics to see the areas served by a single unit (this is, however, unavoidable if the AHU serves more than one floor.

When a floor plate is split into 2 or more graphics, a floor plate symbol should be created which shows the location of the viewed space within the overall floor plan. This symbol can then also serve as a page link to the other graphics which make up the floor. The following symbol was created for Goddard Level 1.



b) Excessive Number of Plant Items

Another problem for floor plan graphics occurs when the area is served by a large number of AC and ventilation plant. As per the guidelines above, details of the ventilation plant can be moved off to a ventilation summary graphic with a link provided in the header navigation bar. Where there are large numbers of air condition units, priority is given to major items of plant. In these circumstances, the air conditioning table is reserved for air handling units.

The rooms that are served by Fan Coil Units are not individually colour coded in the same manner as Air Handling Units. Using more than 8 or so colours on a single page creates a busy appearance and means using multiple shades of a single colour which makes it hard for the viewer to keep track of the colour coding. For this reason, fan coil units are logically grouped and share the same room colour and fan

coil unit summary graphic. Links to fan coil unit summary graphics are provide both on the floor plan and in the room temperature table.

Air Handling Schematic Graphics

Air Handling Graphic Purpose

The purpose of an air handling unit schematic graphic is to provide a pictorial representation of the physical components of the air handling system and capture the BMS interface to the controlled plant. The user should be able to discern the key parameters and functions which determine the operation of the system. The graphic forms a sub-graphic to the associated floor plan graphic with page links to toggle between them.

Air Handling Graphic Overview

All graphics for a building are located within the graphics folder allocated to each building within a userview. Primary access to an air handling unit graphic will be via the associated floor plan graphic. The air handling unit graphics can also be opened directly from a graphics sub-folder which groups the air handling graphics by floor. The graphic header should replicate the corresponding features of the floor plan graphic. The top left hand corner will always include a page link back to the parent floor plan graphic symbolised by a series of back arrows in green **<<<**.

The central component of the air handling graphic is a schematic type depiction of the physical plant including all relevant components such as dampers, filters, cooling and heating coils, duct heaters, fans, valves and sensors. Connected ductwork should accurately define the type of air handling system. In this way, it should be obvious if the unit is 100% outside air or has mixed return air and whether the unit is single zone or multi-zone.

A table of key control parameters is located in the top right corner of the graphic. This shows the scheduled operating mode for the unit and any other elements which determine the running of the unit such as after hours or AMX calls. Also appearing in this table are the representative control temperature and setpoint. If there are multiple zone sensors then these are shown in a separate table vertically below the control parameters labelled room temperatures.

Other parameter tables might also be required for specific control items such as carbon dioxide level control, economy mode control, room pressure control and variable speed drive interfaces.

Air Handling Unit Graphic Design Details

The air handling unit graphic should clearly show the type of air handling system it represents and contain all aspects of the BMS control interface to the main plant and associated ancillary plant. The following items detail the different components of the graphic:

1. ***Outside Air***
   The air handling unit graphic should capture how make-up outside air is delivered to the system. This should include some text explaining the outside air source and any of the following components which may be relevant:
   - A manual outside air damper on the unit
   - An outside air duct running to the unit
   - An outside air fan which runs in conjunction with the unit
   - A motorised outside air damper with CO2 or economy mode control

   Motorised dampers should show the outside air damper position adjacent the damper with any related control in a key parameter table (see item 8). Outside air fans should show a dynamic fan symbol which is grey and stationary but changes to green and rotating when the fan status is received. Other relevant points such as fan command, fan speed or fan fault should be displayed adjacent the fan.

2. Air Handling Unit

The air handling unit representation should include any of the following components which may be relevant:

- A grey supply fan which changes to green and rotates when the status is received
- A cooling coil with pipework, chilled water valve and displayed valve position
- A heating coil with pipework, heating hot water valve and displayed valve position
- A filter with differential pressure or pressure switch status if available
- Supply fan command state and run status displayed above the unit
- Supply fan overload fault or VSD fault
- Supply fan speed displayed as VSD reference %
- Dampers (refer to Items 1 and 4)

The supply fan command state text should be displayed as start-stop, the run status off-on and the fan fault normal-alarm. If the supply fan has a variable speed drive with a high level interface (HLI) then parameters from the HLI are listed in a separate table (see item 7).

The building supply and return water temperatures should be displayed below the chilled water valve. This may be from a dedicated secondary chilled water system serving the building or from a primary chiller system. The graphic header will include links to both the primary and the secondary chilled water systems.

3. Supply Air

There may be one or several supply air ducts depending on the whether the air handling unit is a single or multi-zone unit. Multi-zone units will show separate duct heating and HPT status for each supplied zone and any associated control dampers such as face-bypass dampers. Units serving Variable Air Volume systems will show a single supply duct leading to a page link which connects to a separate VAV summary graphic containing all the zone details.

The supply air duct should include any of the following components as may be relevant:

- Supply air temperature sensor with displayed temperature and setpoint
- Supply air humidity sensor with displayed humidity and setpoint
- Supply air pressure sensor with displayed pressure and setpoint
- Steam or adiabatic humidifier with operating % and fault or status
- Desiccant de-humidifier with operating % and fault or status
- Supply duct heater with heater staging or operating % (electric type heaters)
- Heater protection thermostat fault status
- Supply or face-bypass dampers with displayed opening position

The supply duct should extend as far as is required to accommodate the displayed data and components.

4. Return Air

Return air ducting should be shown to distinguish between units with return air and 100% outside air units. The return air duct should include any of the following components as may be relevant:

- Return air temperature sensor with displayed temperature
- Return air humidity sensor with displayed humidity
- Return air carbon dioxide sensor with displayed CO2 levels.
- Return air volatile organic compound sensor with displayed VOC levels.
- Manual return air damper on the ductwork entering the unit

- Motorised return air damper with CO2 or economy mode control
- Motorised relief damper with CO2 or economy mode control
- Return or relief air fan which runs in conjunction with the unit

Motorised dampers should show the return or relief air damper position adjacent the damper with any related control in a key parameter table (see item 8). Return or relief air fans should show a dynamic fan symbol which is grey and stationary but changes to green and rotating when the fan status is received. Other relevant points such as fan command, fan speed or fan fault should be displayed adjacent the fan.

5. ***Air Conditioning Parameter Table***

A table of key control parameters is always located in the top right hand corner of the graphic with a light blue heading entitled “Air Conditioning” (see item 11). The schedule description for the unit is the first item displayed in the table with an adjacent clock symbol signifying a page link to the unit time schedule. The schedule description is dynamic text which is bound directly to the object description of the unit’s time schedule. Static text can also be used where there is no time schedule or the air conditioning is centrally controlled via a room booking system, for example:

THIS UNIT RUNS	THIS UNIT IS CENTRALLY

Any other elements which impact on the running of the unit are then listed underneath. These may include any of the following:

- The scheduled operating mode
- After hours air conditioning call status
- AMX interface air conditioning call status
- Central room booking call status
- Motion detector call status
- Mechanical fire relay status
- Interlocked plant control status
- The effective operating mode

The last of these items is the effective or resultant operating mode. Reading the table from top to bottom therefore provides the scheduled mode, any intervening elements which may affect this and then the resulting operating mode for the unit.

Other items in the table are the representative control temperature and setpoint for the unit. This may be a single zone temperature, an averaged or maximum zone temperature, a supply air temperature or return air temperature. In itself this defines the main control function for the unit. For VAV air handling systems the maximum box delta-T should be shown as an indication of the call for cooling from the zones.

A trend link symbol is shown in the table header which links to a trend study containing the main control parameters for the unit. If the unit is centrally controlled then a link is provided to the central teaching room graphic for that building - >>>.

6. ***Room Temperature Table***

If there are multiple zone sensors then these are shown in a separate parameter table below the main table described in item 5 above. The zones should be identified by room number and listed in room number order. The table heading should read “Room Temperatures” and the purple fill colour should match the room temperature table on the floor plan graphic (see item 11). The header also includes a page link to a trend study for the room temperatures. For VAV

air handling systems a page link to the VAV Summary graphic is positioned at the bottom right of the room temperature table – VAV Summary >>>.

7. ***VSD Parameter Table***
   If the supply fan has a variable speed drive with a high level interface then a subset of the available parameters are shown in a table vertically below the other tables. This table will show the auto-manual mode for the drive, the VSD fault status, the fan speed in Hz, the current draw in amps and the accumulated power consumption in kWh. The table heading should read "Supply Fan VSD" and the heading fill colour should be mid grey (see item 11).

8. ***Economy Mode Table***
   If the unit has motorised outside air or return dampers which are modulated as part of an economy mode function then the control details are captured in a parameter table titled "Economy Mode". The heading fill colour for the table should be a mid-green in colour (see item 11). The table will show the outside air and return air temperatures and the threshold values at which economy mode control is activated. There will also be an economy mode operational status displayed as active or inactive. This parameter table is located in the top left hand corner of the graphic, below the page link to the floor plan graphic and above the dampers which instigate the economy control actions.

9. ***Carbon Dioxide Control Table***
   If the unit has a motorised outside air damper which is modulated as part of a high level CO2 control then the control details are captured in a parameter table titled "CO2 Control". The heading fill colour for the table should be mid blue in colour (see item 11). The table will show the zone or return air carbon dioxide sensor reading and the high and low limits which determine the setting of the outside air.

10. ***Room Pressure Control Table***
    A room pressure control table is titled "Room Pressure Control" with a heading fill colour of light brown (see item 11). This table should be located in the bottom right hand corner of the graphic. The room pressure setpoint and current room pressure are always the first two items in the table. The elements involved in room pressure control will vary from one system to the next and may include any of the following which should appear in the table:
    - Modulating supply, outside air or relief dampers
    - Exhaust fan status
    - Exhaust fan variable speed drive reference %
    - Fume cupboard run status

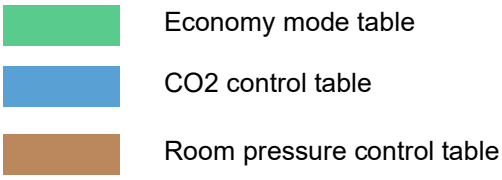
    If an exhaust fan is integral to the room pressure control and operates in conjunction with the air handling unit then this fan should be appear on the graphic. Exhaust fans should show a dynamic fan symbol which is grey and stationary but changes to green and rotating when the fan status is received. Other relevant points such as fan command, fan speed or fan fault should be displayed adjacent the fan.

11. ***Parameter Table Colour Coding***
    The colour coding for parameter table headings should be applied consistently and follow the examples provided below.

    Air conditioning parameter table

    Room temperature table

    Variable speed drive parameter table


Economy mode table
CO2 control table
Room pressure control table

VAV Summary Graphics

VAV Summary Graphic Purpose

The purpose of the VAV summary graphic is to provide a cross comparison of all Variable Air Volume zones in a system. The user should be able to discern how each zone is performing and readily identify boxes which are struggling to achieve conditions. The graphic forms a sub-graphic to the associated floor plan graphic and air handling unit graphic with page links to toggle between them.

VAV Summary Graphic Overview

All graphics for a building are located within a graphics folder allocated to each building within a userview. Primary access to a VAV summary graphic will be via the associated floor plan graphic located in the top level graphics folder. The VAV summary graphic can also be opened from the corresponding AHU graphic or directly from a graphics sub-folder which groups the air handling graphics by floor.

The VAV summary graphic will have a banner or header at the top that contains the name of the building in question with a black navigation bar located below the banner. A narrow footer defines the bottom of the graphic. These elements should replicate the corresponding features of the floor plan graphic. The top left hand corner will always include a page link back to the parent floor plan graphic symbolised by a series of arrows <<<. Located in the centre at the top of the page is the floor level number followed by “VAV Summary”

A VAV summary graphic can represent one or more VAV systems depending on the number of zones and available space. The zone data is presented in a tabular format with clear identification of each zone including the room numbers served and the VAV control box number. Page links are provided from the VAV box number to the VAV control device summary which shows all related parameters for that box.

VAV Summary Graphic Design Details

The graphic consists of one or more tables of VAV zone data located on the same floor of a building. The table header should be given the same colour that has been allocated for the same zones on the floor plan graphic. The title in the left hand side of the header should include the air handling unit number followed by “VAV ZONES”. The right hand side of the header includes a page link to the air handling graphic symbolised by the text AHU and a series of forward pointing arrows >>>. A trend page link also located in the header links to a trend study for all the room temperatures in the table.

The VAV Zone table consists of the room number and VAV box number along the Y axis and nine zone parameters along the x axis. The room number has a fill colour the same as the header and also acts as a page link to the air handling unit graphic. The VAV box number serves as a link to the controller for the VAV box. The parameter headings and the data they represent are listed below in the order in which they appear across the page.

	Location	Room number or range of rooms served by the VAV (RM 528/529)
	VAV box #	VAV number usually VAV - AHU # - Zone# (VAV 5-1-2)
1	Zone Temp	Single zone temperature or average of multiple sensors
2	Temp SP	Common zone temperature setpoint (the cooling setpoint)
3	Cool SP	Effective cooling setpoint
4	Heat SP	Effective heating setpoint
5	Flow	The measured air flow through the box
6	Flow SP	Calculated flow setpoint to achieve temperature conditions
7	Damper	VAV box damper position
8	OCC Mode	Occupied mode status for the box
9	A/H Button	Box after-hours call status
10	Box Heater	Box heating status or heating control %

11	HPT	Heater protection thermostat fault status

The data should be evenly spaced across the page and horizontally and vertically aligned. Any data which is not relevant for a particular box should contain a text box with N/A in lieu of the data for that column.

Fan Coil Unit Graphics

Fan Coil Unit Graphic Purpose

The purpose of a fan coil unit graphic is to capture the BMS control interface to one or more simple fan coil units with basic zone temperature control only. If the unit is more complex than this then an air handling unit graphic should be utilised instead. The graphic is intended for use where there are building floors with large quantities of fan coil units and the aim is to combine 3 or 4 fan coil units per graphic. The user should be able to check the key operating parameters and discern the control performance of the system. The graphic forms a sub-graphic to the associated floor plan graphic with page links to toggle between them.

Fan Coil Unit Graphic Overview

All graphics for a building are located within a graphics folder allocated to each building within a user view. Primary access to a fan coil unit graphic will be via the associated floor plan graphic located in the top level graphics folder. The fan coil unit graphic can also be opened directly from a graphics sub-folder which groups the air handling graphics by floor. The name of the graphic should incorporate all the fan coil units shown in the graphic. For instance, graphic FCU 4-14_15_19 displays the control interface for fan coil units FCU 4-14, FCU 4-15 and FCU 4-19.

The fan coil unit graphic will have a banner or header at the top that contains the name of the building in question with a black navigation bar located below the banner. A narrow footer defines the bottom of the graphic and includes a date stamp on the right hand side to record the most recent update. These elements should replicate the corresponding features of the floor plan graphic. The top left hand corner will always include a page link back to the parent floor plan graphic symbolised by a series of back arrows <<<.

An important aspect of the fan coil unit graphic is to group together units of similar size serving areas in adjacent locations. In this way a comparison can be made of the performance of units with similar duties. Each fan coil unit is represented by a straight section of duct with all relevant components such as fan, cooling coil, valve and heater. A table of key control parameters is located to the right of the fan coil unit and related outside air details to the left. The fan coil unit number, location and the outside air fan number (if applicable) should be clearly displayed in a title box between the fan coil unit and the outside air detail. The control parameter table includes the room number for the zone being served.

Fan Coil Unit Graphic Design Details

The following items detail the different components displayed for each fan coil unit. These are replicated down the page for each unit:

1. ***Outside Air***
   The graphic should capture how outside air is delivered to each fan coil unit system. This should include some text explaining the outside air source or an outside air fan if there is one dedicated to the room. The outside air fan should show a dynamic fan symbol which is grey and stationary but changes to green and rotating when the fan status is received. Other relevant points such as fan command, fan speed or fan fault should be displayed adjacent the fan.

2. ***Fan Coil Unit***

The fan coil unit symbol should include any of the following components which may be relevant:

- A grey supply fan which changes to green and rotates when the status is received
- A cooling coil with pipework, chilled water valve and displayed valve position
- A heating coil with pipework, heating hot water valve and displayed valve position
- Supply fan command displayed above the fan
- Unit heater state and HPT fault status displayed above the heater

The unit command state text should be displayed as start-stop, the heater command as on-off and the HPT fault as normal-alarm.

3. ***Air Conditioning Parameter Table***

A table of the key control parameters is located to right of each fan coil unit entitled “Air Conditioning Parameters” with a light blue heading. The time schedule description appears below the heading with an adjacent clock symbol signifying a page link to the unit time schedule. The schedule description is dynamic text which is bound directly to the object description of the unit’s time schedule. Static text can also be used where there is no time schedule or the air conditioning is centrally controlled via a room booking system, for example:

THIS UNIT RUNS	THIS UNIT IS CENTRALLY

The table contains two columns of data. The scheduled operating mode is the first item in the first column. Below the operating mode is the after-hours call status if applicable. The second column of data contains the zone temperature and temperature setpoint.

Ventilation Graphics

Ventilation Graphic Purpose

A ventilation graphic page is required when the floor plan graphics for the building do not have enough space to show the relevant ventilation details. The purpose of the ventilation graphic is to capture the BMS control interface to all the ventilation plant within the building. The user should get a sense of where exhaust or outside air is vertically ducted to serve multiple floors of the building such as toilet exhaust systems. The graphic forms a sub-graphic to the associated floor plan graphics with page links to toggle between them.

Ventilation Graphic Overview

All graphics for a building are located within a graphics folder allocated to each building within a user view. Primary access to the ventilation graphic will be from the associated floor plan graphics located in the top level graphics folder. The ventilation graphic can also be opened directly from this folder.

The ventilation graphic will have a banner or header at the top that contains the name of the building in question with a black navigation bar located below the banner. A narrow footer defines the bottom of the graphic and includes a date stamp on the right hand side to record the most recent update. These elements should replicate the corresponding features of the floor plan graphic.

The graphic is segregated vertically by building floor. On the left hand side, the corresponding floor number is identified and this also serves as a page link to the parent floor plan graphic for that floor. For each floor the ventilation fans are shown with details of the BMS control interface. Ventilation systems serving multiple floors are designated by ductwork which traverses the relevant floors.

Ventilation Graphic Design Details

Each item of plant appears in a coloured box and is labelled with the plant tag and room number location. The following items detail the different ventilation plant which might appear in the graphic and the components displayed for each.

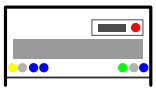
1. ***Outside Air Fans***
   The outside air fan should show a dynamic fan symbol which is grey and stationary but changes to green and rotating when the fan status is received. Other relevant points such as fan command, fan speed or fan fault should be displayed adjacent the fan. If the outside air fan runs to a time schedule then a link should be provided to the schedule for that fan. Alternatively, if the fan is interlocked to run with other plant then the status of the fan interlock should be shown.

2. ***Exhaust fans***
   Exhaust fans might include kitchen exhaust, toilet exhaust, general exhaust, PC2 exhaust, articulated arm exhaust, switch room exhaust or plant room exhaust. If the fan provides room pressure or temperature control then the control setpoint should be shown along with the measured parameter. If the exhaust serves a gas store or loading dock then any gas monitoring data should be shown.

   The exhaust air fan should show a dynamic fan symbol which is grey and stationary but changes to green and rotating when the fan status is received. Other relevant points such as fan command, fan speed or fan fault should be displayed adjacent the fan. The fan command state text should be displayed as start-stop, the fan status as on-off and the fan fault as normal-alarm.

   If the exhaust fan runs to a time schedule then a link should be provided to the schedule for that fan. Alternatively, if the fan has a local run switch or is interlocked to run with other plant then the status of the fan switch or interlock should be shown.

3. ***Fume Cupboards***



   Fume cupboards are represented by a designated symbol with the run or fault status from the fume cupboard controls shown above. Other relevant points may include sash height and fume cupboard fan speed.

Secondary Chilled Water Graphics

Secondary Chilled Water Graphic Purpose

The purpose of the secondary chilled water graphic is to capture the BMS control interface to the delivery of chilled water to a building. In most cases this will take the form of a secondary chilled water pump station. The graphic should also capture the distribution of water through the building including individual chilled water valve positions for air handling plant.

Secondary Chilled Water Graphic Overview

All graphics for a building are located within a graphics folder allocated to each building within a user view. The secondary chilled water graphic is located in the top level graphics folder. This graphic can also be opened from a header page link from other graphics within the building.

The secondary chilled water graphic will have a banner or header at the top that contains the name of the building in question with a black navigation bar located below the banner. A narrow footer defines the bottom of the graphic and includes a date stamp on the right hand side to record the most recent update. These elements should replicate the corresponding features of the floor plan graphic.

The main component of the graphic is a schematic type depiction of the physical plant with all relevant components such as pumps, piping, valves and sensors. Sufficient pipework is shown to give an indication of how the water is reticulated around the building. The chilled water plant and pipework should be positioned on the graphic to give a reasonable comprehension of the physical installation within the building.

The graphic is segregated vertically by building floor. On the left hand side, the corresponding floor number is identified and this also serves as a page link to the parent floor plan graphic for that floor. For each floor the main air handling unit chilled water valve positions are shown grouped together by plant room or approximate location. These are positioned relative to the chilled water pipe risers which are shown fed from the chilled water plant. If there are too many chilled water valves to sensibly fit on the graphic then the average and maximum valve position for a group of units should be shown instead.

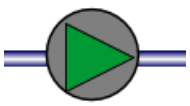
A table of key control parameters is located on the right hand side of the graphic. This shows the control setpoints for the chilled water plant and the status of the corresponding control actions. A page link is provided to a trend study for the chilled water system.

Secondary Chilled Water Graphic Design Details

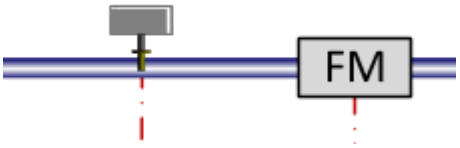
The following items detail the different components of the chilled water plant which might appear in the graphic and the details displayed for each.

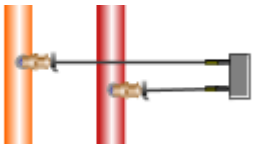
1. ***Chilled Water Pumps***
   The chilled water pumps should show a dynamic pump symbol which is grey and stationary but changes to green and rotating when the pump status is received. Other relevant points such as pump command, pump speed or pump fault should be displayed adjacent the pump. The pump command state text should be displayed as start-stop, the pump status as on-off and the pump fault as normal-alarm.

   The standard pump symbol is a dark grey circle with a dynamic triangle pointing in the direction of flow which turns green when the pump is running.



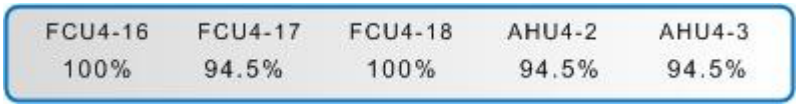
2. ***Chilled Water Sensors***
   Symbols should be used to show the location of chilled water sensors relative to the pump and pipework risers. These may include supply and return temperature sensors, flow meter, and building differential pressure sensor. Typical symbols and pipework below.





3. ***Chilled Water Valves***

Chilled water throttling valves or bypass valves are shown in their approximate location relative to the pump with their opening position displayed adjacent to the valve. Where possible, the air handling unit chilled water valve positions within the building are shown to provide an indication of the water distribution within the building.



The valves should be grouped together by floor and positioned relative to the pipework risers shown on the schematic. Refer to the Chamberlain secondary chilled water graphic for an example. If the number of valves within a building is excessive (80+) then only the major air handling plant should be included with the average and maximum valve position for minor plant shown for each floor.

4. ***Secondary Chilled Water Parameter Table***

A table of key control parameters is located on the right hand side corner of the graphic with a mid-blue heading titled “Secondary Chilled Water”. The control parameters for the building chilled water shown and may include any of the following:

- Return temperature control setpoint and temperature
- Building chilled water flow setpoint and flow
- Building differential pressure setpoint and pressure
- Chilled water throttling valve or bypass valve position
- Chilled water pump command
- Chilled water pump VSD speed reference
- Duty-standby lead pump arrangement

A trend symbol in the top right corner of the table header indicates a link to a trend study for the secondary chilled water sensors and control outputs. If there are duty and standby pumps there will also be a link to a time schedule for the lead pump rotation.

Chiller Graphics

Chiller Graphic Purpose

The purpose of the chiller graphic is to capture the BMS control interface to the main plant within a chiller precinct and portray the overall delivery of chilled water to the buildings served. The graphic should incorporate a schematic layout that is representative of the physical chiller, pump and pipework configuration. The graphic will form part of a suite of graphics which may include chiller high level interface data, cooling tower and condenser water reticulation and secondary chilled water systems.

Chiller Graphic Overview

All graphics for a building are located within a graphics folder allocated to each building within a user view. The chiller graphic is located in the top level graphics folder. This graphic can also be opened from a header page link from other graphics within the building or buildings served by the chiller plant.

The chiller graphic will have a banner or header at the top that contains the name of the chiller precinct with a black navigation bar located below the banner. A narrow footer defines the bottom of the graphic and includes a date stamp on the right hand side to record the most recent update.

The main component of the graphic is a schematic type depiction of each chiller with all relevant components such as pumps, piping, valves and sensors. The chiller plant, pumps and pipework should be positioned on the graphic to give a reasonable comprehension of the physical installation of the plant. The chilled water and condenser water pipework terminate in direction arrows and text explaining the destination for the water supply and includes the supply and return water temperatures.

Sufficient pipework is shown to give an appreciation of the how the chilled water and condenser water are reticulated within the precinct including any bypass or decoupling lines. The pipework is colour coded as follows.

Chilled water supply

Condenser water supply

Chilled water return

Condenser water return

Tables of control parameters are positioned vertically above and below each chiller which show the key operational data for the chiller. If extensive data is available via a chiller high level interface then this should be captured on a separate graphic with a page link from the chiller graphic. Further page links may be required to corresponding graphics representing cooling tower/condenser water reticulation, chiller sequencing details and secondary chilled water graphics. Page links are also provided to trend studies for the each chiller and the overall chilled water system.

Chiller Graphic Design Details

The following items detail the different components of the chilled water plant which might appear in the graphic and the details displayed for each.

1. ***Chillers and chiller parameter table***
   Each chiller is represented by a symbol which reflects the type of chiller such as centrifugal, screw compressor, reciprocating, air or water cooled. A dynamic status box located with the chiller is grey when the chiller is not running and changes to green when a chiller run status is received. A parameter table below each chiller displays key operational data which may include some or all of the following:
   - Chiller availability flag
   - Chiller enable command
   - Chiller fault state
   - Chiller amps or percent full load amps

2. ***Chilled Water Pumps***
   The chilled water pumps are represented by a dynamic pump symbol which is grey and stationary but changes to green and rotating when the pump status is received. A parameter table above each chiller displays key operational data pertaining to the chilled water supply which may include some or all of the following:
   - Chiller chilled water entering and leaving temperatures
   - Chilled water pump command
   - Chilled water pump status
   - Chilled water pump VSD %Speed
   - Chiller chilled water flow
   - Chiller chilled water differential pressure

3. ***Chilled Water Sensors***

Symbols should be used to show the location of chilled water sensors relative to the pump and chiller. These may include supply and return temperature sensors, flow meter, and chiller differential pressure sensor.

4. Condenser Water Pumps

The chiller condenser water pumps are represented by a dynamic pump symbol which is grey and stationary but changes to green and rotating when the pump status is received. Other details pertaining to the condenser water pumps are shown on a separate graphic for the cooling towers and condenser water system.

5. Common Chilled Water Supply

The chilled water supply pipework terminates with an arrow table of key control parameters is located on the right hand side corner of the graphic with a mid-blue heading titled “Secondary Chilled Water”. The control parameters for the building chilled water shown and may include any of the following:

- Return temperature control setpoint and temperature
- Building chilled water flow setpoint and flow
- Building differential pressure setpoint and pressure
- Chilled water throttling valve or bypass valve position
- Chilled water pump command
- Chilled water pump VSD speed reference
- Duty-standby lead pump arrangement

A trend symbol in the bottom left hand corner of the parameter table indicates a link to a trend study for the secondary chilled water sensors and control outputs. If there are duty and standby pumps there will also be a link to a time schedule for the lead pump rotation.