Building Management Systems Design Standards

MACQUARIE University

DOCUMENT HISTORY

Version	Description	Date Issued
2.8	BMCS standards fully revised, previous version superseded.	13/03/2023

Guideline Design Standard for Building Management Systems (BMCS)

Macquarie University, Sydney

Circulation Approval

Name	Position	Approved
Conor Kelly	Engineering Manager	✓
Damien McLynskey	Technical Services & Infrastructure Manager	✓
Alan Vidler	Facilities & Operations Manager	✓
David Warner	HVAC & BMS Team Leader	✓

Purpose

The purpose of this Design Standard, covering requirements and specifications, is to provide a design guide for Project Managers and Designers (includes D&C contractors), developing specifications for Building Monitoring and Control Systems at the Macquarie University.

Scope

This document scopes the type of technology and systems that are compatible with the current MACQUARIE UNIVERSITY BMS system architecture.

NOTE WHERE THIS SYMBOL APPEARS: Overview functionality is included in this document. It is expected that designers will customize the requirements within their documentation package, however this specification includes minimum requirements.

Controllers and other system equipment are specified to the extent that compliance with BACnet and some basic architecture and functionality requirements are met. It is not intended to completely specify requirements that consultants may need but is aimed at providing a minimum and encouraging vendors to offer innovative solutions. Vendors may offer equipment that exceeds these specifications.

References and Standards

1. Macquarie University, Sydney. MACQUARIE UNIVERSITY Design Standards
2. National Institute of Standards and Technology (NIST). GSA Guide to Specifying Interoperable Building Automation and Control Systems Using ANSI/ASHRAE Standard 135-1995, BACnet
3. American Society of Heating Refrigeration and Air-conditioning Engineers. BACnet PICs (protocol Implementation Conformance Statement)
4. American National Standards Institute (ANSI). EIA-485 Communications Standard
5. Current AS/NZS 3000:Standards Australia.– noting the most current version of the standards available must be used at all times
6. Australian Communications and Media Authority: Radio-communications (Electromagnetic Compatibility) Standard 2008

Definitions and Abbreviations

MQU, Air Conditioning Unit
AHU, Air Handling Unit
AI, Analog Input a value that can be read from a controller
AO, Analog Output, value that be read from a controller and written to by software
AV, Analog Value, a holding variable such as a setpoint,
N4 Server N4 BMS Supervisor running on http://10.253.26.252
BACnet, Interoperability protocol ASHRAE Standard 135p.
BACnet Advanced Application Controller (BACnet AAC), application controller
BACnet Application Specific Controller (BACnet ASC), application controller for VAV, FCU etc.
BACnet Building Controller (B-BC), controller device profile for high level network based controllers.
BACnet Operator Workstation (B-OWS), network level workstation
BCS, Building Control Station, a high level BMS controller typically connected directly to the Macquarie University WAN. Commonly used to control chillers, large Air Handling systems and other complex equipment. Must conform to BACnet B-BC or MSTP device profile.
BI, Binary Input, a digital value read from a controller
BO, Binary Output, a digital value that can be written to by software
BV, Binary Value, a digital holding variable
BMCS Contractor, company employed to deliver individual Macquarie University BMCS
DSC, Distributed Control System
DMZ, Demilitarized Zone
FCU, Fan Coil Unit
JACE, Java Application Control Engine (trademark of Tridium Inc.)
KVM Switch Keyboard/Video/Mouse switching device
LDAP, Lightweight Directory Access Protocol
Lonworks, Echelon Corporation Lonworks network standard
Modbus/RTU, Modbus over serial link (RS-485)
Modbus/TCP, Modbus over IP (Transmission Control Protocol)
MSTP Master Slave Token Passing
MUP, Macquarie University Property
Native BACnet system, a system that can be proven to be designed around the BACnet standard.
N4 Server N4 Supervisor running on https://10.253.26.252 (https://niagaran4.int.mq.edu.au)

NMS, Network Management System, a software system for monitoring network devices.
NTP, Network Time Protocol
RDC, Remote Distributed Controller, BACnet application oriented controllers, typically linked to a BCS or a BACnet router for supervisory functionality, may reside on a lower speed (78Kbs) peer to peer LAN. Commonly provide VAV, FCU, small AHU, and Packaged Equipment local control. Required to support B-AAC or B-ASC profile.
RDP, Remote Desktop Protocol (multi-channel allowing remote clients to connect to Microsoft Terminal Services).
SNMP, Simple Network Management Protocol
SMTP, Simple Mail Transfer Protocol
SDD, System Design Document, includes all design information for approval prior to installation
VAV, Variable Air Volume (referencing the controller/actuator)
VPN, Virtual Private Network
UTC, Coordinated Universal Time (*Temps Universel Coordonné)*

Introduction

This Technical Standard encompasses Macquarie University's ("MQU") operational procedures, contents, specifications and documentation standards for the design, installation, and operation of the Tridium Niagara N4 Building Management System ("BMS").

> *The purpose of this document is to ensure the development of the Tridium Niagara N4 BMS is of a consistent and high quality across MQU Campus, to provide efficient and cost effective implementation of systems, and the operation of the University's building assets, whilst ensuring a comfortable and safe learning and working environment for our students, staff, and visitors.*

The content of this Technical Standard is intended to be used as the minimum requirements in undertaking projects and retrofits unless otherwise specified and approved by the MQU Properties.

1.1 Scope

MQU has adopted the Tridium Niagara N4 product suite as the BMS for managing the University's building services including HVAC, fire, electrical, hydraulic, and lighting and energy assets.

The Tridium Niagara N4 Supervisor Server is located as a virtual server within the MQU IT infrastructure.

The system is connected across the Campus via a dedicated campus network and is capable of accommodating future expansion. As the BMS is on the University's network it can be accessed anywhere via the network with the correct password. This includes remote access via MQU's secure VPN.

The BMS shall be interfaced with other building systems including lighting, electrical, fire alarms, metering and related building systems.

All new and refurbished buildings are to be monitored and controlled by a DDC system connected to the University BMS per this technical standard.

> *IMPORTANT NOTE - Standalone DDC System installations are generally not acceptable to the University.*

This technical standard encompasses the following aspects of all vendor project works:-

- Standardising Documentation
- Controls Engineering Standards
- Graphics Standards
- Network Connection process
- Operations Manual Standards
- Points Lists Standards
- Wiring Diagram Standards

1.2 Controls Standards

The following section details the operating guidelines for the standardization of all works to be performed by the vendor. All exclusions, specific inclusions, and specialized instructions in any project will be clearly stated and identified and cannot be assumed.

1.2.1 Supervisor

All equipment and software installed and used on MQU's campuses are:

- To meet Australian Standards and are fully tested, AND,
- Not in an Alpha or Beta testing phase.

MQU utilises Tridium Niagara N4 as the only accepted BMS Supervisor. All communication to the Supervisor must be done via the Tridium Niagara N4 protocol from JACE controllers. The Supervisor is maintained by the MQU Property team and all modifications performed on the Supervisor, including, but not limited to, graphics, modules, programming, and updates must be informed to, acknowledged, and approved by the BMS administration team prior to the implementation of said modification.

Each component of any BMS installed in a building by the vendor is to be fully compatible and integrated with Tridium Niagara N4.

Web gateways, StruxureWare, StruxureWare Lite, enteliWEB, and Optergy are not acceptable on new projects and retrofits. It is not desired to have multiple systems together in one building.

It is a requirement that all additions to buildings with existing controls installed by the vendor, to be fully compatible with the existing system and successfully integrates together. Open General controls cannot be used.

1.2.2 System Controllers (JACE 8000)

The University's acceptable standard requires the use of;

- Non-propriety "open" licence Tridium, Honeywell, Vykon or Easy IO Niagara JACE 8000 or greater
- A minimum of one unit per building.
- Either one JACE 8000 be utilised per each floor of a building or a maximum of 100 field devices be connected to a single JACE.
- A separate JACE 8000 is to be utilised when energy monitoring meters are required if the total number of meters is greater than 10
- It is a requirement that each MSTP network is to serve a maximum of one floor and no more than 32 devices.

All Honeywell JACE 8000 System Controllers MUST have Spyder Engineering Tools installed and licenced.

In making modification or additions to an existing JACE(s) the vendor is to ascertain whether the existing JACE(s) have the capacity to accommodate for new works *in accordance with this standard*. If the existing JACE(s) are inadequate in handling the additional project works, the vendor must provide additional JACE(s) for new works unless otherwise specified or instructed. In the event of the overloading and causing of instability of JACE controllers, the vendor is to bear the costs of rectification the problem.

The vendor will be responsible for connecting the new project works onto the BMS network, coordinating with MQU IT services for IP addresses, and all other related works. Under no circumstance will JACE(s) from other buildings be used in performing control functions, store trends, store graphics, and other related processes.

Any additional BACnet system controllers or routers, to be installed or currently existing onsite, are acceptable but must adhere to the following:

- Communicate to the JACE(s) controlling the building, AND,
- Must not communicate to the Supervisor directly.

1.2.3 Field Controls Protocols and Hardware

The protocols at field level that are acceptable by The University are;

- BACnet MSTP
- BACnet IP

All new installations must communicate using BACnet IP or BACnet MSTP. Wireless communications shall not be used for field controller communication. No LON based controllers are permitted. Any existing LON networks shall not be expanded or added to. New devices shall be added to existing buildings as BACnet devices.

Tertiary monitoring of devices such as VSDs, power meters and the like are permitted to use ModBus.

The following gateways are acceptable to the University:

- Mitsubishi Industries VRV system BACnet gateway
- Daikin VRV system BACnet gateway
- Temperzone VRV system BACnet gateway

Except for the above listed gateways, the University will not accept BACnet/Ethernet, proprietary communications protocols or gateways to proprietary protocols.

In plant rooms and cupboards, all BMS controllers must be installed in lockable, dustproof enclosures (not in mechanical services switchboards). Only unit mounted controllers in ceiling spaces may be installed without an enclosure. All controllers installed must be brand new. No refurbished, repaired or second hand controls to be used except for repairs of legacy systems with written permission of the MQU Property Support team.

All controllers are to be powered on a dedicated and separate power supply with a dedicated circuit breaker. All controllers that allow DC power shall be supplied with a DC power supply.

Only the following products are acceptable:

- EasyIO
- Honeywell

Controllers that require individual licencing or ILC are not accepted by the University.

All field controllers must be programmable using approved engineering tools. IP based controllers are preferred but not mandatory.

Only the following engineering tools are approved:

- CPT
- Honeywell Engineering Tool

EasyIO FCxx controllers are not acceptable.

It is a requirement that large plant systems e.g. Chillers and AHUs are all controlled by one controller and not split across multiple small controllers for that system (unitary operation – see below). The only exception is if there is a dedicated controller for enabling equipment at the Mechanical Services Switchboard (MSSB). In such an instance, the plant that is being controlled can be split over no more than two (2) controllers; one (1) controller located locally at the equipment for control and one (1) controller located adjacent to the MSSB for enable.

- Note: The term ‘unitary’ is defined as collating all points necessary for a complete system into one controller. It is not acceptable to collate points over comms for unitary operation. If a single controller will not accommodate all required points, additional controllers may be used, but may not be combined via comms. They must have low level connections between them to facilitate unitary operation.

It is the University's preference that modular controllers not be used because of maintenance issues and requirements to carry numerous spare parts for a single controller.

New systems will be capable of future expansion with spare capacity in memory and processing power and 20% spare Input/Output capacity.

All firmware updates and bugs to be upgraded throughout the DLP at no additional cost. The field controllers system shall be guaranteed to be compatible with future software and hardware updates.

1.2.4 Sensors, Actuators and Field Devices

All sensors, actuators and field devices shall be installed to meet Australian Standards with the following requirements:

- Accessible for maintenance without unreasonable access requirements
- Protected from moisture, physical damage, and UV. Outdoor sensors and actuators shall always be provided with a weatherproof outdoor enclosure, UV rated, with a gasketed door or lid, regardless of the IP rating of the sensor or actuator. Sealing sensors or actuators inside boxes with silicone is not acceptable. When installed outside, no sensor or other device shall be installed on the top of any duct, AHU, FCU or other such enclosure, but shall instead be located on the side to prevent the drilling of penetrations, screws, or other such openings where rainwater can enter.
- Sensors and actuators shall not be wireless or HLI, all sensors shall operate as low level sensors.
- Temperature sensors are preferred to be thermistor type, although voltage sensors are acceptable.
- Current sensors are not acceptable unless there is no other available type for that sensor.
- Pressure sensors shall be selected to the smallest range required for maximum operation of the item of plant.
- All cable shields shall be earthed in dedicated earth terminals, not in duct, and insulated as necessary.
- Cables shall cross at right angles, be secured, and neatly arranged.
- Cable spacing requirements from mains power shall be followed at all times.
- Installation of VSDs outdoors is not acceptable, regardless of IP rating.
- Sensor locations shall be documented on all as built documentation and referenced in all ITPs and points lists.

1.2.5 Controls Contractor Standards

Only a specialist experienced in the manufacture, installation and maintenance of the equipment and software proposed shall install the system as to ensure that the entire system can interface with one another seamlessly. The vendor's local office shall be staffed with qualified personnel capable of providing support and routine maintenance on the complete installation.

Each technician from the vendor is required to have completed the Tridium Certified Program (TCP) or Honeywell Building Management Systems training prior to performing any works on the University Tridium Niagara N4 system and be factory trained on the controls they are using. Vendors working on the Tridium Niagara N4 software must all be fully Tridium licensed and must be an authorised Australian Tridium System Integrator to have the backing of Tridium should an issue arise.

Controls contractors must seek approval from MQU Properties before they can begin works on any new projects, replacements or upgrades

The use of proxy certifications is not acceptable.

1.2.6 Control Software Specification

The only software accepted by The University for modification, setting up, commissioning, programming, editing, backing up or servicing any controllers is Tridium Niagara N4 Workbench.

No new standalone software packages are to be utilised for future projects at the University.

The current build for all Tridium Niagara N4 platforms accepted is:

- Version: 4.10

Each vendor must provide the required modules for modification, setting up, commissioning, programming, editing, backing up or servicing the field controllers and install the modules into Tridium Niagara N4 Workbench to allow the BMS administration team to service the controllers from one central location. The following are examples of compliant Tridium modules:

- Honeywell Building Management Systems
- EasyIO

Any licencing for these modules must not require renewal and should be unrestricted for use by the MQU Property Support team. The vendor working on the Tridium software must all be fully Tridium licenced and must be an authorised Tridium System Integrator. *No Personal/company modules are to be used.*

The use of proxy certifications is not acceptable.

Controls that require 3rd party tools outside of those listed here and by Tridium Niagara N4 Workbench to modify, setup, commission, program, edit, backup or service shall not be deemed acceptable in any circumstances. This specifically includes all 3rd party software that requires dongles or software locks.

1.2.7 Base Points Requirements

A base minimum requirement for control and monitoring points is included in section 1.22 *Minimum Required Points*.

1.3 Password Standard

1.3.1 Platform Passwords

The platform credentials for all JACE controllers shall be:-

Username:	MUP_Admin
Password:	MUPofm@mac1

The passcode for all JACE controllers shall be:

MUPofm@mac1

1.3.2 Station Passwords

MQU has three levels of user permissions that are required to be setup on each JACE connected to the University Network.

- Read Only
- Read Write Access
- Super User

Only the MQU Admin account will be setup as a Super User and the password shall be set as directed by the MQU Property Support team. Vendors are to use separate user accounts as required.

1.3.3 Assignment of Vendor Users

Each Vendor requiring access to the BMS is to request the necessary user access via the MQU Property Support team. Vendors do not have permissions to assign their own users.

It is University policy that each individual user from the vendor has their own login credentials and utilises their assigned credentials when logged in at any time to the BMS. The ability to audit BMS activity is a compliance matter for the University.

The use of generic admin or vendor passwords is not permissible.

1.3.4 JACE Communications Passwords

The University has adopted a standard for JACE communications credentials, which is:-

Username:	JACEJACE
Password:	*Vendor to request password from MQU Property Support*

1.3.5 Controller Passwords

It is a requirement that there are no passwords for login to individual controllers.

1.3.6 Third party software Passwords

It is a requirement that admin passwords for login to any third-party software including programming and commissioning software be clearly documented and be part of the handover documentation. It is preferable that default passwords are kept to aid in standardisation.

1.4 Tridium Niagara N4 Version Standard

The current build for all Tridium Niagara N4 platforms accepted by the University is:-

Current installed build (minimum standard)	**Version**	4.10.xx

Any project works carried out involving existing JACEs that do not meet the minimum version requirements are to be upgraded at the cost of the vendor.

1.5 Tridium Niagara N4 Station Naming Convention

Each Tridium Niagara N4 Station at the University must be named to the following standard:

1. The first part of the name for each station will be a prefix of “BMS_”
2. The second part of the name will be the building code where the station is located:

BMS_12WW_	Eg 12 Wallys Walk
BMS_16MW_	Eg 16 Macquarie Walk

3. The third part of the name will have a prefix of “LVLxx_” (Level) followed by the floor the station is located on:

BMS_29WW_LVL05_	Eg 29 Wallys Walk, Level 5

4. The last part of the name will have a prefix of “Rm_” and will indicate the room number. All plantrooms have a room number assigned:

BMS_18WW_LVL05_Rm_413	Eg 18 Wallys Walk, Level 5, Room 413

Note: Single digit numbers are always preceded by a “0”

1.6 BACnet Device Instance Convention

Note: Automatic Device Instance numbering including Derived Network Addressing (DNA) is not to be used.

Each and every BACnet Device Instance must be unique and used in the following format. XXYYYY

XX = Building unique number identifier

YYY = Unique Device ID in the building

1.6.1 BACnet/IP Device or IP BACnet router

XXZYYY

XX represents the building number. Z represents the network number. YYY represents the last 3 digits of the IP address.

An example:-

- IP device 10.254.34.56 in building 12WW on network 2 would be addressed as 122056

1.6.2 MSTP Device

XXZYY

MSTP networks shall not have more than 99 devices on any one network.

XX represents the building number. Z represents the network number. YY represents the sequential order of the BACnet devices on a given network.

An example:-

- MSTP device 56 in building 12WW on network 3 would be addressed as 12356

1.6.3 Network Numbering

XXY

XX represents the building number.

Y represents the sequential order of networks. Separate JACEs within the same

building shall not have the same numbered networks.

An example:-

- MSTP network 4 on JACE 1 in building 12 would be numbered as 124
- IP network 6 on JACE 2 in building 12 would be numbered as 1

1.6.4 Network Performance

All serial network polling rates shall be set to the following default tuning policy:

1 second – fast

5 seconds – normal

30 seconds – slow

Serial networks shall be balanced, tuned and constructed to achieve a successful polling rate of no more than 1500ms per poll.

1.7 Controller Labelling

All equipment connected to the BMS must have a traffolyte or other strongly adhesive label mounted on the equipment clearly noting:

- Full device name
- IP/MSTP/RTU address
- The JACE name it is connected to

1.8 Controller Cabling

All cables to BMS controllers being IP/MSTP/RTU etc must have the origin and destination of the cable clearly written on a permanent heat shrink style label.

The Ethernet system must meet the latest MQU Communications Infrastructure Cabling Standard and match the current system installed onsite.

All solutions and test results for cabling systems are to be submitted and approved by the MQU IT before installation.

Patch leads are to be factory made.

All network switches are to be DIN rail mounted and hard wired for power. Each switch shall have at least 20% spare ports.

1.9 Station Organisation

1.9.1 Point naming conventions

- Point names shall be clear and if suitable use industry standard acronyms in capital letters. Point names shall not contain spaces, periods or dashes but underscores are to be used instead.
- To aid in maintaining a well organised database of points and objects, each Tridium Niagara N4 Station and Supervisor will be setup into structured folders as detailed below.

1.9.2 Device and Points Folders

- Under the driver object on the Tridium Niagara N4 Supervisor a device folder will be created for the building that the JACE(s) reside and the JACE(s) will be imported inside the folder. e.g. “26WW”.
- Under each JACE in the points system, the vendor is required to set up point’s folders for a logical hierarchy arrangement of devices e.g. Level_1, FCU_2 or Roof_Plant_Room, Chillers, AHU etc. See examples in the appendix of this standard.

1.9.3 Graphics Folders

- Under the config object on the Tridium Niagara N4 Supervisor a folder will be created using the building name code for the graphic folders to reside under (e.g. “26WW”).
- Under this folder, the vendor is required to set up additional folders for a logical hierarchy arrangement of graphics starting with Floor and Plant e.g. Building_A, Level_1, FCU_2 etc. Folders dedicated to Documentation, Alarms and Schedules shall also be created.

- These folders shall also be set up with relations and organized in the Hierarchy service to allow hierarchy creation for users.

1.9.4 Programming Folders

- In each JACE, a Programming folder shall be set up within a logical location in the device tree relevant to the programming. For example, Chilled Water System programming would be located within the sub-tree of the Chilled Water System. Level 1 programming would be located within the sub-tree of a “Level_01” sub-folder and then subsequent sub-folders if relevant. See examples in the appendix of this standard.

- Note: Base operational programming shall not reside in the JACE. Field controllers shall hold all programming necessary to operate a given item of plant or group of items in a unitary fashion (see section “Field Controls Protocol and Hardware” for physical hardware requirements for unitary operation). JACE level programming shall be limited to collecting and collating functions across a range of controllers and associated points for the purpose of establishing setpoints and the like, but shall not perform any primary operational functions such as PID loops, valve control, damper control, etc.

1.9.5 File Folders

- Under the px and Images folders, the vendor is required to set up folders in a logical hierarchy arrangement under the Building Number.

- PX includes shall be located separately from the px files they reside in, as well as common headers and other px includes that are combined for a user interface page.

1.9.6 History Folders

- Under the History object on the Tridium Niagara N4 Supervisor history groupings shall be set up by the vendor.

- Points with history extensions in each JACE shall utilize meta-tagging to organise histories into folders and sub-folders. History groupings shall be setup by the vendor to logically group histories. See examples in the appendix of this standard.

1.9.7 Schedules Folders

- Under the config object on the Tridium Niagara N4 Supervisor a folder will be created called Schedules for the Schedules to reside under.

1.10 Alarming

1.10.1 Alarm Priority

This document details the alarming standard of the University including alarm groups escalation and BACnet Event routing

Alarms must be set in the JACE controller. Field controller based alarms are not acceptable. The Alarms will then be sent through to the Supervisor in one of four alarm classes.

- Critical
- Maintenance
- Information
- Network Health

The "Default Alarm Class" is not to be used.

A table of alarms is required to be prepared and submitted by the vendor to the Property support team for acceptance and approval.

1.10.2 Alarm configuration

The alarm source and alarm text shall be configured in the following way to allow an MQU BMS user to easily identify the source and cause of the alarm.

The alarm source must contain Building, Location and specific plant identifier. For example:-

16MW_Level_3_AHU_02_Filter_Blocked

It is preferred to use the "offNormal" algorithm and not the "toFault" algorithm unless specifically called for.

The alarm text shall be populated with specific data about the plant in alarm. In most cases the "To offNormal" text shall contain information clearly identifying the condition of alarm and which part of the plant is affected. For example:-

16MW_Level_3_AHU_02 Filter Blocked status is active.

The "To Normal" text shall contain information clearly identifying the condition of alarm has returned to normal and which part of the plant was affected.

The Hyperlink ORD shall have the full address to the graphical page on the supervisor to allow the MQU Property Support team to check the relevant plant from the alarm page.

Additional alarming requirements may exist depending on individual project requirements as directed by the project specification and/or project management.

1.11 Schedules

All Schedules shall all reside on the Supervisor.

Each JACE shall synchronise the relevant schedules from the supervisor at 1 minute intervals via the Tridium Niagara N4 protocol. The Vendor may choose to export the schedule from the JACE via BACnet to the field devices for Optimum Start or internal programming etc., *a schedule residing on the field controllers is not permitted.*

A schedule register identifying schedule name, building, level, rooms and plant ID is to be supplied by the vendor to the MQU Property Team for approval.

1.12 History

Each JACE controller will be connected to the Tridium Niagara N4 Supervisor and all trend logs setup on the JACE shall be imported into the Tridium NiagaraN4 Supervisor via the Tridium Niagara N4 protocol.

The histories shall be automatically uploaded every one hour. The histories will be sorted using the history grouping service. Each history shall have the following tags: Building, and Plant Identifier. E.g. “12 Macquarie Walk AHU 02”

The tags shall be populated with metadata about the trend to group the histories into folders, for example; Building=Bld_AA Location=Level_4

All physical inputs and outputs must be trended as a minimum. All points must be trended in 15 minute intervals unless otherwise specified. The JACE shall hold up to 5000 samples at any given time.

No COV history extensions shall be used. Only interval histories are allowed.

1.13 Time Synchronisation

Each Tridium Niagara Station shall connect to the university NTP server to update the time on the platform.

The NTP server address is provided by IT.

The local clock sync to NTP and Use local clock as backup shall also be enabled.

1.14 Protocol Specification

The protocols acceptable at field level acceptable by The University are;-

1.14.1 System Level

Tridium Niagara N4 protocol

1.14.2 Field Level

- BACnet MSTP protocol
- BACnet IP protocol (preferred)

All new installations must communicate using BACnet IP, or BACnet MSTP. Wireless communications cannot be used for field controller communication. All JACE controllers shall operate as BACnet clients, no field controllers shall operate as BACnet clients.

ModBus is acceptable for power meters, VSDs and some items of plant that only offer ModBus interface. ModBus comms shall be connected to a JACE controller, no field controllers shall operate as ModBus masters.

LON is not acceptable.

No additions shall be made to existing LON systems. New controllers shall be BACnet.

1.15 Control Software specification

The only software accepted by the University for modification, setting up, commissioning, programming, editing, backing up or servicing any system controllers (ie JACEs and Niagara Supervisor) is Tridium Niagara N4 Workbench. Each vendor must provide the required modules for modification, setting up, commissioning, programming, editing, backing up or servicing the controllers and install the modules into Tridium Niagara N4 Workbench so that the BMS administration team can service the controllers from one central location. Any licencing for these modules must not require renewal and should be unrestricted for use by the BMS administration team.

Field controllers may only use the following engineering software for configuration and programming:

- CPT
- Honeywell Spyder Tool

Controllers that require third party tools other than those specified above to modify, setup, commission, program, edit, backup or service shall be deemed not acceptable

1.16 Backup specification

1.16.1 JACE Backups

Each JACE controller shall be automatically backed up from the Supervisor weekly. The JACE will be connected to the Supervisor Backup Service and setup to automatically backup daily at midnight by the vendor.

After any change has been made to a station a copy of the backup must be submitted to the MQU Property Support team. The backup file name shall be appended by the date in the flowing order YYYYMMDD

Example:-

- BMS_12WW_Lvl03_Rm02_20220916

1.16.2 Controller Backups

After any change has been made to a field controller a copy of the backup must be submitted to the MQU Property Support team. The backup file name shall be appended by the date in the flowing order YYYYMMDD

1.17 Documentation

Each project shall include the following documentation:

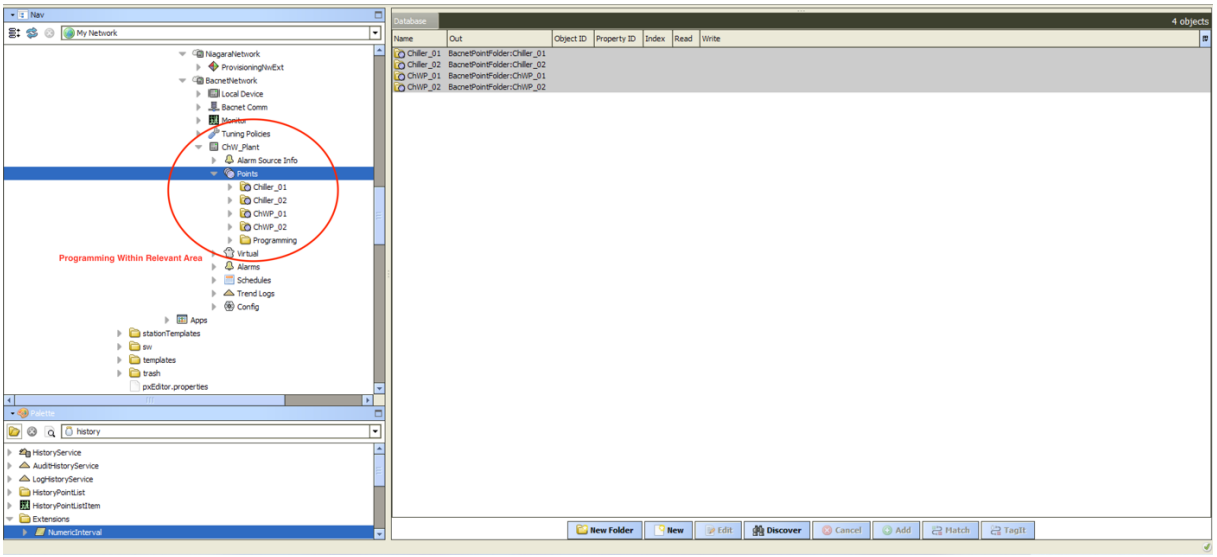
- A fully completed “as installed” points list stored as an editable excel file and a PDF on the server in the “documentation” folder (also see section 1.22 *Minimum Required Points* for detail of minimum required points).
- Printed and laminated points list for each controller located in a door mounted pocket of each BMS board containing the controllers listed. Editable copies of each (word, visio, etc) shall be stored on the server in the “documentation” folder (word, visio or similar).
- A full functional description in word and PDF format representing the “as installed” condition of the system.
- Manufacturers data sheets for all installed equipment.
- A full schematic representation of all networks, controllers and network components with

addressing, baud rate and physical location stored as a PDF and as an editable document (word, visio, etc) on the server in the “documentation” folder.

1.18 Standards for programming

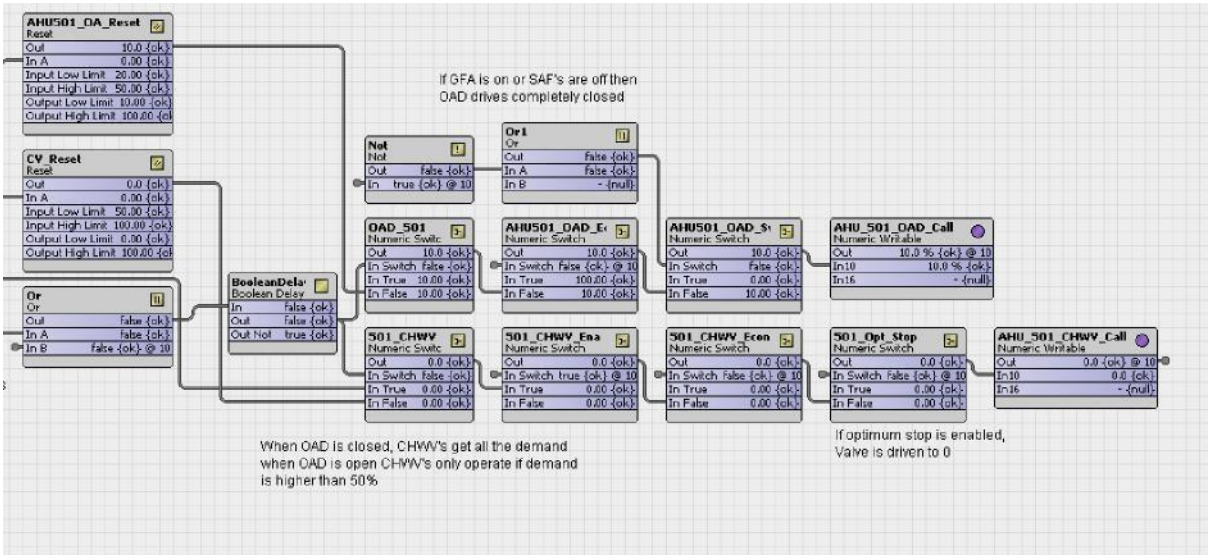
- Programs must be built in a common location, specifically a folder named ‘Programming’ under the relevant object. *No custom programming blocks shall be allowed.*

- In addition to being in a relevant location, programs are to be separated in to logical folders. For example: Boiler and Chiller programs should be in separate folders. Individual FCU, VAV etc programs should also be in separate folders under logical floor folders and room folders. The following is an example of a programming folder for a Chilled Water System:

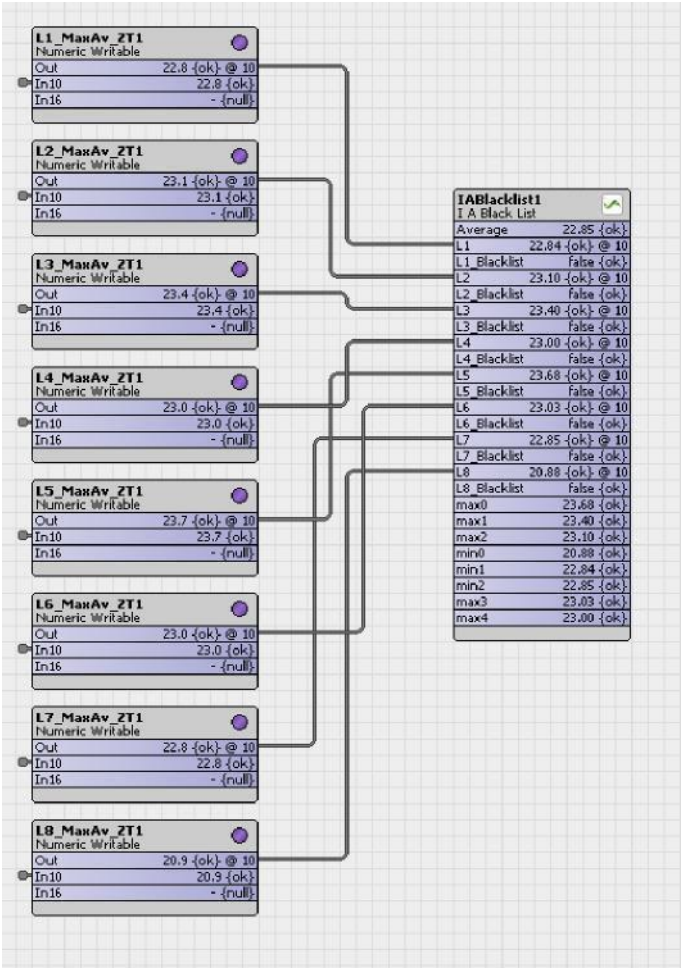


- Programs should flow in a logical progression and be easy to read. Where possible the program should read from left to right, with Inputs on the left, processes/logic in the middle and outputs on the right.

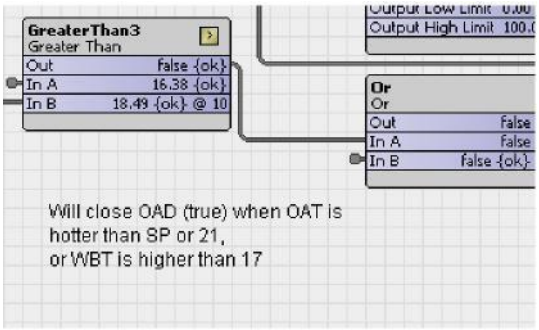
- Programs are to be neat and blocked out in an orderly fashion. Elements of the program are not to overlap and must have sufficient space to reduce link “knob” indicators. The elements should also be laid out in such a way to avoid links crossing over.



- Where practical, use “proxy variables” for data from other locations (Other programs, controllers, etc). Avoid linking points or variables from another folder or controller directly to logic blocks.



- Programs split between the JACE and controllers are to be avoided where possible. When a program is split between JACE and a controller, it must be failsafe e.g. if communication is lost between JACE and controller it must not result in danger or damage.
- Program variables should follow point naming conventions.
- Groups of code blocks should be commented when it is not obvious what they are for or how it works.



1.19 Graphics Formats

1.19.1 Slots

The Graphics pages reside on the Tridium Niagara N4 Supervisor for each building and are sorted as per the station organisation section.

All points shown on graphic pages must have the appropriate override capabilities and show clear instruction for that point IE overrides for a fan should be force on/force off rather than active/inactive.

Emergency override options are not to be displayed. The “set” option is to be applicable for

setpoints only.

Program points such as average room temp and SA temp setpoint are not to have an override option unless they are connected to common floor or building setpoint.

1.19.2 General Property graphics format

The graphics shall include the following Property standard graphics:-

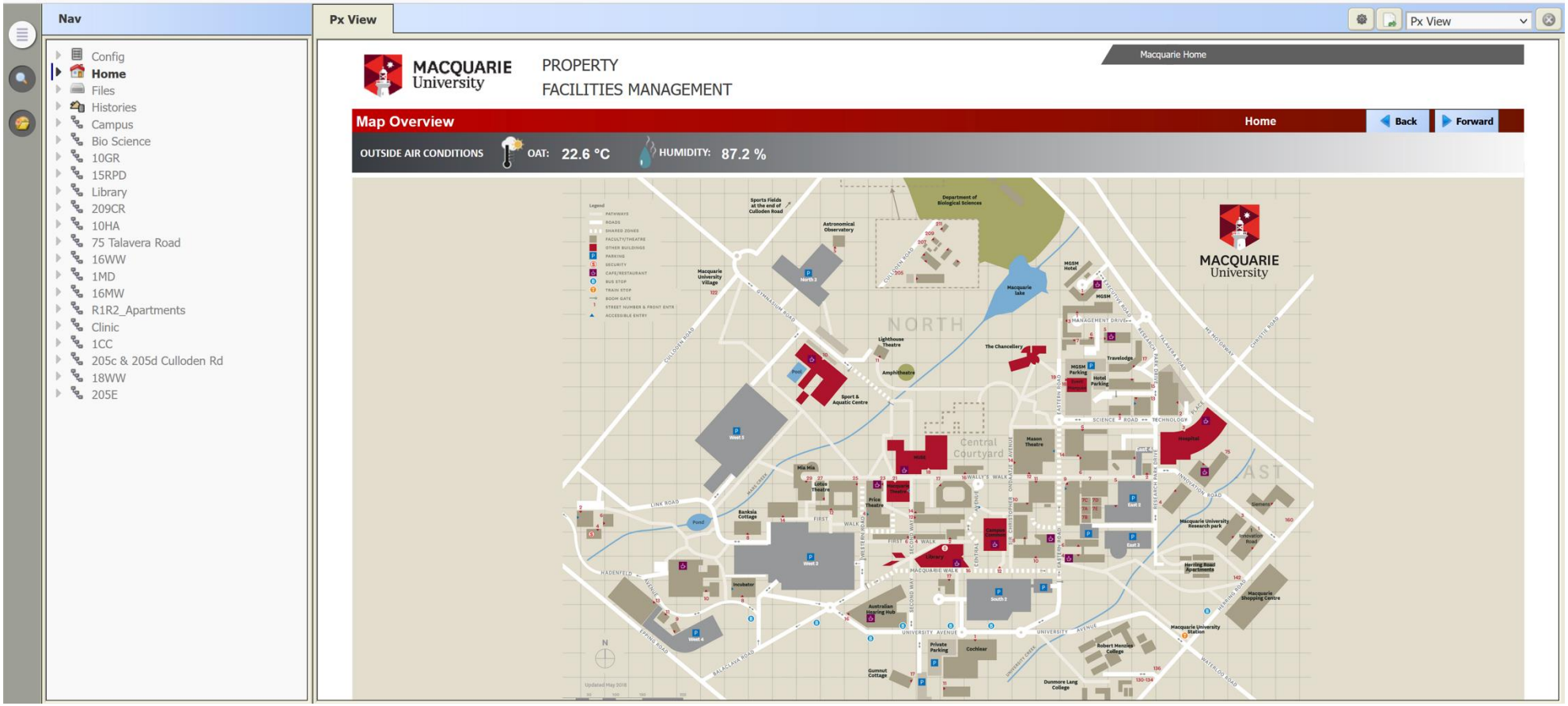
- MQU Welcome Page which consists of a campus map with selectable building hyperlinks that highlight when the building is selected. Once a user has arrived within a selected building, the user will then use the tree on the left to navigate as graphic pages are displayed on the right.
- Plant graphics with the following:
    - A table of AHUs.
    - A table of FCUs.
    - A separate graphic page for each AHU. Each AHU graphic must include all operational components (valves, dampers, duct heaters, fans, sensors, etc) and shall have a “mouse over” effect for all writable points.
    - FCUs may require separate graphic pages depending on complexity of operation.
    - A dedicated graphic page for each system of centralised plant, such as chilled water systems, heating water systems and dedicated condenser water systems that are not part of the chilled water system. All plant shall be shown on one page, with extended control points, field valves, and other related system points on separate tab. All writable points shall have a “mouse over” effect applied.
    - All graphic points shall have the “colour” function enabled to allow points to indicate status (overridden, offline, down, disabled, etc).
    - A dedicated tab with a history console and relevant significant data points populated on the opening console tab.
    - Each temperature, humidity and pressure data point on each graphic page shall have a popup history graph available from a mouse click at each location on the page.
    - All plant graphics shall represent the actual installed layout and operation of each depicted system.
- Floor Plan graphics with plant location, colour coding and selectable device hyperlinks.
    - Floor plan graphics are to be 2D and include plant and duct layouts and room numbers. Plant and duct layout drawings shall be high resolution with BMS control points overlaid in a logical manner.
- Pop ups are to be limited to only VAVs, schedules, small FCUs and history tables launched from a graphic link. Pop ups shall not include a banner, side bar or tabs.
- All graphic pages shall automatically adjust to different user screen ratios.

- All graphic pages shall be sized correctly so that no sliders are present on any page.
- A documentation page shall also be included that allows user viewing and download of relevant documentation (functional description, drawings, etc).
- An energy console (if relevant) shall be present with “dashboard” layout for viewing and extracting energy consumption data.
- A hierarchy shall be configured for user navigation for all buildings.

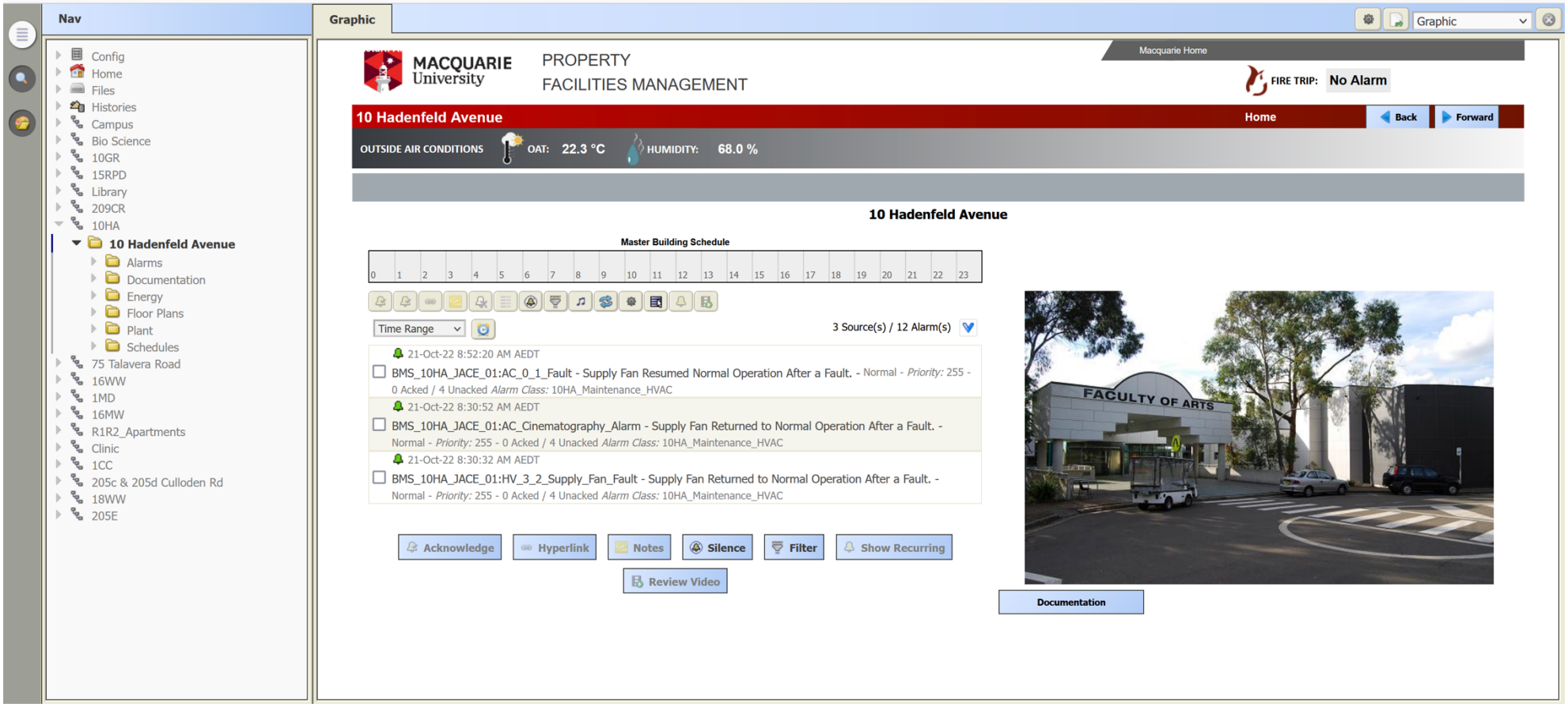
1.19.3 Property Graphics Format

The following examples illustrate the standard to be used for BMS graphics at the University. All colours and fonts (size/type) must be identical to the samples provided here. These provide examples and guidance only and are meant as a representative example of what is required.

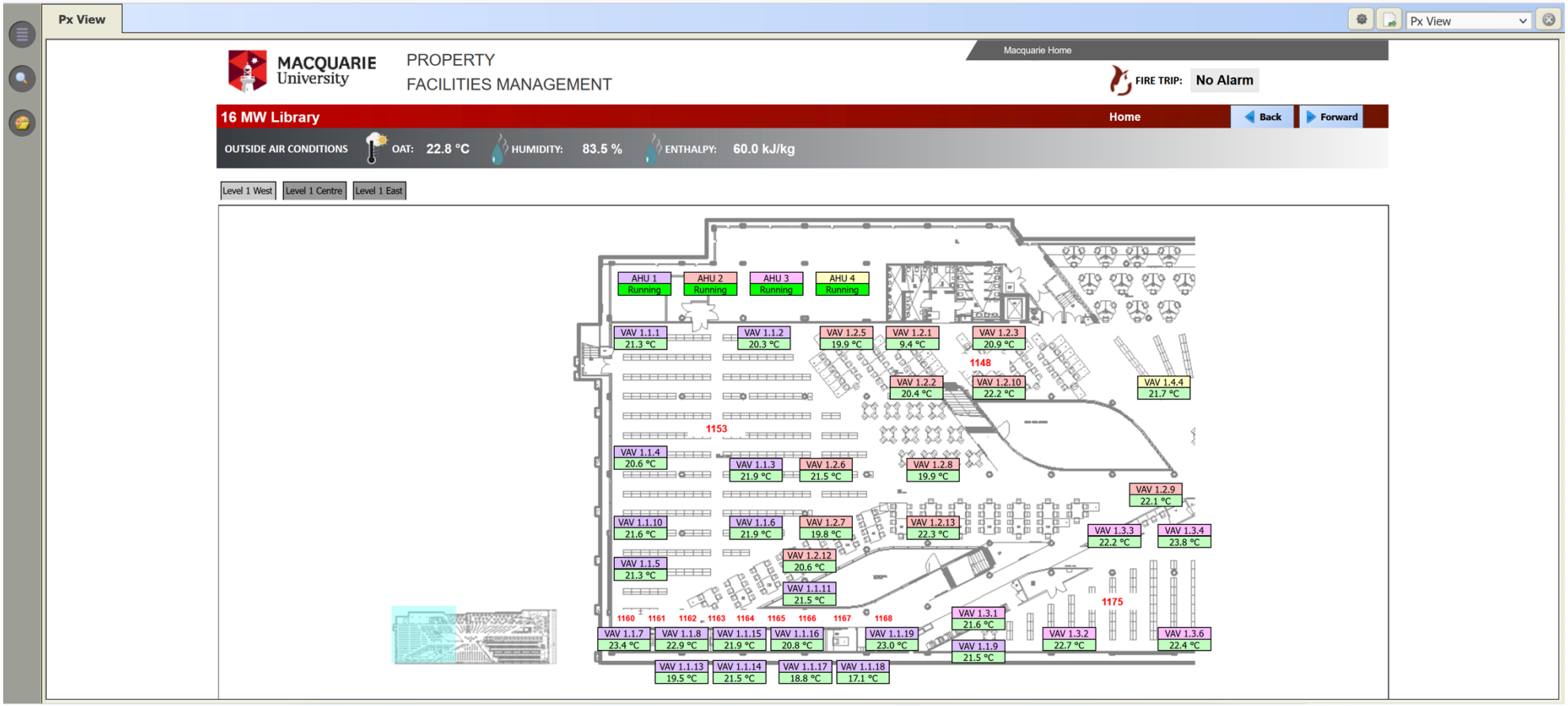
1.21.3.2 - Property Campus



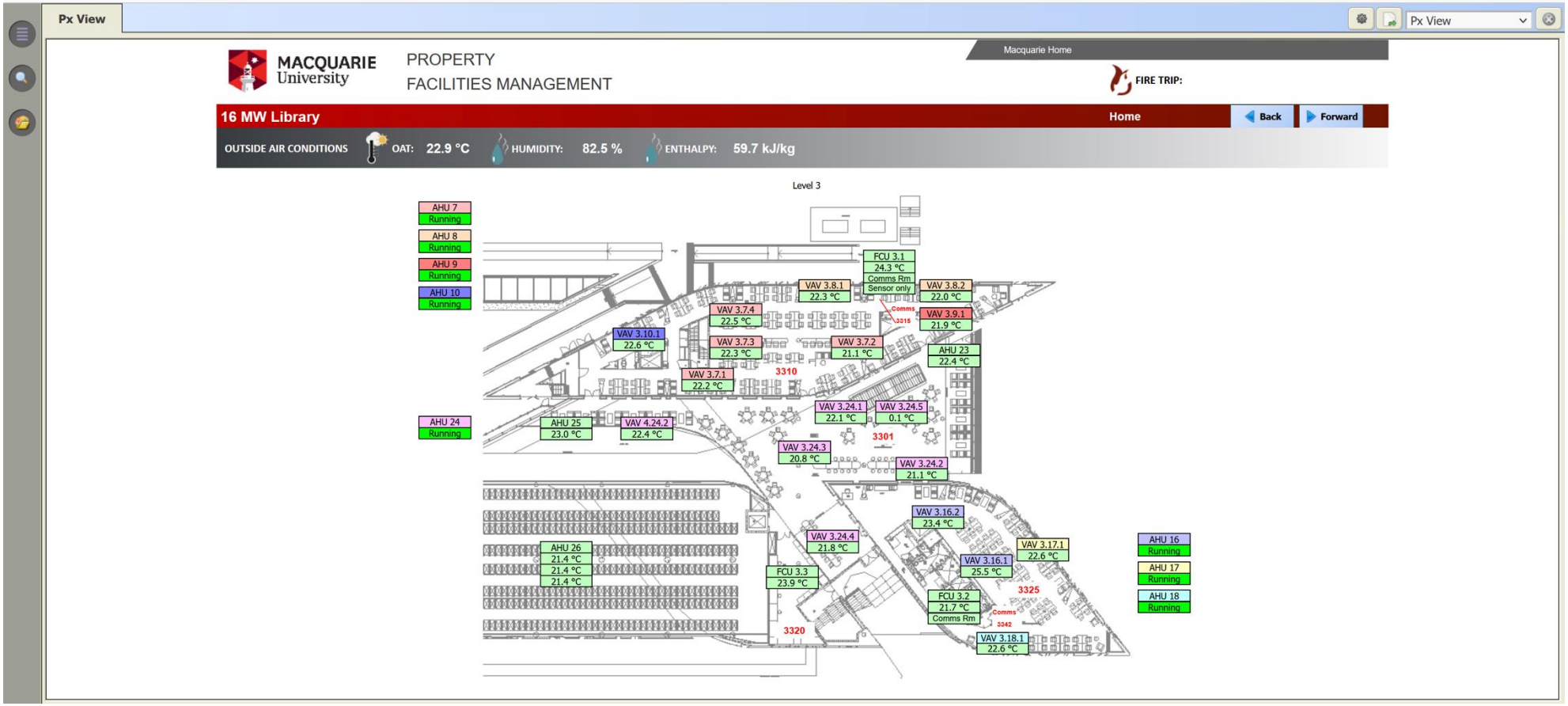
1.21.3.3 - Property Building



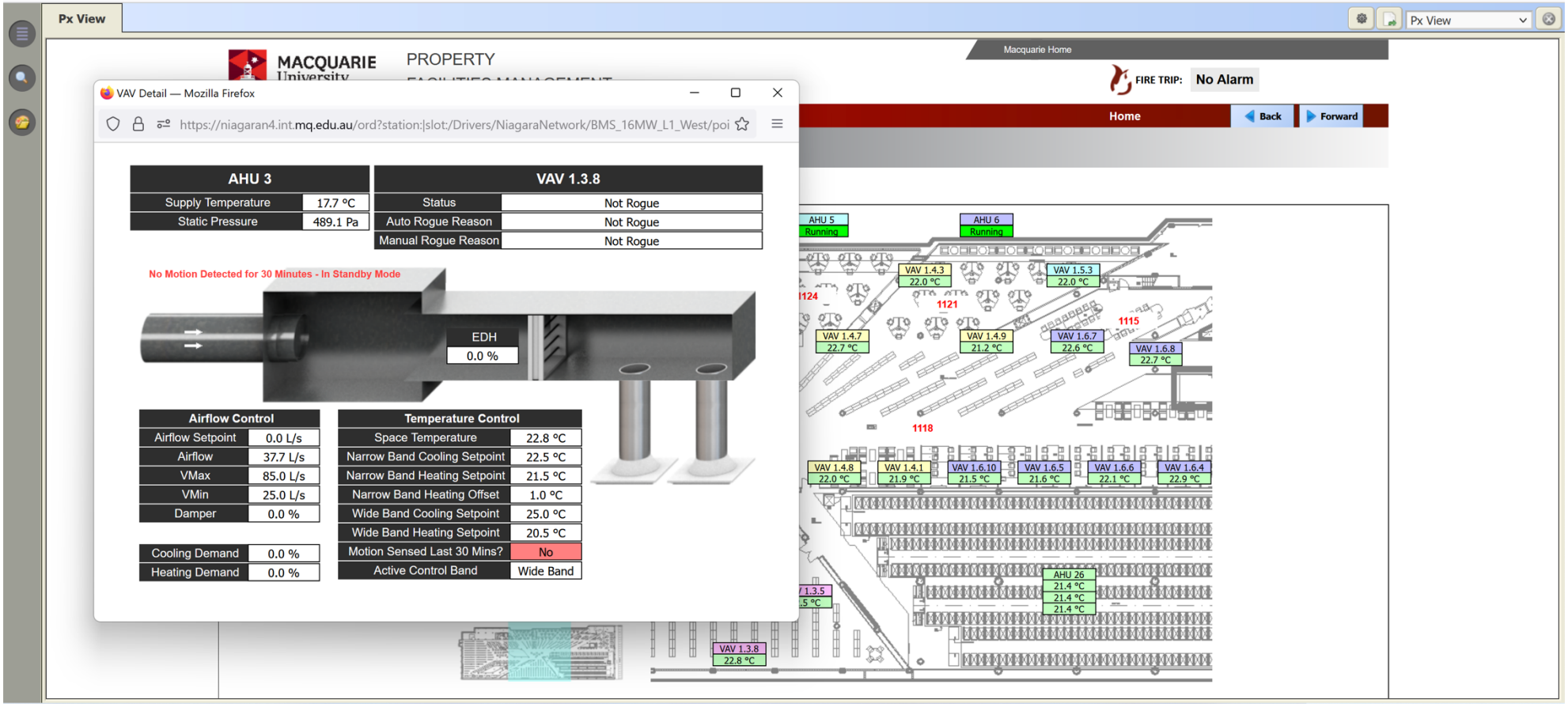
1.21.3.4 - Property Floor Pages



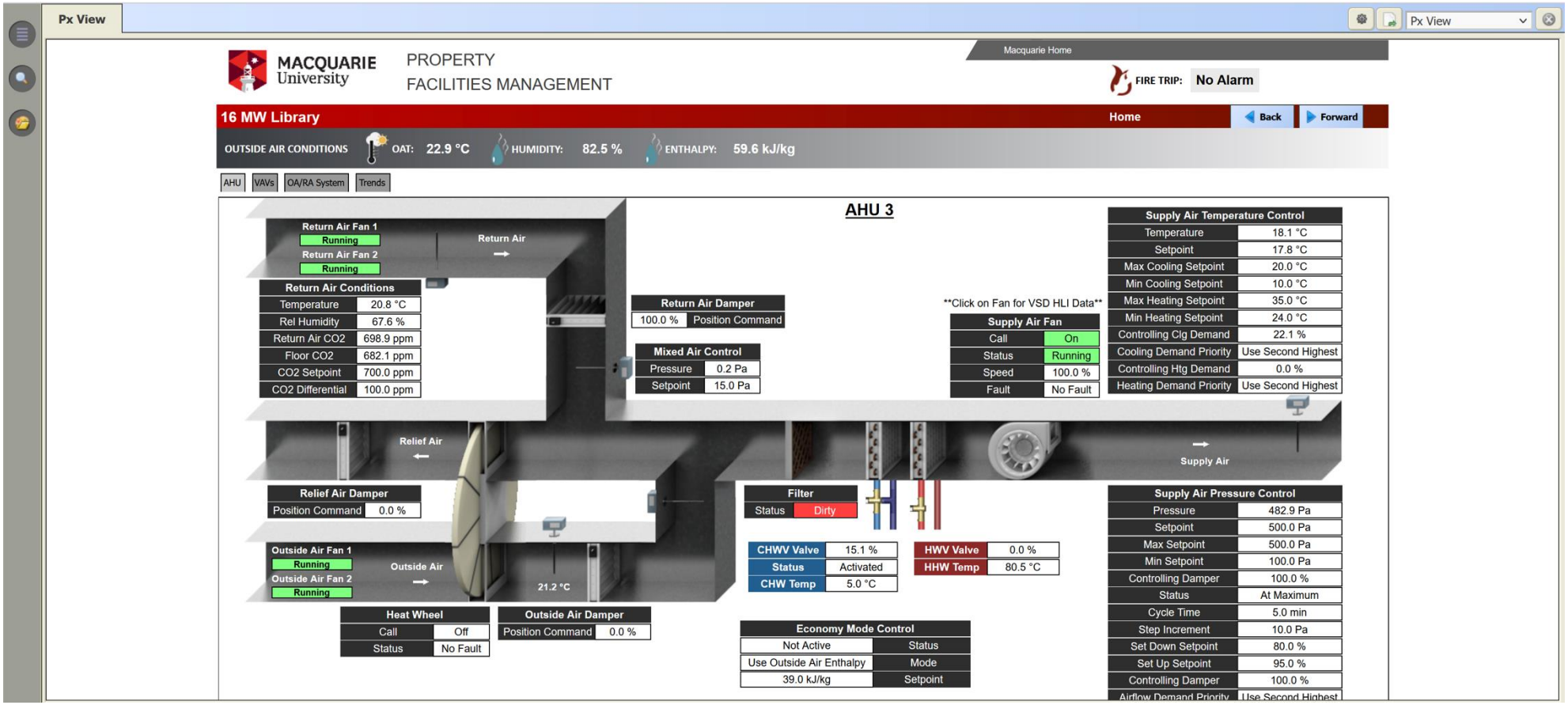
1.21.3.4 - Property Floor Pages



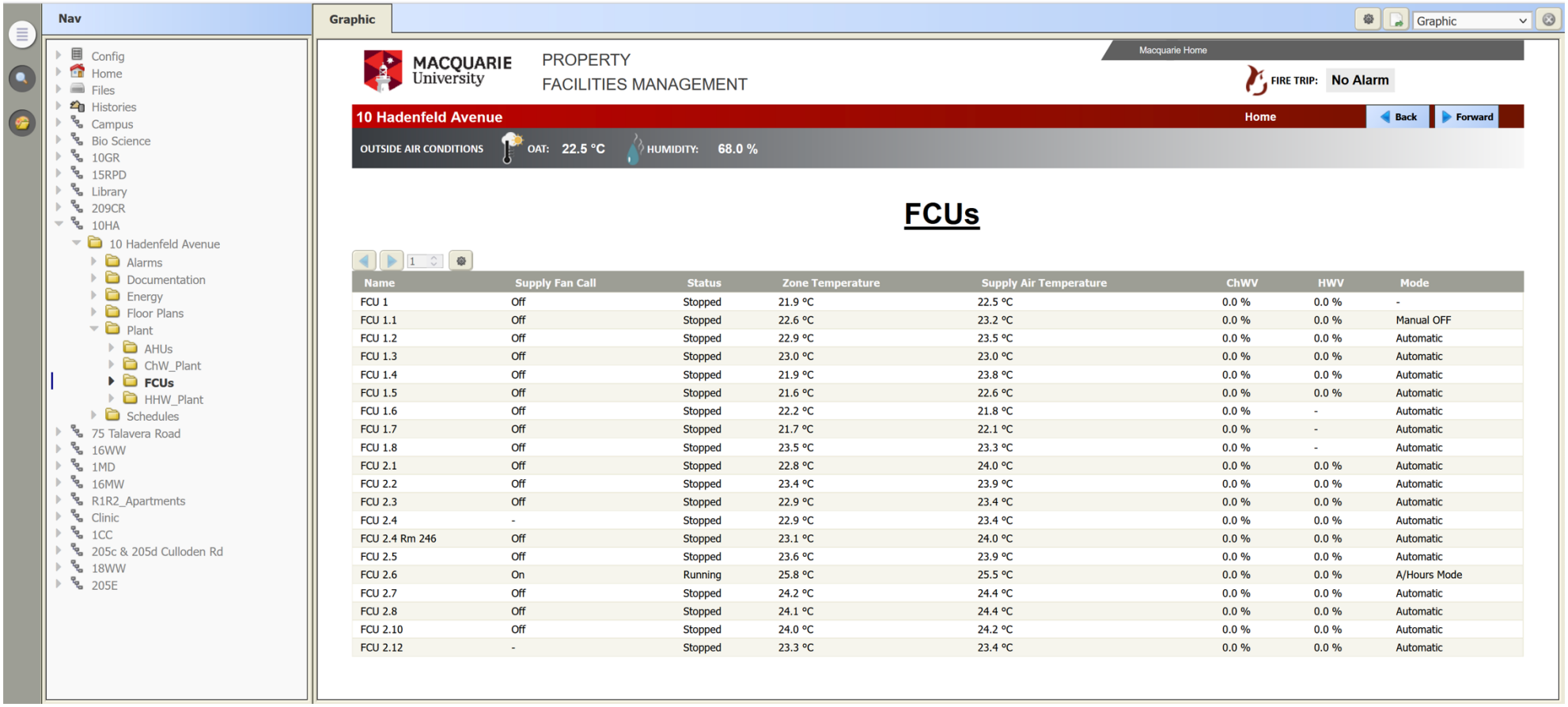
1.21.3.4 - Property Floor Pages



1.21.3.5 - BMS Systems Page: AHU – Example

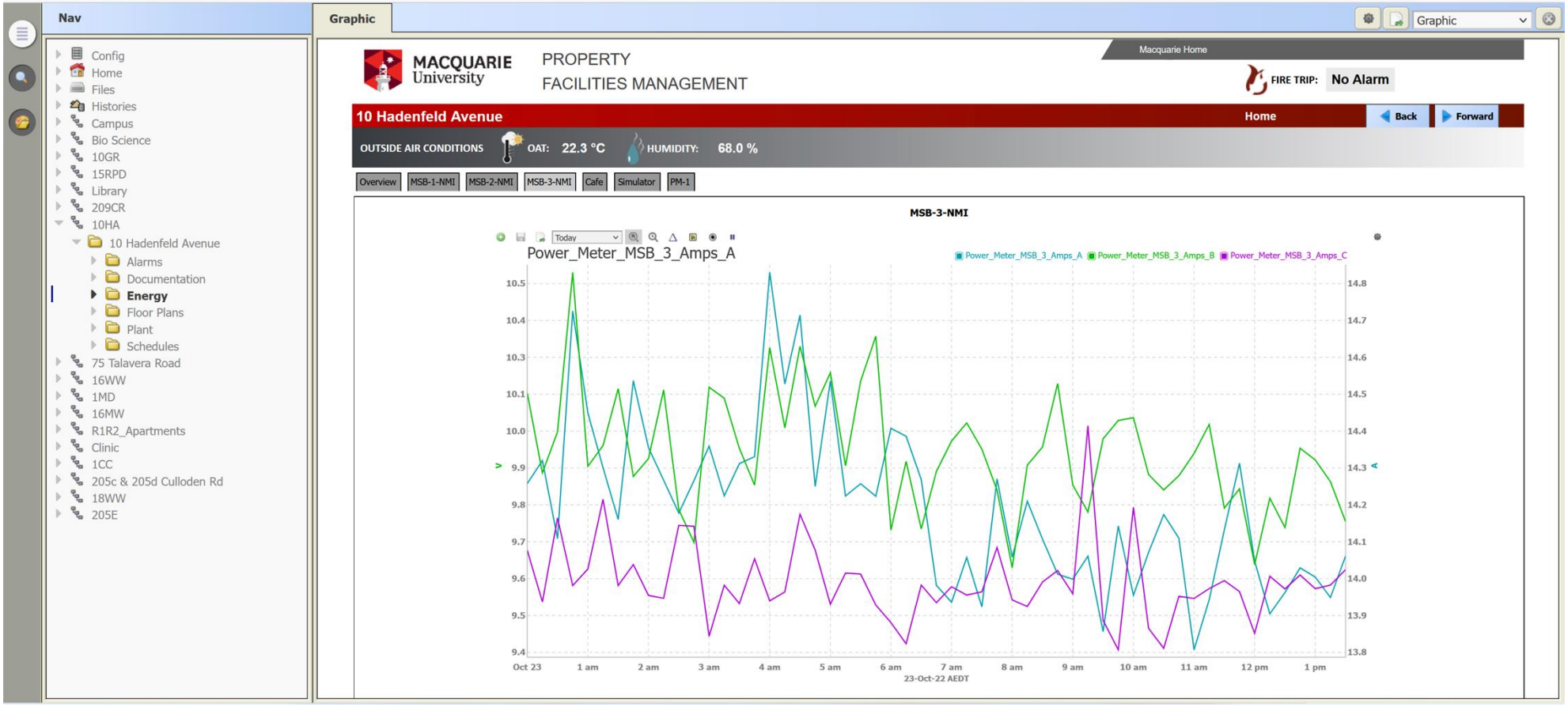


1.21.3.6 - BMS Systems Page: Table

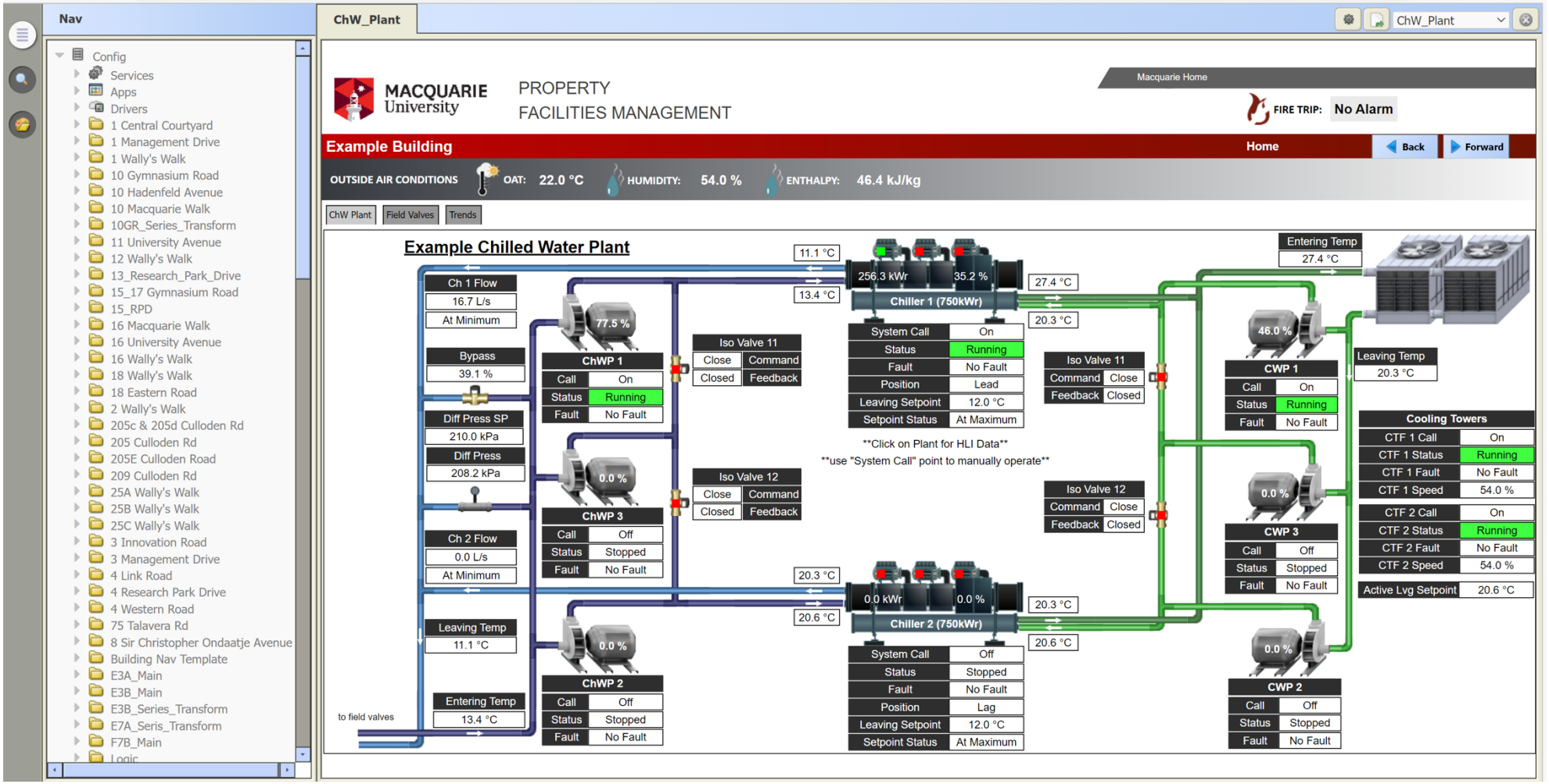


Name	Supply Fan Call	Status	Zone Temperature	Supply Air Temperature	ChWV	HWV	Mode
FCU 1	Off	Stopped	21.9 °C	22.5 °C	0.0 %	0.0 %	-
FCU 1.1	Off	Stopped	22.6 °C	23.2 °C	0.0 %	0.0 %	Manual OFF
FCU 1.2	Off	Stopped	22.9 °C	23.5 °C	0.0 %	0.0 %	Automatic
FCU 1.3	Off	Stopped	23.0 °C	23.0 °C	0.0 %	0.0 %	Automatic
FCU 1.4	Off	Stopped	21.9 °C	23.8 °C	0.0 %	0.0 %	Automatic
FCU 1.5	Off	Stopped	21.6 °C	22.6 °C	0.0 %	0.0 %	Automatic
FCU 1.6	Off	Stopped	22.2 °C	21.8 °C	0.0 %	-	Automatic
FCU 1.7	Off	Stopped	21.7 °C	22.1 °C	0.0 %	-	Automatic
FCU 1.8	Off	Stopped	23.5 °C	23.3 °C	0.0 %	-	Automatic
FCU 2.1	Off	Stopped	22.8 °C	24.0 °C	0.0 %	0.0 %	Automatic
FCU 2.2	Off	Stopped	23.4 °C	23.9 °C	0.0 %	0.0 %	Automatic
FCU 2.3	Off	Stopped	22.9 °C	23.4 °C	0.0 %	0.0 %	Automatic
FCU 2.4	-	Stopped	22.9 °C	23.4 °C	0.0 %	0.0 %	Automatic
FCU 2.4 Rm 246	Off	Stopped	23.1 °C	24.0 °C	0.0 %	0.0 %	Automatic
FCU 2.5	Off	Stopped	23.6 °C	23.9 °C	0.0 %	0.0 %	Automatic
FCU 2.6	On	Running	25.8 °C	25.5 °C	0.0 %	0.0 %	A/Hours Mode
FCU 2.7	Off	Stopped	24.2 °C	24.4 °C	0.0 %	0.0 %	Automatic
FCU 2.8	Off	Stopped	24.1 °C	24.4 °C	0.0 %	0.0 %	Automatic
FCU 2.10	Off	Stopped	24.0 °C	24.2 °C	0.0 %	0.0 %	Automatic
FCU 2.12	-	Stopped	23.3 °C	23.4 °C	0.0 %	0.0 %	Automatic

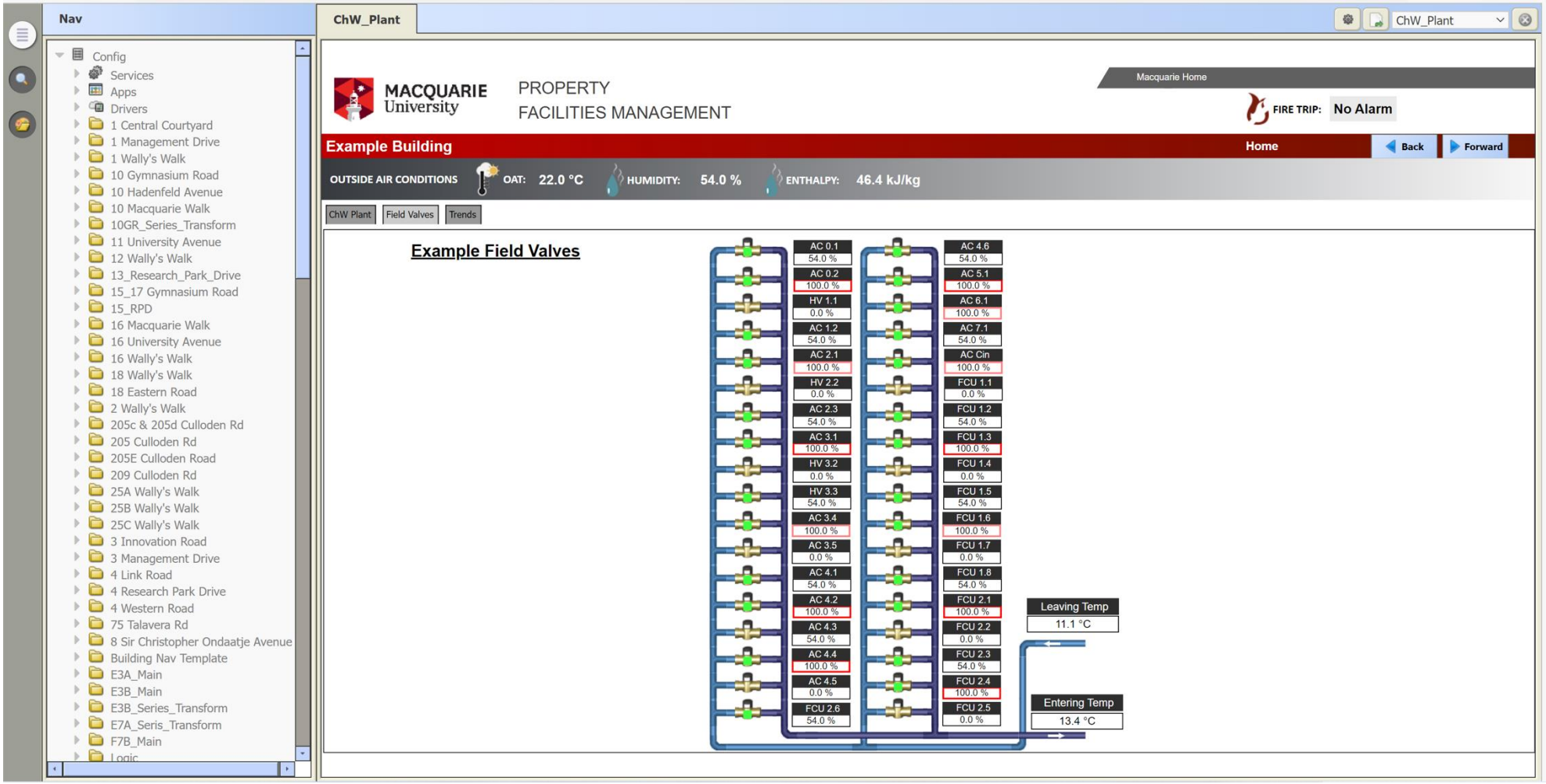
1.21.3.7 - BMS Systems Page: History Console with Trend Logs



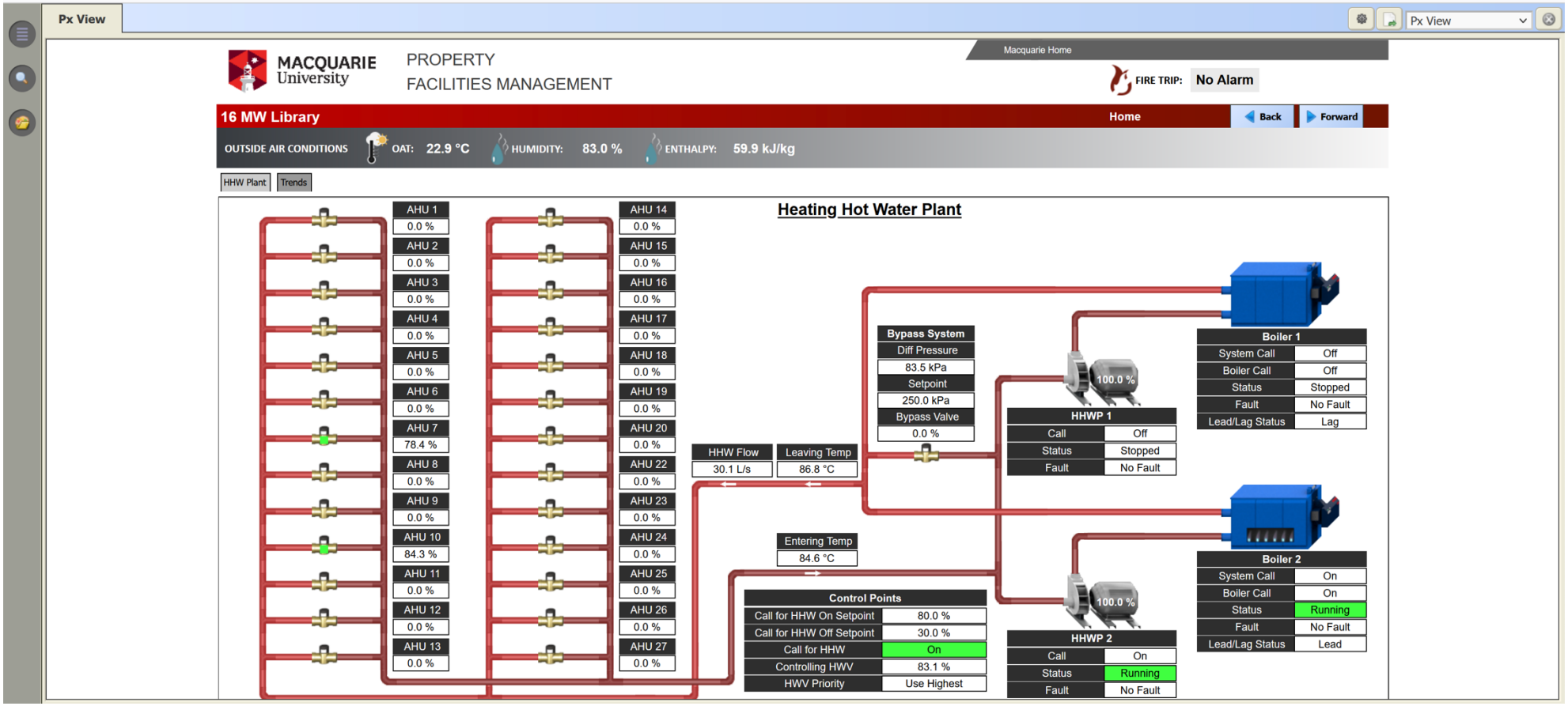
1.21.3.8 - BMS Systems Page: CHW System



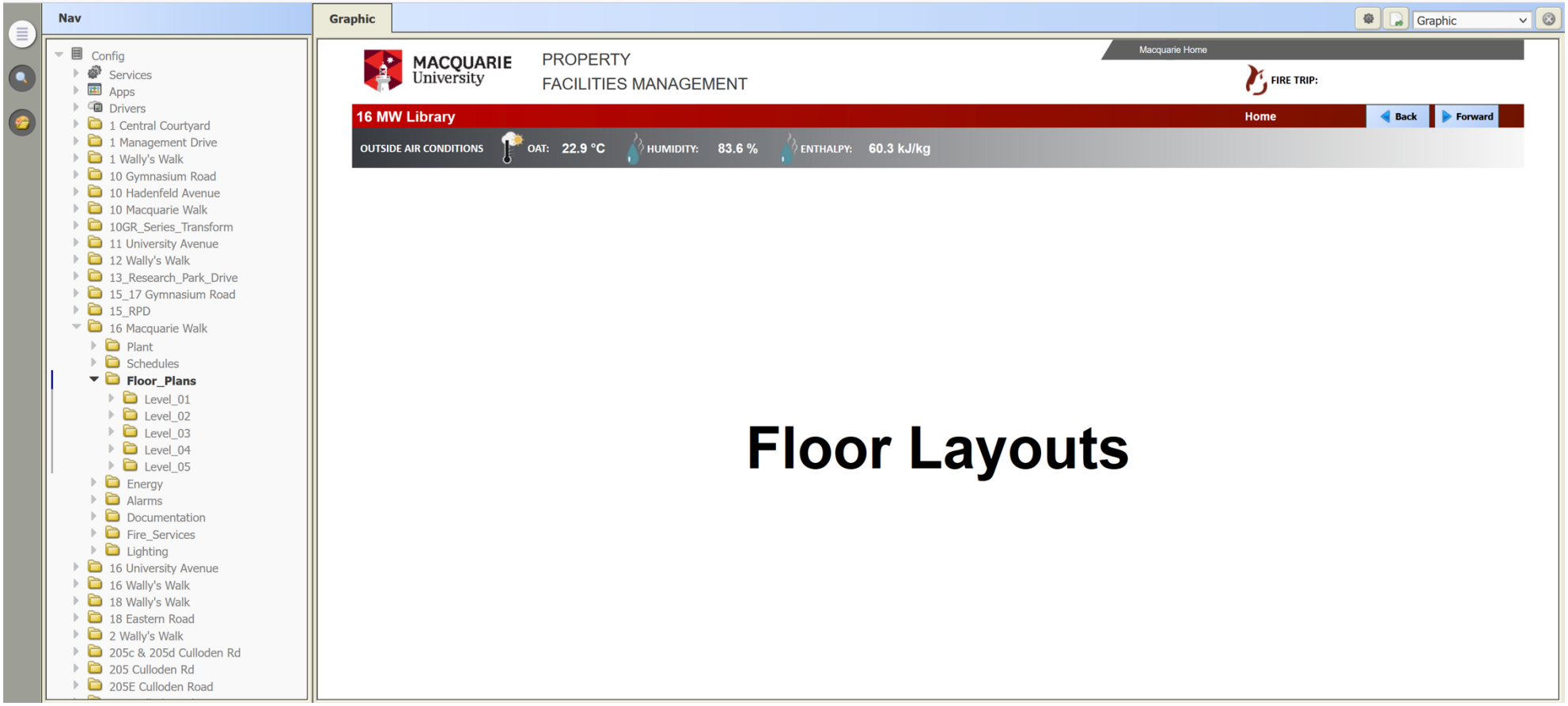
1.21.3.9- BMS Systems Page: CHW System



1.21.3.10- BMS Systems Page: HHW Plant



1.21.3.11- BMS Systems Page: Page Separator



1.22. Minimum Required Points

The following tables illustrate the minimum required points for the listed item of plant. Additional points may also be necessary for individual project requirements, however these points represent the minimum acceptable points.

VAV

Point Name	AI	BI	AO	BO	AV	BV
Occupied Mode						R/W
Space Temp	R					
Supply Temp (from VAV)	R					
CO2*	R					
Space RH*						
Damper				R/W		
Air Flow	R					
Air Flow Setpoint					R/W	
Heating Airflow SP					R/W	
Mode					R/W	
EDH*				R/W		
EDH Safety Trip Fault*		R				
HWV*					R/W	

*May not be present in all situations depending on design

Chilled Beams

Point Name	AI	BI	AO	BO	AV	BV
Occupied Mode						R/W
Space Temp	R					
Space RH	R					
ChWV			R/W			

FCU

All FCUs with HLI interface available shall be connected to the BMS and relevant points shall be monitored via HLI in addition to the low level points shown below.

Point Name	AI	BI	AO	BO	AV	BV
Occupied Mode						R/W
Start/Stop^				R/W		
Status (CT Relay)		R				
Space Temp	R					
Space Setpoint					R/W	
Supply Temp	R					
Return Temp	R					
Filter Condition (pd)	R					
Heating Valve*			R/W			
Cooling Valve			R/W			
EDH*				R/W		
EDH Safety Trip Fault*		R				

*May not be present in all situations
^EC Fans shall maintain power at all times and switch 0-10v speed signal via start relay

AHU (Variable Volume)

Point Name	AI	BI	AO	BO	AV	BV
Occupied Mode						R/W
Start/Stop^				R/W		
Status**		R				
Supply Press SP					R/W	
Supply Air Pressure	R					
Supply Fan Speed			R/W			
Supply Temp Setpoint					R/W	
Supply Temp	R					
Supply Air RH***						
Return Air Temp	R					
Return Air RH***	R					
Outside Air Damper			R/W			
Return Air Damper			R/W			
Min OA Damper*				R/W		
Filter Condition (pd)	R				R	
Heating Valve*			R/W			
Cooling Valve			R/W			

*****May not be present in all situations
**Fan status via CT in MSSB or relay output from VSD
***Only if RH control is present
^EC Fans shall maintain power at all times and switch 0-10v speed signal via start relay

AHU (Constant Volume)

Point Name	AI	BI	AO	BO	AV	BV
Occupied Mode						R/W
Start/Stop^				R/W		
Status**		R				
Supply Temp Setpoint					R/W	
Supply Temp	R					
Supply Air RH***	R					
Space Temp	R					
Return Air Temp	R					
Return Air RH***	R					
Outside Air Damper			R/W			
Return Air Damper			R/W			
Min OA Damper				R/W		
Filter Condition (dp)	R				R	
Heating Valve*			R/W			
Cooling Valve			R/W			

*****May not be present in all situations
**Fan status via CT in MSSB or relay output from VSD
***Only if RH control is present
^EC Fans shall maintain power at all times and switch 0-10v speed signal via start relay

Chilled Water System

Chiller data must be delivered directly from the Chiller controller via BACnet (no gateways). BACnet HLI interface shall be provided with all chillers.

All control must be via low level connections (no HLI control), monitoring is allowed via HLI. If pumps are controlled directly by a chiller, the signal shall pass through the chilled water system DDC controller to allow overrides via the BMS.

DP and temperature sensors are to be supplied together with HLI data.

Point Name	AI	BI	AO	BO	AV	BV
Cooling Call						R/W
ChW Entering Temp	R					
ChW Leaving Temp	R					
CW Leaving Temp	R					
CW Entering Temp	R					
Amps	R^^					
COP	R				Alt. Calc	
Load kWh	R^^		R/W			
ChW Setpoint			R/W			
Evap refrig Press	R^^					
Evap refrig temp	R^^					
Cond refrig Press	R^^					
Cond refrig temp	R^^					
Comp Disch refrig temp	R^^					
Oil Temp	R^^					
Oil press	R^^					
CW Water Flow Status		R				
ChW Flow Status		R				
ChW Flow (if Magflow)	R					
Chiller Operating Status		R				
Chiller Alarm		R				
Chiller Start/Stop				R/W		
ChW Pump Start				R/W		
ChW Pump Status**		R				
ChW Pump Fault		R				
ChW Pump Speed			R/W			
ChW Supply Temp (S)	R					
ChW Return Temp (S)	R					
CW Pump Start				R/W		
CW Pump Status**		R				
CW Pump Speed			R/W			
CW Supply Temp (S)	R					
CW Return Temp (S)	R					
CT Fan Start				R/W		
CT Fan Status		R				
CT Fan speed			R/W			
Evaporator DP (S)	R					
Condenser DP (S)	R					

**Pump status via CT in MSSB or relay output from VSD
^^May be via HLI only if available

Heating Hot Water System

If HLI is available, all boilers shall be interfaced via BACnet (or ModBus if BACnet is not available from the manufacturer)

All control must be via low level connections (no HLI control), monitoring is allowed via HLI. If pumps are controlled directly by a boiler, the signal shall pass through the heating hot water system DDC controller to allow overrides via the BMS.

Point Name	AI	BI	AO	BO	AV	BV
Heating Call						R/W
HW Entering Temp	R					
HW Leaving Temp	R					
HW Water Flow Status		R				
Boiler Start				R/W		
Boiler Status		R				
Boiler Fault		R				
HHW Flow (If Magflow)	R					
HHWP Start/Stop				R/W		
HHWP Status**		R				
HHWP Fault		R				
HHWP Speed			R/W			

**Pump status via CT in MSSB or relay output from VSD

Ambient Air Conditions (Local Building)

Point Name	AI	BI	AO	BO	AV	BV
Ambient Temperature	R					
Ambient Humidity	R					
Absolute Humidity*	R				R	
Solar energy sensor*	R					

*****May not be present in all situations

Weather Station (Provide only if required by project design)

The system will receive global variables from the local weather station.

Point Name	AI	BI	AO	BO	AV	BV
Ambient Temperature	R					
Ambient Humidity	R					
Wind Speed	R					
Wind Direction	R					
Cloud Cover	R					
Dew Point	R					
Rain Condition	R					
Temp prediction Day+1	R					
Temp prediction Day+2	R					
Temp prediction Day+3	R					
Temp prediction Day+4	R					
Temp prediction Day+5	R					
Barometric Pressure	R					

Variable Speed Drive

Must be interfaced via BACnet or Modbus. The following tables indicates the minimum points required.

All control shall be via low level inputs (no HLI), monitoring may be by HLI only.

Point Name	AI	BI	AO	BO	AV	BV
VSD Status		R				
VSD Fault status		R				
Speed (%)			R/W			
Output Power	R					
VSD Start/Stop				R/W		
VSD setpoint						R/W
Controlled Input	R					

Hydraulic and Lift Services/Misc Services

This is not a complete list but an example only. If an item of building plant or equipment is present and has capability of interface, it shall be connected.

Point Name	AI	BI	AO	BO	AV	BV
Booster Pump Fail		R				
Booster Pump low press		R				
Hot Water Pump Start				R/W		
Hot Water Pump Status		R				
LMR Hi Temp		R				
Sump Pump Status		R				
Sump Pump Fault		R				
Tank Low Level		R				
Tank Extra Low Level		R				
Tank High Level		R				
Supply Pressure	R					
Compressed Air Fault		R				

Power Meters

All points listed may not be present depending on design.

Electrical Points	AI	BI	AO	BO	AV	BV
Circuit Breaker Status		R				
Circuit Breaker Trip		R				
Phase Fail		R				
Room Temp	R					
Mains Fail		R				
CRAC Status		R				
CRAC Temp	R					
CRAC Fault		R				
CRAC Force Start				R/W		

Generator Status		R				
Generator Run		R				
Generator Start				R/W		
Generator Fault		R				
Generator Fuel Low		R				
Battery Charger Fault		R				
3ph Volts	R					
Current – A phase	R					
Current – B phase	R					
Current – C phase	R					
3ph kW	R					
3ph kWr	R					
3ph kVA	R					
Power Factor	R					
Frequency	R					

1.24. EMS Graphics Format

The following diagrams illustrate the standard to be used for EMS graphics at the University.

All colours and fonts (size/type) must be identical to the samples provided here.

--TBA--

--TBA--

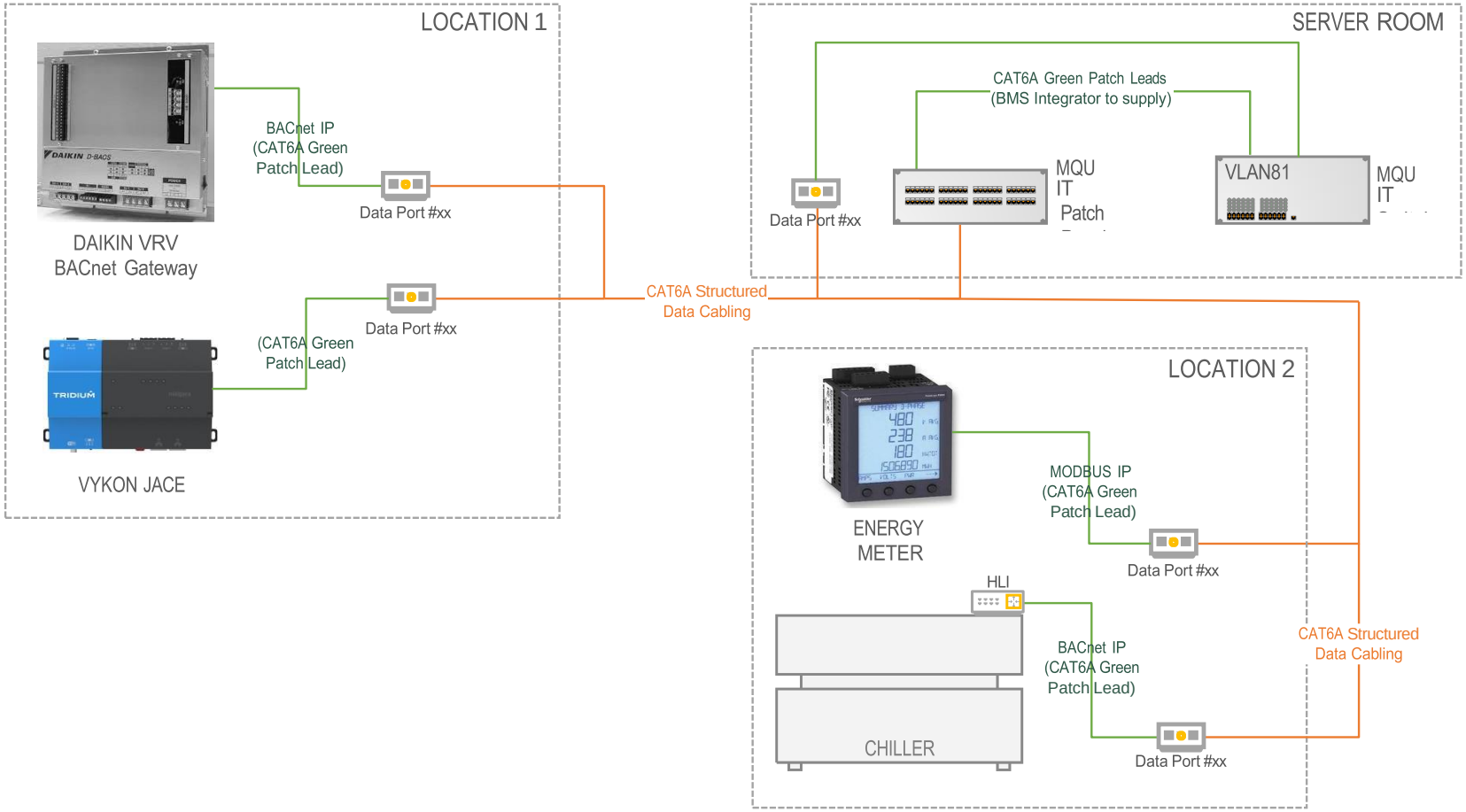
1.25. HLI Device to Property Connection

The following table describes the steps required to be completed by each party when connecting an approved HLI Device to the Property (VLAN81).

Note: IP addresses will not be released until the network connection register is completed as per the MQU specification.

HLI (Device) Connection Responsibility Table

No.	Task or Item	Responsibility
1.	Data communications and cabling infrastructure	The BMS Integrator is responsible for the data communications from the HLI Device to the JACE (either direct connection or via the WAN). The BMS Integrator will liaise with 3rd party cable installers (where applicable) to ensure the physical communications link is in place and commissioned. • NOTE: Installation of LAN infrastructure must be in accordance with MQU IT requirements. Property Support can provide a copy of the MQU Structured Cabling Guide.
2.	Identify HLI Device/s to be connected to the Property	The BMS Integrator is responsible for identifying and documenting the communications connection between the HLI (Device) and the Property (VLAN81). The HLI Device may be a JACE, energy meter, FIP, Chiller HLI, or VSD, or other device that meets the BMS Technical Standard. The BMS Integrator shall provide Property Support with the following:- • Details of the HLI devices, connection points, and their locations as per the MQU Network Connection Register provided by Property Support. • A network schematic within the As-Built documents.
3.	Issue HLI IP addresses	Once a completed Network Connection Register is submitted to Property Support, the assigned IP addresses will be provided by Property Support via the BMS Integrator to the HLI Installer.
4.	Prepare HLI Mapped Points Table	The BMS Integrator will prepare a HLI Mapped Points Table and provide a copy to the HLI Installer and Property Support. A copy of this will be included in the BMS Integrator's As-Built documents.
5.	Connection of the HLI Device to the LAN and MQU IT ping. LAN Port assignment.	The BMS Integrator is to confirm to Property Support once the communications link to the HLI is completed, the IP address set and the HLI is enabled. Property Support will coordinate the final WAN connections with MQU IT. • MQU IT will ping the HLI device to confirm the correct IP address has been assigned • MQU IT will then finalise the patch cable connections to the switch and enable a port for VLAN81. • Once completed, Property Support will confirm the connection with the BMS Integrator.
6.	Programming and configuration of the HLI Device	Programming and configuration of the HLI Device will be conducted by the HLI Installer in coordination with the BMS Integrator utilising the HLI Mapped Points Table. The HLI Installer will assign the IP Addresses as provided by the BMS Integrator.
7.	Commissioning of the HLI Device to the Property	Conducted by the BMS Integrator in coordination with the HLI Installer. The BMS Integrator has final commissioning responsibility of the HLI Device's output to the Property



NETWORK CONNECTION REGISTER - VLAN81													
DEVICE LOCATION					DEVICE DETAILS					MQU SWITCH DETAILS			
Tag	Building	Level	Room Number	Outlet Number	Device Type	Host Id	IP Address	MAC Address	BacNET Address	Level	Room Number	ID - Switch IP	Switch Port
NET1	12WW	2	Comms Room 2.65A	2.1-2-209	BMS Controller	TBA	192.168.11.8	-	-	2	Comms Room 2.65A	10.42.1.194	41
NET2	12WW	6	Comms Room 6.65A	6.1-6-067	BMS Controller	TBA	192.168.11.9	-	-	6	Comms Room 6.65A	10.42.1.212	48

1. MQU Building Number Identification Table

Old Building Reference	New Building Reference	Address	Commercial Building	Building Name / Description
1 University Ave	1UA	1 University Ave	Yes	Cochlear Building
105 Delhi Rd		105 Delhi Road North Ryde		
112 Talavera	n/a	Unit 13, 112-119 Talavera Rd	Yes	
123PITT	123PS	L23-24 Angel Place	Yes	
12MW	n/a	12 Macquarie Walk	Yes	Campus Common Temporary Food Hub
13HA	n/a	13 Hadenfeld Ave		(Demountable) Y2 (previously carpark)
156 Talavera		156 Talavera Rd		Geology Garage
160Herring	160HR	L2-160 Herring Rd	Yes	Siemens Building
18 Eastern Rd	18ER	18 Eastern Rd		Marquee
1INNVRD	1IR	1 Innovation Rd		
2 Wally's Walk	2WW	2Wally's Walk		CBMS Building
205B Culloden Rd	205BCR	205B Culloden Rd		Bio Facility/Bio Science Building (next to W19F)
299 Lane Cove Rd	299 Lane Cove Rd	299 Lane Cove Rd	Yes	ABBOTT Building
44 Waterloo Rd	44W	44 Waterloo Road	Leased	Science Building
68 Waterloo Rd	68WR	68 Waterloo Rd	Yes	Warehouse
75Talavera Rd	75TR	75 Talavera Rd	Yes Blended	Luxotica Bldg-Faculty of Medicine & Health Services
BD	4RPD	4 Research Park Drive	Yes Blended	BD Building
Trafalgar Square	Trafalgar Square	Trafalgar Shopping Village	Yes	
W6 A,B,C	25WW	25 Wally's Walk A,B,C		Arts Precinct
C9A, C10A	1CC	1 Central Courtyard		Campus Hub Campus Life Facilities (Demolished)
C1A	17MW	17 Macquarie Walk		(Projects-HV Enablement)
C3A	4FW	4 First Walk		
C3B	2FW	2 First Walk		
C3C	16MW	16 Macquarie Walk		Library
C5A	12SW	12 Second Way		
C5B	14SW	14 Second Way		
C5C	17WW	17 Wally's Walk		Law School (future)
C7A	18WW	18 Wally's Walk		MUSE
C8A	16WW	16 Wally's Walk		Lincoln Building
C9A	1CC	1 Central Courtyard		Campus Hub (Demolished)
CHI-EAS	n/a	24/1 Lakeside Rd-Eastwood		Centre for Chiropractic Macquarie University
CHI-SHILL	n/a	40 Lackey St-Summer Hill		Macquarie University Summer Hill Outpatient Clinic & Research Centre
COGEN	n/a	18 Wally's Walk		Generator at MUSE
DAYMAN	n/a	7 Dayman Place Marsfield	University Managed	Dayman Apartments (Student Accommodation)
E11A	19ER	19 Eastern Road		Chancellery
E12A	5MD	5 Management Drive		MGSM-Malcolm Irving Building
E12B	6MD	6 Management Drive		MGSM-E Gregory Dunne Building

LATEST UPDATE 25 MAY 2022

Old Building Reference	New Building Reference	Address	Commercial Building	Building Name / Description
E12C	7MD	7 Management Drive		MGSM
E14A	1MD	1 Management Drive		MGSM
E14B	3MD	3 Management Drive		MGSM
E14C	1EXR	1 Executive Road		MGSM (Executive Accommodation)
E14D	1EXR	1 Executive Road		MGSM (Executive Accommodation)
E3A	10MW	8 Sir Christopher Ondaatje Avenue		NOTE: previously called 10 Macquarie Walk
E3B	8SCO	8 Sir Christopher Ondaatje Avenue		
E4A	4ER	4 Eastern Road		
E4B	6ER	6 Eastern Road		
E5A	11WW	11 Wally's Walk		
E5B	10SCO	10 Sir Christopher Ondaatje Avenue		
E6A	9WW	9 Wally's Walk		
E6B	7WW	7 Wally's Walk		
E6C	7AWW	7A Wally's Walk		(Demountable)
E6D	7BWW	7B Wally's Walk		(Demountable)
E6E	7CWW	7C Wally's Walk		(Demountable)
E6F	7EWW	7E Wally's Walk		(Demountable)
E6G	7DWW	7D Wally's Walk		(Demountable)
E7A	12WW	12 Wally's Walk		Mitchell Building (Science Admin)
E7B	14SCO	14 Sir Christopher Ondaatje		Graduation Hall
E8A	14ER	14 Eastern Road		Science Building
E8B	6SR	6 Science Road		Science Building
E8C	6WW	6 Wally's Walk		Science Building
EMC	3IR	3 Innovation Rd	Yes Blended	EMC
F10A	2TP	2 Technology Place	Yes Blended	Macquarie University Clinic-MUCA
F11A	17RPD	17 Research Park Drive	Yes	Travelodge Hotel
F3A	n/a			P East 3 (new Carpark)
F5A	5WW	5 Wally's Walk		Biological Laboratories (Level 4) P East 2 (Other levels are carpark) A
F5B	n/a	5 Wally's Walk/ P East 2		Glass House (Level 3) P East 2 (Other levels are carpark) B
F7A	4SR	4 Science Road		Zone Sub-Station
F7B	4WW	4 Wally's Walk		Science Building
F7B Substation	11 RPD	11 Research Park Drive		Sub-station
F8A	3TP	3 Technology Place		Macquarie University Hospital
F9A	15RPD	15 Research Park Drive		Science (Animal Holding Facility)
F9B	3SR	3 Science Road		METS (Mechanical Engineering Workshop)
F9C	13RPD	13 Research Park Drive		
HERRING	142HR	142 Herring Road Marsfield		Herring Road Apartments (Student Accommodation)
INCUBATOR	8HA	8 Hadenfeld Avenue		Incubator

LATEST UPDATE 25 MAY 2022

Old Building Reference	New Building Reference	Address	Commercial Building	Building Name / Description
LCR	n/a	299 Lane Cove Road	Yes	ABBOTT Laboratories
MQ	n/a	Various		Common Area Maintenance
MQ-1				Campus-HVAC Water Treatment
MQ-2				Campus-Roof and Gutter Cleaning & Ground,Infrastructure(creeks,pits,lakes)
MQ-3				Campus-Fire Systems
n/a	n/a	Coonabarabran		Siding Springs Observatory (new)
n/a	n/a	22 Giffnock Avenue, Macquarie Park		Offices (new)
156 TAL	n/a	156 Talavera Rd		Science Boat Garage (new)
n/a	2WW	2 Wally's Walk		CBMS Lab (Science)
n/a		50 Waterloo Rd		Offices (new) (Science and IT)
S11A	11UA	11 University Avenue		Waratah Building (Vacation Care)
S1A	17UA	17 University Avenue		Gumnut Cottage
S2.6	16UA	16 University Avenue	Yes Blended	Australian Hearing Hub
SPORTS	n/a	Cr Talavera & Culloden Roads		Sports Fields
SPTA	n/a			Campus Life-Ron Reilly Pavilion
SPTB	n/a			Campus Life-Changing rooms for Blue Barclay Pavilion sports teams
STE	n/a	(various)		Campus Grounds (includes Infrastructure)
STRRPD	n/a	Research Park Drive		(Inactive)
TBRBS	n/a	Tamborine Bay Road, Riverview NSW 2066		Macquarie University Rowing Club Boat Shed
TRAFALGAR	n/a	Marsfield	Yes	Trafalgar Shopping Centre
TUNNEL	n/a			Tunnel network
W10A	10GR	10 Gymnasium Road		Sports and Aquatic Centre
W11A	11GR	11 Gymnasium Road		Lighthouse Theatre
W16A	5GR	5 Gymnasium Road		Astronomical Observatory
W2.4A W5B	21WW	21 Wally's Walk		Macquarie Theatre
W3A	6FW	6 First Walk		
W5A	23WW	23 Wally's Walk		
W5C	4WR	4 Western Road		
W6A	25BWW	25B Wally's Walk (formerly 12 First Walk)		25WW-NEW ARTS PRECINT
W6B	25AWW	25A Wally's Walk		
W6C	n/a	25C Wally's Walk		(under construction)
W6D	27WW	27 Wally's Walk		Lotus Theatre
X5A	14FW	14 First Walk		
X5B	29WW	29 Wally's Walk		Mia Mia. Level 3 Museum of Ancient Cultures
X6A	8LR	8 Link Road		Banksia Cottage

LATEST UPDATE 25 MAY 2022

Old Building Reference	New Building Reference	Address	Commercial Building	Building Name / Description
Y1A	9HA	9 Hadenfeld Avenue		
Y2A	11HA	11 Hadenfeld Avenue		
Y3A	10HA	10 Hadenfeld Avenue		
Y4A	4LR	4 Link Road		Security Services
Y6A	2LR	2 Link Road		Property
Y6B	6LR	6 Link Road		
CARPARKS:				
C3 & C2	P South 2			Carpark-Multi-storey
E1	P South 2			Carpark-Open
E2				Carpark
E4				Carpark
E5				Carpark
E10	P East 5			Carpark-Open MGSM Carpark
E10	P East 4			Carpark for Travelodge, Chancellery visitors, Service visitors
F3A	P East 3			Carpark-Multistorey
N1	n/a			(Demolished) Carpark Part of MUCCP site
N3	P North 3			Carpark-Open
S2				Carpark
W3				Carpark
W4	P West 3			Carpark-Open
W5				Carpark
X13	n/a			Carpark-Open (future removal)
X3	P West 3			Carpark-Open
X4	P West 3			Carpark-Open
X8	P West 5			Carpark-Open (Old Golf House)
Y1	P West 4			Carpark-Open
Y2	P West 4			Carpark-Open Australian History Museum-13 Hadenfeld
		Campus		All roads and paths
FAUNA PARK:				
Fauna Park Grounds	n/a			Including creeks, pits & lakes
C17A	205G-J	205-211 Culloden Rd		Fauna Park (vacant Aviaries)
C19A	211J	205-211 Culloden Rd		Fauna Park (Orchard Shed)
C19B	211K	205-211 Culloden Rd		Possum Shed
C19B	211K	205-211 Culloden Rd		Possum Shed
C19C	211I	205-211 Culloden Rd		Fauna Park (Finch Aviaries)
C19D	211H	205-211 Culloden Rd		Fauna Park (Finch Aviaries)
C21A	211A	205-211 Culloden Rd		Fauna Park (Bee Shed)
C21B	211B	205-211 Culloden Rd		Fauna Park (Bee Flight cage 1)

LATEST UPDATE 25 MAY 2022

Old Building Reference	New Building Reference	Address	Commercial Building	Building Name / Description
C21C	211F	205-211 Culloden Rd		Fauna Park (old Aviaries)
C21F	n/a	205-211 Culloden Rd		Fauna Park (Bee Flight cage 2)
E17A	211O	205-211 Culloden Rd		Fauna Park (Fish Shed)
W19-21	205-211CR	205-211 Culloden Rd		Fauna Park (group of small buildings)
W19A	209ECR	205-211 Culloden Rd		Fauna Park (Laboratory, Offices)
W19D	209G	205-211 Culloden Rd		Fauna Park (Laboratory, Research) Frog Store
W19E	209H	205-211 Culloden Rd		Fauna Park (Offices, HDR students) Frog Store
W19F	205ACR	205-211 Culloden Rd		Fauna Park (Brain Behaviour Laboratory, Offices, HDR Academic)
W19G	209FCR	205-211 Culloden Rd		Fauna Park (Finch Shed)
W19J	n/a	205-211 Culloden Rd		Fauna Park-Cage A (Invertebrate)
W19K	205FCR	205-211 Culloden Rd		Fauna Park-Cage B (Invertebrate)
W19L	205CCR	205-211 Culloden Rd		Fauna Park (Freshwater Facility)
W19M	205DCR	205-211 Culloden Rd		Fauna Park (Seawater Facility)
W19N	205ECR	205-211 Culloden Rd		Fauna Park (Interim Bio Security Laboratories-NEW)
W19O	n/a	205-211 Culloden Rd		Fauna Park (Freshwater Tubs)
W21A	209ACR	205-211 Culloden Rd		Fauna Park (First Aid Room, mail, students)
W21B	209BCR	205-211 Culloden Rd		Fauna Park (Offices, students)
W21C	209CCR	205-211 Culloden Rd		Fauna Park (Reptile Cognition)
W21D	209DCR	205-211 Culloden Rd		Fauna Park (Lizard Shed)
W21E	209ICR	205-211 Culloden Rd		Fauna Park (Office, students) Emergency Animal Housing
W21F	209JCR	205-211 Culloden Rd		Fauna Park (Storage) Lab Store
W21G	209KCR	205-211 Culloden Rd		Fauna Park (Storage) Lab Store
	209M			Ponds

LATEST UPDATE 25 MAY 2022