Charles Sturt University

Infrastructure Design Standards

Module S04: Building Management System

Division of Finance (Strategic Infrastructure)
Charles Sturt University

Document Control

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1. Introduction

1.1. Overview

The Charles Sturt University Infrastructure Design Standards (the Standards) outline the University's expectations for its built forms to achieve consistency in the quality of the design and construction of those built forms.

The Standards have been developed to provide guidance to the design team and to assist Facilities Management to drive a consistent approach to the design, construction, commissioning, handover, and operation of new capital projects to ensure the new asset is fully integrated into campus life and conforms to the University's standards and policies.

The successful integration of any new project into the day-to-day operation of campus life cannot be underestimated and is vital to ensuring the new asset provides a fully functional platform for Facilities Management clients and the University. The Standards will ensure Facilities Management is successful in supporting the University's strategic objectives now and into the future. The pitfall of viewing any new project as a standalone entity must be avoided as any new project is an extension of the existing campus.

The Standards are aligned with Charles Sturt's requisites for aesthetic appeal, life cycle maintenance and environmental sustainability, while ensuring that there is sufficient scope for innovation and technological advancements to be explored within each project.

1.2. The University

The history of Charles Sturt University dates to 1895, with the establishment of the Bathurst Experiment Farm. Formed progressively through the merge of regional institutions in south-western and western NSW, Charles Sturt was formally incorporated on 19 July 1989 under the Charles Sturt University Act 1989. As one of Australia's newer universities, Charles Sturt has been built on a tradition of excellence in teaching and research spanning more than 100 years.

With over 40,000 current students studying both on-campus and online, Charles Sturt University is the largest tertiary education institution in regional Australia. The University operates six main campuses across New South Wales in Albury-Wodonga, Bathurst, Dubbo, Orange, Port Macquarie, and Wagga Wagga, alongside specialist campuses in Canberra, Parramatta, and Goulburn. Charles Sturt University is structured around three Faculties: Arts and Education; Business, Justice and Behavioural Sciences; and Science and Health.

1.3. University Vision and Values

Charles Sturt University is committed to building skills and knowledge in its regions by offering choice and flexibility to students, while collaborating closely with industries and communities in teaching, research, and engagement. As a significant regional export industry, the University brings both strength and learning back to

its regions, positioning itself as a market-oriented institution. Its goals are to remain the dominant provider of higher education in its regions and a sector leader in flexible learning.

Charles Sturt University believes that wisdom has the power to transform communities. With perseverance and dedication, the University contributes to shaping resilient and sustainable regions for the future. Acknowledging the deep culture and insight of First Nations Australians, the University's ethos is encapsulated by the Wiradjuri phrase *yindyamarra winhanganha,* which translates to "the wisdom of respectfully knowing how to live well in a world worth living in." Through its values, Charles Sturt University fosters a welcoming community and learning environment that supports innovation, drives societal advancement, and gives back to the regions it serves.

1.4. Using the Infrastructure Design Standards

The Infrastructure Design Standards are written to advise Charles Sturt University performance requirements and expectations that exist above and beyond existing industry codes and standards.

The Infrastructure Design Standards do not repeat codes and standards.

Performance to Codes and Standards are a non-negotiable regulatory minimum of any design solution, to be determined for each project by the design team.

The Standards are to be used by all parties who are engaged in the planning, design, and construction of Charles Sturt's facilities. This includes external consultants and contractors, Charles Sturt's planners, designers, and project managers as well as faculty and office staff who may be involved in the planning, design, maintenance, or refurbishment of facilities. All projects must comply with all relevant Australian Standards, NCC, EEO as well as Local Government and Crown Land Legislation.

1.5. Modules

The Standards are divided into the following modules for ease of use, but must be considered in its entirety, regardless of specific discipline or responsibilities:

- S01 Overview and Universal Requirements
- S02 Active Transport
- S03 Acoustics
- **S04 Building Management System**
- S05 Electrical and Lighting
- S06 Energy Management
- S07 Ergonomics
- S08 Fire and Safety Systems
- S09 Floor and Window Coverings
- S10 Furniture
- S11 Heritage and Culture
- S12 Hydraulic

- S13 Information Technology
- S14 Irrigation
- S15 Mechanical Services
- S16 Roof Access
- S17 Termite Protection, Vermin Proofing and Pest Management
- S18 Security Systems
- S19 Signage
- S20 Sustainable Building Guidelines
- S21 Waste Management
- S22 Project Digital Asset and Data Requirements
- S23 Commissioning, Handover and Training

1.6. Related Documents

1.6.1. University Documents

The Standards are to be read in conjunction with the following relevant University documents, including but not limited to:

- Facilities and Premises Policy along with supporting procedures and guidelines
- Charles Sturt University Accessibility Action Plan 2020 - 2023
- Relevant operational and maintenance manuals
- Charles Sturt University Asbestos Management Plan
- Charles Sturt University Signage Guidelines
- Charles Sturt University Modern Slavery Statement
- Charles Sturt University Sustainability Statement
- Charles Sturt University Work Health and Safety Policy
- Charles Sturt University Risk Management Policy
- Charles Sturt University Resilience Policy
- Charles Sturt University Health, Safety and Wellbeing Policy

1.6.2. Federal Legislation

The planning, design and construction of each Charles Sturt University facility must fully comply with current relevant Federal legislation, including but not limited to:

- National Construction Code (NCC)
- Disability Discrimination Act 1992 (DDA)
- Environment Protection and Biodiversity Conservation Act 1999 (EPBC)
- Work Health and Safety Act 2011

1.6.3. NSW State Legislation

The planning, design and construction of each Charles Sturt University facility must fully comply with current relevant Federal legislation, including but not limited to:

- Work Health and Safety Act 2011
- Environmental Planning and Assessment Act 1979 (EP&A Act)
- Building and Development Certifiers Act 2018
- Heritage Act 1977
- Protection of the Environment Operations Act 1997 (POEO Act)
- Design and Building Practitioners Act 2020
- State Environmental Planning Policies (SEPPs)
- Local Government Act 1993

1.6.4. Federal Regulations and Standards

- Relevant Australian or Australian/New Zealand Standards (AS/NZS)
- Safe Work Australia Model Codes of Practice
- Work Health and Safety Regulations 2011
- Disability (Access to Premises – Buildings) Standards 2010
- National Environment Protection Measures (NEPMs)

1.6.5. NSW State Regulations and Standards

- SafeWork NSW Codes of Practice
- Disability (Access to Premises – Buildings) Standards 2010
- Building and Development Certifiers Regulation 2020
- NSW Work Health and Safety Regulation 2017
- Protection of the Environment Operations (General) Regulation 2022
- NSW State Environmental Planning Policies (SEPPs)
- Fire and Rescue NSW Fire Safety Guidelines
- NSW Local Council Development Control Plans (DCPs)

1.6.6. Manufacturer Specifications and Data Sheets

All installation must be carried out in accordance with manufacturer specifications and data sheets to ensure product performance over its intended life and so as not to invalidate any warranties.

1.6.7. Project-Specific Documents

Requirements specific to a particular project, campus, or other variable, will be covered by project specific documentation, such as client briefs, specifications, and drawings. These Standards will supplement any such

project specific documentation. The Standards do not take precedence over any contract document, although they will typically be cross-referenced in such documentation.

Extracts from the Standards may be incorporated in specifications; however, it must remain the consultant's and contractor's responsibility to fully investigate the needs of the University and produce designs and documents that are entirely 'fit for purpose' and which meet the 'intent' of the project brief.

1.7. Discrepancies

The Standards outline the University's generic requirements above and beyond the above-mentioned legislation. Where the Standards outline a higher standard than within the relevant legislation, the Standards will take precedence. If any discrepancies are found between any relevant legislation, the Standards and project specific documentation, these discrepancies should be highlighted in writing to the Manager, Capital Works.

1.8. Departures

The intent of the Standards is to achieve consistency in the quality of the design and construction of the University's built forms. However, consultants and contractors are expected to propose 'best practice / state of the art' construction techniques, and introduce technological changes that support pragmatic, innovative design. In recognition of this, any departures from relevant legislation, or the Standards, if allowed, must be confirmed in writing by the Manager, Capital Works. Any departures made without such written confirmation shall be rectified at no cost to the University.

1.9. Professional Services

All projects at Charles Sturt University require the involvement of adequately skilled and experienced professionals to interpret and implement the Standards. Consultants or contractors lacking proper qualifications and licenses are not permitted to conduct any work.

1.10. Structure of Document

This document is structured into 4 sections:

Section 1 Introduction (this Section).

Section 2 General Requirements – outlines the general requirements or design philosophies adopted at Charles Sturt University.

Section 3 Supporting Documentation – Legislation, Standards, Codes of Practice, University Policies, and other applicable technical references.

Section 4 Specifications (if applicable) – materials specifications and/or preferred lists for materials, processes or equipment used by Charles Sturt University.

2. General Requirements

2.1. Overview

This module of the Facilities Design Standards outlines Charles Sturt University's essential criteria for designing, installing, and operating Building Automation System (BAS) services. The BAS contractor (or project consultant for larger projects) is required to develop a comprehensive BAS specification based on the following details. All designs must be submitted to the University's Energy Manager for review and approval before tendering and commencing any on-site work.

Please refer to this section alongside the complete Design Standards documentation.

2.2. Building Automation System Environment

CSU has undertaken to utilise Open Protocol Building Automation and Control Systems in their campuses to provide the tools necessary to manage and reduce their operating and maintenance costs.. The system supports expansion into additional buildings using Open Protocol Communications, allowing multiple vendors to expand it, and is permissible for both Design and Construct or Fully Documented projects.

This standard is intended to assist the Consultant produce detailed controls and system specifications which conform to the requirements of this Design Standard whilst providing additional project specific conditions relating to scope and functionality including general requirements relating to the quality of the installation.

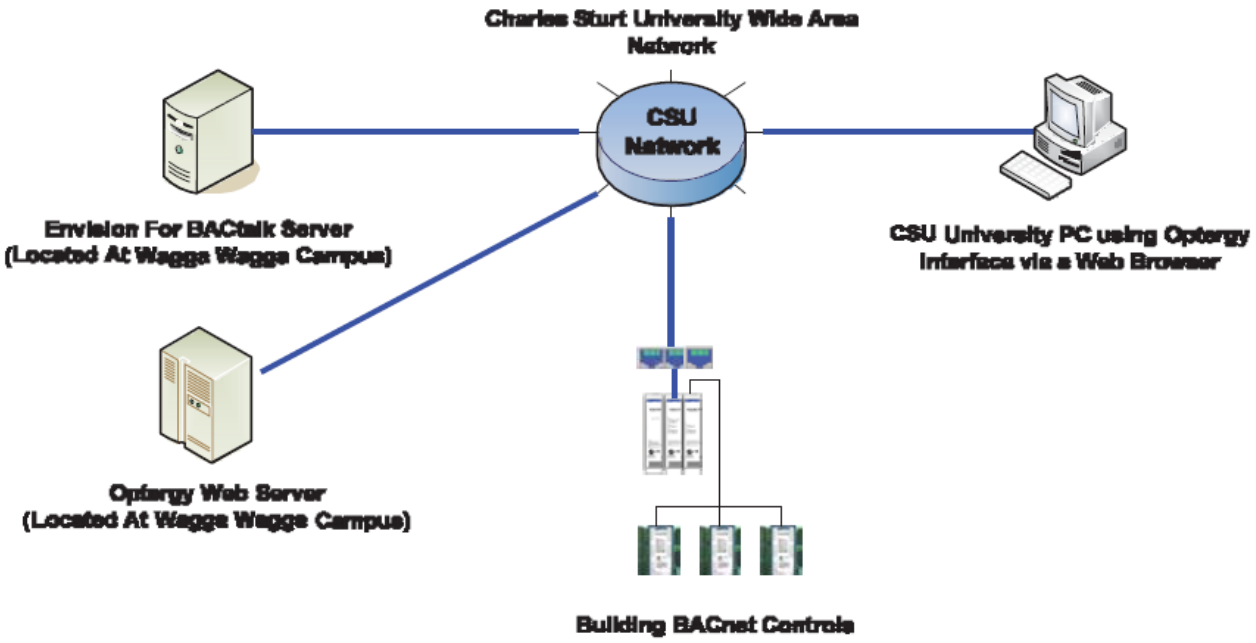
BMIS technology and protocol standards are changing; hence these standards are subject to revisions. Designers must consult BACnet standards, and the Energy Manager/Project Managers, to ensure they are working to the latest revisions of this and other mentioned standards.

BMS Server: The BMS Server represents the existing BMIS Server system that was supplied and configured by Alerton Australia. The BMIS Server contains the databases, graphics, historical trends, logs, events, providing access to all DDC controls, hardware and software points for remote supervisory access and control of the services controlled AND provides Remote Supervisory Access and Control of the localised building DDC. The BMIS Server adheres to ASHRAE / ANSI Standard 135-2004, ISO 16484-5 BACnet – Data Communication Protocol for Building Automation and Control Systems.

DDC controls: The DDC controls represents all controls, routers, relays, wiring, field equipment, field controllers, software and hardware inputs/outputs and points, valves, high-level chiller interfaces, boiler interfaces, MODBus and BACnet interfaces, actuators and associated equipment to provide a complete control system that is building or project specific. The DDC controls for each project are to be capable of operating in isolation with connection to the BMIS Server to allow the remote supervisory access and control. The DDC controls will communicate and integrate with the BMIS Sever via CSU's network providing Remote Supervisory Access and Control of the building services as connected.

BACnet over LON is not acceptable.

The BMIS and DDC network layout is as follows.



2.3. Approval

Contractor to submit a project plan outlining all aspects of the project including milestones of the below (include certification).

1. Submit all design documents 2 weeks prior to construction to Charles Sturt University to review and approve for construction. Design documents to include: Detailed BACnet Object list, sensor and hardware data sheets and wiring diagrams.
2. Submit to Charles Sturt University all control strategy designs in block format with clear and easy to understand labelling of each object (hardware or software), time schedules, alarms and events 2 weeks prior to implementation. Charles Sturt University to review documents and approve for implementation.
3. Submit to Charles Sturt University completed integration table (provided in Section 5.5). Charles Sturt University to review spreadsheet and approve. Contractor to verify that all BACnet objects are accessible for integration of BMIS. BMIS contractor to attend site for demonstration to Charles Sturt University of all BACnet objects (including software BVs, AVs, etc) are accessible via BMIS. Practical completion will not be granted until this is complete.
4. Contractor to demonstrate all controls operation and points calibration (using 6 monthly NATA certified devices with certificates). Refer section 1.9 for more information.
5. The BMIS Contractor is to work with Charles Sturt University and its appointed independent commissioning agent (where applicable) for the DDC and controls. The contractor must allow for the commissioning and re commissioning schedule including (refer section on Independent Commissioning Optimisation for details) optimisation over 12 months.
6. Certification by Charles Sturt University is required prior to practical completion..

Building Automation System section from Design Standards

Building Management Information System (BMIS) and Energy Management System (EMS) The University has an area-wide Building Management Information System (BMIS) and Energy Management System (EMS) that function over the University's Wide Area Network (WAN).

The inclusion of a Building Automation System (BAS) and/or smart meters in any new building project must include the connection of the systems within the building to the University's LAN.

The proposed BAS must be registered as a BACnet 'compliant' system under the ASHRAE standard for a BACnet protocol. This will generally limit BMS systems to the Alerton Australia's Envision & Optergy systems. Written approval is required from the Director, Facilities Management before an alternative BMS supplier will be considered.

- The selected BAS shall be able to interface with University's Building Management Information System (BMIS) front-end and provision allowed for this interface through the University's Local Area Network (LAN)/WAN.
- A fully accredited service agent within a reasonable distance from the campus.
- Refer to the Charles Sturt University Building Automation Systems Selection and Installation Guidelines.
- The University's preselected BMIS head-end is Optergy which is distributed by Alerton Australia.
- As a minimum the design team will include the Director, Operational Services in the initial design development to determine the need for ongoing guidance and approval throughout the remaining detailed design process. The Director, Operational Services shall determine if the project is significant enough to warrant the engagement of the University's preferred BAS and mechanical controls consultant.
- The University has established standard graphical design and functionality requirements that are required to be followed to ensure a seamless integration with the BMIS & EMS head end software, the latter of which will be coordinated through the university's preferred BMIS supplier Alerton Australia and this requirement will form part of the contract requirements.
- The project BAS designer shall specify that the project BAS installer (if not Alerton Australia) will allow a minimum of sixteen (16) hours of detailed technical support with the University's preselected BMIS headend supplier Alerton Australia to integrate and test that the project BAS has successfully integrated with the BMIS.
- The project BAS designer shall specify that the project BAS installer will allow a minimum of twenty (20) hours of detailed training for the University's operational staff immediately prior to building handover.

2.4. Standards

All DDC controls to be compliant with ASHRAE / ANSI Standard 135-2004, ISO 16484-5 BACnet – Data Communication Protocol for Building Automation and Control Systems (or the latest version including Appendums). ALL DDC controls to be BTL listed.

BACnet Device numbering to be within a range commencing with Building Number (TBA).

BACnet subnet LAN addressing to be within a range of commencing with Building Number (TBA).

2.5. Preferred System Suppliers

The BMS vendors for all BAS and DDC projects shall beAlerton Australia

2.6. BACnet Conformance

Refer Appendix 1 (Section 5.5).

All BACnet objects/points to be visible from BMIS

All Controllers are visible and respond to ‘who is’ BACnet commands

Out Of Service flag not to be used on any points.

No proprietary objects accepted.

2.7. Guidelines for the Design of BMS/DCC Controls

The controls works shall comprise the design, supply and installation, commissioning, support and warranty of new DDC controls and all associated equipment.

Certify system will only use Direct Digital type controls (DDC). No electronic or pneumatic controls accepted.

In general, system to consist of unit controllers, routers, engineering software, sensors, actuators, power supplies, cabinets, panels, actuators, valves, installation, service and commissioning, CSU personnel training and full documentation. All DDC equipment and software to conform to ASHRAE / ANSI Standard 135-2004, ISO 16484-5 BACnet – Data Communication Protocol for Building Automation and Control Systems.

Include the following or similar to ensure that the contractor is responsible for a fully functional system is provided by: “Where equipment or hardware/software points are not listed in this specification or project documentation and are required for contractor to provide a fully functional DDC system, it is the contractor’s responsibility to provide these parts/equipment as part of the control system and project”.

No Lon, LonTalk, LonWorks componentry, communications devices, gateways or associated equipment to be accepted. BACnet over LON is not acceptable as a method of communications.

No proprietary communications or devices to be permitted on projects without the inclusion of compliant BACnet gateway devices.

2.7.1. Scope and Extent of Work

Any graphics provided are required only to demonstrate to Charles Sturt University personnel the working and operation of the plant and equipment. This Standard brief describes the DDC component only. The BMIS server will interrogate the new Router or BACnet IP controllers to be located in the DDC panel for access to the DDC information and controls. The new Router will connect to the University’s network via the local LAN in the building. CSU will supply a point for connection of the new DDC Router at the DDC panel. The contractor

to wire to the network point to the latest CSU Ethernet and wiring standards. The new controls are to act standalone but also need to be able to be overridden, commanded, setpoints modified; time schedules of every point, trended, events accessed, and any other BMIS functions including Energy Management from the BMIS Server.

2.7.2. Controls Minimum Provision

2.7.2.1. General Performance

It is essential that all necessary components for a complete DDC control system are incorporated into the DDC Specification. All equipment to be controlled by DDC controls is to operate within the following guidelines.

- Energy efficiency is paramount but must be consistent with the effective operation of the controls such that their primary purpose is achieved.
- Controls to interface with and operate equipment seamlessly.
- High-level interfacing (as required on any given project) is to allow read with write capability of all parameters. Communications need to be error free with no disconnections or “drop outs”.
- System performance is to be optimised to meet the concurrent requirements of providing timely accurate control and energy efficient operation.

All project documentation is to be produced in hard copy format and on CD. Wiring diagrams, controller and Operating and Maintenance manuals are to be submitted in PDF format with no locking of the document or security enabled. Points lists and object lists are to be submitted in Excel version 6.0 or later.

Appendix 1 is a spreadsheet that must be completed for integration of the controllers’ BACnet objects into the BMIS Server.

2.7.2.2. Prescribed Requirements for Inclusion in the Specification

The following requirements are to be included within the specification as part of the contractor’s responsibility.

All system software programming and configuration.

12 months Warranty

Controllers are to have utilised PIDs that can be tuned for all analogue outputs. Contractor to be advised that tuning is required as part of their contract.

Control strategies to be submitted by controls Consultant or other nominated representative of CSU.

All points, objects, controls information, loop tuning, for a complete DDC controls system that is easily integrated into the BMIS BACnet Server.

Connection to all building electrical, gas and water meters using high-level interface as available or otherwise low level interface.

Connection to VSDs, chillers, boilers via Hi-level interfaces as available. Preferable use of ABB ECH series VSD drives with BACnet interface

The controls equipment is to follow the guidelines as described in this brief for the architecture and LAN arrangement.

Modifications to the architecture described in the layout drawing must be submitted and approved prior to the works commencing, and that any additional works are to be the responsibility and cost to the Contractor.

The equipment submitted shall provide a maximum of 1 second information updates from the unit controllers to the Routers.

Routers shall be the interface between the MS/TP LAN for the unit controllers and the Ethernet LAN connecting to/through the University network to the BMIS Server or BACnet Ethernet IP may be used. All ethernet-connected devices are to be DHCP compliant.

Unit controllers are to operate error free communication speed at minimum of 78 KBAUD at the MS/TP level. Speed shall be adjustable to a minimum of 9600 BAUD. Router to be able to communicate on Ethernet at speeds equal to or greater than 100 Mbps full duplex.

Only one Router or Ethernet IP connection to be per building. All other controllers to link to this device via MS/TP (RS484 local to the building LAN provided by contractor)

- DDC controls be configured so that from BMIS Server graphics users can:
    - Configure, store and access all trends dynamically and historically down to 1 second intervals (for short periods of time – 60 minutes). Also support trends based on events triggering, change-of-state to conserve memory. Data reports can be generated either in graphical or tabular format. Trends to be stored in BMIS Server uploading from the DDC field controllers during after-hours time periods.

Modify all PID loop characteristics dynamically online.

View, access and store all events that reside in DDC controls.

All BACnet points (objectives) are to be made visible and that all controllers are visible (able to respond to ‘who is’ BACnet commands)

Time schedules locally stored in DDC field controllers can be modified by BMIS Server using BACnet only (controllers shall be BACnet compliant in the time schedules)

DDC controllers to have internal clocks and internal time schedules that can be programmed locally or from BMIS Server with BMIS Server to have overriding control.

DDC controllers to be configured with PID control on all analogue outputs. Contractor to configure and tune all loops to satisfaction of Consultant and CSU personnel.

Configure software and controllers points to be Energy Management controlled from BMIS Server.

Provide up to 10 levels of load shedding including resetting of all setpoints.

Contractor to allow for minimum of 16 hours provision for BMIS Server – DDC Controls interface and ensuring all parameters are configured.

The contractor must allow for the commissioning and re-commissioning schedule including (refer section on Independent Commissioning and Optimisation for details) optimisation over 12 months.

2.7.2.3. Controls Hardware Provision

All DDC controllers are to have PID loops and provide loop tuning capability from the BMIS Sever and locally.

Controllers are to be standalone and contain battery backed time clocks and scheduling capability.

Each controller to have non-volatile memory to store alarms, historical events and all parameters/data/trends for a minimum of 4 weeks at 1 minute intervals. Storage of data shall only be on an as changed basis with tolerances to reduce nuisance data recording. The controllers shall have the capability to read and record down to 1 second time intervals for short periods of time (60 minutes minimum). The data/information/trends shall be able to be stored on the BMIS Server.

Where contractor is providing BACnet Ethernet IP device, contractor is to supply and install Ethernet cable consistent with requirements of Charles Sturt University Communications standard in buildings between controllers and CSU network point (provided by CSU IT department).

2.7.2.4. Minimum Extra Hardware Points Allocation

The DDC shall have sufficient points to meet the control, operation and trend logging requirements of the project. Additional physical hardware points shall be provided to allow for minimal expansion without the requirement of additional points hardware. These additional points must be spaced out per controllers throughout project.

Additional analogue and digital control points shall be provided as follows.

Number of Project Points	AI	AO	BI	BO
Up to 20 control points	2	2	2	2
20 to 100 control points	4	4	4	4
From 100 to 250 control points	6	6	6	6
From 250 to 500 control points	12	12	12	12
Above 500 control points	15	15	15	15

For DDC systems which incorporate universal points (configurable analogue and/or digital points), the following physical points apply.

Number of Project Points	Universal Points
Up to 20 control points	4
20 to 100 control points	10
From 100 to 250 control points	20
From 250 to 500 control points	40

Number of Project Points	Universal Points
Above 500 control points	50

2.7.2.5. Installation

The installation of the BMS shall include all new enclosures, hardware and software to meet operational requirements for the project. The use of second hand equipment is prohibited and all supplied equipment shall be readily available, commercial quality product.

2.7.2.5.1 Connection To Mechanical Switchboards

It is recommended that all controllers be powered via a UPS power supply (continuous online) to reduce down time, resetting service and lengthen the life of the controllers.

All control on/off switches shall pass through manual on/off switches mounted on the Mechanical Services switchboard. Unless otherwise agreed, these switches shall conform to CSU's usage and shall be provided with indicator lamps as follows and AS431.2 – 1989 or as agreed with the CSU's representative:

RED: Alarm or device is in fault

GREEN: Device is switched on (either manually or remotely)

BLUE: BMIS/DDC Call on

In general controllers shall be housed externally, but near to, a mechanical services switchboard which shall supply the necessary power to the controller. Note that all cabling passing through a mechanical services switchboard shall conform to appropriate standards but the controller shall be limited to extra low voltages and data cable shall be rated accordingly.

All controls to be 24volt AC. Power supply to controls cabinet to be 240volt and the controls are to operate over 24volts through a step down transformer. Controls outputs are to switch volt free contracts that are 24volt powered. All inputs are to be volt free contacts.

For internal installations, the enclosure shall be and IP56 rated powder-coat metal enclosure with positive seal, with key locks.

Externally mounted BMS enclosures shall be IP66 rated powder-coat metal enclosures with key lockable secure access. Sufficient weather protection shall be provided to all external BMS enclosures to prevent direct rain or solar contact.

All hardware within the switchboard enclosure shall be clearly identified, including cable identification, terminal strip identification, hardware device, power supply and circuit breaker identification. All equipment and cable labeling and identification shall be in accordance with AS3000.

2.7.2.5.2 Wiring Installation

All wiring and labelling of power, control and interface wiring shall be in accordance with the relevant communication or electrical standards.

Provide all interlock and control wiring. All wiring shall be installed neatly and professionally, in accordance with requirements of applicable Specification Division 16 sections and all national, state, and local electrical codes. All the wiring shall be installed in accordance with the current Electrical Code.

Provide wiring as required by functions as specified and as recommended by equipment manufacturer's to serve specified control functions.

Control wiring shall not be installed in power circuit raceways. Magnetic starters and disconnect switches shall not be used as junction boxes. Provide auxiliary junction boxes as required.

The term "control wiring" is defined to include the providing of wire, conduit, and miscellaneous materials as required for mounting and connecting electric or electronic control devices in pilot circuits of contactors, starters, relays, etc., and wiring for valve and damper operators.

Install signal, communication, and fiber-optic cables as follows:

Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.

Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.

Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

Provide auxiliary pilot duty relays on motor starters as required for control function.

All exposed control wiring and control wiring in the mechanical, electrical, telephone, and similar rooms shall be installed in raceways. All other wiring shall be installed neatly and inconspicuously above ceilings.

Install exposed control wiring system in conduit for electric/electronic control systems. Conceal wiring, except in mechanical rooms and areas where other conduit and piping are exposed. Plenum-rated cable shall be provided when located in ceiling spaces. All control wiring shall be installed in a neat and workmanlike manner parallel to building lines with adequate support. Both conduit and plenum wiring shall be supported from or anchored to structural members. Conduit or plenum wiring supported from or anchored to piping, duct supports, the ceiling suspension system, is not acceptable. Wiring buried in slab-on-grade concrete or explosion-proof areas shall be in rigid metal conduit. Provide adequate strain relief for all field terminations.

Number-code or color-code conductors, excluding those used for individual zone controls, appropriately for future identification and servicing of control system.

2.7.2.5.3 Control Device Installation

All room sensors and thermostats shall be mounted so as to be accessible in accordance with NCC Guidelines, unless otherwise noted on the drawings

Remote control devices not in local panels shall be accessible for adjustment and service below 20cm above finished floor whenever possible.

Install guards on thermostats in the following locations:

Entrances.

Public areas.

Where indicated

Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

Local controllers shall be mounted at eye level for accessibility and service, and located within 50' of the system served, unless otherwise shown on the plans.

Freestanding enclosures and panels shall be supported on steel unistrut frames, or approved equal, and be securely anchored to the floor and be well braced.

Enclosures and panels mounted directly to the wall shall be provided with a minimum airspace of 25mm" between the enclosure and the wall.

A minimum of 1 m working clearance shall be provided in front of all enclosures and panels; clearance shall be ensured to permit the enclosure door to open at least 90° from its closed position.

Mounting height shall be a maximum 2 m to the top of the enclosure.

Shall be suitable for use in environments having an ambient temperature range of -5°C to 50°C and a relative humidity of up to 95% noncondensing.

There shall be no pneumatic equipment or device installed in a Global Building Controller/Router enclosure.

There shall be no equipment or device installed in a Global Building Controller/Router that is not a functional component of the campus system interface or building BAS system.

A padlocking hasp and staple or keyed cylinder shall be provided for each door.

A field-installed, 14-gauge galvanised steel drip shield shall be provided where enclosures and panels may be subjected to dripping water.

2.7.2.5.4 Connections

Piping installation requirements are specified. Drawings indicate general arrangement of piping, fittings, and specialties.

Ground equipment: Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.

2.7.2.5.5 Control Power

Power supply for Global Building Controllers/Routers and associated BAS components shall be connected via a dedicated circuit to the building normal-emergency panel. A grounding conductor shall be run from building service entrance panel ground bus. Conductor shall be insulated and isolated from other grounded conductors and building conduit system.

Power supply for Application Controllers used to monitor emergency equipment and/or equipment serving critical spaces (i.e. Animal Rooms, Computer Server Rooms, etc.) shall be connected via a dedicated circuit to the building normal/emergency panel.

UPS: Uninterruptible Power Supply(s) shall supply power for the Global Building Controller(s), and Application Controllers that monitor emergency equipment, if Normal/Emergency Power is not available in the building.

Provide power for Application Controllers and all associated control components from nearest electrical control panel or as indicated on the electrical drawings—coordinate with Electrical Contractor.

Power for each control panel shall be provided through a switch (standard light switch) located inside the panel. A standard duplex receptacle shall also be provided inside the control panel. The receptacle shall be unswitched. Control transformer(s) shall be located outside the control panel and attached to the side of the panel.

2.7.2.5.6 Identification

The contractor shall label each system device with a point address or other clearly identifiable notation inside the device cover. Labels shall be permanent, and method of labelling shall be approved by the University's Facilities Management Group.

All control equipment shall be clearly identified by control shop drawing designation as follows:

Control valves and damper actuators: brass tags or engraved Bakelite tags.

Other Remote Control Devices: Metal tags or laser printed, adhesive backed, metalized polyester film labels.

Control Enclosures and Panels: Engraved nameplate with panel number and system served.

2.7.2.6. Requirements for Sensors and Actuators

The specification shall call for sensors and actuators with the following attributes and characteristics.

Provide temperature sensors of the resistance bulb or thermistor type with operating ranges to suit the particular application.

Insertion sensors complete with stainless steel wells.

Sensor mounting medium location to ensure a rapid response to changing temperature is achieved.

Absolute Accuracy of measured temperature value and range of sensor

- Room temperature sensors: □ 0.3 □C range: -5□C to +45□C

- Heating hot water sensors: □ 0.1 □C range: +10□C to +110□C
- Chilled water sensors: □ 0.1 □C range: -10□C to +40□C
- Other sensors: □ 0.1 □C

Static and Differential Pressure Sensors.

- Manufacture from corrosion resistant material
- Accuracy of □1% Span

Velocity Sensors

- Multi point averaging (air only)
- Select sensor range to suit velocity range

Humidity Sensors

- Capacitance type
- Complete with duct sampling devices and protected from air borne dust particles and free air moisture
- Temperature compensated
- Accuracy □ 5.0% RH

Damper Actuators

- Use spring return, fail safe position maximum 40 seconds
- Maximum run time full stroke
    - Terminal units: 6 minutes
    - Other applications: 30 seconds
    - Manual override

Valve Actuators

- Manual override
- Direction selection switch
- Maximum runtime full stroke
    - 30 seconds

2.7.2.7. Software Provision

The Integration spreadsheet must be completed to enable complete and full control BMIS server access and connection and for BMIS Server personnel to program and develop database, graphics, trends, events, energy management functionality, demand control and provide complete and full access of all controllers and software. DDC is to be programmed and contractor to provide software documented information so that BMIS Server can display live, dynamic control strategies on graphics. Program the DDC to indicate to BMIS Server of points that are in manual.

All loops are to be tuned to the satisfaction of the Charles Sturt University representative.

Demand control is to be provided so that when demand levels or generator loads are reached, the DDC system will make changes to the operation of the equipment such as:

- Set-point re-scheduling or varied.
- Up to 10 levels of load shedding.
- Override equipment operation to control demand.
- To be commanded from the BMIS Server and locally and automatic.

Utilise CO2 sensing and associated control strategies to regulate minimum outside air position (if available in building).

Provide optimum start of all plant and equipment.

Stagger start of all equipment to reduce demand.

DDC control to be configured so that BMIS Server to be able to view, modify, change setpoints, override, control, command to manual/off/auto, access all hardware and software points of all hardware (external inputs/outputs), software (internal programmed points), programs, control strategies including PID parameters.

DDC control to be configured so that BMIS Server to be able to setup and upload trends, events, logs with ability to generate reports and graphs of the data.

2.7.2.8. Trends

All input and output control and status points will have trends programmed as follows. Each trend will store a minimum of 1000 samples in the associated controller utilising a first-in/first-out algorithm so that the oldest data is over-written as new data is stored. The controller will also be programmed for the capability of enabling historical trending on each trended point individually so that historical trending can be enabled on any point without enabling it on any other trended point.

All trends shall be programmed to be triggered according to the type of point, as follows:

All equipment start/stop control point trends will be triggered on the control point's change of state.

All equipment status point trends will be triggered on the status point's change of state.

All space-temperature and outside-air trends will be triggered on any change of value of 2 degrees Celsius.

All space-humidity and outside-air-humidity trends will be triggered on any change of value of 5%.

All fan air temperature trends will be triggered on any change of value of 4 degrees Celsius.

All water temperature trends will be triggered on any change of value of 2 degrees Celsius. All damper motor control point trends will be triggered on any change of value of 10% of it's control range.

All valve control point trends will be triggered on any change of value of 10% of it's control range.

All VSD motor control point trends will be triggered on any change of value of 5% of it's control range.

All fan air static pressure trends will be triggered on any change of value of 12 Pa.

All water pressure trends will be triggered on any change of value of 20 kPa.

2.7.2.9. Alarms

All Input/Output objects listed on the object tables, for each piece of equipment, shall have an event (alarm) defined for the off-normal condition as follows.

Analog objects shall list the high and low alarm limits.

Every device connected to the system shall also be alarmed for an off-line condition. The contractor shall provide a BACnet BV for the offline status.

Two notification classes shall be defined to route alarms.

Critical alarms shall be printed, logged, and pop-up windows shall occur via an email notification.

Maintenance level alarms shall be printed and logged.

The event objects and alarm routing shall be reviewed by Charles Sturt University to identify the class, routing, limits, and message content for each object prior to implementation.

An event shall be generated for a device communications failure or a device program changing to a halt or failure state. All devices shall have this feature implemented.

2.7.2.10. Schedules

A list of schedules to be implemented shall be reviewed and approved by Charles Sturt University. The list shall also include the schedule times to be implemented. Integration with Charles Sturt's Enterprise Timetabling System shall be included for all spaces managed via the University's Timetabling system.

2.8. Optimal Provision

At the request of the Project Manager the consultants shall include the following items in the overall project as optional additions to the tender:

60 months warranty (see Warranty section for details)

High-level interfaces to:

- Chiller (if chiller is in the building or part of the project) – via BACnet as first choice if unavailable then MODbus interface.
- Electrical meters – via MODbus– connect to the Optergy EMS
- Lighting control system via DALI as first choice if unavailable then BACnet, MODBus or other interface.
- Low level interface to gas and water meters.
- VSDs (preference is to ABB ECH series with BACnet interface)
- Connection to split ACUs via BACnet

Provide the ability (if boiler in building or part of project) to change boiler flow set-point with a range of 8C to 95C. Include boiler controls modifications as well as DDC controls necessary to provide this DDC control. Include modifications to the boiler controls to provide full modulation (0-100%) to replace High/low/on/off burner control if possible. Modifications to the boiler may require boiler certification; this is the responsibility of the contractor. Provision for software, control equipment, relays, etcetera including control strategies to integrate the boiler control into the new controls.

2.9. Testing and Commissioning

The Consultant shall in association with the contractor prepare a testing and commissioning procedure four weeks prior to practical completion.

The testing and commissioning is to include the following:

- Each item of equipment individually and each complete system as a whole shall be checked and adjusted to achieve satisfactory performance.
- Calibrate all existing field equipment (sensors, valves, actuators, analogue points, etcetera).
- Ensure that all DDC Controls hardware and software points and all software as outlined in this specification are working as required from BMIS Server.
- Practical Completion

Prior to the issue of the Certificate of Practical Completion the Consultant shall via the Principal Consultant provide to the University certification by the contractor that the equipment, plant and services comply with the documentation and are in a condition that it is fit for purpose in accordance with industry practice and warranties.

2.9.1. Acceptance of Completed BAS Installation

Upon completion of the installation, the contractor shall start up the system and perform all necessary calibration, testing, and debugging operations. An acceptance test shall be performed by the contractor in the presence of the Sattler Consulting. Acceptance test shall be scheduled with at least 10 working days advance notice.

Manufacturer's Field Service: Engage a factory- authorised service representative to inspect field assembled components and equipment installation, including piping and electrical connections. Report results in writing.

Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.

Test and adjust controls and safeties.

Replace damaged or malfunctioning controls and equipment.

Start, test, and adjust control systems.

Demonstrate compliance with requirements, including calibration and testing, and control sequences.

Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.

The acceptance test shall include, but not be limited to:

The contractor shall submit a checklist of the objects for the test. The checklist shall be submitted to Charles Sturt University, and reviewed and approved, prior to the test. The checklist shall include all objects that have event (alarm) routing defined.

The contractor shall verify the proper operation of all input/outputs.

The contractor shall verify the proper event (alarm) routing to the BMIS for all points on the main equipment and perform a complete check of the operations of all equipment.

The contractor shall verify that the software programs meet the design intent of the control sequences in the Construction Documents.

The contractor shall verify the proper operation of the system software on the operator workstation.

The contractor shall verify all inputs meet or exceed manufacturer's stated tolerances for accuracy.

The contractor shall verify that all on-line graphical displays of equipment accurately represent the real time state of the field equipment.

The contractor shall verify that all on-line graphical displays of programming logic accurately represent the real time state of the field equipment.

The test shall include all workstation/server level integration included in the scope of this project with the contractor.

The test shall include functional verification of all interfaces and system integration required to meet the scope of this project.

Final acceptance shall include acceptance by the University's Facilities Management Group.

The Acceptance Test shall be conducted with the contractor, the Head Contractor representative (where applicable), and a representative from Charles Sturt Univerty present.

Turnover of ALARMS to CSU Facilities Management staff: Alarms being turned-over to CSU Facilities Management staff shall have been activated, tested for proper routing and determined to not be producing frequent and nuisance alarms. It is expected that Alarms will not be turned-over to CSU Facilities Management staff until there is final acceptance of the completed BAS installation.

All of the points which are alarmed shall be trended and archived from the time of installation through the end of the warranty period. All archived files will be readily accessible to the University's Facilities Management Group.

Start-up and commission systems: Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.

Provide any recommendation for system modification in writing to the University's Facilities Management Group. Do not make any system modification, including operating parameters and control settings, without prior approval of the University's Facilities Management Group.

Provide certificate stating that control system has been tested and adjusted for proper operation.

Equipment Panel As-Built Drawings: After the above final approval, one set for the entire project shall be provided in the Building Controller Panel, and a paper-copy set of just the Drawings for that System shall be provided in each System Panel, and submitted for inclusion into the manuals.

2.9.2. Independent Commissioning

Charles Sturt University will provide advice when the services of an Independent Commissioning Agent is to be involved. Where directed, the contractor shall allow for involvement in the independent commissioning of this project as follows.

Commission to (as pertaining to controls):

- ASHARE Guideline 1-1996 The HVAC Commissioning Process
- CIBSE Commissioning Code M: Commissioning Management
- In general, the goals of the commissioning procedure are as follows:
    - Adherence to items 1 & 2.
    - Proof that the services perform in conformity to the design intent.
    - 4 times commissioning and re-commissioning (on site).
    - 12 Months tuning in conjunction with all services including prescribed software.
    - Modifications as per Independent Commissioning Agent's instruction for optimisation of services.
- Contractor to allow for commissioning and re-commissioning.
    - 4 total commissioning and re-commissioning system operation demonstrations per 12 months, one each quarter. First commissioning is prior to handover. Second recommissioning is 3 months after handover; third re-commissioning is 6 months after handover and fourth re-commissioning is 12 months after handover. All recommissioning is to be in attendance on site and demonstrate every BACnet Object to Independent Commissioning Agent including system operation.
    - Provision of documentation stating all BACnet Objects (software and hardware) complete with sign off sheet by contractor and Independent Commissioning Agent.
- Contractor to use NATA certified instruments (certified within 6 months) for testing, commissioning and demonstration of system operation.
- Provision of Independent Commissioning Agent to access system and check system operation, access and download trends and review alarms historically.
- Demonstration of system operation through trends (and system operation observation by Independent Commissioning Agent). AO trends to be at 1 second intervals for maximum 1 hour and over 8 hours at 15 minutes (configured for Independent Commissioning Agent to review dynamically and historically) and all other trends to be as per Independent Commissioning Agent's requirements based on Object type and services controlled (TBA).
- Each AI is to be calibrated, every BI, BO to be tested and checked for operation and correct signal response and all AO to be checked/calibrated for full stroke of field equipment (or full output control). All PID loops tuning to be checked using 1 second interval trends showing output, input and loop percentage for 60 minutes. Additional trends of 8 hours (occupancy) showing general trend of zones.
- Demonstrate that control strategies are working as per design. Show trends of operation proving strategies work as per design.

2.9.3. Training

The BMS Contractor shall initiate the training of nominated Charles Facilities Management personnel in the operation and maintenance of the installed systems. The approved O & M Manual and approved as-installed drawings are to be used in this training.

The training shall include the following:

- Instruct the Proprietor's nominated representatives in details of the BMIS/DDC equipment and installation, and operation and use of the BMIS/DDC.
- The Contractor's staff shall be experienced in providing adequate training.
- Training shall be covered at a period of 4 hours of direct contact at nominated location.
- Training of operators – allow for 4 individuals to undergo training.
- Training for the integration of controllers and associated software to the BMIS Server (the BMIS server is located at CSU – Wagga Wagga).

Only at the conclusion to this training, and provided the contractor has fulfilled all other obligations, will the Certificate of Practical Completion be issued.

2.9.4. Operation and Maintenance Manuals

Detailed instructions shall be included in the Tender Specification for the preparation and supply of Operation and Maintenance Manuals.

Initiation of the services contractor's preparation of the draft Operations and Maintenance Manual is the responsibility of the Principal Consultant at the point of time when the detailed engineering of the systems is completed and approval has been given for all equipment and materials. The expected timing of the submission of the draft Manual is half way through the construction period.

The Consultant shall require the Main Contractor to first check the draft Manual for its compliance with the set format before its submission, and the final Manual is to be signed as approved by the Consultant before it is offered to the University's Senior Project Manager, Services for acceptance.

All O&M documentation to be supplied electronically as well as hard copy.

The minimum configuration of an Operation and Maintenance Manual shall comprise:

- The title and description of the works
- A list of designers, contractors and sub-contractors
- A description of the plant
- Plant operation and operation instructions including fault diagnostic & remediation
- A schedule of all items of equipment and suppliers
- Installation details
- A fully detailed description of the automatic control systems
- Commissioning, Testing and Balancing Reports

- Maintenance schedule and manufacture's literature on maintenance and service of each item of plan
- Drawings and Wiring Diagrams (As Installed)
- Certification of Compliance
- Warranty Certificates
- Other information relevant to the betterment of the plant maintenance requirements.

2.9.5. Drawings

All "As-Built" drawings shall also be produced on the latest version of the Auto Cad software program.

As-built drawings shall accurately reflect the arrangement of DDC Services installation. Components shall be allotted an asset tag.

The signature of the contractor, the main contractor and the services Consultant shall be clearly displayed on each drawing.

Drawings to be submitted also in PDF format electronically.

2.9.6. Defects Liability Period (DLP)

Prior to Practical Completion the installation shall be commissioned and tested by the contractor to the satisfaction of the appointed personnel by CSU and the Statutory Authorities prior to the acceptance of the installation and the commencement of the Defects Liability Period.

2.9.7. Defects List

Rectification of all defects is to be monitored by the Consultant during the Defects Liability Period. The listing shall then become the property of Charles Sturt University, to be available for reference during the ongoing operation and maintenance of the building.

2.9.8. Routine Maintenance and Servicing

Six monthly maintenance and servicing on all new equipment and existing field equipment shall be specified to be carried out during the Defect Liability Period & extended warranty period. All sensors to be calibrated every 6 months, all points to be checked for operation every 6 months during warranty. All alarms to be rectified within 30 days. Ensure all DDC information is available/ accessible at BMIS Server. Provide ability to calibrate from the BMIS Server.

Six monthly maintenance shall be deemed to be the regular maintenance of equipment shall include not less than:

- Checking the operation of the DDC as a whole: resolve alarms and associated problems, resolve any CSU personnel temperature complaints that relates to controls.
- Checking the operation, setting and calibration of all sensors, statuses, inputs, outputs actuators, valves and general equipment operation bi-annually.

- Minimum provision of hours per maintenance visit (Consultant to determine based on size of project). Contractor must be on site for the allocated hours as a minimum to provide the service.
- Review and ensure that all data/ information/ points (hardware and software) are accessible from the BMIS Server and continue to be so. Resolve any outstanding issues as identified by the Consultant of CSU nominate the hours for the provision.
- Ensure mechanical modifications are performing as installed, resolve any problems that occur, etcetera.
    - Check and tune all PID loops during service.
    - Emergency service shall be carried out on a 24 hour call out basis.
    - Maintenance procedures shall be as appropriate to ensure the safe and proper operation of all systems and shall be in accordance with current standard requirements of the Building Act and Regulations have jurisdiction, Australian Standards, Local Authority Regulations and the schedule provided in the installation Manual as outlined in section – “Testing and Commissioning”.
    - All maintenance procedures shall be strictly in accordance with equipment manufacturer’s recommendation, adapted as necessary for the particular installation.
    - The last maintenance visit prior to the end of the Maintenance and Defects liability Period shall be a major visit for complete service including resolving all outstanding warranty issues. Service shall provide for a complete operational DDC System and include the following:
        - All sensors calibrated.
        - All inputs/ outputs checked and operating as required.
        - All DDC data/ points/ information /objects/ points (hardware and software) are accessible from the BMIS Server.
        - All controllers checked for normal operation, faults, power supply.
        - Any communication problems resolved.
        - All alarms to be rectified.
- At the conclusion of each maintenance visit, a checklist of items checked and serviced shall be completed and submitted to a responsible person on site.
- The tender submission shall include recommendations for any further maintenance servicing procedures required for the particular equipment offered and such services shall be included for in the tender price.

3. Checklist for Project Teams

Activity	Responsibility	Stakeholders	Timeframe

4. Supporting Documentation

These below lists are not all-inclusive and those associated with the project are responsible for identifying and complying with all standards relevant to the scope of works.

4.1. Supporting Legislation

National Construction Code of Australia (NCC) 2022 (Cth)

Work Health and Safety Act 2011 (NSW)

Work Health and Safety Regulation 2017 (NSW)

Work Health and Safety Act 2011(ACT)

Work Health and Safety Regulation 2011(ACT)

Building and Development Certifiers Act 2018 (NSW)

Environmental Planning and Assessment Act 1979 (NSW)

4.2. Supporting Standards

Standard Number	Standard Title
AS 1428 Series	Design for access and mobility
AS 1851: 2012	Routine service of fire protection systems and equipment (Amd 1:2016)
AS 1668 Series	The use of ventilation and air conditioning in buildings
AS/NZS 1680 Series	Interior and workplace lighting
AS 2118.1:2017	Automatic fire sprinkler systems, Part 1: General systems
AS/NZS 2293.1:2018	Emergency lighting and exit signs for buildings, Part 1: System design, installation and operation
AS/NZS 2293.2:2019	Emergency lighting and exit signs for buildings, Part 2: Routine service and maintenance
AS/NZS 2293.3:2018	Emergency lighting and exit signs for buildings, Part 3: Emergency luminaires and exit signs (Amd 1:2021)
AS 2419.1:2021	Fire hydrant installations, Part 1: System design, installation and commissioning
AS/NZS 3000:2018	Electrical installations (known as the Australian/New Zealand Wiring Rules) (Amd 3:2023)
AS/NZS 3008.1.1:2017	lectrical installations - Selection of cables, Part 1.1: Cables for alternating voltages up to and including 0.6/1 kV - Typical Australian installation conditions
AS/NZS 3666 Series	Air-handling and water systems of buildings
AS 3745:2010	Planning for emergencies in facilities (Amd 2:2018)
AS/NZS 4804:2001	Occupational health and safety management systems — General guidelines on principles, systems and supporting techniques

4.3. Industry Codes of Practice

AIRAH (Australian Institute of Refrigeration, Air Conditioning and Heating) - DA24 Guidelines

https://airah.org.au/site/site/resources/da-manuals/Default.aspx

NEBB (National Environmental Balancing Bureau) - Technical Commissioning Guidelines
https://www.nebb.org/resources/nebb-bookstore/procedural-standards/

ARC (Australian Refrigeration Council) - Refrigeration and Air Conditioning Industry Codes of Practice
https://www.arctick.org/refrigerant-handling-licence/codes-of-practice/

IBPSA (International Building Performance Simulation Association) - Guidelines and Standards
https://ibpsa.org/publications/

NABERS (National Australian Built Environment Rating System)
https://www.nabers.gov.au/

4.4. University Documents

Charles Sturt University Facilities and Premises Policy
https://policy.csu.edu.au/document/view-current.php?id=465&version=1

4.5. Other Resources

BuildingSMART Australasia
https://www.buildingsmart.org.au/

4.6. Glossary

Term	Definition / Description
ASHRAE	American Society of Heating Refrigeration and Airconditioning Engineers
BACnet	Building Automation Control Network
BACnet Device	BACnet compliant controls equipment
BIBB	BACnet Interoperability Building Blocks
BMIS	Building Automation System
BTL	BACnet Testing Laboratories. Products must be certified as BACnet compliant by BTL
DDC Controls	Direct Digital Controls (older controls were electronic or pneumatic)
LAN	Local Area Network
MS/TP	BACnet Communications Standard: Master Slave/Token Passing
Objects	BACnet objects as defined by BACnet standard
PICS	BACnet Standard Protocol Implementation Conformance Statement
Protocol Implementation Conformance Statement	Stated manufacturer's compliance to BACnet standard

5. Specifications

5.1. Generic Control Strategies

		Method of Control (Indicate those that apply)			Operating Schedule (Where applicable)										
Building	Space Type	Time Schedule E=Enable A=Activated	Occupancy Sensor	Users Activated	Start Time	Finish Time	Occupied Run Time	After hours Runtime	Pre-Conditioning or Set Back Temperature	Operating Mode	Fan Speed	Cooling Setpoint	Heating Setpoint	Deadband Occupied	Occupant Adjustable Setpoint (and range)
BA Grange	Meeting Room	A	N	N	06:00 (M-F)	18:00 (M-F)		4 Hrs	N/A			21	21	1	Y (Full)
WW FM Offices	Enclosed Workspace	E	N	Y	08:00 (M-F)	17:00 (M-F)		2 Hrs	N/A	User Adjustable	User Adjustable	User Adjustable	User Adjustable	Dakin Controller	Y (Full)
WW FM Offices	Open Plan Workspace	A	N	N	08:00 (M-F)	17:00 (M-F)			N/A						
AW Residence	Student Residences	E	Y	Y	Not Scheduled	Not Scheduled	1 Hr	N/A	N/A	User Adjustable	User Adjustable	User Adjustable	User Adjustable	Dakin Controller	Restricted 20°C to 24°C
WW Residence	Student Residences	A	Y	Y	08:00 (M-F)	17:00 (M-F)		2 Hrs	28°C Summer 18°C	User Adjustable	User Adjustable	User Adjustable	User Adjustable	Dakin Controller	Restricted 20°C to 24°C
Lecture Theatre	Lecture Theatre	E	Y		08:00 (M-F)	17:00 (M-F)		2 Hrs	28°C Summer 18°C	User Adjustable	User Adjustable	User Adjustable	User Adjustable	2°C	Restricted 20°C to 24°C
Port Macquarie	Learning Space	A	N	N	08:00 (M-F)	17:00 (M-F)		2 Hrs	N/A	N/A	N/A	26°C	19°C	Cooling 4°C / Heatin	Restricted 20°C to 24°C
Port Macquarie	Workspace	A	N	N	08:00 (M-F)	17:00 (M-F)		2 Hrs	N/A	N/A	N/A	26°C	19°C	Cooling 4°C / Heatin	Restricted 20°C to 24°C
Port Macquarie	Labs	A	N	N	08:00 (M-F)	17:00 (M-F)		2 Hrs	N/A			22°C	22°C	1°C	Restricted 20°C to 24°C
BA Eng	Learning Space	A	Y	N	08:00 (M-F)	17:00 (M-F)		2 Hrs	28°C Summer 18°C	N/A	N/A	22°C	22°C	1°C	Restricted 20°C to 24°C
BA Eng	Workspace	A	Y	N	08:00 (M-F)	17:00 (M-F)		2 Hrs	28°C Summer 18°C	N/A	N/A	22°C	22°C	1°C	Restricted 20°C to 24°C
BA Eng	Meeting Room	A	N	N	08:00 (M-F)	17:00 (M-F)		2 Hrs	N/A	N/A	N/A	22°C	22°C	1°C	Restricted 20°C to 24°C

5.2. Trend Logs and Alarms

Equipment Type	Required Points	Trend Log Required	Alarm Required	Alarm Type
Boiler	Supply Temp	Yes	-	-
	Return Temp	Yes	-	-
	Status	Yes	-	-
	Call / Enable	Yes	-	-
	Lead / Flag Status	Yes	-	-
	Fault	-	Yes	SMS
	Setpoint	Yes	-	-
	Bypass Valve Position	Yes	-	-
	Override	-	-	-
Chiller	Status	Yes	-	-
	Supply Temp	Yes	-	-
	Return Temp	Yes	-	-
	Status	Yes	-	-
	Call / Enable	-	-	-
	Fault	-	Yes	SMS
	Setpoint	Yes	-	-
	Override	-	-	-
	Lead / Flag Status	Yes	-	-
	Additional info via HLI	-	-	-
CWP / HHWP	Status	Yes	-	-
	Diff pressure	-	-	-
	Call / Enable	Yes	-	-
	Pressure setpoint (if rel)	-	-	-
	Speed (if rel)	Yes	-	-
	Fault	-	Yes	SMS
	Override	-	-	-
AHU	Zone temp	Yes	Yes (if Rel)	Aurora
	Zone setpoint	Yes	-	-
	Zone humidity (if rel)	Yes	-	-
	Zone humidity stpt (if rel)	-	-	-
	Fan status	Yes	-	-
	Fan call / Enable	Yes	-	-

Equipment Type	Required Points	Trend Log Required	Alarm Required	Alarm Type
	Fan Fault	-	Yes	SMS
	Damper position (if VAV)	Yes	-	-
	Supply air temp	Yes	-	-
	Return air temp	Yes	-	-
	CHW valve position	Yes	-	-
	HHW valve position	Yes	-	-
	CHW valve override	-	-	-
	HHW valve override	-	-	-
	CHW valve override value	-	-	-
	HHW valve override value	-	-	-
	Economy dampers (if rel)	Yes	-	-
	Economy enabled	Yes	-	-
	Economy lockout temps	-	-	-
FCU (includes multi-head splits)	Zone temp	Yes	Yes (If Rel)	Aurora
	Zone setpoint	Yes	-	-
	Fan status	Yes	-	-
	Fan Call / Enable	Yes	-	-
	Control Panel Lockout	-	-	-
	Operating mode	Yes	-	-
	Compressor Call	Yes	-	-
	Compressor Fault	-	Yes	SMS
Packaged units	Zone temp	Yes	Yes (If Rel)	Aurora
	Zone setpoint	Yes	-	-
	Fan status	Yes	-	-
	Fan Call / Enable	Yes	-	-
	Control Panel Lockout	-	-	-
	Operating mode	Yes	-	-
	Compressor Call	Yes	-	-
	Compressor Fault	-	Yes	SMS
	Supply air temp	Yes	-	-
	Return air temp	Yes	-	-
Cooling Towers	Supply Water Temp	Yes	-	-
	Return Water Temp	Yes	-	-

Equipment Type	Required Points	Trend Log Required	Alarm Required	Alarm Type
	By Pass Valve Position	Yes	-	-
	Fan Call / Enable	Yes	-	-
	Fan Fault	-	Yes	SMS
	Pump Call	Yes	-	-
	Pump Fault	-	Yes	SMS
Exhaust Systems	Fan Call / Enable	Yes	-	-
	Fan Fault	-	Yes (If Rel)	Aurora
	Run Time	Yes	-	-
Lighting	Lighting Status	Yes	-	-
Windows	Window Status	Yes	-	-
Fume Hoods	Fan Call	Yes	-	-
	Fan Fault	-	Yes (If Rel)	Aurora
	Sash Position (If Rel)	-	-	-
Air Compressors	Compressor Call	Yes	-	-
	Run Time	Yes	-	-
Medical Gas	Alarm Status	-	Yes	SMS
	Bottle Change	-	-	-
Fire Panels	Alarm Status	-	Yes	SMS
	Fault Status	-	-	-
	Isolation Status	-	-	-

5.3. BACnet Conformance

The following applies to version 135-2004 of the BACnet protocol.

The contractor is to be made aware of the need to submit a Vendor Compliance Statement indicating compliance on the following minimum BACnet Interoperability Building Blocks (BIBB) and Device Profiles. Refer to Protocol Implementation Conformance Statement (Normative) as per Annex A of BACnet Standard as submission guideline and Appendix D of this standard. It is important that the minimum acceptable conformance be confirmed as: BIBB and Device Profiles.

Minimum Conformance – BIBB and Device Profiles

Definitions (Relevant to the BIBB and Device Profiles)

1) Data Sharing

   a) Data Sharing is defined as the exchange of information between BACnet devices. It may be unidirectional or bidirectional.

   b) Data Sharing is specified for several categories of interoperability in the Table that follows overpage

2) Alarm and Event Management
    a) Alarm and Event Management is the exchange of data between BACnet devices specifically related to the occurrence of a pre-defined condition.
    b) In the case of an Alarm, interoperability shall mean the ability to annunciate, acknowledge and display data related to the event.
3) Scheduling
    a) Scheduling is the exchange of data between BACnet devices that permit the establishment and maintenance of dates and times at which specified output actions are to be taken.
    b) Interoperability in this area permits the use of date and time schedules for the purpose of starting and stopping equipment and changing of control setpoints as well as other analogue or binary parameters.
4) Device and Network Management
    a) Device and Network Management is the exchange of data between BACnet devices concerning the operation and status of specified devices.
    b) Interoperability shall permit the determination of which devices are present on a given network.
    c) Interoperability shall permit the start-up and shut down of the communication activities of a particular device.
    d) Interoperability shall permit the synchronisation of time in devices.
    e) Interoperability shall permit the re-initialisation of a particular device.
5) Trending and Archiving
    a) Trending and Archiving is the accumulation of (Time and Value) pairs at specified rates and for a specified duration.
    b) Trending is not defined as real time plotting and or display of data derived from network device.
    c) Interoperability shall permit the establishment of trending parameters and the subsequent retrieval and storage of the data.
    d) Trending intervals shall be a minimum of 1 second.
    e) Trending intervals shall be a maximum of 1 year.
    f) Trending data value for a particular interval shall be selectable as “Average over the Interval” or “Minimum during the Interval” of “Maximum during the Interval”.
    g) The number of Trending Intervals possible within a particular network device shall be stated by the vendor in terms of how many Trend arrays, containing 2 discrete analogue point values of 5 digits plus decimal point each along with the time stamp for the values, for 1000 intervals of 1 hour are possible. The time stamp shall contain at minimum, DD/MM/YYYY – hh/mm/ss. The Vendor shall state the number of Trend arrays possible within the context of the fully configured system as specified, with operating programs, schedules, setpoints, etcetera.

BIBB Capability Matrix

Refer to Section 5.4 for BACnet standard definitions.

Contractor to indicate compliance for each item in their Vendor Compliance Statement.

Data Sharing	B-OWS	B-BC	B-ACC	B-ASC	B-SA	B-SS
1	DS-RP-A,B	DS-RP-A,B	DS-RP-B	DS-RP-B	DS-RP-B	DS-RP-B
2	DS-RPM-A	DS-RPM-A,B	DS-RPM-B	DS-WP-B	DS-WP-B	
3	DS-WP-A	DS-WP-A,B	DS-WP-B			
4	DS-WPM-A	DS-WPM-B	DS-WPMB			
5		DS-COVUA,B				
Alarm and Event Management	**B-OWS**					
6	AE-N-A	AE-N-B	AE-N-B			
7	AE-ACK-A	AE-ACK-B	AE-ACK-B			
8	AE-ASUM-A	AE-ASUM-B				
9	AE-ESUM-A	AE-ASUM-B				
Scheduling	**B-OWS**	**B-BC**	**B-AAC**	**B-ASC**	**B-SA**	**B-SS**
10	SCHED-A	SCHED-B	SCHED-B			
Trending	**B-OWS**	**B-BC**	**B-AAC**	**B-ASC**	**B-SA**	**B-SS**
11	T-VMT-A	T-VMT-B				
12	T-ATR-A	T-ATR-B				
Device Management & Network Management	**B-OWS**	**B-BC**	**B-AAC**	**B-ASC**	**B-SA**	**B-SS**
13	DM-DDB-A,B	DM-DDB-A,B	DM-DDB-B	DM-DDB-B	DM-DDBB	
14	DM-DOBA,B	DM-DOB-A,B	DM-DOB-B	DM-DOB-B		
15	DM-DCC-A	DM-DCC-B	DM-DCC-B	DM-DCC-B		
16	DM-TS-A	DM-TS-B	DM-TS-B			
17	DM-RD-A	DM-TS-B	DM-TS-B			
18	DM-BR-A	DM-RD-B	DM-RD-B			
19	NM-CE-A	NM-CE-A				

5.4. BACnet Interoperability Building Block Definitions

BIBB	Description
B-OWS	BACnet Operator virtual Work Station (accessible via Optergy)
B-BC	BACnet Building Controller
B-AAC	BACnet Advanced Application Controller
B-ASC	BACnet Application Specific Controller
B-SA	BACnet Smart Actuator
B-SS	BACnet Smart Sensor
DS	Data Share
AE	Alarm Event
SCHED	Scheduling
TREND	Trending
DM	Device Management
NM	Network Management
RP	Read Property
WP	Write Property
RPM	Read Property Module
WPM	Write Property Module
N	Notification
A	Acknowledge
ASUM	Alarm and Event Summary
ESUM	Event Summary
RPC	Read Property Conditional
COV	Change of Value
COVU	Change of Value Unsubscribed
VMT	View and Modify Trend
BR	Backup and Restore
TS	Text Message
TM	Text Message
DDB	Dynamic Device Binding
DOB	Dynamic Object Binding
DCC	Device Communication Control
PT	Private Transfer
UTC	Coordinated Universal Time (GMT)

BIBB	Description
RD	Reinitialise Device
LM	List Manipulation
OCD	Object Creation and Deletion
CE	Connection Establishment
RC	Router Configuration
VT	Virtual Terminal
ATR	Automatic Trend Retrieval

5.5. BACnet Object Integration (Appendix 1)

Expand as required to include all parameters, objects, virtual points, hardware, or software points, etc. Include any additional information to assist Charles Sturt University in the integration of the BACnet Objects into the BMIS Server.

Hardware / Software Point name (where applicable)	Point # or address	Point Type (AI,AO, DI,DO, MS, virtual)	Detailed Point Description	Device Instance	Object Type	Object Instance	Array Index	Read / Write