Design Guidelines
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UC
UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Section 17 Metering and Controls.

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Standards in the Design Guidelines Suite

Design Standard Guidelines Index:

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17.1 Overview

User-friendly and effective control of all equipment, devices, lighting and plant is fundamental to energy management. Switches and other controls should be located intuitively and easy to use with minimal instruction.

Information will be collected from electricity and water meters. Data will be used by the University to optimise energy and water consumption of the buildings and to provide feedback to the University through the Energy Management System (EMS) and the Building Management System (BMS).

This section of the Design Standard Guidelines is intended to be read in conjunction with **Section 01 – General** and any project specific brief and agreements.

17.1.1 Existing Systems

17.1.1.1 Building Management System (BMS)

The University has installed a BACnet compatible Building Management System (BMS) to control its buildings in both the Ilam and Dovedale campuses.

All campus water and water energy metering are connected to the campus BMS for processing; this connection must be via high level communication (BACnet, MODBUS or M-bus).

The BMS allows building plant to be monitored and controlled by the BMS controllers situated within the buildings Motor Control Centre (MCC) or distribution boards (depending on the application, lighting control or mechanical).

The BMS controllers use a variety of factors (outside air temperatures etc.) to optimise the start/stop and set-points of air conditioning plant. The plant operation may be viewed from the front end via dedicated building graphics, and any adjustment of control systems can be implemented from there.

17.1.1.2 Energy Management System (EMS)

The University has installed a dedicated Energy Management System (EMS) which is separate to the campus Building Management System (BMS). There are multiple serial communication protocol connections between the two systems to allow for data exchange between the BMS and the EMS.

All campus electricity meters are connected directly to this EMS via the campus IT network.

Table 1: Metering Communications Breakdown

Type of Service	Connected To	Connected Via
Electricity	EMS	Ethernet/EtherGate (ION protocol) EGX100 (MODBUS)
Domestic Cold Water (DCW)	BMS	MODBUS, BACnet or M-BUS
Domestic Hot Water (DHW)	BMS	BACnet
Artesian Ground Water (ARTW)	BMS	MODBUS, BACnet or M-BUS
Heating Water (MTHW)	BMS	BACnet
Cooling Water (CHW)	BMS	BACnet

17.1.2 Specific Approvals Required

In addition to the approvals required in the General Section of the Design Standard Guidelines, and any project specific brief, the following specific approvals are required:

- The integration of all new meters into the campus Energy Management System (EMS) must be undertaken by the University. The University will need 10 working days' notice to undertake this work. All associated communications cabling must be completed prior to the University's involvement.
- The metering communication topology must be approved by the University.
- All proposed instance numbering, network numbering and IP addressing associated with BACnet communications is of the upmost importance and must be submitted in writing to the University for approval before any connection to the Building Management System (BMS) is made. This process eliminates the possibility of address conflicts resulting in system wide communications disruptions.

Consultants will also be required to attend documentation reviews with Engineering Services Building Controls staff at the following key stages:

- At completion of schematic design
- At 90% completion of tender documentation
- On completion of 'draft' BMS graphics pages; prior to commissioning

17.2 Design Concepts

17.2.1 Building Management System (BMS)

New plant or controls installed in existing buildings, and any new buildings, shall be fitted with controls suitable for connection to the University Building Management System (BMS).

The existing system will support expansion into additional buildings via the BACnet protocol consisting of only two BMS hardware vendors, Siemens and Delta, who are the only BMS approved vendors approved for use at the University.

The BMS may also be required to control complex lighting designs or Audio Visual (AV) interfaces (lecture theatres and large teaching spaces). This control is to be achieved via a Siemens Desigo Total Room Automation (TRA).

There shall be a demarcation between the two electrical disciplines (general electrical and electrical for mechanical) in the form of individual Network Communications Protocol (KNX) buses.

The Desigo TRA shall connect to the campus Audio Visual (AV) system via a KNX gateway. This allows complete visibility and control of the building lighting system, eliminating the need for separate lighting control systems.

17.2.1.1 Graphic Page Format

Graphics page development shall be part of all new works or modifications to existing systems. Additions and alterations to the BMS graphic interface shall be compliant with the current BMS default graphic page format which consists of but is not limited to:

- Appropriate jump links from the main campus map page to a new installation
- A main building page consisting of a building index with jump links to each floor and links to all centralised plant within the building
- All centralised plant graphics must show pipework / ducting schematics with associated field device readings shown on the schematic
- Each floor of the building shall have a detailed as-built floor plan showing all HVAC zones (with links to each individual Air Conditioning plant), the floor plan shall also show space temperatures, radiator zones and associated zone valves, lighting zones and lighting statuses (if applicable) and an ambient temperature. All space temperatures, zone valves and lighting zones shall be placed on the floor plan as close to the actual as-built location as possible
- The graphic pages for each specific Air Conditioning plant shall show all associated field devices time schedule links for all plant with attached schedules
- Cooling water valve summary page, and heating water valve summary page
- A dedicated building time schedule page
- All lighting graphics must show individual light fitting addresses (if applicable)
- Fire alarm statuses

17.2.1.2 Trend Logs

All points associated with building plant shall be trend logged for performance monitoring and to assist with any plant fault finding.

All trend logs must automatically upload data to the BMS and have a minimum sampling time of five minutes. Any trending of instantaneous consumption values must be performed via a time based average.

17.2.1.3 Point Licencing

Any new installation must allow for the upgrade of the any software license to incorporate additional points should they be required for the project.

17.2.2 Metering Requirements

Metering is required for all new buildings and/or major plant items or specified services. All new meters must be fitted with a high level communications output and a pulse output to allow remote interrogation. As a minimum, metering of services to buildings and sub metering within buildings shall include:

- Electricity
- Domestic cold water
- Domestic hot water
- Artesian ground water
- Heating water (MTHW)
- Cooling water (CHW)

17.2.3 Automated Lighting Control

17.2.3.1 Smaller Office Areas

In general, any lighting within smaller office areas (4 light fittings or less) shall have standalone lighting control in the form of a standard light switch and occupancy sensor.

17.2.3.2 Lecture Theatres and Large Teaching Spaces

All lighting control within a lecture theatre or large teaching space shall have an interface to the campus Audio Visual (AV) system and provide control of the lighting via a single lecture control panel.

This interface will provide the control system a method of turning all lights on or off, selecting lighting scenes and controlling projector screens (if applicable).

17.3 Materials & Equipment

17.3.1 BMS Controllers

17.3.1.1 BACnet Communications

All Building Management System (BMS) controllers are to be located in plant rooms with an allowance of network data points and one double GPO.

All BMS controllers shall communicate via BACnet IP and allowance must be made for the installation of network data points for connection to the Building Management System (BMS) Virtual Local Area Network (VLAN) with the provision of one spare port for a laptop connection.

BACnet MS/TP may also be used in specific cases but should be limited to auxiliary BACnet devices/ 3rd party devices such as variable speed drives (VSDs), chillers, energy meters and other high level interfaces where BACnet points are referenced but there is no requirement for a BACnet device to be imported into Desigo Insight. If a BACnet MS/TP device is be imported into Desigo Insight, the appropriate Desigo MS/TP router must be used (PXG3.M).

17.3.2 Metering Equipment

17.3.2.1 Electrical Metering

All electrical metering shall be Schneider PowerLogic type meters and be directly compatible with the current version of the power monitoring software.

All additional electrical meters shall be added to the existing power monitoring device licence with associated costs covered by each specific project as a part of the new installation.

All new buildings must have an ION7650 meter on the low voltage main incomer installed within the building main switchboard (MSB), all sub-main metering shall also be installed within the building MSB where possible.

17.3.2.2 Artesian Metering

All artesian ground water metering shall be ABB Magflow type (WaterMaster) meters with a remote mounted transmitter and MODBUS communication for connection to the campus BMS.

These Magflow meters must be installed in the appropriate undisturbed straight pipe length as per the manufacturer's instructions. Where possible, a bypass and associated isolation valves should be installed in parallel with this meter to enable the meter to be changed out without building downtime.

17.3.2.3 Domestic Cold Water Metering

All domestic cold water metering shall be ABB Magflow (WaterMaster) type meters with a remote mounted transmitter and MODBUS communication for connection to the campus BMS.

These Magflow meters must be installed in the appropriate undisturbed straight pipe length as per the manufacturer's instructions. Where possible, a bypass and associated isolation valves should be installed in parallel to this meter to enable the meter to be changed out without building downtime.

17.3.2.4 Energy Metering

All energy metering shall be Siemens type energy meters and have removable temperature probes and a remote mounted transmitter along with a BACnet communications card for connection to the campus BMS.

All energy metering must have suitable temperature rating for each specific application.

17.3.3 Automated Lighting Control

Any automated lighting control, including DALI ballasts, shall be controlled via Desigo TRA. This involves the installation of a Siemens PXC3.E72a controller within the relevant electrical DB along with network data outlets to provide connection back to Desigo Insight via the BMS VLAN.

Any peripheral devices associated with lighting control, such as control points, switches, occupancy sensors, lux sensors etc. shall be of the Siemens KNX PL-Link series.

Other third party KNX peripheral devices can be used upon approval of the University Building Controls Specialist.

The general electrical KNX cabling shall be white in colour and be run to all general electrical peripheral devices (switches, occupancy sensors etc.).

The electrical for mechanical KNX bus shall be green in colour and be run to all mechanical peripheral devices (temperature sensors, dampers etc.).

17.3.4 Variable Speed Drives

Refer to the University standard equipment list for approved Variable Speed Drive (VSD) suppliers. They must have a native BACnet connection along with the BACnet communications label described in the BACnet Communications section of this document.

17.3.5 Control Valves

All control valves shall be Siemens Magnetic type where possible. All valve actuators must provide a 0-10v position feedback signal to the BMS.

17.4 Installation Requirements

17.4.1 Commissioning

Commissioning point lists must be available at controller enclosures and kept up to date throughout the duration of all projects. At the completion of all projects an up to date installation point list must at be available at controller enclosures and a copy included in the maintenance manuals.

Any Siemens Desigo PX device must be created on the University Desigo Insight development PC located in the Controls Office (R201) of the Engineering Services building to ensure correct controller numbering and that the most up to date site database is being utilised.

An appointment will need to made through the University Project Manager for access to the system and the University Building Controls Specialist.

17.4.2 AV Interface to BMS for Lighting Control

The interface to the campus AV system shall be via a KNX to AMX gateway which is to be installed inside the electrical distribution board adjacent to the Siemens TRA PXC3 controller.

The KNX to AMX gateway requires a duel power outlet and a triple data outlet.

17.5 Numbering & Labelling

17.5.1 Point and Cable Labelling Formats

All cables (both the outer sheath and individual cores) are to be identified at the field and the controller using the University standard cable numbering materials.

Building Management System (BMS) cable marking shall include field device cabling and BMS controller communication cabling such as communication trunks (BACnet, Modbus, M-Bus etc.) and also remote I/O bus cabling.

Field device cable marking shall be twofold, the outer cable sheath shall be labelled at each end with a heatshrink tube label, and one of the individual cable cores (preferably the signal core) shall have 'Grafoplast Trasp' type markers at both the field termination and the BMS controller termination.

For controller communication trunk cabling a single heatshrink tube label at each end is suitable.

17.5.1.1 BMS Point Labelling Format

All BMS points must comply with the current the University BMS labelling format which is as follows:

Building identifier-floor level OR type of centralised plant-room number OR area served-field device label.

Example 1: SC02-LV2-R234-RMT

Example 2: SC02-HEATING-WEST RADS-FWT

17.5.1.2 Heatshrink Tube Labelling

The label must contain information, similar to the BMS Point Labelling Format.

Building Level _Room # OR Service _Device

Example 1 *Lv2_R233_RMT - Level 2, Room 233, room temperature sensor*

Example 2 *Lv0_WEST RADIATORS_FWT - Level 0, west radiators, flow water temperature*

Example 3 *Lv3_343_HWV" - Level 3, Room 343, heating water valve*

Example 4 *Lv0_ARTESIAN WATER_FL - Level 0, artesian water, flow*

Example 5 *Lv0_MSTP_TRUNK 1 - Level 0, BACnet MSTP Comms, Trunk #1*

17.5.1.3 Grafoplast Trasp' Labelling

Field device cable marking shall include labelling of individual cable cores labelling with a 'Grafoplast Trasp' transparent sleeve with six marking elements, split into three sections as shown in Figure 1 below.

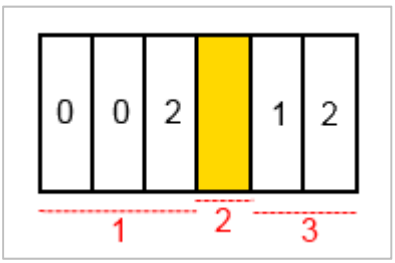

Figure 1: Grafoplast Trasp label diagram

Section 1 is the first three marking elements which will contain the last octet of the BMS controllers IP address of which the cable is connected to. (Figure 1 shows IP address ***.***.***.002)

Section 2 is the 4th marking element which shall be a single coloured element representing the type of I/O point, the colours are as follows:

- Yellow = Digital input
- Red = Universal input
- Blue = Universal output
- Green = Digital output

Section 3 is the 5th and 6th marking elements which shall be a unique number within Section 3 of the label and must be sequential.

This labelling allows for 99 digital inputs, 99 universal inputs, 99 universal outputs and 99 digital inputs per BMS controller.

17.5.1.4 BACnet Labelling

Any auxiliary or third Party BACnet device such as Variable Speed Drives (VSD's), chillers, energy meters and other high level interfaces connected via MS/TP must be clearly labelled. The label is to have a waterproof, adhesive label attached in the right hand corner (as near as practicable) of the plant / equipment with the following BACnet configuration information:

- Device name
- BACnet Instance #
- MSTP Network #
- MSTP MAC Address
- Baud Rate
- Max Masters

An example device label is shown in Figure 2 below.

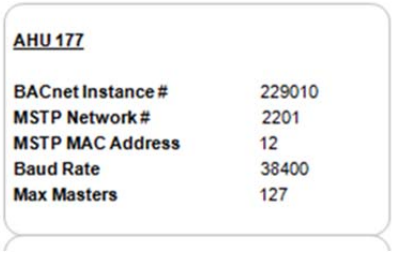

Figure 2: Example of Label

17.5.1.5 BACnet Instance Numbering

Third party BACnet devices requiring an instance number must use the following format.

- First 3 digits = Building IP
- Next digit = Building floor
- Last 2 digits = MAC address or device number

An example of the required numbering format is shown in Figure 3 below.

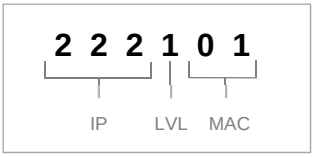

Figure 3: BACnet Instance Numbering Example

Compliance Checklist

Project Name:	Date:
Submitting Consultant:	Design Stage:

Section 17 – Metering and Controls Compliance Checklist		Complies	Does Not Comply	Not Applicable	Comments:
1.0	**Design Standard Guidelines**				
All Clauses	Section 01 – General	☐	☐	☐	
Error! Reference source not found.	**Overview**				
17.1.1	Existing Systems	☐	☐	☐	
17.1.2	Specific Approvals Required	☐	☐	☐	
17.2	**Design Concepts**				
17.2.1	Building Management System (BMS)	☐	☐	☐	
17.2.2	Metering Requirements	☐	☐	☐	
17.2.3	Automated Lighting Control	☐	☐	☐	
17.3	**Materials & Equipment**				
17.3.1	BMS Controllers	☐	☐	☐	
17.3.2	Metering	☐	☐	☐	
17.3.3	Automated Lighting Control	☐	☐	☐	
17.3.4	Variable Speed Drives	☐	☐	☐	
17.3.5	Control Valves	☐	☐	☐	
17.4	**Installation Requirements**				
17.4.1	Commissioning	☐	☐	☐	
17.4.2	AV Interface to BMS for Lighting Control	☐	☐	☐	
17.5	**Numbering & Labelling**				
17.5.1	Point and Cable Labelling Formats	☐	☐	☐	

Compliance Checklist

Project Name:	Date:
Submitting Consultant:	Design Stage:

Section 17 – Metering and Controls Compliance Checklist	Complies	Does Not Comply	Not Applicable	Comments:
Date:			☐	Acceptable
University Reviewer:			☐	Acceptable subject to comments
Signed:			☐	Resubmission required