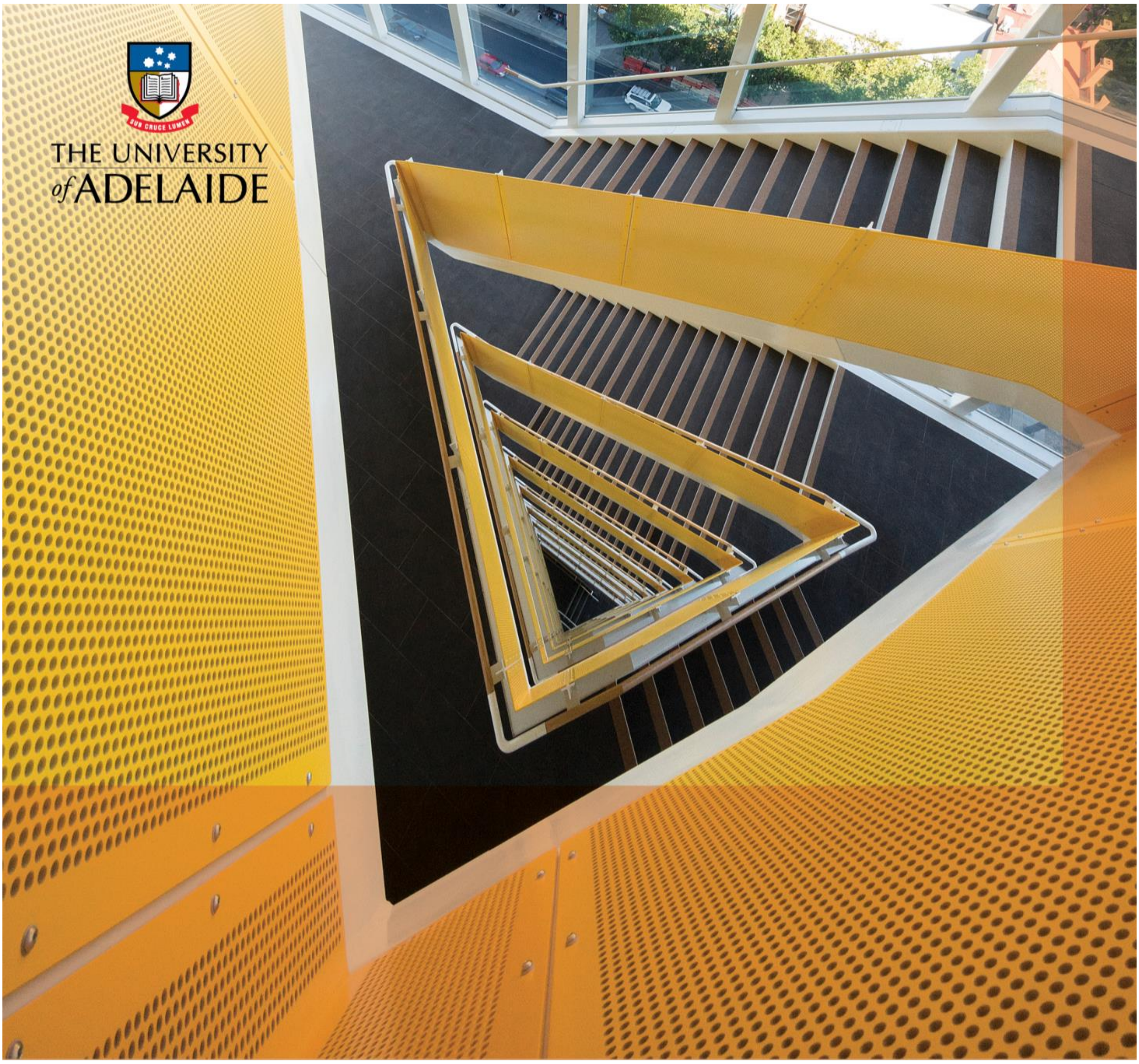

DESIGN STANDARD

L. Metering and Monitoring

Contents

Revision log

Current issue

M. Metering and Monitoring - UoA Design Standards. FINAL Version 3.0 March 2018

Previous issues

Version	Authors	Description	Revision	Date
1.0	Vicki Jacobs, Capital Project Delivery, UoA /Vikram Kenje, Enery Manager, UoA	M. Metering and Monitoring - UoA Design Standards.	DRAFT Version 1.	December 2017
2.0	GHD	M. Metering and Monitoring - UoA Design Standards.	DRAFT Version 2	March 2018
3.0	Vicki Jacobs, Capital Project Delivery, UoA / GHD	M. Metering and Monitoring - UoA Design Standards.	FINAL Version 3	August 2018

List of revised items

Version	Authors	Revised items	Date

Revision management

It is envisaged that revisions to this document will be undertaken at intervals of not more than two (2) years.

Endorsement body

Director of Infrastructure

Owner

Director, Capital Projects Delivery

Contact person

Associate Director, Capital Project Delivery

Authors and acknowledgements

The standards have been developed by Capital Projects with the assistance of UoA staff, external consultants, contractors, and colleagues from other education institutions. The University conveys its thanks.

Abbreviations

AS/NZS	Australia or Australian/New Zealand Standards
BCA	Building Code of Australia
CPD	University of Adelaide- Capital Projects Delivery
DDA	Disability Discrimination Act
NCC	National Construction Code
OSH	Occupational Safety and Health
SEPP	State Environmental Planning Legislation
SiD	Safety in Design
UoA	University of Adelaide
WHS	Work, Health and Safety

1. Introduction

This section outlines the purpose, structure, related documents, and definitions for the University of Adelaide (UoA) Design Standards.

1.1 Purpose of the document

The UoA Design Standards (the Standards) respond to the strategic vision for the University, outlined in Beacon of Enlightenment 2016-2035, and the guiding planning principles contained in the UoA Masterplan 2016-2035. Prepared in recognition of the University's unique historical context, the Standards are guided by the aims of supporting physical, social and cultural connectivity, embracing diversity, equity and accessibility, and promoting sustainability and academic excellence.

The Standards specify the minimum, mandatory requirements for the design, construction and management of all University of Adelaide infrastructure projects. Requirements are specific to the University's needs, and are over and above minimum mandatory Authority requirements. They include:

- Methodological requirements for project delivery; and
- Technical requirements for the finished product.

The objective is to support the consistent delivery of a high quality product, while allowing sufficient scope for innovation, creativity and technological advancements.

The Standards must be used by any parties involved in the planning, design, construction, occupation management, maintenance and operation of UoA facilities. This includes external consultants and contractors, UoA planners, designers and project managers as well as professional and faculty staff, facility managers, maintenance contractors and other service providers – all of whom must be aware of the Standards as they apply to their project and scope of work.

1.2 Structure of UoA Design Standards

L. Metering and Motoring Design Standard (this document) is a part of the UoA Design Standards suite of documents (the Standards).

The Standards are divided into the following volumes for ease of use:

- A. Project Process Checklist
- B. Building and Architecture
- C. Mechanical Services
- D. Electrical Services
- E. Communication Services
- F. Hydraulic Services
- G. Fire Services
- H. Security Services
- I. Vertical Transport
- J. External Works
- K. Documentation
- L. Metering and Monitoring (this document)
- M. Audio Visual
- N. Signage and Wayfinding

The Standards must be considered in their entirety, regardless of the project's size, specific disciplines or responsibilities.

In particular, UoA staff and consultants using this volume must ensure familiarity with the mandatory project procurement obligations, detailed in A. Project Process Checklist.

Each volume within the Standards is structured into four parts:

- Part 1 – Introduction
- Part 2 – General requirements
- Part 3 – Technical requirements
- Part 4 – Schedules

1.3 Related documents and legislation

1.3.1 Documents

During the earliest strategic feasibility and planning stages of the project, review and analysis of the latest edition of the following UoA strategic planning documents must be carried out and outcomes of that review reflected in the Project Brief (refer to clause 1.4 – Definitions of this volume).

These documents should also be read in conjunction with the UoA Design Standards.

- UoA Masterplan 2016-2035
- UoA Strategic Plan - Beacon of Enlightenment, 2013-2035
- Disability Action Plan 2013-2019
- Campus/ Building-specific Disability Action Plans
- Dormwell Framework
- UoA Reconciliation Statements
- Campus/ Precinct/ Building-specific Masterplans (e.g. Waite Masterplan, Union House Masterplan)
- Campus/ Building-specific Conservation Management Plans
- Faculty Masterplans
- Technical discipline/ space-specific Masterplans, including:
  - ITS Strategy Masterplan
  - Mechanical Services Masterplan
  - SAMP
  - Teaching Spaces Masterplan
  - Labs Standards and Masterplan
  - Library of the Future Masterplan
  - Space Standards Guidelines
  - Deferred Maintenance Schedule
  - Bushfire Prevention Plans
  - Campus Water Management Plan
- Campus Sustainability Plan 2017 and associated documents, including:
  - The Carbon Neutral Adelaide Action Plan 2016-2021
  - Innovation Hub/ Smart Cities
  - Building Performance Rating System

1.3.2 Relevant legislation

The planning, design and construction of each UoA facility must fully comply with current legislation. Legislation includes but is not limited to:

- Australia or Australian/ New Zealand Standards (AS/NZS)
- National Construction Code (NCC)
- Building Code of Australia (BCA)
- Occupational Safety and Health (OSH) legislation
- Disability Discrimination Act (DDA)
- Accessibility Aspiration Design Factors
- State Environmental Planning Legislation (SEPP)
- Commonwealth and State Legislation
- Local Council and Authority requirements
- Relevant Heritage Acts (for both Places and Natural Resources)

1.4 Definitions

For the purpose of this document, the following definitions apply:

Must	Indicates that a statement is mandatory
Should/ shall	Indicates a recommendation
May/ can	Indicates the existence of an option
The Standard/s	The University of Adelaide Design Standards
Project Manager	University of Adelaide staff member responsible for delivering the building project
Project Brief	The strategic brief detailing project scope and objectives, developed at the project feasibility and initiation phase, from which the Return Brief must be developed.
Return Brief	The detailed design brief prepared by the Design Team and signed off by the Project Stakeholder/s prior to commencement of Concept Design

2. General requirements

This section outlines:

- General administrative requirements related to the use of the B. Building and Architecture, and the process for project delivery for all projects, including: project specific documentation; discrepancies; departures; certification of compliance; project procurement process; value management; safety in design; WHS; environmental management; independent building commissioning; manufacturer's specifications; and professional services requirements; and
- General design requirements related to the B. Building and Architecture, including the University policy on sustainable design as well as durability, economy and flexibility.

2.1 Project specific information

Project-specific information will be contained in project- specific documentation, such as Project Brief. The Standards will supplement any project-specific documentation. Refer below clause 2.2- Discrepancies for clarification of precedence, should a discrepancy between Project Specific Documentation and The Standard arise.

Extracts from the Standards may be incorporated in contract documentation specifications. However, the consultant and the contractor must fully investigate the needs of the University and produce designs and documents that are entirely fit for purpose, which meet the intent of the Project Brief.

2.1.1 The project brief

In accordance with A. Project Process Checklist and clause 2.4 Certification of Compliance, the Project Brief must be developed and signed-off in the following manner, and utilised as a measure, against which periodic certification must be carried out.

- The Pre-feasibility Statement and preliminary project brief contained therein, communicates proposed project objectives and scope, preliminary budget and any project- specific strategic targets (if known).
- The Strategic Project Brief is typically developed by the University during the feasibility phase of the project. This brief reflects outcomes of the strategic project investigations. The Strategic Project Brief must be interrogated and verified by the Project Delivery Unit, Project Manager and key strategic stakeholders, prior to proceeding to the next Detailed Briefing Phase of the project delivery process. It is from this verified Strategic Brief, that the consultants brief will be developed.

The Strategic Project Brief must:

- Identify project- specific sustainability targets, over and above the Standards, and associated reporting obligations;
- identify proposed project budget and funding source. This must include:
- Capital Budget (separated into construction and university costs), and
- Operating Budget (reflecting project- specific sustainability targets);
- identify other strategic targets associated with the project;
- identify list of known Stakeholders with a preliminary engagement plan developed. This includes identification of key stakeholders with whom sign-off approvals obligations will sit. Refer below Clause 2.4 Certification of Compliance with the Standard;
- identify general spatial and operational requirements of the end users;
- identify decanting and relocations proposals associated with works;
- identify a list of further investigations that are required (e.g. Heritage, DDA etc.);

- identify an indicative project program for the delivery of works;
- identify strategic risks associated with the project (Refer Clause 2.7 Risk Register);
- communicate any safety in design risks identified to date (Refer Clause 2.8 Safety in Design);
- The Return Brief (also referred to as Project Brief) is typically prepared by the Consultant at the end of the detailed briefing phase, during which intensive stakeholder consultation has occurred. The Project Brief must be signed-off by key stakeholders prior to proceeding to the next Concept Design Phase of the project delivery process. It is against the signed- off Return Brief (also typically referred to as Project Brief), that the mandatory, milestone, compliance certifications will be measured. (Refer to clause 2.4 Certification of compliance, in this document). For very simple projects, compliance may be measured against the Strategic Project Brief, or equivalent, provided it meets all mandatory due diligence obligations, related to the development of a brief, listed in A – Project Process Checklist.

The Return Brief must:

- Meet the obligations of the Strategic Project Brief (including, but not limited to budget and sustainability targets);
- identify detailed operational and spatial requirements of the end users;
- include room data sheets for complex projects (refer to Vol. A Checklist for clarification).

2.2 Discrepancies

The Standards outline the University's general requirements above and beyond mandatory authority requirements and legislation.

Where the Standards outline a standard higher than the relevant legislation, the Standards will take precedence.

If any discrepancies are found between any relevant legislation, the Standards, or project-specific documentation, these discrepancies must be highlighted in writing to the Associate Director, Capital Projects Delivery.

2.3 Departures

The intent of the Standards is to achieve consistency in the quality of the design and construction of the University's built forms.

In addition, University staff, consultants and contractors are expected to apply industry best-practice and strive for improvement and innovation in design and construction techniques wherever possible. In recognition of this expectation, application to depart from the Standards, must be made in writing to the Associate Director, Capital Projects Delivery via the UoA Project Manager, using the Alternative Design Solution Application Form. The application must include:

- Reference to the Standard clause under consideration
- Details of the departure and alternative proposal
- Impact of that departure on:
  - Compliance with the Project/ Return Brief
  - Project capital budget
  - Operating budget

Where a departure from the Standards is sought, dual-approval to proceed must be issued in writing by both the Associate Director, Capital Projects Delivery and the Director of Infrastructure. Until this approval is granted, the consultant is not authorised to proceed to the next project phase. Any departures made without written confirmation must be rectified at no cost to UoA.

At the completion of the project, all authorised Alternative Design Solution Application Forms must be submitted to the Associate Director, Capital Projects Delivery by the UoA Project Manager. Alternative Design solutions shall be monitored over time for success and may be considered for inclusion in subsequent versions of the Standards.

2.4 Certification of compliance

At regular intervals the consultant team must certify in writing that both the Standards, and the Project Brief, have been met.

This can be done using the templates provided in A- Project Process Checklist, or an equivalent, approved reporting tool.

Discrepancies and departures must be declared, with justification, at this time, in accordance with clauses 2.2 Discrepancies and 2.3 Departures of this document.

Approval must be granted prior to proceeding to the next project phase in accordance with the process outlined in A- Project Process Checklist.

It should be noted that The Standards, as they relate to this clause, refer to all Volumes of the Standard, including A- Project Process Checklist.

2.4.1 Frequency of certification

Frequency of certification is based on the size and complexity of the project. Refer to A. Project Process Checklist for frequency of certification requirements based on the complexity of the project.

For new all new building projects, (multi-disciplinary) projects, or projects with a value greater than $500,000, Certification must occur at the end of each of the following project phases:

- Concept Design Phase
- Design Development Phase
- 50% Complete Contract Documentation Phase
- 100% Complete Contract Documentation Phase
- Project Hand-Over Phase

For very small or simple (single discipline) projects, Building Standard Certification must occur at the following times:

- At an agreed point, prior to the end of the 50% Complete Documentation Phase
- At an agreed point prior to the end of the 100% Complete Contract Documentation Phase

2.4.2 Additional certification requirements

In addition to the above mandatory certification check-points, certification of compliance with the Design Standards and The Project Brief, must also occur as part of any Value Management Session, in accordance with clause 2.6. Value management of this document.

2.5 Project procurement process

All project team members must follow the project process outlined in A. Project Process Checklist. The checklist is a planning and tracking tool to be used by the project manager, consultants and contractors, to ensure adherence to the approved UoA process for project delivery and to ensure the Standards are achieved as a minimum on all projects.

A. Project Process Checklist Design Standard caters for different project complexity types. For clarification of the project complexity type, refer to Manager, Capital Projects Delivery.

A. Project Process Checklist Design Standard does not alleviate any responsibility to ensure familiarity and compliance with all aspects of the Design Standards. The checklist (or an approved, project specific version) must be maintained as an active document throughout the project, and must be submitted to the Manager, Capital Projects Delivery, via the UoA Project Manager at project completion.

A. Project Process Checklist Design Standard is divided into project delivery phases. While the order of actions listed can be varied to suit a project, all actions listed must be completed, and certified as complete, prior to proceeding to the next phase. Project-specific variations of the checklist involving alteration to the number of mandatory milestone certification checkpoints, or elimination of any action, must be treated as a departure from the Standards and submitted for approval to the Associate Director, Capital Project Delivery at the commencement of the project start-up phase.

Project managers, consultants and contractors must ensure that adequate time and resources are allocated to meet the requirements of A. Project Process Checklist Design Standard and, in particular:

- Mandatory milestone certification checkpoints and associated approvals processes (refer to clause 2.4 Certification of compliance)
- Engagement and consultation obligations with stakeholders
- DDA, Safety in Design, and Risk Management workshops
- UoA peer reviews
- Two-step value management process, refer to 2.6 Value- management

2.6 Value management

1. A mandatory two-step value management (VM) session must be carried out when the project has reached the 50% Complete Contract Documentation Phase (or at a time deemed appropriate by the UoA Project Manager). Additional value management sessions may be required and must follow the same process. Consultants and Project Managers must make appropriate allowance for resources and time to meet the requirements of this clause.

Any value management sessions must take the following two-step process:

1. Value management (VM) session; followed by
2. Written certification (in accordance with disclosure and approvals obligations set out in clause 2.4 Certification of compliance in this volume), that the proposed value managed solution:

- Meets the requirements of the Design Standard
- Meets the requirements of the Brief. This includes (but is not limited to) confirmation of the following:

— Estimated order of cost for capital and operating budget; and

— Project-specific sustainability objectives

2.7 Risk Register

The Risk Register records details of all the risks identified at the beginning and during the life of the project, their grading in terms of likelihood of occurring and seriousness of impact on the project, initial plans for mitigating each high-level risk, the costs and responsibilities of the prescribed mitigation strategies and subsequent results.

This Risk Register must be maintained for all projects, throughout the life of the project. Initial risk assessment must form part of the Project Feasibility Phase for the project. If strategic risks are identified, they must be recorded and managed separately to those that are related to worksplace health and safety. The preliminary register (or list of issues) must be communicated in the Strategic Project Brief.

The register must continue to be developed and maintained by the UoA Project Manager for all projects. Later the register will be maintained by the Managing Contractor, Service Delivery maintenance staff, and potentially end-users. The register will be updated regularly as existing risks are re-graded in the light of the effectiveness of the mitigation strategy, and new risks are identified. For larger projects a Risk Management Plan may be required also. In smaller projects, the Risk Register can be used as the Risk Management Plan.

Refer to clause 2.8 for further discussion about Safety in Design and the mandatory Safety in Design Risk Assessment Workshop.

Refer to A. Project Process Checklist for the Project Risk Register Template.

Refer to clause 2.8 Safety in Design/ workplace health and safety for discussion on cultural safety.

2.8 Safety in Design/ workplace health and safety

Safety in Design (SiD) aims to prevent injuries and disease by considering hazards as early as possible in the planning and design process. A safe design approach considers the safety of those who construct, operate, clean repair and demolish an asset (the building, structure, plant or equipment) as well as those who work in or with it. Designers are in a unique position to reduce the risks that arise during the life cycle of the asset during the design phase.

In accordance with Safety in Design/ WHS Legislation, at each phase of the design process, risk identification must take place with the view to eliminating the risk, or where this is not possible, reducing risk as low as reasonably practicable, through the implementation of control measures. Safety in Design Risk Assessments must be carried out throughout the job and reported on at regular team meetings, keeping the status of control measures and the residual risks at a current level. Refer to clause 2.7 Risk Register for further information about reporting obligations.

For all new building projects, complex refurbishment projects, or high-risk projects a mandatory Safety in Design Risk Assessment Workshop must be carried out no later than the 50% Documentation Phase. This should be led by a member of the consultant team and in addition to the contractor, the consultant team and relevant other parties such as fabricators/ operators specific to the project, the workshop must be attended by a UoA WHS Representative and the UoA End-User Representative.

The assessment should involve hazard identification, assessment of risk of harm for each hazard, and strategy for eliminating or controlling the risk. One outcome of the assessment may be that Safe Operating Procedures (SOP) need to be developed. The SOPs identified in the Safety in Design Risk Assessment Workshop must be incorporated into the End-User Building User Guide and Safety Induction.

As part of the Safety in Design Risk Assessment, confirm with the Associate Director Capital Projects Delivery, as to whether consultation with the Gender Equity and Diversity Committee (or delegate) is required, to establish risks associated with cultural and gender safety associated with the project.

2.9 Independent building commissioning

For all new buildings, or where the Project Brief requires it, an independent commissioning agent not involved with the design or construction of the project must be engaged.

Detailed testing and commissioning requirements must be specified for each project by the UoA-appointed consultant/designer.

Project hand over inspection and testing plans (ITPs) must be developed by the consultant/contractor to allow the system to be handed over to the University. Detailed testing and commissioning records must be provided for each system and each component, taking into account the requirements of the Standards. All such records must be witnessed and verified by the UoA-appointed project consultant/ designer.

2.10 Post-occupancy Building Services Performance Report

After one seasonal cycle of operation, an independent building services performance review must be carried out and report prepared. Refer to the Manager, Sustainability for details. This may be carried out internally, or by an external consultant. Requirements of the Post-Occupancy Building Services Performance Report will be established by the Manager of Sustainability.

2.11 Manufacturer specifications

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.

2.12 Sustainable design

The adoption of environmentally sustainable building philosophies must be considered a primary objective of all projects, regardless of size. Opportunity to implement responsible design and construction solutions must be considered as a matter of course during every phase of the project. Project specific sustainability initiatives and targets must be identified in the Project Brief along with associated reporting obligations relating to both:

the requirement for the designer to certify/ rate/ measure the proposed design solution prior to construction; and

the requirement for the designer to include physical equipment and processes for measuring the performance of the building throughout its life- cycle (refer Vol Metering and monitoring).

In the absence of the identification of project- specific sustainability targets, and in addition to sustainability considerations covered in the relevant Volumes, the following must be incorporated in all architectural and engineering services designs.

2.12.1 Energy demand and thermal comfort

To minimise energy demand and improve thermal comfort in buildings, the following must be considered:

a. Use of basements and underground parking areas and labyrinths to pre-cool intake fresh air in mechanical systems if viable and where excessive dehumidification is not required.

b. High levels of thermal insulation to roof, floors and walls.

c. Reflectance of external building materials.

d. Thermal and solar performance of glazing.

e. External shading of north, east and west facing windows and walls.

f. Building orientation and massing.

g. Design glazing to achieve optimal day lighting and solar heat gain and to minimise the need for mechanical heating or cooling.

h. Appropriate design for temperature, air velocity, fresh air ventilation rates, relative humidity for different functional spaces as required by C. Mechanical Services Design Standard.

2.12.2 Use of natural daylight

a. Design façades and windows to maximise natural daylight in usable floor areas and incorporate use of sky lights, light wells and internal atriums or courtyards where appropriate.

b. Avoid overshadowing and visual intrusion onto adjoining sites.

c. Design buildings to avoid undesirable glare impacts on pedestrians, motorists, people using open spaces and those in other buildings.

d. Minimise the impact of night lighting on adjacent sites and buildings.

2.12.3 Indoor environmental quality

a. Provide appropriate lighting to suit the use of the space in accordance with E. Electrical Design Standard. Record the as-designed lighting levels and controls per functional space within the post-construction As-built documentation package.

b. Use materials, fittings and furnishings with low-VOC content i.e. paints, adhesives, sealants, carpets, timber products and furniture to avoid and minimise off-gassing impacts on building occupants' health.

c. Design to minimise unacceptable noise.

d. Utilise natural cross ventilation of habitable rooms and corridors to minimize the requirement for mechanical air conditioning.

2.12.4 Energy efficiency

a. Electrical appliances with the highest Australian Government Energy Star Ratings must be used for the relevant capacity ranges of appliances. These appliances include but are not limited to refrigerators, freezers, clothes dryers, dishwashers, electric hot water boilers, televisions, computer monitors and air-conditioning units.

b. Preference must be given to locally manufactured products where multiple products have the highest energy rating.

c. Electrical equipment, including specialised laboratory equipment not covered by Energy Star Rating Scheme must include energy efficiency as part of the selection criteria and have controls to prevent unnecessary energy consumption.

d. All buildings must provide utility meters to monitor, electricity, gas and water in accordance with C. Mechanical Services Design Standard, D. Electrical Services Design Standard, F. Hydraulic Services Design Standard, and L. Metering and Monitoring Design Standard:

— Energy efficient lighting and lighting controls must be provided to meet minimum illumination requirements in accordance with the D. Electrical Services Design Standard.

— Buildings must incorporate technology to reduce peak power demand, i.e. use of thermal storage for cooling and heating, power factor correction devices, etc.

— Roof design must maximise orientation to the northwest to northeast to optimise potential for installing roof top solar energy systems.

2.12.5 Water use

a. Water sub-metering must be provided to monitor large water consuming processes in accordance with F. Hydraulic Services Design Standard and L. Metering and Monitoring Design Standard.

b. All sanitary fixtures and tap ware must achieve WELS ratings specified in F. Hydraulic Services Design Standard.

c. Rainwater harvesting and reuse (toilets, cooling towers, fire test water and landscape irrigation) must be considered for all projects and applied where feasible. Ensure system design allows for future upgrade and expansion. Opportunities to integrate 'demonstrator' education must be explored. Refer also to F. Hydraulic Services Design Standard.

2.12.6 Water sensitive urban design

University campuses must implement water sensitive urban design principles by:

a. Reducing potable water demand through water efficient appliances, hydraulic standard.

b. Capturing rainwater for beneficial reuse including irrigation, cooling water and toilet flushing.

c. Minimising wastewater generation and treatment of wastewater to a standard suitable for effluent re-use and or release to receiving waters.

d. Passively treating urban stormwater using bio-filtration and wetlands systems to meet water quality objectives for reuse and or discharge to surface waters.

e. Using stormwater in the urban landscape to maximise the visual and recreation amenity of developments.

f. Grey water must not be reused where expensive wastewater treatment involving significant inputs of energy, chemicals and high maintenance is required.

2.12.7 Materials

a. Materials must be selected to meet sustainability requirements specified in Section 12 of B. Architecture and Building Design Standard (this document).

b. Selection of construction materials must consider 'cradle-to-grave' environmental impacts which look at impacts associated with raw materials extraction, manufacture, use and re-use potential and disposal.

c. Preference must be given to construction materials with recycled content and reused materials where practical.

d. Life cycle costing principles must be considered in selection of materials and systems. This includes capital, operations and maintenance, and disposal costs.

e. Use recycled and recyclable content in building materials, where fit-for-purpose from a durability and performance perspective.

f. Use suitable demolition materials for on-site fill.

g. Rainforest timber and timber from Australian high conservation forests must not be used.

h. Consider appropriate design detailing for engineered products to avoid any off-gassing potential from volatile compounds used in manufacture.

2.12.8 Noise mitigation

a. During the planning process isolate noise generating activities to avoid impact on sensitive receptors and quiet activities.

b. Protect all occupied spaces from noise pollution from external and internal sources.

c. Plant and equipment located on roofs must have acoustic treatment if they generate excessive noise.

d. Plant locations and noisy equipment must be designed and situated to avoid noise impacts on sensitive receptors and local residents.

e. Minimise noise emitted from external equipment such as fans, air-conditioners, compressors, and from other noise generating sources.

f. Minimise noise transmission within multiple occupancy buildings.

2.12.9 Construction and demolition waste

Building contractors and designers must provide infrastructure for recovery of building, construction and demolition materials to minimise waste disposal to landfill. They must:

a. Prepare and implement a materials recycling and waste management plan in the construction phase for all construction and demolition waste as part of the project environmental management plan.

b. Identify the range of materials that will be collected for recycling and describe procedures, management practices and reporting.

c. Formally apply dimensional co-ordination where it will practically assist the efficiency of material use, preference for modular components and materials supplied in set sizes or dimensions.

d. Consider ease of disassembly and recycling of construction materials and components at the time of refurbishment or completion of a facility's life.

e. Ensure project planning, specification and programming for the recovery, storage and transfer of reusable materials from demolition works including their transport from site to recycling and re-use facilities.

f. Implement procedures for disposal or recycling of hazardous materials at properly licensed facilities.

2.13 Durability, economy and flexibility

The University's goal is to achieve the optimal balance between capital and operating costs, whilst providing occupants a high level of environmental quality and service throughout the lifetime of each building. A whole-of-life asset value-for-money solution must be sought.

The University's building elements, services and external spaces must be:

- Cost-effective to operate and maintain.
- Designed with consideration of capital as well as operating expenditure in mind.
- Robust and durable.
- Easily and safely cleaned and maintained.
- Standardised to minimise individual specialisation and customisation.
- Flexible in the design to allow for expansion or adaption to new uses.
- Designed with built-in flexibility of space, plant and equipment to reasonably accommodate future uses.

2.14 Building compartmentation and sealing

Building fire compartments (existing and proposed) must be clearly identified within the contract documentation package and within the post-construction package. All penetrations through the barrier must be fire treated. Provide motorized dampers connected to the fire alarm system for any fixed open louvers such as at elevator shafts. Provide damper and controls to all air intakes/ exhausts.

Building envelopes must be designed and constructed with a continuous air barrier to control air leakage into, or out of, the conditioned space. Clearly identify all air barrier components on construction documents and detail the joints, and penetrations of the air barrier. The air barrier must be durable to last the anticipated service life of the assembly. Do not install lighting fixtures with ventilation holes through the air barrier.

3. Technical requirements

This section outlines the specific technical requirements for L. Metering and Monitoring Design Standards.

The Metering and Monitoring standard sets out the UoA's requirements for the installation and integration of utilities metering into the University's Energy Metering and Monitoring System (EMMS) platform, which is used to monitor and space charging for electricity, gas, water and thermal meters installed in campus buildings. All the collected data can be utilised for the purpose of business case development, teaching and researching, and education awareness.

If any clarification is required regarding metering selection, re-configuration, space charging and major building services upgrades, please consult the UoA Energy Manager during (but not limited to):

- Initial scoping stage
- Detailed design and tender stage
- Final recommendation (prior to installation stage) – if required

3.1 Metering platform

3.1.1 Schneider Electric's power monitoring expert

Power Monitoring Expert (PME) is a complete supervisory software package for power management application through collecting and organizing data gathered from facility's energy meters and presenting on a user friendly web interface. It is an open architecture supports industry standard protocols and an expansive range of Schneider Electric and third-party devices in order to leverage and optimize the existing infrastructure. It can also be integrated with other energy management and automation systems (e.g. SCADA, BAC, DCS, ERP) or web services.

PME provides the following benefits:

- Intuitive, customizable web client interface
- Real time monitoring with pre-defined screen templates
- Standard and advanced energy reports for consumption analysis and cost management
- Full WAGES (Water, Air, Gas, Electricity, Steam) support (dashboards, reports and screens) across the software tools
- Pre-defined or custom alarm management
- Input metering support
- Automatic database logging
- Fully compatible with ION technology
- Supports PowerLogic ION Enterprise software and System Manager software migrations

3.1.2 AZZO automation

AZZO provides a complete suite of metering and monitoring products and solutions for a wide range of applications. From metering and energy analysis to energy efficiency control systems.

AZZO provides the following benefits:

- Energy Metering and Verification (Water, Air, Gas, Electricity, Steam)
- Demand Management and Control
- Power Quality Analysis
- Power Factor Correction/Active Harmonic Filtering
- Solar/Renewables
- Tenant Billing
- Carbon Emissions Reporting
- Energy Profiling
- Energy Savings Control Systems
- Energy Efficiency Opportunities
- Cost Savings Identification
- Visualization (Reporting, Engagement, Modelling, Usage/KPI Alarms, Public Displays)

3.1.3 Metering dynamics

Metering Dynamics collects, manages and stores energy information to support network core functions including billing, monitoring, and network planning via the metering monitoring platform, Energex.

Metering Dynamics offers a total systems approach to multi-utility metering with solutions that enable remote reading of data from a range of metering points including electricity, gas, hot and cold water, and waste water.

Metering Dynamics provides reliable and robust, high quality revenue and sub-metering solutions that can remotely read a range of metering applications and forward data to billing and information management systems. However, this system will only be used for tenant sub-metering and recharging.

3.2 Metering type

3.2.1 Electrical meter

The Schneider Electric ION series meters should be considered with any new installation.

Besides, the primary model number listed below for selection.

- EM4800
- PM820
- 7330
- EM3555
- EM3550

- PM5560
- 7550
- 6200
- PM5350
- INTEGRA_1530
- PM800 Series
- STP_nn000-TL-10
- PM3255
- 7300
- iEM3250
- iEM3150

Any other proposed meter must be compatible with existing EMMS platform to achieve specific performance and in consultation with University's Energy team for approval.

3.2.2 Water meter

The water smart meter must be compatible with the existing EMMS platform to achieve specific performance with pulsed output and in consultation with University's Energy team for approval.

The water smart meter must come with proprietary data logger installed and configured on existing SA Water mains water and recycled water meters.

On a case-by-case basis, any additional sub-metering of water to major facilities is to be reviewed via the University's Hydraulic Manager to ensure multiple feeds and reductant supplies are also captured, or else the sub-metered data may be incorrect, as it only captures a portion of the supply.

3.2.3 Gas meter

Gas smart meter must be proprietary EDMI configured and compatible with existing EMMS platform to achieve specific performance with pulsed output and in consultation with University's Energy team for approval.

3.2.4 Thermal energy meter

Thermal energy smart meter must be able to monitor and manage hot and chilled water in order to work out energy consumption within ±1% accuracy. It must be compatible with existing EMMS platform to achieve specific performance with Modbus connection and in consultation with University's Energy Team for approval.

3.3 Metering parameters

The minimum parameters of meter for electricity, gas and water are summarised in Table 1.

Table 1 Metering parameters

Type	Value
Electricity (per meter)	3 phase kW
	3 phase kVA (average maximum)
	3 phase kWh (totaliser)
	L-N Voltage (each phase)
	L-L Voltage (each phase)
	3 phase kVar
	3 phase Current (each phase)
	3 phase Power Factor
	Frequency
	Total Harmonic Distortion (total and phase %)
	Neutral Current (calculated)
	Direction of Disturbance (upstream of downstream)
Gas	Uncorrected Volume (m3)
Water	Uncorrected volume (L)
	Flow (L/s)
Thermal	kW (Heating and Cooling)

3.4 UoA campus requirement

Table 2 states the various EMMS platforms installed to each UoA campus.

Table 2 UoA Campus EMMS platforms

UoA Campus	EMMS
North Adelaide	Schneider Electric's Power Monitoring Expert (PME) AZZO
Waite	Schneider Electric's Power Monitoring Expert (PME) AZZO
Roseworthy	Metering Dynamics (Energex)

3.5 Meter installation

Installation of new sub-meter must comply with the protocol below:

- Trigger 1: Creation of new space as part of new build or major refurbishment of space. Depending on whether intended occupier of space is 'University Internal Tenants' or 'External Commercial Tenant', the appropriate model of meter from the Schneider ION series needs to be chosen.
- Trigger 2: Replacement of old manually read sub-meter.
- Trigger 3: Special cases where a school or faculty has specialised equipment which may cause major distortions to the overall space charging model and goes against the principles of minimum cross subsidisation.

3.6 Communication

All meters and platform must be linked via the UoA Tech Services Team managed network system. Each LAN port must be provided and configured by Tech Services Team only, to allow local and remote access to EMMS platform.

Where the University network system is not available, GSM (3G network) must be provided to make connection back to EMMS Platform without engaging Tech Service Team for provision of network ports.

3.7 Gateway

3.7.1 Smart meter gateway

The smart meter gateway is a device that allows data to be gathered and stored as a history (time stamped data) in the memory of the device. All smart gateways must satisfy the following requirements:

- They must be diskless, low maintenance and of sufficient capacity to allow for all data gathered to be stored locally for at least 72 hours, in the event that the WAN is unavailable, after which the data may be overwritten
- Each gateway must have the capacity to gather log data from a minimum of 32 meters at 15 minute intervals for 7 days while offline from the WAN
- They must support Modbus/RTU and Modbus/TCP for integration of metering directly from meters or from EMMS
- A Serial-to-Ethernet gateway is required for new electrical installations to allow the University's EMMS to access the Modbus meters by polling the gateway directly from the Campus Area Network. Each electrical switch room containing metering equipment is to be provided with a Serial-to-Ethernet gateway, such that any system, including the local EMMS, can access the meters
- They must be capable of multi-master operation. This means, the server may poll the gateway for adhoc live data in response to a user graphic request while logging is carried on in the background without any interruption of the 15 minute data logging
- They must be capable of logging any selected variable at user configurable intervals from 30 seconds to 10 minutes. When in this mode, historical logging at 15 minute intervals must continue normally and must not be affected by live viewing
- All data logged must be logged with an inherent floating point accuracy to class 0.5s (AS 62053.22:2005) for active power and class 1 (AS 62053-21:2005) for reactive power
- They must support pulse counting (to 100Hz) and analog inputs for whole current electricity meters, water, gas, and heat meters must be supported by the gateways
- They must be capable of operating independently on local batteries for at least 5 minutes during mains power outages. All programming and configuration will be stored in non-volatile memory in the event of prolonged mains power failure for at least 7 days without mains power
- The ability to timestamp all data for storage and update the gateway clock via a central master device

3.7.2 Modbus gateway

The smart gateway is complemented by an advanced industrial grade Modbus Gateway that integrates Modbus the Modbus/RTU protocol with Modbus/TCP, allowing the meters to be polled across the Campus Area Network.

Where water and gas meters are remote, a DIN rail mounted Modbus IO server may be deployed within an adjacent switchboard and MODBUS cable reticulated from the nearest GATEWAY.

3.7.3 Serial-to-ethernet gateway

In addition to the gateways, the EMMS implements Serial-to-Ethernet gateways for local metering interface within building only, the Serial-to-Ethernet gateways must not be used for building to building communication they are only permissible for internal building communication.

An Ethernet data port is to be supplied within 5 meters of the Serial-to-Ethernet gateway. The gateways must be connected to the data port using as a minimum CAT6A T/UTP patch lead.

Modbus serial networks can only handle one query at a time; queries from different masters are queued and processed one by one. No more than 30 meters must be connected to any one Serial-to- Ethernet gateway.

Any requirement of the BMS or other local system to communicate with electricity meters must pass through the Serial-to-Ethernet gateway using Modbus/TCP protocol.

3.7.4 Gateway and wireless receiver enclosure and location

- The Serial-to-Ethernet gateways, smart (meter) gateways and wireless receivers must be located in the switch room or other location approved by CPD Engineering and Sustainability Unit.
- Each gateway must be equipped with ELV power supply at 24VAC or 24VDC, DIN rail mounted and fitted in a lockable industrial 600x400x200mm steel panel enclosure.
- Small backup power supply must be included in wireless ARM power supply circuit to allow for 3 days' operation without mains power.
- Where external enclosure is required for wireless receiver then it must be weather proof and of an IP rating of at least 65.
- Power point must be fitted in board with appropriate RCD protection and surge diverter installed.
- inside the cabinet on the incoming power supply.
- The steel panel enclosure must be labelled 'University of Adelaide Energy Management System' with the following contact details 'University of Adelaide - Capital Projects Delivery' using traffolyte labels.
- Where gas meters are connected to the EMMS an intrinsically safe barrier must be provided or an appropriate certification from a hazardous area consultant confirming the classification for the area/installation.

3.8 Software

3.8.1 Meter software

All meters must be loaded with the latest software version as per the manufacturer's specification. Changes to meter software must be agreed with CPD Engineering and Sustainability Unit.

All meter addressing must be unique and the meter addresses submitted to CPD for approval. The project must ensure that meter schematics are submitted for inspection of meter configuration and addressing.

3.8.2 Gateway software

All Serial-to-Ethernet and Modbus gateways must be loaded with the latest software version as per the manufacturer's specification.

Serial-to-Ethernet and Modbus gateway addressing must be approved by the CPD Engineering and Sustainability Unit to ensure that all gateways are accessible from the EMMS Server.

3.8.3 EMMS server software data analysis and reporting

The EMMS software loaded on the University's server provides the following reporting tools and data output capabilities.

3.8.4 Graphical data outputs

- Time-series daily load profiles displayed with time, in intervals of an hour or less, along the horizontal axis and load along the vertical axis
- Overlay plots displaying multiple daily profiles on a single 24-hour time-series graph
- Viewing of multiple time series data points on the same graph
- Calendar profile: view up to an entire month of consumption profiles on a single screen as one long time series
- X-Y scatter plots: X-Y scatter plots for visualizing correlations between two variables
- Intuitive graphical axes that are scaled and labelled
- A comprehensive and simple graphical programming tool allowing the University users to create their own views, graphs, charts, gauges, and other widgets for viewing live or historical data. Dashboards must be capable of export to printers or .pdf, .csv, .xls or .jpg formats for use in reports, spreadsheets or as live media to campus display systems.
- Dashboards must be accessible using simple web browsers. They must at least be readable by Internet Explorer, FireFox, Safari and mobile smart phone web browsers. Secure dashboard access via web browsers must be provided via username and password to access. A customised navigation tree with hyperlinked graphics must be provided such that each user (or user group) is provided with personalised access to data relevant to their specific requirements. Users must be able to access utility metered data by clicking on a digital map showing campus buildings.
- Dashboards as a minimum must contain (for each building group, building, area, switchboard, or grouping in the metering tree) graphics showing live and historical utilities usage, loads, CO_2 emissions, utility targets and maximum demand. System administrators must be able to manage meter lists, add new meters, create virtual meters and remove decommissioned meters.
- See Attachment 1 for existing dashboard configuration and standard tabs setup
- Direct access to schematics and Single Line Diagrams showing current utilities reticulation relevant to the meter being interrogated.
- Alarms
- Building specific dashboards must be developed on a project-by-project basis refer to table below.

Table 3 Meter gateway and type

Meter Gateway	Meter Type	Description
Total mechanical services Virtual meter	Electrical/Gas/Water	Provide Dashboard under the building tab for mechanical (collate on an individual dashboard w Mechanical gas, water ,electrical and thermal usage)
Total general load virtual meter	Electrical	Provide Dashboard under the building tab for General electrical loads (This would be all meters that are not lighting and HVAC related)

Meter Gateway	Meter Type	Description
Total building lighting load virtual meter	Electrical	Provide Dashboard under the building tab for Lighting loads (not including any tenancy lighting loads)
Total building Tennant	Electrical/Gas/Water	Provide Dashboard under the building tab for Tennant (collate on an individual dashboard with gas, water, electrical and thermal usage)Note a Dashboard for each tenancy must be provided.
Total Building PV Meter	Electrical	Provide Dashboard under the building tab for mechanical usage such as
Total Building Hydraulics meter	Gas	Provide Dashboard under the building tab for Building Gas usage (excludes mechanical gas usage)
Total Building Hydraulics meter	Water	Provide Dashboard under the building tab for Building hydraulics (excludes water treatment and mechanical usage)
Treatment	Water	Provide dashboard for water treatment plants
Chilled Water	Thermal	Provide dashboard with thermal meters where available
Hot Water	Thermal	Provide dashboard with thermal meters where available

3.8.5 Analytical data outputs

Analytical data outputs are to include:

- Basic statistical analysis such as mean, median, standard deviation, correlation, and regression
- Benchmarking against set building energy standards
- Intra/inter-facility comparisons against the building's historical data or across multiple buildings
- Aggregate data among multiple data points. Integrate different energy units using energy conversions
- Data mining (data slice/drill-down) time series data by monthly, weekly, daily, hourly, or trended interval
- Normalisation of energy usage or demand by factors such as building area, number of occupants, outside air temperature, and cooling or heating degree-days (CDD, HDD) to make a fair comparison between buildings
- Hierarchical summary of usage and cost information by different levels.

3.8.6 System-specific outputs

System-specific output are to include:

- Validation, editing, estimation to ensure quantities (kWh, kW, kVar, etc.) retrieved from meters are correct. The process includes validation of data within acceptable error tolerances, editing or correcting erroneous data, and estimating missing data.
- Equipment fault detection and diagnostics to identify equipment failure or degradation based on customised algorithms and parameters.
- Power quality analysis of voltage or current phases for conditions that could affect electrical equipment.
- Forecasting future trends based on historical data and related parameters.

3.8.7 Utility outputs

Utility outputs are to include:

- Energy cost breakdown using energy tariff and usage data to calculate daily or hourly energy cost breakdown and validate utility bills.
- Real-time cost tracking to calculate electricity costs daily or hourly using real-time meter reading and rate tariffs.
- End-use cost allocation to tenants using user-defined parameters and algorithms to estimate end-use energy consumption from whole-building energy.
- Provide cost recovery report where applicable.

3.9 Calculation and analysis tools

The system must be able to develop calculation and analytical reports using scripted mathematical operators, logical and scientific functions built into the server software suite. All these functions must be transparently recorded in the EMMS.

The software must offer an accessible programming environment (such as Visual Basic) or other scripting language such that complex calculations and formulas can be created using the stored data. For example, the software must be able to calculate greenhouse gas equations, or create a water leak detection model that can be used to generate alerts, or generate load profiles, peak demand prediction and other energy demand management functions.

Note that systems that require an external controller to be deployed to provide this capability are not acceptable.

Data must be stored for review and later manipulation using built-in energy analysis tools for load collection and reconciliation to the NMI meters, load profiling, load duration, rollup (into varying periods), load base-lining (period comparison), comparison and rating of building performance, identification of cyclic loads, abnormal loads, service outage events, load contribution from each meter, cost comparison, tariff modelling, normalisation to parameters such as Gross Floor Area (GFA) and ambient conditions (e.g. Degree Days).

3.10 Enterprise integration and analysis tools

The system must be able to configure the system to export data to SQL database or spreadsheets. The system must offer open SQL data connectivity (such as ODBC) in addition to export of .csv files.

The software must be capable of user-friendly import of meter data either by meter or in bulk by defining a data structure and method for users to input adhoc data or historical utility data.

The method of manual data entry is via a web-based form where data for meters can be manually entered into the EMMS using a wireless connected tablet computer or smart phone.

3.11 Alarms

The system must be able to set alarms for thresholds on each individually metered value and send alert notifications for corrective action via SMS, SNMP and Email.

Alarm thresholds levels must be displayed in dashboards using colour. An alarm management system must be included allowing users to view, prioritise, acknowledge and archive alarms.

Alarms must be setup for each project including: max demand, water/gas leakage, meter disconnection, controller fault, comms failure and out of parameter data. Alarms must be setup and sent to nominated users, further alarms identified during the design phase must be emailed. For the wireless systems alarms must be setup for low battery alarm and loss of communication alarm.

3.12 Workflow

The system must be able to provide functionality that allows users to create workflows based on triggered events (such as alarms). For example, in the event of a water leak alarm, the system may create a water leak report and email it automatically to relevant personnel for action. Another example is the creation of energy reports (e.g. .csv files) which are automatically exported to a carbon reporting system on a daily, or weekly or monthly frequency.

3.13 Commissioning

Building tuning and re-commissioning must be undertaken post commissioning as required by the UoA contract and as appropriate to achieve the agreed energy performance targets.

The design Service Provider must actively participate in commissioning to confirm the correct operation of the building.

An Independent Commissioning Agent must facilitate the commissioning process if required by the University contract.

3.14 System tuning

Once the system is fully operational and building occupied, full system tuning must be conducted to ensure control loops are operating effectively, parameters and set-points are tuned to improve performance of building ensuring that no hunting is occurring and design conditions are achieved. All settings and changes are to be documented.

Network tuning must also be provided to ensure that minimal traffic and data transfer across IP and MSTP networks is achieved, in order to provide stable communications and prevent network interruption across a shared building management network. This relates to smart programming and the correct configuration of points and change of value settings.

3.15 Verification

Commissioning of the connection of the meters to the EMMS must:

- Verify communication to each meter from the EMMS
- Complete successful EMMS remote reading of meter data and verification of stored values against those stored within the meter register (meter values = stored values)

- Validate of the meters' communication to the remote metering system in accordance with the
- Apply NABERS validation protocols
- Include schedule and checking of all ratios applied to meter data
- Confirm correct operation of scheduled data polling over a period of 7 days at the EMMS
- Complete successful retrieval of data from storage database for each meter to the EMMS
- Provide access details and logins/passwords to any software components required by the EMMS to connect or maintain the interface to metering
- Demonstrate the end-to-end system, including dashboards, meter hierarchy, historical data,
- Scheduled polling and adhoc polling.
- Conduct user training for up to five UoA staff. All for two full days of training on site.

3.16 Documentation and records

The following documents must be provided during the design phase and upon practical completion:

- New meter ID schedule
- New metering connections and configuration
- Commissioning records
- Product manufacturer specific information
- System schematics
- Network Addressing schedule
- Metering Single SLD.

A project handover plan must be developed by the consultant/designer to allow systems to be handed over to the University, including updating all EMMS documentation (Operations and Maintenance manuals, configuration records, commissioning and equipment records) to ensure that it remains current.

3.17 Training

The specification must require the Contractor to instruct relevant University personnel and its nominated Contractors in the operation of the system.

Training must be provided to allow the University staff to perform future alterations and additions to the system without dependence upon the controls supplier.

A training course must be conducted on site to enable operators to operate the system on a day to day basis, understand the operation of the system, and perform programming procedures including the following (but not limited to):

- View building control parameters such as set points, PID settings, time schedules, manual overrides and control strategies.
- Select and alter system programs and point settings
- Acknowledge and alter alarm settings
- Turn on and off controlled points manually
- Log trend data
- Create reports
- Identify and test field equipment including controllers, end devices interfaces and communications.

The amount of training and number of attendees to be trained is project specific and must be agreed with the University Facilities and Services Maintenance Manager prior to completing and finalising tender documents.

On project completion, a further 1 day (or as appropriate) must be spent on-site, with specific training on the system as installed.

Six months into the Defects Liability Period, or at a time nominated by the University staff, a further 1 full day on site training must be provided if and when requested by the University. Such training must concentrate on higher level functioning and control of the system.

3.18 References

Standard	Title
AS 60044.1-20017/Amdt 1-2012	Instrument transformers – Current transformers
AS 60044.1-2007.	Instrument Transformers (IEC 60044-1 Ed. 1.2 (2003) MOD)
AS 62053.22 (2005)	Electricity Metering Equipment (AC) Static meters for active energy (Classes 0.2S and 0.5 S)
AS 62053.23 (2006)	Electricity metering equipment (AC) –Particular Requirements – static meters for reactive energy (Class 2 and 3).
BCA	Building Code of Australia Building Code of Australia, specifically Section J energy efficiency
--	All Health Authority Requirements
--	All Local Council regulations
--	Electricity Safety (Installations) Regulation
--	NABERS Energy and Water for offices (version 3.0)
--	National Institute of Standards and Technology (NIST). GSA Guide to Specifying Interoperable
--	State Fire Brigade requirements
--	Workcover requirements
--	www.modbus.org
Schneider Electric's PME	https://www.schneider-electric.com.au/en/product-range-presentation/62919-ecostruxure%E2%84%A2-power-monitoring-expert-8.2/
AZZO	http://azzo.com.au/
Metering Dynamics	https://www.meteringdynamics.com.au/