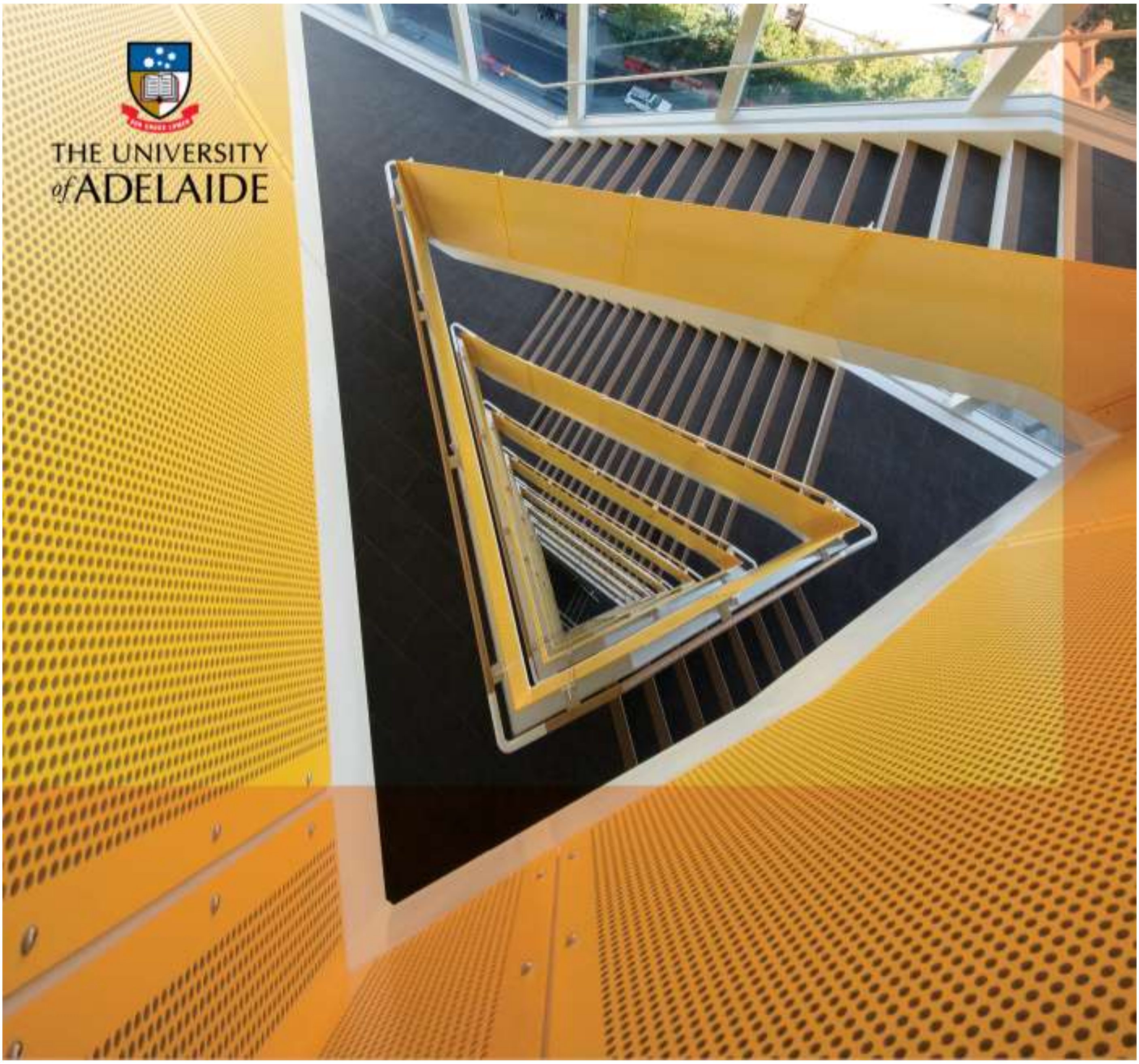

DESIGN STANDARD

L. Metering and Monitoring

Contents

Revision log

Current issue

M. Metering and Monitoring - UoA Design Standards. FINAL Version 4.0 May 2023

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
4.0	Vicki Jacobs, Capital Project Delivery, UoA / GHD	M. Metering and Monitoring - UoA Design Standards.	FINAL Version 4	

List of revised items

Version	Authors	Revised items	Date
4.0	Infrastructure, UoA	Abbreviations, 1.Introduction, 2.General Requirements removed and reference in Vol.A Project Process Checklist	May 2023

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

Manager, 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

(refer –Standard Volume A. Project Process Checklist)

1. Introduction

(refer –Standard Volume A. Project Process Checklist)

2. General requirements

(refer –Standard Volume A. Project Process Checklist)

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-	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/