## CIS Advanced Utilities Monitoring System (AUMS) Standard

<table>
<thead>
<tr>
<th>Documents No:</th>
<th>CIS-Standard-Advanced Utilities Monitoring System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revision No:</td>
<td>001</td>
</tr>
<tr>
<td>Prepared by:</td>
<td>David Dunn</td>
</tr>
<tr>
<td>Position:</td>
<td>Mechanical Engineer</td>
</tr>
<tr>
<td>Signature:</td>
<td><img src="signature.png" alt="Signature" /></td>
</tr>
<tr>
<td>Approved by:</td>
<td>Greg Robinson</td>
</tr>
<tr>
<td>Position:</td>
<td>Director CIS</td>
</tr>
<tr>
<td>Signature:</td>
<td><img src="signature.png" alt="Signature" /></td>
</tr>
<tr>
<td>Issued by:</td>
<td>Campus Infrastructure Services</td>
</tr>
<tr>
<td>Issue date:</td>
<td>4 September 2013</td>
</tr>
</tbody>
</table>
## Table of Contents

1 Purpose .................................................................................................................. 1
2 Scope ..................................................................................................................... 1
3 Glossary of Terms .................................................................................................. 1
4 Authorities & Responsibilities .................................................................................. 2
5 Design and Construction Requirements .................................................................. 2
   5.1 Metering Equipment ......................................................................................... 2
   5.1.1 Electricity Meters ...................................................................................... 2
   5.1.2 Water and Gas Meters ............................................................................... 3
   5.2 Current Transformers ...................................................................................... 3
   5.3 AUMS System Architecture ........................................................................... 4
   5.4 Meter Identification Protocol ......................................................................... 5
   5.5 Gateways ......................................................................................................... 5
   5.5.1 Smart Meter Gateways ............................................................................... 6
   5.5.2 Modbus Gateway ...................................................................................... 7
   5.5.3 Serial to Ethernet Gateways ..................................................................... 7
   5.5.4 Gateway Enclosure and Location ............................................................ 7
   5.6 Software .......................................................................................................... 7
   5.6.1 Meter Software .......................................................................................... 7
   5.6.2 Gateway Software ...................................................................................... 8
   5.6.3 Software data inputs ................................................................................. 8
   5.7 Software Configuration .................................................................................... 9
   5.8 User Configuration .......................................................................................... 11
   5.9 Calculation and Analysis Tools ....................................................................... 11
   5.10 Enterprise Integration and Manual Data Entry ............................................. 11
   5.11 Alarms ........................................................................................................... 11
   5.12 Workflow ....................................................................................................... 12
6 Commissioning ...................................................................................................... 12
   6.1 Verification ...................................................................................................... 12
7 Documentation & records ...................................................................................... 12
8 Operations .............................................................................................................. 13
9 Authorisation of variations .................................................................................... 13
10 Quality control ...................................................................................................... 13
11 References ............................................................................................................ 14
12 Notes ..................................................................................................................... 15
13 Attachments .......................................................................................................... 15
1 PURPOSE

The CIS Advanced Utilities Monitoring System (AUMS) Standard sets out the University of Sydney's requirements for the installation and integration of utilities metering into the University’s AUMS, which is used monitor electricity, gas and water meters installed in campus buildings.

Applicable requirements documented in Australian and New Zealand Standards (AS/NZS), the Building Code of Australia (BCA), Australian National Construction Codes, Workplace Health and Safety legislation and other relevant statutory requirements are minimum compliance requirements that are considered mandatory. The minimum relevant AS/NZS documents are provided in Section 11 of this standard. Where any ambiguity exists between this standard and the aforementioned mandatory requirements then:

   a. the highest performance requirements must apply
   b. applicable requirements must follow this order of precedence:
      I. Workplace Health and Safety legislation and other relevant statutory requirements
      II. Building Code of Australia (BCA)
      III. AS/NZS
      IV. This standard and other University of Sydney standards

2 SCOPE

This standard specifies the metering and communication requirements to enable connection of new electricity, gas and water meters to the AUMS via the University Campus Area Network.

AUMS is a platform for utility monitoring, electricity, gas and water. It is a distributed system for high reliability and uses network synchronised time stamping at the gateway to ensure highly accurate interval data.

The standard applies to project managers, consultants, contractors, sub-contractors, tenants, managing agents, University staff and others involved in the design, construction and maintenance of existing, new and proposed University buildings and facilities.

3 GLOSSARY OF TERMS

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEST</td>
<td>Australian Eastern Standard Time</td>
</tr>
<tr>
<td>AUMS</td>
<td>Advanced Utility Metering System</td>
</tr>
<tr>
<td>BACnet</td>
<td>Interoperability protocol ISO 16484-5</td>
</tr>
<tr>
<td>BACnet Operator Workstation (B-OWS)</td>
<td>network level workstation</td>
</tr>
<tr>
<td>BACnet Advanced Workstation (B-AWS)</td>
<td>advanced operator workstation</td>
</tr>
<tr>
<td>BMS</td>
<td>Building Management System</td>
</tr>
<tr>
<td>CN</td>
<td>Campus Network</td>
</tr>
<tr>
<td>NTP</td>
<td>Network Time Protocol</td>
</tr>
<tr>
<td>SMS</td>
<td>Short Message Service</td>
</tr>
<tr>
<td>SMTP</td>
<td>Simple Mail Transfer Protocol</td>
</tr>
<tr>
<td>THD</td>
<td>Total Harmonic Distortion</td>
</tr>
<tr>
<td>VPN</td>
<td>Virtual Private Network</td>
</tr>
<tr>
<td>UTC</td>
<td>Coordinated Universal Time</td>
</tr>
</tbody>
</table>
4 AUTHORITIES & RESPONSIBILITIES

This standard is owned by CIS. It is approved and signed-off by the Director CIS. The CIS Engineering and Sustainability Unit is responsible for maintaining the standard and keeping it up-to-date. The Standard must be reviewed biennially.

5 DESIGN AND CONSTRUCTION REQUIREMENTS

Installation of utility meters and sub-meters are required for new buildings and major refurbishment works involving installation, or upgrades to, electrical distribution boards. All meters and their associated communication hardware and software must be connected to, and configured in, the University’s AUMS.

5.1 METERING EQUIPMENT

Where revenue meters are connected these meters must be supplied fitted with Modbus ports and the Modbus data made available through the specified Serial to Ethernet gateway by connecting the meter to the nearest Serial to Ethernet gateway.

5.1.1 ELECTRICITY METERS

Electrical meters generally for Sub main metering must be specified in accordance with Standards Australia AS 62053.22 (2005) Electricity Metering Equipment (AC) Static meters for active energy (Classes 0.2S and 0.5 S) and AS 62053.23 (2006) Electricity metering equipment (AC) –Particular Requirements – static meters for reactive energy (Class 2 and 3).

Sub main loads to be measured as 4 wire unbalanced loads. The meter will calculate the neutral current.

The minimum parameters to be metered for electricity, gas and water are summarised in Table 1.

Table 1 Metering Requirements for Electricity, Gas and Water

<table>
<thead>
<tr>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity (per meter)</td>
<td>3 phase kW</td>
</tr>
<tr>
<td></td>
<td>3 phase kVA (average maximum)</td>
</tr>
<tr>
<td></td>
<td>3 phase kWh (totaliser)</td>
</tr>
<tr>
<td></td>
<td>L-N Voltage (each phase)</td>
</tr>
<tr>
<td></td>
<td>L-L Voltage (each phase)</td>
</tr>
<tr>
<td></td>
<td>3 phase kVar</td>
</tr>
<tr>
<td></td>
<td>3 phase Current (each phase)</td>
</tr>
<tr>
<td></td>
<td>3 phase Power Factor</td>
</tr>
<tr>
<td></td>
<td>Frequency</td>
</tr>
<tr>
<td></td>
<td>Total Harmonic Distortion (total and phase %)</td>
</tr>
<tr>
<td></td>
<td>Neutral Current (calculated)</td>
</tr>
<tr>
<td>Gas</td>
<td>Uncorrected Volume (m³)</td>
</tr>
<tr>
<td>Water</td>
<td>Uncorrected volume (l)</td>
</tr>
<tr>
<td></td>
<td>Flow (l/s)</td>
</tr>
</tbody>
</table>
Electricity meters must support the following (as per IME NEMO 96HD or equivalent meter):

- LCD display on the front of the meter for ease of set-up and operation, and in the event that manual reading of the meter is required, all critical values can be easily obtained from the meter.
- Support –/1A or –/5A current transformer operation.
- Accuracy for Voltage +/- 0.2% (80 to 500V phase voltage).
- Accuracy for Current +/- 0.2% (10 to 120 % line current).
- Accuracy for Active energy class 0.5 (EN/IEC62053-22).
- Accuracy for Reactive energy class 2 (EN/IEC62053-23).
- Voltage measurement range 3-phase - 80…500V 50/60Hz.
- Voltage measurement range Single phase - 50…290V 50/60Hz.
- Programmable CT ratio 1…9999 (max CT primary 50kA/5A or 10kA/1A).
- Programmable VT ratio 1…10 (max VT primary 1200V).
- Programmable display contrast and backlight intensity. Backlit to be programmable to auto off when not in use to increase life of backlight.
- Field updatable firmware.
- Resettable parameters - min + max voltage, current demand, current max demand, active, reactive, apparent power max demand, hours run, partial active energy, partial reactive energy.
- Measurement and storage of apparent power maximum demand such that AUMS can retrieve average and maximum demand held by meter for each month.
- Where neutral current is not measured explicitly meter must provide a calculated value.

5.1.2 WATER AND GAS METERS

Provide a pulse measurement device to water and gas meters that will convert the water or gas meter volt free pulses (at a minimum of 100Hz, 25% duty cycle) to a Modbus value that can be accessed by the AUMS server through the gateway.

Pulse measurement from Water and Gas meters must be connected to DIN rail based Modbus/TCP Pulse counters converting the pulses to a Modbus register to be polled by the Smart Gateway.

Where water and gas meters are available via BACnet controllers, the Project will configure the AUMS Server to access these BACnet variables directly through the nearest BMS controller/router.

5.2 CURRENT TRANSFORMERS (CT)

CT selections must be encapsulated in Epoxy Resin and extended range type of Class 0.5s or better. Adequate consideration must be given to dimensions of bus bars, cables, access for installation, range, overload, voltage and other factors.

Current Transformers must be specified in accordance with AS 60044.1 (2007) as amended.

Split CTs must not be used unless approved by CIS.

The Project must ensure appropriately sized CT rating for each load and select the minimum size (based on full load usage) to maintain the highest level of data accuracy, as follows:

- Primary input current between 5A and 10,000A, secondary input current 5A and 1A.
- Sensing current range 10mA to 10A and input voltage 18V to 700 V AC.
Shorting links and barrier terminals must be fitted to permit disconnection of the meters and CTs for maintenance or replacement.

Current signals from the CTs must be clearly colour coded to the phase and labelled at each end of the cable to indicate the phase and secondary orientation of current signal (e.g. Red S1 and S2).

5.3 AUMS System Architecture

The AUMS system consists of a protected Server, hosted in the University’s externally operated Data Centre, and gateway devices fitted in a steel panel mounted in the electricity distribution hub. The gateway devices collect data from smart meters via the Campus Network (CN). The AUMS is linked to the Campus time and SMTP mail servers to receive time sync and to allow notifications to be emailed to users.

In addition to the Smart Gateways, the AUMS implements Serial to Ethernet gateways for local metering interface. These are one or two port Moxa Type or equivalent. The gateway is configured to allow the AUMS to access Modbus meters by polling the gateway directly from the Campus Network.

Any other system requiring data from the meter (such as a local Building Management Control System [BMCS]) must poll the Serial to Ethernet gateway using the Modbus/TCP protocol. It is not permissible for a local BMCS or other system to directly access the meters on the daisy chain bus (i.e. using the lower level Modbus/RTU protocol). This approach is used to create a clean interface and use of IP protocols to promote best practice in structured cabling. Figure 1 depicts the tiered architecture of the system.
5.4 METER IDENTIFICATION PROTOCOL

Meters addressing must be configured in accordance with the requirements of CIS Engineering and Sustainability Unit to ensure that all meters are uniquely identified across the Campus. The naming convention used to identify meters must be standardised in accordance with CIS direction. All labelling on meters must reflect this standard.

Meters must be supplied fitted with Modbus ports and the Modbus data made available through the specified Serial to Ethernet gateway by connecting the meter to the nearest Serial to Ethernet gateway.

The meters must be connected by a daisy chain buss (wired in EIA-485 compliant 2 wire communications cable) to the nearest Serial to Ethernet Gateway.

5.5 GATEWAYS

Deemed-to-comply gateways are provided in Table 2. Alternatives may be used with prior review and approval of the CIS Engineering & Sustainability Unit.
Table 2  Deemed-to-Comply Gateways

<table>
<thead>
<tr>
<th>Meter Gateway</th>
<th>Manufacturer</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>JACE-200 (Part J-200) (for up to 30 Modbus meters)*</td>
<td>Tridium</td>
<td>DIN rail mounted gateway device (shipped with Niagara version 3.5.39 or later). To be fitted in 600x400x200 steel panel to drawing Q0142-001.</td>
</tr>
<tr>
<td>NBP-PWR 24V DIN Rail mounted Power supply (or equal)</td>
<td>Tridium</td>
<td>DIN rail mounted 24 VAC power supply</td>
</tr>
<tr>
<td>MODBUS Driver (DR-MDB-TC-AX)</td>
<td>Tridium</td>
<td>Modbus/TCP Driver to be used when installing with MODBUS meters.</td>
</tr>
<tr>
<td>BACNET Driver (DR-BACNET-AX) for BMS integration</td>
<td>Tridium</td>
<td>Driver to be installed when integrating with BACnet/IP BMS systems</td>
</tr>
</tbody>
</table>

5.5.1  **SMART METER GATEWAYS**

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:

a. 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.

b. 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.

c. They must support Modbus/RTU, Modbus/TCP, BACnet/MSTP and BACnet/IP for integration of metering directly from meters or from BCMS.

d. A serial-to-ethernet gateway is required for new electrical installations to allow the University's AUMS to access the Modbus meters by polling the gateway directly from the Campus Area Network. Each electrical switchroom containing metering equipment is to be provided with a serial-to-ethernet gateway, such that any system, including the local BCMS, can access the meters.

e. 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.

f. 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.

g. 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.

h. 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.

i. 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.

j. The ability to timestamp all data for storage and update the gateway clock via a central master device.
5.5.2 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.

Detailed information is provided in the MGate MB3180 Modbus gateway quick installation guide, available from the manufacturer.

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.

5.5.3 SERIAL TO ETHERNET GATEWAYS

In addition to the gateways, the AUMS implements Serial to Ethernet gateways for local metering interface.

Each electrical switchroom containing metering equipment is to be provided with a Serial to Ethernet gateway. 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 patch lead.

Serial to Ethernet gateway devices must be Moxa MB3170/3270 or equivalent to permit simultaneous polling of meters by the AUMS server or other masters to communicate with the Modbus serial network.

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.

5.5.4 GATEWAY ENCLOSURE AND LOCATION

The Serial to Ethernet gateways and Smart (meter) Gateways must be located in the Switch room or other location approved by CIS 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.

The steel panel enclosure must be labelled “University Advanced Utilities Monitoring System” with the following contact details “Campus Infrastructure Services, Engineering & Sustainability Unit” using trafolyte labels.

5.6 SOFTWARE

5.6.1 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 CIS Engineering & Sustainability Unit.
All meter addressing must be unique and the meter addresses submitted to CIS for approval. The Project must ensure that meter schematics are submitted for inspection of meter configuration and addressing.

5.6.2 GATEWAY SOFTWARE

All Serial to Ethernet gateways must be loaded with the latest software version as per the manufacturer’s specification.

Serial to Ethernet gateway addressing must be approved by the CIS Engineering & Sustainability Unit to ensure that all gateways are accessible from the AUMS Server.

5.6.3 AUMS SERVER SOFTWARE DATA ANALYSIS AND REPORTING

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

5.6.3.1 Graphical Data Outputs

a. 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
b. Overlay plots displaying multiple daily profiles on a single 24-hour time-series graph
c. Viewing of multiple time series data points on the same graph
d. Calendar profile: View up to an entire month of consumption profiles on a single screen as one long time series
e. X-Y scatter plots: X-Y scatter plots for visualizing correlations between two variables
f. Intuitive graphical axes that are scaled and labelled
g. 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, Excel or jpg formats for use in reports, spreadsheets or as live media to Campus display systems.
h. 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.
i. 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, CO₂ 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.
j. Direct access to schematics and Single Line Diagrams showing current utilities reticulation relevant to the meter being interrogated.
k. Alarms
5.6.3.2 Analytical Data Outputs

a. Basic statistical analysis such as mean, median, standard deviation, correlation, and regression.
b. Benchmarking against set building energy standards.
c. Intra/inter-facility comparisons against the building’s historical data or across multiple buildings
d. Aggregate data among multiple data points. Integrate different energy units using energy conversions.
e. Data mining (data slice/drill-down) time series data by monthly, weekly, daily, hourly, or trended interval.
f. 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.
g. Hierarchical summary of usage and cost information by different levels.

5.6.3.3 System Specific Outputs

a. 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.
b. Equipment fault detection and diagnostics to identify equipment failure or degradation based on customised algorithms and parameters.
c. Power quality analysis of voltage or current phases for conditions that could affect electrical equipment.
d. Forecasting future trends based on historical data and related parameters.

5.6.3.4 Utility Outputs

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

5.7 AUMS SERVER SOFTWARE CONFIGURATION

A qualified System Integrator must be engaged to configure the AUMS meter hierarchy. The software must automatically aggregate meters, create virtual meters (by load subtraction or addition) and logical meters (by user defined grouping of meters, such as for Light and Power or Mechanical Load groups).

Driver configuration to link meters into the gateways must be integrated with the server software by the System Integrator.

Meters must be set up as templates allowing easy replication where meters are added or deleted.

The software configuration must:
a. Define the structure of the metering system.

b. Apply and create analytical processes.

c. Create and edit visualisation dashboards and reports.

d. Apply dashboards and reports to any part of the energy metering system.

e. Set alarm levels to trigger on detection of anomalies

A data model tree must be created, defining nodes that reflect the metering structure. The software will define aggregation rules for various data types, allowing nodes that do not have physical meters installed to be aggregated in dashboards and reports without specific virtual meters or calculations being required.

Additionally configure the below, where applicable:

a. network time-of-use (TOU) schedules,
b. tariffs
c. normalisation metrics such as energy per floor area or per cooling degree day.
d. Modelling water and gas usage per time interval, area or function
e. Alarm triggering levels (with suppression of false alarms)

The software must calculate variables to be trended and stored in the SQL database, visualised in dashboards.

All analytical tools, calculations must be made available to authorised CIS users and be able to be edited using drag and drop techniques in real time via a graphical "wire sheet".

The System Integrator must develop a comprehensive intelligent user interface to accurately model and interact with building users. All tools to edit and apply dashboards to all parts of the system must be provided within the web browser functionality. The system must provide a full suite of dashboard tools including:

a. Line, Bar and Pie Charting Tools
b. Tabular Data
c. Symbols, Indicators and the like.
d. Embedded Multimedia, webpages etc
e. Ability to develop and add custom widgets
f. Energy, water and gas alarms

All charts must allow drill down capability based on defined aggregation rules. Additionally data can be dragged and dropped into charts as required. The system must be able to save any dashboard created as a template and to then apply this across any or all nodes in the system.

The system must include data reporting and export tools that allow users to export data and dashboards in PDF, XLS and CSV formats. Reports must be able to be created a scheduled or exported as required. The Contractor must work with the CIS Engineering & Sustainability Unit to develop required reports.

The system must be designed to allow flexibility to develop the system based on evolving needs. The system must allow third party reporting and other data tools from Excel to Microsoft Reporting Services to be used without fundamentally altering the underlying hardware and database infrastructure. Licensing for Microsoft Reporting Services will be provided by the University.
5.8 **USER CONFIGURATION**

User permissions must be configured by CIS Engineering & Sustainability Unit.

5.9 **CALCULATION AND ANALYSIS TOOLS**

The System Integrator must 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 AUMS.

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).

5.10 **ENTERPRISE INTEGRATION AND MANUAL DATA ENTRY**

The System Integrator must 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 AUMS using a wireless connected tablet computer or smart phone.

5.11 **ALARMS**

The System Integrator must 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.
5.12 WORKFLOW

The System Integrator must 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.

6 COMMISSIONING

Commissioning must be performed according to the CIS-Commissioning Standard.

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

Commissioning, tuning and re-commissioning must be carried out to ASHRAE Guideline 1-1996 The HVAC Commissioning Process and to the HVAC commissioning process described in ASHRAE Handbook ‘HVAC Applications’ chapter 43 Commissioning or CIBSE.

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.

6.1 VERIFICATION

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

a. Verify communication to each meter from the AUMS
b. Complete successful AUMS remote reading of meter data and verification of stored values against those stored within the meter register (Meter values = stored values)
c. Validate of the meters’ communication to the remote metering system in accordance with the NABERS validation protocols
d. Confirm correct operation of scheduled data polling over a period of 7 days at the AUMS
e. Complete successful retrieval of data from storage database for each meter to the AUMS
f. Provide access details and logins/passwords to any software components required by the AUMS to connect or maintain the interface to metering
g. Demonstrate the end-to-end system, including dashboards, meter hierarchy, historical data, scheduled polling and adhoc polling.
h. Conduct user training for up to 5 CIS staff. All for two full days of training on site at CIS.

7 DOCUMENTATION & RECORDS

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

a. New meter ID schedule
b. New metering connections and configuration
c. Commissioning records
d. Product manufacturer specific information
e. System schematics
A project handover plan must be developed by the consultant/designer to allow systems to be handed over to the University, including updating all AUMS documentation (Operations and Maintenance manuals, configuration records, commissioning and equipment records) to ensure that it remains current.

8 OPERATIONS

N/A

9 AUTHORISATION OF VARIATIONS

Project managers, consultants, contractors, commissioning agents and facilities maintenance personnel must ensure compliance with these requirements is achieved.

Variations to this standard must only be considered where:

a. the University Standard’s requirement cannot physically or technically be achieved.
b. the alternative solution delivers demonstrated and proven superior performance for the same capital and life cycle cost or better.

Consultants and contractors must identify and justify requirements of the standard that do not apply to the project or which need to be varied and these which must be approved by the issuer of this standard. Formal requests for all variations to this Standard must be submitted using the CIS Request Dispensation from Standard Form (CIS-ENG-F001). The issuer of this standard or their delegated authority must review and consider requirements of stakeholders from clients, projects and facilities management before deciding whether to approve variations. Their formal sign-off is required for acceptance of any non-compliances and departures from this standard’s requirements.

10 QUALITY CONTROL

10.1 DESIGN STANDARD COMPLIANCE

Compliance with requirements of this standard must be checked throughout the design, construction and commissioning phases of projects by:

a. The CIS project consultant
b. The issuer of this standard or their delegate

Competent CIS representatives must check compliance with this standard during design reviews and formal site inspections. Any non-compliances with requirements of this standard must be documented in the Non-conformance Report Form, CIS-SYS-F001 and provided to the CIS Project Manager for issue to contractors and their consultants. Project Managers must maintain a register of non-conformances and manage close out of outstanding non-conformances. Contractors and their consultants issued with non-conformances must take appropriate corrective or preventive actions. Proposed corrective or preventive actions and close out of non-conformances must first be formally approved by issuer of the standard or their delegate.
10.2 DESIGN STANDARD CERTIFICATION

Contractors and their consultants must certify compliance to the design standard by completing and submitting the CIS Project Design Certification Form, CIS-PROJ-F001 to the CIS Project Manager at each of the following project phases:

a. Design and Documentation
b. Tender
c. Construction

Notwithstanding CIS’ internal quality control processes, contractors and their consultants must implement their own robust quality assurance and control procedures to ensure compliance with requirements of this standard.

11 REFERENCES

<table>
<thead>
<tr>
<th>Standard</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS 60044.1-20017/Amrd 1-2012</td>
<td>Instrument transformers – Current transformers</td>
</tr>
<tr>
<td>AS 62053.22 (2005)</td>
<td>Electricity Metering Equipment (AC) Static meters for active energy (Classes 0.2S and 0.5 S)</td>
</tr>
<tr>
<td>AS 62053.23 (2006)</td>
<td>Electricity metering equipment (AC) – Particular Requirements – static meters for reactive energy (Class 2 and 3).</td>
</tr>
<tr>
<td>BCA</td>
<td>Building Code of Australia Building Code of Australia, specifically Section J energy efficiency</td>
</tr>
<tr>
<td>--</td>
<td>Alerton Optergy 2 System Description</td>
</tr>
<tr>
<td>--</td>
<td>All Health Authority Requirements</td>
</tr>
<tr>
<td>--</td>
<td>All Local Council regulations</td>
</tr>
<tr>
<td>--</td>
<td>American Society of Heating Refrigeration and Air-conditioning Engineers. BACnet PICs (protocol Implementation Conformance Statement)</td>
</tr>
<tr>
<td>--</td>
<td>Electricity Safety (Installations) Regulation</td>
</tr>
<tr>
<td>--</td>
<td>Moxa. Datasheet. MB3170 Modbus Serial to Ethernet Gateway</td>
</tr>
<tr>
<td>--</td>
<td>NABERS. NABERS Energy and Water for offices (version 3.0)</td>
</tr>
<tr>
<td>--</td>
<td>National Institute of Standards and Technology (NIST). GSA Guide to Specifying Interoperable</td>
</tr>
<tr>
<td>--</td>
<td>State Fire Brigade requirements</td>
</tr>
<tr>
<td>--</td>
<td>Workcover requirements</td>
</tr>
</tbody>
</table>
### Standard

<table>
<thead>
<tr>
<th>Standard</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><a href="http://www.bacnet.org">www.bacnet.org</a></td>
</tr>
<tr>
<td></td>
<td><a href="http://www.modbus.org">www.modbus.org</a></td>
</tr>
</tbody>
</table>

#### 12 NOTES

N/A

#### 13 ATTACHMENTS

N/A