Guideline Design Standard for Energy and Utility Monitoring Systems (EMS)

Macquarie University, Sydney

1 Revision

Version	Description	Date
1	Issued for review	07/05/2017
2	1) Additional details of EMS Server requirements 2) Natural gas and water meter requirements added. 3) Testing and validation requirements added. 4) Trades responsibilities added. 5) General revision after review of Rev 1 Draft	19/5/2017
3	1) Added requirements for Regional Switchboards 2) Added requirement for Patter Approval for billing meters, removed specific meter nomination. 3) Added table of metering coverage by Switchboard Function	3/7/2017
4	1) Added Section 12 – External Lighting Controls 2) Expanded Electrical and Mechanical Contractor's scope. 3) Added enclosure requirements as per Mechanical Services and BMS Guidelines. 4) Removed Diris A20 and added Diris A10 to deemed to comply meters. 5) Added 15.6 Typical Electrical Energy Meter Wiring 6) Typical 15.7 EMS Panel Layout	14/11/2017
5	1) Added references to Halytech Wireless infrastructure 2) Clarified External Lighting control interface to BMS, moved to Section 11.4. 3) Changed Station Name requirements to reflect new Building Address format 4) Added External Lighting metering and Solar Generation metering to where metering is required.	17/11/2017

2 Approvals

Name	Organisation	Role
Adrian Michaels	AM Building Efficiency	Author
Damien McLynskey	Macquarie University	Approved
Phil Hunt	Macquarie University	Approved

Contents

Figures

Tables

3 References

1. AS/NZS 3000:2007 Standards Australia. Electrical Installations
2. Australian Communications and Media Authority: Radio - communications (Electromagnetic Compatibility) Standard 2008
3. Building Management Systems (BMS) Design Standard V2.1 Issued March 2016
4. Alarm Handling Subsystem (AHS) Requirements Specification Issued March 2016
5. Mechanical Services Design Standards V1.3 Issued May 2016
6. AER (Retail) Exempt Selling Guideline Version 4 - March 2016
7. Electricity Network Service Provider Registration Exemption Guideline Ver 3 - 27 August 2013
8. National Electricity Rules Version 79 (10 March 2016) Chapter 7 - Metering
9. NCC 2016 BCA Volume One Appendix J – Energy Efficiency
10. NABERS Energy and Water for Offices – Appendix 8 Metering Systems

4 Definitions and Abbreviations

AI,	Analog Input, a physical analog input connected to a DDC controller
AO	Analog Output, a physical analog output connected to a DDC controller
BACnet	Interoperability protocol ASHRAE Standard 135p.
BMS	Building Management System
BMS Server	Macquarie University Tridium Niagara BMS Server (Address 10.15.225.50)
CAN	Campus Area Network
CT	Current Transducer
EMS	Energy and Utility Metering System
FOX	Tridium Niagara FOX protocol for communicating between Tridium Niagara Stations.
HV	Natural gas Heating Value
Halytech	433MHz Wavenis wireless technology by Halytech Pty Limited
IO	Input / Output
JACE	Java Application Control Engine (trademark of Tridium Inc.). Current deemed to comply JACE is 8000 Series with Niagara AX 3.8.111 software.
Metering Server	Macquarie University Tridium Niagara Energy and Utility Metering Server (Address 10.15.225.10).
MCC	Motor Control Centre
Modbus	Modbus communications protocol over serial link (RS-485)
MBus	Meter-Bus communication protocol.
MSTP	Multi-Slave Token Passing BACnet Communication Protocol.
MU	Macquarie University
MUP	Macquarie University Property
PF	Gas Meter Pressure Factor
RDC	Remote Distributed Controllers
SI	Tridium Niagara System Integrator
VSD	Variable Speed Drive.

5 Nomenclature used in this document

This document uses the nomenclature “shall provide”, “shall be”, “shall be provided with”, “must be capable” or similar where the functionality required is mandatory and it is expected that the completed system will have the functions specified without any further hardware, software or configuration.
Where the document uses the nomenclature “shall have the capability” this indicates that system is able to provide the functions required, although this may involve additional hardware, software or configuration.

6 Purpose

This design guideline describes the Macquarie University Energy and Utility Monitoring System (EMS) and defines the scope of work and technical specifications for Projects integrating new electrical, natural gas meters, water meters and lighting controls at Macquarie University (MU). The document is designed to provide a guide to Projects developing scope to connect new building metering to the Macquarie University EMS.

This specification does not replace the consulting engineer’s requirement to stipulate the quantity and location of metering required to provide adequate coverage of energy services in new buildings.

7 Scope

This document covers the minimum requirements for new and refurbished buildings EMS works to enable connection of metering to the Macquarie University EMS. The document details the requirements with respect to BMS and EMS integration of lighting controls.

It provides selected details of equipment and standards used within the EMS, to assist designers in the integration of new metering equipment into the EMS.

8 Standard of Work

EMS works shall be undertaken in compliance with the requirements of this document, relevant Australian Standards, Macquarie University Design Standards and accepted industry best practices.

EMS integration works specific to the Tridium Niagara technology used by the EMS, at the EMS Gateway and EMS Server level must be undertaken by Tridium Niagara certified Integrators approved by MUP.

9 EMS Architecture

9.1 General

The Energy and Utility Monitoring System (EMS) implemented at Macquarie University is based on Tridium Niagara technology. Energy and other utility data is integrated to the Macquarie University Campus EMS and BMS Servers.

The EMS and BMS Servers reside on a dedicated Virtual Private Network (VPN). The servers are administered by Macquarie University MUP and use specialist integration contractors. The EMS system consists of the EMS Server, hosted in the Building E6A Data Centre, and Tridium Niagara JACE gateway devices that collect data from smart meters, wireless systems and I/O devices.

The EMS collects electrical, gas and water data from gas meters, water meters, thermal meters, and Variable Speed Drives (VSD's). It also collects consumption data for gas and water meters from a Halytech wireless data collection system.

New electrical, gas and water meters installed in new or existing refurbished buildings shall integrate to the existing EMS based on Tridium Niagara as the integration technology platform.

9.2 EMS Server

The EMS system consists of a protected server, hosted in MU data centre and gateway devices fitted in a steel panels mounted in the electricity distribution hub. The JACES EMS Gateway devices collect data from smart meters, pulse meters and other smart devices and pass the data to the EMS Server.

EMS JACES are integrated to the EMS and BMS server via the Campus Network (CAN).

9.3 EMS Gateway Devices

The EMS uses Tridium Niagara technology to integrate the metering to the EMS Server.

Deemed-to-comply gateways are the Tridium Niagara JACE 8000 with AX V3.8.111 operating system.

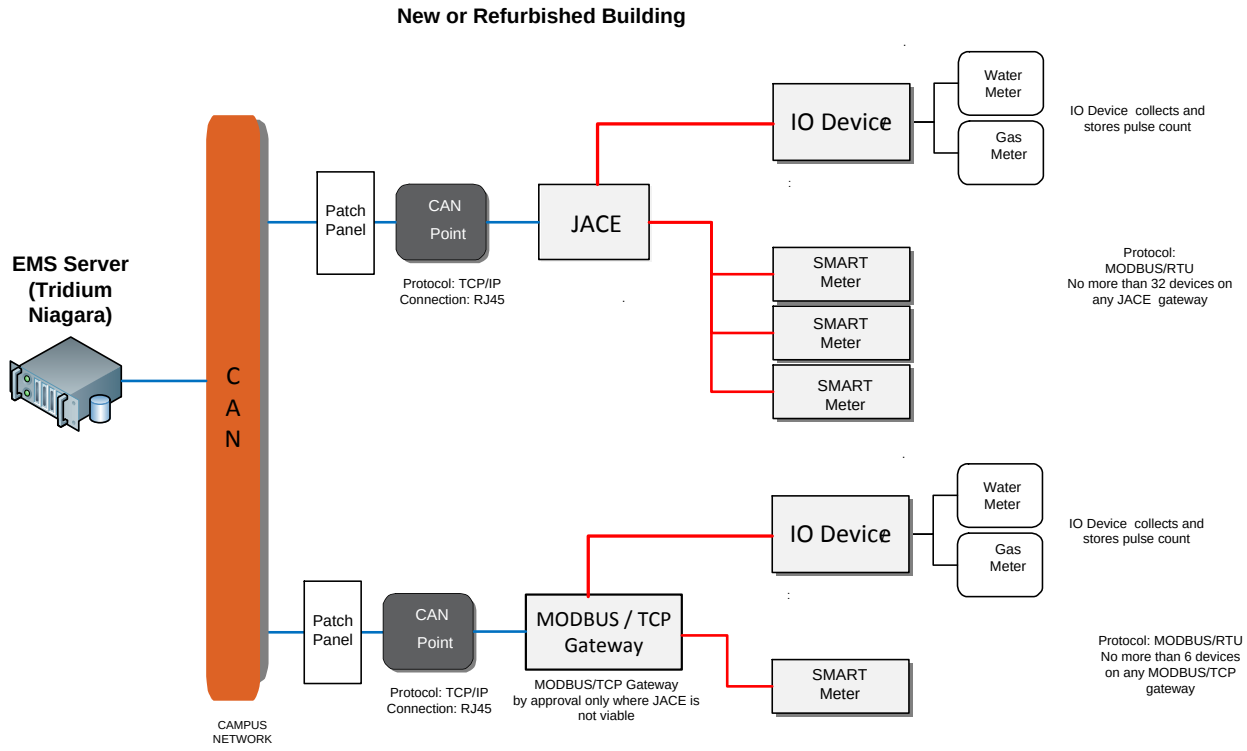


Figure 1. EMS Architecture, Hardwired Metering

9.4 Wireless Architecture (External Gas and Water Meters)

In addition to the hard-wired meter integration architecture a wireless (radio) architecture is implemented where hardwiring is not feasible, the wireless system is based around the Halytech wireless product range. The wireless network is provided for gas and water meters located in external areas (sports fields etc) can be connected to the EMS.

Four off radio base station receivers installed within buildings X5B, E12C, E3B and W21B, connected to the Campus network collect meter data from wireless and provides the EMS Server with data from wireless transmitters connected to gas and water meters. Data is transmitted every 6 hours from the transmitters that are collecting 15-minute interval consumption data.

The Halytech wireless system has the capability to collect 3 days' worth of data without mains power and to store six days' worth of data without network connectivity, upon reconnection to network data is to be automatically uploaded.

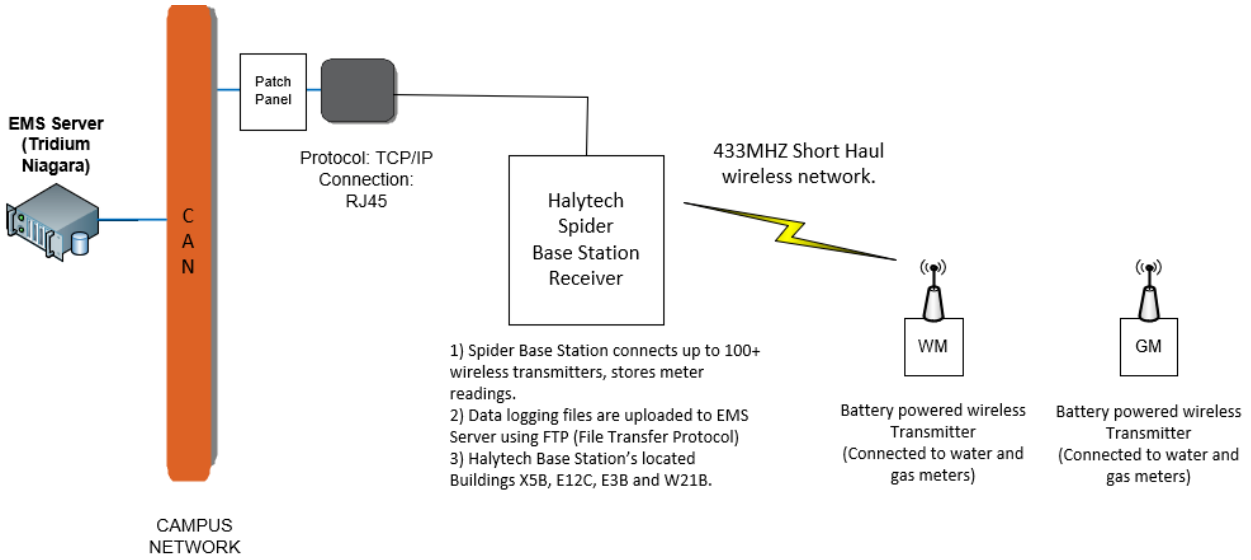


Figure 2: Halytech Wireless Metering Architecture

10 EMS Project Works Responsibilities

10.1 Electrical Contractor

- Selecting, supplying and installing electrical metering that meets the requirements of the guideline and the project.
- Liaise with EMS Integrator on meter selections and EMS connections.
- Installation of electrical smart meters and associated hardware, including but not limited to CT's, CT terminal & shorting blocks, potential fuses, meter wiring etc.
- Provision of power outlets for EMS equipment.
- Provision of data outlets, configured as per MUP requirements, for connection of EMS and BMS systems to Campus network.

10.2 Mechanical Services Contractor

- Selecting, supplying and installing electrical metering in Mechanical Services switchboards and MCC's that meets the requirements of the guideline and the project.

- Liaise with EMS Integrator on meter selections and EMS connections.
- Installation of electrical smart meters and associated hardware in Mechanical Services switchboards and MCC's, including but not limited to CT's, CT terminal & shorting blocks, potential fuses, meter wiring etc.

10.3 Hydraulic Services Contractor

- Selecting, supplying and installing water and natural gas metering that meets the requirements of the guideline and the project.
- Liaise with EMS Integrator on meter selections and EMS connections.

10.4 EMS System Integrator

The EMS System Integrator shall be responsible for the following:

- Engineering, Installing, Programming, Commissioning and Servicing all EMS specific system works including JACES, EMS Server Integration, Graphics, Dashboards and Reports.
- Coordinating with Electrical, Mechanical, Hydraulic Contractors to ensure metering is selected in accordance with these requirements.
- Coordinating final connection and integration of metering either directly or by coordination with other Trades.
- Liaising with BMS System Integrator to ensure integration with BMS.

10.5 BMS System Integrator

- Undertaking integration of EMS with BMS systems and BMS Server.
- Undertaking BMS Integration works as per the requirements of this guideline.
- Liaise with EMS Integrator where BMS energy and metering data (such as VSD's) is required by the EMS.

11 Metering Requirements

11.1 General

The Project shall supply, install and commission meters, CT's, communications networks, gateway devices and EMS programming compatible with the EMS. The EMS Server will be configured by the Project to include all new metering added or existing metering deleted or changed by the Project.

The Project shall ensure that any additions or modifications to the EMS are checked for design compatibility, capacity, reliability and maintainability by MUP. MUP may refer designs to the EMS vendor for inspection to ensure that the EMS design is not compromised.

11.2 Electricity Metering and External Lighting Controls

11.2.1 General

Private electrical sub-meters are utilised for the following purposes:

- Energy management and reporting.
- Building Control (Demand Management)
- Cost Recovery / Billing Purposes.

Where the metering is to be used for cost recovery or billing purposes the specifier must ensure that that both energy meters and the billing / cost reporting specified meet regulatory requirements for energy selling.

11.2.2 Metering Communications Connections

Where meters are preinstalled into switchboards and distribution boards the EMS (RS485) connection terminals shall be provided in a separate section of the board that will allow connection of communications cabling without shutting down or isolating any circuit. Internal communications cabling shall be looped so that no star connections created by the EMS cabling.

11.2.3 Meter Requirements

Electrical Meters shall be specified to meet the following requirements as indicated in this document and by the requirements of the Project.

The following electricity data points shall be configured to be monitored by the EMS:

Value	Logging Interval	EMS Server Storage Requirement
3 phase kW	15 min	Indefinite
3 phase kVA (average maximum)	15 min	Indefinite
3 phase kWh (totaliser)	15 min	Indefinite
L-N Voltage (each phase)	15 min	1 month
L-L Voltage (each phase)	15 min	1 month
3 phase kVAR	15 min	Indefinite
3 phase Current (each phase)	15 min	Indefinite
3 phase Power Factor	15 min	Indefinite
Frequency	15 min	1 month
Total Harmonic Distortion (total and phase %)	15 min	1 month
Neutral Current (calculated)	15 min	1 month

The interval data shall be stored in the JACE Gateway for a minimum of 1 week in the event of a loss of communications from the server to the JACE Gateway. The naming convention used to identify meters shall be standardized in accordance with MUP direction. All labelling on meters shall reflect this standard.

11.2.4 Energy Retailer (Revenue) Meters

Where revenue meters are installed these meters shall be supplied fitted with Modbus ports and the Modbus data made available for connection to the EMS via an approved MODBUS / TCP Gateway or directly to an EMS Gateway.

11.2.5 Private Sub-Meters (Energy Efficiency and Monitoring)

The prime purpose of the EMS is to allow sufficient visibility of the energy and utility use in the building to detect wastage and measure for efficiency and optimisation purposes. Private electrical meters generally for submain metering for monitoring and energy management purposes shall be specified in accordance with AS 62053.22 (2005) Electricity Metering Equipment (AC) Static Meters for Active Energy (Class 0.5 S) and AS 62053-21 (2005) for Reactive Power (Class 1).

Submain loads are to be measured as 4 wire unbalanced loads. The meter is required to calculate the neutral current.

Private Electricity meters must support the following:

- 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 are to be easily obtained from the meter display.
- 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)
- 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 EMS 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

11.2.5.1 Approved Private Sub-Meters for Energy Efficiency and Monitoring

The following meters are approved for general sub-metering application:

- NEMO 96HD
- Diris A40
- Diris A10 (Where DIN Rail Mount applications are required)

Other meters, that meet the functional and accuracy requirements specified, may be utilised with prior approval from MUP.

Where additional meters are added to an existing building ensure that the new meters match the existing installation.

11.2.5.2 Metering Coverage

It is critical that the design team carefully review and consider both the use of the building and the ongoing operation in determining metering requirements. It is expected, but not limited to, all mechanical loads, all loads in excess of 50 amps, and where compliance with the BCA Part J is required, will be metered.

In addition to the requirements of NCC 2016 BCA Volume One Section J8 the metering coverage should provide detailed coverage to allow ongoing operational optimisation of the building utility consuming system.

Specifically, sufficient metering shall be provided to differentiate the following loads:

1. Mechanical Services Loads:
    a. Central Cooling Plant (Chillers, Cooling Towers, Pumping Loads)
    b. Airside Plant by floor or logically zoned as suits the installation.
    c. Central Heating Plant
    d. Exhaust Systems
    e. Tenant / Occupant systems.
2. Building Lighting Loads
    a. External Lighting.
    b. By floor or logically zoned as suits the installation.
    c. Base building lighting.
    d. Tenancy / Occupants lighting.
3. General base building power
4. Solar Generation
5. Tenant / Occupant Floor plug loads
6. Lifts / Vertical Transportation
7. Special Purpose loads (building usage dependent).

11.2.5.3 Electrical Switchboards – Minimum Metering Coverage

The table below defines the minimum metering coverage for different electrical switchboard types:

Switchboard Types	Minimum Coverage	Notes
Regional Board	All circuits, Incoming Feed.	
Building Main Switchboard	All circuits greater than 50A rating. Incoming feed.	
Distribution Board	All circuits greater than 50A rating. Power & Lighting chassis.	
Mechanical Switchboards	Incoming Feed, All circuits greater than 50A	
External Lighting Distribution Boards	Incoming Feed, All circuits greater than 50A	

Table 1: Metering Coverage by Switchboard Function

11.2.6 Private Sub-Meters (Billing or Cost Recovery)

Where there is no other option (due to infrastructure or other configuration) but to use private metering instead of the required revenue metering, approval in writing must be given by MUP. Where billing or cost recovery is undertaken the requirements of the Australian Energy Regulator, National Electricity Rules and other relevant regulatory requirements must be adhered to.

11.2.6.1 Approved Private Sub-Meters for Billing or Cost Recovery

Where private sub-metering is to be used for Billing or Cost Recovery meters the metering installation must be specified to comply with AER guidelines. Meters must be pattern approved consistent with requirements of National Measurement Act (Cth) and listed by the NMI as Pattern Approved at the time of installation. The Project scope shall require Certificates of

Approval and certification of verification (or verification mark) to be provided as part of the documentation requirements of the Project.

Metering accuracy must be in accordance with the National Electricity Rules (NER) Schedule 7.2. Meters must be supplied fitted with Modbus ports and the Modbus data made available for connection to the EMS via an approved MODBUS / TCP Gateway or directly to an EMS Gateway.

At the time of specifying a project the specifier shall ensure that approved meters are Pattern Approved as required above.

11.3 Current Transformers

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

Current Transformers shall be specified in accordance with AS 60044.1 (2007). Split CT's may be used in exceptional circumstances, with approval of MUP.

The Project is to 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.

- 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

As much as is reasonably practical the cable travelling through the CT must be kept centred. The metering installation shall be specified to ensure that the meter / CT burden limitation are not compromised (Refer Appendix 14.1 – Current Transformer and Metering Burden)

The installation must be specified to include associated equipment including meter protection fuses/CB, meter test blocks and wiring etc. Shorting links and barrier terminals shall be fitted to permit disconnection of the meters and CT's for maintenance or replacement. Current signals from the CTs shall 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).

11.4 External Lighting Controls

External Lighting, that is lighting outside of the building envelope, must be controlled using a contactor based hardwired interface integrated to the BMS Server. This must be configured to provide group control as necessary and be integrated directly to BMS / EMS IO controllers. Each BMS / EMS controlled external lighting circuit is to be equipped with status monitoring to confirm operation of the lighting circuit to the BMS / EMS.

Where it suits the project, the IO Devices controlling External Lighting may be connected to a EMS JACE Gateway. This circumstance is the ONLY BMS function allowed to be connected to an EMS JACE Gateway.

11.5 Water Metering

11.5.1 General

Water metering shall be provided for water efficiency, reporting and cost recovery / billing purposes. Where the metering is to be used for cost recovery or billing purposes the specifier must ensure that that both energy meters and the billing / cost reporting specified meet regulatory requirements for energy selling.

The following water utility points will be monitored or calculated by the EMS.

Value	Logging Interval	EMS Server Storage Requirement
Water Consumption (kL)	15 min	Indefinite
Water Flow Rate (l/s) – Calculated based on consumption over time.	15 min	Indefinite

11.5.2 Water Retailer (Revenue) and Private Sub-Meters

Revenue meters shall be specified as per the requirements of this guideline and the regulatory requirements. The meters shall be provided with a pulse output (voltage free or open collector output S0) suitable for connection to the EMS. Minimum resolution of pulses shall be 5L per pulse and maximum resolution shall be 100L per pulse.

11.5.3 Coverage

Water submeters shall be provided to meet the requirements of the Project. Minimum coverage shall include:

- Main Building Potable Water Supply
- Total Recycled / Rainwater Water Supply.
- Potable Makeup to Recycled / Rainwater Water Supply.
- Cooling Towers Makeup Supply
- Toilets / Restroom Water Usage

11.6 Natural Gas Metering

11.6.1 General

Natural gas metering shall be provided for energy efficiency, reporting and cost recovery / billing purposes. Where the metering is to be used for cost recovery or billing purposes the specifier must ensure that both energy meters and the billing / cost reporting specified meet regulatory requirements for energy selling.

All equipment and materials installed in natural gas systems must where applicable, be approved for use by AGL and Jemena. Intrinsic Isolation barriers must be provided in accordance with Jemena requirements for retail meters. Private meters must be provided with intrinsic isolation unless a hazard assessment is undertaken by a qualified person that determines that isolation is not required.

The following natural gas utility points will be monitored or calculated by the EMS.

Value	Logging Interval	EMS Server Storage Requirement
Natural Gas Volume (m^3)	15 min	Indefinite
Meter Pressure Factor	15 min	Indefinite
Natural Gas Heating Value	15 min	Indefinite
Natural Gas Energy Use (MJ)- Calculated	15 min	Indefinite

11.6.2 Coverage

Natural gas submeters shall be provided to meet the requirements of the Project. Minimum coverage shall include:

- Main Building Natural Gas Supply
- Mechanical Services Natural Gas Supply (Boilers or other heating).
- Domestic Hot Water Heating
- Steam Boilers
- Laboratory Supplies
- Commercial Kitchens/Communal Kitchens in Student Accommodation facilities
- Spaces proposed for tenancy leasing agreements

11.6.3 Natural Gas Retailer (Revenue) and Private Sub-Meters

Natural gas meters shall be specified as per the requirements of this guideline and regulatory requirements. The meters shall be provided with a pulse output (voltage free or open collector output S0) suitable for connection to the EMS. Minimum resolution of pulses shall be $0.1m^3$ per pulse and maximum resolution shall be $1m^3$ per pulse.

11.6.4 Meter Pressure Factor and Heating Value

Natural gas energy usage shall be calculated based up recorded consumption multiplied by Meter Pressure Factor and Heating Value.

Meter Pressure Factors and Gas Heating Values shall be programmed into the EMS on a per meter basis as part of the project specification.

12 EMS and BMS System Integration Requirements

12.1 General

12.2 Certified System Integrator

The Project shall ensure that all SI works are undertaken by a certified Tridium Niagara SI using engineers that have undertaken Tridium Niagara AX and N4 certification training. SI's approved by MUP are:

- Environmental Automation
- Greenstar Citywide
- Logical Building Automation
- Enviro Building Services
- iControl Systems

12.3 EMS JACE Gateway Requirements

12.3.1 General

Tridium Niagara JACE's shall be the only devices interfacing, via the Campus Network, to the EMS Server. The only acceptable JACE hardware to be used is the JACE 800 licenced for Tridium Niagara AX (ie: Ver 3.8U – JACE 8000 support).

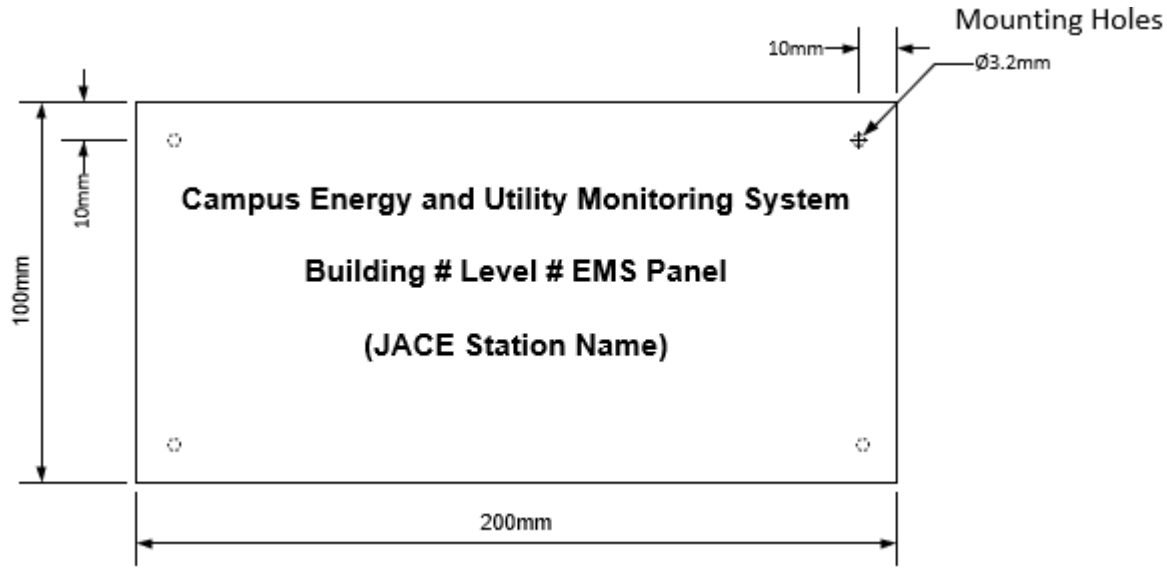
The Project shall identify all Campus Network interface points and shall request IP addresses and provide identify all campus network outlets (existing or new) required to be used.

12.3.2 Enclosures

All EMS equipment is to be enclosed appropriately to provide environmental, electrical, RFI and mechanical protection, security against unauthorised access and indication of function.

Enclosures shall be compliant with the Mechanical Design Guide for MSSB and MCC enclosures, specifically they shall be steel, have a minimum size of 400w X 600h X 200d with IP65 rating. Enclosure shall be finished in powder coated X15 Orange with white backing plate. They shall be fitted with lockable, chrome plated Tee handle, keyed to CL001

EMS panels are to be clearly labelled on the front of the panel in accordance with Australian Standards. Front panel label to be black lettering on white background type commonly referred as 'traffolyte' type as per below:



Label Size	200mm x 100mm
Font Height	8mm
Font Type	Arial
Font Colour	Black
Label Colour	White
Material	White / Black "traffolyte" labels
Mounting Holes	3.2mm

To be provided with adhesive tape for mounting

EMS Gateway connection diagrams and network diagrams will be plastic coated and placed in a pocket in the enclosure or in a metal holder A4 size next to the enclosure.

12.3.3 JACE Station Names

The Station Names must comply with Design Guideline naming requirements, specifically the station name must follow the format *BBBBBBBBBBB_AAAAA,* where:

BBBBBBBBBBB	Building Identifier (ie: 12WW for 12 Wally's Walk)
AAAAA	Room Number that the JACE is located (ie 402A)

Example: A JACE located in room 302 of 29 Wally's Walk would use the Station Name:

29WW_302

Note that if a room number does not exist a generic description that identifies its location is acceptable provided it is clear as to the location and has been approved by MU.

Example: 29WW_RoofPlantroom

12.3.4 JACE Engineering

The EMS shall be engineered to avoid large single points of failure. EMS Gateways shall be distributed in accordance with best practice distributed processing. A project shall be specified to have dedicated EMS and BMS JACE Gateway devices.

The number of metering devices monitored by each JACE shall be limited to a maximum 32, irrespective of whether they are directly connected or otherwise. Where energy or other utility data required for metering purposes is sourced from a device connected to the BMS the relevant data shall be subscribed from a metering JACE within the same building using Niagara Fox protocol.

The JACE shall be configured with Macquarie University standard administrative passwords, the integrator shall liaise with MUP on password / security policies.

12.3.5 MODBUS / TCP Gateway

The EMS shall utilise MODBUS TCP to RTU Gateways where it is impractical or not cost effective to directly connect secondary devices directly to the JACE.

Deemed to comply gateways are MOXA MGate MB3180 Series.

12.4 EMS / BMS Server Requirements

12.4.1 General

Energy and utility metering data is collected and stored both on both EMS and BMS servers running Tridium Niagara AX Supervisor application. The Project shall be specified to include Niagara integration works including;

- Integration of JACE Gateways to EMS and BMS Servers.

- Configuration of point subscriptions, histories, alarms, graphics, dashboards and reports on the BMS and EMS servers to meet the requirements of this Guideline and the Project.

12.4.2 EMS Server

12.4.2.1 General

The EMS Server is a Microsoft Server 2008 R2 Virtual Machine running on a DELL Server located in the Macquarie University datacentre. Details as follows:

Supervisor Version: AX Version 3.7.104
Drivers Installed: SQL Server 2008
Reporting Software: Prophet DataEye Ver 2.5

12.4.2.2 Minimum Building Energy and Utility Dashboards and Reporting

The Project shall specify that energy monitoring dashboards are configured as part of the project works. Minimum requirements for the Energy Dashboards are as follows:

- Monthly Energy Consumption and Demand Data (by Building)
- Trends over time.
- Calculation of Energy Intensity and comparison against targets
- Breakdown of energy and power by sub-circuit.
- Ability to export and email dashboards and reports.
- Ability to calculate and create billing reports using a combination of metered variable and fixed costs.

12.4.2.3 EMS Alarms

Energy and Utility alarms shall be configured as part of the Project. The alarms shall be configured to be emailed to selected users. Minimum alarm requirements are as follows:

- Water Leak Detection based upon threshold limits set for low usage time frames (ie 2am – 3am). Times and thresholds are to be user selectable.
- Demand and or Consumption limit alarms.
- High and Low Voltage alarms.

12.4.3 BMS Server

12.4.3.1 Building Energy and Utility Logs

The BMS Server shall be specified to be configured as part of the Project. Minimum requirements are that all sub-metering points and histories shall be enrolled into the BMS Server. The BMS Graphics shall include a set of metering graphics that shall include the following:

- Live Data on a per meter basis showing all monitored points.
- On a per meter basis display Daily, Weekly, Monthly and Annual consumption data.

13 Metering Testing and Validation

13.1 General

Meters must be tested for accuracy and validation of meter readings against the recorded reading undertaken as part of the Project. Validation must be undertaken in accordance with the requirements of NABERS Energy and Water for Offices Version 3 – Section 8 Metering.

Evidence of testing and validation must be provided in a format as per the samples provided in Appendix 14

14 Apendixes

14.1 Current Transformer and Metering Burden)

The EMS general requires an electrical meter accuracy Class 0.5 for active Power. The electrical contractor is to ensure this accuracy is not compromised, by installing cabling large enough to satisfy the secondary lead burden to ensure accuracy errors are not introduced.

Australian Standard 1675 specifies the maximum permissible errors for different accuracy classes and lists typical cable burdens. The contractor is to remember that cable burdens refer to route length (cable length between meter & CT x 2), when considering the appropriate size cable.

Cable Diameter (mm)	*VA / meter*	*VA / meter*
	1 Amp CT	**5 Amp CT**
1	0.039	0.970
1.5	0.026	0.654
2.5	0.016	0.392
4	0.010	0.248
6	0.007	0.166

To maintain metering accuracy, the following formula must be satisfied:

Meter Burden + Cable Burden ≤ CT Burden

Where; Meter Burden (eg: Diris A40) = 0.5VA
CT burden (Generally) = 5 VA

Then maximum permissible cable burden is 5VA – 0.5VA = **4.5VA**

14.1.1 Burden Charts (Information Only)

The following charts are a guide indicating the size of cables required for 1A and 5A CT circuits.

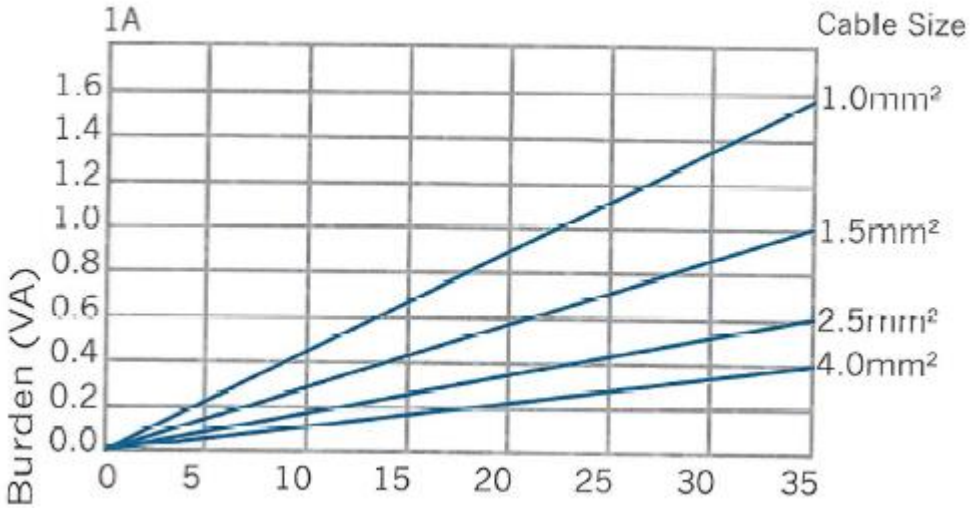


Figure 3: Burden v Overall Cable Length (m) for 1A CT

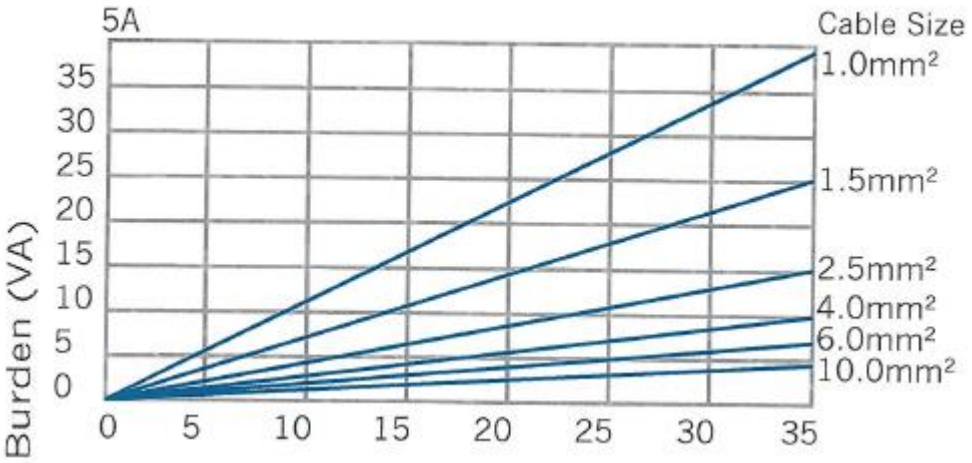
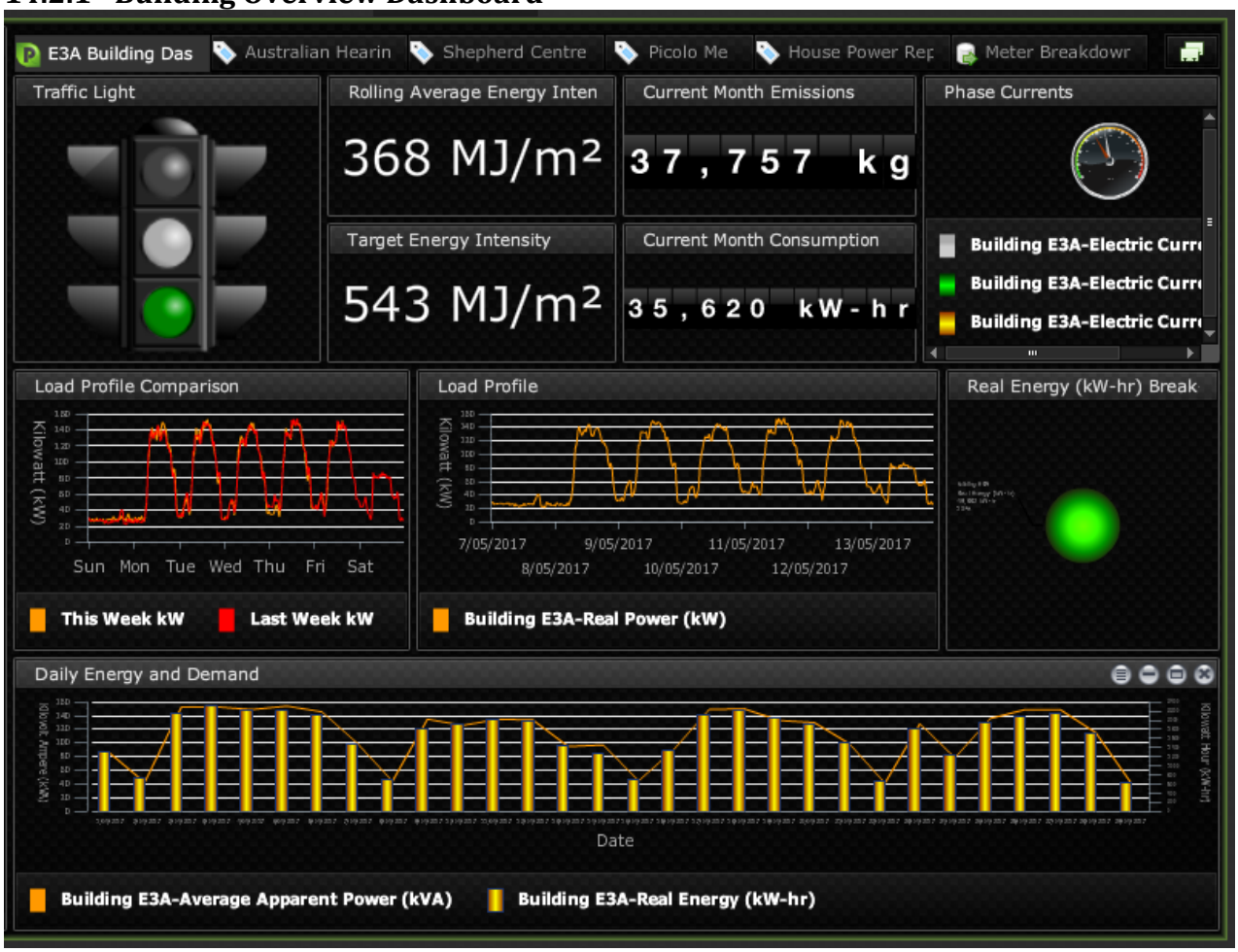


Figure 4: Burden v Overall Cable Length [m] for 5A CT

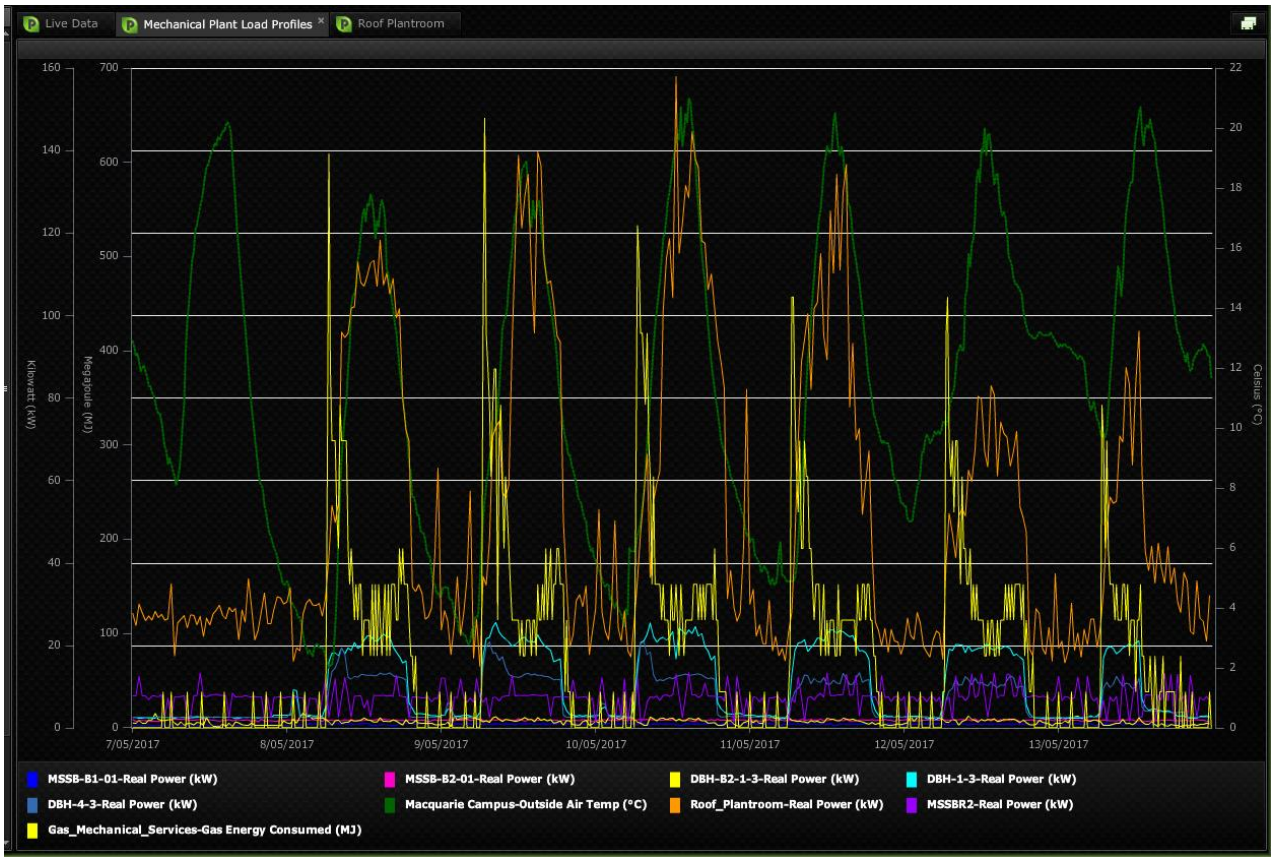
14.2 Example Energy Dashboards

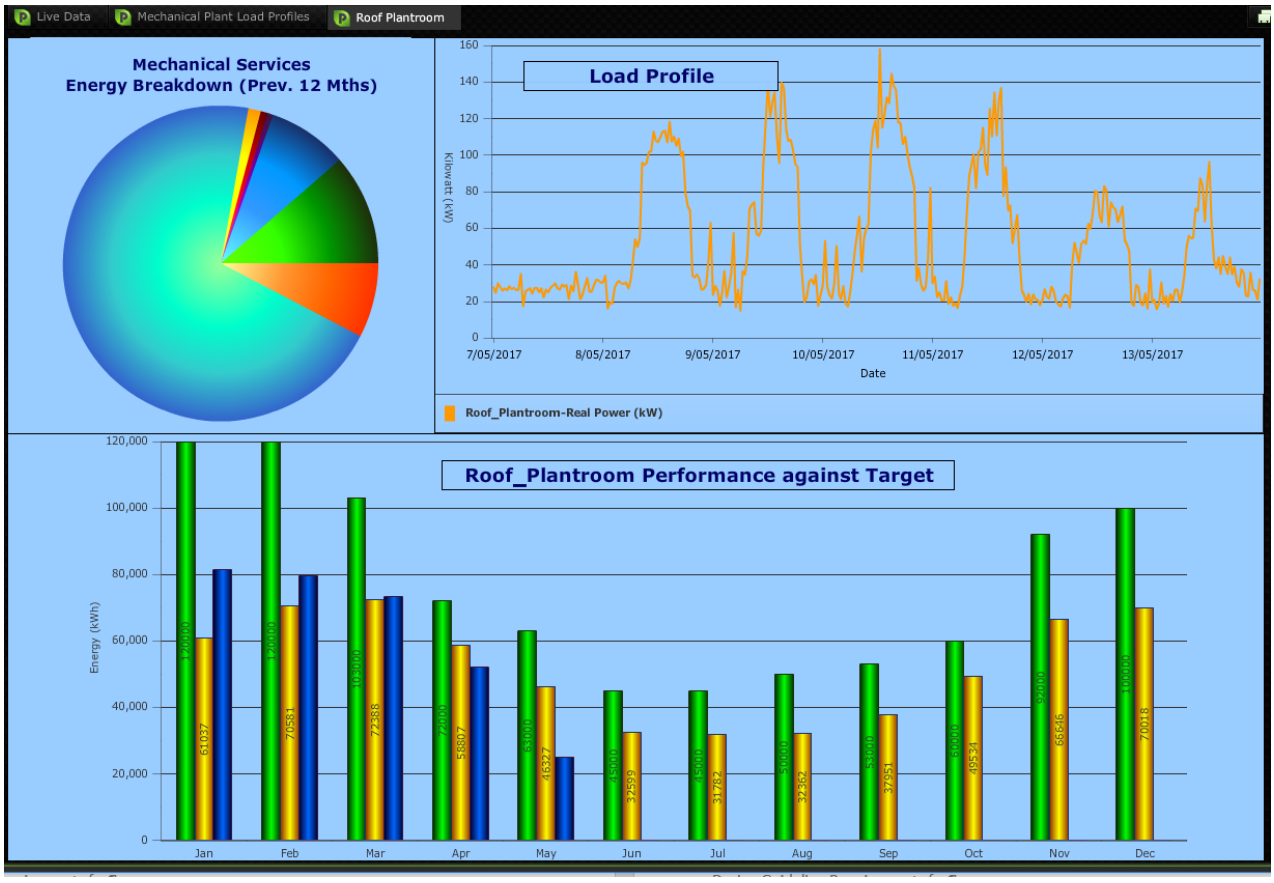
14.2.1 Building Overview Dashboard



14.2.2 Live Data Dashboard

14.2.3 Load Profiles Dashboards





14.2.4 Energy Billing Report

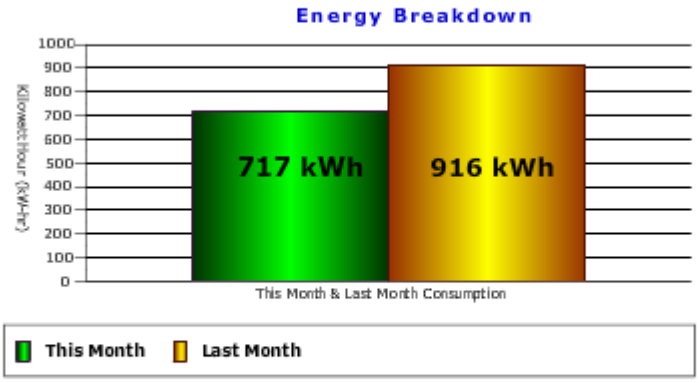
AUSTRALIAN HEARING HUB ELECTRICITY BILLING REPORT

MACQUARIE University

Account Number: SS2.6 - Shepherd Centre
Invoice Number: 123456
Tenancy Name: Shepherd Centre
Address: No1 University Ave, Macquarie University NSW 2109

Period: 01/04/2017 to 30/04/2017
Date of Issue: 19-May-2017
Due By: 18-Jun-2017

CHARGES	Qty	x	Rate (cents)		TOTAL
Energy and Network Charges					
Energy Charges:	717 kWh		5.7027	$	40.89
Network Charges:	717 kWh		3.2740	$	23.47
Demand Charge:	2.80 kW		35.1909 c / Day /kW 30 Days	$	29.56
			Total Consumption & Demand Charges:	**$**	**64.36**
Other Charges					
Environmental Charges:	717 kWh		1.6510	$	11.84
Meter Charge				$	36.76
			Total Other Charges:	$	**48.60**
Total emissions for this month: 782 kg of CO2-e			**Sub-Total:**	$	**112.96**
			GST:	$	**11.30**
			TOTAL:	$	**124.26**



Last Months Consumption: 916 kWh

Macquarie University customers, occupying the AHH building are individually metered. Tariffs & charges included in this invoice are as received by the University, with no additional amount for Metering, Access, Administration or Other charges passed onto the customer. Tariffs for Peak, Shoulder & Off-peak times are apportioned equally to the total energy consumed. (A break-up of the components for each charge is available on request.)

Shepherd Centre Meter Nos. DBT-GA-2-B1, DBT-GA-2-B2.

Account Enquiries (MQ Property): 02 - 9850 - 7145 Emergency Contact: 02 - 9850 - 7112

14.3 Natural Gas and Water Meter Validation Form

Building Name: **Building Address**

Testers Name: **Licence Number / Qualification:**

Date of Validation:

Meter ID / Description	Remote Meter Reading Checks				Gas Meter Pressure Factor	Gas Heating Factor	Notes
	Time A [Note 1]		Time B [Note 1]				
	Remote Reading	Meter Reading	Remote Reading	Meter Reading			
	Time:		Time:				
	Time:		Time:				
	Time:		Time:				
	Time:		Time:				
	Time:		Time:				
	Time:		Time:				
	Time:		Time:				

Note 1: A minimum of 2 hours between readings and / or a significant change of value must be discernible.

Signed: _____ **Dated:** _____

14.4 Electrical Energy Meter EMS Validation Form

Building Name: **Building Address**

Testers Name: **Licence Number / Qualification:**

Date of Validation:

Meter ID / Description	CT Ratio	Wiring Checked	Remote Meter Reading Checks				Notes
			Time A [Note 1]		Time B [Note 1]		
			Remote Reading (kh)	Meter Reading (kWh)	Remote Reading	Meter Reading	
			Time:		Time:		
			Time:		Time:		
			Time:		Time:		
			Time:		Time:		
			Time:		Time:		
			Time:		Time:		
			Time:		Time:		

Note 1: A minimum of 2 hours between readings and / or a significant change of value must be discernible.

Signed: _____ **Dated:** _____

14.5 Electrical Energy Meter Calibration Check Form

Building Name: _____ **Building Address** _____

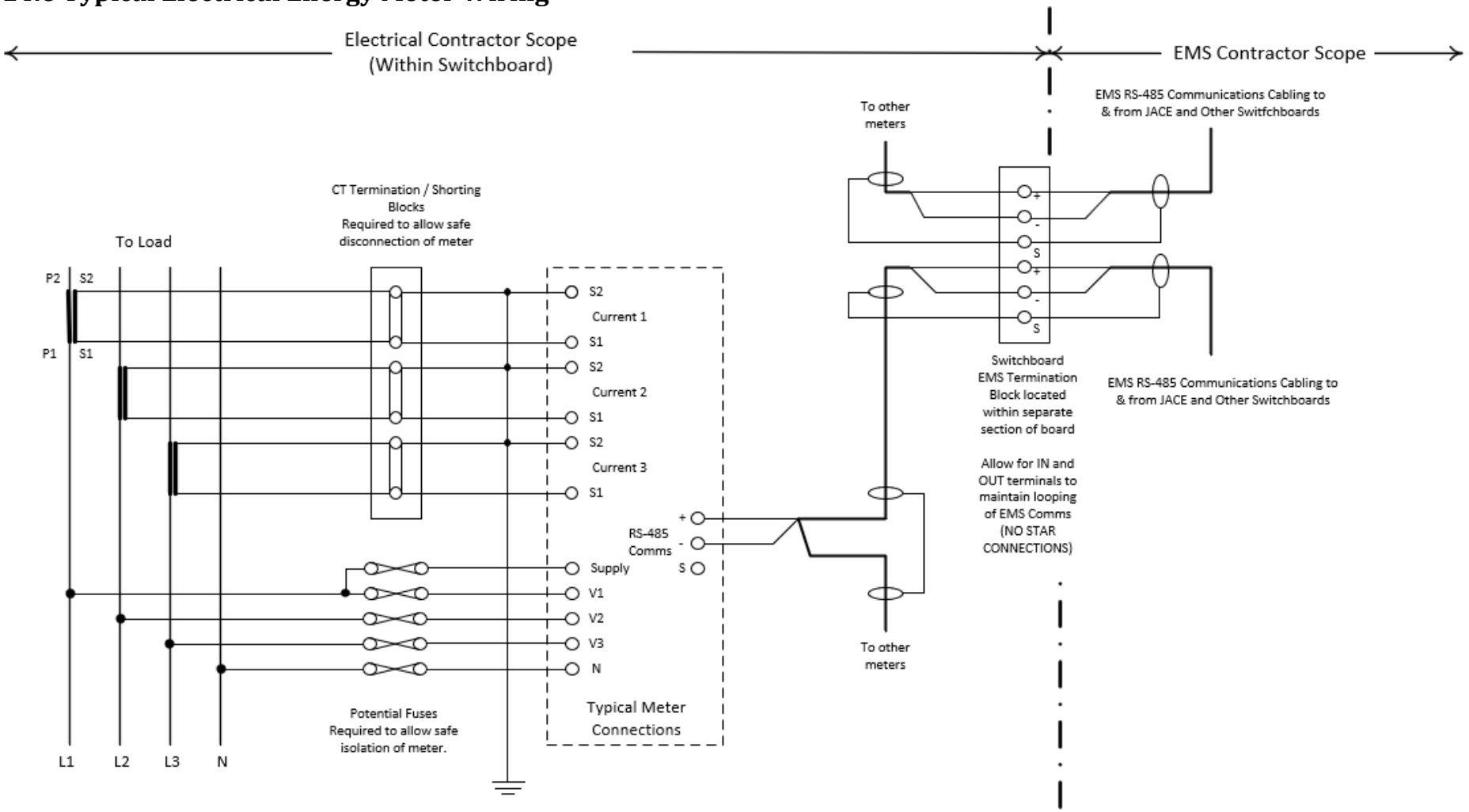
Testers Name: _____ **Licence Number / Qualification:** _____

Date of Validation: _____ **Test Current Meter:** _____

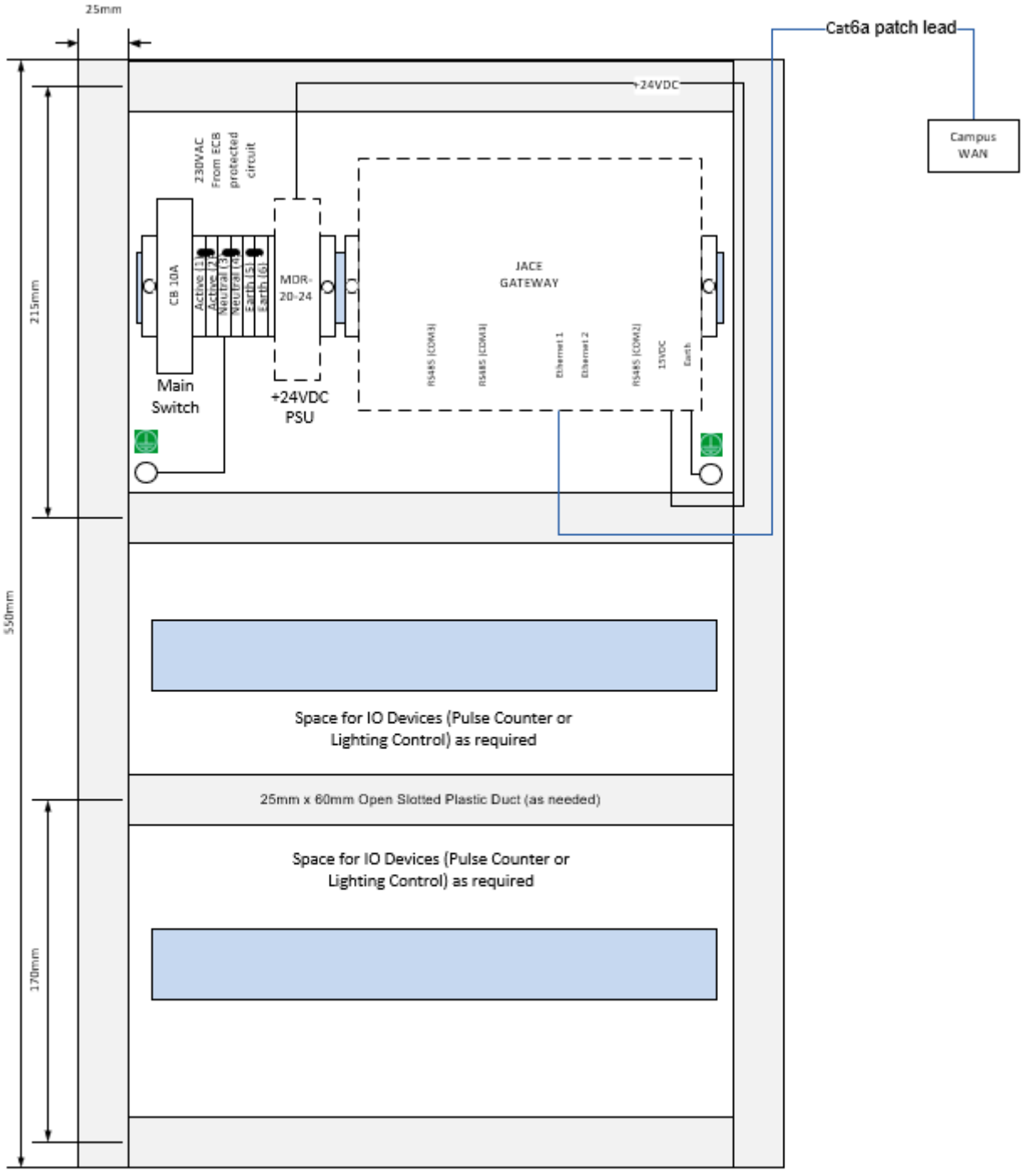
Meter ID / Description	A Phase Current Checks		B Phase Current Checks		C Phase Current Checks		Calculated Power (kW)	Reading Power (kW)	Notes
	Reading	Check	Reading	Check	Reading	Check			

Signed: _____ **Dated:** _____

14.6 Typical Electrical Energy Meter Wiring



14.7 Typical EMS Panel Layout



Cabinet Details

Fit 600(H) x 400(W) X 200(D) mm steel panel, exterior X15 Orange
Backing Plate White
Fitted with keyed locks (key number CL001)