CURTIN UNIVERSITY

PROJECT DELIVERY GUIDELINES

SERVICES METERING GUIDELINES

000346

Curtin University

Details of revisions			
Level	***Details***	***Date***	***Initial***
1	*Initial guidelines produced from Metering Project Delivery Guideline_rB.docx*	*Oct-18*	*FC*
1	*Inclusion of wording to allow departures from the existing guideline*	*Nov-19*	*RPS*
2	*Major revision to remove proprietary system names from the text*	*June-20*	*FC*
3	*Update to clarify installation and commissioning responsibilities and demarcations, and general minor updates*	*Nov - 20*	*FC*

CONTENTS

1 OVERVIEW

1.1 GENERAL

The purpose of this Project Delivery Guidelines document is to provide information on services metering. This document is not intended to be all encompassing and is provided to assist consultants and contractors to develop metering strategies for Curtin University campuses and buildings. This guideline does not outline all technical requirements needed to achieve a complete metering system and consultants/contractors are required to ensure such technical requirements are addressed.

The Project Delivery Guidelines have been prepared in consultation with Curtin University subject matter experts and stakeholders. It is recognised that the subject matter of Guidelines will not always be suitable for all project elements and departures from the Guidelines may be required or desirable. Departures from Guidelines must be agreed upon in consultation with the relevant University Guideline subject matter expert. Departures must be recorded in a project register and recorded and reviewed in the Project Control Group meeting minutes under its own meeting agenda item "Project Delivery Guideline Departures". Where the University subject matter expert identifies that a departure adds ongoing value to the University, the subject matter expert will update the relevant Guideline.

1.2 SERVICES TO BE METERED

The following services shall be metered, and sub-metered as required. Sub-metering beyond the list below may be required and must be determined in consultation with Curtin University.

1.2.1 ELECTRICAL

- power
- lighting
- services
- tenancies sub-metering.

1.2.2 GAS

- per building
- per mechanical plant room
  - per mechanical boiler
- tenancies sub-metering.

1.2.3 IRRIGATION

- per bore
- per developer lot/building.

1.2.4 POTABLE AND NON-POTABLE WATER

- per building
- per mechanical plant room
  - make-up water
  - cooling tower supply.
- tenancies sub-metering.

1.2.5 SEWER TRADE WASTE

- per trade waste discharge point (as required)
- per mechanical plant room
  - cooling tower bleed
  - cooling tower waste
- tenancies sub-metering.

1.2.6 MECHANICAL – THERMAL METERING (CHILLED AND HEATING WATER)

- per building
- per mechanical plant room
- tenancies sub-metering.

1.2.7 AUTHORITY METERS

- electricity by interface or duplication
- gas by interface or duplication
- water by interface or duplication.

THE FOLLOWING SERVICES SHALL HAVE PRESSURE MONITORING UNDERTAKEN AS PART OF THE METERING INSTALLATION.

1.2.8 GAS

- per authority connection
- per building
- per mechanical plant room
  - per mechanical boiler.

1.2.9 POTABLE AND NON-POTABLE WATER

- per authority connection
- per building

- per mechanical plant room
  - make-up water
  - cooling tower supply
- wet fire system
  - third-party developer lots.

1.3 METERING OBJECTIVES

Outcomes expected by the University include:

- improved campus-wide energy and water resource management
- billable level of accuracy of measurement of energy and water consumption
- improved energy and water monitoring and reporting
- clarity and uniformity of graphics display at the Building Management System (BMS) head ends
- connection of the meters to the central energy management reporting system (reporting software)
- Enablement for compliance with NABERS and Green Star metering accuracy requirements
- Enablement for compliance with University reporting obligations to authorities and rating agencies
- Internet Protocol (IP) connectivity to all devices to facilitate open protocol and interconnectivity of existing and future systems requiring access to the data
- smart metering types that are NMIA-certified (or appropriately certified where NMIA-certified metering to suit the application is unavailable), that can be connected via IP.

1.4 DEFINITIONS

The following definitions apply to terminology within this guideline.

Term	**Definition**
Consultant	design engineer, who may be part of a consultant team including project manager and lead consultant
Contractor	head contractor and associated subcontractors and suppliers

Term	Definition
Metering Devices	energy meter (electricity and gas), flow meter (water, waste, chilled and heating water, irrigation and the like), high level interfaces (HLI), totaliser/counter, temperature sensors (chilled and heating water), IP gateways, data points and associated switchboards or panels to house the equipment to suit specific service requirements
Metering Contractor	the contractor who supplies and installs the metering devices. The nature of this work will vary depending on the service being metered. This contractor may require licensed electricians and plumbers to assist in completing the works. It is likely that each service contractor will have their own sub-contractor fulfilling this role.
Metering Consultant	the Consultant who is appointed to be responsible for the coordination of the design of all the metering and the management of the commissioning and interfaces to the reporting software and to the building management systems. The Metering Consultant may be one of the commissioned design consultants such as a mechanical, independent commissioning agent or other to suit the specific project.
Reporting Software System (RSS)	A reporting software platform, managed by an incumbent servicer provider (RSS Contractor [RSC]), whose responsibilities relate to providing software points that retrieve metered data via the Curtin IT network and interfacing metering from the Curtin network into the reporting software, reporting on it and providing energy and billing management. The reporting software is not a BMS.
Building Management System	One of two mechanical building management systems (BMS) on Curtin campuses and one electrical building management system, managed by incumbent service providers, whose responsibilities relate to interfacing to the metering via the Curtin network through to BMS graphics, fault management, programming and data storage, to suit specific services requirements. The BMS is not the reporting software system.
Energy	electrical, gas and thermal, however may also include fuel if it forms part of the energy mix
Curtin, Client, University	means Curtin University

Term	Definition
Infrastructure Manager	means Curtin University infrastructure manager for the specific discipline under consideration which may include electrical, mechanical, hydraulic and irrigation

1.5 ABBREVIATIONS

Abbreviation	Meaning
BC	BMS Contractor
BMS	Building Management System
CHW	chilled water
CMMS	Computerised Maintenance Management System
CT (ratio)	Current Transmission
DTS	Curtin University Digital & Technology Solutions
EC	Electrical Contractor
FOBOT	Fibre Optic Break Out Terminal/tray
HC	Hydraulic Contractor
HLI	high level interface
HV	High voltage
IC	Irrigation Contractor
IP	Internet Protocol
LV	Low voltage
LoRa	Long Range – LoRa devices and wireless radio frequency technology is a long-range, low-power wireless platform
MC	Mechanical Contractor
MSTP	Master/Slave Token Passing protocol
NMIA	National Measurement Institute of Australia
NSX	type of circuit-breaker
PME	Power Monitoring Expert

Abbreviation	Meaning
RCM	Regulatory Compliance Mark
SLD	Single Line Diagram
RSC	RSS Contractor
RSS	Reporting Software System
TO	Telecommunications Outlet
UPS	uninterruptible power supply
VT (ratio)	Voltage Transmission

1.6 Incumbent Service Providers

The Consultant(s) must contact the Curtin University Responsible Officer to obtain the details of the incumbent service providers for:

- metering reporting software system (RSS) and the service provider managing the software
- building management system(s) and the service providers managing the BMS as they relate to
  - mechanical
  - electrical
  - hydraulic
  - irrigation.

There are multiple BMS providers that may relate to the above services.

It is the Consultants' responsibility to obtain the required details and to engage with the University Infrastructure Managers to ensure that the requirements for the systems are fully understood.

1.7 REFERENCES

The following reference documents can be found within the Project Delivery Guidelines listings on the Guidelines page of the Properties, Facilities & Development website at:

https://properties.curtin.edu.au/workingwithus/guidelines.cfm

- Building Services Labelling Standard
- *000089 Documentation Deliverables Guidelines*
- *000313 PDG Data Communications Cabling Requirements*

- *000312 PDG Electrical Services Guidelines*
- *000311 PDG Mechanical Services Guidelines*
- *000326 PDG Hydraulic Services Design Guidelines*
- Appendix Reference Document – Services Metering Commissioning Sample Forms.

2 GENERAL REQUIREMENTS

2.1 CONSULTANT REQUIREMENTS

It will be each service consultant's responsibility to design their respective metering system including but not limited to:

- design according to the National Construction Code and this Guideline, whichever is the more stringent
- consult with the Infrastructure Manager(s)
- adequately and clearly specify the full requirements for the metering system in totality, including metering devices, communications protocols, system installation, commissioning, interfaces to BMS and reporting software system, validation requirements and coordination with other services
- provide adequate and clear design drawings including but not limited to:
  - SLD showing the metering tree that identifies master meters, sub-meters and virtual meters and identifies the meters by preliminary CMMS coding
  - floor plans indicating IP requirements for coordination with the data system design
  - SLD showing IP requirements
- coordination where systems may use the same protocols
- management and resolution of contractor queries
- be involved in the commissioning of the meters
- ensure BMS and reporting software systems are correctly capturing the metering
- review commissioning and As Constructed records, and operation and maintenance manuals for compliance to Curtin requirements.

Consultants shall not cut and paste this document verbatim.

Regarding BMS interfaces and graphics, please refer to the *000311 Mechanical Project Delivery Guidelines,* which nominates responsibility of the Mechanical Consultant to specify the BMS requirements for all services, except electrical.

Otherwise consultants are expected to coordinate and develop integrated metering systems that are interfaced to the reporting software system. The design team, at its discretion may appoint one consultant to manage the coordination.

2.2 SCOPE CLARIFICATIONS

The following items must be considered by the consultants as part of the briefing or design process:

- Living Campus and Laboratory requirements and visualisation. Curtin may engage the reporting software provider for these works or other provider to suit the requirements.

  Where a Living Campus or Laboratory is specified within a project brief, then refer to the project brief for responsibility for the design, coordination and implementation of the work.

- For all capital works projects that are a new site/building, refurbishment or the like, the engagement of the reporting software provider is to be by the Contractor.

2.3 METER LOCATIONS

All meters shall be installed in an accessible location for reading and maintenance. Metering devices shall not be installed in ground unless there is no other feasible alternative and then only with the written approval of Curtin University.

2.4 METER IDENTIFICATION AND LABELLING

2.4.1 CMMS IDENTIFICATION

Refer to the Building Services Labelling Standard.

The general format for labelling identification is:

- if related to a building – building.metertype.floorlevel.meternumber
- if related to a site – site.metertype.floorlevel.meternumber.

Examples of metering labelling include:

- electrical
  - main switchboard: 500-SWB-01-0001 Main Meter
  - main distribution board: 500-SWB-01-0001 Submains Meter
- hydraulic
  - potable/non-potable water: 404-WMR-01-0001
  - wastewater: 117-WWM-01-0001
  - gas: 404-GMR-01-0001
  - wet fire water: 404-FMR-01-0001
- mechanical
  - chilled water: 101-CWM-01-0001
  - heating water: 101-HWM-01-0001
- irrigation
  - irrigation water: 000-IMR-00-0001.

2.4.2 OBTAINING A CMMS ID

The Contractor shall prepare a schedule (in MS Excel spreadsheet format) of equipment that requires CMMS IDs and set up all information except the final number, which will be assigned by Curtin. The Contractor shall submit the schedule to the Service Manager, Building Maintenance, Operations & Maintenance at Curtin who will assign the IDs and return the spreadsheet to the Contractor.

CMMS labelling must be obtained early in planning and construction as the labelling is required to be present on shop drawings, as-constructed drawings, as-constructed records, and physically on metering devices. The Contractor is responsible for obtaining the information in a timely manner.

2.5 METER INSTALLATION AND COMMISSIONING RECORDS

2.5.1 REGISTERS AND DRAWINGS

Curtin retains comprehensive registers for metering, which are managed by:

- Maintenance – metering identification and maintenance systems via the CMMS.

Examples of registers can be found in the separate Appendix Reference Document.

Any new metering or changes to existing metering must be captured by the following:

- the FM Asset Register using the template per *000089 Documentation Delivery Guidelines*
- Data and Communications Register in accordance with *000313 Data and Communications Cabling Requirements*
- Reporting Software Validation Register as managed by the Reporting Software Contractor
- Other registers that may be developed from time to time
- Building Services drawings locating all meters
- site metering schematics, meter trees and site plans
- building metering schematics and meter trees.

2.5.2 OPERATIONS AND MAINTENANCE MANUALS

Curtin retains master Operations and Maintenance manuals for metering, managed by Building and Services Data Management (Drawing Services).

The manuals shall be upgraded as required, however if none exist, a new manual shall be developed using the format provided by Curtin.

Where a master manual exists, the consultant/contractor will be provided with native copies of:

- the manual – MS Word document.

2.5.3 RECORDS UPDATE PROCESS

The Consultant and Contractor shall consult and meet with Building and Services Data Management (Drawing Services) and determine the update process, if any. It is envisaged that this update process will be developed into a Project Delivery Guideline and may therefore be formalised at the time of commencing works.

2.6 VIRTUAL METERING

Virtual meters occur when a software-created addition or subtraction of meters is required to obtain the metered values, for example:

> *There is a site master meter and a number of sub-meters but not all of the system is sub-metered. To determine the consumption/demand of the system parts that are not sub-metered a calculation is required to determine the values by subtracting the actual sub-meters from the master meter.*

'Subtraction' or 'virtual' meters shall be avoided due to the potential risk of increased inaccuracy. Correctly designed water, gas, waste drains, irrigation, wet fire, chilled and heating water piping and electrical arrangements must negate the necessity for virtual metering. Issues that arise with virtual metering include:

- When comparing master to sub-meters, a virtual meter will see that sub-meters always add up to the master meter. In reality they should not be exact but within a reasonable tolerance.
- Virtual metering of this nature impacts on the reporting software ability to identify potential metering or consumption issues between master and sub-meters, and between sets of sub-meters.

2.7 METERING DATA FREQUENCY AND MANAGEMENT

All data collection shall be undertaken on the following basis:

- All data points should be measured simultaneously.
- Data points should be taken at 5-minute intervals.
- All data point recording intervals shall start exactly at the top of the hour.
- Data should be stored for at least 36 months to account for any changes to the system e.g. a controls upgrade, added gross floor area.
- After 36 months the data shall be archived in accordance with existing procedures.

2.8 ALTERNATIVE PRODUCTS

Alternative products may be proposed in lieu of those designated but they must be comparable with an acceptable device. Details of the proposed device, detailing all relevant technical compliance parameters must be submitted to the Curtin University Infrastructure Manager, via the Consultant(s), for approval before being used on the site. Curtin University will determine whether the product is an acceptable alternative and is not obliged to accept any proposed alternative.

2.9 MODEL NUMBERS

Where a model number is provided for a particular product and it is not capable of delivering the specified functional requirements, then the Consultant shall determine an appropriate product model that meets the functional requirements, in consultation with the University Infrastructure Manager.

2.10 TENDER INFORMATION REQUIRED

The Consultant shall, as part of the tender documentation, require the Contractor to provide a detailed breakdown of cost and suppliers that includes but is not necessarily limited to the following:

- the number of meters being installed and the type i.e. electrical, thermal, water, gas, etc.
- general cost breakdown per system or building
- contract preliminaries
- decommissioning of existing systems
- metering devices supply and installation
  - meters
  - panel assemblies
  - IP converters
  - HLI interfaces
  - UPS
- pipework/lagging as appropriate
- drain downs
- pipe freezing
- electrical works
- BMS works (to suit)
- reporting software works
- data installation
- operations and maintenance manuals
- as-constructed drawings
- maintenance
- suppliers and manufacturers
  - energy and/or flow meter
  - temperature sensors
  - totaliser/calculator
  - IP gateway

- subcontractors
  - pipework
  - pipework freeze
  - lagging
  - electrical
  - metering
  - BMS
  - reporting software provider
  - communications/data.

3 ELECTRICAL SERVICES

3.1 INTRODUCTION

The purpose of this section is to describe the minimum acceptable standards, products and installation requirements for electrical metering equipment installed and connected on the Curtin University Campus.

The selection and installation of metering equipment on the site must comply with Australian and international standards, and with the requirements described in this document in order to successfully integrate with the existing site-wide meter monitoring systems.

Metering information is used by the University in the following areas:

- Billing – on-selling of energy to University tenants
- Environmental Sustainability **–** energy rating tools and driving energy improvements
- Planning **–** infrastructure management and campus load analysis for future projects
- Technical Analysis **–** investigating faults and diagnosing power quality issues.

BILLING

Billing meters require energy use and are not concerned with the time of that usage beyond the most rudimentary timeframes. Contested bills may be interested in time of use and tracking time periods where higher than normal energy use has occurred. Billing meters tend to concentrate on the area metered with regard to energy usage rather than energy category, e.g. the 1st floor of a building occupied by tenant A as opposed to total energy used throughout the building by the lighting.

Curtin also routinely performs energy retailer data checks. All facilities shall be capable of creating energy consumption data that supports analysis of energy usage relating to energy retailer costs and the potential to contest a bill.

ENVIRONMENTAL SUSTAINABILITY

Environmental rating tools require similar information to billing but often have a different breakdown, focusing more on energy usage category than area. Refer to the example above where category is the focus rather than the area.

PLANNING

Future project and expansion planning typically any meter can be used for these purposes. It is more important where the meter is located and that half hourly (or better) data can be recorded, compared and summated to build a picture of campus growth and peaks on service infrastructure.

TECHNICAL ANALYSIS

Technical analysis generally requires power quality information. That information is infrequently used but of high value in rapid evaluation and analysis of faults. Power quality and faults cause operational issues that affects research and damages equipment. The cost to replace equipment, support warranty claims and reduce insurance premiums is improved by the University's ability to reduce or avoid power quality issues.

Power quality information assists in diagnosing and remediating issues on campus. Power analysis meters are expensive, and those functions should be aimed at high-value or high-risk operational areas within the University facilities requiring meters to be located on those electrical sub-main and even final circuit supplies. Each electrical supply is to be considered high value as a whole and therefore an engineering meter should be included at the LV point of connection closest to the transformer for purposes of power quality analysis.

3.1.1 METER SELECTIONS

Most electrical meters available in Australia provide basic power information including voltage and current. Power analysis-capable meters are more expensive and many are not approved for billing. Where both billing approval and power analysis is required it may be necessary to have two meters.

All meters are to be connected to the Curtin network and be graphically represented on existing visualisation software at the University. Currently visualisation of meters for billing (including energy sustainability and planning) and technical analysis is done on energy reporting software, Schneider StruxureWare and PME, respectively. Currently all meters are interfaced to Schneider StruxureWare and PME with the energy reporting software receiving data via an SQL database produced from Schneider Struxureware or PME.

Key factors for meter selection include:

- compliance to applicable standards
- accuracy class
- networking and communications capability
- approval for billing purposes
- availability of product and technical support within Australia.

Key factors for meter installation include:

- compliance to applicable standards, codes and legislation
- consistent installation methodology
- correct and consistent commissioning and verification procedure
- consistent documentation and record keeping.

All installation work must be carried out by electrical workers appropriately qualified to work on the metering equipment with consideration to the voltage levels present.

3.2 ACCEPTABLE METERS

3.2.1 ELECTRICITY METERS – FOR BILLING, ENERGY SUSTAINABILITY OR PLANNING

Meters utilised for billing, energy sustainability or planning purposes must:

- be pattern approved by the National Measurement Institute of Australia (NMIA). Meters subject to or under grandfathering or transitional arrangements by the NMIA are not acceptable
- be verified in accordance with the National Test Instrument Procedures (NITP 14 — Utility Meters)
- include Modbus serial (EIA 485) or Modbus/TCP communications capability
- include a local (faceplate) LCD display for viewing parameters and for validation purposes.

Acceptable electricity meters for billing purposes include:

- Schneider Acti9 iEM3200-NMI series (iEM3155/iEM3255/iEM3355).

3.2.2 ELECTRICITY METERS – FOR TECHNICAL ANALYSIS

Meters utilised for technical analysis must comply with the following requirements:

- IEC 62053-21 Class 1.0 for real energy measurement
- include Modbus serial (EIA 485) or Modbus/TCP communications capability
- include a local (faceplate) LCD display for viewing parameters and for validation purposes.

Electrical supply meters that may be subject to technical analysis shall include the following functions as a minimum:

- power
- energy
- voltage
- current
- harmonic distortion to 40th or higher
- power factor
- frequency.

Acceptable electricity meters include:

- Schneider Power Logic ION series
- Schneider Power Logic PM series
- Schneider Power Logic Micrologic series.

Meters used for transformer and main switchboard monitoring shall be high accuracy (class 0.5 or better) and include the following functions as a minimum:

- sag/swell monitoring
- power
- energy
- voltage
- current
- harmonic distortion to 50th or higher
- power factor
- frequency.

Acceptable electricity meters include:

- Schneider Power Logic PM8000.

3.2.3 IP NETWORK GATEWAYS

IP network gateways are used to connect and integrate networked electricity meters to the existing meter network that supports the meter monitoring system. Meters must be connected to the meter network using a suitable IP gateway.

Acceptable IP network gateways include:

- Schneider Link 150 Gateway.

3.2.4 ALTERNATIVE PRODUCTS

Alternative products may be proposed in lieu of those designated however they must be comparable with an acceptable device listed in sections 3.2.1, 3.2.2 and 3.3.3. Details of the proposed device, detailing all relevant technical compliance parameters must be submitted to the Curtin University Infrastructure Manager, via the project engineer, for approval before being used on the site. Curtin University is not obliged to accept any proposed alternative.

3.2.5 ANCILLARY EQUIPMENT

The meter shall be provided with all ancillary equipment required to mount and connect it to the monitored circuit or equipment. This includes but is not limited to:

- current and voltage transformers
- fuses and protective devices
- test links
- terminal and shorting blocks
- cabling
- conduit and ductwork.

Current and voltage transformers must be compliant with the requirements set out in the appropriate parts of AS60044 and shall be of a sufficient accuracy to ensure that the associated meters meet the accuracy class specified.

Shorting and test links shall be installed for all current transformers.

Voltage (potential) transformers shall be installed for high-voltage meters and are to incorporate fuse protection on the secondary side.

Fusible links shall be installed for all voltage connections to meters.

Current and voltage transformers must be installed so that the rating and ID label of the device is directly visible without the use of mirrors or the like.

Wherever possible, voltage transformer potential fuses and current transformer links shall be fitted inside the switchboard or meter enclosure. If this is not practicable, then the location of the fuses and links shall be clearly identified on a label permanently affixed to the meter enclosure.

3.3 COORDINATION

All energy monitoring devices (meters and NSX devices) must be commissioned and integrated to both energy monitoring software suites (Schneider/PME and the reporting software). The electrical contractor must liaise with the appointed reporting software provider for all associated works. The reporting software service provider will acquire the services of an external contractor to commission the energy monitoring devices.

The electrical contractor is responsible for ensuring works occur in a timely manner to achieve identified project timelines.

Prior to the commissioning of any new networked meters, the electrical contractor must liaise with the appointed RSC to coordinate the commissioning date and time.

The electrical contractor must provide at least 14 days' notice to the reporting software provider prior to the proposed commissioning date.

The electrical contractor must provide the following information prior to any commissioning works commencing:

- meter trees that show hierarchy of meters, master, sub-meters and virtual meters
- number of energy monitoring devices (meters and NSX devices)
- updated SLD including approved switchboard and energy monitoring device labels (all labels to be in line with the Curtin University Building Services Labelling Standard)
- switchboard location drawing.

Prior to providing the above detailed information the electrical contractor must:

- request all required IP addresses from Curtin University (refer to section 3.3.1)
- ensure all IP telecommunications outlets have been patched and tested
- provide reporting software provider with communications configuration parameters (e.g. node and IP addresses) for each energy monitoring device and IP gateways
- liaise with the reporting software provider during the commissioning and verification process to ensure and confirm that the energy monitoring

devices are communicating with, and passing data correctly to, the site meter monitoring systems (Schneider StruxureWare, PME and the reporting software system).

The reporting software provider will undertake all configuration modifications to the reporting software as necessary to allow for the integration of the new energy monitoring devices.

3.3.1 REQUESTING AN IP ADDRESS

The process below must be followed when requesting IP addresses from Curtin University. Please allow seven days for the process to be completed. IP addresses are for telecommunications outlets (TO).

Copy all the text below, complete the information above the line and email Properties System Support on PropertiesSystemSupport@curtin.edu.au. The support group will complete the information below the line:

Building	Xxx
Device Type/Model	Xxx
TO Room #	Xxx
TO #	Xxx
TO Colour	white/green/blue CAT5E/CAT6/CAT6A
MAC Address	Xxx
IP Allocation	
Subnet Mask	255.255.254.0
Default Gateway	

3.3.2 DELIVERY PROCESS

Table 3-1 – Delivery process for Reporting Software and BMS

New Project/Capital Works	Details
Design	• Consultant(s) nominated
Contract documents prepared	• scope of works specification and drawings • new or updated site or building metering tree • new or updated site or building metering plan • virtual meter calculations (if any) • single line diagrams • floor plan information • metering devices and installation requirements documented • electrical supply to metering devices documented

New Project/Capital Works	Details
	• communications (data) requirements documented • coordination with authorities documented (where necessary) • schedules of metering and labels documented • liaise with reporting software and BMS systems providers • number of energy monitoring devices (meters, NSXs) • Switchboard drawings
Tendering	• Electrical Contractor issues tender documents to the reporting software provider and other sub-contractors. • The reporting software provider provides a quote to the electrical sub-contractor for inclusion into the tender submission. • The reporting software provider shall include the BMS component of the metering and obtain a BMS quotation and include it in its quotation to the electrical sub-contractor. • Quotes must cover the required scope of work
Construction	• Contractor nominated • EC issues an order to the reporting software provider and other sub-contractors • Reporting software provider issues an order to the BMS provider
Contractor to ensure all network connectivity is commissioned.	• requests all required IP addresses from Curtin University • ensure all IP TOs have been patched and tested • provide communications configuration parameters for reporting software and BMS • ensure all devices and meters are commissioned
BMS provider completes works and notifies the Reporting Software provider	• Meter commissioning to be verified by the reporting software provider. • BMS additions reviewed by the reporting software provider. • Where due to low or no occupancy meters are not recording any change in values, the contractor shall force systems to a state that provides suitable commissioning readings
Reporting software provider completes its scope of work and notify electrical contractor of works	• Reporting software additions are in line with the BMS additions • Site meter register to be updated by the reporting software provider
Handover – provide documentation to be submitted by sub-contractors for inclusion into O&M manuals.	• Handover pack to include validation documentation, commissioning documentation, graphic screen, captures and report configurations and alarm configurations. • Consultant to have validated that RSS and BMS works have been completed and that reports, trends and graphics are available to suit the respective platforms.

3.4 INSTALLATION REQUIREMENTS

Electricity is supplied to and reticulated around the site using high-voltage (HV) ring mains. The HV supply is stepped down to low voltage (LV) via transformers in substations local to the end user.

Meters on three-phase supplies must be installed as 3-phase – 4-wire (includes a neutral conductor) connections with separate current transformers and voltage tappings on each phase.

Meter installations must include suitable protection for the meters and ancillary equipment to suit the voltages and expected fault currents at the point of installation.

Wherever practicable, meter sensing devices such as current and voltage transformers shall be installed on the load side rather than the line side of main isolation switches.

Meters must be installed so that they can be easily accessed for viewing and maintenance without the need for ladders or the like. The meter faceplate shall be accessible for viewing and display parameter selection purposes.

3.4.1 NEW INSTALLATIONS – LOW VOLTAGE

For new low-voltage installations, meters shall be installed as integral components within a separate metering section of the electrical LV switchboards. The meter and associated ancillaries such as current transformers and voltage connections must be installed so as to ensure that all power distributed by the LV switchboard is metered. There must be no unmetered power leaving the switchboard.

3.4.2 NEW INSTALLATIONS – HIGH VOLTAGE

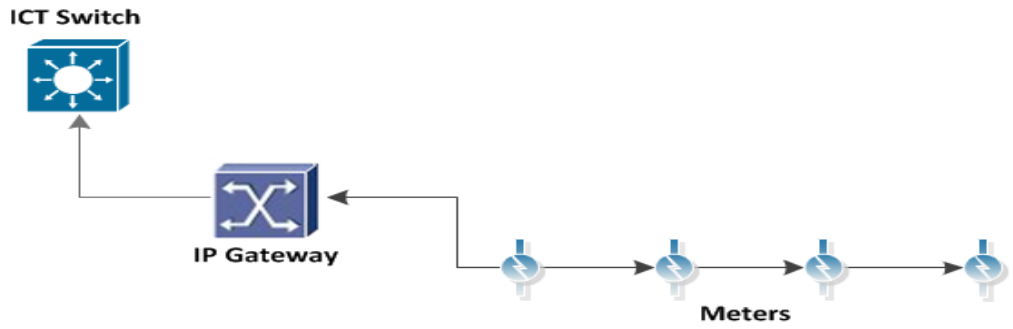
For new high-voltage installations, metering requirements shall be confirmed with the Curtin University Infrastructure Manager, via the project engineer.

3.4.3 NETWORK CABLING

All EIA-485 (RS-485) meter communications cabling shall be as per the meter manufacturer's specification. If not specified, Belden 9841 cable shall be used.

Terminate RS-485 meter communications cabling in a bus topology. Ensure line resistance is in accordance with the meter manufacturer's recommendation. Supply and install any end-of-line resistors required to maintain correct line resistance.

A sample acceptable meter connection topology is shown in the following figure:



All meter communications cabling within electrical switchboards shall be installed within a conduit.

All meter communications cabling installed within electrical switchboards, switch rooms and shared cable support structures shall be installed in accordance with AS/ACIF S009:2001. In particular, segregation distances between communications and power cables must be maintained.

3.4.4 LABELLING

Curtin University's meter labelling procedures shall be adhered to for all new meters. (All labels are to be in line with the Building Services Labelling Standard.) Meter tag IDs must be approved by the Curtin University Project Engineer prior to implementation.

Meter labels shall be included for each meter and shall be self-adhesive Traffolyte labels also fixed with non-conductive screws or barbed pins and shall be located immediately above or below the meter. Lettering shall be black on white and 5 mm high. Meter labels shall include the following information:

- meter tag
- metered service
- CT ratio.

Where meter potential fuses and/or CT links are not located immediately adjacent to the meter, the location of the fuses and links must also be included on the meter label.

3.4.5 METER SECURITY

Password protection shall be implemented at the programming/configuration level for each meter. Default passwords are to be initially set to 0000.

Meters used for billing purposes shall be mechanically sealed and seals shall only be removable via the use of a tool.

3.4.6 IP NETWORK GATEWAYS

The meter installation contractor shall supply and install the IP network gateways wherever practicable within the switchboard that supports the site meter monitoring system. The contractor shall provide and install all network patch cables between the

gateways and available RJ45 ports on the network switches and shall be responsible for:

- configuration of the IP addresses into the gateways
- configuration of the RS485 communications parameters into the gateways
- configuration of the meter node address availability into the gateways.

As IP gateways consume ICT network resources, meter connection networks should be designed and installed in such a way as to minimise the number of gateways required. Note that PM8000 meters currently include an Ethernet gateway, so confirm with Schneider the inclusion of this facility.

DTS shall provide gateway configuration information to the meter installation contractor and shall be responsible for configuring ICT network switches and updating network configuration documentation. Where works require an upgrade to the network infrastructure as a result of the installation of new energy monitoring devices, this will be undertaken by the project team undertaking the works.

3.5 COMMISSIONING AND VERIFICATION

Commissioning, verification and documentation shall be undertaken for each new networked electricity meter by a suitably qualified meter technician.

3.5.1 METER COMMISSIONING

Meter commissioning shall confirm that the meter is functional across its measured range and that the meter is:

1) installed to the correct location (by matching the meter serial number to the designated location)
2) correctly wired to meter sensing and protection devices such as:
    - current transformers and voltage connections and/or transformers
    - potential fuses
3) correctly configured for sensor device ratios (e.g. CT and VT ratios)
4) configured with the correct wiring configuration (e.g. 4-wire)
5) correctly configured to make available kW, kWh, KVA, KVAR and Maximum Demand values and times from the internal Modbus registers of the meter
6) configured to display measured values on the meter faceplate
7) configured to display site and meter details on the scrolling LCD display (where applicable)
8) configured to display set-up parameters on the meter faceplate (password protected)
9) configured to communicate via open protocol to IP level.

METER COMMISSIONING DOCUMENTATION

Meter commissioning documentation shall confirm that the commissioning process has been completed successfully and in its entirety and shall include the following as a minimum:

1) a unique document per meter commissioned
2) location, manufacturer, model, tag and serial number of the meter commissioned
3) size of the sub-mains that the meter is measuring
4) record of meter sensing device ratios (CTs and VTs)
5) confirmation of correct wiring between the meter and the meter sensing devices
6) record of each configuration parameter programmed into the meter
7) record of each measuring parameter programmed into the meter
8) confirmation of open protocol communications to IP level
9) record of any faults identified and of any corrective action recommended or taken
10) date and time of commissioning, business name, name and signature of meter technician.

3.5.2 METER VERIFICATION

Meter verification shall confirm that the meter and its associated sensing equipment is accurate across its measured range of parameters and shall document any departures identified. The verification procedure shall confirm that each measured parameter of the meter is verified against a calibrated reference instrument.

METER VERIFICATION DOCUMENTATION

Meter verification documentation shall confirm that the verification process has been completed successfully and in its entirety and shall include the following as a minimum:

1) a unique document per meter verified
2) reference instrument details including manufacture, model, serial number and calibration information
3) location, manufacturer, model, serial number and tag of the meter verified
4) record of the testing of each measuring parameter programmed into the meter against those of the reference instrument. Verified measuring parameters shall include as a minimum:
    - kW
    - kVA
    - kVAR
    - Power Factor
    - frequency

- phase C=current
- voltage (line to neutral)
- voltage (phase to phase)

5) record of any faults identified, and any corrective action recommended or undertaken
6) date and time of verification, business name, name and signature of meter technician.

METER VALIDATION

Refer to Section 3.6.

3.6 INSTALLATION AND COMMISSIONING RESPONSIBILITIES AND DEMARCATION

3.6.1 GENERAL

It shall be the responsibility of the meter installation Contractor to select the correct meter type and sensing size, the range and capacity of associated meter ancillaries (e.g. current and voltage transformers) to ensure their suitability for purpose.

The Contractor's meter technician shall be responsible for the installation, configuration and commissioning of meters and IP network gateway devices and to confirm that meter data is accurate and is being transmitted correctly through the IP network gateway devices to the site meter monitoring system.

It shall be the responsibility of the RSC and the Contractor to liaise and work together to initially commission and verify the meter readings into the RSS and to then re-validate the readings after a nominal period of time has transpired.

It shall be the responsibility of the Curtin University project engineer to:

- approve alternative products
- approve meter tag information
- provide meter passwords.

3.6.2 METER INSTALLATION AND COMMISIONING

Based on experience from previous electrical metering projects, the matrix below leverages each contractor's respective strengths and areas of experience while providing clear delineation of the expectations. Some key areas to note:

1) The Electrical Contractor (EC) is responsible for the procurement and installation of the meters as well as the supply and installation of all electrical wiring and gateways in accord with the system design up to the Curtin-owned network switch.
2) The Electrical Contractor (EC) is also responsible for requesting network resources from DTS as applicable to the specific design (e.g. IP addresses, ethernet port patching).

3) DTS as owners and managers of the network are responsible for all hardware and software configuration between the network switch and the application servers (e.g. RSS, BMS, etc.)

4) The RSS Contractor (RSC) is responsible for all onsite programming of devices including the meters and the gateways.

5) The RSS Contractor (RSC) is responsible for integration of the data into the RSS database and for creating long-term trend repositories and configuring reports, trends, master-submeter relationships, dashboards and tenant statements as per the standard Curtin requirements.

Component	Supply	Install	Programming
Meter	EC	EC	RSC
Cabling (M-Bus Head to Gateway)	EC	EC	N/A
Gateway	EC	EC	RSC
Cabling (Gateway to Switch)	EC	EC	N/A
Network Configuration, Management and Allocation of IP Addresses	DTS	DTS	DTS
RSS Integration(s)	RSC	RSC	RSC

3.6.3 METER VALIDATION

Meter validation refers to the end-to-end validation between the meter and the application database (RSS). Meter validation works should not commence until network connection between the physical meter and the applications has been confirmed and data histories have been configured.

Two separate meter readings of consumption will be recorded with a gap of at least five days in between and containing a load. For new buildings and low utilisation legs, consumption may need to be forced. A meter verification record should include the following evidence (at a minimum) for both the first and second readings:

1) the meter faceplate reading including any decimal places and units, time and date-stamped with a supporting photograph

2) a screenshot of the gateway configuration showing the value being read from the meter including decimal places, units, time and date-stamped

3) a screenshot of the history database for all applications (RSS, BMS, etc.) illustrating the recorded reading and units for the same point in time as the physical reading.

Responsibility for each reading is as follows:

Description	Responsible Contractor
Physical Meter Reading and Photo	EC
Meter Verification Records	RSC
Gateway Configuration Screenshot	RSC

Description	Responsible Contractor
StruxureWare/iEnergy Software Reading and Screenshot	RSC
Data Collation into Validation Register	RSC

The data from these readings should be recorded in a validation register, which details the following and is the responsibility of the RSC:

1) Archibus reference (Meter Name)
2) Meter Type, Meter Location, Switchboard Location, Fed From, CT Ratio, Overload Setting
3) Gateway Type, MAC Address, UTP, IP Address
4) first and second readings from the faceplate and all relevant RSS with time and date stamps
5) a comparison of the consumption recorded in the validation period on the physical meter and in any applications.

Any meters where the recorded consumption deviates from the faceplate by more than 2% should be validated on a third occasion or further investigated to understand where the discrepancy has originated.

3.7 APPLICABLE STANDARDS

The meters, ancillaries, cabling and installation provided shall comply with the following standards including all current amendments.

Reference	Application
IEC 62053-21	Electricity Metering Equipment Particular Requirements
AS/ACIF S009:2013	Installation Requirements for Customer Cabling (Wiring Rules)
AS/NZS3000:2000	Electrical installations (known as the Australian/New Zealand Wiring Rules)
AS/NZS3080:2013	Telecommunications installations - Generic cabling for commercial premises (ISO/IEC 11801:2002, MOD)
AS60044.1:2003	Instrument transformers – Current transformers
AS60044.2:2003	Instrument transformers – Voltage transformers
Modbus Application Standard V1.1b	Group of standards governing the Modbus Protocol
Industrial Communication Network Profiles IEC 61784	
Fieldbus IEC 61784	

Reference	Application
EIA-485	Communication standard for RS-485 installation
Building Services Labelling Standard	Labelling requirements of all asset types for Curtin University
000313 PDG Data Communications Cabling Requirements	Data Communication Cabling Standards and Specifications

4 MECHANICAL SERVICES THERMAL METERING

4.1 INTRODUCTION

This purpose of this section is to describe the minimum acceptable standards, products, installation and commissioning and documentation requirements for chilled and heating water thermal energy metering devices installed on the Curtin University sites.

Designers and contractors are also referred to the Cooling Towers Water and Waste Metering section (section 5) for details pertaining to metering, water supply pressure and water treatment plant connectivity.

The selection, installation and commissioning of metering devices on the site must comply with the requirements described in this document to successfully integrate with the existing site-wide meter monitoring system.

Key factors for meter selection include:

- compliance to applicable standards
- accuracy class
- networking and communications capability
- availability of product and technical support within Australia.

Key factors for meter installation include:

- compliance to applicable standards
- consistent location and configuration criteria
- correct and consistent commissioning procedure
- correct and consistent labelling procedure in accordance with Curtin University labelling standards
- consistent documentation and record keeping.

All installation work must be carried out by appropriately qualified personnel to work on the metering equipment with respect to plumbing, lagging, electrical, communications and building management systems.

4.2 GENERAL

Specific outcomes expected for thermal metering include:

- improved campus-wide thermal energy management
- clarity and uniformity of graphics displays at the BMS head ends
- European Standard EN1434 Class 2 metering accuracy
- thermal energy use and performance reporting.

4.3 METERING CONCEPT

The diagram below provides contextual information on the metering process.

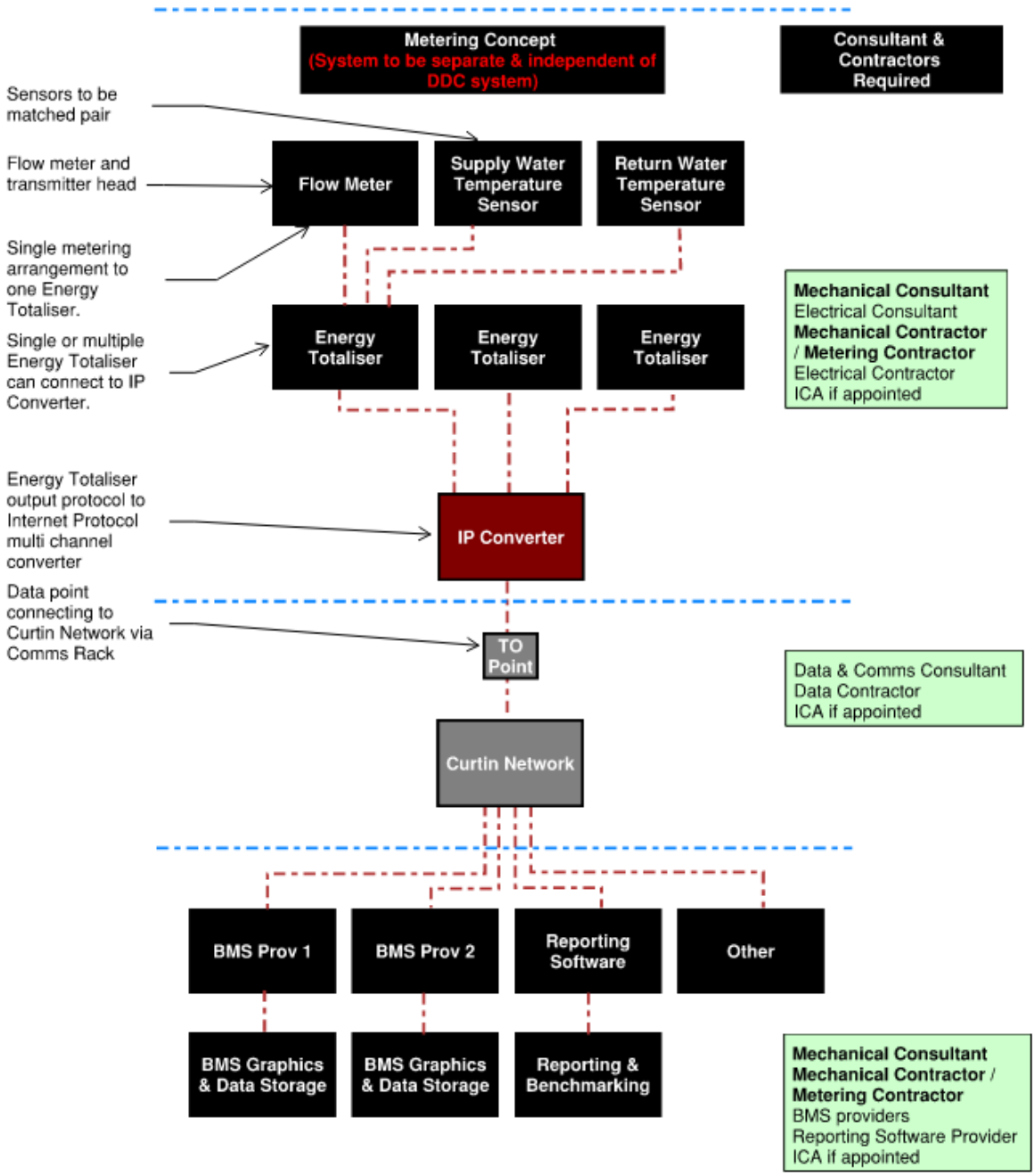


Figure 4A – Thermal Metering concept

4.4 ACCEPTABLE METERS AND DEVICES

Thermal energy meters shall be supplied and installed as in-line electromagnetic flow (magflow) meters for pipe sizes up to and including 300 mm diameter, with matched pair insertion temperature sensors coupled with a compatible energy meter that calculates and transmits the energy consumption of the monitored service, and as ultrasonic clamp-on energy meters for pipe sizes 350 mm diameter and above, with matched pair insertion temperature sensors coupled with a compatible energy meter that calculates and transmits the energy consumption of the monitored service.

4.4.1 IP NETWORK GATEWAYS

IP network gateways shall be used to integrate thermal energy meters into the existing ICT network. Meters must be connected to the ICT network using a suitable IP gateway.

Suitable IP gateways shall be those deemed to meet the requirements as set out in section 4.4.2 below.

4.4.2 COMMUNICATIONS PROTOCOL

The communications protocol utilised to exchange data between the thermal energy meters and the BMS and reporting software systems shall be BACnet.

Data from thermal energy meters supporting BACnet and operating over serial MSTP channels shall be converted to BACnet IP protocol by the Metering Contractor prior to connection to the ICT network. The ICT network does not directly support serial protocols such as MSTP. An IP network gateway shall undertake the BACnet MSTP to IP protocol conversion.

All BACnet devices shall be BTL (BACnet Testing Laboratories) compliant, support open BACnet connectivity and shall be provided with a conforming PICS (Protocol Implementation Conformance Statement).

BACnet devices shall:

- comply with the BACnet standard ISO 16484
- represent all inputs and outputs, including configuration properties, as appropriate BACnet Objects
- support the status attribute of BACnet Objects
- make Objects overridable with support for the Priority and Relinquish Default properties of Objects
- support the Calendar and Schedule Objects in the time clock functionality
- where local trending is hosted, must support the Trend Log Object and must retain trend data for a minimum of three days' storage before requiring a network upload. Devices shall retain all trend data upon loss of power.
- retain, once assigned, the Device and Object IDs irrespective of changes to application programs, or replacement of the device.

BACnet energy meters shall:

- incorporate an EIA-485 transceiver with connections for MSTP control network wiring and be capable of supporting baud rates of up to 115.2 kbps.

IP network gateways shall:

- incorporate an EIA-485 transceiver with connections for MSTP control network wiring and be capable of supporting baud rates of up to 115.2 kbps
- support ICT network speeds of a minimum of 100 Mbps.

- support BBMD mode
- support DHCP for configuration purposes
- include an embedded webserver that supports multiple web browsers for configuration purposes.

BACNET ADDRESSING CONVENTIONS:

The Contractor must submit the addressing scheme proposed for devices to the Infrastructure Manager, Hydraulic and Civil, Capital Projects at Curtin for approval prior to configuring the MSTP network addresses on site.

APPROVED MAKE:

SWG Automation BACRouter V2.0, or more current model as the product develops. Hardware shall have RCM certification.

4.4.3 MAGNETIC FLOW METERS AND DEVICES

Where in-line electromagnetic flow meters are installed, the magflow sensor tube shall be approved to International Standard OIML R 49-1:2006.

GENERAL ARRANGEMENTS

The diagrams below both show the relationship between the following devices, as examples:

- flow meter
- matched pair temperature sensors
- calculator/totaliser
- power supply
- multichannel IP converter.

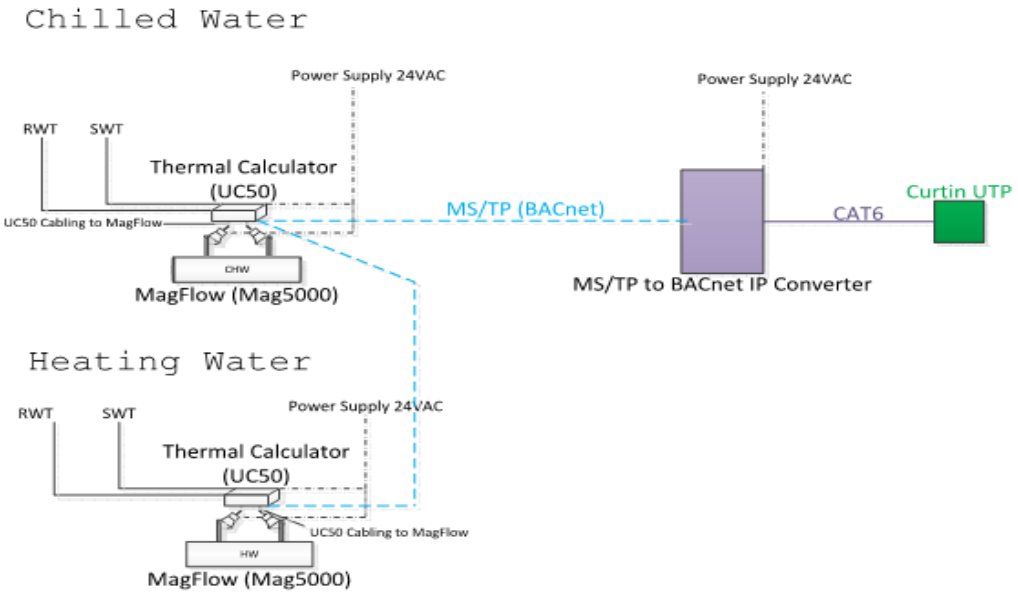


Figure 4B – thermal metering magflow schematic

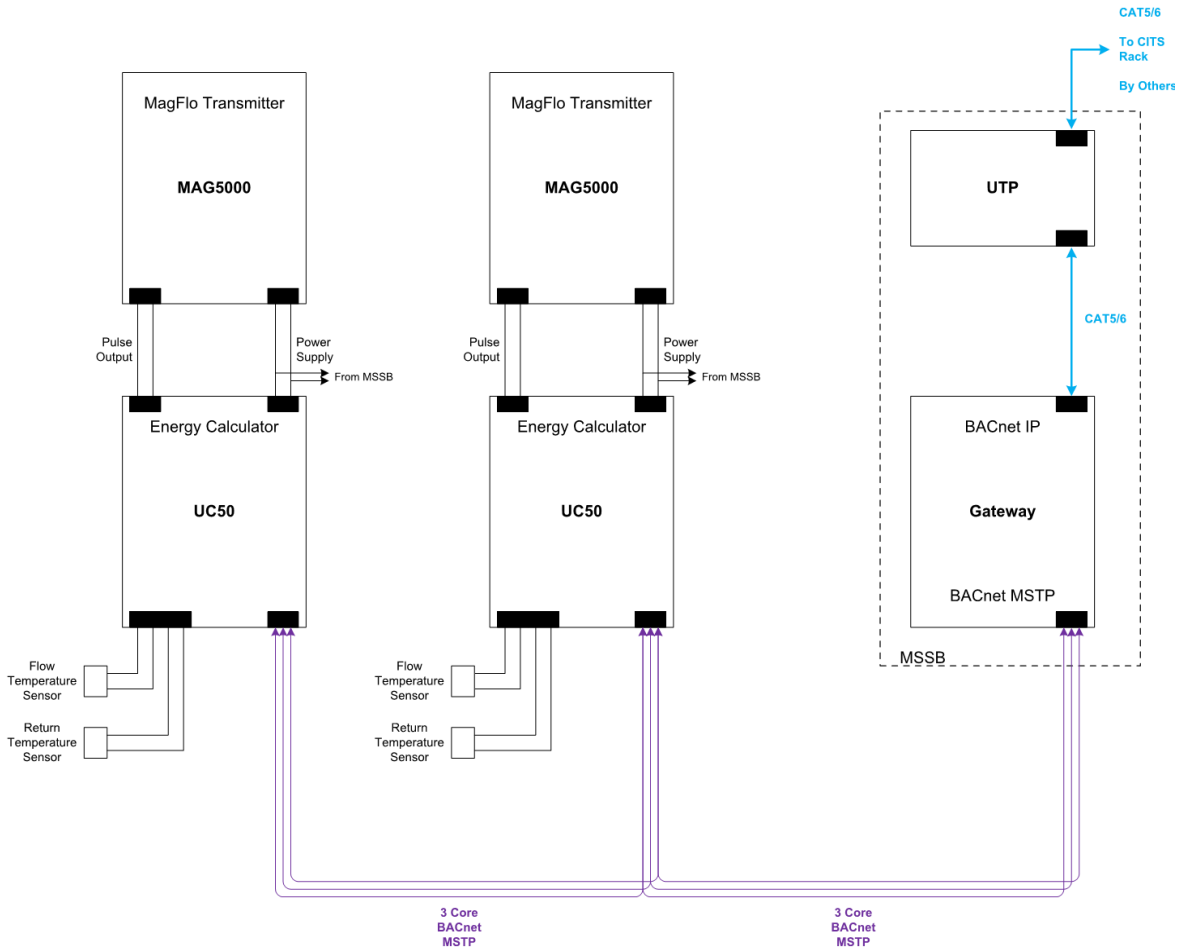


Figure 4C – Thermal Metering Magflow GA

MAGFLO – CHILLED WATER

Supply and install Siemens Sitran MAG5100W.

MAGFLO – HEATING WATER

Supply and install Siemens Sitran MAG3100P.

MAGFLO TRANSMITTER HEAD

Supply and install Siemens Sitran Magflo transmitter MAG6000.

MAGFLO REMOTE TRANSMITTER MOUNTING KIT

Where it is not possible to mount the transmitter head at the meter, install a remote mounting kit and extend the cables to suit.

a) Sitrans, Magflo Accessory, Wall Mounting Kit for Magflo Transmitter: Part number SBTFDK-085U1018.

b) Sitrans, Magflo Accessory, 10 m cable, 3 x 1.5 mm² with shield, PVC: Part number SBTFDK-083F0121.

ENERGY CALCULATOR/TOTALISER

Supply and install Siemens Landis Gyr Energy calculator UC50 with the following features:

- model number to suit meter location (flow/return) and system type (CHW/HW)
- passive pulse input
- information displayed on the dial plate and LCD
- simple 2-button operation
- logbook for easy diagnosis
- battery service life of 10 years minimum
- hardwired power supply unit to be provided
- optical interface to EN 62056-21
- data from 60 preceding months to be stored and read from the calculator
- tariff functions customisation
- automatic self-diagnosis and fault detection – provide alarm out to BMS and reporting software
- EN 1434-approved
- temperature range 0–180 ºC.
- 20-minute power failure bridging.

4.4.4 ULTRASONIC ENERGY METERS

Supply and install Flexim energy meters, with flexibility on single channel (Fluxus F502TE) or dual channel (Fluxus F704TE) arrangements. Before deciding on the use of single or dual channel configuration, the designer must provide a cost benefit and risk analysis on the suitability of using dual channel and consult with Curtin prior to completing designs.

4.4.5 TEMPERATURE SENSORS

- matched pair with the selected flow meter type
- resistance bulb, thermistor type or thermocouple type (complete with operational amplifier)
- selected to best suit operating parameters of the measured variable
- provide a total accuracy of +1% of span on the calculator/totaliser readout
- resolution of 0.1 K
- housed in a removable cover without thermometer with insulating block incorporated in the enclosure
- located to ensure rapid response to changes in temperature
- insertion sensors
- supply and install 45º stainless steel wells for fitting into piping angled in the direction of flow.
- factory calibrated and commissioned on site by the manufacturer for correct accuracy
- label sensors indicating equipment served
- located in weatherproof enclosures as required.

4.4.6 METERING ENCLOSURES

ENCLOSURES

All metering devices that the flow meter and temperature sensors connect to, shall be housed within a powder coated steel panel construction. The boards shall be large enough to accommodate all devices including the IP converter and data point.

Where devices are located externally they shall be within an IP66-rated enclosure complete with Curtin key locks. The enclosure may be to external switchboard construction standard or be a panel housed within a weatherproof enclosure.

POWER SUPPLIES

Power supplies to metering panels/switchboards shall be fed from a localised mechanical services switchboard from an extra low voltage (ELV) circuit. The use of ELV means that maintenance can be undertaken on the devices within the panel without a need for an electrical licence.

If an ELV supply is not available and a low voltage (LV) supply is necessary, then compartmentalise the LV from the ELV within the panel. The panel will require Curtin standard electrical key locks, in accordance with *000312 PDG Electrical Services Guidelines*.

SECURITY

Consult with the Curtin Network Infrastructure Manager on requirements for data point security.

LABELLING

Metering enclosures shall be externally labelled in accordance with Curtin University labelling requirements.

4.5 INSTALLATION REQUIREMENTS

4.5.1 METERS

Where practical, meters shall be installed to be readily accessible in locations such as:

- externally within a weatherproof enclosure
- mechanical plant rooms
- service tunnels
- accessible ducts or risers.

Flow meters must be installed in the return line and in accordance with the manufacturer's guidelines. In particular, requirements for straight lengths of pipe before and after flow sensors must be maintained.

METER SECURITY

Where provided with a key or touchpad for programming purposes, access to the internal parameters of meters shall be password protected.

EARTHING

Meters installed in non-metallic pipework shall be separately earthed.

4.5.2 THERMAL INSULATION

All meters (irrespective of pipe size) and associated isolation valves (irrespective of pipe size) and temperature sensor pockets shall be insulated and vapour-sealed to the requirements outlined in *000311 PDG Mechanical Services Guidelines* for pipework insulation standards.

4.5.3 MSTP NETWORK CABLING

The Contractor shall provide and install communications cabling between the meter and the IP gateway. The meter MSTP communications cable type shall be as per the

meter manufacturer's specification. If not specified, Belden 9841 or equivalent cable shall be used.

All MSTP communications cabling shall be terminated in a bus network topology. Star and T-type network topology cabling terminations are not acceptable.

EIA-485 cabling line resistance must be in accordance with the meter manufacturer's recommendation. End-of-line resistors should be supplied and installed as required to maintain correct line resistance.

Where communications cabling leaves or spans between buildings, surge and lightning protection must be provided at each end where the cabling leaves and/or enters the building. Surge protection devices should include visual indication of operation and actuation.

Meter communications cabling within electrical switchboards must be installed within communications conduit.

Meter communications cabling installed within electrical switchboards and on shared cable support structures shall be installed in accordance with AS/ACIF S009:2001. Segregation distances between communications and power cables must be maintained.

4.5.4 IP NETWORK GATEWAYS

IP network gateways shall be installed wherever practicable adjacent to the nearest ICT data point. The contractor shall provide and install Cat 6 network patch cables between gateways and ICT data points and shall be responsible for:

- configuration of IP addresses into the gateways
- configuration of the communications parameters into the gateways
- configuration of the meter node addresses into the gateways.

As IP gateways consume ICT network resources, meter MSTP networks should be designed and installed in such a way as to minimise the number of gateways required.

A basic acceptable meter connection topology is shown in the following figure:

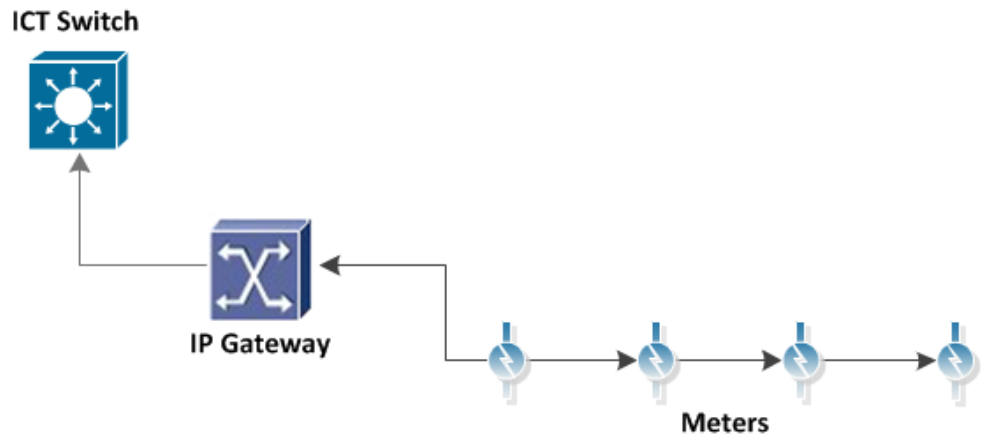


Figure 4D – Sample Meter Connection Topology

4.6 COMMISSIONING

Commissioning and documentation shall be undertaken for each new networked meter by a suitably qualified meter technician.

4.6.1 METER COMMISSIONING

Commissioning shall confirm that:

- The meter flow sensor is:
  - installed to the correct location (by matching the serial number to the designated location)
  - installed in a suitable location (in consideration of disturbances to flow)
  - configured with the correct monitored pipe information (e.g. composition, thickness)
  - configured with the correct measured media information (e.g. CHW).
- The meter calculator/transmitter is:
  - installed to the correct location (by matching the serial number to the designated location)
  - configured with the correct internal thermal formulae
  - configured to display measured values on the meter display
  - configured to make available measured values from the meter via BACnet
  - configured to communicate all available metered values to the reporting software meter monitoring system.

Meter commissioning is to be carried out by and signed off by the vendor.

4.6.2 METER FACEPLATE (SCREEN) DISPLAY

Where meter screens have the capacity for a static or scrolling display, the following minimum information shall be included in the display per active channel:

- instantaneous energy demand in kilowatts
- totalised energy consumption in kWh (ultrasonic energy) or MWh (Totaliser)
- flow in l/s
- volume in m^3
- temperature (flow and return) in $^{\circ}C$
- temperature differential in K.

4.6.3 METER COMMISSIONING DOCUMENTATION

The Contractor is responsible for completing all meter commissioning documentation, which shall confirm that the commissioning process has been completed successfully in its entirety and shall include the following as a minimum:

- a unique document per meter commissioned
- location, manufacturer, model and serial numbers of the commissioned meter and its sensors
- confirmation of the serial communications from the meter to the IP network gateway and to and from the IP gateway to the reporting software meter monitoring system
- record of the communications parameters programmed into the meter
- record of any faults identified and of any corrective action recommended or taken
- date and time of commissioning, business name, name and signature of meter technician

Refer to the separate Appendix Reference Document for a sample commissioning document.

The Contractor must liaise with reporting software provider when commissioning the first meter to ensure communication is established and all specified meter data is exposed and correctly validated. This will reduce any potential reworks on the remaining meter integration works.

4.7 METER VERIFICATION

The Contractor shall provide confirmation of traceable factory calibration data for each meter in the form of manufacturer's certificates.

4.8 METER VALIDATION

Refer to Section 4.10.

4.9 COORDINATION

All meters must be commissioned and integrated to both the site-wide energy RSS and the onsite BMS systems. The Contractor must liaise and engage with the reporting software provider for all reporting software works. The Contractor must liaise and engage with the BMS providers for BMS associated works. The reporting software provider will require the services of either the BMS provider or the Service Contractor to commission the metering devices.

The Contractor is responsible for ensuring works occur in a timely manner to achieve identified project timelines.

Prior to the commissioning of any new, replacement, relocated or amended meters to reporting software, the Contractor must liaise with the appointed reporting software provider to coordinate the commissioning date and time.

The Contractor must provide at least 14 days' notice to reporting software provider prior to the proposed commissioning date.

The Contractor must provide the following information prior to any commissioning works commencing with reporting software provider:

- meter trees that show hierarchy of meters, master, sub-meters and virtual meters
- number of meters
- approved meter labels (all labels to be in accordance with Building Services Labelling Standard)
- meter location
- media being monitored.

Prior to providing the above information the Contractor must:

- request all required IP addresses from Curtin University
- confirm with DTS that all IP communications outlets have been patched and tested
- provide reporting software provider with communications configuration parameters (e.g. meter node address, device ID, object list and IP address) for each metering arrangement and IP gateway
- liaise with reporting software provider during the commissioning and validation process to ensure and confirm that the meters are communicating with and are passing data correctly and accurately to the reporting software site meter monitoring systems.

The reporting software provider will undertake all configuration modifications to the reporting software as necessary to include for the integration of new meters and/or meter amendments.

4.9.1 REQUESTING AN IP ADDRESS

Refer to Section 10 COMMUNICATIONS (DATA).

4.9.2 DELIVERY PROCESS FOR REPORTING SOFTWARE AND BMS

Table 4-1 – Delivery Process for Reporting Software and BMS

New Project/Capital Works	**Details**
Design	• Consultant(s) nominated
Contract documents prepared	• scope of works specification and drawings • new or updated site or building metering tree • new or updated site or building metering plan single line diagrams • floor plan information • metering devices and installation requirements documented

New Project/Capital Works	Details
	• electrical supply to metering devices documented • communications (data) requirements documented • coordination with authorities documented (where necessary) • schedules of metering and labels documented • liaise with reporting software and BMS systems providers
Tendering	• Contractor issues tender documents to the reporting software provider and other sub-contractors. • The reporting software provider provides a quote to the Contractor for inclusion into the tender submission. • Quotes must cover the required scope of work
Construction	• Contractor nominated • Contractor issues an order to the reporting software provider and other sub-contractors
Contractor notifies subcontractors of Scope of Works and issues Project Documentation	• number of meters • location and labelling of meters • updated metering tree • updated site map of meter locations • virtual meter calculations (if any)
Contractor to ensure all network connectivity is commissioned.	• requests all required IP addresses from Curtin University • ensure all IP TOs have been patched and tested • provide communications configuration parameters for reporting software and BMS • ensure all devices and meters are commissioned
Commission meters into Reporting Software and BMS	• Contractor to take 2 separate faceplate readings (kWh or KL to suit), 1 week apart and issue to reporting software and BMS companies • RSC and BMS companies to validate the readings against their respective software platforms • Where due to low or no occupancy meters are not recording any change in values, the contractor shall force systems to a state that provides suitable commissioning readings
Handover – provide documentation to be submitted by subcontractors for inclusion into O&M manuals.	• Handover pack to include validation documentation, report configurations and alarm configurations. • Consultant to have validated that RSC and BMS works have been completed and that reports, trends and graphics are available to suit the respective platforms.

4.10 RESPONSIBILITIES AND DEMARCATION

4.10.1 GENERAL

It shall be the responsibility of the design engineer and installation contractor to select the correct metering system, device sizes and types to ensure the suitability for

purpose. As a minimum, the following characteristics shall be taken into consideration for thermal energy meter selection:

- pipe (DN) size
- pipe composition
- pipe wall thickness
- media being monitored/measured
- flow tube lining requirement
- minimum flow and velocity rates
- maximum flow and velocity rates
- maximum pressure loss through metering arrangement shall not exceed 3 kPa
- manufacturer-required clearances
- criticality of building function and risk to business continuity.

It shall be the responsibility of the Consultant to ensure that the meter is correctly sized, and the metering system is fully and adequately documented to facilitate the contractor's installation obligations.

It shall be the responsibility of the Contractor to ensure that the meter is correctly sized, constructed, installed and adjusted for safe and accurate operation.

The Contractor's meter technician shall be responsible for the installation, configuration and commissioning of the meters and the IP network gateway devices to confirm that the meter data is accurate and is being transmitted correctly through the IP network gateway devices to the reporting software and BMS meter monitoring systems.

It shall be the responsibility of the RSC to liaise and work with the BMS Contractor to initially commission and verify the meter readings into the reporting software system and to then re-validate the readings after a nominal period of time has transpired.

It shall be the responsibility of the BMS contractor to liaise and work with the Contractor to initially commission and verify the meter readings into the BMS metering system(s) and to then re-validate the readings after a nominal period of time has transpired. It is also the BMS contractor's responsibility to upgrade graphics into the BMS system(s).

It shall be the responsibility of the data contractor to obtain IP addresses and to validate that they have been commissioned and activated.

It shall be the responsibility of Curtin University to:

- approve meter labelling
- provide passwords.

4.10.2 METER INSTALLATION AND COMMISIONING

Based on experience from previous thermal metering projects, the matrix below leverages each contractor's respective strengths and areas of experience while providing clear delineation of the expectations. Some key areas to note:

1) The Mechanical Contractor (MC) is responsible for the procurement and installation of the meter.
2) The Electrical Contractor (EC) is responsible for the supply and installation of all electrical wiring and gateways in accord with the system design up to the Curtin-owned network switch.
3) DTS as owners and managers of the network are responsible for all hardware and software configuration between the network switch and the application servers (e.g. RSS, BMS, etc.)
4) The BMS Contractor (BC) is responsible for all onsite programming of devices including the meters and the gateways. If required under the scope they may also be required to integrate the data from the gateway into the BMS.
5) The RSS Contractor (RSC) is responsible for integration of the data into the RSS database and for creating long-term trend repositories and configuring reports, trends, master-submeter relationships, dashboards and tenant statements as per the standard Curtin requirements.
6) Typically, the BMS contractor (BC) is engaged through the Mechanical Contractor (MC), in which case ultimate responsibility for all MC and BC activities will fall to the Mechanical Contractor (MC).

Component	Supply	Install	Programming
Meter	MC	MC	BC
Cabling (Meter to Gateway)	EC	EC	N/A
Gateway	EC	EC	BC
Cabling (Gateway to Switch)	EC	EC	N/A
Network Configuration, Management and Allocation of IP Addresses	DTS	DTS	DTS
BMS Integration (if required)	BC	BC	BC
RSS Integration	RSC	RSC	RSC

4.10.3 METER VALIDATION

Meter validation refers to the end-to-end validation between the meter and the application databases (BMS and RSS). Meter validation works should not commence until network connection between the physical meter and the applications has been confirmed and data histories have been configured.

Two separate meter readings of consumption will be recorded with a gap of at least five days in between and containing a load. For new buildings and low utilisation legs, consumption may need to be forced. A meter verification record should include the following evidence (at a minimum) for both the first and second readings:

1) the meter faceplate reading including any decimal places and units, time and date-stamped with a supporting photograph
2) a screenshot of the gateway showing the value being read from the meter including decimal places, units, time and date-stamped
3) a screenshot of the history database for all applications (RSS, BMS, etc.) illustrating the recorded reading and units for the same point in time as the physical reading.

Responsibility for each reading is as follows:

Description	Responsible Contractor
Physical Meter Reading and Photo	MC
Meter Verification Records	MC
Gateway Configuration Screenshot	BC
BMS Software Reading and Screenshot	BC
RSS Software Reading and Screenshot	RSC
Data Collation into Validation Register	RSC

The data from these readings should be recorded in a validation register, which details the following and is the responsibility of the RSS contractor:

1) Archibus reference
2) serial number of the meter
3) physical location
4) network information to connect to the device, which may include GatewayIP, Instance Number, Device ID, MAC Address, MSTP Number, Remote Address, Instance Number, etc.
5) first and second readings from the faceplate, RSS and BMS with time and date stamps
6) a comparison of the consumption recorded in the validation period on the physical meter and in any applications.

Any meters where the recorded consumption deviates from the faceplate by more than 2% should be validated on a third occasion or further investigated to understand where the discrepancy has originated.

In the event of a failure, the Contractor must liaise with RSC to ensure the meter has been commissioned and configured correctly and the validation process has been repeated until the meter passes.

4.11 APPLICABLE STANDARDS

Reference	Application
OIML R 49-1:2006	Water Meters Metrological and Technical Requirements

AS/NZS 3500	Plumbing Code
AS/ACIF S009:2013	Installation Requirements for Customer Cabling (Wiring Rules)
AS/NZS3000:2000	Electrical installations (known as the Australian/New Zealand Wiring Rules)
AS/NZS3080:2013	Telecommunications installations - Generic cabling for commercial premises (ISO/IEC 11801:2002, MOD)
EIA-485	Communication standard for RS-485 installation
Building Services Labelling Standard	Labelling requirements of all asset types for Curtin University
000313 PDG Data Communications Cabling Requirements	Curtin Data Communication Cabling Standards and Specifications

The currency of the above standards will change from time to time and it is the designer's and contractor's responsibility to ensure that the currently applicable standards are used.

4.12 DATA AND REPORTS

Data will be retrieved via the IP network. In all cases, no matter the software, hardware and data storage systems in place, some calculations will still be required, but this tends to be at the reporting software level where, for the reports to be meaningful, they will need to encompass:

- date and time
- chilled water supply temperature
- chilled water return temperature
- chilled water flow rate (l/s)
- chilled water instantaneous demand (kW)
- chilled water energy use (kWhr)
- heating water supply temperature
- heating water return temperature
- heating water flow rate (l/s)
- heating water instantaneous demand (kW)
- heating water energy use (kWhr).

The reporting software system will make use of the above information for reports including but not necessarily limited to:

- hourly data presentation of intervals from 5 minutes to 15 minutes to suit application requirements
- summation of hourly data for consumption purposes
- daily data presentation
- summation of daily data for consumption purposes
- monthly data presentation

- monthly data presentation to suit the number of days, with various summations
- annual data presentation to suit the number of months, with various summations
- summation to operational periods such as "On peak", "Off peak" and "Shoulder" (should it ever arise)
- comparison of data with same time last year results
- comparison of data for energy use, available capacity, floor area (gross, nett and/or air conditioned) and other benchmarks for each facility
- determination of building daily peak flow and use
- metering fault reporting via F codes from UC50 or internal to reporting software.

4.13 BMS GRAPHICS PAGES

The BMS will no longer be used as the means to calculate thermal energy. The new metering systems will be provided with their own calculator/totalisers and will transmit the data via IP, and therefore the BMS must simply draw the information and display it at each building graphics page (irrespective of BMS provider), as well as the centralised metering graphics pages contained by a BMS provider.

The display of the data shall follow the latest controls graphics pages template.

The front page and subsequent pages for each building are to display the following criteria for each of chilled and heating water, as they relate to that building:

- CMMS ID
- flow temperature
- return temperature
- flow rate (l/s)
- instantaneous thermal energy consumption (kW)
- cumulative monthly consumption reset to zero at end of each month (kWh).

The Central Energy Plant shall have graphics pages dedicated to thermal energy metering and separate graphics pages dedicated to providing a summary of the meters, all managed by the BMS system.

A thermal metering summary page shall be provided that encompasses all metering and F code status where connected to UC50. Metering fault management is by BMS via F codes from UC50 devices.

5 COOLING TOWERS WATER AND WASTE METERING

5.1 GENERAL

This section is applicable to both Hydraulic and Mechanical Services.

Specific outcomes expected for cooling towers water and waste metering include:

- interfacing to water treatment equipment
- defining and capturing tower water consumption, evaporation and bleed
- capturing sump drain down volumes
- capturing accurate trade waste outflow for the Water Corporation
- clarity and uniformity of graphics display at the BMS head ends
- water use and performance reporting
- NMIA-certified metering with installation standard compliance to Water Corporation requirements.

5.2 METERING CONCEPT

The diagram below provides contextual information on the metering process.

5.2.1 WATER AND WASTE

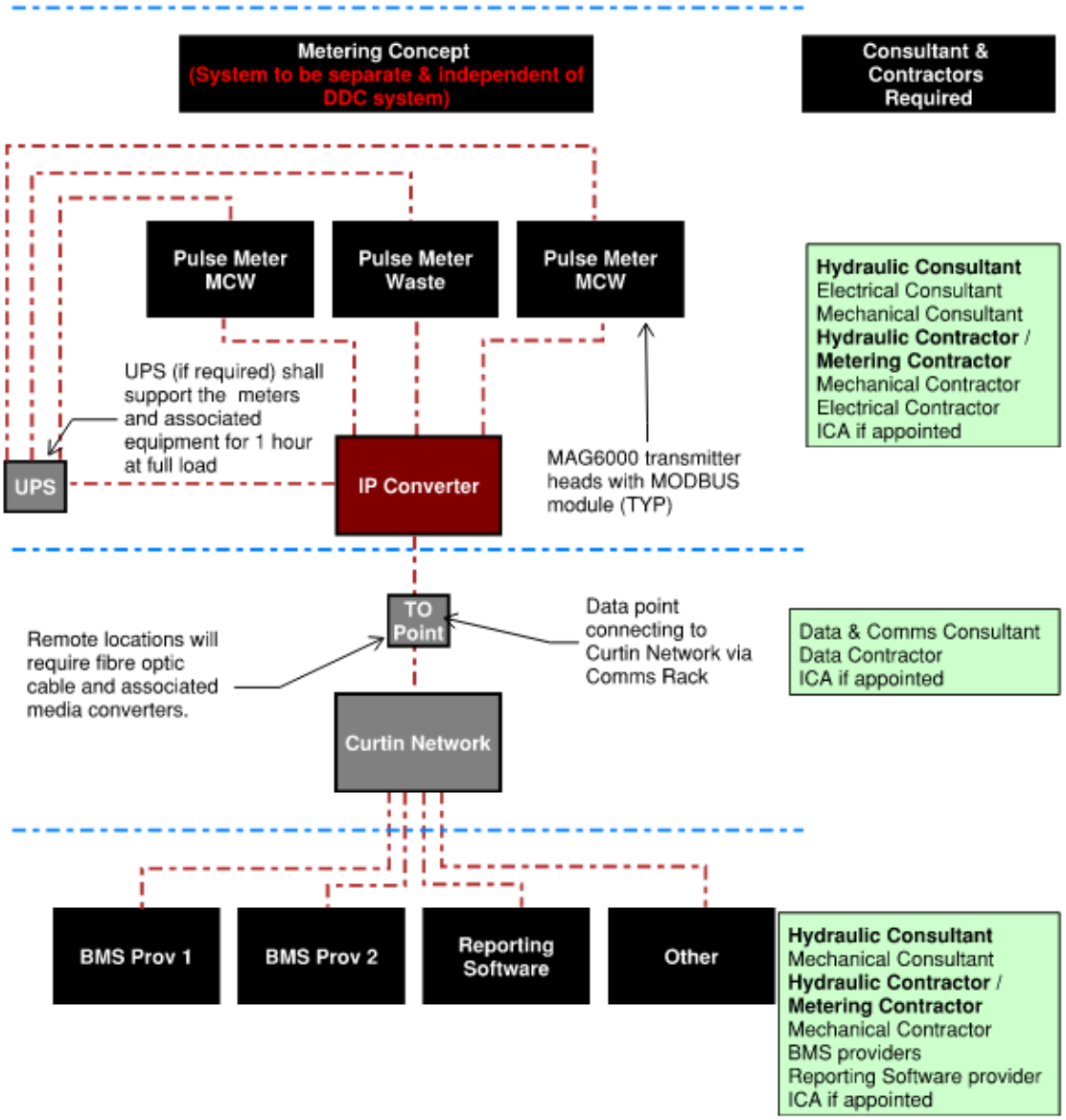


Figure 5A – Water and Waste Metering Concept

5.2.2 WATER TREATMENT

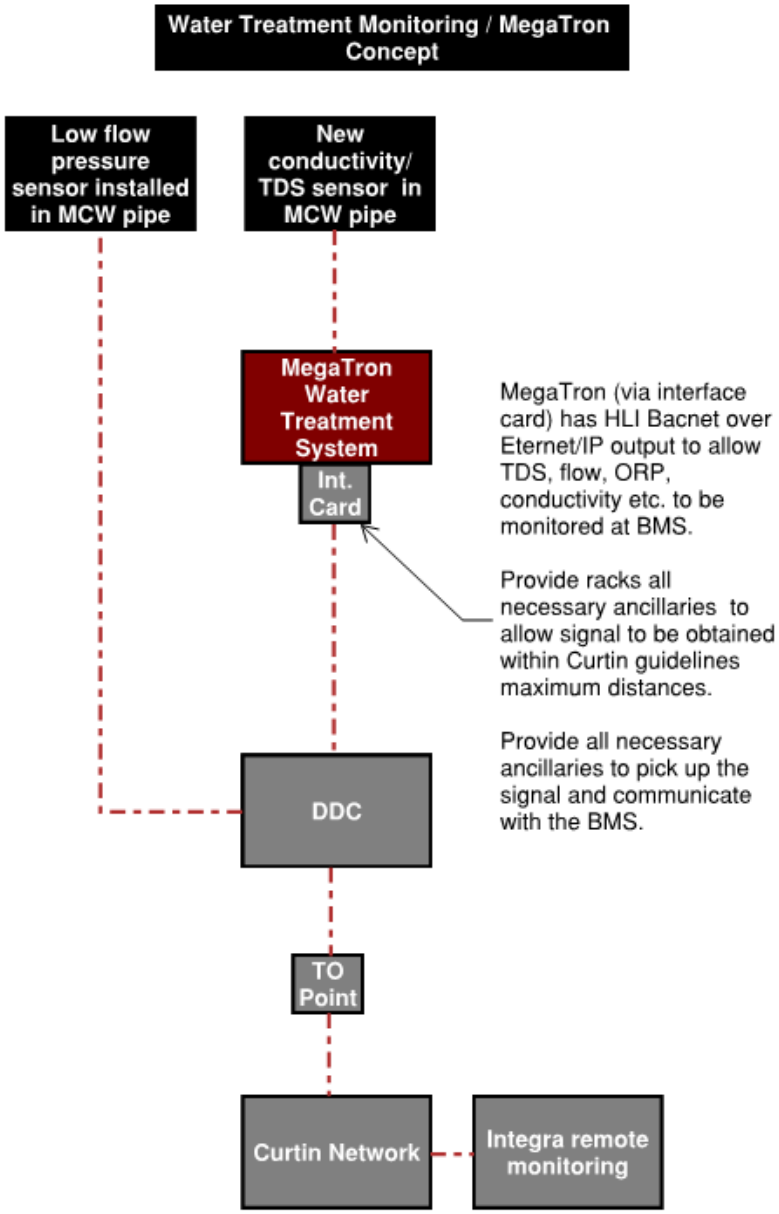


Figure 5B – Water Treatment System Concept

5.3 ACCEPTABLE METERS AND DEVICES

Water and waste meters shall be supplied and installed as in-line electromagnetic flow (magflow) meters. Where in-line electromagnetic flow meters are installed, the magflow sensor tube shall be approved to international standard OIML R 49-1:2006 and be NMIA-certified.

5.3.1 IP NETWORK GATEWAYS

IP network gateways shall be used to integrate meters into the existing ICT network. Meters must be connected to the ICT network using a suitable IP gateway.

Suitable IP gateways shall be those deemed to meet the requirements as set out in Section 5.3.2 below.

5.3.2 COMMUNICATIONS PROTOCOL

The communications protocol utilised to exchange data between the meters and the BMS and reporting software systems shall be Modbus output from the meter transmitter, to a Modbus RTU to BACnet IP gateway.

Data from meters supporting Modbus RTU and operating over serial MSTP channels shall be converted to BACnet IP protocol by the metering contractor prior to connection to the ICT network. The ICT network does not directly support serial protocols such as Modbus. An IP network gateway shall undertake the Modbus RTU MSTP to IP protocol conversion.

BACNET ADDRESSING CONVENTIONS:

The Contractor must submit the addressing scheme proposed for devices to the Infrastructure Manager, Hydraulic and Civil, Capital Projects at Curtin for approval prior to configuring the network addresses on site.

APPROVED MAKE:

Chen Sen Controls, Chen Sen Gateway (GSGW) – the gateway device to convert serial protocols (Modbus RTU or proprietary protocols) to BACnet IP. Hardware shall have RCM certification.

5.3.3 METERS – WATER AND WASTE

Supply and install Siemens Sitran MAG5100W.

5.3.4 TRANSMITTER HEAD

Supply and install Siemens Sitran Magflo transmitter MAG6000 with Modbus RTU interface card.

5.3.5 UPS

Supply and install UPS units of PowerShield Commander (1100 | 1100/2000 VA Line Interactive) manufacture complete with BMS interface card (Modbus or BACnet) or approved equivalent, providing for a minimum of 1-hour operation to support meter heads.

5.3.6 WATER PRESSURE SENSORS

Supply and install pressure sensors in water supply lines to cooling towers, connected to BMS.

Sensors shall be Siemens QBE2003/2013 range (or approved equivalent) to suit either 1–10V or 4–20mA output and to suit the pressure range 0–500 kPa or the particular site.

5.3.7 METERING ENCLOSURES

ENCLOSURES

All metering devices that the flow meter and temperature sensors connect to, shall be housed within an enclosure of powder coated steel panel construction. The boards shall be large enough to accommodate all devices including the IP converter and data point.

Where devices are located externally, they shall be within an IP66-rated enclosure complete with Curtin key locks. The enclosure may be to external switchboard construction standard or be a panel housed within a weatherproof enclosure.

POWER SUPPLIES

Power supplies to metering panels/switchboards shall be fed from a localised mechanical services switchboard from an extra low voltage (ELV) circuit. The use of ELV means that maintenance can be undertaken on the devices within the panel without a need for an electrical licence.

If an ELV supply is not available and a low voltage (LV) supply is necessary, then compartmentalise the LV from the ELV within the panel. The panel will require Curtin standard electrical key locks, in accordance with *000312 PDG Electrical Services Guidelines.*

SECURITY

Consult with the Curtin Network Infrastructure Manager on requirements for data point security.

LABELLING

Metering enclosures shall be externally labelled in accordance with Curtin University labelling requirements.

5.3.8 INTEGRATION OF METERS TO CAMPUS NETWORK

Refer to Section 10 COMMUNICATIONS (DATA).

5.4 INSTALLATION REQUIREMENTS

5.4.1 METERS

Meters shall be installed to be readily accessible in locations such as:

- externally within weatherproof enclosures
- plant rooms
- service tunnels
- accessible ducts or risers.

Meters must be installed in in accordance with the manufacturer's guidelines. In particular, requirements for straight lengths of pipe before and after flow sensors must be maintained.

METER SECURITY

Where provided with a key or touchpad for programming purposes, access to the internal parameters of meters shall be password protected.

EARTHING

Meters installed in non-metallic pipework shall be separately earthed.

5.4.2 MSTP NETWORK CABLING

The Contractor shall provide and install communications cabling between the meter and the IP gateway. The meter MSTP communications cable type shall be as per the meter manufacturer's specification. If not specified, Belden 9841 or equivalent cable shall be used.

All MSTP communications cabling shall be terminated in a bus network topology. Star and T-type network topology cabling terminations are not acceptable.

EIA-485 cabling line resistance must be in accordance with the meter manufacturer's recommendation. End-of-line resistors shall be supplied and installed as required to maintain correct line resistance.

Where communications cabling leaves or spans between buildings, surge and lightning protection must be provided at each end where the cabling leaves and/or enters the building. Surge protection devices should include visual indication of operation and actuation.

Meter communications cabling within electrical switchboards must be installed within communications conduit.

Meter communications cabling installed within electrical switchboards and on shared cable support structures shall be installed in accordance with AS/ACIF S009:2001. Segregation distances between communications and power cables must be maintained.

5.4.3 IP NETWORK GATEWAYS

IP network gateways shall be installed, wherever practicable, adjacent to the nearest ICT data point. The Contractor shall provide and install Cat 6 network patch cables between gateways and ICT data points and shall be responsible for:

- configuration of IP addresses into the gateways
- configuration of the communications parameters into the gateways
- configuration of the meter node addresses into the gateways.

As IP gateways consume ICT network resources, meter MSTP networks should be designed and installed in such a way as to minimise the number of gateways required.

A basic acceptable meter connection topology is shown in the following figure:

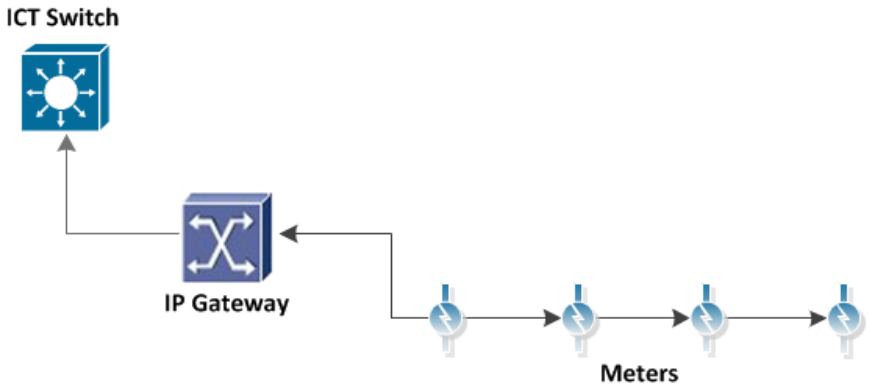


Figure 5C – Sample Meter Connection Topology

5.5 COMMISSIONING

Commissioning and documentation shall be undertaken for each new networked meter by a suitably qualified meter technician.

5.5.1 METER COMMISSIONING

Commissioning shall confirm that:

- the meter flow sensor is:
  - installed to the correct location (by matching the serial number to the designated location)
  - installed in a suitable location (in consideration of disturbances to flow)
  - configured with the correct monitored pipe information (e.g. composition, thickness)
  - configured with the correct measured media information (e.g. water/waste)
- the meter calculator/transmitter is:
  - installed to the correct location (by matching the serial number to the designated location)
  - configured with the correct internal settings
  - configured to display measured values on the meter display
  - configured to make available measured values from the meter via Modbus RTU
  - configured to communicate all available metered values to the reporting software meter monitoring system and BMS systems.

Meter commissioning is to be carried out and signed off by the vendor.

5.5.2 METER FACEPLATE (SCREEN) DISPLAY

Where meter screens have the capacity for a static or scrolling display, the following minimum information shall be included in the display per active channel:

- totalised consumption in kilolitres
- instantaneous flow in l/s
- volume in m^3.

5.5.3 METER COMMISSIONING DOCUMENTATION

The Contractor is responsible for completing all meter commissioning documentation which shall confirm that the commissioning process has been completed successfully in its entirety and shall include the following as a minimum:

- a unique document per meter commissioned
- location, manufacturer, model and serial numbers of the commissioned meter and its sensors
- confirmation of the serial communications from the meter to the IP network gateway and to and from the IP gateway to the reporting software meter monitoring system
- record of the communications parameters programmed into the meter
- record of any faults identified and of any corrective action recommended or taken
- date and time of commissioning, business name, name and signature of meter technician.

Refer to the separate Appendix Reference Document for a sample commissioning document.

The Contractor must liaise with reporting software provider when commissioning the first meter to ensure communication is established and all specified meter data is exposed and correctly validated. This will reduce any potential reworks on the remaining meter integration works.

5.6 METER VERIFICATION

The Contractor shall provide confirmation of traceable factory calibration data for each meter in the form of manufacturer's certificates.

5.7 METER VALIDATION

Refer to Section 5.9.

5.8 COORDINATION

All meters must be commissioned and integrated to both the site-wide energy RSS and the onsite BMS systems. The Contractor must liaise and engage with the reporting software provider for all reporting software associated works. The Contractor must

liaise and engage with BMS providers for BMS associated works. The reporting software provider will require the services of either the BMS provider or the Service Contractor to commission the metering devices.

The Contractor is responsible for ensuring works occur in a timely manner to achieve identified project timelines.

Prior to the commissioning of any new, replacement, relocated or amended meters to the reporting software the Contractor must liaise with the appointed reporting software provider to coordinate the commissioning date and time.

The Contractor must provide at least 14 days' notice to the reporting software provider prior to the proposed commissioning date.

The Contractor must provide the following information prior to any commissioning works commencing with the reporting software provider:

- meter trees that show hierarchy of meters, master, sub-meters and virtual meters
- number of meters
- approved meter labels (all labels to be in accordance the Building Services Labelling Standard)
- meter location
- media being monitored.

Prior to providing the above detailed information the Contractor must:

- request all required IP addresses from Curtin University
- confirm with (DTS) that all IP communications outlets have been patched and tested
- provide reporting software provider with communications configuration parameters (e.g. meter node address, device ID, object list and IP address) for each metering arrangement and IP gateway
- liaise with reporting software provider during the commissioning and validation process to ensure and confirm that the meters are communicating with and are passing data correctly and accurately to the reporting software site meter monitoring systems.

The RSC will undertake all configuration modifications to the reporting software as necessary to include for the integration of new thermal energy meters and/or meter amendments.

5.8.1 REQUESTING AN IP ADDRESS

Refer to Section 10 COMMUNICATIONS (DATA).

5.8.2 DELIVERY PROCESS FOR REPORTING SOFTWARE AND BMS

Table 5-1 – Delivery Process for Reporting Software and BMS

New Project/Capital Works	Details
Design	• Consultant(s) nominated
Contract documents prepared	• scope of works specification and drawings • new or updated site or building metering tree • new or updated site or building metering plan single line diagrams • floor plan information • metering devices and installation requirements documented • electrical supply to metering devices documented • communications (data) requirements documented • coordination with authorities documented (where necessary) • schedules of metering and labels documented • liaise with reporting software and BMS systems providers
Tendering	• Contractor issues tender documents to the reporting software provider and other sub-contractors. • The reporting software provider provides a quote to the Contractor for inclusion into the tender submission. • Quotes must cover the required scope of work
Construction	• Contractor nominated • Contractor issues an order to the Reporting Software provider and other-sub contractors
Contractor notifies subcontractors of Scope of Works and issues Project Documentation	• number of meters • location and labelling of meters • updated metering tree • updated site map of meter locations • virtual meter calculations (if any)
Contractor to ensure all network connectivity is commissioned.	• requests all required IP addresses from Curtin University • ensure all IP TOs have been patched and tested • provide communications configuration parameters for reporting software and BMS
Commission Meters into Reporting Software and BMS	• ensure all devices and meters are commissioned • Contractor to take 2 separate faceplate readings (kWh or KL to suit), 1 week apart and issue to reporting software and BMS companies • reporting software and BMS companies to validate the readings against their respective software platforms • Where due to low or no occupancy meters are not recording any change in values, the contractor shall force systems to a state that provides suitable commissioning readings

New Project/Capital Works	Details
Handover – provide documentation to be submitted by subcontractors for inclusion into O&M manuals.	• Handover pack to include validation documentation, report configurations and alarm configurations. • Consultant to have validated that RSS and BMS works have been completed and that reports, trends and graphics are available to suit the respective platforms.

5.9 RESPONSIBILITIES AND DEMARCATION

5.9.1 GENERAL

It shall be the responsibility of the design engineer and installation contractor to select the correct metering system, device sizes and types to ensure the suitability for purpose. As a minimum, the following characteristics shall be taken into consideration for meter selection:

- pipe (DN) size
- pipe composition
- pipe wall thickness
- media being monitored/measured
- flow tube lining requirement
- minimum flow and velocity rates
- maximum flow and velocity rates
- maximum pressure loss through metering arrangement shall not exceed 3 kPa.
- manufacturer-required clearances.

It shall be the responsibility of the Consultant to ensure that the meter is correctly sized, and the metering system is fully and adequately documented to facilitate the Contractor's installation obligations.

It shall be the responsibility of the Contractor to ensure that the meter is correctly sized, constructed, installed and adjusted for safe and accurate operation.

The Contractor's meter technician shall be responsible for the installation, configuration and commissioning of the meters and the IP network gateway devices to confirm that the meter data is accurate and is being transmitted correctly through the IP network gateway devices to the reporting software and BMS meter monitoring systems.

It shall be the responsibility of the RSC to liaise and work with the Contractor to initially commission and verify the meter readings into the reporting software metering system and to then re-validate the readings after a nominal period of time has transpired.

It shall be the responsibility of the BMS contractor to liaise and work with the Contractor to initially commission and verify the meter readings into the BMS metering system and to then re-validate the readings after a nominal period of time has transpired. It is also the BMS contractor's responsibility to upgrade graphics in the BMS system(s).

It shall be the responsibility of the data contractor to obtain IP addresses and to validate that they have been commissioned and activated. It shall be the responsibility of Curtin University to:

- approve meter labelling
- provide passwords.

5.9.2 METER INSTALLATION AND COMMISIONING

Based on experience from previous hydraulic metering projects, the matrix below leverages each contractor's respective strengths and areas of experience while providing clear delineation on the expectations. Some key areas to note:

1) The Hydraulic Contractor (HC) is responsible for the procurement of the M-Bus meter head (which will be specific to the physical meter installed) but the Electrical Contractor (EC) is responsible for the installation of the meter head.
2) The Electrical Contractor (EC) is responsible for the supply and installation of all electrical wiring and gateways in accord with the system design up to the Curtin-owned network switch.
3) DTS as owners and managers of the network are responsible for all hardware and software configuration between the network switch and the application servers (e.g. RSS, BMS, etc.)
4) The BMS Contractor (BC) is responsible for all onsite programming of devices including the M-bus head and the gateways. If required under the scope they may also be required to integrate the data from the gateway into the BMS.
5) The RSS Contractor (RSC) is responsible for integration of the data into the RSS database and for creating long-term trend repositories and configuring reports, trends, master-submeter relationships, dashboards and tenant statements as per the standard Curtin requirements.

Component	Supply	Install	Programming
Meter	HC	HC	N/A
M-Bus Head	HC	EC	BC
Cabling (M-Bus Head to Gateway)	EC	EC	N/A
Gateway	EC	EC	BC
Cabling (Gateway to Switch)	EC	EC	N/A
Network Configuration, Allocation of IP Addresses, etc.	DTS	DTS	DTS
BMS Integration (if required)	BC	BC	BC
RSS Integration	RSC	RSC	RSC

5.9.3 METER VALIDATION

Meter validation refers to the end-to-end validation between the meter and the application databases (BMS and RSS). Meter validation works will not commence until network connection between the physical meter and the applications has been confirmed and data histories have been configured.

Two separate meter readings of consumption will be recorded with a gap of at least five days in between and containing a load. For new buildings and low utilisation legs, consumption may need to be forced by running taps, boilers, etc. A meter verification record will include the following evidence (at a minimum) for both the first and second readings:

1) the meter faceplate reading including any decimal places and units, time and date-stamped with a supporting photograph
2) a screenshot from the M-Bus programming software showing the current reading including decimal places, time and date-stamped
3) a screenshot of the gateway showing the value being read from the M-Bus head including decimal places, units, time and date-stamped
4) a screenshot of the history database for all applications (RSS, BMS, etc.) illustrating the recorded reading and units for the same point in time as the physical reading.

   Responsibility for each reading is as follows:

Description	Responsible Contractor
Physical Meter Reading and Photo	HC
M-Bus Software Reading and Screenshot	BC
Gateway Reading and Screenshot	BC
BMS Software Reading and Screenshot	BC
RSS Software Reading and Screenshot	RSC
Data Collation into Validation Register	RSC

The data from these readings will be recorded in a validation register, which details the following and is the responsibility of the RSS contractor:

1) Archibus reference
2) serial number of the meter
3) physical location
4) network information to connect to the device, which may include GatewayIP, Instance Number, Device ID, MAC Address, MSTP Number, Remote Address, Instance Number, etc.
5) first and second readings from the faceplate, RSS and BMS with time and date stamps

6) a comparison of the consumption recorded in the validation period on the physical meter and in any applications.

Any meters where the recorded consumption deviates from the faceplate by more than 2% will be validated on a third occasion or further investigated to understand where the discrepancy has originated.

In the event of a failure, the Contractor must liaise with RSC to ensure the meter has been commissioned and configured correctly and the validation process has been repeated until the meter passes.

5.10 APPLICABLE STANDARDS

Reference	Application
OIML R 49-1:2006	Water Meters Metrological and Technical Requirements
AS/NZS 3500	Plumbing Code
AS/ACIF S009:2013	Installation Requirements for Customer Cabling (Wiring Rules)
AS/NZS3000:2000	Electrical installations (known as the Australian/New Zealand Wiring Rules)
AS/NZS3080:2013	Telecommunications installations - Generic cabling for commercial premises (ISO/IEC 11801:2002, MOD)
Modbus Application Standard V1.1b	Group of standards governing the Modbus Protocol
Industrial Communication Network Profiles IEC 61784	
Fieldbus IEC 61784	
EIA-485	Communication standard for RS-485 installation
Building Services Labelling Standards	Curtin Labelling requirements of all asset types for Curtin University
000313 PDG Data Communications Cabling Requirements	Curtin Data Communication Cabling Standards and Specifications

The currency of the above standards will change from time to time and it is the designer's and contractor's responsibility to ensure that the currently applicable standards are used.

5.11 DATA AND REPORTS

Data will be retrieved via the IP network. In all cases, no matter the software, hardware and data storage systems in place, some calculations will still be required, but this tends to be at the reporting software level where, for the reports to be meaningful, they will need to encompass:

- date and time
- MCW supply mass flow rate (l/s)
- drain mass flow rate (l/s).
- evaporation/drift loss (l/s).

- instantaneous cumulative consumption (kilolitres)
- cumulative annual total and monthly consumption (kilolitres)
- cumulative evaporation/drift loss (kilolitres)
- water/waste consumption: (litres/hour, day, month, year).

The reporting software system will make use of the information for reports including but not necessarily limited to:

- hourly data presentation of intervals from 5 minutes to 15 minutes to suit application requirements
- summation of hourly data for consumption purposes
- daily data presentation
- summation of daily data for consumption purposes
- monthly data presentation
- monthly data presentation to suit the number of days, with various summations
- annual data presentation to suit the number of months, with various summations
- summation of operational periods such as "On peak", "Off peak" and "Shoulder" (should it ever arise)
- comparison of data with same time last year results
- comparison of data for energy use, available capacity, floor area (gross, nett and/or air conditioned) and other benchmarks for each facility
- Determination of building daily peak flow and use
- Flow meter fault management.

5.12 BMS GRAPHICS PAGES

Existing BMS graphics have been developed for Bentley Campus cooling towers water and waste metering and the automatic chemical dosing system outputs. Graphics for new systems are to be modelled on the graphics for Bentley Campus, which comprise:

1) site entry via CECS entry point
2) meter and dosing system entry point leading to a Dosing and Water Metering Home Page
    a. links to individual plant rooms:
        - B117
            - water meter readings
            - evaporation rate
            - chemical dosing HLI
            - link to Building Equipment Map – simplified floor plan with meter locations and IDs.

- B154
  - water meter readings
  - evaporation rate
  - chemical dosing HLI
  - link to Building Equipment Map – simplified floor plan with meter locations and IDs.
- B612
  - water meter readings
  - evaporation rate
  - chemical dosing HLI
  - link to Building Equipment Map – simplified floor plan with meter locations and IDs.
- B155
  - water meter readings
  - evaporation rate
  - chemical dosing HLI
  - link to Building Equipment Map – simplified floor plan with meter locations and IDs.

b. link to meter summary page displaying:
   - each meter flow rate
   - each meter consumption
   - mains water pressure
   - UPS battery percentage
   - UPS estimated time left.

The meter summary page is expected to be added to over time with building flow meters and be connected to the Hydraulics section of the BMS.

6 WATER

6.1 GENERAL

Refer also to the Cooling Tower Water and Waste metering section for other metering and BMS requirements.

Specific outcomes expected for potable and non-potable water metering include:

- capturing building potable water consumption to facilitate benchmarking to monitor building performance
- capturing building wet fire water consumption for developer lots
- NMIA-certified metering with installation standard compliance to Water Corporation requirements to facilitate on-charging of potable water billing to building tenants
- capture of existing Outpost Central data
- water use and performance reporting
- leak detection by monitoring building water consumption and comparing against building benchmark data.

6.2 METERING CONCEPT

6.2.1 PRE-EXISTING METERING CONCEPT (PRE-2018)

Existing potable and non-potable water metering within the Bentley Campus is captured by Outpost Central 3G loggers, processed remotely and accessed through a web-based graphical user interface (GUI). This data is currently accessed by reporting software for reporting to the University.

Outpost Central 3G loggers capture the Bentley Campus site main water meters and approximately 40 per cent of the existing Bentley Campus sub-meters. These meters are subject to the following limitations:

- battery powered, with a limited read frequency due to the requirement to replace batteries should meter reading and upload be frequent
- cellular communication mode so meters require connection to the cellular network
- remote data storage.

The existing Outpost Central 3G loggers will continue to be used until the existing meters are replaced or upgraded to the new concept.

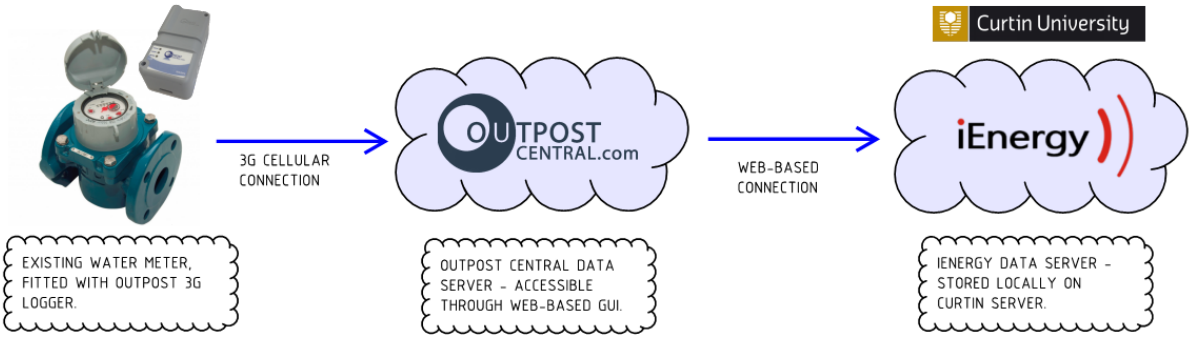


Figure 6A – Pre-Existing Campus Water Metering Strategy

6.2.2 CURRENT METERING CONCEPT

All new meters or meter replacements shall be directly connected to the University communications infrastructure. The new meters shall be capable of:

- pulse output
- water meters generally – high level interface of M-Bus connection – for integration with Campus communication infrastructure and capture by DTS.
- wet fire meters – high level interface of Modbus connection – for integration with Campus communication infrastructure and capture by DTS.

The diagram below provides contextual information on the metering processes for water and wet fire (required for developer lots).

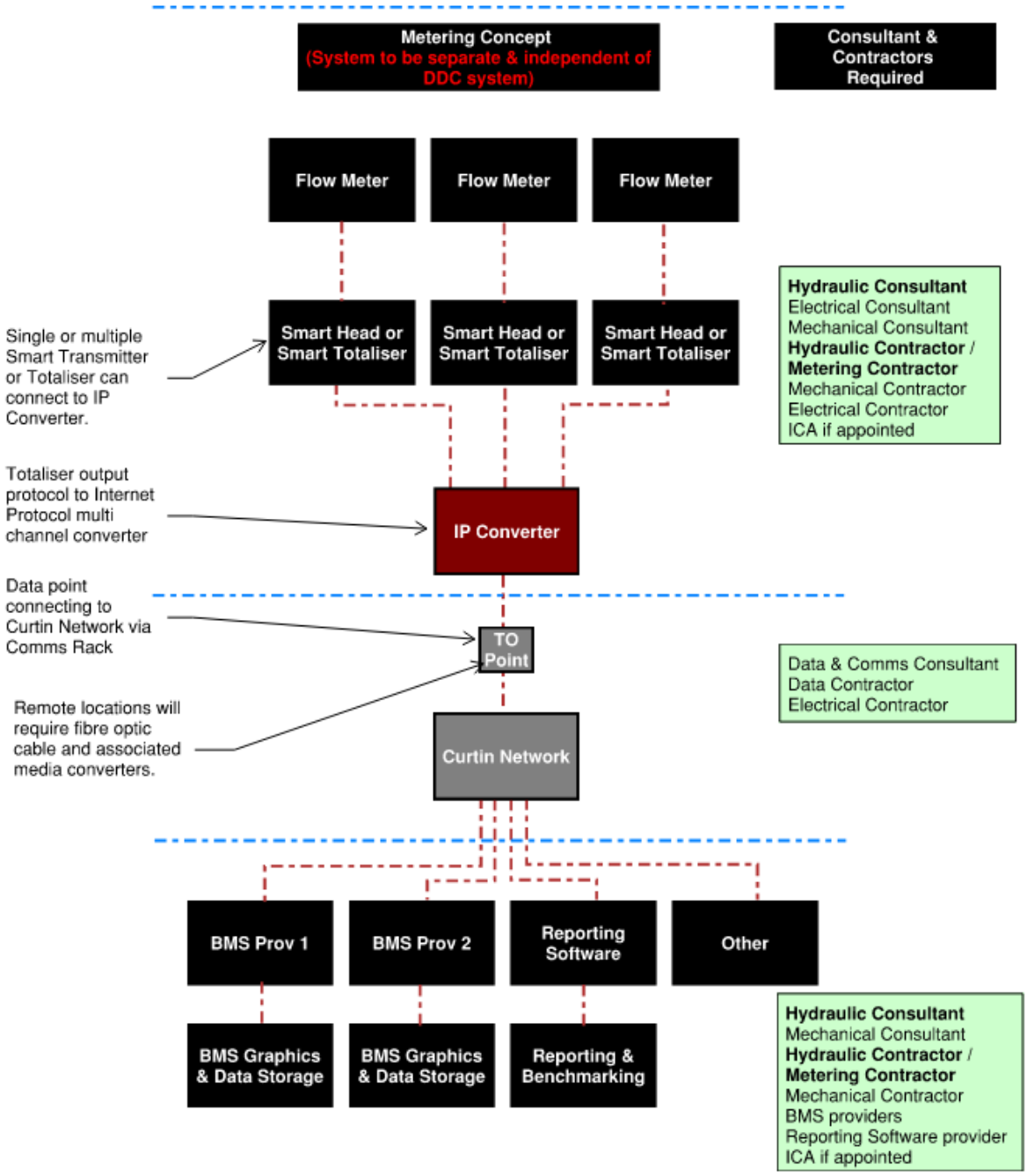


Figure 6B – Water Metering Strategy

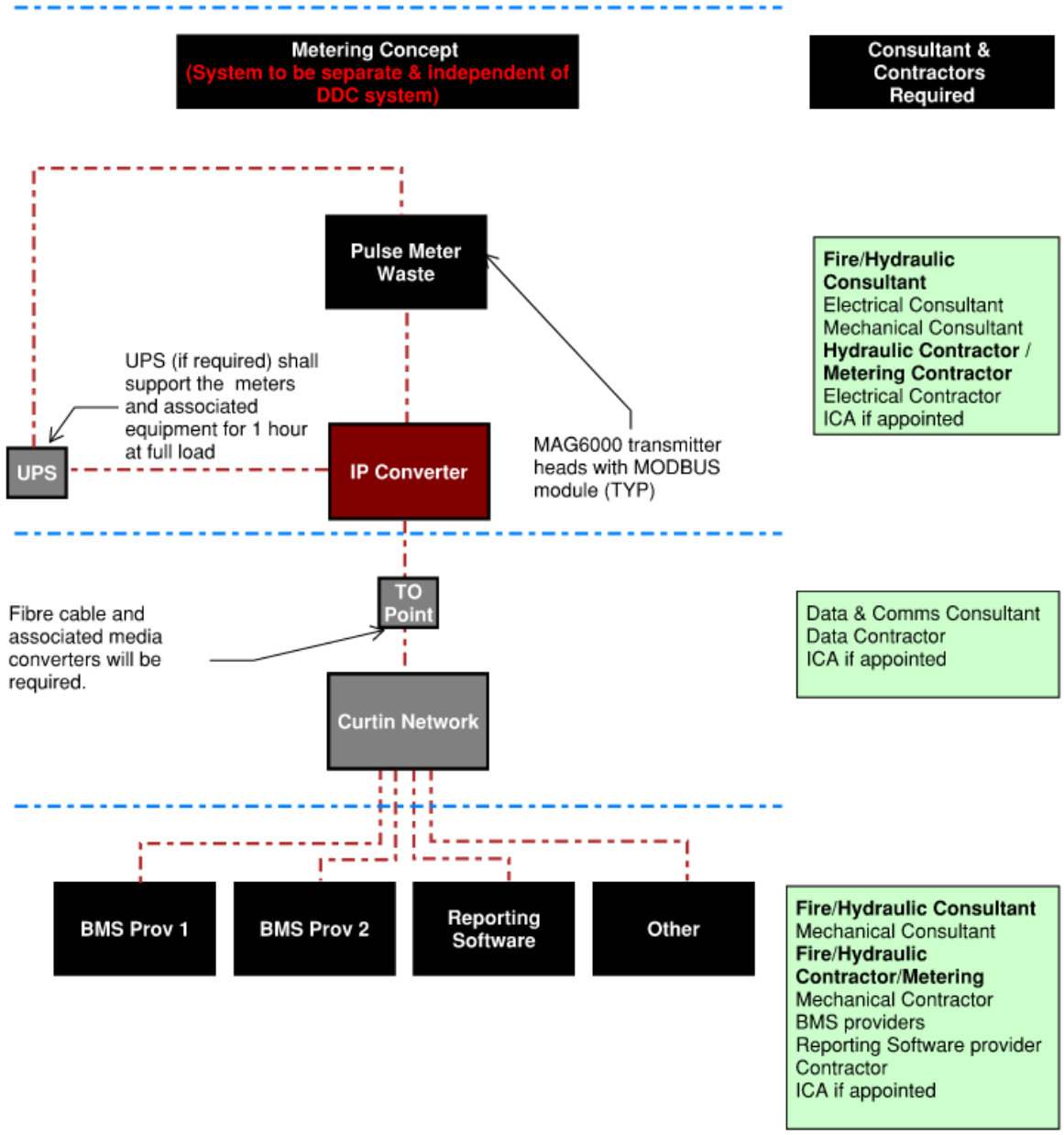


Figure 6C – Wet Fire Metering Strategy

6.3 ACCEPTABLE METERS AND DEVICES

6.3.1 IP NETWORK GATEWAYS

IP network gateways shall be used to integrate meters into the existing ICT network. Meters must be connected to the ICT network using a suitable IP gateway.

Suitable IP gateways shall be those deemed to meet the requirements as set out in Section 6.3.2 below.

6.3.2 COMMUNICATIONS PROTOCOL

The communications protocol utilised to exchange data between the meters and the BMS and reporting software systems shall be Mbus (general water meters) and Modbus (wet fire meters) output from the meter transmitter, to an IP gateway protocol converter.

Data from meters shall be converted to IP protocol by the metering contractor prior to connection to the ICT network. An IP network gateway shall undertake the conversion to IP protocol.

ADDRESSING CONVENTIONS:

The Contractor must submit the addressing scheme proposed for devices to the Infrastructure Manager, Hydraulic and Civil, Capital Projects at Curtin for approval prior to configuring the network addresses on site.

APPROVED MAKES:

The consultant and/or the contractor shall determine appropriate hardware for communication conversions to IP. Hardware shall have RCM certification.

6.3.3 METERS

Water meters shall be approved to International Standard OIML R 49-1:2006 and be NMIA-certified.

Water meter selection shall be determined by connection size. Potable water meters shall be capable of:

- pulse output
- water meters generally – high level interface of M-Bus output.
- wet fire water meters – high level interface of Modbus RTU output.

The following are provided as examples of potentially suitable water meters, but the Consultant shall conduct a review of suitable water meter types with smart head interfaces and present a meter options analysis to the University for review and approval prior to proceeding with detailed documentation.

20–32 MM WATER SUPPLY

iTron TD 8 Rotary Piston Volumetric type water meter, complete with Cyble target to allow communication through pulse output and M-Bus protocol.

Figure 6D –TD 8 Rotary Piston Volumetric type water meter

40–150 MM WATER SUPPLY

Flostar M type water meter, complete with Cyble target to allow communication through pulse output and M-Bus protocol.

Figure 6E – Flostar M type water meter

METERS – WET FIRE DEVELOPER LOTS

Siemens Sitran MAG5100W. Siemens Sitran Magflo transmitter MAG6000 with Modbus RTU interface card.

6.3.4 WATER PRESSURE SENSORS

Supply and install pressure sensors in water supply lines to a building's entry point, connected to the building BMS system.

Sensors shall be Siemens QBE2003/2013 range (or approved equivalent) to suit either 1–10V or 4–20mA output and to suit the pressure range 0–500 kPa or the particular site.

6.3.5 METERING ENCLOSURES

Where existing building water connections are metered, water meters are located:

- external to buildings
- in ground, external to buildings
- within building plant rooms
- within dedicated meter enclosures
- within services risers.

New meter installations are to be located within the following spaces:

- within building plant rooms
- within dedicated meter enclosures.

ENCLOSURES

All metering devices that the meter connects to shall be housed within an enclosure of powder coated steel panel construction. The boards shall be large enough to accommodate all devices including the IP converter and data point.

Where devices are located externally they shall be within an IP66-rated enclosure complete with Curtin key locks. The enclosure may be to external switchboard construction standard or a panel housed within a weatherproof enclosure.

The space considerations for meter installations should include:

- access and maintenance space requirements
- security of meter
- practicality of provision of communications infrastructure to the meter.

In-ground metering shall not occur, due to the following:

- the potential for water ingress to in-ground meter enclosures
- The potential for disruption during periods of maintenance.

Meter installation limitations shall be considered during the project design phase.

POWER SUPPLIES

Power supplies to metering panels/switchboards shall be fed from a localised mechanical services switchboard from an extra low voltage (ELV) circuit. The use of ELV means that maintenance can be undertaken on the devices within the panel without a need for an electrical licence.

If an ELV supply is not available and a low voltage (LV) supply is necessary, then compartmentalise the LV from the ELV within the panel. The panel will require Curtin standard electrical key locks, in accordance with *000312 PDG Electrical Services Guidelines.*

SECURITY

Consult with the Curtin Network Infrastructure Manager on requirements for data point security.

LABELLING

Metering enclosures shall be externally labelled in accordance with Curtin University labelling requirements.

6.3.6 INTEGRATION OF METERS TO CAMPUS NETWORK

Refer to Section 10 COMMUNICATIONS (DATA).

6.4 INSTALLATION REQUIREMENTS

6.4.1 METERS

Meters shall be installed to be readily accessible in locations such as:

- Externally within a weatherproof enclosure
- plant rooms
- service tunnels
- accessible ducts or risers.

Meters must be installed in in accordance with the manufacturer's guidelines. In particular, requirements for straight lengths of pipe before and after flow sensors must be maintained.

METER SECURITY

Where provided with a key or touchpad for programming purposes, access to the internal parameters of meters shall be password protected.

EARTHING

Meters installed in non-metallic pipework shall be separately earthed.

6.4.2 MSTP NETWORK CABLING

The Contractor shall provide and install communications cabling between the meter and the IP gateway. The meter MSTP communications cable type shall be as per the meter manufacturer's specification. If not specified, Belden 9841 or equivalent cable shall be used.

All MSTP communications cabling shall be terminated in a bus network topology. Star and T-type network topology cabling terminations are not acceptable.

EIA-485 cabling line resistance must be in accordance with the meter manufacturer's recommendation. End-of-line resistors shall be supplied and installed as required to maintain correct line resistance.

Where communications cabling leaves or spans between buildings, surge and lightning protection must be provided at each end where the cabling leaves and/or enters the building. Surge protection devices should include visual indication of operation and actuation.

Meter communications cabling within electrical switchboards must be installed within communications conduit.

Meter communications cabling installed within electrical switchboards and on shared cable support structures shall be installed in accordance with AS/ACIF S009:2001. Segregation distances between communications and power cables must be maintained.

6.4.3 IP NETWORK GATEWAYS

IP network gateways shall be installed wherever practicable adjacent to the nearest ICT data point. The Contractor shall provide and install Cat 6 network patch cables between gateways and ICT data points and shall be responsible for:

- configuration of IP addresses into the gateways
- configuration of the communications parameters into the gateways
- configuration of the meter node addresses into the gateways.

As IP gateways consume ICT network resources, meter MSTP networks should be designed and installed in such a way as to minimise the number of gateways required.

A basic acceptable meter connection topology is shown in the following figure:

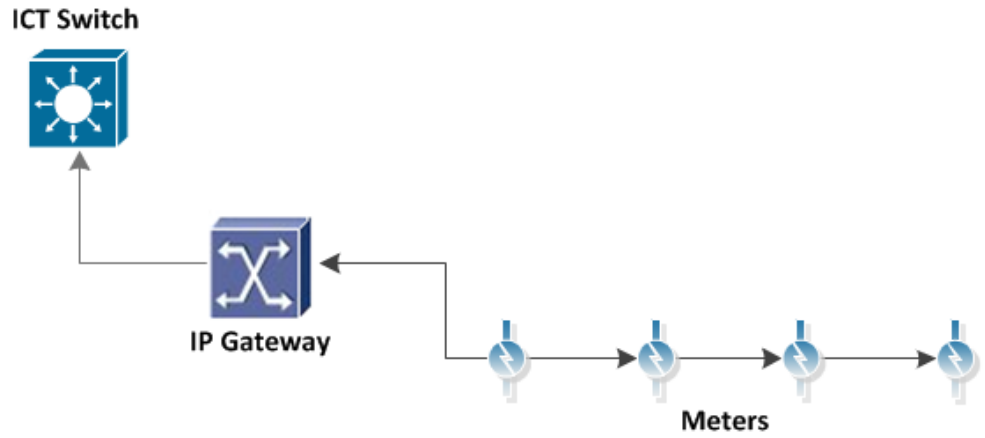


Figure 6F – Sample Meter Connection Topology

6.5 COMMISSIONING

Commissioning and documentation shall be undertaken for each new networked meter by a suitably qualified meter technician.

6.5.1 METER COMMISSIONING

Commissioning shall confirm that:

- the meter flow sensor is:
  - installed to the correct location (by matching the serial number to the designated location)
  - installed in a suitable location (in consideration of disturbances to flow)
  - configured with the correct monitored pipe information (e.g. composition, thickness)
  - configured with the correct measured media information (e.g. water/waste).
- the meter calculator/transmitter is:
  - installed to the correct location (by matching the serial number to the designated location)
  - configured with the correct internal settings
  - configured to display measured values on the meter display
  - configured to make available measured values from the meter via Mbus and Modbus RTU to suit the application
  - configured to communicate all available metered values to the reporting software meter monitoring system and BMS systems.

Meter commissioning is to be carried out and signed off by the vendor.

6.5.2 METER FACEPLATE (SCREEN) DISPLAY

Where meter screens have the capacity for a static or scrolling display, the following minimum information shall be included in the display per active channel:

- totalised consumption in kilolitres
- instantaneous flow in l/s
- Volume in m^3.

6.5.3 METER COMMISSIONING DOCUMENTATION

The Contractor is responsible for completing all meter commissioning documentation, which shall confirm that the commissioning process has been completed successfully in its entirety and shall include the following as a minimum:

- a unique document per meter commissioned
- location, manufacturer, model and serial numbers of the commissioned meter and its sensors
- confirmation of the serial communications from the meter to the IP network gateway and to and from the IP gateway to the reporting software meter monitoring system
- record of the communications parameters programmed into the meter
- record of any faults identified and of any corrective action recommended or taken

- date and time of commissioning, business name, name and signature of meter technician.

Refer to the separate Appendix Reference Document for a sample commissioning document.

The Contractor must liaise with reporting software provider when commissioning the first meter to ensure communication is established and all specified meter data is exposed and correctly validated. This will reduce any potential reworks on the remaining meter integration works.

6.6 METER VERIFICATION

The Contractor shall provide confirmation of traceable factory calibration data for each meter in the form of manufacturer's certificates.

6.7 METER VALIDATION

Refer to Section 6.9.

6.8 COORDINATION

All meters must be commissioned and integrated to both the site-wide energy monitoring RSS and the onsite BMS systems. The Contractor must liaise and engage with the reporting software provider for all reporting software associated works. The Contractor must liaise and engage with BMS provider for BMS associated works. The reporting software provider will require the services of either the BMS provider or the Service Contractor to commission the metering devices.

The Contractor is responsible for ensuring works occur in a timely manner to achieve identified project timelines.

Prior to the commissioning of any new, replacement, relocated or amended meters to the reporting software the Contractor must liaise with the appointed reporting software provider to coordinate the commissioning date and time.

The Contractor must provide at least 14 days' notice to the reporting software provider prior to the proposed commissioning date.

The Contractor must provide the following information prior to any commissioning works commencing with reporting software provider:

- meter trees that show hierarchy of meters, master, sub-meters and virtual meters
- number of meters
- approved meter labels (all labels to be in accordance with Building Services Labelling Standard)
- meter location
- media being monitored.

Prior to providing the above detailed information the Contractor must:

- request all required IP addresses from Curtin University

- confirm with (DTS) that all IP telecommunications outlets have been patched and tested
- provide the reporting software provider with communications configuration parameters (e.g. meter node address, device ID, object list and IP address) for each metering arrangement and IP gateway
- liaise with the reporting software provider during the commissioning and validation process to ensure and confirm that the meters are communicating with and are passing data correctly and accurately to the reporting software site meter monitoring systems.

The RSC will undertake all configuration modifications to the reporting software system as necessary to include for the integration of new meters and/or meter amendments.

6.8.1 REQUESTING AN IP ADDRESS

Refer to Section 10 COMMUNICATIONS (DATA).

6.8.2 DELIVERY PROCESS FOR REPORTING SOFTWARE AND BMS

Table 6-1 – Delivery Process for Reporting Software and BMS

New Project/Capital Works	Details
Design	• Consultant(s) nominated
Contract documents prepared	• scope of works specification and drawings • new or updated site or building metering tree • new or updated site or building metering plan single line diagrams • floor plan information • metering devices and installation requirements documented • electrical supply to metering devices documented • communications (data) requirements documented • coordination with authorities documented (where necessary) • schedules of metering and labels documented • liaise with reporting software and BMS systems providers
Tendering	• Contractor issues tender documents to the reporting software provider and other sub-contractors. • The reporting software provider provides a quote to the Contractor for inclusion into the tender submission. • Quotes must cover the required scope of work
Construction	• Contractor nominated • Contractor issues an order to the reporting software provider and other sub-contractors
Contractor notifies subcontractors of Scope of	• number of meters • location and labelling of meters • updated metering tree

New Project/Capital Works	Details
Works and issues Project Documentation	• updated site map of meter locations • virtual meter calculations (if any)
Contractor to ensure all network connectivity is commissioned.	• requests all required IP addresses from Curtin University • ensure all IP TOs have been patched and tested • provide communications configuration parameters for reporting software and BMS • ensure all devices and meters are commissioned
Commission Meters into Reporting Software and BMS	• Contractor to take 2 separate faceplate readings (kWh or KL to suit), 1 week apart and issue to reporting software and BMS companies • Reporting software and BMS companies to validate the readings against their respective software platforms • Where due to low or no occupancy meters are not recording any change in values, the contractor shall force systems to a state that provides suitable commissioning readings
Handover – provide documentation to be submitted by subcontractors for inclusion into O&M manuals.	• Handover pack to include validation documentation, report configurations and alarm configurations. • Consultant to have validated that RSS and BMS works have been completed and that reports, trends and graphics are available to suit the respective platforms.

6.9 RESPONSIBILITIES AND DEMARCATIONS

6.9.1 GENERAL

It shall be the responsibility of the design engineer and installation contractor to select the correct metering system, device sizes and types to ensure the suitability for purpose. As a minimum, the following characteristics shall be taken into consideration for meter selection:

- pipe (DN) size
- pipe composition
- pipe wall thickness
- media being monitored/measured
- flow tube lining requirement
- minimum flow and velocity rates
- maximum flow and velocity rates
- maximum pressure loss through metering arrangement shall not exceed 3 kPa
- manufacturer-required clearances.

It shall be the responsibility of the Consultant to ensure that the meter is correctly sized, and the metering system is fully and adequately documented to facilitate the Contractor's installation obligations.

It shall be the responsibility of the Contractor to ensure that the meter is correctly sized, constructed, installed and adjusted for safe and accurate operation.

The Contractor's meter technician shall be responsible for the installation, configuration and commissioning of the meters and the IP network gateway devices to confirm that the meter data is accurate and is being transmitted correctly through the IP network gateway devices to the reporting software and BMS meter monitoring systems.

It shall be the responsibility of the RSC to liaise and work with the Contractor or BMS Contractor to initially commission and verify the meter readings into the reporting software metering system and to then re-validate the readings after a nominal period of time has transpired.

It shall be the responsibility of the BMS contractor to liaise and work with the contractor to initially commission and verify the meter readings into the BMS metering system(s) and to then re-validate the readings after a nominal period of time has transpired. It is also the BMS contractor's responsibility to upgrade graphics in the BMS system(s).

It shall be the responsibility of the data contractor to obtain IP addresses and to validate that they have been commissioned and activated. It shall be the responsibility of Curtin University to:

- approve meter labelling
- provide passwords.

6.9.2 METER INSTALLATION AND COMMISIONING

Based on experience from previous hydraulic metering projects, the matrix below leverages each contractor's respective strengths and areas of experience while providing clear delineation on the expectations. Some key areas to note:

1) The Hydraulic Contractor (HC) is responsible for the procurement of the M-Bus meter head (which will be specific to the physical meter installed) but the Electrical Contractor (EC) is responsible for the installation of the meter head.
2) The Electrical Contractor (EC) is responsible for the supply and installation of all electrical wiring and gateways in accord with the system design up to the Curtin-owned network switch.
3) DTS as owners and managers of the network are responsible for all hardware and software configuration between the network switch and the application servers (e.g. RSS, BMS, etc)
4) The BMS Contractor (BC) is responsible for all onsite programming of devices including the M-bus head and the gateways. If required under the scope they may also be required to integrate the data from the gateway into the BMS.
5) The RSS Contractor (RSC) is responsible for integration of the data into the RSS database and for creating long-term trend repositories and configuring reports,

trends, master-submeter relationships, dashboards and tenant statements as per the standard Curtin requirements.

Component	Supply	Install	Programming
Meter	HC	HC	N/A
M-Bus Head	HC	EC	BC
Cabling (M-Bus Head to Gateway)	EC	EC	N/A
Gateway	EC	EC	BC
Cabling (Gateway to Switch)	EC	EC	N/A
Network Configuration, Allocation of IP Addresses, etc.	DTS	DTS	DTS
BMS Integration (if required)	BC	BC	BC
RSS Integration	RSC	RSC	RSC

6.9.3 METER VALIDATION

Meter validation refers to the end-to-end validation between the meter and the application databases (BMS and RSS). Meter validation works will not commence until network connection between the physical meter and the applications has been confirmed and data histories have been configured.

Two separate meter readings of consumption will be recorded with a gap of at least five days in between and containing a load. For new buildings and low utilisation legs, consumption may need to be forced by running taps, boilers, etc. A meter verification record will include the following evidence (at a minimum) for both the first and second readings:

1) the meter faceplate reading including any decimal places and units, time and date-stamped with a supporting photograph
2) a screenshot from the M-Bus programming software showing the current reading including decimal places, time and date-stamped
3) a screenshot of the gateway showing the value being read from the M-Bus head including decimal places, units, time and date-stamped
4) a screenshot of the history database for all applications (RSS, BMS, etc.) illustrating the recorded reading and units for the same point in time as the physical reading.

Responsibility for each reading is as follows:

Description	Responsible Contractor
Physical Meter Reading and Photo	HC
M-Bus Software Reading and Screenshot	BC
Gateway Reading and Screenshot	BC
BMS Software Reading and Screenshot	BC
RSS Software Reading and Screenshot	RSC

Description	Responsible Contractor
Data Collation into Validation Register	RSC

The data from these readings will be recorded in a validation register, which details the following and is the responsibility of the RSS contractor:

1) Archibus reference
2) serial number of the meter
3) physical location
4) network information to connect to the device, which may include GatewayIP, Instance Number, Device ID, MAC Address, MSTP Number, Remote Address, Instance Number, etc.
5) first and second readings from the faceplate, RSS and BMS with time and date stamps
6) a comparison of the consumption recorded in the validation period on the physical meter and in any applications.

Any meters where the recorded consumption deviates from the faceplate by more than 2% will be validated on a third occasion or further investigated to understand where the discrepancy has originated.

In the event of a failure, the Contractor must liaise with RSC to ensure the meter has been commissioned and configured correctly and the validation process has been repeated until the meter passes.

6.10 APPLICABLE STANDARDS

Reference	Application
OIML R 49-1:2006	Water Meters Metrological and Technical Requirements
AS/NZS 3500	Plumbing Code
AS/ACIF S009:2013	Installation Requirements for Customer Cabling (Wiring Rules)
AS/NZS3000:2000	Electrical installations (known as the Australian/New Zealand Wiring Rules)
AS/NZS3080:2013	Telecommunications installations - Generic cabling for commercial premises (ISO/IEC 11801:2002, MOD)
Modbus Application Standard V1.1b	Group of standards governing the Modbus Protocol
Industrial Communication Network Profiles IEC 61784	
Fieldbus IEC 61784	
EN 13757-2 physical and link layer,	M-Bus (Meter-Bus) is a European standard for the remote reading of water meter, gas or electricity meters.
EN 13757-3 application layer	
EIA-485	Communication standard for RS-485 installation

Reference	Application
Building Services Labelling Standard	Curtin Labelling requirements of all asset types for Curtin University
000313 PDG Data Communications Cabling Requirements	Curtin Data Communication Cabling Standards and Specifications

The currency of the above standards will change from time to time and it is the designer's and contractor's responsibility to ensure that the currently applicable standards are used.

6.11 DATA AND REPORTS

Data will be retrieved via the IP network. In all cases, no matter the software, hardware and data storage systems in place, some calculations will still be required, but this tends to be at the reporting software level where, for the reports to be meaningful, they will need to encompass:

- date and time
- flow rate (l/s)
- cumulative annual total and monthly consumption (kilolitres)
- provide for a separate discharge factor report that incorporates cooling tower and other trade wastes, and the Water Corporation standard for nominal building discharge (precluding cooling towers).

The reporting software system will make use of the information for reports including but not necessarily limited to

- hourly data presentation of intervals from 5 minutes to 15 minutes to suit application requirements
- summation of hourly data for consumption purposes
- daily data presentation
- summation of daily data for consumption purposes
- monthly data presentation
- monthly data presentation to suit the number of days, with various summations
- annual data presentation to suit the number of months, with various summations
- summation to operational periods such as "On peak", "Off peak" and "Shoulder" (should it ever arise)
- comparison of data with same time last year results
- comparison of data for water use, available capacity, floor area (gross, nett and UFA) and other benchmarks for each facility
- determination of building daily peak instantaneous flow and use

- financial reporting of tenancy potable water consumption for utility on-charging
- validation of site main meters.

6.12 BMS GRAPHICS PAGES

Provide dedicated graphics pages for water and waste metering generally as follows:

BOUNDARY

1) site entry point
2) link to Central Gas Metering Pages
    - link displaying a site map with meter locations
    - links to centralised meter schedule, displaying the following for the boundary
        - CMMS ID
        - instantaneous use in m^3/s
        - consumption in m^3
        - water pressure via separate sensor
        - other meter HLI information that may be available
        - calculation of discharge factor (site only).

Within the same schedule, provide the above display information for each building and;

- Other meter HLI information that may be available
- UPS battery percentage (if provided)
- UPS estimated time left (if provided).

BUILDING

1) links to individual buildings on a site map – to connect to Buildings Graphics pages
2) Building Home Page
3) metering sub pages
    - typical building
        - water meter flow
        - water meter usage
        - floor plans indicating meter locations and IDs and mains pressure sensors
        - other meter HLI information that may be available
        - UPS battery percentage (if provided)

- UPS estimated time left (if provided)
- link to central meter summary page.

The Consultant shall determine with Curtin which BMS system the above graphics are to reside on.

7 SEWER TRADE WASTE (WHERE REQUIRED)

7.1 GENERAL

Refer also to Cooling Tower Water and Waste metering section for other metering and BMS requirements.

Specific outcomes expected for traded waste metering include:

- capture of any specific trade waste required by authorities
- capture of accurate trade waste outflow data for the Water Corporation
- clarity and uniformity of graphics display at the BMS head ends
- NMIA-certified metering with installation standard compliance to Water Corporation requirements.

7.2 METERING CONCEPT

The diagram below provides contextual information on the metering process.

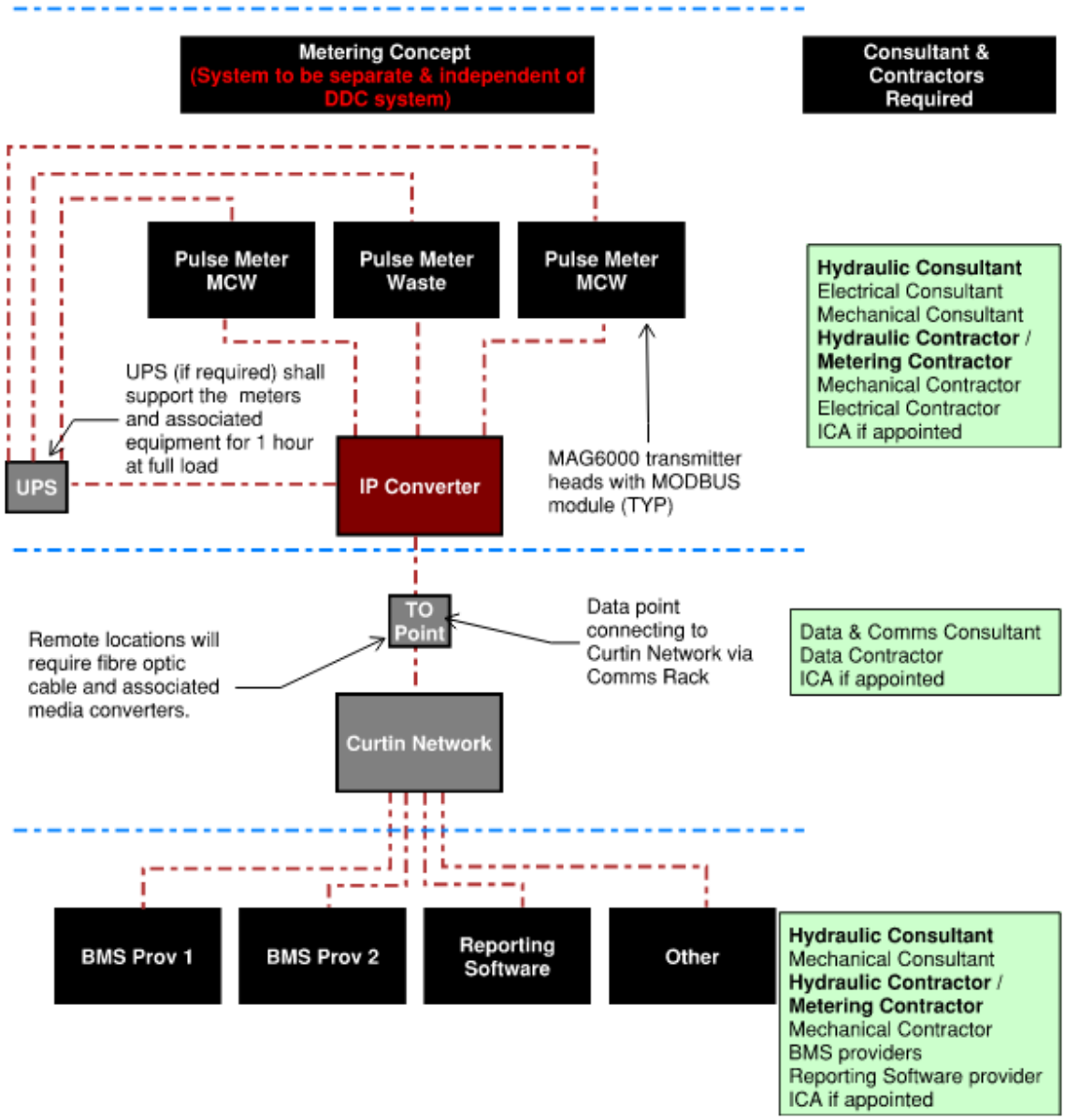


Figure 7A – Waste Metering Concept

7.3 ACCEPTABLE METERS AND DEVICES

Waste meters shall be supplied and installed as in-line electromagnetic flow (magflow) meters. Where in-line electromagnetic flow meters are installed the magflow sensor tube shall be approved to international standard OIML R 49-1:2006 and be NMIA-certified.

7.3.1 IP NETWORK GATEWAYS

IP network gateways shall be used to integrate meters into the existing ICT network. Meters must be connected to the ICT network using a suitable IP gateway.

Suitable IP gateways shall be those deemed to meet the requirements as set out in Section 7.3.2 below.

7.3.2 COMMUNICATIONS PROTOCOL

The communications protocol utilised to exchange data between the meters and the BMS and reporting software systems shall be Modbus output from the meter transmitter, to an IP gateway protocol converter.

Data from meters shall be converted to IP protocol by the metering contractor prior to connection to the ICT network. An IP network gateway shall undertake the conversion to IP protocol.

ADDRESSING CONVENTIONS:

The Contractor must submit the addressing scheme proposed for devices to the Infrastructure Manager, Hydraulic and Civil, Capital Projects at Curtin for approval prior to configuring the network addresses on site.

APPROVED MAKES:

The consultant and/or the contractor shall determine appropriate hardware for communication conversions to IP. Hardware shall have RCM certification.

7.3.3 METERS – WASTE

The following is provided as an example of a potentially suitable meter however the consultant shall conduct a review of suitable meter types with smart head interfaces and present meter options analysis to the University for review and approval prior to proceeding with detailed documentation.

Supply and install Siemens Sitran MAG5100W.

7.3.4 TRANSMITTER HEAD

Supply and install Siemens Sitran Magflo transmitter MAG6000 with Modbus RTU interface card.

7.3.5 UPS

Consultants shall determine the requirement for a UPS. If required, supply and install UPS units of PowerShield Commander (1100 | 1100/2000 VA Line Interactive) manufacture complete with BMS interface card (Modbus or BACnet) or approved equal providing for a minimum of 1-hour operation to support meter heads.

7.3.6 METERING ENCLOSURES

Trade waste metering devices may be installed:

- below ground
- above ground.

ENCLOSURES

All metering devices that the meter connects to, shall be housed within an enclosure of powder coated steel panel construction. The boards shall be large enough to accommodate all devices including the power supply, the IP converter and data point. If UPS units are provided they shall not reside inside the panel but be located in a suitable position nearby.

Where devices are located externally they shall be within an IP66-rated enclosure complete with Curtin key locks. The enclosure may be to external switchboard construction standard or a panel housed within a weatherproof enclosure.

Below ground trade waste metering devices shall be installed in an appropriate pit, with connection to an external control panel and flow monitoring device within an IP66-rated cabinet. The enclosure may be to external switchboard construction standard or a panel housed within a weatherproof enclosure.

POWER SUPPLIES

Power supplies to metering panels/switchboards shall be fed from a localised mechanical services switchboard from an extra low voltage (ELV) circuit. The use of ELV means that maintenance can be undertaken on the devices within the panel without a need for an electrical licence.

If an ELV supply is not available and a low voltage (LV) supply is necessary, then compartmentalise the LV from the ELV within the panel. The panel will require Curtin standard electrical key locks, in accordance *with 000312 PDG Electrical Services Guidelines.*

SECURITY

Consult with the Curtin Network Infrastructure Manager on requirements for data point security.

LABELLING

Metering enclosures shall be externally labelled in accordance with Curtin University labelling requirements.

7.3.7 INTEGRATION OF METERS TO CAMPUS NETWORK

Refer to section 10 COMMUNICATIONS (DATA).

7.4 INSTALLATION REQUIREMENTS

7.4.1 METERS

Meters shall be installed to be readily accessible in locations such as:

- below ground
- plant rooms
- service tunnels

- accessible ducts or risers.

Meters must be installed in in accordance with the manufacturer's guidelines. In particular, requirements for straight lengths of pipe before and after flow sensors must be maintained.

METER SECURITY

Where provided with a key or touchpad for programming purposes, access to the internal parameters of meters shall be password protected.

EARTHING

Meters installed in non-metallic pipework shall be separately earthed.

7.4.2 MSTP NETWORK CABLING

The Contractor shall provide and install communications cabling between the meter and the IP gateway. Meter MSTP communications cable type shall be as per the meter manufacturer's specification. If not specified, Belden 9841 or equivalent cable shall be used.

All MSTP communications cabling shall be terminated in a bus network topology. Star and T-type network topology cabling terminations are not acceptable.

EIA-485 cabling line resistance must be in accordance with the meter manufacturer's recommendation. End-of-line resistors shall be supplied and installed as required to maintain correct line resistance.

Where communications cabling leaves or spans between buildings, surge and lightning protection must be provided at each end where the cabling leaves and/or enters the building. Surge protection devices should include visual indication of operation and actuation.

Meter communications cabling within electrical switchboards must be installed within communications conduit.

Meter communications cabling installed within electrical switchboards and on shared cable support structures shall be installed in accordance with AS/ACIF S009:2001. Segregation distances between communications and power cables must be maintained.

7.4.3 IP NETWORK GATEWAYS

IP network gateways shall be installed, wherever practicable, adjacent to the nearest ICT data point. The Contractor shall provide and install Cat 6 network patch cables between gateways and ICT data points and shall be responsible for:

- configuration of IP addresses into the gateways
- configuration of the communications parameters into the gateways
- configuration of the meter node addresses into the gateways.

As IP gateways consume ICT network resources, meter MSTP networks should be designed and installed in such a way to minimise the number of gateways required.

A basic acceptable meter connection topology is shown in the following figure:

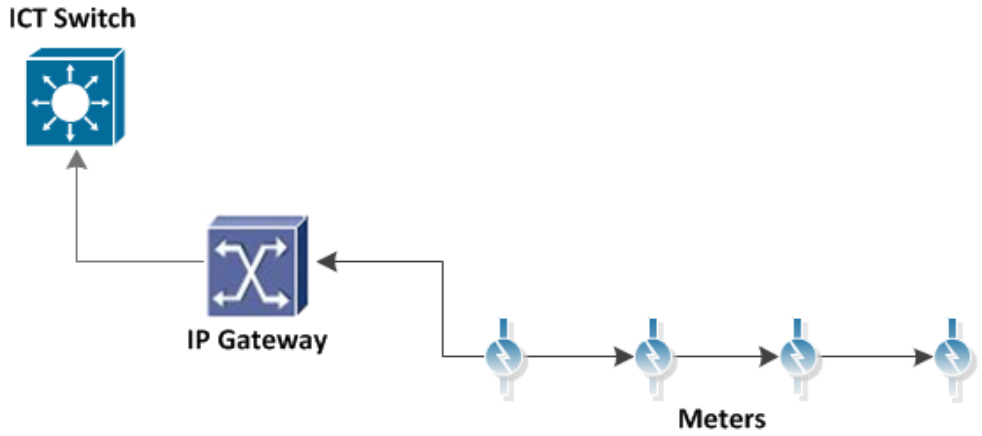


Figure 7B – Sample Meter Connection Topology

7.5 COMMISSIONING

Commissioning and documentation shall be undertaken for each new networked meter by a suitably qualified meter technician.

7.5.1 METER COMMISSIONING

Commissioning shall confirm that:

- the meter flow sensor is:
  - installed to the correct location (by matching the serial number to the designated location)
  - installed in a suitable location (in consideration of disturbances to flow)
  - configured with the correct monitored pipe information (e.g. composition, thickness)
  - configured with the correct measured media information (e.g. water/waste).
- the meter calculator/transmitter is:
  - installed to the correct location (by matching the serial number to the designated location)
  - configured with the correct internal settings
  - configured to display measured values on the meter display
  - configured to make available measured values from the meter via Modbus RTU
  - configured to communicate all available metered values to the reporting software meter monitoring system and BMS systems.

Meter commissioning is to be carried out and signed off by the vendor.

7.5.2 METER FACEPLATE (SCREEN) DISPLAY

Where meter screens have the capacity for a static or scrolling display, the following minimum information shall be included in the display per active channel:

- totalised consumption in kilolitres
- instantaneous flow in l/s
- volume in m^3.

7.5.3 METER COMMISSIONING DOCUMENTATION

The Contractor is responsible for completing all meter commissioning documentation, which shall confirm that the commissioning process has been completed successfully in its entirety and shall include the following as a minimum:

- a unique document per meter commissioned
- location, manufacturer, model and serial numbers of the commissioned meter and its sensors
- confirmation of the serial communications from the meter to the IP network gateway and to and from the IP gateway to the reporting software meter monitoring system
- record of the communications parameters programmed into the meter
- record of any faults identified and of any corrective action recommended or taken
- date and time of commissioning, business name, name and signature of meter technician.

Refer to the separate Appendix Reference Document for a sample commissioning document.

The Contractor must liaise with reporting software provider when commissioning the first meter to ensure communication is established and all specified meter data is exposed and correctly validated. This will reduce any potential reworks on the remaining meter integration works.

7.6 METER VERIFICATION

The Contractor shall provide confirmation of traceable factory calibration data for each meter in the form of manufacturer's certificates.

7.7 METER VALIDATION

Refer to Section 7.9.

7.8 COORDINATION

All meters must be commissioned and integrated to both the site-wide energy monitoring RSS and the onsite BMS systems. The Contractor must liaise and engage with the reporting software provider for all reporting software associated works. The

Contractor must liaise and engage with the BMS provider for BMS associated works. The reporting software provider will require the services of either the BMS provider or the Service Contractor to commission the metering devices.

The Contractor is responsible for ensuring works occur in a timely manner to achieve identified project timelines.

Prior to the commissioning of any new, replacement, relocated or amended meters to reporting software, the Contractor must liaise with the appointed reporting software provider to coordinate the commissioning date and time.

The Contractor must provide at least 14 days' notice to the reporting software provider prior to the proposed commissioning date.

The Contractor must provide the following information prior to any commissioning works commencing with the reporting software provider:

- meter trees that show hierarchy of meters, master, sub-meters and virtual meters
- number of meters
- approved meter labels (all labels to be in accordance with Building Services Labelling Standard)
- meter location
- media being monitored.

Prior to providing the above detailed information the Contractor must:

- request all required IP addresses from Curtin University
- confirm with (DTS) that all IP telecommunications outlets have been patched and tested
- provide the reporting software provider with communications configuration parameters (e.g. meter node address, device ID, object list and IP address) for each metering arrangement and IP gateway
- liaise with reporting software provider during the commissioning and validation process to ensure and confirm that the meters are communicating with and are passing data correctly and accurately to the reporting software site meter monitoring systems.

The RSC will undertake all configuration modifications to the reporting software system as necessary to include for the integration of new meters and/or meter amendments.

7.8.1 REQUESTING AN IP ADDRESS

Refer to Section 10 COMMUNICATIONS (DATA).

7.8.2 DELIVERY PROCESS FOR REPORTING SOFTWARE AND BMS

Table 7-1 – Delivery Process for Reporting Software and BMS

New Project/Capital Works	Details
Design	• Consultant(s) nominated
Contract documents prepared	• scope of works specification and drawings • new or updated site or building metering tree • new or updated site or building metering plan single line diagrams • floor plan information • metering devices and installation requirements documented • electrical supply to metering devices documented • communications (data) requirements documented • coordination with authorities documented (where necessary) • schedules of metering and labels documented • liaise with reporting software and BMS systems providers
Tendering	• Contractor issues tender documents to the reporting software provider and other sub-contractors. • The reporting software provider provides a quote to the Contractor for inclusion into the tender submission. • Quotes must cover the required scope of work
Construction	• Contractor nominated • Contractor issues an order to the reporting software provider and other sub-contractors
Contractor notifies subcontractors of Scope of Works and issues Project Documentation	• number of meters • location and labelling of meters • updated metering tree • updated site map of meter locations • virtual meter calculations (if any)
Contractor to ensure all network connectivity is commissioned.	• requests all required IP addresses from Curtin University • ensure all IP TOs have been patched and tested • provide communications configuration parameters for reporting software and BMS
Commission Meters into Reporting Software and BMS	• ensure all devices and meters are commissioned • Contractor to take 2 separate faceplate readings (kWh or KL to suit), 1 week apart and issue to reporting software and BMS companies • Reporting software and BMS companies to validate the readings against their respective software platforms • Where due to low or no occupancy meters are not recording any change in values, the contractor shall force systems to a state that provides suitable commissioning readings
Handover – provide documentation to be submitted by subcontractors	• Handover pack to include validation documentation, report configurations and alarm configurations. • Consultant to have validated that RSS and BMS works have been completed and that reports, trends

for inclusion into O&M manuals.	and graphics are available to suit the respective platforms.

7.9 RESPONSIBILITIES AND DEMARCATION

7.9.1 GENERAL

It shall be the responsibility of the design engineer and installation contractor to select the correct metering system, device sizes and types to ensure the suitability for purpose. As a minimum, the following characteristics shall be taken into consideration for meter selection:

- pipe (DN) size
- pipe composition
- pipe wall thickness
- mm dia being monitored/measured
- flow tube lining requirement
- minimum flow and velocity rates
- maximum flow and velocity rates
- maximum pressure loss through metering arrangement shall not exceed 3 kPa
- manufacturer-required clearances.

It shall be the responsibility of the Consultant to ensure that the meter is correctly sized, and the metering system is fully and adequately documented to facilitate the Contractor's installation obligations.

It shall be the responsibility of the Contractor to ensure that the meter is correctly sized, constructed, installed and adjusted for safe and accurate operation.

The Contractor's meter technician shall be responsible for the installation, configuration and commissioning of the meters and the IP network gateway devices to confirm that the meter data is accurate and is being transmitted correctly through the IP network gateway devices to the reporting software and BMS meter monitoring systems.

It shall be the responsibility of the RSC to liaise and work with the Contractor or BMS contractor to initially commission and verify the meter readings into the reporting software metering system and to then re-validate the readings after a nominal period of time has transpired.

It shall be the responsibility of the BMS contractor to liaise and work with the Contractor to initially commission and verify the meter readings into the BMS metering system and to then re-validate the readings after a nominal period of time has

transpired. It is also the BMS contractor's responsibility to upgrade graphics into the BMS system(s).

It shall be the responsibility of the data contractor to obtain IP addresses and to validate that they have been commissioned and activated. It shall be the responsibility of Curtin University to:

- approve meter labelling
- provide passwords.

7.9.2 METER INSTALLATION AND COMMISIONING

Based on experience from previous hydraulic metering projects, the matrix below leverages each contractor's respective strengths and areas of experience while providing clear delineation on the expectations. Some key areas to note:

1) The Hydraulic Contractor (HC) is responsible for the procurement of the M-Bus meter head (which will be specific to the physical meter installed) but the Electrical Contractor (EC) is responsible for the installation of the meter head.
2) The Electrical Contractor (EC) is responsible for the supply and installation of all electrical wiring and gateways in accord with the system design up to the Curtin-owned network switch.
3) DTS as owners and managers of the network are responsible for all hardware and software configuration between the network switch and the application servers (e.g. RSS, BMS, etc.)
4) The BMS Contractor (BC) is responsible for all onsite programming of devices including the M-bus head and the gateways. If required under the scope they may also be required to integrate the data from the gateway into the BMS.
5) The RSS Contractor (RSC) is responsible for integration of the data into the RSS database and for creating long-term trend repositories and configuring reports, trends, master-submeter relationships, dashboards and tenant statements as per the standard Curtin requirements.

Component	Supply	Install	Programming
Meter	HC	HC	N/A
M-Bus Head	HC	EC	BC
Cabling (M-Bus Head to Gateway)	EC	EC	N/A
Gateway	EC	EC	BC
Cabling (Gateway to Switch)	EC	EC	N/A
Network Configuration, Allocation of IP Addresses, etc	DTS	DTS	DTS
BMS Integration (if required)	BC	BC	BC
RSS Integration	RSC	RSC	RSC

7.9.3 METER VALIDATION

Meter validation refers to the end-to-end validation between the meter and the application databases (BMS and RSS). Meter validation works will not commence until network connection between the physical meter and the applications has been confirmed and data histories have been configured.

Two separate meter readings of consumption will be recorded with a gap of at least five days in between and containing a load. For new buildings and low utilisation legs, consumption may need to be forced by running taps, boilers, etc. A meter verification record will include the following evidence (at a minimum) for both the first and second readings:

1) the meter faceplate reading including any decimal places and units, time and date-stamped with a supporting photograph
2) a screenshot from the M-Bus programming software showing the current reading including decimal places, time and date-stamped
3) a screenshot of the gateway showing the value being read from the M-Bus head including decimal places, units, time and date-stamped
4) a screenshot of the history database for all applications (RSS, BMS, etc.) illustrating the recorded reading and units for the same point in time as the physical reading.

   Responsibility for each reading is as follows:

Description	Responsible Contractor
Physical Meter Reading and Photo	HC
M-Bus Software Reading and Screenshot	BC
Gateway Reading and Screenshot	BC
BMS Software Reading and Screenshot	BC
RSS Software Reading and Screenshot	RSC
Data Collation into Validation Register	RSC

The data from these readings will be recorded in a validation register, which details the following and is the responsibility of the RSS contractor:

1) Archibus reference
2) serial number of the meter
3) physical location
4) network information to connect to the device which may include GatewayIP, Instance Number, Device ID, MAC Address, MSTP Number, Remote Address, Instance Number, etc.
5) first and second readings from the faceplate, RSS and BMS with time and date stamps

6) a comparison of the consumption recorded in the validation period on the physical meter and in any applications.

Any meters where the recorded consumption deviates from the faceplate by more than 2% will be validated on a third occasion or further investigated to understand where the discrepancy has originated.

In the event of a failure, the Contractor must liaise with RSC to ensure the meter has been commissioned and configured correctly and the validation process has been repeated until the meter passes.

7.10 APPLICABLE STANDARDS

Reference	Application
OIML R 49-1:2006	Water Meters Metrological and Technical Requirements
AS/NZS 3500	Plumbing Code
AS/ACIF S009:2013	Installation Requirements for Customer Cabling (Wiring Rules)
AS/NZS3000:2000	Electrical installations (known as the Australian/New Zealand Wiring Rules)
AS/NZS3080:2013	Telecommunications installations - Generic cabling for commercial premises (ISO/IEC 11801:2002, MOD)
Modbus Application Standard V1.1b	Group of standards governing the Modbus Protocol
Industrial Communication Network Profiles IEC 61784	
Fieldbus IEC 61784	
EIA-485	Communication standard for RS-485 installation
Building Services Labelling Standard	Curtin labelling requirements of all asset types for Curtin University
000313 PDG Data Communications Cabling Requirements	Curtin Data Communication Cabling Standards and Specifications

The currency of the above standards will change from time to time and it is the designers and contractor's responsibility to ensure that the currently applicable standards are used.

7.11 DATA AND REPORTS

Data will be retrieved via the IP network. In all cases, no matter the software, hardware and data storage systems in place, some calculations will still be required, but this tends to be at the reporting software level where, for the reports to be meaningful, they will need to encompass:

- date and time
- trade waste flow rate (l/s)
- cumulative annual total and monthly discharge (kilolitres)

The reporting software system will make use of the information for reports, including but not necessarily limited to:

- hourly data presentation of intervals from 5 minutes to 15 minutes to suit application requirements
- summation of hourly data for discharge purposes
- daily data presentation
- summation of daily data for discharge purposes
- monthly data presentation
- monthly data presentation to suit the number of days with various summations
- annual data presentation to suit the number of months with various summations
- comparison of data with same time last year results
- comparison of data to discharge, available capacity, floor area (gross, nett and UFA) and other benchmarks for each facility
- determination of trade waste daily peak flow and use.

7.12 BMS GRAPHICS PAGES

Provide dedicated graphics pages for water and waste metering generally as follows:

1) site entry point
2) building entry point
3) meter entry point leading to a Water and Waste Metering Home Page.
    - links to individual buildings and plant rooms displaying
        - typical building
        - waste meter readings
        - floor plans indicating meter locations and IDs
        - link to central meter summary page
    - link to meter summary page(s) displaying
        - each meter flow rate
        - each meter consumption
        - UPS battery percentage (if provided)
        - UPS estimated time left (if provided).

The Consultant shall determine with Curtin which BMS system(s) the above graphics are to reside on.

8 NATURAL GAS

8.1 GENERAL

Specific outcomes expected for metering of natural gas include:

- capturing gas consumption to facilitate benchmarking to monitor building/facility performance
- metering of buildings with natural gas connections
- sub-metering of tenancies within buildings to allow on-charging of utility costs
- clarity and uniformity of graphics display at the BMS head ends
- energy use and performance reporting
- NMIA-certified metering.

8.2 METERING CONCEPT

8.2.1 PRE-EXISTING METERING CONCEPT (PRE-2018)

Existing natural gas metering at the Bentley Campus site boundary is captured by Outpost Central loggers. Generally, there is no monitored sub-metering of natural gas consumption within the Campus at building connections. The exception to this is mechanical plant, which is monitored by a BMS.

8.2.2 CURRENT METERING CONCEPT

Meters to be capable of M-Bus connection – for integration with Campus communication infrastructure and capture by DTS.

The diagram below provides contextual information on the metering process.

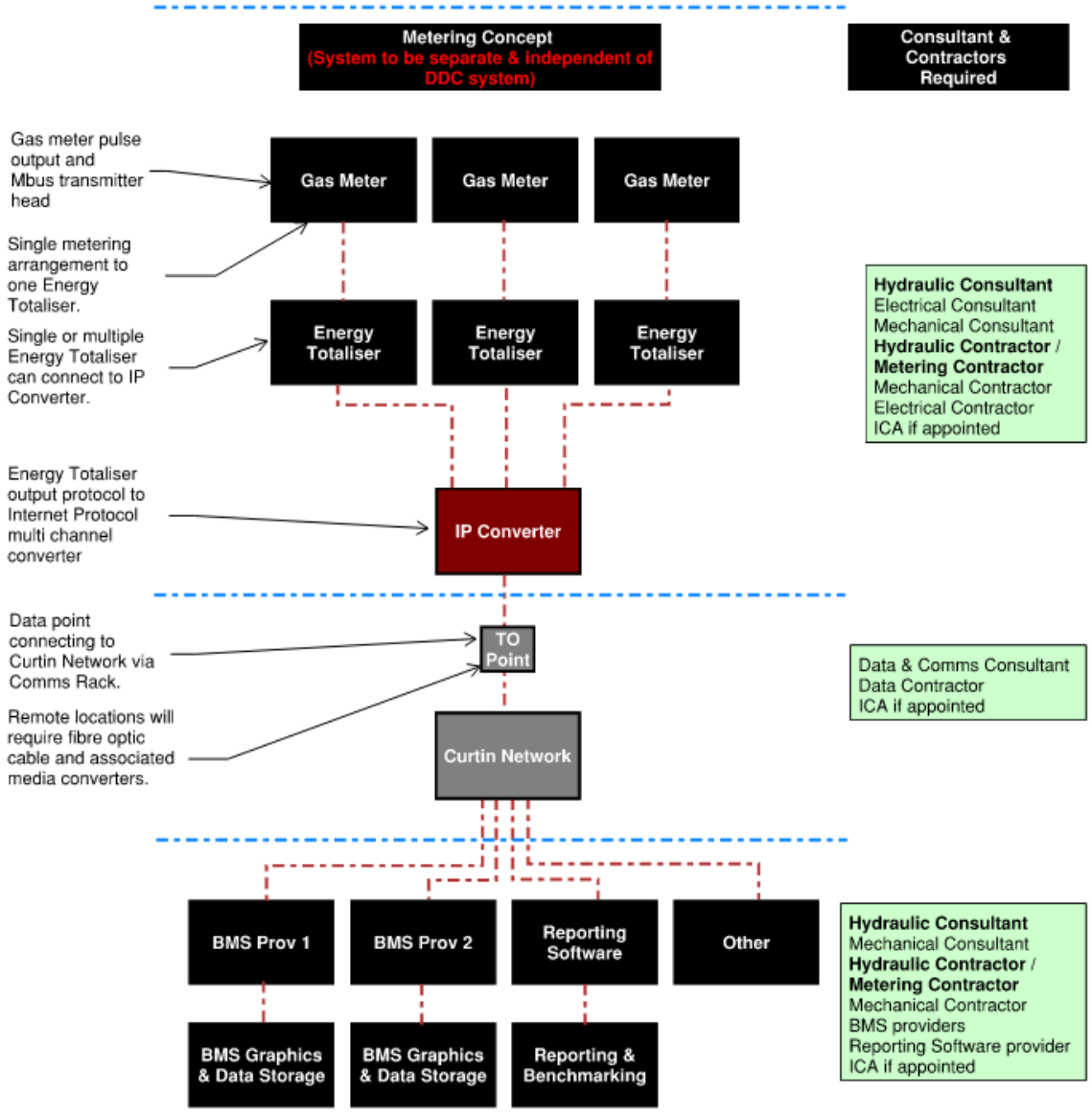


Figure 8A – Gas Metering Strategy

8.3 ACCEPTABLE METERS AND DEVICES

8.3.1 IP NETWORK GATEWAYS

IP network gateways shall be used to integrate meters into the existing ICT network. Meters must be connected to the ICT network using a suitable IP gateway.

Suitable IP gateways shall be those deemed to meet the requirements as set out in Section 8.3.2 below.

8.3.2 COMMUNICATIONS PROTOCOL

The communications protocol utilised to exchange data between the meters and the BMS and reporting software systems shall be Mbus output from the meter transmitter, to an IP gateway protocol converter.

Data from meters shall be converted to IP protocol by the metering contractor prior to connection to the ICT network. An IP network gateway shall undertake the conversion to IP protocol.

ADDRESSING CONVENTIONS:

The Contractor must submit the addressing scheme proposed for devices to the Infrastructure Manager, Hydraulic and Civil, Capital Projects at Curtin for approval prior to configuring the network addresses on site.

APPROVED MAKES:

The consultant and/or the contractor shall determine appropriate hardware for communication conversions to IP. Hardware shall have RCM certification.

8.3.3 METERS

Natural gas meters shall be supplied and installed in accordance with the below. Meters shall be approved to International Standard OIML R 137 and be NMIA-certified, as well as recognised as intrinsically safe in accordance with the IECEx Scheme.

Natural gas meter selection shall be determined by the natural gas supply requirement. Natural gas meters shall be capable of:

- pulse output
- high level interface of Mbus signal output.

The following are provided as examples of suitable meters, however the Consultant shall conduct a review of suitable meter types with smart head interfaces and present meter options analysis to the University for review and approval prior to proceeding with detailed documentation.

0–300 MJ/HR

Itron RF1 Residential Diaphragm gas meter, complete with Cyble target to allow communication through pulse output and Mbus protocol.

Figure 8-A – RF1 Residential Diaphragm gas meter

300–5000 MJ/HR

Itron F4788 Rotary Meter Delta gas meter, complete with Cyble target to allow communication through pulse output and Mbus protocol.

Figure 8-B – F4788 Rotary Meter Delta gas meter

5000 MJ/HR & ABOVE

Itron Quantometer MZ Turbine gas meter, complete with Cyble target to allow communication through pulse output and Mbus protocol.

Figure 8-C - Quantometer MZ Turbine gas meter

8.3.4 GAS PRESSURE SENSORS

Supply and install pressure sensors in the main line entering a building or on the common line at each mechanical boiler, connected to BMS.

Sensors shall be determined by the Consultant or Contractor and shall be installed to be intrinsically safe for the environment it is installed in.

8.3.5 METERING ENCLOSURES

Where existing building gas connections are metered, gas meters are located:

a) external to buildings

b) within building plant rooms

c) within dedicated meter enclosures

d) within services risers.

New meter installations shall be located within the following spaces:

a) within building plant rooms

b) within dedicated meter enclosures.

Enclosures All metering devices that the meter connects to shall be housed within an enclosure of powder coated steel panel construction. The boards shall be large enough to accommodate all devices including the IP converter and data point.

Where devices are located externally they shall be within an IP66-rated enclosure complete with Curtin key locks. The enclosure may be to external switchboard construction standard or a panel housed within a weatherproof enclosure.

The space considerations for meter installations should include:

- access and maintenance space requirements
- security of meter
- practicality of provision of communications infrastructure to meter
- intrinsically safe meter installation requirements
- ventilation for pressure regulators (where applicable).

POWER SUPPLIES

Power supplies to metering panels/switchboards shall be fed from a localised mechanical services switchboard from an extra low voltage (ELV) circuit. The use of ELV means that maintenance can be undertaken on the devices within the panel without a need for an electrical licence.

If an ELV supply is not available and a low voltage (LV) supply is necessary, then compartmentalise the LV from the ELV within the panel. The panel will require Curtin standard electrical key locks, in accordance with *000312 PDG Electrical Services Guidelines.*

SECURITY

Consult with the Curtin Network Infrastructure Manager on requirements for data point security.

LABELLING

Metering enclosures shall be externally labelled in accordance with Curtin University labelling requirements.

8.3.6 INTEGRATION OF METERS TO CAMPUS NETWORK

Refer to Section 10 COMMUNICATIONS (DATA).

8.4 INSTALLATION REQUIREMENTS

8.4.1 METERS

Meters shall be installed to be readily accessible in locations such as:

- Externally within a weatherproof enclosure
- plant rooms
- service tunnels
- accessible ducts or risers.

Meters must be installed in in accordance with the manufacturer's guidelines. In particular, requirements for straight lengths of pipe before and after flow sensors must be maintained.

METER SECURITY

Where provided with a key or touchpad for programming purposes, access to the internal parameters of meters shall be password protected.

EARTHING

Meters installed in non-metallic pipework shall be separately earthed.

8.4.2 MSTP NETWORK CABLING

The Contractor shall provide and install communications cabling between the meter and the IP gateway. Meter MSTP communications cable type shall be as per the meter manufacturer's specification. If not specified, Belden 9841 or equivalent cable shall be used.

All MSTP communications cabling shall be terminated in a bus network topology. Star and T-type network topology cabling terminations are not acceptable.

EIA-485 cabling line resistance must be in accordance with the meter manufacturer's recommendation. End-of-line resistors shall be supplied and installed as required to maintain correct line resistance.

Where communications cabling leaves or spans between buildings, surge and lightning protection must be provided at each end where the cabling leaves and/or enters the building. Surge protection devices should include visual indication of operation and actuation.

Meter communications cabling within electrical switchboards must be installed within communications conduit.

Meter communications cabling installed within electrical switchboards and on shared cable support structures shall be installed in accordance with AS/ACIF S009:2001. Segregation distances between communications and power cables must be maintained.

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IP network gateways shall be installed, wherever practicable, adjacent to the nearest ICT data point. The Contractor shall provide and install Cat 6 network patch cables between gateways and ICT data points and shall be responsible for:

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As IP gateways consume ICT network resources, meter MSTP networks should be designed and installed in such a way to minimise the number of gateways required.

A basic acceptable meter connection topology is shown in the following figure:

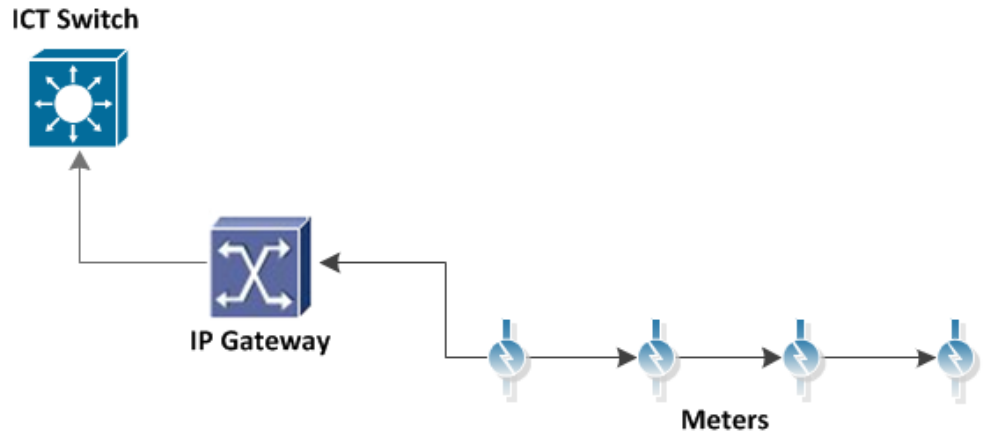

Figure 8-D - Sample Meter Connection Topology

8.5 COMMISSIONING

Commissioning and documentation shall be undertaken for each new networked meter by a suitably qualified meter technician.

8.5.1 METER COMMISSIONING

Commissioning shall confirm that:

- the meter flow sensor is:
  - installed to the correct location (by matching the serial number to the designated location)
  - installed in a suitable location (in consideration of disturbances to flow)
  - configured with the correct monitored pipe information (e.g. composition, thickness)
  - configured with the correct measured media information (e.g. water/waste).
- the meter calculator/transmitter is:

- installed to the correct location (by matching the serial number to the designated location)
- configured with the correct internal settings
- configured to display measured values on the meter display
- configured to make available measured values from the meter via Modbus RTU
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Meter commissioning is to be carried out and signed off by the vendor.

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Where meter screens have the capacity for a static or scrolling display, the following minimum information shall be included in the display per active channel:

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The Contractor is responsible for completing all meter commissioning documentation, which shall confirm that the commissioning process has been completed successfully in its entirety and shall include the following as a minimum:

- a unique document per meter commissioned
- location, manufacturer, model and serial numbers of the commissioned meter and its sensors
- confirmation of the serial communications from the meter to the IP network gateway and to and from the IP gateway to the reporting software meter monitoring system
- record of the communications parameters programmed into the meter
- record of any faults identified and of any corrective action recommended or taken
- date and time of commissioning, business name, name and signature of meter technician.

Refer to the separate Appendix Reference Document for a sample commissioning document.

The Contractor must liaise with reporting software provider when commissioning the first meter to ensure communication is established and all specified meter data is exposed and correctly validated. This will reduce any potential reworks on the remaining meter integration works.

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8.8 COORDINATION

All meters must be commissioned and integrated to both the site-wide energy monitoring RSS and the onsite BMS systems. The Contractor must liaise and engage with the reporting software provider for all reporting software associated works. The Contractor must liaise and engage with BMS provider(s) for BMS associated works. The reporting software provider will require the services of either the BMS provider or the Service Contractor to commission the metering devices.

The Contractor is responsible for ensuring works occur in a timely manner to achieve identified project timelines.

Prior to the commissioning of any new, replacement, relocated or amended meters to reporting software, the Contractor must liaise with the appointed reporting software provider to coordinate the commissioning date and time.

The Contractor must provide at least 14 days' notice to the reporting software provider prior to the proposed commissioning date.

The Contractor must provide the following information prior to any commissioning works commencing with the reporting software provider:

- meter trees that show hierarchy of meters, master, sub-meters and virtual meters
- number of meters
- approved meter labels (all labels to be in accordance with Building Services Labelling Standard)
- meter location
- media being monitored.

Prior to providing the above detailed information the Contractor must:

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Contractor notifies subcontractors of Scope of Works and issues Project Documentation	• number of meters • location and labelling of meters • updated metering tree • updated site map of meter locations • virtual meter calculations (if any)
Contractor to ensure all network connectivity is commissioned.	• requests all required IP addresses from Curtin University • ensure all IP TOs have been patched and tested • provide communications configuration parameters for the reporting software and BMS • ensure all devices and meters are commissioned

New Project/Capital Works	Details
Commission Meters into Reporting Software and BMS	• Contractor to take 2 separate faceplate readings (kWh or KL to suit), 1 week apart and issue to reporting software and BMS companies • Reporting software and BMS companies to validate the readings against their respective software platforms • Where due to low or no occupancy meters are not recording any change in values, the contractor shall force systems to a state that provides suitable commissioning readings
Handover – provide documentation to be submitted by subcontractors for inclusion into O&M manuals.	• Handover pack to include validation documentation, report configurations and alarm configurations. • Consultant to have validated that RSS and BMS works have been completed and that reports, trends and graphics are available to suit the respective platforms.

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It shall be the responsibility of the design engineer and installation contractor to select the correct metering system, device sizes and types to ensure the suitability for purpose. As a minimum, the following characteristics shall be taken into consideration for meter selection:

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- pipe composition
- pipe wall thickness
- media being monitored/measured
- flow tube lining requirement
- minimum flow and velocity rates
- maximum flow and velocity rates
- maximum pressure loss through metering arrangement shall not exceed 3 kPa
- manufacturer-required clearances.

It shall be the responsibility of the Consultant to ensure that the meter is correctly sized, and the metering system is fully and adequately documented to facilitate the Contractor's installation obligations.

It shall be the responsibility of the Contractor to ensure that the meter is correctly sized, constructed, installed and adjusted for safe and accurate operation.

The Contractor's meter technician shall be responsible for the installation, configuration and commissioning of the meters and the IP network gateway devices to confirm that the meter data is accurate and is being transmitted correctly through the IP network gateway devices to the reporting software and BMS meter monitoring systems.

It shall be the responsibility of the reporting software contractor to liaise and work with the Contractor or the BMS contractor to initially commission and verify the meter readings into the reporting software system and to then re-validate the readings after a nominal period of time has transpired.

It shall be the responsibility of the BMS contractor to liaise and work with the Contractor to initially commission and verify the meter readings into the BMS metering system and to then re-validate the readings after a nominal period of time has transpired. It is also the BMS contractor's responsibility to upgrade graphics in the BMS system(s)

It shall be the responsibility of the data contractor to obtain IP addresses and to validate that they have been commissioned and activated. It shall be the responsibility of Curtin University to:

- approve meter labelling
- provide passwords.

8.9.2 METER INSTALLATION AND COMMISIONING

Based on experience from previous hydraulic metering projects, the matrix below leverages each contractor's respective strengths and areas of experience while providing clear delineation on the expectations. Some key areas to note:

1) The Hydraulic Contractor (HC) is responsible for the procurement of the M-Bus meter head (which will be specific to the physical meter installed) but the Electrical Contractor (EC) is responsible for the installation of the meter head.
2) The Electrical Contractor (EC) is responsible for the supply and installation of all electrical wiring and gateways in accord with the system design up to the Curtin-owned network switch.
3) DTS as owners and managers of the network are responsible for all hardware and software configuration between the network switch and the application servers (e.g. RSS, BMS, etc.)
4) The BMS Contractor (BC) is responsible for all onsite programming of devices including the M-bus head and the gateways. If required under the scope they may also be required to integrate the data from the gateway into the BMS.
5) The RSS Contractor (RSC) is responsible for integration of the data into the RSS database and for creating long-term trend repositories and configuring reports, trends, master-submeter relationships, dashboards and tenant statements as per the standard Curtin requirements

Component	Supply	Install	Programming
Meter	HC	HC	N/A

M-Bus Head	HC	EC	BC
Cabling (M-Bus Head to Gateway)	EC	EC	N/A
Gateway	EC	EC	BC
Cabling (Gateway to Switch)	EC	EC	N/A
Network Configuration, Allocation of IP Addresses, etc	DTS	DTS	DTS
BMS Integration (if required)	BC	BC	BC
RSS Integration	RSC	RSC	RSC

8.9.3 METER VALIDATION

Meter validation refers to the end-to-end validation between the meter and the application databases (BMS and RSS). Meter validation works will not commence until network connection between the physical meter and the applications has been confirmed and data histories have been configured.

Two separate meter readings of consumption will be recorded with a gap of at least five days in between and containing a load. For new buildings and low utilisation legs, consumption may need to be forced by running taps, boilers, etc. A meter verification record will include the following evidence (at a minimum) for both the first and second readings:

1) the meter faceplate reading including any decimal places and units, time and date-stamped with a supporting photograph
2) a screenshot from the M-Bus programming software showing the current reading including decimal places, time and date-stamped
3) a screenshot of the gateway showing the value being read from the M-Bus head including decimal places, units, time and date-stamped
4) a screenshot of the history database for all applications (RSS, BMS, etc.) illustrating the recorded reading and units for the same point in time as the physical reading.

Responsibility for each reading is as follows:

Description	Responsible Contractor
Physical Meter Reading and Photo	HC
M-Bus Software Reading and Screenshot	BC
Gateway Reading and Screenshot	BC
BMS Software Reading and Screenshot	BC
RSS Software Reading and Screenshot	RSC
Data Collation into Validation Register	RSC

The data from these readings will be recorded in a validation register, which details the following and is the responsibility of the RSS contractor:

1) Archibus reference
2) serial number of the meter
3) physical location
4) network information to connect to the device, which may include GatewayIP, Instance Number, Device ID, MAC Address, MSTP Number, Remote Address, Instance Number, etc.
5) first and second readings from the faceplate, RSS and BMS with time and date stamps
6) a comparison of the consumption recorded in the validation period on the physical meter and in any applications.

Any meters where the recorded consumption deviates from the faceplate by more than 2% will be validated on a third occasion or further investigated to understand where the discrepancy has originated.

In the event of a failure, the Contractor must liaise with RSC to ensure the meter has been commissioned and configured correctly and the validation process has been repeated until the meter passes.

8.10 APPLICABLE STANDARDS

Reference	Application
OIML R 49-1:2006	Gas Meters Metrological and Technical Requirements
Gas Code	Gas Code
Gas Supply Authority	Gas Supply Authority
AS/NZS 3500	Plumbing Code
AS/ACIF S009:2013	Installation Requirements for Customer Cabling (Wiring Rules)
AS/NZS3000:2000	Electrical installations (known as the Australian/New Zealand Wiring Rules)
AS/NZS3080:2013	Telecommunications installations - Generic cabling for commercial premises (ISO/IEC 11801:2002, MOD)
Modbus Application Standard V1.1b	Group of standards governing the Modbus Protocol
Industrial Communication Network Profiles IEC 61784	
Fieldbus IEC 61784	
EIA-485	Communication standard for RS-485 installation
Building Services Labelling Standard	Curtin labelling requirements of all asset types for Curtin University
000313 PDG Data Communications Cabling Requirements	Curtin Data Communication Cabling Standards and Specifications

The currency of the above standards will change from time to time and it is the designer's and Contractor's responsibility to ensure that the currently applicable standards are used.

8.11 DATA AND REPORTS

Data will be retrieved via the IP network and shall include the following:

- date and time
- natural gas flow rate (m^3/s, l/s etc.)
- natural gas volume consumption (m^3)
- natural gas energy instantaneous demand (MJ, kW)
- natural gas energy consumption (MJ/hr, kWh)
- natural gas pressure (kPa) (for supplies to mechanical plant, but within BMS works)
- cumulative annual total and monthly consumption (MJ)

Data shall be used by the reporting software system for reports including but not necessarily limited to;

- hourly data presentation of 15-minute intervals to suit application requirements
- summation of hourly data for consumption purposes
- daily data presentation
- summation of daily data for consumption purposes
- monthly data presentation
- monthly data presentation to suit the number of days with various summations
- annual data presentation to suit the number of months with various summations
- summation to operational periods such as "On peak", "Off peak" and "Shoulder" (should it ever arise)
- comparison of data with same time last year results
- determination of building daily peak flow and use.

8.12 BMS GRAPHICS PAGES

The Contractor shall provide dedicated graphics pages for gas metering generally as follows:

MECHANICAL PLANT ROOMS

1) Provide new gas monitoring graphics that facilitate access by both mechanical and hydraulics services for Curtin
    - for boiler sub-meters

- Mbus ID
- CMMS ID
- primary and secondary addresses
- volume and backflow indexes
- alarms – tampering detection and low battery
- peak flow management
- monthly fixed data reading
- leakage detection
- instantaneous use m³/s
- consumption m³
- instantaneous power in kW
- totalised energy consumption in kWh
- gas pressure by independent sensor

- for boundary meter
  - CMMS ID
  - Instantaneous use m³/s
  - consumption m³
  - instantaneous power in kW
  - totalised energy consumption in kWh.

2) Modify mechanical programming and graphics to integrate gas sub-metering to various pages for programming data and graphics points. Examples of items to update include:
   - plant room/energy pages with COP calculations and display
   - plant room/energy pages with consumption, instantaneous use and the like.

BOUNDARY

1) Site entry point
2) Link to Central Gas Metering Pages
   - link displaying a site map with meter locations
   - links to centralised boundary meter schedule displaying the following for the boundary
     - CMMS ID
     - instantaneous use m³/s
     - consumption m³
     - instantaneous power in kW
     - totalised energy consumption in kWh

  - gas pressure via separate sensor
- within the same schedule, provide the above display information for each building; and
  - other meter HLI information that may be available
  - UPS battery percentage (if provided)
  - UPS estimated time left (if provided).

BUILDINGS

1) Links to individual buildings on a site map – to connect to Buildings Graphics pages
2) Building Home Page
3) metering sub-page
   - typical building
     - gas meter flow
     - gas usage
     - gas energy (calculated)
     - floor plans indicating meter locations and IDs and mains pressure sensors
     - other meter HLI information that may be available
     - UPS battery percentage (if provided)
     - UPS estimated time left (if provided)
     - link to central meter summary page.

The Consultant shall determine with Curtin which BMS system(s) the above graphics are to reside on.

9 IRRIGATION

9.1 GENERAL

Specific outcomes expected for irrigation metering:

- capturing accurate irrigation water consumption for the Department of Water
- clarity and uniformity of graphics display at the BMS head ends
- NMIA-certified metering with installation standard compliance to Water Corporation requirements.

9.2 METERING CONCEPT

9.2.1 PRE-EXISTING METERING CONCEPT (PRE-2018)

Existing potable and non-potable water metering within the Bentley Campus is captured by Outpost Central 3G loggers, processed remotely and accessed through a web-based graphical user interface (GUI). This data is currently accessed by the reporting software for reporting to the University.

Outpost Central 3G loggers capture the Bentley Campus site main water meters and approximately 40 per cent of the existing Bentley Campus sub-meters. These meters are subject to the following limitations:

- battery powered, with limited reading frequency due to the requirement to replace batteries should meter reading and uploading be frequent
- use cellular communication, so the meters require connection to a cellular network
- remote data storage.

The existing Outpost Central 3G loggers will continue to be used until the existing meters are replaced or upgraded to the new concept.

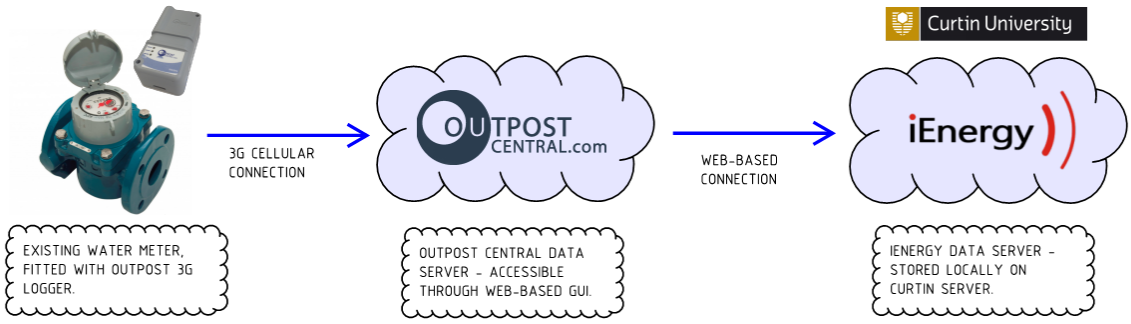

Figure 9-A – Pre-Existing Campus Water Metering Strategy

9.2.2 NEW METERING CONCEPT (FROM 2018)

The diagram below provides contextual information on the metering process.

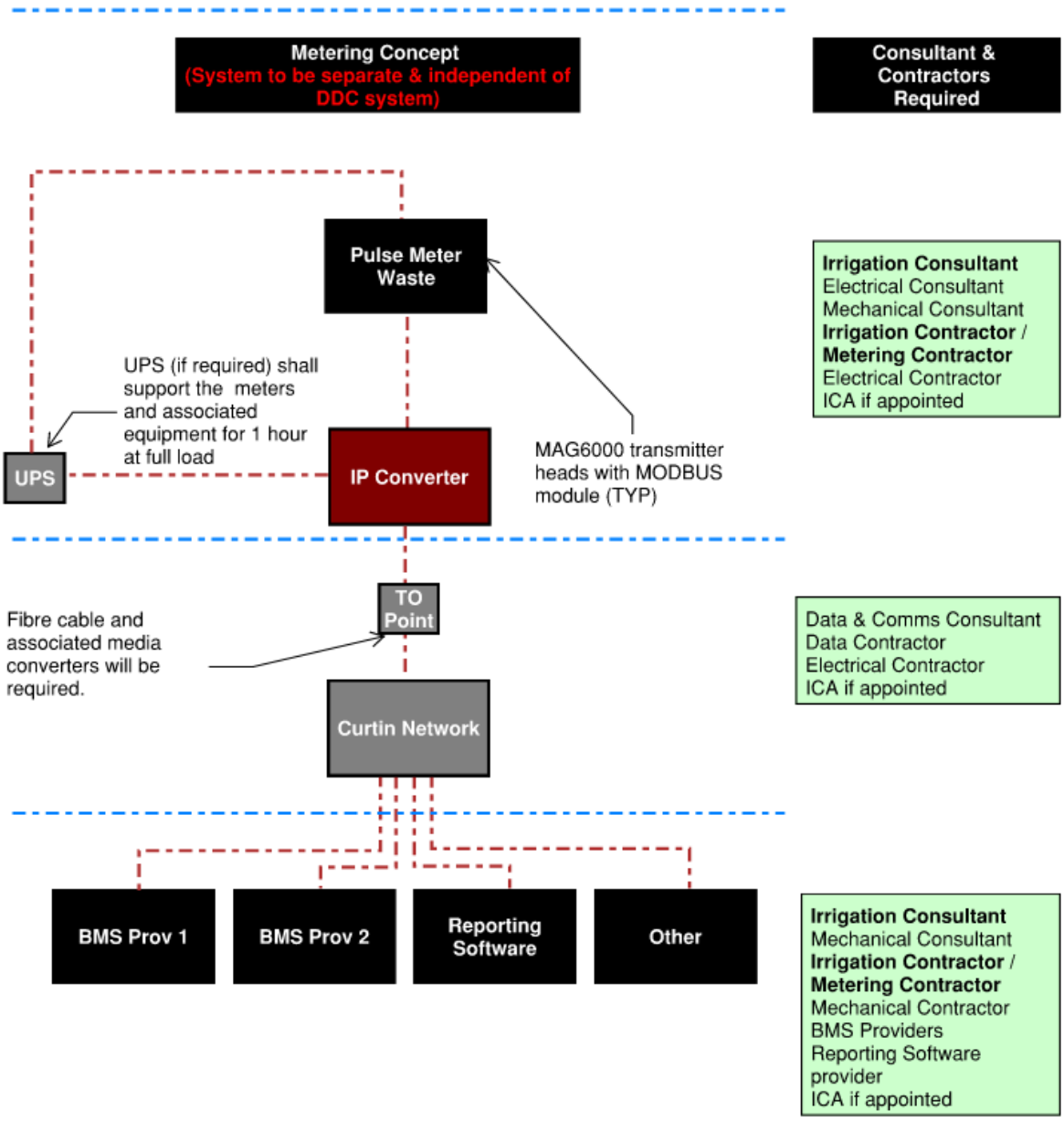

Figure 9B – Irrigation Metering Concept

9.3 ACCEPTABLE METERS AND DEVICES

Meters shall be supplied and installed as in-line electromagnetic flow (magflow) meters. Where in-line electromagnetic flow meters are installed the magflow sensor tube shall be approved to International Standard OIML R 49-1:2006 and be NMIA-certified.

9.3.1 IP NETWORK GATEWAYS

IP network gateways shall be used to integrate meters into the existing ICT network. Meters must be connected to the ICT network using a suitable IP gateway.

Suitable IP gateways shall be those deemed to meet the requirements as set out in Section 9.3.2 below.

9.3.2 COMMUNICATIONS PROTOCOL

The communications protocol utilised to exchange data between the meters and the BMS and reporting software systems shall be determined by the Consultant and shall be Modbus output from the meter transmitter, to an IP gateway protocol converter.

Data from meters shall be converted to IP protocol by the metering contractor prior to connection to the ICT network. An IP network gateway shall undertake the conversion to IP protocol.

ADDRESSING CONVENTIONS:

The Contractor must submit the addressing scheme proposed for devices to the Infrastructure Manager, Hydraulic and Civil, Capital Projects at Curtin for approval prior to configuring the network addresses on site.

APPROVED MAKES:

Chen Sen Controls, Chen Sen Gateway (GSGW) – the gateway device to convert serial protocols (Modbus RTU or proprietary protocols) to BACnet IP. Hardware shall have RCM certification.

9.3.3 METERS – IRRIGATION

Supply and install Siemens Sitran MAG5100W.

9.3.4 TRANSMITTER HEAD

Supply and install Siemens Sitran Magflo transmitter MAG6000 with Modbus RTU interface card.

9.3.5 UPS

Consultants shall determine the requirement for a UPS. If required, supply and install UPS units of PowerShield Commander (1100 | 1100/2000 VA Line Interactive) manufacture complete with BMS interface card (Modbus or BACnet) or approved equivalent providing for a minimum of 1-hour operation to support meter heads.

9.3.6 METERING ENCLOSURES

ENCLOSURES

All metering devices that the meter connect to shall be housed within an enclosure of powder coated steel panel construction. The boards shall be large enough to accommodate all devices including the power supply, the IP converter, FOBOT and data point. If provided, UPS units shall not reside inside the panel but be located in a suitable position nearby.

Where devices are located externally they shall be within an IP66-rated enclosure complete with Curtin key locks. The enclosure may be to external switchboard construction standard or a panel housed within a weatherproof enclosure.

POWER SUPPLIES

Power supplies to metering panels/switchboards shall be fed from a localised mechanical services switchboard from an extra low voltage (ELV) circuit. The use of ELV means that maintenance can be undertaken on the devices within the panel without a need for an electrical licence.

If an ELV supply is not available and a low voltage (LV) supply is necessary, then compartmentalise the LV from the ELV within the panel. The panel will require Curtin standard electrical key locks, in accordance with *000312 PDG Electrical Services Guidelines.*

SECURITY

Consult with the Curtin Network Infrastructure Manager on requirements for data point security.

LABELLING

Metering enclosures shall be externally labelled in accordance with Curtin University labelling requirements.

9.3.7 INTEGRATION OF METERS TO CAMPUS NETWORK

Refer to section 10 COMMUNICATIONS (DATA).

9.4 INSTALLATION REQUIREMENTS

9.4.1 METERS

Meters shall be installed to be readily accessible in locations such as:

- at the meter bore heads. Remote metering devices are utilised due to the distance of bore heads from buildings.

Meters must be installed in in accordance with the manufacturer's guidelines. In particular, requirements for straight lengths of pipe before and after flow sensors must be maintained.

METER SECURITY

Where provided with a key or touchpad for programming purposes, access to the internal parameters of meters shall be password protected.

EARTHING

Meters installed in non-metallic pipework shall be separately earthed.

9.4.2 MSTP NETWORK CABLING

The Contractor shall provide and install communications cabling between the meter and the IP gateway. Meter MSTP communications cable type shall be as per the meter

manufacturer's specification. If not specified, Belden 9841 or equivalent cable shall be used.

All MSTP communications cabling shall be terminated in a bus network topology. Star and - type network topology cabling terminations are not acceptable.

EIA-485 cabling line resistance must be in accordance with the meter manufacturer's recommendation. End-of-line resistors shall be supplied and installed as required to maintain correct line resistance.

Where communications cabling leaves or spans between buildings, surge and lightning protection must be provided at each end where the cabling leaves and/or enters the building. Surge protection devices should include visual indication of operation and actuation.

Meter communications cabling within electrical switchboards must be installed within communications conduit.

Meter communications cabling installed within electrical switchboards and on shared cable support structures shall be installed in accordance with AS/ACIF S009:2001. Segregation distances between communications and power cables must be maintained.

9.4.3 IP NETWORK GATEWAYS

IP network gateways shall be installed, wherever practicable, adjacent to the nearest ICT data point. The Contractor shall provide and install Cat 6 network patch cables between gateways and ICT data points and shall be responsible for:

- configuration of IP addresses into the gateways
- configuration of the communications parameters into the gateways
- configuration of the meter node addresses into the gateways.

As IP gateways consume ICT network resources, meter MSTP networks should be designed and installed in such a way to minimise the number of gateways required.

A basic acceptable meter connection topology is shown in the following figure:

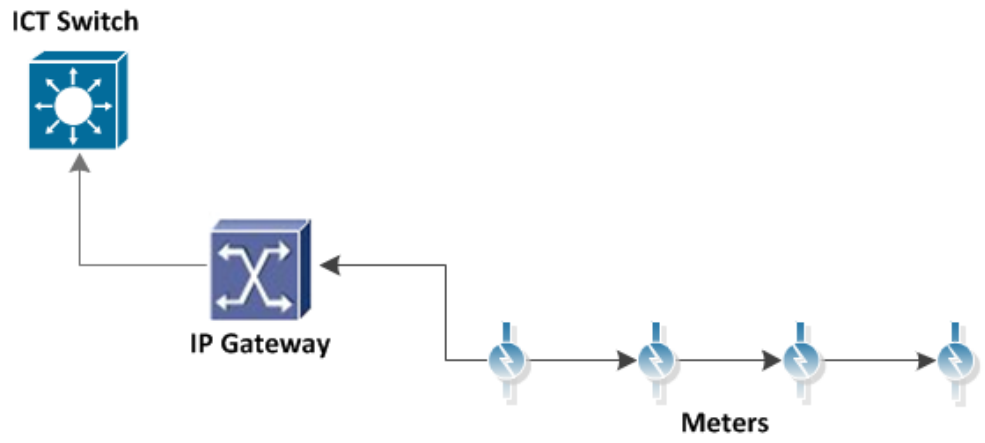

Figure 9-B - Sample Meter Connection Topology

9.5 COMMISSIONING

Commissioning and documentation shall be undertaken for each new networked meter by a suitably qualified meter technician.

9.5.1 METER COMMISSIONING

Commissioning shall confirm that:

- the meter flow sensor is:
  - installed to the correct location (by matching the serial number to the designated location)
  - installed in a suitable location (in consideration of disturbances to flow)
  - configured with the correct monitored pipe information (e.g. composition, thickness)
  - configured with the correct measured media information (e.g. water/waste)
- the meter calculator/transmitter is:
  - installed to the correct location (by matching the serial number to the designated location)
  - configured with the correct internal settings
  - configured to display measured values on the meter display
  - configured to make available measured values from the meter via Modbus RTU
  - configured to communicate all available metered values to the reporting software meter monitoring system and BMS systems.

Meter commissioning is to be carried out and signed off by the vendor.

9.5.2 METER FACEPLATE (SCREEN) DISPLAY

Where meter screens have the capacity for a static or scrolling display, the following minimum information shall be included in the display per active channel:

- totalised consumption in kilolitres
- instantaneous flow in l/s
- volume in m^3.

9.5.3 METER COMMISSIONING DOCUMENTATION

The Contractor is responsible for completing all meter commissioning documentation, which shall confirm that the commissioning process has been completed successfully in its entirety and shall include the following as a minimum:

- a unique document per meter commissioned
- location, manufacturer, model and serial numbers of the commissioned meter and its sensors

- confirmation of the serial communications from the meter to the IP Network Gateway and to and from the IP Gateway to the reporting software meter monitoring system
- record of the communications parameters programmed into the meter
- record of any faults identified and of any corrective action recommended or taken
- date and time of commissioning, business name, name and signature of meter technician.

Refer to the separate Appendix Reference Document for a sample commissioning document.

The Contractor must liaise with reporting software provider when commissioning the first meter to ensure communication is established and all specified meter data is exposed and correctly validated. This will reduce any potential reworks on the remaining meter integration works.

9.6 METER VERIFICATION

The Contractor shall provide confirmation of traceable factory calibration data for each meter in the form of manufacturer's certificates.

9.7 METER VALIDATION

Refer to Section 9.9.

9.8 COORDINATION

All meters must be commissioned and integrated to both the site-wide energy RSS and the onsite BMS systems. The Contractor must liaise and engage with the reporting software provider for all reporting software associated works. The Contractor must liaise and engage with BMS providers for BMS associated works. The reporting software provider will require the services of either the BMS provider or the Service Contractor to commission the metering devices.

The Contractor is responsible for ensuring works occur in a timely manner to achieve identified project timelines.

Prior to the commissioning of any new, replacement, relocated or amended meters to reporting software, the Contractor must liaise with the appointed reporting software provider to coordinate the commissioning date and time.

The Contractor must provide at least 14 days' notice to the reporting software provider prior to the proposed commissioning date.

The Contractor must provide the following information prior to any commissioning works commencing with the reporting software provider:

- meter trees that show hierarchy of meters, master, sub-meters and virtual meters
- number of meters

- approved meter labels (all labels to be in accordance with Building Services Labelling Standard)
- meter location
- media being monitored.

Prior to providing the above detailed information, the Contractor must:

- request all required IP addresses from Curtin University.
- confirm with (DTS) that all IP telecommunications outlets have been patched and tested
- provide reporting software provider with communications configuration parameters (e.g. meter node address, device ID, object list and IP address) for each metering arrangement and IP gateway
- liaise with the reporting software provider during the commissioning and validation process to ensure and confirm that the meters are communicating with and are passing data correctly and accurately to the reporting software site meter monitoring systems.

The RSC will undertake all configuration modifications to the reporting software system as necessary to include for the integration of new irrigation meters and/or meter amendments.

9.8.1 REQUESTING AN IP ADDRESS

Refer to section 10 COMMUNICATIONS (DATA).

9.8.2 DELIVERY PROCESS FOR REPORTING SOFTWARE AND BMS

Table 9-1 – Delivery Process for Reporting Software and BMS

New Project/Capital Works	Details
Design	• Consultant(s) nominated
Contract documents prepared	• scope of works specification and drawings • new or updated site or building metering tree • new or updated site or building metering plan single line diagrams • floor plan information • metering devices and installation requirements documented • electrical supply to metering devices documented • communications (data) requirements documented • coordination with authorities documented (where necessary) • schedules of metering and labels documented • liaise with reporting software and BMS systems providers
Tendering	• Contractor issues tender documents to the reporting software provider and other sub-contractors.

New Project/Capital Works	Details
Construction	• The reporting software provider provides a quote to the Contractor for inclusion into the tender submission. • Quotes must cover the required scope of work • Contractor nominated • Contractor issues an order to the reporting software provider and other sub-contractors
Contractor notifies subcontractors of Scope of Works and issues Project Documentation	• number of meters • location and labelling of meters • updated metering tree • updated site map of meter locations • virtual meter calculations (if any)
Contractor to ensure all network connectivity is commissioned.	• requests all required IP addresses from Curtin University • ensure all IP TOs have been patched and tested • provide communications configuration parameters for reporting software and BMS
Commission Meters into Reporting Software and BMS	• ensure all devices and meters are commissioned • Contractor to take 2 separate faceplate readings (kWh or KL to suit), 1 week apart and issue to reporting software and BMS companies • RSS and BMS companies to validate the readings against their respective software platforms • Where due to low or no occupancy meters are not recording any change in values, the contractor shall force systems to a state that provides suitable commissioning readings
Handover – provide documentation to be submitted by subcontractors for inclusion into O&M manuals.	• Handover pack to include validation documentation, report configurations and alarm configurations. • Consultant to have validated that RSS and BMS works have been completed and that reports, trends and graphics are available to suit the respective platforms.

9.9 RESPONSIBILITIES AND DEMARCATION

9.9.1 GENERAL

It shall be the responsibility of the design engineer and installation contractor to select the correct metering system, device sizes and types to ensure the suitability for purpose. As a minimum, the following characteristics shall be taken into consideration for meter selection:

- pipe (DN) size
- pipe composition
- pipe wall thickness
- media being monitored/measured

- flow tube lining requirement
- minimum flow and velocity rates
- maximum flow and velocity rates
- maximum pressure loss through metering arrangement shall not exceed 3 kPa
- manufacturer-required clearances.

It shall be the responsibility of the Consultant to ensure that the meter is correctly sized, and the metering system is fully and adequately documented to facilitate the contractor's installation obligations.

It shall be the responsibility of the Contractor to ensure that the meter is correctly sized, constructed, installed and adjusted for safe and accurate operation.

The Contractor's meter technician shall be responsible for the installation, configuration and commissioning of the meters and the IP network gateway devices to confirm that the meter data is accurate and is being transmitted correctly through the IP network gateway devices to the reporting software and BMS meter monitoring systems.

It shall be the responsibility of the RSC to liaise and work with the Contractor to initially commission and verify the meter readings into the reporting software metering system and to then re-validate the readings after a nominal period of time has transpired.

It shall be the responsibility of the BMS contractor to liaise and work with the Contractor to initially commission and verify the meter readings into the BMS metering system(s) and to then re-validate the readings after a nominal period of time has transpired. It is also the BMS contractor's responsibility to upgrade graphics in the BMS system(s).

It shall be the responsibility of the data contractor to obtain IP addresses and to validate that they have been commissioned and activated. It shall be the responsibility of Curtin University to:

- approve meter labelling
- provide passwords.

9.9.2 METER INSTALLATION AND COMMISIONING

Based on experience from previous hydraulic metering projects, the matrix below leverages each contractor's respective strengths and areas of experience while providing clear delineation on the expectations. Some key areas to note:

1) The Irrigation Contractor (IC) is responsible for the procurement of the M-Bus meter head (which will be specific to the physical meter installed) but the Electrical Contractor (EC) is responsible for the installation of the meter head.
2) The Electrical Contractor (EC) is responsible for the supply and installation of all electrical wiring and gateways in accord with the system design up to the Curtin-owned network switch.

3) DTS as owners and managers of the network are responsible for all hardware and software configuration between the network switch and the application servers (e.g. RSS, BMS, etc.)

4) The BMS Contractor (BC) is responsible for all onsite programming of devices including the M-bus head and the gateways. If required under the scope they may also be required to integrate the data from the gateway into the BMS.

5) The RSS Contractor (RSC) is responsible for integration of the data into the RSS database and for creating long-term trend repositories and configuring reports, trends, master-submeter relationships, dashboards and tenant statements as per the standard Curtin requirements.

Component	Supply	Install	Programming
Meter	IC	IC	N/A
M-Bus Head	IC	EC	BC*
Cabling (M-Bus Head to Gateway)	EC	EC	N/A
Gateway	EC	EC	BC*
Cabling (Gateway to Switch)	EC	EC	N/A
Network Configuration, Allocation of IP Addresses, etc	DTS	DTS	DTS
BMS Integration (if required)	BC	BC	BC
RSS Integration	RSC	RSC	RSC

*Substitute with IC if there is no BC.

9.9.3 METER VALIDATION

Meter validation refers to the end-to-end validation between the meter and the application databases (BMS and RSS). Meter validation works will not commence until network connection between the physical meter and the applications has been confirmed and data histories have been configured.

Two separate meter readings of consumption will be recorded with a gap of at least five days in between and containing a load. For new buildings and low utilisation legs, consumption may need to be forced by running taps, boilers, etc. A meter verification record will include the following evidence (at a minimum) for both the first and second readings:

1) the meter faceplate reading including any decimal places and units, time and date-stamped with a supporting photograph

2) a screenshot from the M-Bus programming software showing the current reading including decimal places, time and date-stamped

3) a screenshot of the gateway showing the value being read from the M-Bus head including decimal places, units, time and date-stamped

4) a screenshot of the history database for all applications (RSS, BMS, etc.) illustrating the recorded reading and units for the same point in time as the physical reading.

Responsibility for each reading is as follows:

Description	Responsible Contractor
Physical Meter Reading and Photo	IC
M-Bus Software Reading and Screenshot	BC
Gateway Reading and Screenshot	BC
BMS Software Reading and Screenshot	BC
RSS Software Reading and Screenshot	RSC
Data Collation into Validation Register	RSC

The data from these readings will be recorded in a validation register which details the following and is the responsibility of the RSS contractor:

1) Archibus reference
2) serial number of the meter
3) physical location
4) network information to connect to the device, which may include GatewayIP, Instance Number, Device ID, MAC Address, MSTP Number, Remote Address, Instance Number, etc.
5) first and second readings from the faceplate, RSS and BMS with time and date stamps
6) a comparison of the consumption recorded in the validation period on the physical meter and in any applications.

Any meters where the recorded consumption deviates from the faceplate by more than 2% will be validated on a third occasion or further investigated to understand where the discrepancy has originated.

In the event of a failure, the Contractor must liaise with RSC to ensure the meter has been commissioned and configured correctly and the validation process has been repeated until the meter passes.

9.10 APPLICABLE STANDARDS

Reference	Application
OIML R 49-1:2006	Water Meters Metrological and Technical Requirements
AS/NZS 3500	Plumbing Code
AS/ACIF S009:2013	Installation Requirements for Customer Cabling (Wiring Rules)
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AS/NZS3080:2013	Telecommunications installations - Generic cabling for commercial premises (ISO/IEC 11801:2002, MOD)
Modbus Application Standard V1.1b	Group of standards governing the Modbus Protocol
Industrial Communication Network Profiles IEC 61784	

Fieldbus IEC 61784	
EIA-485	Communication standard for RS-485 installation
Building Services Labelling Standard	Curtin labelling requirements of all asset types for Curtin University
000313 PDG Data Communications Cabling Requirements	Curtin Data Communication Cabling Standards and Specifications

The currency of the above standards will change from time to time and it is the designer's and Contractor's responsibility to ensure that the currently applicable standards are used.

9.11 DATA AND REPORTS

Data will be retrieved via the IP network. In all cases, no matter the software, hardware and data storage systems in place, some calculations will still be required, but this tends to be at the reporting software level where, for the reports to be meaningful, they will need to encompass:

- date and time
- irrigation supply flow rate (l/s)
- cumulative annual total and monthly consumption (litres)

The reporting software system will make use of the information for reports, including but not necessarily limited to;

- hourly data presentation of intervals from 5 minutes to 15 minutes to suit application requirements
- summation of hourly data for consumption purposes
- daily data presentation
- summation of daily data for consumption purposes
- monthly data presentation
- monthly data presentation to suit the number of days with various summations
- annual data presentation to suit the number of months with various summations
- comparison of data with same time last year results
- comparison of data to irrigation use, available capacity, floor area (gross, nett and/or irrigated areas) and other benchmarks for each facility.

10 COMMUNICATIONS (DATA)

10.1 GENERAL

The following section outlines the general requirements for data and communications. The Contractor shall install data points sufficient to provide communications via the ICT network. Data design and installations shall be in accordance with *000313 PDG Data Communications Cabling Requirements.*

Consult with the Curtin Network Infrastructure Manager on requirements for data point (TO) security.

10.2 INTEGRATION OF METERS TO CAMPUS NETWORK

The following diagram is provided to indicate one strategy of provision of a data point to an internally mounted meter enclosure.

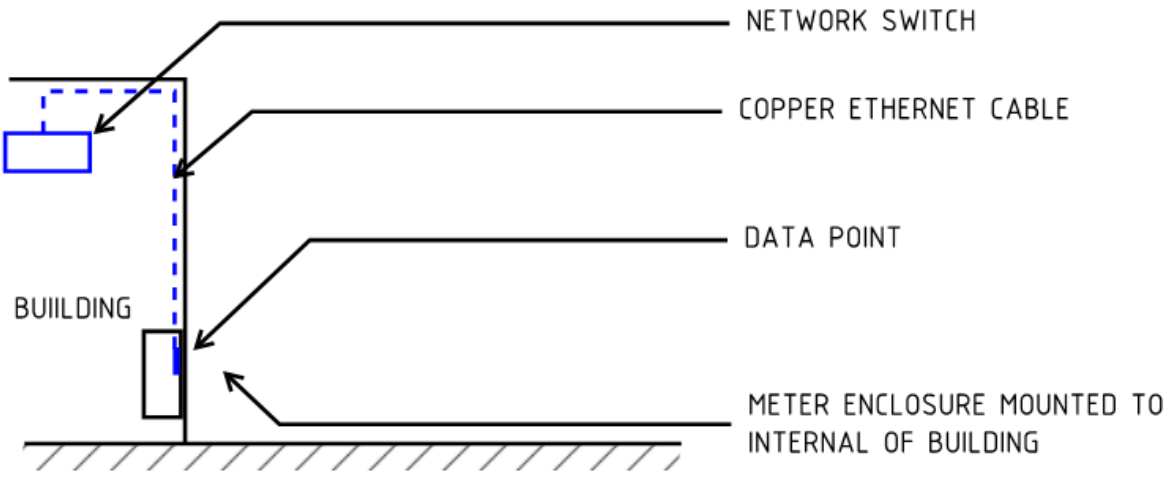

Figure 10A – Data point to meter enclosure mounted internal to building

The following diagram is provided to indicate one strategy of provision of a data point to an externally mounted meter enclosure.

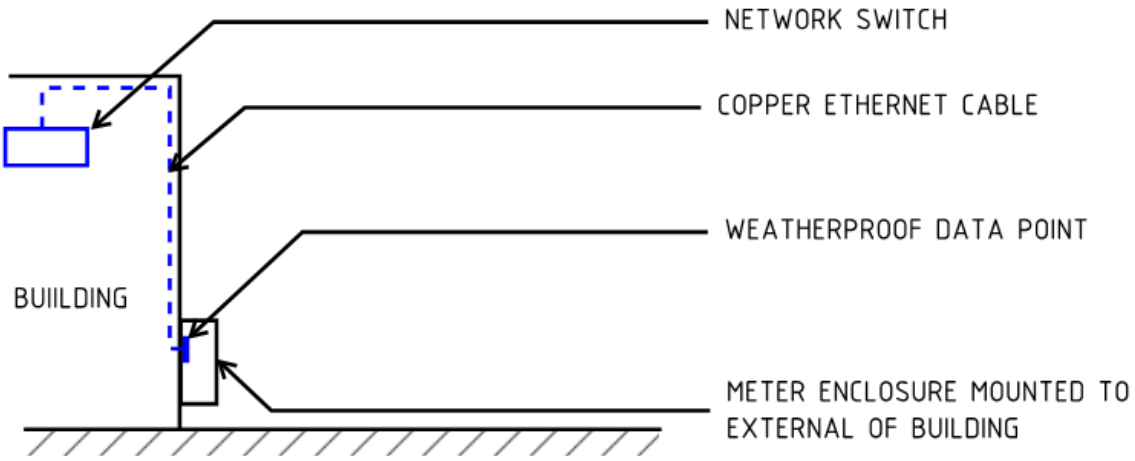

Figure 10B - Data point to meter enclosure mounted to exterior of building

The following diagram is provided to indicate a strategy for provision of a data point, external to a building that requires the use of fibre-in-conduit communication.

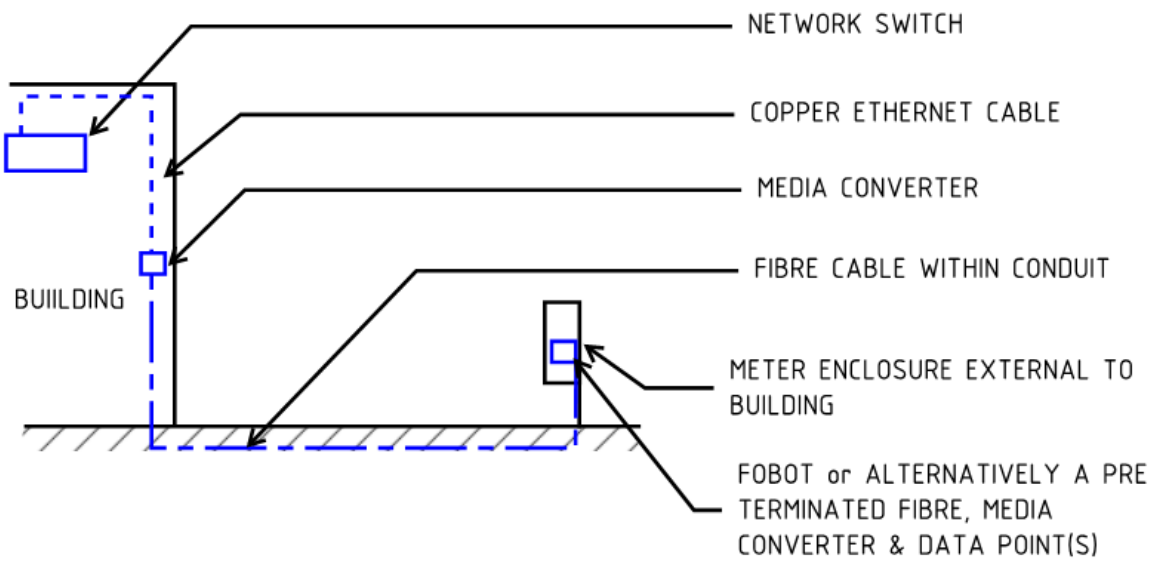

Figure 10C - Data point, remote to buildings that requires the use of fibre communication

As technologies progress, there may be alternative means of connecting to data and/or communications networks. Alternatives may include POE, LoRa or radio. Should there be a case for such alternatives, the Consultant shall consult with Infrastructure Managers prior to commencing design.

10.3 REQUESTING AN IP ADDRESS

The process below must be followed when requesting IP addresses from Curtin University. Please allow seven days for the process to be completed. IP addresses are for telecommunications outlets (TO).

Copy all the text below, complete the information above the line and email Properties System Support on PropertiesSystemSupport@curtin.edu.au. The support group will complete the information below the line:

Table 10-1 - IP Address Request

Building	Xxx
Device Type/Model	Xxx
TO Room #	Xxx
TO #	Xxx
TO Colour	white/green/blue CAT5E/CAT6/CAT6A
MAC Address	Xxx
IP Allocation	

Subnet Mask	255.255.254.0
Default Gateway	

10.4 COMMISSIONING

It shall be the responsibility of the data contractor to obtain IP addresses from Curtin and to validate that they have been commissioned and activated. The data contractor shall obtain the necessary details from the Contractor, Metering Contractor or Sub-Contractor to facilitate requesting an IP address.

11 APPENDIX REFERENCE DOCUMENT

The following reference document can be found within the Project Delivery Guidelines listings on the Guidelines page of the Properties, Facilities & Development website at:

https://properties.curtin.edu.au/workingwithus/guidelines.cfm

The Services Metering Commissioning Sample Forms document provides sample forms for:

- Commissioning Sheet
- Thermal Metering Sample Registers
  - FM Asset Register, which replaced the following:
    - Device Register
    - CMMS Register
  - Data (TO) Register
  - Validation Register
- Cooling Tower Water and Waste Metering Sample Registers
  - FM Asset Register, which replaced the following:
    - Device Register
    - CMMS Register
  - Data (TO) Register
  - Validation Register.