UNITED ENERGY

Document No UE PL 2037

METERING STRATEGY

AND PLAN

This document outlines the Life Cycle Strategy and Plan for Metering Assets on United Energy's network

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1. Executive Summary

This Metering Strategy and Plan (MSP) outline the strategy for United Energy electricity metering assets. Metering assets are predominantly AMI (Advanced Metering Infrastructure) direct and current transformer (CT) connected meters, but also include a diminishing number of non AMI meters as well as Low Voltage Current Transformers (LVCTs).

MSP involves a combination of monitoring and planned maintenance testing to ensure regulatory compliance, efficient and cost effective utilisation of the assets while minimising risks. All metering equipment purchased by UE is Pattern Approved, meets the required standards and is issued with Verification test certificates.

Monitoring and planned maintenance testing consists of metrological accuracy testing, reviewing event data and a physical inspection of the metering assets. Where metering equipment fails the prescribed testing regime, the equipment will be deemed faulty and replaced.

Metering assets that are removed from service due to faults are assessed to determine if there are systemic issues with the equipment or if it is an isolated incident.

United Energy is a Market Participant and Responsible Person (RP) as defined under the National Electricity Rules (NER) and as such has Meter Provider (MPB) accreditation. A key requirement of the NER is for a RP to have an approved Metering Asset Management Strategy (MAMS). United Energy has a MAMS that is approved by the Australian Energy Market Operator (AEMO). The MAMS is a key document that needs to be referred to when reading this MSP.

UE achieves the objectives in this document by implementing the following strategies across the whole of the asset life cycle:

- Comprehensive specification and assessment of vendor products to ensure that the product purchased and installed meets the functional and reliability requirements of the business and key regulatory requirements as defined in the National Measurement Act, the NER and Jurisdictional requirements, with a goal of achieving the lowest overall life cycle cost while meeting all regulatory and legal requirements;
- Implementation of a meter equipment testing program as per the AEMO approved Asset Management Strategy;
- Risk analysis on metering assets.

2. Introduction

This document specifies the strategies for lifecycle management of Metering Assets to

- Meet regulatory compliance in ensuring accuracy of the metering installation and all other Service Level Requirements.
- Minimise or avoid systematic expensive damage to valuable strategic assets.
- The actual service life of Advanced Metering Infrastructure (AMI) meters is not proven at this point in time however it is expected to be at least 15 years. This strategy addresses the monitoring, maintenance and replacement options to sustain the metering system.

This Strategy covers UE Metering infrastructure, which comprises:

- AMI & Non AMI Electricity Direct and Current Transformer (CT) connected Meters.
- Low Voltage Current Transformers (LVCT).
- Inter Distribution Business (DB) High Voltage Metering in Zone Substations.

It does not include:

- AMI communication Relays and Access Points.
- AMI Network Management System.
- Back Office Systems (such as the Itron IEE Meter Data Management system or SAP IS-U Network Revenue Management system).
- Customer Home Area Network (HAN) devices (such as in home displays).
- Asset operations (Customer relations, Finance, HR, etc.).

3. Purpose

This document forms the Asset Lifecycle Strategy and Plan for the Metering Assets within United Energy. It is intended to define the specific approach to, and principles for, the management of Metering infrastructure within United Energy.

It provides a justified and evidence based Asset Lifecycle Strategy that is used to forecast the volumes and types of intervention and associated costs/risks considered necessary to achieve a defined level of infrastructure, system or asset capability or output, for Metering Infrastructure. As such it provides a whole-life; whole-system based intervention and cost/risk analysis for Metering Infrastructure.

This document and the principles captured within it are derived from and consistent with the overall United Energy Asset Management Policy.

As explained in further detail in section 4, this strategy and the principles within it are derived from, and consistent with United Energy's Asset Management Policy. This document is based on good practice guidance from internationally recognised sources, including the Global Forum on Maintenance and Asset Management (GFMAM) and the Institute of Asset Management (IAM). It has been specifically developed to align with key elements of ISO 55000.

This is a "live" document, and will continue to be updated and revised as new information, tools and technology become available.

4. Asset Management Framework

4.1. Asset management objectives

United Energy is committed to the efficient and safe delivery of reliable services to customers. Efficient and effective management of United Energy's electricity network assets is critical to achieving this outcome.

Accordingly, United Energy has an asset management framework in place, which aims to:

- ensure the safety of the public and United Energy's personnel and contractors at all times;
- ensure that all compliance obligations are met;
- manage risk efficiently; and
- ensure the prudent, efficient and reliable delivery of an essential service that meets customers' and stakeholders' needs.

The asset management framework aligns United Energy's Asset Management Policy, strategy and Life Cycle Management Plans to ensure the achievement of the company's overarching corporate objectives. This is explained in further detail below.

4.2. Overview of the framework

United Energy's asset management framework provides an integrated and structured approach to guide the development, coordination and execution of asset creation and maintenance activities so as to optimise the total lifecycle costs, risk and performance of United Energy's network assets. As such, the framework provides a key conduit for the execution of United Energy's corporate plan. It provides a clear line-of-sight between the delivery of asset management projects and activities, and the company's overarching corporate objectives, which are detailed in UE PR 2051.

The asset management framework translates United Energy's corporate plan into specific asset management objectives and actions. It employs a systematic approach - including processes and documented asset strategies and plans – to ensure that the asset management objectives and actions deliver prudent and efficient outcomes over the asset life cycle. The framework ensures the alignment of asset management activities with all other related management processes, including United Energy's risk management, health and safety, environmental and quality management systems.

The framework is shown in the diagram on the following page. The diagram shows how this Life Cycle Management Plan fits into the overarching asset management framework governed by United Energy's corporate strategy. A detailed description of the framework is provided in United Energy's Asset Management Strategy and Objectives document (UE PO 2050).

This Life Cycle Strategy

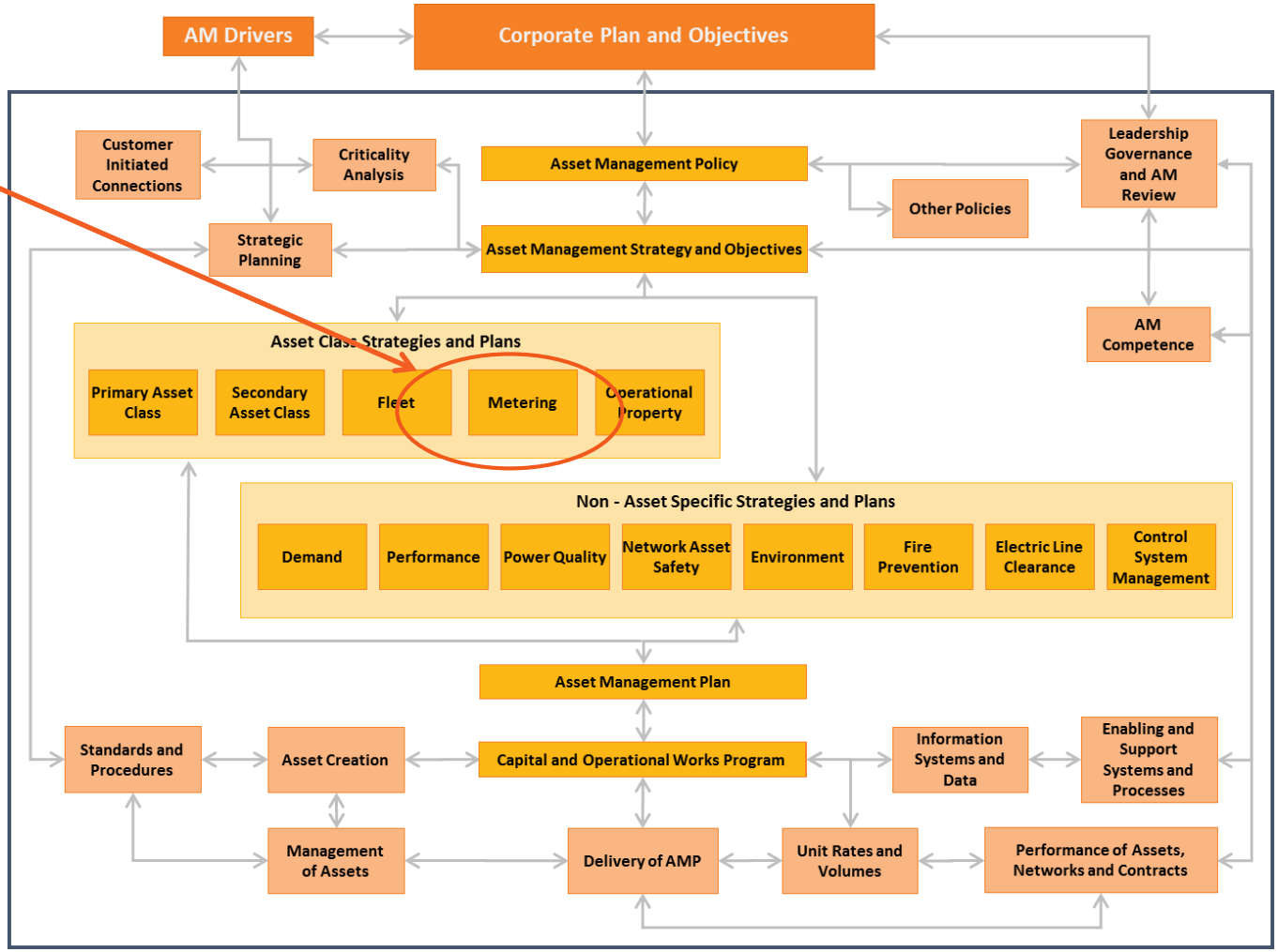


Figure 1: Asset Management Framework

4.3. Asset management drivers

United Energy's asset management plans are driven by the Asset Management Strategy and Objectives, which in turn reflects the objectives set out in United Energy Asset Management Policy (UE PO 2001), which was promulgated by the Chief Executive Officer in December 2014. The Asset Management Policy identifies the following principles as the basis for all asset management expenditure:

- Safety
- Risk
- Performance
- Legal & regulatory
- Customer Service
- Continuous improvement & innovation
- Good asset management
- Adherence to relevant Australian & International standards
- Minimise of long-term cost structure
- Reputation
- Skills and Resources

Further details of the way in which these drivers are taken into account in the development of this particular Life Cycle Management Plan are provided in section 6.

4.4. Alignment with good asset management practice

United Energy's asset management framework has been developed based on good practice guidance from internationally recognised sources, including the Global Forum on Maintenance and Asset Management (GFMAM) and the Institute of Asset Management (IAM).

In January 2014, ISO 55001 was released by the International Organisation for Standardisation as the new international standard for asset management systems. United Energy's asset management framework now aligns with key elements of ISO 55001. Aligning United Energy's asset management system with key requirements of ISO 55001 provides all stakeholders with a high level of confidence that risks and costs associated with the management of assets are carefully considered and optimised.

5. Scope – Metering Assets

5.1. Asset Function

UE operates the electricity distribution network in Melbourne's South East and the Mornington Peninsula. UE is the licensed entity charged with carrying out the role of electricity distribution in accordance with all legal and regulatory requirements.

There are approximately 665,000 AMI meters (more than 95% of installations), electromechanical, electronic accumulation and electronic interval meters and over 24,000 LVCTs installed in the UED network. These assets are individually relatively low cost items but as an asset class, meters represent a significant proportion of the total value of the network. Each customer installation has a meter installation to record the consumption and where applicable the generation of electrical energy. Only medium to large customers also have LVCTs included as part of the metering installation.

As the Local Network Service Provider (LNSP) and default Meter Provider (MP), regulatory responsibility requires UE to provide metering infrastructure and services to 1st and 2nd tier customers who consume less than 160MWhrs per annum within its Distribution Network (where UE is Responsible Person).

UE is also responsible for meter installations, maintenance and testing associated with 1st tier customers who consume greater than 160MWhrs per annum with in its network where a contestable MP has not been contracted by the customer's Retailer to provide the corresponding metering services.

To facilitate all its obligations, UE has established contracts with a number of service providers to carry out all its' metering services. These contracts ensure that UE metering assets operate as per the regulatory requirements, are fit for purpose as well as being a technically correct and safe installation of metering equipment for the purpose of accurately recording and charging customers for their energy consumption.

UE is also adapting its current metering practices to incorporate and leverage operational benefits associated with AMI metering. It is envisaged that efficiencies in managing AMI meter equipment can be gained from both a strategic and operational perspective as well as ensure that UE delivers on being an Intelligent Utility that provides customers access to the best technology and the most advanced network.

5.2. Asset Interfaces

As per Victorian Government mandate, Advanced Metering Infrastructure (AMI) has been deployed for most customers, with consumption less than 160 MWh per annum. Figure 4 provides a high-level overview of the AMI communication and metering system. The system consists of customer meters, communication infrastructure consisting of Access Points and Relays and the management system for the network (NMS). Meter communications is realised using Silver Springs mesh radio or Local Area Network (LAN). The LAN is a self-configuring network which determines the best route for messaging between Meters and pole mounted Access Points. The route may be via a series of other meters and / or pole mounted Relays. From Access Points the 3G mobile network or WAN is used to connect with the NMS. The Home Area Network (HAN) enables devices in the home to be interfaced to the meter and upstream services.

The AMI components are summarised in Table 1 and described in the following sub-sections. This includes AMI Metering infrastructure and AMI Communication Infrastructure. This Strategy includes only Metering Assets.

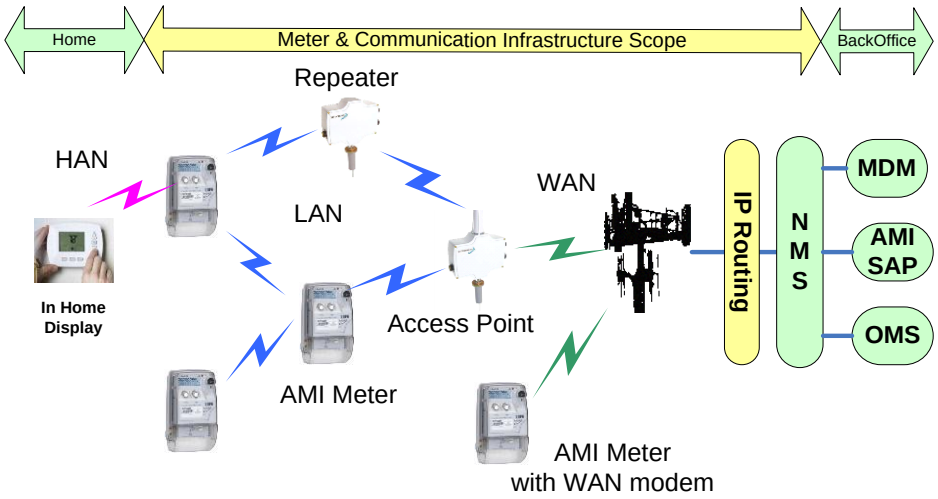


Figure 2: Advanced Metering Infrastructure

Table 1 : AMI Infrastructure Components

Component	Function	Provider	DOCUMENT SCOPE
Communications			
Access Point	WAN – LAN Interface	SSN	No
RELAY	LAN range extender	SSN	No
AP & Relay Battery	Battery backup for APs & Relays	SSN	No
WAN Service	Communication service from AP / WAN enable meters to NMS	Telstra	No
Meter Antenna	Used when meter is installed in a metal meter box	Secure	No
Meters			
iCredit 500- CAT 1	Single phase single element	Secure	Yes
iCredit 500- CAT 2	Single phase single element with contactor	Secure	Yes
iCredit 500- CAT 3	Single phase two element with contactor	Secure	Yes
Sprint 200 –CAT 4	3 phase direct connect	Secure	Yes
Sprint 200 –CAT 5B	Three phase direct connected meter with contactor	Secure	Yes
Premier 200 – CAT 6A	3 phase CT connected	Secure	Yes
Premier 200 – CAT 6B	3 phase CT&VT connected	Secure	Yes
NMS			
NMS software	Production, Test, DR	SSN	No
Hardware	Servers etc.		No
Tools			
M-Cubed	Portable Secure meter communication test tool PC required	Secure	Yes
Flextend	Meter Program (tariff) generation	Secure	Yes

UE's mmetering Infrastructure now includes and interfaces with the following components.

- Direct connect and CT connected energy meters
- Remote communications Network Interface Card (NIC)integrated within AMI meters
- Metering Current Transformers
- Metering Voltage Transformers
- Load control devices
- Cables connecting metering components
- Utility IQ (UIQ), which is the AMI network management software application
- Access Points and Relays

In addition to the AMI metering, there are approximately 10 inter DB sites for which UED is responsible for metering provision. Each installation has an energy meter and instrument transformers to record the bidirectional active and reactive interval energy. These meters are Type 2 or 3 metering installations as per National Electricity Rules.

UE is not responsible for any High Voltage Customer metering as all that customer type have transitioned to a competitive MP where the Retailer is the RP.

Due to the increase in technical complexity associated with AMI infrastructure, there is now a greater emphasis for various departments within UE to coordinate their day to day activities. Real time data from AMI infrastructure require UE to establish and execute a coordinated approach to deal with network or AMI infrastructure issues that impact on UE operations and or UE's customers.

To establish an effective and coordinated approach to resolve technical issues, it is envisaged that UE will continue to develop and integrate UIQ with IT systems to further leverage AMI infrastructure data capability.

5.3. Asset Base

UE have an array of meter infrastructure that accommodates particular installation requirements. These installation requirements are subject to demand and the physical attributes for the site. UE's metering infrastructure can be summarised within the following categories.

5.3.1. LV Meters

United Energy is responsible for approximately 665,000 Low Voltage Metering Assets. These assets consist of Basic, Interval & AMI Meters that are either single or multiphase.

Table 2 : LV Meter Asset base as on 31 Dec 14

Meter Type	Population
Accumulation Meters	
Single phase non off peak	9418
Single phase off peak	5510
Multi-phase direct connect	9891
Three phase Current transformer connected meter	214
Total accumulation meters	25033
MRIM meters	
Single phase non off peak	460
Single phase off peak	91

Meter Type	Population
Multi-phase direct connect	690
Three phase Current transformer connected meter	461
Total MRIM meters	1,702
AMI meters	
Single phase single element	486,328
Single phase single element with contactor	13,121
Single phase two element with contactor	52,512
Three phase direct connected meter	85,216
Three phase direct connected meter with contactor	3,703
Three phase Current transformer connected meter	2,525
Total AMI meters	643,405
Total meters	670,140

5.3.2. LV Current Transformers

United Energy is responsible for approximately 3200 current transformer sites. There are 3 LVCTs per site.

Table 3 LV Current Transformer Assets

Type	Quantity
LVCT's Ue Responsible	9366
LVCT's Ue only supplied	14900

5.3.3. HV Inter DB Metering:

Below table lists Metering Assets in United Energy Zone Substations.

Table 4 HV Inter DB Assets

Feeder / Meter/ Transformer	Type of Energy Meter		kV	Connected Ratio	Manufacturer	Available Ratios/Burden
WD STATION						
WD Feeder 2	Mk6E	CT	11	400/5	Dalian	400-600/5 15 VA
WD Feeder 4	Mk6E	CT	11	400/5	Dalian	400-600/5 15 VA
WD Feeder 6	Mk6E	CT	11	400/5	Dalian	400-600/5 15 VA
WD Feeder 7	Mk6E	CT	11	400/5	Dalian	400-600/5 15 VA
WD Feeder 12	Mk6E	CT	11	400/5	Dalian	400-600/5 15 VA
WD Transformer 1		VT	11	11000/110	Dalian	11000/110 50VA

Feeder / Meter/ Transformer	Type of Energy Meter		kV	Connected Ratio	Manufacturer	Available Ratios/Burden
WD Transformer 2		VT	11	11000/110	Dalian	11000/110 50VA
WD Transformer 3		VT	11	11000/110	Dalian	11000/110 50VA
DN STATION						
DN-HPK Meter Rev	Mk3	CT	66	800/5	PFIFFNER	800-1200/5
DN-HPK Meter Check	Mk3	CT	66	800/5	PFIFFNER	800-1200/5
HPK 66KV Line VT		VT	66	66000/√3/ 110/√3 /110/√3	ABB	1HSE8727 463
EW STATION						
EW Transformer 1	Mk1	CT	11	1600/5	Email	400-800-1200-1600/5, 25-40-40-40 VA -50VA, Class BM-C
EW Transformer 2		CT	11	1600/5	Email	400-800-1200-1600/5, 25-40-40-40 VA -50VA, Class BM-C
EW No1 Bus VT		VT	11		Email	11000/110, 200VA, Class A
EW No 2 Bus VT		VT	11		Email	11000/110, 200VA, Class A
K STATION						
K Feeder 11	Mk1	CT	11	400/5	Westinghouse Roseberry Pty Ltd	400-200/5 25 - 15VA
K Transformer 3 No 3 Bus	Mk1	CT	11	800/5	Email	400/600/800/1200/5 25/40/40/40VA
K Transformer 3 No 2 Bus		CT	11	800/5	Westinghouse	400/600/800/1200/5 25/40/40/40VA
K Transformer 2 No 2 Bus		CT	11	800/5	Westinghouse	400/600/800/1200/5 25/40/40/40VA
K Transformer 2 No 1 Bus		CT	11	800/5	Westinghouse	400/600/800/1200/5 25/40/40/40VA
K No 2 Bus VT		VT	11		Email	11000/110, 200VA, Class A
K No 3 Bus VT		VT	11		Email	11000/110, 200VA, Class A

To date UE have been actively replacing its current meter asset base of basic and interval meters with AMI meters. Based on current projections and best endeavours, it is envisaged that at the conclusion of 2015 calendar year, there will be approximately 15,000 active legacy meters within the United Energy network.

Due to the conclusion of the AMI meter mass rollout program in 2015, these sites will not have an AMI installed as part of dedicated program. Over time, these sites will have their non AMI meter replaced, where the current meter fails accuracy testing, is deemed faulty or the customer requests an alteration to the meter installation or specially requests for an AMI compliant meter to be installed.

5.4. Asset Information Requirements

In order to best manage UE's assets, all information about the asset and its' performance metrics are required in order to make informed decisions that best meet the business objectives as well as to meet legal and regulatory requirements. This includes:

- Installed asset data & attributes, including but not limited to, asset design and construction, asset attributes, manufacturer information including intended performance, drawings, reports and test certificates;
- Regulatory information such as Pattern Approval, Type Test Results, Standards, accuracy and standing data related to electricity market requirements;
- Periodic accuracy testing & inspection of metering installation;
- Applicable asset condition data taken from smart meter throughout the asset's life. Remotely
- Importance is given to metrological performance.

6. Metering Asset Lifecycle Management Objectives

Based on and aligned with the United Energy corporate and organisational objectives a suite of Asset Lifecycle objectives are defined below which will assure that management of the changing asset base and requirements (as defined above) is achieved in the most robust, efficient and sustainable manner.

The objective of the strategies specified in this document relating to the lifecycle management of metering assets is to:

- Comply with all legal and regulatory requirements (compliance, safety, security, etc.)
- Minimize life cycle cost while maintaining asset value, availability, integrity and capacity
- Ensure that risk does not exceed the level acceptable to the business
- Promote increased asset utilization & value (by evaluating & developing new opportunities)
    - Use standard components (where ever possible) to minimise cost and risk associated with unique systems and to take advantage of potential feature improvements
    - Maximise system flexibility to allow for future opportunities
    - 15 year warranty on AMI meters
    - Influence regulation regarding testing activities
    - Ensure the correct use and application of the asset from a technical and cost perspective

7. Asset Profile & Historical Analysis

7.1. Asset Age & Service Life

As of 31 Mar 2014, there are approximately 665,000 active Electricity Meters within the UED network.

Prior to the AMI meter program, a significant proportion of UEDs' metering infrastructure had an average 30 years of service. Post 2015, the average years of service years would reduce to less than 15 years due to AMI meters being rolled out from 2009. Nevertheless, there will be a small population of non AMI meters active within the network post 2015 with an average of 30 years of service.

The 15-year asset life of AMI Meter is based on the warranty. While it is possible that the equipment will be viable past this time, factors such as vendor support, technology change & new requirements are likely to warrant asset write off and replacement.

Metering installation Asset Quantity, Age and growth forecasts listed as below.

7.1.1. LV Meters

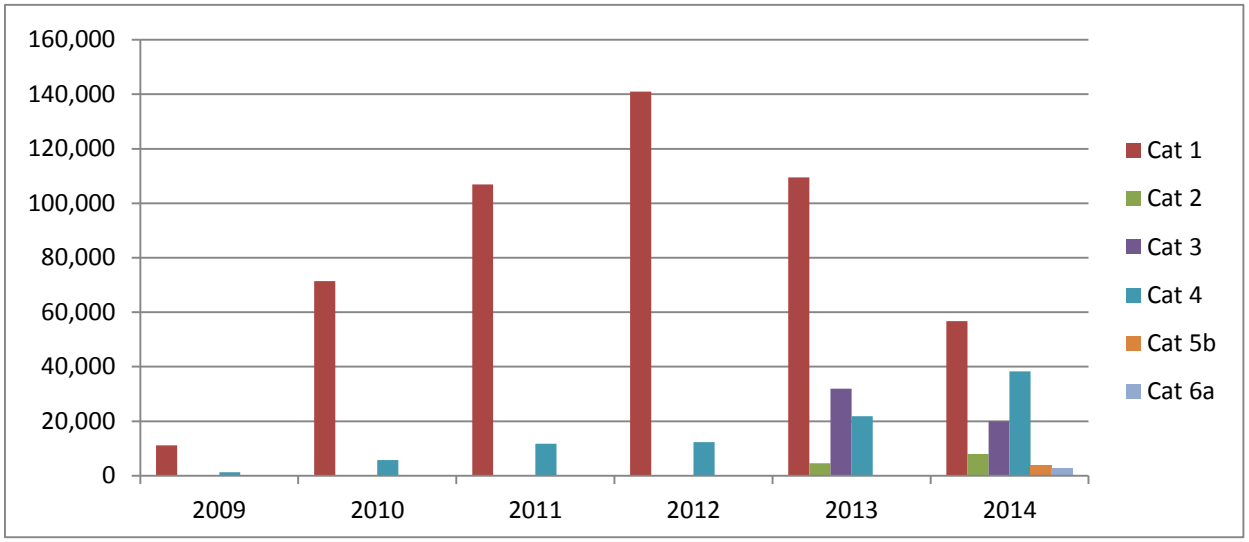
Table 5: Meter Quantity- 31 Dec 2014

TYPE	DESCRIPTIONS	QUANTITIES
Cat 1	1ph, 2 wire / Direct Connect (single element)	486328
Cat 2	1ph, 2 wire / Direct Connect (single element, 31.5A load control)	13121
Cat 3	1ph, 2 wire / Direct Connect (Two element, 31.5A load control)	52512
Cat 4	3ph, 4 wire / Direct Connect (no load control)	85216
Cat 5a	3ph, 4 wire / Direct Connect (31.5A load control)	0
Cat 5b	3ph, 4 wire / Direct Connect (31.5A and 2A load control)	3703
Cat 6a	3ph, 4 wire Low Voltage Transformer Connect (CT connect)	2525
Cat 6b	3ph, 3 wire High Voltage Transformer Connect (CT / VT connect)	0
Other	Non AMI Meters	25088

Table 6: AMI Meter Age Profile

AMI Meters on Network Installed per Year		2009	2010	2011	2012	2013	2014
Cat 1	Single Phase, single element	11,131	71,453	106,911	140,956	109,494	56709
Cat 2	Single Phase, single element, with 31.5A load control	0	0	0	3	4,569	7947
Cat 3	Single Phase, Two element, with 31.5A load control	0	0	0	0	31,919	19948
Cat 4	3 Phase with no load control	1,232	5,794	11713	12,306	21,834	38344
Cat 5b	3 Phase with 31.5A and 2A load control	0	0	0	0	0	3718
Cat 6a	3 Phase CT connect	0	0	0	0	0	2524
Cat 6b	3 Phase CT & VT connect	0	0	0	0	0	0

Figure 3 : AMI Meter Age Profile



7.1.2. LV Current Transformers

Table 7 : Low Voltage Current Transformer Age Profile

CT Type	Installation years	Ratio	NMI	Total CT quantity
A Type	pre-1979	150/5	61	183
150-300-600/5	pre-1979	300/5		
	pre-1979	600/5		
A Type	1979-1988	150/5	89	267

CT Type	Installation years	Ratio	NMI	Total CT quantity
150-300-600/5	1979-1988	300/5		
	1979-1988	600/5		
A Type	1989-1998	150/5	46	138
150-300-600/5	1989-1998	300/5		
	1989-1998	600/5		
B Type	pre-1979	400/5	42	126
400-800-1200/5	pre-1979	800/5		
	pre-1979	1200/5		
B Type	1979-1988	400/5	123	369
400-800-1200/5	1979-1988	800/5		
	1979-1988	1200/5		
B Type	1989-1998	400/5	167	501
400-800-1200/5	1989-1998	800/5		
	1989-1998	1200/5		
B Type	1999-2003	400/5	146	438
400-800-1200/5	1999-2003	800/5		
	1999-2003	1200/5		
C Type	pre-1984	1000/5	7	21
1000-2000-3000/5	pre-1984	2000/5		
	pre-1984	3000/5		
C Type	1984-1993	1000/5	7	21
1000-2000-3000/5	1984-1993	2000/5		
	1984-1993	3000/5		
C Type	1994-2003	1000/5	8	24
1000-2000-3000/5	1994-2003	2000/5		
	1994-2003	3000/5		
S Type 200/5	pre-1979	200/5	48	144
S Type 200/5	1979-1988	200/5	268	804
S Type 200/5	1989-1998	200/5	532	1596
S Type 200/5	1999-2003	200/5	477	1431
TOTAL			2022	6063

7.1.3. HV Metering:

Table 8 : HV Inter DB Metering Asset Base

Feeder / Meter/ Transformer	Station	Type of Energy Meter	Installation year
WD Feeder 2	WD	Mk6E	2013
WD Feeder 4	WD	Mk6E	2013
WD Feeder 6	WD	Mk6E	2013
WD Feeder 7	WD	Mk6E	2013
WD Feeder 12	WD	Mk6E	2013
DN-HPK Meter Rev	DN	Mk3	2010
DN-HPK Meter Check	DN	Mk3	2010
EW Total Tr 1& 2	EW	Mk1	2002
K Feeder 11	K	Mk1	2002
K Transformer 3 No 3 Bus	K	Mk1	2002
K Transformer 3 No 2 Bus	K		
K Transformer 2 No 2 Bus	K		
K Transformer 2 No 1 Bus	K		

From 2015, the number of installed meters will increase with population growth. The expected annual meter growth is 6500 for year 2015 and 2016. We have estimated no meter growth from year 2017 due to metering contestability. Estimated cumulative numbers of meters at the end of each year given in the below table.

Table 9: Cumulative Meter number forecast

Cumulative number of meters						
Accumulation meters	31-Dec-15	31-Dec-16	31-Dec-17	31-Dec-18	31-Dec-19	31-Dec-20
Single phase non off peak	7386	6032	5812	5592	5372	5152
Single phase off peak	4321	3529	3400	3271	3142	3013
Multi phase direct connect	7757	6335	6104	5873	5642	5411
Multi phase current transformers	168	137	132	127	122	117
Total accumulation meters	19633	16033	15448	14863	14278	13693
MRIM meters						
Single phase non off peak	298	190	172	154	136	118
Single phase off peak	59	38	35	32	29	26
Multi phase direct connect	447	285	259	233	207	181
Multi phase current transformers	298	190	172	154	136	118
Total MRIM meters	1102	702	637	572	507	442
AMI meters						
Single phase single element	493744	500493	495055	489617	484179	478741

Cumulative number of meters						
Single phase single element with contactor	13489	13737	13595	13453	13311	13169
Single phase two element with contactor	53122	53514	52887	52260	51633	51006
Three phase direct connected meter	88799	91517	90056	88595	87134	85673
Three phase direct connected meter with contactor	4068	4331	4305	4279	4253	4227
Three phase Current transformer connected meter	2683	2812	2756	2700	2644	2588
Total AMI meters	655,905	666,405	658,655	650,905	643,155	635,405
Total meters	**676640**	**683140**	**674740**	**666340**	**657940**	**649540**

7.2. Asset Condition

7.2.1. Meters:

In lieu of MTTF (Mean Time to Fail) data, AMI metering equipment life expectancy is estimated based on contracted warranty requirements.

Table 10 summarises the meter warranty. Refer to the vendor supply terms and conditions for detail.

Table 10 : Meter Warranty

Component	Burn-in	Return to base	Backstop
Secure AMI Meter	45 days	5 years	10 years Excessive defect level >1.5% in any one year with carry forward credit of lower failure rate in earlier years
Meter WAN modem		3 years	4 years
LAN / Meter WAN antenna		1 year	

Burn-in Warranty

Period start: Installation

Coverage: Repair or Replacement + Installation cost (capped)

Return to Base warranty

Period Start: 45 days after installation

Coverage: Unit cost

Backstop warranty

Period start:	following return to base warranty period
Coverage:	Unit & reinstallation cost for excessive defects

In years 5 through 15, meter failure less than 1.5% will not be covered by the backstop warranty.

For the largest meter category – type 1 single phase, no contactor, the maximum cost to UED occurs when the failure rate equals or exceeds 1.5%

= 1.5% x 500,000 = 7500 meters per year and 75,000 over 10 years

7.2.2. LV Current Transformers:

Low Voltage Current transformers failure rate is almost equal to zero. In last 10 years in United Energy network had a total of 10 LVCT failures.

Below graphs explains accuracy average ratio errors (Abs) of current transformers with installation years.

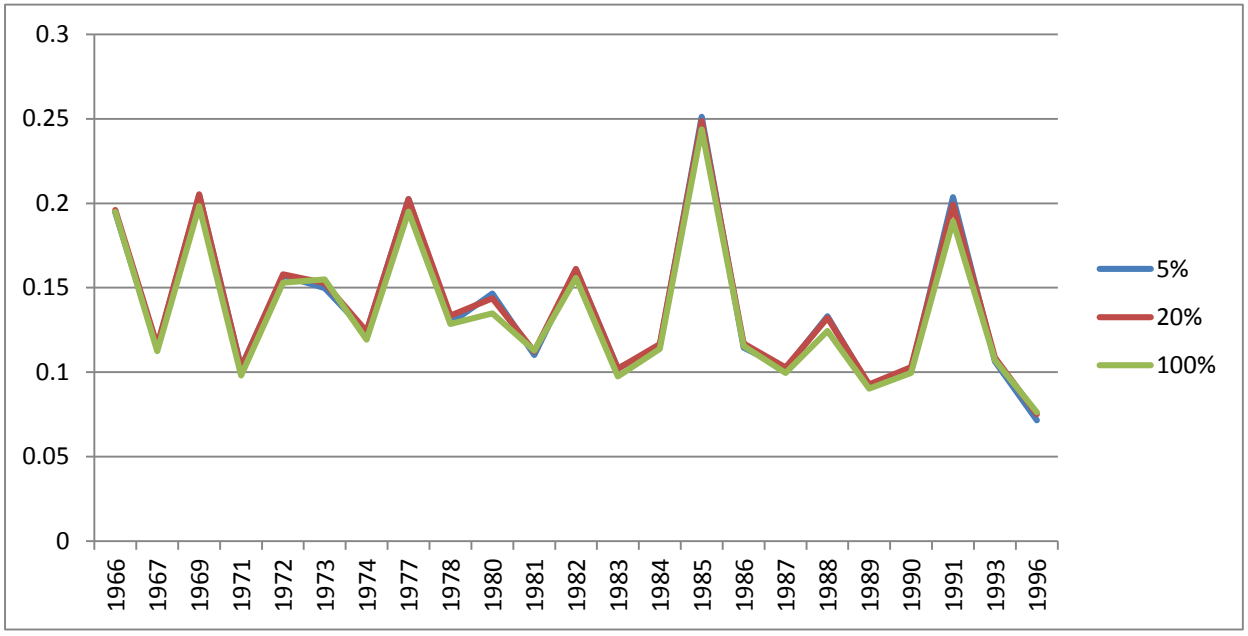


Figure 4 : Accuracy Average ratio errors (abs) with year of install (all tested CTs of A Type)

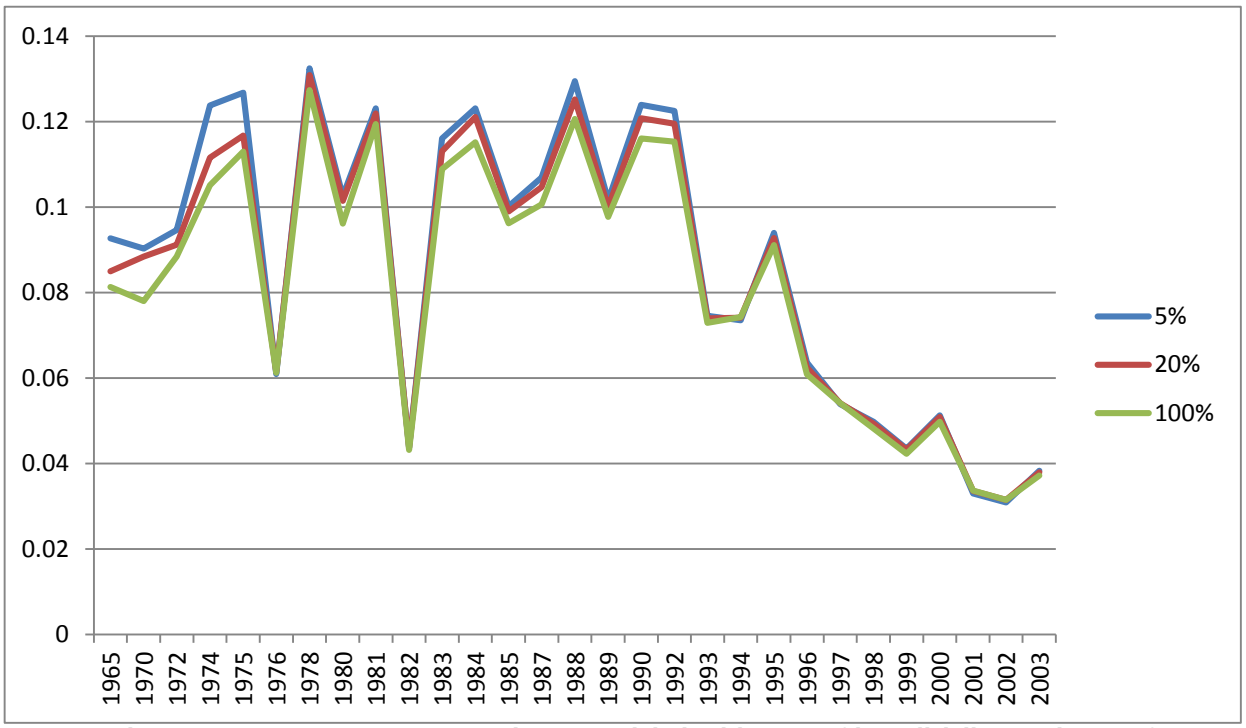


Figure 5 : Accuracy Average ratio errors (abs) with year of install (all tested CTs of B Type)

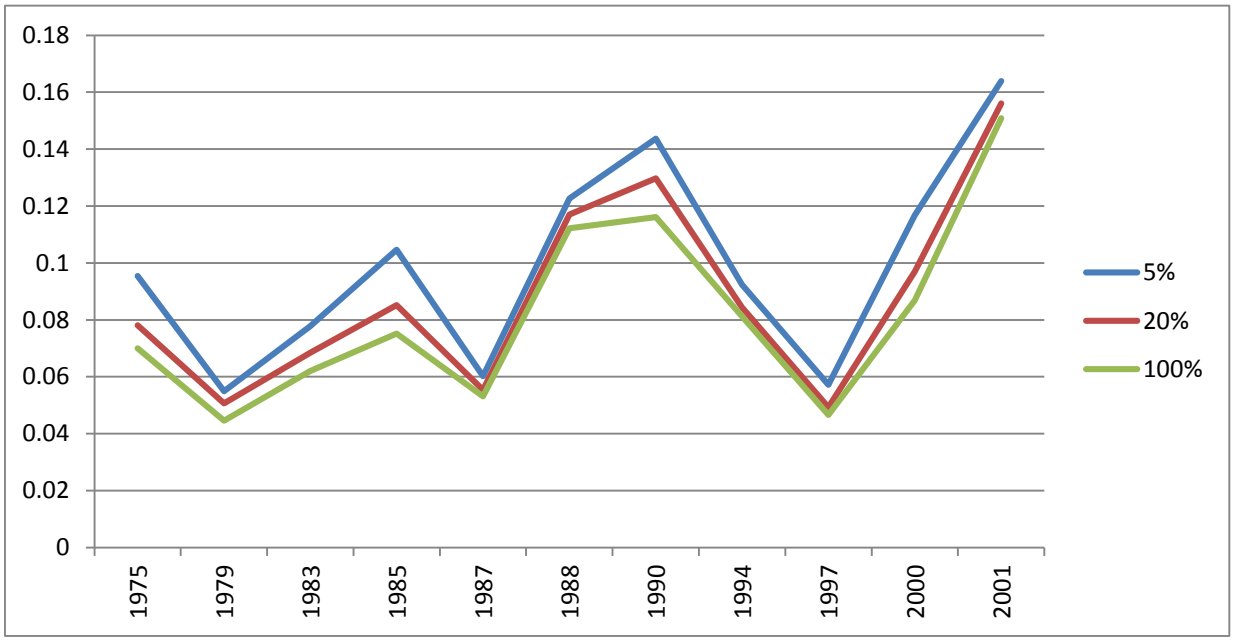


Figure 6 Accuracy Average ratio errors (abs) with year of install (all tested CTs of C Type)

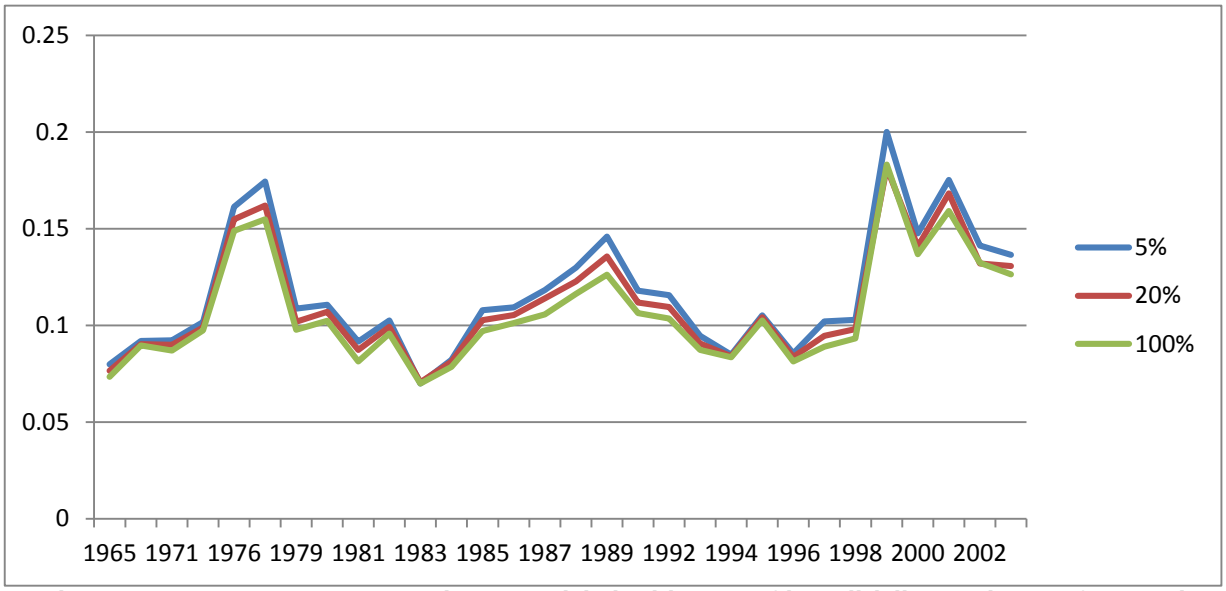


Figure 7: Accuracy Average ratio errors (abs) with year of install (all tested CTs of S Type)

From above trends, we cannot observe any specific trend of current transformer accuracy change with age.

7.3. Failure History

7.3.1. Metering Assets

7.3.1.1 Direct Connect Meters

Since UE commenced installing AMI meters within the distribution network, there has been a failure rate of less than 0.5% for AMI meters installed between 2009- 2013. Each mode of failure is recorded as part of UE's meter asset management practices and detailed within below chart.

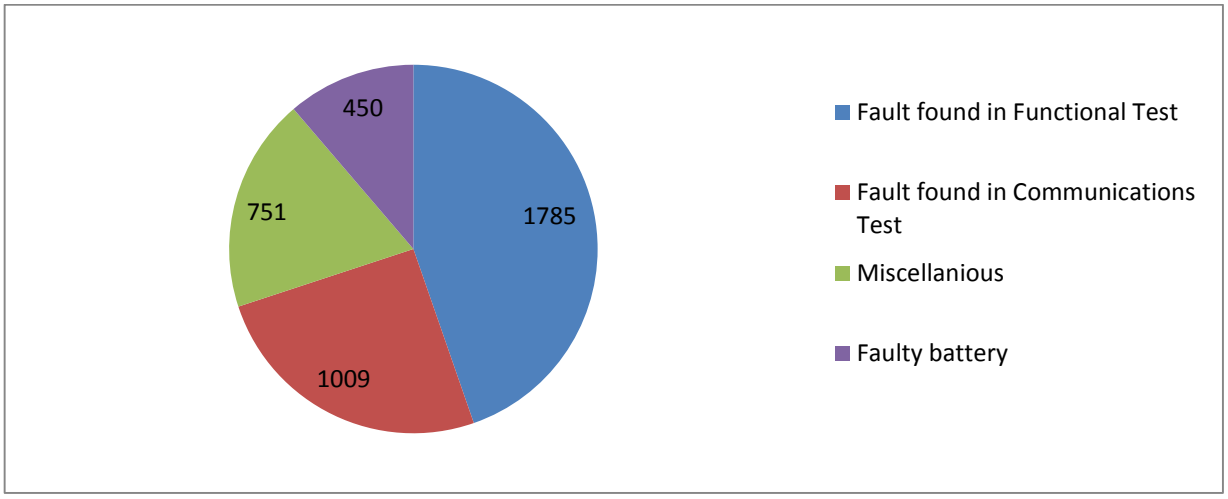


Figure 8 : AMI meter faults from 2009-2013

These failure modes are assessed to determine if the corresponding faults are an isolated incident, associated with a batch of meters issued to UED or if there are any systemic issues with the meter type.

From a metrology perspective, metering assets will be tested periodically as per Meter Asset Management Strategy approved by AEMO.

7.3.1.2 LV/HV Metering

High Voltage metering transformers are tested every 10 years for accuracy and no failures have been found in recent years.

To date, there have been no metrological failures associated with the initial sample testing for AMI meters conducted in 2012 and 2013. All meters families targeted for sample testing passed accuracy testing.

7.3.2. Low Voltage Current Transformers

Low Voltage Current transformers are Epoxy Resin encapsulated, extremely stable and homogeneous. LVCT's accuracy tested by sample testing and also 100% admittance testing every 5 years and no failures found in recent years.

7.4. Operational Expenditure

Metering services operational expenditure forecast given in Appendix-C.

7.5. Capital (Renewal) Expenditure

Metering services capital expenditure forecast given in Appendix-D.

7.6. Other Key Asset Monitoring Metrics

NONE

7.7. Improvements

AMI Meters offer a leap in technical capability that can underpin many of the initiatives which will deliver these Network benefits –

- Using the vast amounts of data available from Smart Meters to improve the quality of the business' forecasting and reporting to deliver efficiency improvements,
- Using the vast amounts of data available from Smart Meters to improve the efficient allocation of field crew resources with day to day metering activities,
- Using the vast amounts of data available from Smart Meters to improve the efficient allocation of field crew resources with day to day metering activities from a financial perspective
- Using the spare capacity in the AMI network to increase the penetration of intelligent monitoring and control,
- Unlocking the advanced capabilities of the Smart Meters to better manage demand, faults and extreme events,
- Build upon the Home Area Network to deliver the information and control needed by consumers to manage their consumption in an increasingly energy conscious world
- Utilise AMI metering data and AMI systems to proactively identify and replace faulty meters.
- Utilise functionalities and notifications to assist in improving metering Asset Management including but is not limited to:
    - Meter tamper flag
    - Reverse running
    - Phase failure
    - Under Voltage
    - Over Current
    - Restoration notifications

8. Asset Criticality

Electricity metering assets are a critical component within the distribution network for market settlement purposes. Metering assets that are deployed at each connection point within UE's distribution network to measure and record the corresponding energy consumed. Metering data is then validated and issued to the market for billing purposes.

Due to the strategic importance and regulatory requirements for these assets from a revenue and market settlement perspective, UE's metering assets must be managed in a manner that ensures their ongoing accuracy, reliability, availability, regulatory compliance and capacity is maintained. Regulatory agencies that govern metering requirements include National Measurement Institute, Australian Energy Regulator, Australian Energy Market Operator, Australian Energy Market Commission, Essential Services Commission and other Government bodies for the compliance of various market rules.

Failure to comply to these regulated requirements, would result in UE breaching its statutory requirements that could lead to substantial penalties and loss of operating license, if deemed necessary,

With the advent of AMI technology, AMI meters have established a layer of complexity. In addition to its core metrology functions AMI meters have been designed with the additional functionality that includes remote two way communication; remote and local dis/reconnections via a 100amp main switch contactor, provision for remote firmware and meter program upgrades. AMI meter functionality identified as being critical in ensuring the correct operation of these assets include.

- 30 minute interval energy data collection
- Correct operation of remote and local de energisation/ re energisation
- Last GASP messaging
- Tampering of AMI meters by a third party (Revenue protection)
- Alarms & Events

From a network perspective, AMI meters have been installed at every connection point within the network that provides critical and real time data to the business to monitor network performance. From this perspective, AMI meters are now becoming a critical component in effectively operating UE's distribution network. Data retrieved from AMI meters to assist in network performance includes but is not limited to:

- Power Quality event recording
- Supply capacity control – Demand management
- Connection point last gasp and power restoration notifications
- Peak load management

From an operational perspective, UE distribution network covers a large geographic area. Therefore, monitoring AMI meter data and events and provide useful information to determine if field visits are warranted. Through real time data and site details, preliminary investigations into suspicious meter installations or faults can be assessed prior to issuing service orders to a field crew for a site inspection. From a resource and financial perspective, UE can effectively utilise its field resources for site visits that are considered as high importance while preliminary office investigation would mitigate the need for some site visits.

9. Asset Deterioration & Consequences

9.1. Deterioration Drivers

Electricity meters are designed and manufactured to meet specific standards that ensures mechanical and metrology compliance. However, meters are still susceptible to both internal and external factors that can compromise physical and electrical design as well as its metrology. Factors that can result in meter being compromised are detail below and prioritised accordingly.

Atmospheric conditions

Operating Voltage & currents.

High Voltage injection

Sabotage /Vandalism of meters

Battery faults

Network Interface Card fault

Age

Operating current exceed the rated value

Switchboard Fire

Theft

Current transformers are Epoxy Resin encapsulated, extremely stable and homogeneous. Deterioration drivers for Current transformers include

High burden

Atmospheric conditions

atrophy due to age

Physical damage

Electrical fault

Switchboard Fire

9.2. Failure Modes

9.2.1. Direct Connect and LV CT Connected Meters

Meters are now manufactured with on board communications models for remote communication purposes as well as internal contactors to control customer dedicated loads. Due to this added complexity with AMI meters, there is now a potential for multiple points of failure.

Failure modes can be segmented into three sections, hardware, firmware and physical construction. In addition to faults attributed to the internal mechanics of the meter, the physical environment to which they are deployed to can also add to the probability of a meter failure. Meters installed within the network are susceptible to environmental contamination, third party tamper and potential high voltage injection associated with lighting strikes HV power lines making contact with LV segments of the distribution network. Approximately 30 HV incidents across the UE's electricity network are reported to ESV each year.

To date, UE have identified 25 different failure modes and are details below:

Table 11: AMI Meter failure modes

Fault code	Fault description
1	No display
2	Communication failure on optical port
3	HAN communication not working
4	LAN communication not working
5	WAN communication not working
6	LCD segment cut
7	LCD backlit not glowing
8	Consumer load does not re-connect
9	Consumer load does not dis-connect
10	Push button defective
11	Physical damage on meter body
12	Any abnormality logged in meter reading data like flags, events etc.
13	MAC ID mismatch between ID shown on display & ID mentioned on sticker pasted on front cover of meter
14	NIC Fault
15	NIC Firmware upgrade error
16	Displayed as disconnected in UIQ but connected in field
17	NIC Rebooting
18	Clock Error
19	CLEM stuck
20	Manufacturing Defect (this covers the terminal screws, labels etc)
21	Refurbish only no faults
22	Refurbish and assess.
23	Meter not powering up
24	Phase 1,2 or 3 not registering
25	Load test or accuracy failed

9.2.2. Low Voltage Current Transformers

UE LVCT testing and inspection program has identified that there is no observed specific accuracy failure mode or trend for Current Transformers and is not dependant on the service life of the asset.

The only observable mode of failure for LV CT's within the last 10 years was associated with atrophy and a broken terminal.

9.3. Consequences

The consequences of the various failure modes detailed within 9.2 can impact UE from regulatory, financial and branding perspective.

The consequence of a meter fault can include the following:

- Customer and retailer complaints due to substitute data
- Incorrect billing
- Unnecessary customer paid tests and meter investigations at the expense of UE
- Loss of reputation for UE brand
- Non-conformance to Victorian Government mandated service level requirements
- Negative media attention
- Non-compliance to regulatory requirements and potential fines or loss of operating licenses

For CT installations, the potential consequences are magnified due to the customer base being considered more sensitive to inaccurate billing.

Response time to identifying and responding to meter faults is also a risk to the business. Failure to effectively and efficiently identify and resolve meter related faults prior to customer intervention may lead to increased financial burden due to:

- Allocating resources to customer relations to assist with customer resolution
- Fines applied by regulators or ombudsmen
- Multiple site visits to resolve customer complaints

10. Intervention Options and Analysis

Over the life cycle of the Metering Assets, we can expect the risk profile of the system to change. Consequently, there will be a need to update the risk assessment periodically to keep the risk evaluation, controls and/or mitigations current.

The sources of risk include:

- Changing Environment (Political, Social, Regulatory, Technical)
- System & Component degradation and/or obsolescence
- System Augmentation (exposing new threats and vulnerabilities)
- Changing security concerns (arising from changing threat sources, threat motivation and likelihood)
- Financial

The life cycle strategy RISK TABLE in Appendix-B assesses the risk identified in this section and defines appropriate controls.

10.1. Minimum WLWS Risk

The recommended strategy for Metering Assets has been developed and continually improved over many years through the use of not only experience and knowledge, but also by use of Accuracy testing techniques and Inspections/Data Validation. These assessments and fine tuning have developed a practical condition based and cost effective management regime.

The summary risk assessment table in Appendix-B demonstrates the clear management of risks by implementing the recommended strategy. Risk management is considered much more important than simply comparing options on a cost basis alone.

10.2. Alternative Scenarios

Metering Assets have regulatory requirements to periodically demonstrate accuracy of installation. Any deviation in testing schedules would not be acceptable to regulators, stakeholders and the community at large.

11. Recommended Strategy

Metering Strategy and Plan provides a systematic approach to the planning of programs which are intended to ensure that the condition and performance of the metering infrastructure and assets are being efficiently maintained and/or improved to comply with regulatory requirements and satisfy stakeholders' requirements.

The metering installation lifecycle management strategy includes, time based inspections, accuracy testing and meter asset health check through Meter Data Provider data validation.

United Energy 's Metering Asset management strategy has been developed to provide a systematic approach to the planning of programmes which are intended to ensure that the condition and performance of metering infrastructure and assets are being efficiently maintained and/or improved.

The strategy adopted for the management of metering assets is a performance and compliance based one. It is intended to maintain regulatory compliance, safety for staff and public, customer services – asset reliability and economic efficiency by monitoring the condition and performance of the metering assets against the regulated performance requirements.

This strategy provides a focus for on-going analysis of United Energy metering systems and is aimed at continuously improving the management of the assets.

11.1. Strategic Management

This section sets out the life cycle strategy management requirement.

The management objective is to ensure the strategy is effective and aligned with business and regulatory requirements.

Management of the strategy is performed using a simple plan-do-check-act approach. Maintenance activities are performed and the success / deviation from the strategy reported for assessment by the management team. Maintenance responsibilities and accountabilities are outlined in Table 13.

Business, regulatory and technology changes are monitored and assessed by the strategy & Technology team / manager. The life cycle strategy is updated and changes communicated to the operational teams.

As AMI technology and requirements are new and evolving there is a need for continuous appraisal of internal and external factors (systems, opportunities, threats, etc.). At least one formal strategy review is required per year, aligned to the financial year so that operational and capital budgets can be adjusted if necessary.

Table 12: AMI Strategic Management

Responsibility	Activities	Accountability
Strategy maintenance	Strategy alignment with business & regulatory requirements	Strategy & Technology Manager
Compliance	Audit Service levels / Performance Audit Metrology Identify & report on maintenance issues (systematic failure, end-of-life detection, etc.)	Strategy & Technology Manager
Skills & Training	Maintenance of the technical and management skills to support: Meter Metrology	Strategy & Technology Manager

Responsibility	Activities	Accountability
Opportunity planning	Business case preparation, strategic planning and management activities responding to: Regulatory changes New business requirements New customer requirements and Technology changes	Strategy & Technology Manager
Operations	AMI Communications Network and meter event/alarm monitoring & maintenance	Network Operations Manager

11.2. Strategy Summary

Table 13Table 14 provides an outline of the maintenance strategy. The strategy is discussed in detail in the indicated sub-sections.

Table 13 Maintenance Strategy Summary

Sub System	Strategy Summary	Section
Meter Maintenance		
Metrology Inspection & Test	Direct Connect Meters Sample testing LVCT connected sites – 100% testing of meters Sample testing of LVCTs 100% Admittance & Burden test on LVCTs and site inspections HV sites 100% meter test every 5 years 100% CT&VT Test every 10 years Inspections every 2.5 years	11.3.1
Incident Response (to functional failures)	Failure of meter functions (e.g. meter read, energise / de-energise detected and maintained by NMS	11.3.3

Sub System	Strategy Summary	Section
Function Configuration & Verification	Verify in test environment before deploying to production	11.3.4
Meter Replacement	Monitor failure rates & action if excessive	11.3.5
Tools	Maintain tools & expertise required to support the AMI system	11.3.6
System Disposal / Replacement	Determined when the useful life of the system or system component becomes apparent	11.3.7

11.3. Meter Maintenance

UE have established a meter maintenance program. This program covers AMI & Non AMI metering assets and approximately 10 inter DB metering sites that are communicated to via GSM communications.

Table 14 Meter Maintenance Assessment pulls together the requirements and proposes suitable maintenance mitigations to minimise risk.

Table 14 Meter Maintenance Assessment

#	Requirement	Risk Source	Mitigation
1	Metrology Procedure Part A Clause 2.6 Testing & Inspection of Metering Installations	Higher than expected meter failures (R6.5) Meter Accuracy drift (R6.10)	Metrology Test & Inspection
2	National Electricity Rules Clause 7.6 Inspection, Testing and Audit of Metering Installations		
	NER7.6.1 Testing responsibility		Metrology Test & Inspection
	NER7.6.2 Non-compliance detection		Metrology Test & Inspection
	NER7.6.3 Audit of information	Hacker, malicious or accidental staff action	Compliance Monitoring through division heads ISMS
	NER7.6.4 Retention of test records and documents	Data modified or lost in storage (R8.1)	SAP and Paper results backup ISMS
	NER7.8 Security of metering installation & Data		Field Audits & Events from AMI System
3	DPI Minimum Functional Specification, Victoria		
	DPI3.3 AMI Energy Read	AMI Design flaw, Component failure Communication failure Equipment theft / damage Security Breach (R3, R4, R5, R6, R7)	Incidence response The NMS will flag a read failure for NOC to resolve

#	Requirement	Risk Source	Mitigation
	DPI3.4 AMI Supply Disconnect and Reconnect	As above	Incidence response The NMS will flag the failure to the NOC and Retail operator / NOC to resolve Verify function & config
	DPI3.5 / NER7.12 Time Clock Synchronisation	As above	Incidence response The NMS will flag a time sync failure for NOC to resolve
	DPI3.6 AMI Load Control	As above	Incidence response Customer feedback of fault Verify function & config
	DPI3.7 AMI Meter Loss of Supply detection and outage detection	As above	Incidence response NMS outage detection Customer feedback – backup option
	DPI3.8 AMI Quality of Supply & other event recording	As above	Incidence response NMS Quality of System event Verify function & config
	DPI3.9 AMI Supply Capacity Control	As above	Incidence response The NMS will flag a contactor failure for NOC to resolve Customer feedback – backup option Verify function & config
	DPI3.10 AMI Interface to Home Area Network (HAN)	As above	Incidence response Customer feedback NOC or Retailer configuration check Verify function & config
	DPI3.11 AMI Tamper Detection	As above	Incidence response The NMS will flag a tamper event for NOC to resolve On site sample check
	DPI3.12 AMI Communications and data security	Hacker, malicious or accidental staff action (R8.1)	ISMS Incidence response The NMS will flag some security incidents Customer feedback Verify function & config

#	Requirement	Risk Source	Mitigation
	DPI3.13 AMI Remote Firmware Upgrades	AMI Design flaw Component failure Communication failure Equipment theft / damage Security Breach (R3, R4, R5, R6, R7)	Incidence response The NMS will flag a firmware upgrade failure Verify function & config
	DPI3.14 AMI Self registration of meters	As above	All new connections are confirmed

Table 15 outlines the mitigations steps, action frequency and responsibilities.

Table 15 Risk Mitigation Strategy

Item	Mitigation	Method	When	Who
A	Metrology Test & Inspection	Method developed in accordance with Metrology procedure Part A clause 2.6. Refer to section 11.3.1 for details	Refer to Meter Asset Management Strategy	Strategy &Technology
B	ISMS (Security)	Data security and integrity risk control using the Information Security Management System.	Annual Audit Incident detection	ISMS
C	Incidence response	Failure of automatic services (i.e. meter read) identified by NMS Failure of operator control functions (supply control, meter reprogram, etc.) identified operator or customer Other failures identified by customer feedback and/or sample testing Refer to section 11.3.3 for details	Incident Incident Incident or annual	NOC NOC / Retailer Strategy &Technology
D	Function configuration & verification	Meter configuration is controlled by the down loaded meter “program” (or tariff) Changes may be required to meet new regulatory, retail or operational requirements. Change process: Research & create new configuration Verify new configuration operates correctly prior to production deployment Refer to section 11.3.4	As required	Strategy &Technology

11.3.1. Metrology Inspection & Testing

UE have established both a meter installation testing and meter installation inspection regime. Testing and inspection methodology is based on installation type and is detailed below:

Sample testing accuracy of direct connect meters and LVCT is chosen to minimise test cost while complying with regulatory requirements and giving a high probability of accuracy of metering equipment. Sample testing is designed to assess the overall accuracy of a given meter or LVCT family type. Subject to test results, these meter or LCVT families are either replaced or have their operational life extended as per AS 1284.13 for meters and AEMO LVCT Sample Test procedure for LVCT's.

Sample testing is not applicable for LVCT meters. LVCT Meters are tested and the whole installation inspected every 5 years as they are critical sites due to their relative high consumption.

Table 16 summarises the test and inspection strategy as well as the corresponding regulatory standards that dictate the required testing and inspection.

Table 16 Metrology Tests

Installation	Test Method	Requirement
Type 5 & 6 **Direct Connect** **(single & 3 phase)**	• Meter – Sample test • Time clock accuracy – 100% tested checked daily by AMI system <±300seconds • 100% Admittance & Burden test on CTs and site inspections	• AS1284.13:2002 • MP Part A clause 2.6.3.b) • MP Part A clause 5, schedule 2, ID 4.8).
Type 5 & 6 **LV CT** **(3phase)**	• Meter – 100% test, max period between tests – 5 years • CT's - sample test, max period between tests – 10 years • Time clock accuracy – 100% tested	• MP Part A clause 5 schedule 2, ID 5.15 • MP Part A clause 5, schedule 2, ID 5.12 • MP Part A clause 5, schedule 2, ID 4.8
HV CT	• Meter – 100% test, max period between tests – 5 years • CT's – 100% test, max period between tests – 10 years • Time clock accuracy – 100% tested <±20seconds	• MP Part A clause 4, schedule 1, ID 6.5 • MP Part A clause 4, schedule 1, ID 6.5 • MP Part A clause 4, schedule 1, ID 4.9

11.3.2. Meter Asset Management Strategy (MAMS)

A detailed Meter MAMS is required for testing of Metering Assets.

The MAMS shall be approved by AEMO in accordance with Chapter 7 or the NER.

The MAMS shall include:

- **Asset Maintenance Plan** - This plan sets out the program for meter asset replacement based upon meter condition and performance. This program is developed from the results of the Testing and Sampling Plan.
- **Asset Replacement Plan** - This plan sets out the program for asset replacement based upon meter condition and performance. This program is developed from the results of testing and inspection.
- **Audit Program** - Sets out the requirements for an audit program to ensure regulatory compliance is maintained.

- **Responsible Person Accountabilities** - Sets out how the duties and accountabilities of the responsible person are managed and the reporting process designed to allow monitoring of progress by the responsible person against this plan.
- **Asset Disposal Plan** - Sets out the requirements for asset disposal

11.3.3. Incident Response (to functional failures)

Functional failures include non-metrological functions such as energisation / de-energisation, load control, and display visibility / operation. Scheduled inspection and testing is not applicable to identifying functional failures. UE employ three modes of identifying functional failures.

11.3.3.1 Communication Systems

Primarily functional failures are detected by UE's remote communication/backend systems that periodically read and monitor both AMI meter metrology and event data. Specific alarms are pushed by AMI meters.

11.3.3.2 Meter Fault Codes

During the installation process of AMI meters, field crews are required to inspect the meter for specific fault codes displayed by the meter. Where such meter codes are display post installation and energisation, field crew will replace the meter and record the fault accordingly.

11.3.3.3 Customer Inquiries

Potential failures that are not detected by the NMS or meter commissioning checks will require UE to be reliant on customer feedback. e.g. failure hot water service. However, customer complaints that have correctly identified a faulty AMI meter are rare.

The fault detection mechanisms are summarized in Table 17.

Table 17 Meter Function Maintenance

#	Function	Failure Detection
1	AMI Energy Read	NMS
2	AMI Supply Disconnect and Reconnect	a) Customer feedback b) Meter event signalled to NMS
3	AMI Time Clock Synchronisation	NMS
4	AMI Load Control	Customer feedback
5	AMI Meter Loss of Supply detection and outage detection	a) Customer feedback b) Meter event signalled to NMS
6	AMI Quality of Supply & other event recording	a) Customer feedback b) Meter event signalled to NMS e.g. over / under voltage, sag / swell etc.
7	AMI Supply Capacity Control	a) Customer feedback b) Meter event signalled to NMS
8	AMI Interface to Home Area Network (HAN)	a) Customer feedback b) Meter event signalled to NMS
9	AMI Tamper Detection	Meter event signalled to NMS
10	AMI Remote Firmware Upgrades	Meter event signalled to NMS

UE capture details of associated functional failures for the purposes of trending faults. Fault trending will be conducted, and actioned by Strategy & Technology.

- Functional failure trend detection is determined by analysing:
- Failure reports from NOC
- Warranty return repair reports from the meter vendor and
- BAU meter replacement refurbishment reports from the field staff or meter vendor

11.3.4. Function Configuration & Verification

AMI meter “programs” define metrology and functional requirements. AMI meters are issued by suppliers preconfigured with one active and 4 alternative UE approved programs.

AMI meters are capable of having their program reconfigured remotely or locally. Local changes are initiated where there is a need to reconfigure a meter’s program to account for site specific requirements. Field crews are trained on how to access and select the correct meter program locally.

From a remote perspective, predefined meter programs for all of UE’s various meter types are stored and managed within UIQ. All of UE’s meters programs have been created and or updated accordingly to meet regulatory, retail or operational requirements e.g. customer de-energise / re-energise.

Where there is a requirement to create a new program to account for change to business or regulatory requirement, UE enforce a strict process. The deployment of a new program involves:

- Change analysis – operational, risk, etc.
- Program creation
- Program test – verification of the new configuration operates correctly prior to production deployment.

UE employees are a mixture of in-house staff and outsourced test lab contractors that perform the prescribed work.

11.3.5. Meter Failure Replacement & NMI Growth

Meters may require removal or replacement for one of the following reasons:

- Metrology failure as part of a testing program
- Site redevelopment or
- Service upgrade (e.g. single to 3 phase)
- Failure of associated hardware firmware failure

Due to UE only sourcing AMI compliant meters, any meter that needs to be replaced will be replaced with an AMI meter. This includes any existing non AMI meters that are yet to be replaced by the AMI meter replacement program. Considering that UE billing systems have been updated to incorporate the introduction of AMI meter and Victorian Government service level arrangements with interval data recorded by AMI meters, it is imperative that UE continue its policy of replacing both AMI and non AMI meters with AMI meters to ensure the mandated data is issued to the market.

As AMI meters are a new type, the initial failure rate is determined from the warranty and is subject to the requirements detailed below. (Refer Table 18).

Years 0 to 5: Return to base

- Full warranty
- UE pays exchange cost

Years 6 to 15: Backstop

- Warranty for failures only exceeding (number of years installed – 5) x1.5%

- UED pays all cost below the limit and exchange cost above

As the mean failure rate is unknown, an initial value is found by assuming a normal failure distribution with the +3sigma level corresponding to the 1.5% warranty level. This results in a mean of 0.5%. Failure is expected to follow a classical bath tub curve as summarised in Table 18.

Table 18 Meter Function Maintenance

Period	Failure rate	Comment
0 – 1 years	0.5%	Initial life failures Including functional issues requiring Software fixes
1 – 13 years	0.05%	Mid-life failure Random component failures Estimate based on historic rates but may differ for Secure meters
13- 15 years	0.25%	End of life Failure rate increase as components wear out

11.3.6. Tools

This section covers AMI system support tools.

M-Cubed

M-Cubed is the licenced software supplied and supported by the AMI meter vendor Secure. M-Cubed is operated on a Windows platform.

M-Cubed is used to read meters locally and for configuration changes. SECURE will provide two complimentary copies of the M-Cubed for meter fault finding while UE will request an additional 10 licenses of M-Cubed. Licenses will be issued to field crew to address and resolve field issues associated with AMI meters.

Flextend

The Flextend module is part of M Cubed. The Flextend module is used to create meter configuration programs.

GIS

No customised scripting is expected following deployment in 2015. To use power quality/last GASP events in the meter for network planning and management, GIS may play key role in future.

FSU / Contingency Reader

The Field Service Unit (FSU) is a tool used to remotely communicate with AMI meters via its internal NIC. The FSU's hardware and software was designed and owned by Silver Springs Networks (SSN). The FSU can be used for network support and as a backup meter reading tool. This item is managed through AMI Communication Strategy as a consumable item in the Operations budget.

Field Test Equipment

All installation and maintenance work will be subcontracted.

UE only requires special equipment for investigating network problems and customer complaints.

11.3.7. System Disposal / Replacement

The disposal and replacement strategy will be determined when the useful life of the system becomes apparent. The initial target is the expected life of the components.

The target maybe affected by:

- new requirements,
- operating environment change e.g. ISM band reallocation,
- earlier than expected family failure or
- end of vendor or technology support

There is no special requirement for the retirement of non-AMI meters.

12. Output Requirements

To implement the strategies documented in this Metering Strategy and Plan a set of asset management “enablers and controls’ must be in place and activated. The following infrastructure, organisation, resources and activities are required;

Strategy and Operational technical expertise in meter asset management and contract metering services.

A field work force and organisation to perform hands on work and manage and report on these activities. In UE this is performed by external service providers for installation, testing and maintenance.

Maintenance and works management (IT) system to provide a register of assets, facilitate scheduling of both Operational and Capital works, record cost of works against assets, facilitate project management of work tasks over defined time periods, enable reporting of work progress and costs. It is also necessary to have a system for recording defects and scheduling repairs plus recording of condition monitoring results and enable analysis to determine condition of individual assets. In UE the majority of these facilities are provided by the SAP& CIS systems. Current Transformer testing information is recorded in internally developed Access data base. HV Inter DB Metering Asset information stored in Network drives.

Technical specifications for metering assets for procurement.

Systems, methodology and approval procedures for identifying the work task quantities cost and budget provision for Operational expenditure each year. Operational expenditure is included in Appendix G.

Systems, methodology and approval procedures for identifying the scope of work, cost and budget provision for asset replacement Capital expenditure each year. Capital expenditure is included in Appendix G. Refer also to 14.1 Business Case Process below.

Contingency plans and assets to cater for major failures through High Voltage Injection. These will include sufficient number of meter stock to be maintained.

12.1.1. Business Case Process

General

Specific works scheduled for Metering Operations shall be determined during the annual budgetary processes and upon approval detailed within the works program.

Business cases for major asset replacement works shall include individual cost benefit evaluations and all materials and services shall be procured in accordance the UE procurement procedures. The replacement of meter families after sample test failures will be subject to separate business cases where identified.

Alignment of programs

This plan also aims to achieve synergies by the alignment of HV Inter DB metering works with capital works associated with Zone Sub Station rebuild. These work programs are co-ordinated on an ongoing basis within the Asset Management team. Also AMI Meter functional or event settings changed in coordination with Distribution Asset Management team to achieve network security or improve efficiency.

13. KPIs and Performance Criteria

UED metering KPI's and performance criteria are fundamentally driven by regulatory requirements as detailed below:

Regulatory Compliance

Comply with National Measurement Act- No Major non compliances.

Comply with National Electricity Rules - No Major non compliances.

Must comply with AEMO-MPB service level procedure- No Major non compliances.

Must comply with the AEMO Metrology Procedure - No Major non compliances.

All AMI Meters must meet Victorian Government Minimum Functional Specifications - No Major non compliances.

Maintain IS0 9001 Quality System Certification.

Provide the metering installation, provision and/or maintenance services for all components of metering installations for which UE registered as a Metering Provider in MSATS.

UE established KPI's and performance criteria based on regulatory compliance. From business perspective, UE establish the scheduled work that meets regulatory requirements as well as to meet business finance objectives. Scheduled work is established to ensure the most efficient and effective allocation of resources. This in turn reduces the overall costs required to fund prescribed works.

14. References

Metering Asset Management Strategy UE-SP-0033

UED Inter DB HV Metering Maintenance Strategy UE-SP-0034

AS1284.13:2002 Electricity metering Part 13: In-service compliance testing

National Electricity Rules, Chapter 7

Minimum AMI Functionality Specification (Victoria), V1.1, Sep 2008, DPI

ISMS Risk Management Methodology, V1, 3 Feb 2010

AEMO SERVICE LEVEL PROCEDURE: Metering Provider Services Category B for Metering installation Types 1, 2, 3, 4, 5 and 6 ME_MP1962.

AEMO Metrology Procedure Part A

AEMO ALTERNATIVE TESTING MINIMUM REQUIREMENTS-Low Voltage Current Transformer Metering Installations:

15. Appendix- A: Asset Age Profile

15.1. AMI Meters

Table 19: AMI Meters Age Profile

AMI Meters on Network Installed per Year		2009	2010	2011	2012	2013	2014
Cat 1	Single Phase, single element	11,131	71,453	106,911	140,956	109,494	56709
Cat 2	Single Phase, single element, with 31.5A load control	0	0	0	3	4,569	7947
Cat 3	Single Phase, Two element, with 31.5A load control	0	0	0	0	31,919	19948
Cat 4	3 Phase with no load control	1,232	5,794	11713	12,306	21,834	38344
Cat 5b	3 Phase with 31.5A and 2A load control	0	0	0	0	0	3718
Cat 6a	3 Phase CT connect	0	0	0	0	0	2524
Cat 6b	3 Phase CT & VT connect	0	0	0	0	0	0

15.2. Current Transformers

Table 20: Current Transformers Age Profile

CT Type	Installation years	Ratio	NMI	Total CT quantity
A Type	pre-1979	150/5	61	183
150-300-600/5	pre-1979	300/5		
	pre-1979	600/5		
A Type	1979-1988	150/5	89	267
150-300-600/5	1979-1988	300/5		
	1979-1988	600/5		
A Type	1989-1998	150/5	46	138
150-300-600/5	1989-1998	300/5		
	1989-1998	600/5		
B Type	pre-1979	400/5	42	126
400-800-1200/5	pre-1979	800/5		
	pre-1979	1200/5		
B Type	1979-1988	400/5	123	369
400-800-1200/5	1979-1988	800/5		
	1979-1988	1200/5		
B Type	1989-1998	400/5	167	501
400-800-1200/5	1989-1998	800/5		

CT Type	Installation years	Ratio	NMI	Total CT quantity
	1989-1998	1200/5		
B Type	1999-2003	400/5	146	438
400-800-1200/5	1999-2003	800/5		
	1999-2003	1200/5		
C Type	pre-1984	1000/5	7	21
1000-2000-3000/5	pre-1984	2000/5		
	pre-1984	3000/5		
C Type	1984-1993	1000/5	7	21
1000-2000-3000/5	1984-1993	2000/5		
	1984-1993	3000/5		
C Type	1994-2003	1000/5	8	24
1000-2000-3000/5	1994-2003	2000/5		
	1994-2003	3000/5		
S Type 200/5	pre-1979	200/5	48	144
S Type 200/5	1979-1988	200/5	268	804
S Type 200/5	1989-1998	200/5	532	1596
S Type 200/5	1999-2003	200/5	477	1431
TOTAL			2022	6063

15.3. HV Metering:

Table 21: HV Metering Age Profile

Feeder / Meter/ Transformer	Station	Type of Energy Meter	Installation year
WD Feeder 2	WD	Mk6E	2013
WD Feeder 4	WD	Mk6E	2013
WD Feeder 6	WD	Mk6E	2013
WD Feeder 7	WD	Mk6E	2013
WD Feeder 12	WD	Mk6E	2013
DN-HPK Meter Rev	DN	Mk3	2010
DN-HPK Meter Check	DN	Mk3	2010
EW Total Tr 1& 2	EW	Mk1	2002
K Feeder 11	K	Mk1	2002
K Transformer 3 No 3 Bus	K	Mk1	2002
K Transformer 3 No 2 Bus	K		
K Transformer 2 No 2 Bus	K		
K Transformer 2 No 1 Bus	K		

16. Appendix- B: Risk Assessment Tabulation

Hazard/Risk	Consequence Category	Hazard effect	UNTREATED LIKELIHOOD	UNTREATED CONSEQUENCE	UNTREATED RISK RATING	Current Controls (Recommended Strategy)	TREATED LIKELIHOOD	TREATED CONSEQUENCE	TREATED RISK RATING
Secure exiting Australian market.	No technical support and no new meters.	National Electricity Rules non-compliance, Financial impact	2. Rare	4. Major	High	• Maintain meter supply and services contract with Secure. • Monitor available options from other suppliers. • Test group available for testing alternate supplier product. • Maintain approximately 1 year buffer of stock.	1. Exceptional	2. Moderate	Low
SSN exiting Australian market.	No technical support and no new NIC for meters.	National Electricity Rules non-compliance, Financial impact	2. Rare	4. Major	High	• Maintain meter supply and services contract with Secure. • Communication team maintains the LAN contract with SSN. • Monitor available options from other suppliers. • Test group available for testing alternate supplier product. • Maintain approximately 1 year buffer of stock.	1. Exceptional	2. Moderate	Low
Catastrophic individual meter failure due to HVI/ vandalism	Potential injury to general public and staff/contractors. Damage customer property.	Financial impact , Reputation, injury	6. Almost Certain	3. Severe	Very High	• Meter designed to fail safe. • Meter physical inspection for damage prior to re-energisation after a HVI/vandalism event.	1. Exceptional	1. Minor	Low

Hazard/Risk	Consequence Category	Hazard effect	UNTREATED LIKELIHOOD	UNTREATED CONSEQUENCE	UNTREATED RISK RATING	Current Controls (Recommended Strategy)	TREATED LIKELIHOOD	TREATED CONSEQUENCE	TREATED RISK RATING
Not monitoring meter events and alarms.	Meter failure, revenue protection, missed opportunity for customer service.	breach of National Measurement Act, Financial impact and Reputation	6. Almost Certain	2. Moderate	High	Create BI/UIQ Reports and implement monitoring and action by DEC 2015.	2. Rare	1. Minor	Low
Introduction of meter contestability for <160 MWh customers.	Stranded assets due to competition in metering for new connections and churn of existing sites.	Financial impact	4. Possible	2. Moderate	Medium	Continue to influence regulator/ extension of derogation.	1. Exceptional	1. Minor	Low
Deficient asset control/ management tools	Loss of meters, unable to take advantage of warranty.	Financial impact , Reputation	6. Almost Certain	3. Severe	Very High	Improve SAP for meter control process and warranty monitoring by Dec 2015	2. Rare	1. Minor	Low
Systematic meter failures	Financial impact , Reputation , loss of MPB accreditation	National Electricity Rules non-compliance	3. Unlikely	4. Major	Very High	• Meter Warranty • Family testing • Monitoring meter health through NMS • Monitoring meter return process from Secure	3. Unlikely	2. Moderate	Medium

17. Appendix- D: OPEX forecasts

	2015	2016	2017	2018	2019	2020
Sample Testing of Direct connect meters						
Single Phase single element	$20,880	$13,920	$20,880	$20,880	$27,840	$20,880
Single Phase single element with contactor	$0	$6,960	$1,392	$1,392	$1,392	$1,392
Single Phase two element with contactor	$6,960	$6,960	$3,480	$3,480	$3,480	$3,480
3 phase direct connect	$11,640	$8,730	$17,460	$7,566	$5,820	$5,820
3 phase direct connect with contactor	$582	$8,730	$1,164	$1,164	$1,164	$1,164
100% Testing of 3phase CT connect meters	$89,560	$134,340	$134,340	$134,340	$134,340	$134,340
Testing by Variables on Meter family not meeting normality	$25,026	$25,026	$25,026	$25,026	$25,026	$25,026
Non AMI 1 ph. Meter testing	$10,440	$9,048	$9,048	$9,048	$5,707	$5,707
Non AMI 3 ph. Meter testing	$17,460	$15,132	$15,132	$9,545	$15,132	$15,132
LVCT's Sample testing	$57,485	$62,484	$64,983	$37,490	$59,984	$77,480
HV Inter DB Testing	$21,800	$0	$19,000	$1,000	$30,690	$21,350
MPB audit fee	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
Meter Control	$66,500	$66,500	$66,500	$66,500	$66,500	$66,500
Unmetered Supply Audits	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000
Install External Antennas	$12,000	$12,000	$12,000	$12,000	$12,000	$12,000
Total	$375,333	$404,830	$425,405	$364,431	$424,075	$425,271

18. Appendix- C: CAPEX forecasts

Table 22: Capex Forecasts

Description	2015	2016	2017	2018	2019	2020
Meter Purchase						
Single Phase (1ph 1 element)	$0	$0	$0	$0	$0	$0
Single Phase 31.5A contactor	$0	$47,299	$0	$0	$0	$0
Single Phase Two Element 31.5A contactor	$0	$0	$0	$0	$0	$0
Three Phase DC	$0	$177,298	$0	$0	$0	$0
Three Phase DC 31.5A & 2A contactors	$0	$39,000	$0	$0	$0	$0
Three Phase LVCT	$0	$86,026	$0	$0	$0	$0
Meter Faults Direct connect (Labour)	$500,000	$503,533	$484,665	$505,248	$526,570	$548,622
Meter Faults Current Transformer Connect (Labour)	$10,500	$11,386	$12,030	$12,675	$13,319	$13,964
CT Family replacement	$0	$47,058	$47,058	$47,058	$0	$0
Additional AMI Meter exchanges	$1,800,000	$1,227,600	$0	$0	$0	$0
Family fail of meters legacy	$0	$204,600	$0	$0	$0	$0
Total	$2,310,500	$2,343,801	$543,754	$564,981	$539,889	$562,586

19. Forecasting Methodology

Metering Assets growth forecasted based on net customer growth supplied by United Energy Distribution Planning groups. Forecast volumes listed as below. Due to metering contestability growth number is negative

Table 23: Growth Forecast

Year	Growth Forecast
2015	6500
2016	6500
2017	-7750
2018	-7750
2019	-7750
2020	-7750

20. Spares

Energy meters and metering transformers are critical UE assets, and maintaining a requisite number of stock is essential for reliable field operation. Metering asset stock includes refurbished and new procurements and spare parts are not applicable to these assets.

The following is the recommended quantity of stock holdings for Energy meters and Low Voltage Current transformers.

20.1. Electricity meters:

We have to maintain approximately 1 year buffer of stock for Electricity meters to cover new connections, upgrades and Faults. If Sample testing of particular AMI large meter family fails then meters will be replaced as a special project.

20.2. LV Current Transformers:

Low Voltage Current Transformers are supplied by Metering Services Contract for new connections, upgrades and faults. United Energy also supplies Current Transformers to the second tier customers through Metering Services Contract. Appropriate controls should be included in contract to maintain sufficient stocks to meet new LVCT requirements.