STRATEGY

MEASUREMENT ASSET CLASS STRATEGY

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AUTHORISATION

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DOCUMENT HISTORY

Revision	Date	Author	Description of Changes
1.0	31/10/2017		Combined measurement ACS into one document & enhanced to new template.
2.0	25/09/2018		Reviewed the document and removed the outdated content and updated with current information
3.0	02/10/2018		Updated the section 2.5 (5- Minute Settlement)
4.0	10/10/2018		Update the forecast
5.0	12/04/2019		Updated to Information Management sections and capital forecast (not yet completed)
6.0	16/12/2019		Rewritten based on feedback from GHD
7.0	30/01/2024		Full review and update strategies, contents and quantities
8.0	31/12/2024		Full review and update strategies, contents and alignment with EDPR

OWNING FUNCTIONAL GROUP & DEPARTMENT / TEAM

Electricity Distribution: Asset & Operations Electricity: Network Assets

REVIEW DETAILS

Review Period:	Review Date + 3 years
Next Review Due:	December 2027

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EXECUTIVE SUMMARY

Jemena Electricity Networks (JEN) in Victoria has an Asset Management System (AMS) that contains four Asset Class Strategy (ACS) documents.

This ACS document pertains to Electricity Measurement, a term that denotes a range of meters situated at various points in the network.

The first three sections of this ACS are generic to all the ACS documents. The fourth section is where Electricity Measurement is unpacked and divided into two distinct sub-asset classes

- Electricity Advanced Metering Infrastructure (AMI) meters used at customer connection points in accordance with regulatory requirements
- Power Quality Meters (PQMs) selectively used at zone substations and end-of-feeder distribution substations to meet regulatory requirements
- Cross boundary revenue metering assets installed at zone substations and managed in accordance to the NER requirements.

Each sub-asset class is described and discussed in terms of its associated risk, performance, life cycle management and budgetary forecasts.

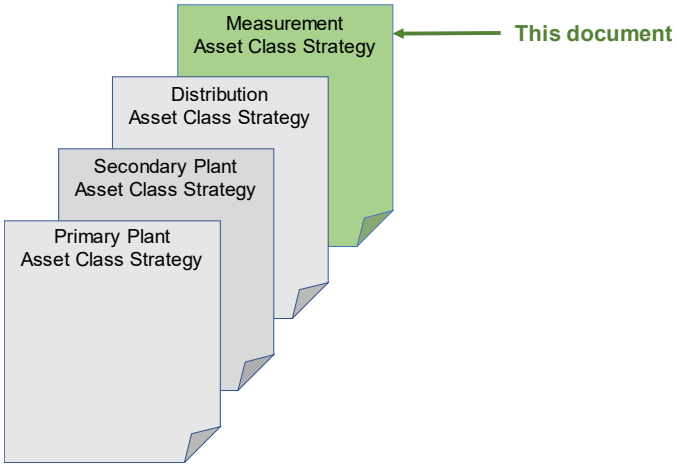
1. INTRODUCTION

This Asset Class Strategy (ACS) covers the Jemena Electricity Networks (JEN) measurement asset class and outlines the methods employed, analysis undertaken and actions to be taken to optimally manage the assets. The document serves as both an internal document to prescribe the management of the measurement asset class but also to support expenditure proposals as part of JEN's electricity distribution price reset (EDPR) submission process.

Within JEN's Investment Framework and Asset Business Strategy (ABS), asset life cycles are considered in terms of creation (acquisition), maintenance or replacement, as applicable, and disposal. Investment recommendations are made by analysing asset condition and age profiling.

There are four Asset Class Strategy (ACS) documents. Each ACS outlines performance measures and objectives which are used to attain key performance targets. This gives visibility to the performance of the asset and, in turn, informs investment decision making.

Figure 1-1: ACS documents hierarchy



The Electricity Measurement assets in this ACS are categorised into the following sub-asset classes located in the following sections of this document

4.1 Electricity meters
4.2 Power quality meters

1.1 PURPOSE

The purpose of the Measurement ACS is to document the approach and principal methods that support the delivery of asset management objectives set out in the JEN's ABS.

This ACS is based on key information about each sub-asset (including risk, performance, life cycle management, capital expenditure and operational expenditure). Based on this information, this ACS contributes to short, medium and long-term planning.

This Measurement ACS addresses:

- Measurement plant asset management practices alignment with the ABS
- Sub-asset risk causes and consequences
- Sub-asset performance against objectives, drivers, and service levels

- Sub-asset class specifications and life cycle management of measurement assets in-service. Asset condition, along with relative cost considerations, are the primary drivers in making asset maintenance versus asset replacement decisions
- Risk weighted decision-making and financial estimates used to inform Operating Expenditure (OPEX) and Capital Expenditure (CAPEX) planning

1.2 ASSET MANAGEMENT SYSTEM

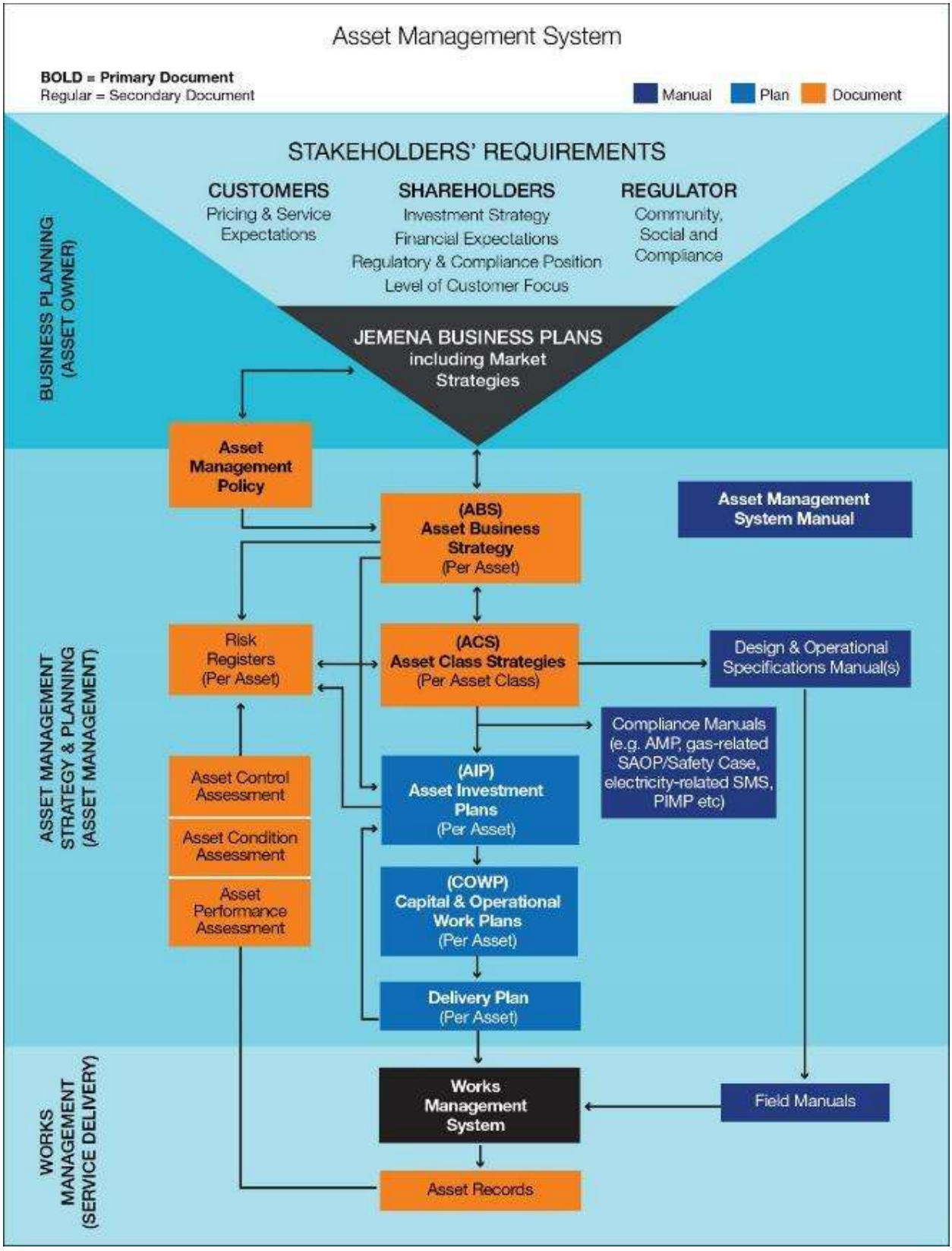
Asset Management is the coordinated activity that we undertake to optimise value from our electricity network. It involves the balancing of costs, opportunities and risks against performance. An Asset Management System (AMS) enables a systematic approach to the combination of management, financial, economic, engineering, and other practices applied to physical assets to provide the required level of service in the most cost-effective manner, whilst managing future risks.

Our AMS enables us to effectively direct, coordinate and control asset management activities throughout an asset's whole life. It facilitates an optimal mixture of capital investments, operations, maintenance, resourcing, risks, performance, sustainability and good governance.

Our AMS is accredited under the ISO55001 standard. Figure 1-2 shows the inputs and outputs of the Asset Management System, which aims to fulfil JEN's corporate strategy and objectives.

This ACS resides in JEN's AMS and creates a line of sight between the Business Plan and JEN's ABS through to the associated Asset Management Plan (AMP). The ACS ensures that the performance, risks and cost of each asset class are analysed, and optimum plans developed to align with the Business Plan.

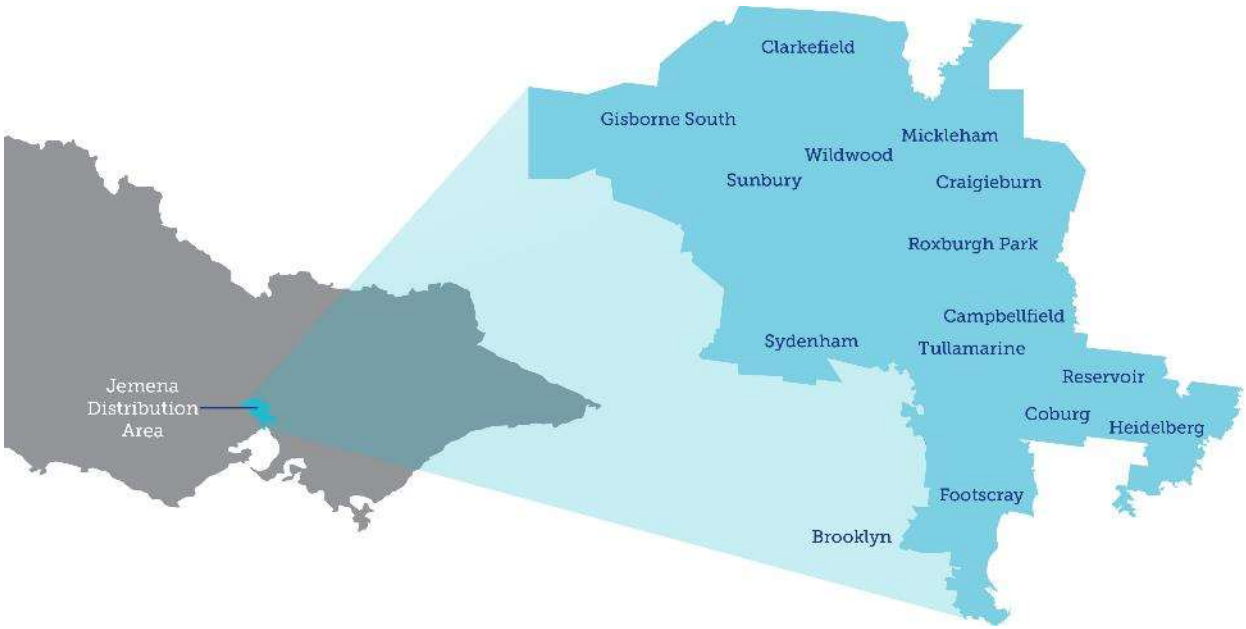
Figure 1-2: JEN's Asset Management System



1.3 DESCRIPTION OF ASSETS COVERED

There are a large number of measurement assets. Individual failures of measuring equipment have a low immediate impact on customers. Consequently, electricity measurement assets do not have inherent redundancy built into their configuration.

Figure 1-3: JEN's geographical footprint



There are two sub-assets in this Measurement ACS

- Electricity meters. JEN manages approximately 387,000 predominantly Advanced Metering Infrastructure (AMI) meters installed at customer premises
- Power Quality Meters (PQM). JEN has two types of power quality monitoring systems spread across 28 zone sub-stations plus 30 end-of-feeder locations. The PQM system records:
    - Steady-state Root Mean Square (RMS) voltage levels;
    - Short-duration voltage disturbances, including sags, swell and transients;
    - Voltage harmonics;
    - Voltage unbalance; and
    - Load current (only at zone substation PQMs)

1.4 GOVERNANCE

1.4.1 APPROVAL AND COMMUNICATIONS

Asset Class Strategy documentation is updated every three years by the Network Assets Manager for approval by General Manager Asset and Operations – Electricity.

The Asset Class Strategy is reviewed every three years to ensure alignment with the Asset Management objectives and to account for any additional asset performance and risk information.

1.4.2 RESPONSIBILITIES

Key stakeholder personnel are shown below in Table 1-1.

Table 1-1: Asset Class Strategy Responsibilities

Job Title	Responsibility
Network Assets Manager	Document Owner and Approver
Secondary Team personnel	Protection and control equipment engineers
	Direct Current supply system equipment engineers
	Zone substation Supervisory Control and Data Acquisition (SCADA) system equipment engineers
	Operational technology communication system equipment engineers

2 ASSET OBJECTIVES

The overarching objective of the Measurement Asset Class is to support the JEN objectives and strategic drivers, through:

- The practice of a Health, Safety and Environmental (HSE) culture that proactively seeks to control HSE risks.
- Optimise asset availability. Each asset failure is recorded and evaluated. Using standard risk assessment guidelines, an estimate of equipment failure rates are made. Annual probabilistic failure rates can be derived. A documented inspection, condition monitoring, maintenance and replacement strategy is included in this document for all assets to minimise the probability of failure and contains deterioration in service levels.
- Optimise asset life cycle. Defer asset replacement expenditure by use of condition monitoring. Where practical, conduct routine inspections that can increase in frequency as the asset approaches its statistical end of life. The aim is to defer capital expenditure whilst controlling the risk of failure and, thus, to constrain deterioration in service levels.
- Standardisation, application of established standards, and regular market testing to minimise the life cycle costs of assets installed. For instance, establishing robust specifications for purchasing electricity meters, together with regular market testing of alliterative suppliers, ensures that JEN measurement equipment is cost-efficient and fit for purpose.

3 SUB-ASSET CLASS STRATEGIES

The Sub Asset Class Strategies provide an asset overview and identify the most appropriate strategies and plans for managing the assets over their lifecycles. Each sub asset class strategy includes information on the asset management practices, including key strategies, options considered and plans that:

- Support the corporate business plan, strategies, and objectives; and
- Inform expenditure plans and work programs.

Specifically, the Sub Asset Class Strategies address the following:

- Introduction - Function and Asset Description;
- Asset Profile – Life Expectancy, Age Profile, and Utilisation;
- Performance – Requirements and Assessment;
- Risk – Criticality, Failure Modes, Current Risks, Existing Controls and Future Risks;
- Life Cycle Management – Asset Creation, Asset Operation and Maintenance, Asset Replacement, Disposal and Spares; and
- Asset Information.

3.1 ELECTRICITY METERING

3.1.1 INTRODUCTION

JEN manages approximately 383,000 AMI meters and about 4,200 legacy meters that still need to be changed out for AMI technology.

Electricity meters must:

- Meet regulatory compliance;
- Ensure meter availability for new connections and abolishment/alterations;
- Be economical to purchase and maintain;
- Support supply investigations; and
- Support future customer experience pathways (‘advanced services’)

Table 3-1: Current (As at December 2024) JEN Metering Types & Volumes positions

Meter type	Volume limit per annum per connection point	Comment	JEN owned quantity
1	Greater than 1,000GWh	JEN is not responsible for operation of these (contestable) meters.[1] Back office systems receive energy data from these types of meters	Zero
2	100 to 1,000GWh		8 HV CT meters
3	750MWh to less than 100GWh		11 HV CT meters
4	Less than 750MWh		Zero
5[2]	Less than 750MWh	AMI meters. Supports 5 minute settlement regime[3]	382,816
6	Less than 750MWh	Legacy meters for accumulated data only	4,200
7	It is a 'notional' meter—the load is technically not metered	For example, public lighting	~75,000 lights assigned to ~30 NMI

JEN owned meters are sorted into categories and sub-categories at Appendix B.

Software platforms used are:

- [redacted] to perform data collection of metered consumption and, depending on meter type, meter-related events:
- SAP Industry Specific – Utilities (IS-U) system supports meter installation activities from customer service to inventory management:
- [redacted]
- SAP Business Intelligence (BI) analyses AMI system data such as detected meter faults, over current, bypass, etc. The BI system is connected to the following systems allowing data from multiple sources to be combined & analysed:
  - MDM;
  - SAP-ISU;
  - NMS;
  - Customer Administration Transfer System (CATS);
  - Geographic Information System (GIS); and
  - Jemena SAP (JSAP)
- Oracle Outage Management System (OMS) manages planned and unplanned outages on the electricity distribution network

Figure 3-1 shows the overall architecture of the AMI and associated system.

[1] This is expected to change if Victoria adopts AEMC's national rules on smart meters (adopted by other states in 2017)
[2] Type 5 has 6 categories covering the permutations of single and multiphase meters
[3] See Appendix E

Figure 3-1: Architecture of the AMI and associated system

3.1.2 RISK

The metering is a highly regulated JEN sub-asset class. Compliance risks are detailed in Appendix C.

3.1.2.1 *Criticality*

Accuracy and reliability of meter operation is highly critical because of compliance, reputational and revenue risks.

3.1.2.2 *Failure modes*

Failure of electricity meters can manifest itself as:

- Non-operation, such as a communications card failure or an LCD screen failure. AMI meters tend not to exhibit signs of deterioration until the failure occurs.
- Inaccurate operation where data recorded is outside of allowable error limits. For example, electro-mechanical devices utilise magnetic bearings that provide long operational lives. They are used in accumulation meters. The failure mode for these meters relates to the weakening of the breaking magnets over time. The result is the meter runs faster and faster and consequently reaches a stage where it exceeds the error limit.

3.1.2.3 *Current risks*

All risks are identified and managed in the Jemena/Zinfra compliance & risk management system (OMNIA).

3.1.2.4 *Existing controls*

Risk mitigation of this sub-asset class can be classified into three types:

- Architectural mitigation. Guiding principles and architectural decisions mitigate risk through design.
- Procedural mitigation. Business as Usual (BAU) procedures, work instructions and planning (e.g. inclusion of budgetary contingencies, careful vendor selection and vendor monitoring regimes) are used to reduce the likelihood and/or impact of procedural error.
- Contractual mitigation. Contractual mechanisms such as service level agreements, liquidated damages, defects liability periods and insurance requirements are used to reduce likelihood of sub-standard third party service delivery.

In addition, all parties involved in provision of metering services are audited by AEMO and JEN's internal teams to ensure they have the requisite training and accreditation in line with national and state-based obligations.

Table 3-2: Existing Controls

#	Threat	Vulnerability	Risk	Controls
1	Over stated product reliability or unexpected environmental conditions	Inadequate product design	Increased operation & maintenance cost. Increased replacement levels may affect customer relations and business reputation	Contractual: Extended warranty periods
3	Geographically or Radio Frequency (RF) isolated customer	Limitation of Local Area Network (LAN) coverage	Increased cost to achieve coverage. Increased probability of not meeting regulatory requirement for meter reading performance	Architectural: Wide Area Network (WAN) Port under the terminal cover allows a modem to be added to replace the built-in mesh radio modem. Design support is for 3G/4G only.
4	Regulator change band access new data services	Meter LAN design ISM 100Kbps limit	Stranded meter assets because of integrated communication technology Increased maintenance/replacement cost	[redacted]
5	4G WAN service end of life	WAN solution uses 4G	Redesign/replacement of Access Points Loss of system availability	Architectural: Design supports modem replacement in AP's
6	New HAN technology	AMI meters support only Zigbee	Stranded assets	Architectural: Use open/widely supported communication standard

#	Threat	Vulnerability	Risk	Controls
7	Unsuitable geography & street design	LAN RF limitations	Poor coverage requiring additional equipment/costs	Procedural: Radio Surveys: Comprehensive radio survey of the distribution territory to ensure the technology selection is based on sound real world and measured data Contractual Silver Spring responsible for 100% coverage
9	New firmware/Programs	Unknown behaviour in the field	AMI system availability and integrity may be compromised. Affects operation & maintenance phases	Procedural: Testing of firmware and meter programs prior to field deployment
10	Delays in supply chain	Unknown performance	Failure to supply metering equipment on time may result in regulatory compliance issues	Procedural: Inventory Management: Jemena will maintain 12 months inventory reserve “in the country” (lead time for new shipment) to provide supply even in the event of delivery issues
11	Single Mesh Network supplier	End of product line or company failure	Unable to maintain and grow the LAN network. Continued supply of NIC modules to ensure supply of new meters. Enhancement to support new opportunities. Continued support for NMS	Contractual: Unlikely considering number of Utilities using this product. Jemena is also protected under the legal ESCROW agreement - a contractual arrangement in which a third party receives and disburses money or documents for the primary transacting parties, with the disbursement dependent on conditions agreed to by the transacting parties, or an account established by a broker for holding funds on behalf of the broker's principal or some other person until the consummation or termination of a transaction
12	Meter and Communications devices supply reliability	Long lead time and supply shortage of meters and communications devices	Unable to meet the meter and communications devices demand required by business as usual activities and unexpected failures	Contractual: Establish and maintain contractual arrangement to ensure supply availability through guaranteed service levels and assurance.

3.1.2.5 *Future risks*

Emerging risks for this sub-asset class are:

- [redacted]
- Continuously evolving regulations and standards such as the introduction of smart meter contestability in Victoria
- Expectations by market operator to utilize smart metering for supporting electricity grid stability initiatives may impose additional requirements on meter capabilities and services.
- Disruption to global electronics supply chain affecting production and delivery of meters.
- Inability to support effective technology substitution: technology obsolescence and/or vendors exiting the market which could significantly affect the network operations

3.1.3 PERFORMANCE

3.1.3.1 *Requirements*

Electricity meters must:

- Support establishment of new connections and abolishment/alterations;
- Measure and record energy use by individual customers and provide billing data in accordance with regulations;
- Support remote energisation/de-energisation of premises;
- Support advanced tariffs such as Time of Use;
- Support demand management; and
- Support future 230/400V distribution network advanced network power status and quality monitoring at each customer connection point

3.1.3.2 *Life expectancy*

According to vendor warranty terms and JEN's experience with similar devices, expected design/product life is:

- AMI meters (installed since 2009) – 15 years (manufacturer's warranty is 5 years);
- JEN has condition based approach to lifecycle management (ref to Sec 3.1.4), hence life expectancy of the meters are updated in line with the latest asset condition measurements (e.g. results of meter accuracy sample testing, meter inspection)
- Legacy meters (pre-AMI) – Legacy electro-mechanical or electronic meters have exceeded their design and expected life, these meters are no longer supported by the manufacturers. These meters are gradually being phased out as their condition fails and are no longer supported by the manufacturers. These meters are no longer repaired or refurbished and will be replaced under the accelerated legacy meter replacement program.
- Meters with current transformers and/or voltage transformers (LVCT, HVCT/VT) - 30 years

NB: Life span of the metering installations can be impacted by the meter's operating environment (e.g. ambient temperature and electrical). If the environment is maintained within the manufacturer's operating limits, and as prescribed by the Victorian Service and Installation Rules (**SIR**) limits,

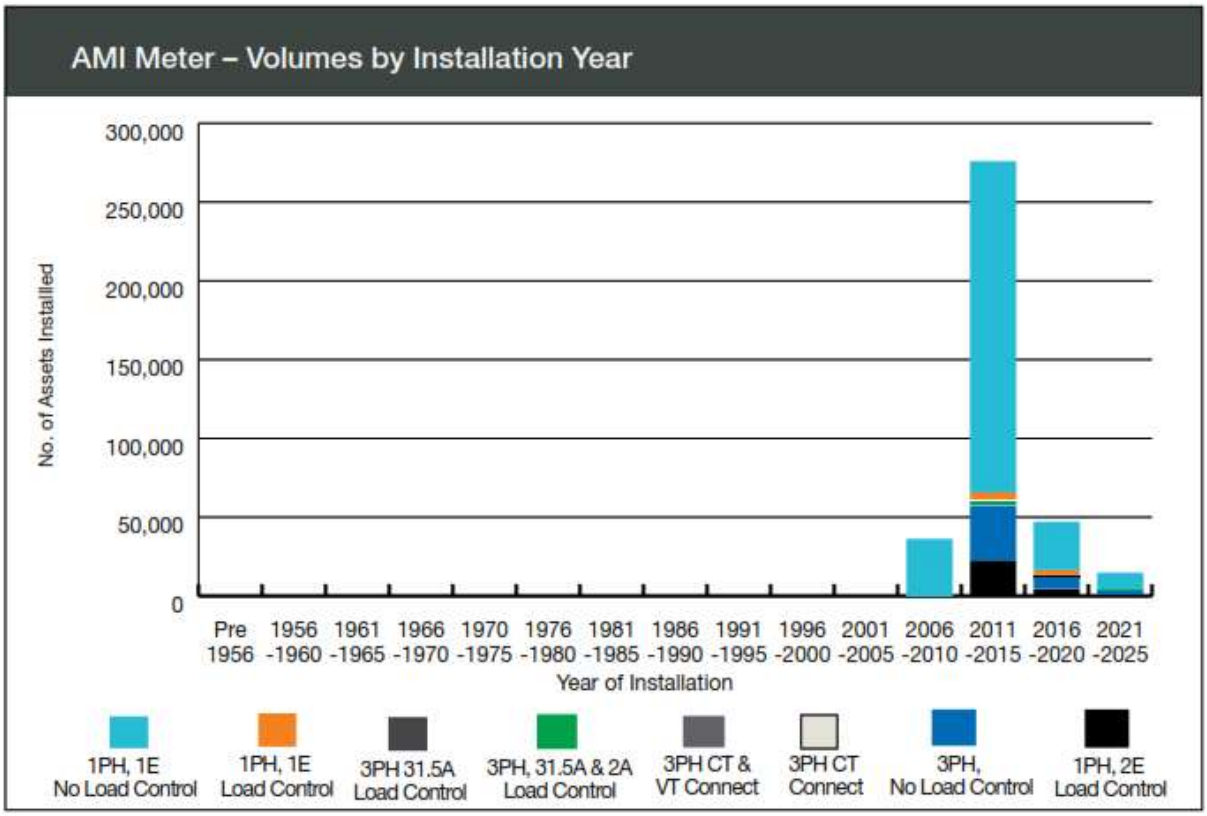
expected life should not be degraded. Where a battery is integral to the meter (e.g. AMI meters) the manufacturer's warranty is also 5 years.

NB: AMI communications infrastructure and metering backend systems are not covered by this ACS. They fall under the purview of JEN's SCADA & RTS department and covered in a different Asset Class Strategy.

3.1.3.3 *Age profiles*

99% of JEN's installed meter base is of the AMI variety as shown in Figure 3-2.

Figure 3-2: AMI meters by year of procurement (commencement of warranty)



As can be seen in Figure 3-2, a mass rollout of AMI meters occurred primarily in the 2010-2013 years. This rollout was completed by not only Jemena but all Victorian distribution businesses. All Jemena AMI meters installed as a part of this rollout will reach the end of their design life during the next regulatory period.

Refer to Chapter 3.1.4 for further information on the lifecycle management program proposed for this population of AMI meters.

3.1.3.4 *Utilisation*

Electricity meters are required by regulation to measure customer consumption accurately at all times.

3.1.3.5 *Performance analysis*

Electricity meter performance is compliant with the objectives specified by the Victorian Government's AMI minimum functionality specification (MFS) and Chapter 7 of the National Electricity Rules (NER). Compliance is audited annually by AEMO.

End-to-end system performance and compliance monitoring is performed by network operations. Asset Management reviews that data and, together with the auditor's report, checks for any emergent performance trend that may modify the sub-asset strategy.

Table 3-3: AMI Meter Failures

Description	2016	2017	2018	2019	2020	2021	2022	2023
Condition fail	423	731	572	677	874	952	857	1,139
Approx % of pop	0.12	0.21	0.16	0.19	0.24	0.26	0.23	0.29

There has been a comparatively small number of AMI meters fail before end of design/product life. These have been replaced and each failed unit evaluated by the meter supplier. LVCTs and HVCTs rarely fail.

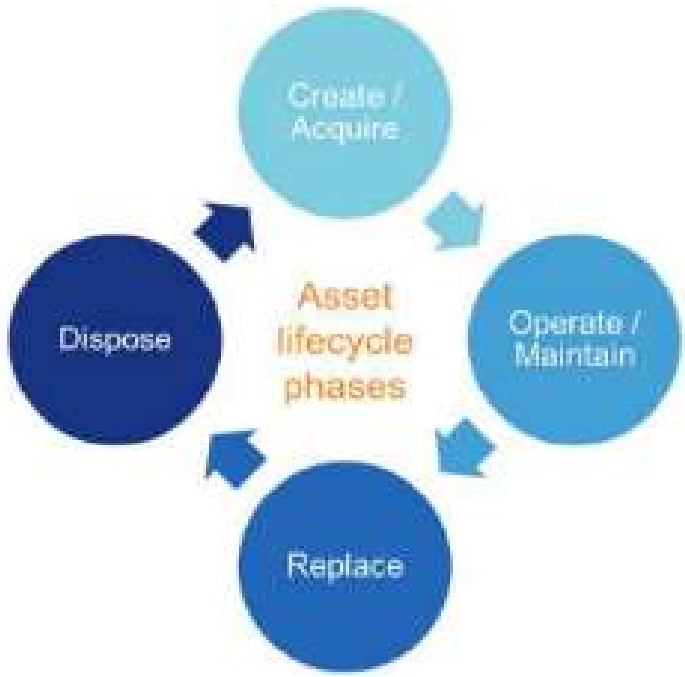
3.1.3.6 *Control effectiveness*

By comparing identified risks and measuring past incidents, control effectiveness is assessed as part of the Jemena Compliance & Risk System (JCAR). The existing controls have proved Adequate or Strong. There has not been a Major or Severe incident in the last 5 years.

3.1.4 LIFE CYCLE MANAGEMENT

3.1.4.1 *Creation*

Sub-asset acquisition is planned annually and logistics process commence ahead (to accommodate for lead time). The aim is to have sufficient, but not excessive, stock to manage the required supply.



Acquisition triggers for this asset class are:

- New connection requests;
- Number of 'condition fail' units;
- Deteriorated metering installations that have reached end of life;
- Deteriorated communication installations that have reached end of life; and
- LAN functional and/or performance improvement driven change of the metering installation

Availability of spares is a critical aspect of this sub-asset class strategy. Spares are held to:

- Mitigate risk of regulatory non-compliance (under NER Chapter 7) of failing to perform meter installation;
- Minimise any communication link outage times; and
- Eliminate any loss of revenue due to unmetered energy

The optimum quantities of meters and associated communication assets takes into account the cost of holding stock balanced against:

- Purchase lead times;
- Anticipated network growth;
- Abolishment/alteration churn; and
- Projected 'condition fail' rates

JEN's nominated contractor monitors stock levels. The minimum stock level is seven months of projected meter consumption for each category[4] of meter (excluding legacy types).

3.1.4.2 *Asset Operation and maintenance*

Based on asset condition and risk-based assessment (i.e. CBRM), assets are:

- Monitored by NMS and BI systems;
- Subject to preventative maintenance inspection and testing; and
- Replaced when necessary

This sub-asset category's maintenance program involves:

- Inspection and testing, i.e. preventative maintenance (NER prescribed periodic testing as per NER clause 7.9.1, schedule 7.6);
- Corrective maintenance (defects); and
- Reactive maintenance (faults and emergencies)

JEN undertakes inspection and testing of the metering and associated communication assets in accordance with JEN's Metering Asset Management Strategy (MAMS, December 2019) as approved by AEMO. The MAMS details JEN's approach to inspection, testing and replacement of electricity meters, as well as required accreditation of involved contractors and meter service providers. JEN Maintenance programs are reviewed annually in light of potential changes to product development, performance, failures, changes in policies and regulatory requirements.

In the event that inspection and testing programs, reveal widespread 'family failure' of the meters, JEN would liaise with AEMO to ensure the proposed replacement program is acceptable and compliant with the NER. The supplier/manufacturer would be held to account to the extent commercially reasonable.

The testing and inspection of metering installations is carried out in accordance with the requirements of NER, Chapter 7.

The MAMS spells out the asset management requirements for the operations, inspection and testing of the different categories of meters and instrument transformers, covering:

- Type tests and pattern approvals;
- Pre-installation tests;
- Meter installation inspections;
- Direct connected meter sample tests;
- HV and LV CT connected meter tests;
- LV CT sample tests; and

[4] Meter category details are provided at Appendix B

- HV CT & VT tests

Corrective maintenance is necessitated when sample testing of metering installations (in accordance to the MAMS) detects a 'condition fail'.

Reactive maintenance is characterised by awareness of 'condition fail' because of:

- A customer complaint; or
- [redacted] Any deviation from expected operational thresholds are analysed for potential reactive maintenance.

3.1.4.3 *AMI meter sample testing*

As mentioned in Section 3.1.4.2, Jemena as part of its asset management (JAM) and market responsibilities (MPB-Metering Provision Category B), performs sample testing on all electricity meters installed in its network, in accordance with the requirements set out in chapter 7 of the National Electricity Rules and the Australian standard AS 1284 – 13.

The aim of sample testing is to monitor the electricity meters' accuracy and functionality to ensure meter performance is maintained within the specified characteristics during its operational life. Electricity meters sample testing is a rolling year by year program based on the year of manufacturing/installations, populations and variance and requirements of our AEMO-approved MAMS.

3.1.4.4 *AMI meter installation site inspection program – site visit and inspection*

Jemena as part of its asset management (JAM) and market responsibilities (MPB-Metering Provision Category B), performs two types of metering installations inspections, they are:

- Metering installations inspection, when performing sample testing on electricity meters. The aim of the metering installations inspections program is to monitor electricity meter installations integrity, safety, security and functionalities to ensure the installation performance is maintained within the specified characteristics during its operational life. AMI metering installations inspections program is a rolling year by year program.
- In addition to the inspections at the time of testing, [redacted] Furthermore, to address AEMO guidelines relating to physical site visits (ref AEMO's Position Paper Whole Current Meter Testing and Inspection, October 2019), Jemena shall further supplement the above inspections with a time-based physical inspection program. The program shall ensure that every whole-current meter on JEN is physically examined (via a site visit) within the two-year period following the 15-year anniversary of the meter installation and every 15 years thereafter.

3.1.4.5 *AMI meter installation inspection program – AMI system data analytics*

Jemena utilises the AMI systems and data provided by the AMI meters in its asset management strategy, operations and maintenance programs. Jemena have implemented the following to better perform its obligations in establishing, operating and maintaining its electricity distribution network.

- Usage of AMI metering last gasp data in its outage management system which allows near real time monitoring and management of customer supply availability and status.

- Monitoring and management of the AMI meter terminal cover tamper events and run analytics to determine the integrity and safety of the metering installations.
- Monitoring and management of the AMI meter main cover tamper events and run analytics and investigations to determine the integrity and safety of the AMI meters and to prevent illegal and unauthorised usage of electricity.
- Monitoring voltage and current fluctuations, sag and swells events from the AMI meters and other networks monitoring devices (SCADA & Power Quality Meters) and run analytics and investigations to determine if installations have been subjected to any tampers.
- Monitoring the magnitude and characteristic of current in live and neutral phases of supply and perform analytics to determine the integrity of the supply neutral from the network to the point of connections/metering installations. (In Development).
- Monitoring active meters with no load.
- Monitoring disconnected sites with load.
- Monitoring 3 phase meters to determine if meter has been tampered with – revenue protection.
- Monitoring abnormal voltage and current pattern to detect potential indicators of specific activities such as drug plantation.

3.1.4.6 *Metering CT & VT's Testing & Inspection*

Meters that are removed from operation, but assessed as having residual value greater than the cost of refurbishment, will be refurbished and returned to stock to be used in new connections / meter upgrades.

3.1.4.7 *Metering CT & VT's Testing & Inspection*

If the metering installation failed to meet accuracy requirements as per Metrology procedure Part A and NER, then following procedure applies.

- If the failure is due to meter error then the meter will be replaced and Meter Data Provider (MDP) will be advised about any substitutions to be done to correct error.
- If Instrument transformers (CT & VT) are found to be faulty then replacement will be scheduled as soon as operationally possible and we will advise AEMO of the issue and seek guidance and approval to mitigate and correct the fault. MDP will also be advised of any data corrections or substitutions may be required.
- If a metering installation test or inspection demonstrates errors in excess of those prescribed and the time at which those errors arose is not known, then we will advise AEMO of the issue and seek guidance and approval to mitigate and correct the fault.

3.1.4.8 *Cross boundary HV metering*

Jemena has interconnections metering arrangements at terminal station and zone substations where energy is supplied or received from transmission or other distribution businesses (DB's)

These metering installations are for compliance with the NER chapter 7 and metrology procedure requirements. HV Cross Boundary metering installations include the following components:

- Energy meter;
- Current transformer; and
- Voltage transformer.

JEN is responsible to fund the cross-boundary HV metering installations as part of its standard control services[5]. However, JEN is not an accredited metering provider / coordinator for such installations. Approved metering providers and metering coordinators (responsible for maintenance & technical compliance of these installations) are appointed for these installations as per the AEMO prescribed process.

Table 3-4: Cross-boundary HV metering quantities

Asset	Type	2024	2025	2026	2027	2028	2029	2030	2031
Meter (EDMI, Mk6)	Type 2 & 3	19	19	19	19	19	19	19	19
HV CT	Class 0.5	23	23	23	23	23	23	23	23
HV VT	Class 0.5	13	13	13	13	13	13	13	13

Due to the large amount of energy transferred through Cross Boundary meters HV Installation assets will be maintained as Zonal/Inter DB sites and HV customers. A periodic inspection, maintenance and test plan is developed and implemented to ensure full compliance with the requirements.

The following are the periodic testing and calibrations performed on all cross boundary meters:

- Metering installation inspection;
- Meter testing;
- Current transformer testing and calibration;
- Voltage transformer testing and calibration; and
- Overall metering installation error calculations.

3.1.4.9 *Replacement/disposal*

Generally there are four replacement approaches pertinent to this sub-asset life cycle management,

- Run to failure (reactive);
- Schedule-based replacement (age-based);
- Condition-based replacement (the most cost effective); and
- Proactive value based replacement

3.1.4.9.1 Run to failure

Run to failure would compromise JEN's ability to meet the requirements of the NER, the Victorian Electricity Distribution Code (VEDC) and electricity safety regulations.

3.1.4.9.2 Schedule-based replacement (age-based)

Scheduled replacement (aged-based) proposes to replace electricity meters at the end of design/product life. Nominal AMI meter product life is 15 years (according to the manufacturer). The AMI rollout commenced in 2009, so far there have not been any end of product life replacements. While the expected product life of AMI meters is 15 years, JEN have not experienced large failures as such the maintenance and monitoring programs are in place to identify any aged or performance based failures. Currently, JEN considers age based replacement uneconomic.

[5] AER, *Final framework and approach for the Victorian electricity distributors, Regulatory control period commencing 1 January 2021*, January 2019

3.1.4.9.3 Condition-based replacement

Condition based replacement represents the best alternative because it excludes 'run to failure' and improves upon 'schedule based replacement' by incorporating age data into overall condition monitoring of the asset. This facilitates the optimal trade-off of CAPEX and OPEX performance. Sub-assets are replaced at the end of their useful life, when their condition has deteriorated below acceptable performance vis-à-vis NER requirements. This mode is optimal because it minimises asset investment whilst meeting, or exceeding, NER compliance.

Condition-based replacement is determined by CBRM data:

- Age of asset;
- Preventative maintenance activities and record keeping;
- Performance of asset; and
- Continuous monitoring of the assets

JEN is further enhancing its meter inspection process with ongoing remote monitoring of its AMI meters. [redacted] The few remaining non-AMI meters are expected to be decommissioned by the end of 2026.

To support ongoing remote monitoring and condition analysis of metering sites, Jemena has implemented (and continues to develop) JEN Analytics. JEN analytics is a backend system that delivers significant insights on the operational integrity of the metering installations, based on the analysis of remotely monitored customer supply characteristics (current, voltage, power factor), as well as meter generated conditions alerts [redacted] This system is pivotal not only to Jemena's ability to proactively identify faulty meters but also to Jemena's ongoing monitoring of the site/installation safety (e.g. integrity of supply neutral connections, identification of potential current leakage) through automated, ongoing analysis of the data collected by the site meter and neighbouring meters.

The events reported by Jemena AMI meters include alerts and data relating to:

- [redacted]
- Supply quality events (e.g. over/under for voltage, current, and power factor events)
- Supply compliance events: (e.g. the presence of voltage on the load-side when mains contactor open, unregistered energy exports, etc)
- [redacted]

The ongoing monitoring of supply instantaneous characteristics (e.g. voltage, current, power factor and temperature sensing) by AMI meters and the real-time correlation of these data with the data collected from neighbouring meters upstream in Jemena's other network devices enables JEN Analytics to identify likely cases of:

- Deterioration / loosening of terminal connections, often not easily identifiable during routine visual inspection
- Meter bypass/electricity theft through monitoring of voltage profile, current and Power Factor (Power Quality indicator)along distribution feeders
- Meter tampering and/or faults through identifying imbalances in the values of instantaneous currents, voltage and energies across different phases of metering installation

- Site wiring and site wiring insulation issues through monitoring of leakage current estimates
- Deterioration of the network's neutral connections (often not easily identifiable through simple visual inspection of the meter) through monitoring variations in the estimated neutral current and the supply source impedance
- Unusual consumption patterns with abnormal/non-correlated voltage and current levels, which might be indicative of likely meter faults and illegal activity

Occurrence of the above events will generate the reports and email notifications triggering further investigation and, where required a follow-up with a physical inspection of the installation by Jemena networks' compliance and operations teams.

The condition based replacement mode fits within JEN's comprehensive asset maintenance programs.

Figure 3-3 (below) provides a diagrammatic summary of the maintenance decision making used in administering AMI meter life cycle.

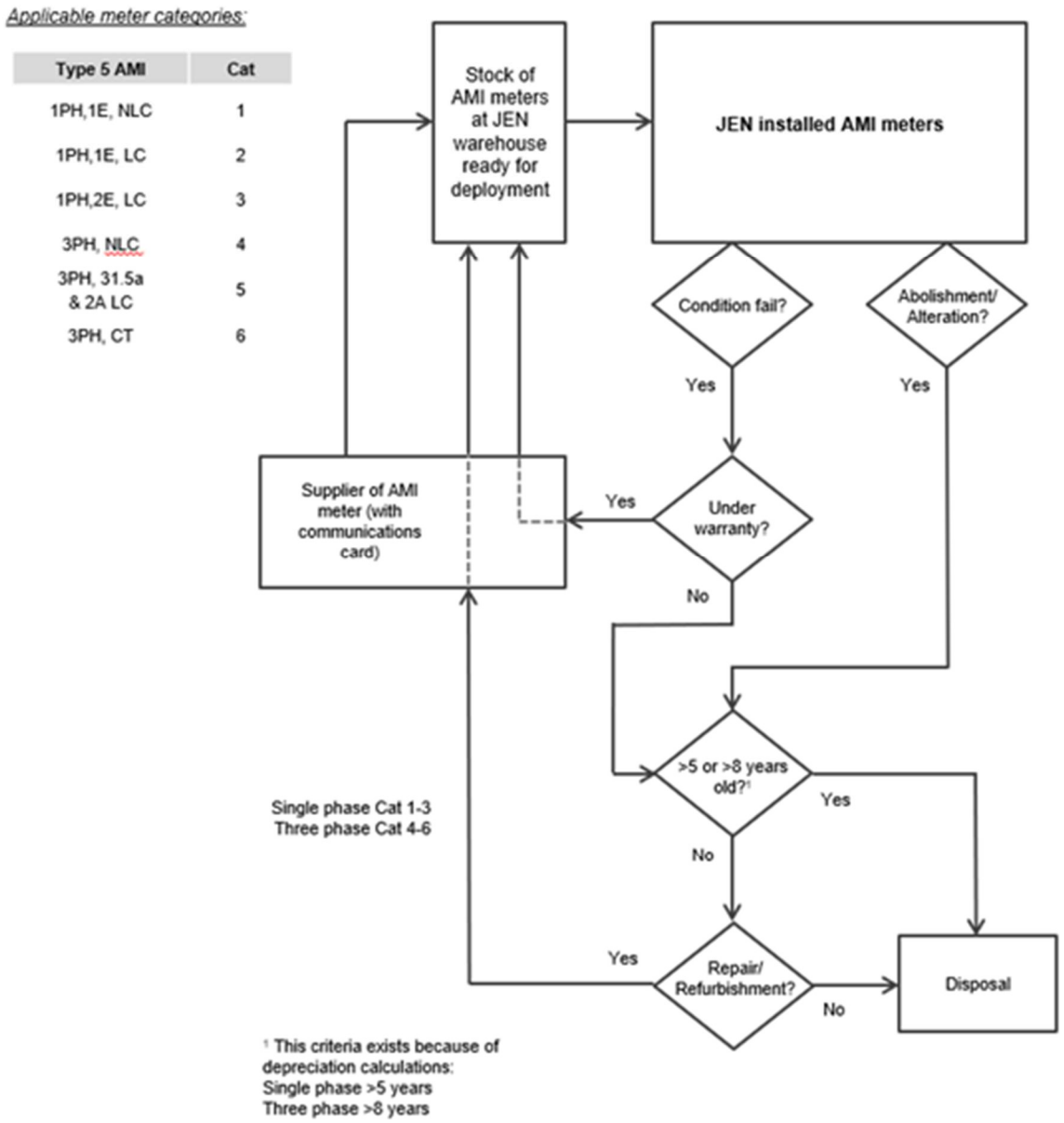
3.1.4.9.4 Proactive value based replacement

Proactive value based replacement represents another effective and optimal alternative because it excludes ‘run to failure’ and improves upon ‘schedule based replacement’ by incorporating asset value into overall condition monitoring of the asset. This facilitates the optimal trade-off of CAPEX versus OPEX when the value of the asset has depreciated to the point that is no longer economical to maintain the asset.

To enable efficient replacement of the AMI meters installed during the mass rollout in the 2010-2013 period, a proactive value based replacement program of work is proposed to commence from the start of the next regulatory period (FY27-31). This program aims to mitigate the risks of supply chain and labour resource constraints expected to be prevalent in the industry as all Victorian distribution businesses move to replace their population of end of life AMI meters. This program is expected to enhance safety, reduce customer disruptions (e.g. minimise outages, billing issues) and reduce maintenance costs associated with running of meters beyond their design life.

Proactive value based replacement represents the optimal strategy for Jemena in the next EDPR period.

Figure 3-3: Maintenance decision making and costings of AMI meters



Meters removed from operation (except for non-AMI legacy to AMI meter upgrades) are assessed for repair/refurbishment and subsequent reuse. However, in view of the cost of the repair/refurbishment, and in view of any reduction in price of new meters, repair/refurbishment may become less and less economical.

Meanwhile, applying linear depreciation to the expected 15-year life of AMI meters, JEN has determined that:

- Single phase AMI meters removed from JEN operation older than 5 years will be written off (i.e. shall not be refurbished), since the refurbishment cost would exceed the residual depreciated value of the meter; and
- Multiphase AMI meters removed from JEN operation that are older than 8 years old will be written off (i.e. will not be refurbished), since the refurbishment cost would exceed the depreciated value of the meter.

LVCTs are robust and have no moving parts. Whenever a LVCT fails it is scrapped. In-service compliance tests and inspections (following a sampling regime) are performed as mandated by AEMO guidelines, NER and MAMS.

Metering installations inspection program is a mandatory requirements under the NER's and AEMO's guideline to ensure the integrity of the metering installations.

HVCT technology is only used at cross-boundary connections. Each instance has a unique site-based design requirement. In-service compliance tests and inspections are performed as required by NER and forecast OPEX in Section 5.

Table 3-5: Forecast AMI meter activity count

Description	FY25	FY26	FY27	FY28	FY29	FY30	FY31
New Connections (Permanent + Temporary) - Growth	9,083	9,220	9,387	9,560	9,730	9,901	10,072
Alterations – Meters Installed	428	434	442	450	458	466	474
Failures / Faults	1,132	1,156	1,294	1,582	2,093	2,981	4,549
AMI Meter Replacement	-	-	1,910	11,460	19,101	22,921	26,741

For privacy reasons, the memory of a meter is cleared before disposal. Any decommissioned equipment is disposed of by a certified recycling company in accordance with Jemena Environment Policy (JEM PO 0397).

3.1.5 INFORMATION

JEN's AMS (refer to Section 1.2 of this document) provides a hierarchical approach to understanding the information requirement to achieve Jemena's business objectives at the Asset Class. In summary, the combination of Jemena's Business Plan, the individual Asset Business Strategy (ABS) and Asset Class Strategy (ACS) all provide the context to determine the information required to deliver the sub-asset class business outcomes.

The high-level information requirements to achieve the ACS's business objectives and inform its critical decisions were identified at a facilitated workshop during the ACS definition process. The electricity meters sub-asset class identified four business objectives together with the business information required to support these objectives as set out in Table 3-6. Current and future information requirements to inform value-added decision-making are in Table 3-7. A proposed improvement for future business information needs is at Table 3-8.

Table 3-6: Electricity metering business objectives and information requirements

Business Objective	Jemena Information Sources	Externally Sourced Data
BO1 (Type 5 AMI) Maintain compliance	AMI SAP ERP SAP ECMS (investigations, revenue protections, work instructions, strategies, metering information, etc) [redacted] Cognos (revenue protection reports) Network drive(s)	AEMC website - National Electricity Rules (AEMC) AEMO website - Metrology Procedures (AEMO) AEMO industry workgroups ENA Meter Coordinator workgroup SAI Global website – Australian standards

Business Objective	Jemena Information Sources	Externally Sourced Data
		Reports from Meter Service providers: • SECURE JIRA portal (meter vendor portal) • Monthly Report with volumes of meters refurbished, repaired, faults& fault analysis • invoices Mondo (specialised service provider) monthly reports (excel and pdfs), include: • Summary of completed training & accreditations • Summary of activities conducted on JEN, including number of tests (compliance, and customer paid tests), Additions/alterations, CT meters commissioned • Meter Stock by category, currently with Mondo. • Outstanding Invoices Zinfra monthly reports: • As per above, plus volumes of non-CT AMI meters installed
BO2 Ensure meter availability (supply) for new connections and/or alterations	AMI SAP ERP SAP (population of legacy meters, purchase orders) ECMS	Vendor Reports and reports as per external data for BO Public announcements and vendor notifications (e.g. Merger and Acquisitions, EOL/EOS announcements)
BO3 Ensure competitive pricing for the meters and metering services	AMI SAP ERP SAP Contract with Suppliers (ECMS)	Tender, market reports
BO4 Support JEN Network Management in provision of better customer experience	[redacted] [redacted] BI/Cognos (revenue protection/reverse energy reports) JEN SCADA/Outage web Energy Portal	Publication from COAG CSIRO ENA forums AEMO RMCF (Retail Market Customer Forum)

Table 3-7: Electricity metering critical decisions business information requirements

Critical Business Decision	Current Information Usage	Future Information Requirement	Value to Asset Class (High, Medium, Low with justification)
CD1: install, maintain and test meters to required standards.	AMI / ERP SAP, with details of each asset and significant components; • Meter category • Meter tariffs • Installations data • Test dates • Location / address • Status • Serial number • Meter program IDs • Maintenance records Network drive: • New connections reports (growth trends) • Vendor status reports • Maintenance condition reports	• Require BI reports for asset life management for better pre-emptive maintenance • Require historic test data be stored in BI warehouse for predicative fault analysis (currently stored in separate spreadsheets from service providers)	• High – (required by National Electricity Rules, National Measurement Act, Vic Government legislation)
CD2a: Maintain viable meter supply contracts	AMI SAP – Meter Volumes (current meter demand) • Meters in stock by categories (1, 2, 3, 4, 5a, 5b, 6a, 6b) ERP SAP – Meter stocks • Meter tariffs • Meters installed by date and categories • Meter currently with vendors for refurbishment • Meter failure rates (Attribute in SAP) • [redacted] • Test reports	• Enhanced meter management and supply/inventory management system	• High – part of JEN obligations under the Electricity Code.
CD2a: Place orders on time, as required by this asset class strategy	Monitoring current stocks: • Available volume of meters of a particular category in store (per store location) • at JEN warehouses	• Enhanced meter management and supply/inventory management system	• High – part of JEN obligations under the Electricity Code.
CD3: Periodically test the market and meter prices	Monitoring the market for: • New meter manufactures • Change in exchange rates	• Enhanced meter management and supply/inventory management system	• High – part of JEN obligations under the Electricity Code.
CD4: actively pursue technological innovation to better leverage	Monitoring the market for • new technology • better use of collected data	• On going architectural and market review	• High – part of JEN commitment for customer focus

Critical Business Decision	Current Information Usage	Future Information Requirement	Value to Asset Class (High, Medium, Low with justification)
capabilities of AMI meters			

Table 3-8: Electricity metering information initiatives to support future business information requirements

Information Initiative	Use Case Description	Asset Class Risk	Data Quality Requirement
Create reports for meter consumption and meter refurbishment volumes to reflect real time demand and utilization of meters by supplier, meter category and type of installation	Monitor the monthly consumption of meters are in line with stated projections and forecasts	Over / under budgeting Running out of stock	All the information attributes are complete and accurate in SAP

3.1.5.1 *Future improvements*

- [redacted]
- Automated remote monitoring of meter integrity. Automated reports-by-exception, for example, identifying irregular meter consumption and meter operations due to:
  - [redacted]
  - Meter by-pass (theft); and
  - Safety concerns (degraded connection)

3.2 POWER QUALITY METERS

3.2.1 INTRODUCTION

Power quality metering is intended to:

- Monitor power quality levels in accordance with regulatory requirements;
- Inform power quality investigations if there is an incidence of non-compliance; and
- Inform a specific customer query concerning a possible anomalous network event

JEN power quality meters (PQMs) presently consist of two types: one type located at zone substations and another at selected end of feeder locations. They continuously monitor the quality of supply.

Table 3-9: PQMs in Use in JEN

Description	Model
Zone substation – 6.6kV, 11kV and 22kV buses	ION 7650, Elspec G5
End of feeder distribution transformer 415V/240V	ION 7400, Elspec G4

Each PQM measures and records:

- Steady state RMS voltage levels;
- Short duration voltage disturbances including sags, swell and transients;
- Voltage harmonics;
- Voltage unbalance; and
- Load current (only at zone substations)

PQMs are programmed to capture voltage and current waveforms associated with a power quality excursion outside of pre-set limits. Captured waveforms provide useful information when analysing specific network power quality disturbances.

Within zone substations, PQMs monitor the network via voltage transformers (VTs) and current transformers (CTs). Meanwhile, at selected end of feeder distribution transformers, a PQM is connected directly to the low voltage network (without voltage transformers). Monitoring of load current is not implemented at end of feeder instances and there are no current transformers present at those locations.

PQMs are devices that measure and convert AC quantities of voltage and current into digital data. The PQM's micro-processor performs mathematical and/or logical operations using algorithms specific to power quality monitoring. Like all digital devices, they comprise a number of basic components including an auxiliary power supply, analogue to digital converter, CPU, RAM, ROM and limited I/O capability.

Table 3-10: PQM present population by model

Description	PQM model	Quantity	Proprietary software platform on JEN host servers
Zone substation 6.6kV, 11kV and 22kV buses	ION 7650	31	Schneider software PME v8.1 on Windows Server 2012 R2 and SQL Server 2014
	Elspec G5	4	Elspec Sapphire Enterprise, and SQL Server 2019
End of feeder distribution transformer 400V/230V	ION 7400	4	Schneider software PME v8.1 on Windows Server 2012 R2 and SQL Server 2014
	Elspec G4	22	Elspec Sapphire Enterprise, and SQL Server 2019

Proprietary software collects, buffers and analyses data from its respective PQM.

Detailed lists of PQMs at each zone substation and each end of feeder location is provided, together with the associated communications method, at Appendix D.

3.2.2 RISK

3.2.2.1 *Criticality*

PQMs record but do not control voltages and currents and therefore, from an electricity system perspective have low criticality. However, PQM functionality is a NER and Victorian Electricity Distribution Code (VEDC) compliance issue. This lifts criticality to moderate.

3.2.2.2 *Failure modes*

A PQM may stop operating, or appear to stop operating, because its:

- Power supply fails;
- Micro-processor fails;
- [redacted]
- Communications link fails (copper or cellular)

3.2.2.3 *Current risks*

All risks are identified and managed in the Jemena/Zinfra compliance & risk management system (OMNIA).

The main risks related to PQMs are:

- Loss of power quality data resulting in non-compliance with NER (Schedule 5.1) and VEDC (Clause 4.2.6); and
- Inability to provide a customer with information on the quality of supply provided to that customer leading to non-compliance with VEDC Clause 9.1.5. For example, a large customer might experience an unexplained HV circuit breaker trip event and request PQM data showing a snapshot of the time-stamped waveform to assist with root cause analysis.

3.2.2.4 *Existing controls*

Each PQM is remotely monitored and normally checked daily (Monday to Friday).

3.2.2.5 *Future risks*

[redacted]

3.2.3 PERFORMANCE

3.2.3.1 *Requirements*

PQMs need to measure and store network supply events around the clock. Typically a power quality metering scheme comprises a meter, associated AC and DC wiring and communications equipment to permit the uploading of collected data to the host server. PQMs are required to:

- Monitor each zone substation as per regulatory requirement under the NER (Schedule 5.1) and VEDC (Clause 4.2.6);
- Provide specific power quality data in response to customer requests as per VEDC Clause 9.1.5; and
- Monitor network power quality performance to help identify problem areas or worsening trends

3.2.3.2 *Life expectancy*

The nominal life of a PQM is 20 years. This is consistent with other solid-state secondary plant equipment, such as Intelligent Electronic Devices (IEDs). PQM life expectancy considerations are:

- Age and condition:
- Meter technology (e.g. solid-state):
- Availability of replacements:
- Manufacturer Mean Time Between Failure (MTBF) ratings: and
- Availability of manufacturer technical support

3.2.3.3 *Age profiles*

Figure Figure 3-4 and Figure 3-5 show the age profile of the zone substation and end of feeder power quality meters.

Figure 3-4: Zone Substation Power Quality Meter Age Profile

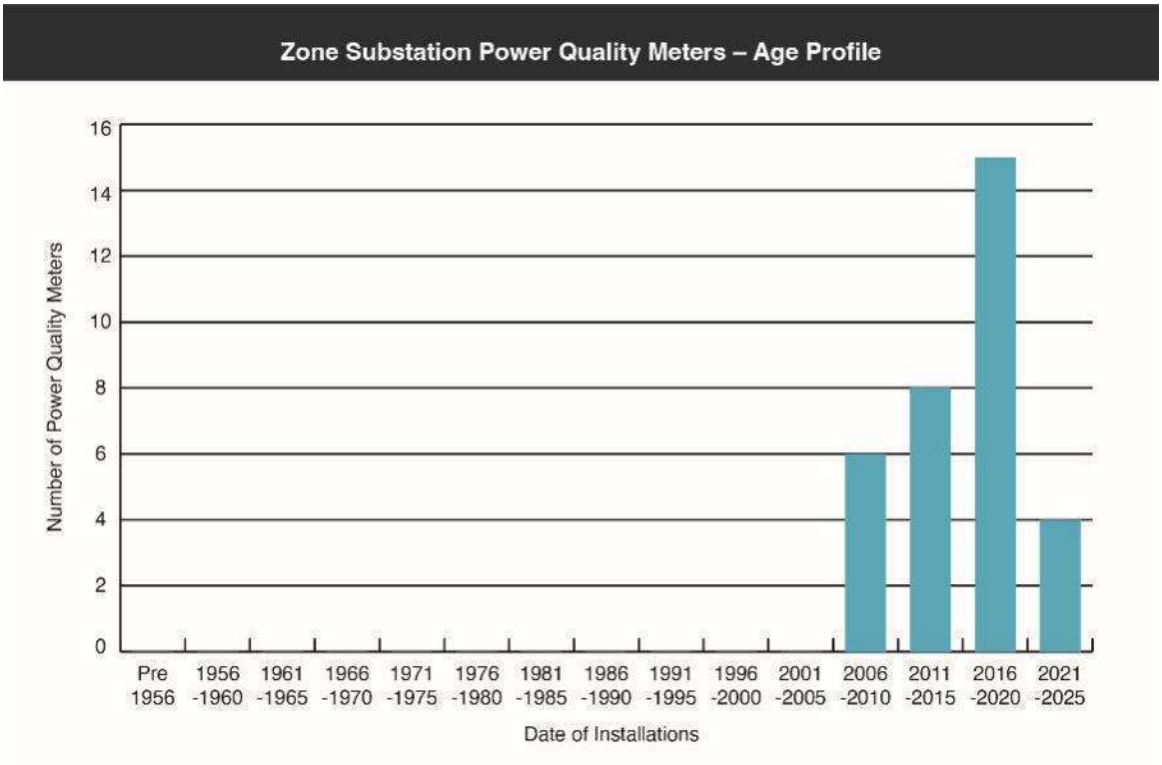
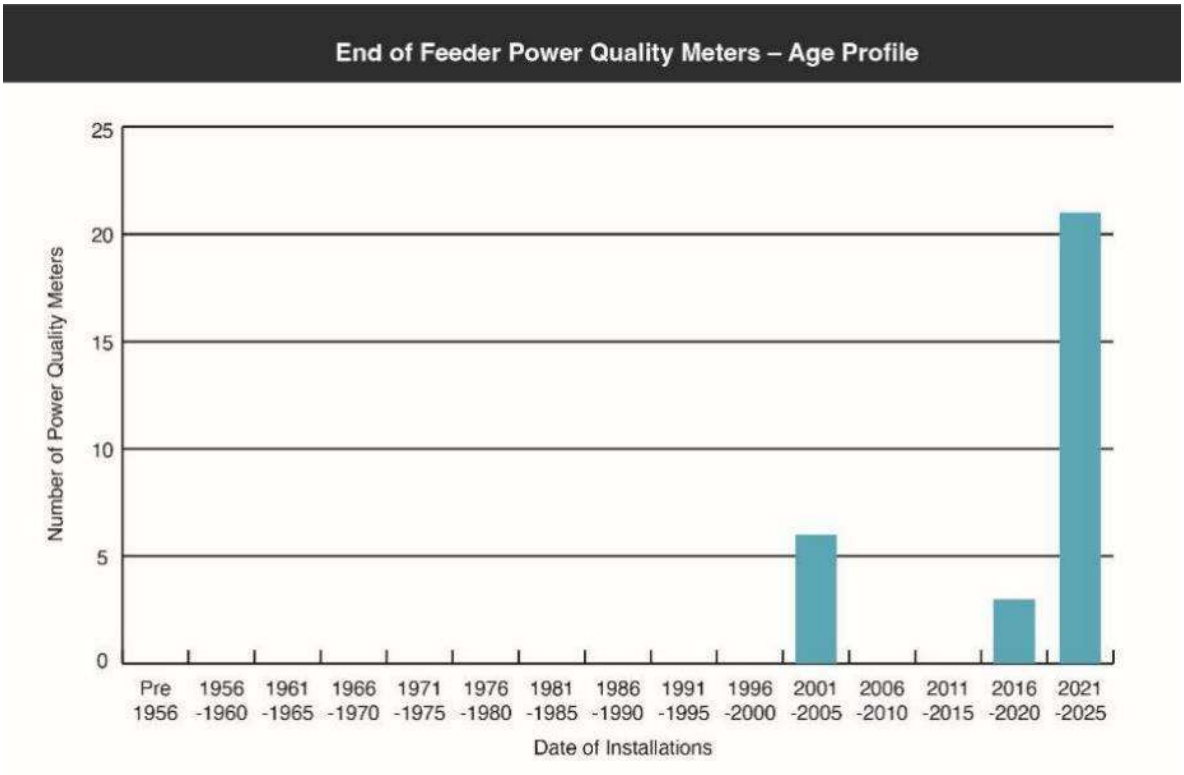


Figure 3-5: End of Feeder Power Quality Meter Age Profile



3.2.3.4 *Utilisation*

Continuous operation of each PQM is fundamental to JEN's capability to continuously monitor power quality.

3.2.3.5 *Performance analysis*

JEN reports power quality performance through the annual Regulatory Information Notice (RIN). During 2018 hundreds of minor voltage excursions were recorded (in keeping with the historical trends) and this is regarded as operationally normal. JEN's Distribution Annual Planning Report (DAPR, 2019) mentions occurrence of some higher voltage excursions outside of VEDC limits. These incidents are investigated so that future occurrences are avoided.

JEN also voluntarily participates in the University of Wollongong's annual Power Quality Compliance Audit (benchmarking JEN against other Australian electricity distributors).

3.2.3.6 *Control effectiveness*

Manual PQM health checks of the communications infrastructure from the host server through to each PQM is performed each day (normally Monday to Friday) and is an adequate control.

3.2.4 LIFE CYCLE MANAGEMENT

3.2.4.1 *Creation*

Above all, the need for a PQM is a regulatory requirement. Once installed and commissioned they tend to have long lives. In 2012, JEN conducted an evaluation of various PQM suppliers. The ION brand met JEN's criteria and, to date, all but one of the zone substations has been changed to this brand. The one remaining old meter was changed during zone substation upgrade works in 2021.

A program of works to replace each and every end of feeder PQM with an ION 7400 were installed in 2021.

PQM equipment procurement complies with the following:

- Zone substation secondary design standard (JEN ST 0600); and
- Protection and control settings manual (ELE AM MA 0003)

The standard types and acquisition triggers for this asset class are:

- As part of a new zone substation development;
- Condition based replacement of power quality meters that have reached end of life; and
- Technological improvement driven change

Spares are held in stock to enable minimal outage time. ION PQM supplier lead times are 2-4 weeks. JEN retains one ION 7650 in stock as a spare for every 13 ION 7650 in service, i.e. 2 in total. The same ratio applies to the ION 7400s spares . Likewise, one spare for each of Elspec G5 and Elspec G4 are kept.

3.2.4.2 *Operation and maintenance*

Generally there are three maintenance modes available for asset life cycle management,

- Run to failure (reactive);
- Schedule-based replacement; and
- Condition-based replacement (hybrid)

PQMs do not readily fall into any single mode. PQMs have no moving parts and are housed so as to be protected from the elements (e.g., environmental conditions etc.). Because of their low criticality, PQMs have been allowed to run until they individually fail. Incidence of running to failure, in recent years, is one end of feeder PQM per annum. Experience has shown it is more likely that new technology shall drive a scheduled replacement program as it has with ION 7650s at the zone substations since 2012. The end of feeder EDMI MK6 meters have all been replaced by Elspec G4 in 2022-23 because of the need for additional PQ capture capability and the need to move away from Windows XP.

The PQM maintenance program involves reactive replacement, scheduled replacement and periodic inspection (as part of site audits). Whilst it is rare for a PQM to fail, when it occurs it is detected by the daily manual check. Scheduled replacement depends on technological advances and project initiatives.

Zone substation PQMs are inspected annually consisting of:

- Visual inspection of PQMs for cleanliness; and
- Visual inspection of all secondary wiring, terminals, test links & meter LEDs

In addition to the annual secondary plant inspections, each installed PQM is physically inspected and tested every 8 years by:

- Checking power supplies of PQMs and modems;
- Checking all terminals, connections and cabling;
- On-load testing to verify that instrument transformers (CTs and VTs) and measuring transducers are providing the correct signals to the meter; and the voltages and currents are accurate in the host software; and
- Testing Sag/Swell trigger monitoring in the PQM

3.2.4.3 *Replacement/disposal*

Table 3-11: CAPEX Program

Item	Timeframe	Reason for Replacement	Comments
BKN ZSS PQM	2024	BKN ZSS (new)	Greenfield project – new ZSS
FW ZSS PQM	2025	Redevelopment of FW ZSS	FW Redevelopment Project
MDT ZSS PQM	2025	MDT ZSS (new)	Greenfield project – new ZSS
CN ZSS PQM	2026	Redevelopment of CN ZSS	CN Redevelopment Project
CS ZSS PQM	2028	Redevelopment of CS ZSS	CS Redevelopment Project

Any decommissioned equipment is disposed of by a certified recycling company in accordance with Jemena Environment Policy (JEM PO 0397).

3.2.5 INFORMATION

JEN's AMS (Section 1.2 above) provides a hierarchical approach to understanding the information requirement to achieve Jemena's business objectives at the Asset Class. In summary, the combination of Jemena's Business Plan, the individual Asset Business Strategy (ABS) and Asset Class Strategy (ACS) all provide the context to determine the information required to deliver the sub-asset class' business outcomes.

The high-level information requirements to achieve the ACS's business objectives and inform its critical decisions were identified at a facilitated workshop during the ACS definition process.

The PQM sub-asset class identified two business objectives together with the business information required to support these objectives are set out in Table 3-12 below.

Table 3-12: PQM business objectives

Business Objective	Jemena Information Sources	Externally Sourced Data
BO1 (PQ Meters) Maintain compliance	ERP SAP ECMS (investigations, work instructions, strategies, PQ metering information) PME 8.1 (reports, data extracts for fault analysis) Elspec Sapphire Enterprise (reports, data extracts for fault analysis) Network drive (manuals, data reports)	AEMC website - National Electricity Rules (AEMC) AEMO website - Metrology Procedures (AEMO) ENA strategy update SAI Global website – Australian standards Reports from external PQ data analysis firm (University of Wollongong): • Yearly data analysis reports of voltage events
BO2: Support JEN Network in investigation of faults and provision on better customer experience	ERP SAP ECMS (investigations, work instructions, strategies, PQ metering information) PME 8.1 (reports, data extracts for fault analysis) Elspec Sapphire Enterprise (reports, data extracts for fault analysis) Network drive (manuals, data reports)	N/A

Current and future information requirements to inform value-added decision making are listed below in

Table 3-13.

Table 3-13: PQM decisions business information requirements

Critical Business Decision	Current Information Usage	Future Information Requirement	Value to Asset Class (High, Medium, Low with justification)
CD1: install, maintain and test meters to required standards.	ERP SAP • Category of meters • Installations Data • Status • Serial number • Test dates • Maintenance records Network Drive • Maintenance condition reports (testers folders)	• Most of the maintenance data is already in SAP and given the small volume of meters here, there are no requirements of specific BI reports. • However, in the future, require historic test data to be stored in BI warehouse for predictive fault analysis (currently stored in SAP)	• High – Required by National Electricity Rules, National Measurement Act and Vic Electricity Distribution Code)
CD2: Maintain the quality of data and consistency of data the meters collect	ERP SAP PM system logs and performance reports. PQ data collected with correct timestamps PME 8.1 (logs, reports, voltage waveforms, data extracts and backups) Elspec Sapphire Enterprise (reports, data extracts for fault analysis) Network drive (PQ data reports)	• Automate monitoring of PQ meters (e.g. via watch dog)	• High • Assist in network fault investigations • Required by National Electricity Rules, National Measurement Act and Vic Electricity Distribution Code

PQM information initiatives to support future business information requirements are listed below in Table 3-14.

Table 3-14: PQM information initiatives to support future business information requirements

Information Initiative	Use Case Description	Asset Class Risk in not Completing	Data Quality Requirement
Centralised collection of all PQ data across different PQMs at ZSS, end of feeders and connection points	Automate monitoring of PQ meters (e.g. via watch dog) • Create the reports • Ensure the test data is in server	Medium (mitigated by manual practices)	All the information attributes are complete and accurate in SAP

3.2.5.1 *Future improvements*

- Automation of PQM status and data. Currently an Asset Management engineer logs onto each PQM individually to validate their respective integrity (at zone substations and distribution kiosks). An automated 24/7 email notification system by exception would be more timely and less labour intensive.
- More regulatory requirements may be imposed for power quality monitoring due to factors like ‘embedded’ generation. ‘Smart grid’ design implications may result.

4 CONSOLIDATED PLAN

4.1 ASSET INVESTMENT PLAN

The Asset Investment Plan (AIP) provides a snapshot of how JEN will be managed to achieve its Asset Management Plan (AMP) objectives and consequently Jemena's strategic objectives. It also outlines the key asset strategies supporting Jemena's goals and objectives and informs the proposed expenditure plans and programs of work. The purpose of the AIP is to:

- Detail the investment plan for the next seven years for the Capex and Opex programs of work including the drivers for expenditure, current issues and the strategies for managing current issues; and
- Outline the current and emerging financial risks and opportunities impacting on JEN and describe how JEN is positioned to mitigate or take advantage of the identified risks and opportunities.

The AIP defines the nature of the works to take place to manage JEN within the constraints of cost and risk whilst at the same time maintaining current levels of network reliability and safety. A high level view of program deliverables is provided that encompasses the major projects to be delivered to ensure supply security for our customers is maintained.

It also contains the rationale for asset management activities, operational and maintenance plans and capital investment (overhaul, renewal, replacement and enhancement) plans.

4.2 CAPITAL AND OPERATIONAL WORK PLAN

The Capital and Operational Work Plan (COWP) contains details on optimised capital and operational expenditures over a two year period. It aggregates the required actions emanating from the JEN Asset Management Plan (AMP) and maintains a line of sight through to the Jemena Business Plan via the AMP as well as various Asset Class Strategies (ACS) and the JEN Asset Business Strategy (ABS).

The COWP aids development of the JEN Delivery Plan, the purpose of which is for Service Providers to critically evaluate field resource availability with the program of work required to be delivered. Refer to Figure 1-2 for the Jemena Asset Management System (AMS) which identifies where the COWP is positioned within the AMS document hierarchy.

5 GLOSSARY

5.1 ZONE SUBSTATION ABBREVIATIONS

Substation	Suburb	Substation	Suburb
AW	Airport West	HB	Heidelberg
BD	Broadmeadows	MAT	Melbourne Airport
BKN	Brooklyn	NEI	Nilsen Electrical Industries
BMS	Broadmeadows South	NEL	North East Link
BY	Braybrook	NH	North Heidelberg
CBN	Craigieburn North	NS	North Essendon
CN	Coburg Nth	NT	Newport
COO	Coolaroo	PTN	Preston
CS	Coburg South	PV	Pascoe Vale
EPA	East Preston A	SBY	Sunbury
EPB	East Preston B	SHM	Sydenham
EPN	East Preston	SSS	Somerton Switching Station
ES	Essendon	ST	Somerton
FE	Footscray East	TH	Tottenham
FF	Fairfield	TMA	Tullamarine Airport
FT	Flemington	VCO	Visy Board
FW	Footscray West	YVE	Yarraville

6 APPENDICES

6.1 APPENDIX A – JEN OWNED METERS BY CATEGORY AND SUB-CATEGORY

Table 6-1: JEN Owned Meters by Category and Sub-Category

Category	Connection type	Current	Voltage	Manufacturer/ product name	NIC hardware version	Product code
1	1ph, 2 wire / Direct Connect (single phase, single element)	I_b- 15 A I_{max}-100 A	240V50Hz	i-Credit 500 (SECURE)	224 224 324	E1E100-021 E1E100-031* E1E100-048†
				U1300 (Landis & Gyr)	422	U1310DSG2 NBN001JEM
2	1ph, 2 wire / Direct Connect (single phase, single element, with 31.5A load control)	I_b- 15 A I_{max}-100 A	240V50Hz	i-Credit 500 (SECURE)	224 224 324	E1E100-022 E1E100-032* E1E100-049†
				U1300	422	U1315DSG2 NBN001JEM
3	1ph, 2 wire / Direct Connect (single phase, two element, with 31.5A load control)	I_b- 10 A I_{max}-100 A	240V50Hz	i-Credit 500 (SECURE)	224 324	E1E102-042* E1E102-050†
				U1300	422	U1325DSG2 NBN001JEM
4	3ph, 4 wire / Direct Connect (3 phases with no load control)	I_b- 15 A I_{max}-100 A	415 V 50Hz	Sprint 200 (SECURE)	224 224 324	SPD100-027 SPD100-034* SPD100-047†
				U3400	422	U3400DSGN NBS001JEM
5a	3ph, 4 wire / Direct Connect (3 phases with 31.5A load control)	I_b- 15 A I_{max}-100 A	415 V 50Hz	Sprint 200 (SECURE)	224 224 324	SPD100-028 SPD100-035* SPD100-048†
				U3400	422	U3401DSGN NBS001JEM
5b	3ph, 4 wire / Direct Connect (3 phases with 31.5A and 2A load control)	I_b- 15 A I_{max}-100 A	415 V 50Hz	Sprint 200 (SECURE)	224 224 324	SPD100-029 SPD100-036* SPD100-049†

Category	Connection type	Current	Voltage	Manufacturer/ product name	NIC hardware version	Product code
6a	3ph, 4 wire Low Voltage Transformer Connect (3 phase CT connect)	I_n- 5A I_{max}- 15A	415 V 50Hz	Premier 200 (SECURE)	224 324	P3T5B0-FHL P3T5B0-FHN†
				U3350	422	U3351NSGNNNN001JEM
6b	3ph, 3 wire High Voltage Transformer Connect (3 phase CT connect and VT connect)	I_n- 5A I_{max}- 15A	110 V 50Hz	Premier 200 (SECURE)	224	P3V5B0-FIL
ZSS Type 2-4	3ph, 3 wire High Voltage Transformer Connect Meter (3 phase CT and VT connect for ZSS cross boundary metering)	I_n- 5A I_{max}- 15A	EDMI Mk6	5-15A	110V	N/A

* Note due to the introduction of an enhanced power supply used in new meters to improve 'last gasp' performance required new product codes to permit differentiation between meters with the standard power, and the enhanced power supply. Thus product codes have been changed to reflect the variation by replacing the 2nd least significant digit, "2" with a "3". Hence Meter Cat 1 with the enhanced power supply is marked with product code E1E100-031. (Only applies to DC meter variants from SECURE)

† These product codes have been introduced to reflect the change from NIC 224 to NIC 324.

Notes

- JEN's non AMI Type 5 & 6 meters are not included in the table
- AMI meters incorporate a [redacted] communication interface. This interface is maintained as part of the SCADA & RTS communication system

6.2 APPENDIX B – METERING COMPLIANCE RISKS

Table 6-2: Metering Compliance Risks

Compliance reference	Requirement	Risk
DPI MFS	Meter Categories Minimum Function & Performance	Functional & Performance requirements are not met
NER S7.2.6.1(f)(1)	Metrology Procedure Part A. 2.4.4 Compliance to Standards	Purchase of new meter model or type without pattern approval
NER S7.2.6.1(f)(2)	Meter Pattern Approval	Purchase of new meter model or type without pattern approval
NER S7.2.6.1(g)	Transformer Pattern Approval	Purchase of CT's and VT's without pattern approval
Metrology Procedure Part A 2.4.1	Standards compliance: For type 1, 2, 3, 4 & 5 metering installations; AS 62052.11, AS 62053.21 & AS 62053.22. For type 6; AS 1284.1, AS 62053.21 & AS 62052.11.	Purchase of non-compliant meters
Metrology Procedure Part A 2.4.4	The RP must ensure that metering equipment purchased must have a valid pattern approval	MPB, Field operations and contract manager are not aware of obligations
NER 7.3.1	The metering coordinator must ensure that the equipment purchased has been tested to the required class accuracy set out in Table S7.3.1 of the NER. The metering coordinator should retain the appropriate test certificates.	Testing is not complete Certificates are lost
NER 7.2.3	The Market Participant must request an offer from the LNSP with standard terms and conditions to act as the metering coordinator for any type 5-7 metering installations.	Non Compliance - If Jemena fails to respond back to the Market Participant within 15 working days
NER 7.2.3	The metering coordinator must provide AEMO with the NMI for the metering installation within 10 business days of entry into a connection agreement with the Market Participants	Non-compliance - If Jemena fails to provide AEMO the new NMI number.
NER 7.3.1	The metering coordinator must ensure that the equipment purchased has been tested to the required class accuracy set out in Table S7.3.1 of the NER. The metering coordinator should retain the appropriate test certificates.	No test results provided by Secure.
NER 7.8.1	The metering coordinator must ensure that a metering installation is secure and the associated links, circuit and information storage and processing	Health and Safety- Inability to secure a metering installation can affect the safety of general public.

Compliance reference	Requirement	Risk
	systems are protected by security mechanisms acceptable to AEMO	Privacy- Inadequate security mechanism to store and report meter data could lead to privacy breach. Jemena could incur significant legal cost if confidential customer details are not securely stored.
NER 7.12	Metering Provider must set the times of clocks of all metering installations with reference to the Eastern Standard time to an accuracy mentioned (+/- 20 sec) in the metrology rules for type 5-7 installation.	Meter data could get corrupted if the meter time clock is not synchronised
SIR 8.3	Metering equipment shall be supplied, installed and maintained by the Meter Provider and shall, unless otherwise agreed in writing, remain the property of the Meter Provider.	Loss of Asset -Unauthorized personnel replacing Jemena meters without getting formal written approval.
SIR 8.8	According to the Victorian Service Installation Rules, the maximum current rating of direct connected meters is 100A per phase. Where the maximum demand of electrical installations cannot be limited accordingly, CT metering shall be required.	Site Safety- The maximum current rating for an AMI meter is 100A. Going above the threshold is a risk for the entire site.

6.3 APPENDIX C – POWER QUALITY METERS PER ZONE SUBSTATION AND END OF FEEDER DISTRIBUTION TRANSFORMER

Table 6-3: Power Quality Meters per Zone Substation and EOF Distribution Transformer

Zone substation	Node name	PQM model	Communication method	VT location
Airport West (AW)	AW_1	ION 7650	Ethernet	22kV Bus
	AW_3	ION 7650	Ethernet	22kV Bus
Broadmeadows (BD)	BD_2	ION7650	Ethernet	22kV Bus
	BD_3	ION 7650	Ethernet	22kV Bus
Broadmeadows South (BMS)	BMS_12	ION 7650	Ethernet	22kV Bus
Braybrook (BY)	BY	ION 7650	Ethernet	22kV Bus
Coburg North (CN)	CN_1	ION 7650	Ethernet	22kV Bus
	CN_23	ION 7650	Ethernet	22kV Bus
Coolaroo (COO)	COO_1	Elspec G5	Ethernet	22kV Bus
	COO_2	Elspec G5	Ethernet	22kV Bus
Coburg South (CS)	CS	ION 7650	Ethernet	22kV Bus
East Preston (EP)	EP	ION 7650	Ethernet	6.6kV Bus
East Preston New (EPN)	EPN	ION 7650	Ethernet	22kV Bus
Essendon (ES)	ES	ION 7650	Ethernet	11kV Bus
Footscray East (FE)	FE	ION 7650	Ethernet	22kV Bus
Fairfield (FF)	FF	ION 7650	Ethernet	6.6kV Bus
Flemington (FT)	FT	ION 7650	Ethernet	11kV Bus
FW (Footscray West)	FW	ION 7650	Ethernet	22kV Bus
HB (Heidelberg)	HB	ION 7650	Ethernet	11kV Bus
NEL(Nortn East Link)	NEL	Elspec G5	Ethernet	22kV Bus
NH (North Heidelberg)	NH_123	ION 7650	Ethernet	22kV Bus
NS (North Essendon)	NS	ION 7650	Ethernet	11kV Bus
NT (Newport)	NT	ION 7650	Ethernet	22kV Bus
PTN (Preston)	PTN	ION 7650	Ethernet	22kV Bus
PV (Pascoe Vale)	PV_12	ION 7650	Ethernet	11kV Bus
	PV_3	ION 7650	Ethernet	11kV Bus
SBY (Sunbury)	SBY	ION 7650	Ethernet	22kV Bus
SHM (Sydenham)	SHM	ION 7650	Ethernet	22kV Bus
SHM (Sydenham)	SHM REFCL	ION 7650	Ethernet	22kV Bus
ST (Somerton)	ST	ION 7650	Ethernet	22kV Bus
TH (Tottenham)	TH	ION 7650	Ethernet	22kV Bus
TMA (Tullamarine)	TMA	ION 7650	Ethernet	22kV Bus
YVE (Yarraville)	YVE_12	ION 7650	Ethernet	22kV Bus
	YVE_4	ION 7650	Ethernet	22kV Bus

Table 6-4: PQM model and communication method by end of feeder distribution transformer

End of feeder	PQM model	Communication method	Distribution transformer location	Voltage
AW11	ELSPEC G4	IP modem over Telstra 4G network	Tulla-Park Prima	22kV/415V
BD10	ELSPEC G4	IP modem over Telstra 4G network	Dimboola TAFE Co.	22kV/415V
BMS23	ION 7400	IP modem over Telstra 3G network	Johnstone-Bamburgh	22kV/415V
BY14	ELSPEC G4	IP modem over Telstra 4G network	Wood-Raglan	22kV/415V
CN5	ELSPEC G4	IP modem over Telstra 4G network	Bakers Audrey	22kV/415V
COO21	ELSPEC G4	IP modem over Telstra 4G network	Barrymore-Lamark	22kV/415V
CS2	ELSPEC G4	IP modem over Telstra 4G network	Attercliff-Sussex	22kV/415V
EP16	ELSPEC G4	IP modem over Telstra 4G network	Reserve-Huntsman	6.6kV/415V
EPN34	ION 7400	IP modem over Telstra 3G network	Sheehan40-Northern	22kV/415V
ES22	ELSPEC G4	IP modem over Telstra 4G network	Anderson-Monash	11kV/415V
FE6	ELSPEC G4	IP modem over Telstra 4G network	Vic-University No.1	22kV/415V
FF89	ELSPEC G4	IP modem over Telstra 4G network	Yarrabend-Fairfield Institute	6.6kV/415V
FT9	ELSPEC G4	IP modem over Telstra 4G network	Bank-MtAlexander	11kV/415V
FW9	ELSPEC G4	IP modem over Telstra 4G network	Ashley-CentWest1	22kV/415V
HB15	ELSPEC G4	IP modem over Telstra 4G network	Russell-Pine	11kV/415V
NH9	ELSPEC G4	IP modem over Telstra 4G network	Waterdale-Crissane	22kV/415V
NS9	ELSPEC G4	IP modem over Telstra 4G network	Dean-MtAlexander	22kV/415V
NT15	ELSPEC G4	IP modem over Telstra 4G network	Breakwater - Pier	22kV/415V
PTN14	ION 7400	IP modem over Telstra 4G network	Bell205-Hotham	22kV/415V
PV24	ELSPEC G4	IP modem over Telstra 4G network	BoxForest-Yooralla	11kV/415V
SBY31	ELSPEC G4	IP modem over Telstra 4G network	Evans-Brook	22kV/415V
SHM14	ELSPEC G4	IP modem over Telstra 4G network	Gourlay-Grevilla	22kV/415V
ST34	ELSPEC G4	IP modem over Telstra 4G network	Northbourne 202-Ainslie	22kV/415V
TH12	ELSPEC G4	IP modem over Telstra 4G network	Quarry-Sunshine	22kV/415V
TMA14	ION 7400	IP modem over Telstra 4G network	Annadale-Willoware	22kV/415V
YVE15	ELSPEC G4	IP modem over Telstra 4G network	Rosemond-HighpointMyer2	22kV/415V