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Jemena Electricity Networks (Vic) Ltd

Meter Asset Management Strategy

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An appropriate citation for this paper is:

Meter Asset Management Strategy

Authorisation

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History

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1.4	Oct 2009	Modified after NEMMCO/AEMO comments	M.Rahimi
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1.6	Mar 2012	Rename document title as Metering Asset Management Strategy. Periodic Review, inclusion of LVCT Testing in accordance with AEMO guidelines & Format standardisation	Goutham Lingam
1.7	Nov 2013	Review the document Update Updated sec 5.2.5 Inspection Plan	Goutham Lingam
1.8	Sept 2016	Update to: • asset quantities, age profiles • organisational charts • names of internal meter management systems minor improvements to text readability	Leon Vilfand

1.9	Aug 2018	Update for the new Metering Coordinator role (replacing the role of Responsible Person)	Leon Vilfand
2.0	Dec 2019	• Update to Jemena org charts, asset quantities, and asset management systems • Improved description of the approach to the management of meter data. • Updated Sec 4.2.5.3: aligning the period of inspection for Type 3 with the requirements of NER • Added Sec 4.2.5.2 document the use of remote condition monitoring of smart meters, as per AEMO guidelines for “Whole Current Metering Installation Testing & Inspection.” • The document template is updated to align with the new Jemena document styles	Leon Vilfand / Rajiv Balasubramanian
2.1	Dec 2021	• Update to Jemena org charts, asset quantities, and asset management systems • Alternative Testing And Inspection Guidelines For Metering Installations In The NEM, VERSION 2.0, 10 March 2020	Leon Vilfand
2.2	June 2024	• Update to Jemena org charts, asset quantities, age profile • Minor improvements throughout the document • Update to Section 4.2.5 asset inspection plan • Added definition (and exclusion) for JEN GMM meter used for monitoring and control of distributed generation in accordance with the Victorian Emergency Backstop Mechanism (not as a meter for market settlements).	Mansour Rahimi / Leon Vilfand

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Owning Functional Area

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Glossary

The following table list the terms and abbreviations used throughout the document.

Term	Definition
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
AMI	Advanced Metering Infrastructure
CATS	Consumer Administration and Transfer Solution
CTMM	Current Transformer Metering Manager Database
ECMS	Enterprise Content Management System
GMM	A Generation Monitor Meter / Network Device could be deployed on customer premises (as part of the agreement with the customer) to enable generation backstop capability for JEN. This device will not be a market meter for any settlement activities and is not in the scope of this Metering Asset Management Strategy.
HV	High Voltage
ID	Identification
JEN	Jemena Electricity Network
KPI	Key Performance Indicator
LNSP	Local Network Service Provider
LV	Low Voltage
LVCT	Low Voltage Current Transformer
MAMS	Metering Asset Management Strategy
MC	Metering Coordinator
MPB	Metering Provider (category B)
MDP	Meter Data Provider
MSATS	Market Settlement and Transfer Solutions
NATA	National Association of Testing Authorities; Australia's national accreditation body
NEM	National Electricity Market
NMI	National Measurement Institute
OH&S	Occupational, Health and Safety

References

The table below lists the guiding standards and references that were used in the production of this document.

Reference Number	Document Title
1.	Chapter 7 of National Electricity Rules (NER)
2.	NEM Metrology Procedure Part A and B (Metrology Procedure)
3.	Essential Services Commission - Electricity Customer Metering code (ECMC)
4.	Guide to the Role of the Metering Coordinator (MC), AEMO
5.	Metering standards: AS1284:1 - 2004, AS1284:5 - 2000, AS1284:9 - 1993, AS 62052.11 – 2005, AS62053.21 – 2005, AS 62053.22 – 2005, NMI M6, AS 1284.13 - 2002 - Electricity Metering, In-Service Compliance Testing
6.	Current Transformer - AS1675 – 1986, AS60044:1 - 2007
7.	Voltage Transformer - AS1243 - 1982, AS60044:2 - 2007
8.	Alternative Testing And Inspection Guidelines For Metering Installations In The NEM, VERSION 2.0, 10 March 2020.
9.	AEMO Service Level Procedure - Metering Provider
10.	Victorian Electricity Distributors Service & Installation Rules - 2014
11.	VESI Installation Supply Connection Tests & Procedures
12.	Jemena Management procedure ELE-999-PR-TI-001 HV Energy Metering Test Procedure
13.	Jemena Management Procedure ELE-999-PR-TI-002 Sample Testing of Meters
14.	Jemena Management Procedure ELE-999-PR-TI-003 LVCT Overall Error Calculation
15.	AEMO Position Paper: Whole Current Meter Testing and Inspection, October 2019
16.	Service Level Procedure: Metering Data Provision Services, 2017
17.	Service Level Procedure: Metering Provider Services, 2017
18.	Victorian AMI Minimal Functional Specification, Release 1.2, 2013
19.	Victorian advanced metering infrastructure (obligations to install meters) Order, 2017
20.	Electricity Customer Metering Code of Practice, ESC
21.	Cross Boundary Supply Guideline v1.1, AEMO
22.	Metering Installation Exemption Guideline, v1.1, AEMO

1. Executive Summary

The National Electricity Rules (NER), together with the Victorian Government Order-In-Council on metering coordinators in Victoria, require Jemena Electricity Networks (JEN), as a distribution business, to provide metering services to all residential and small business customers within its distribution area who consume up to 160 MWh of electricity per annum.

JEN maintains registration in the National Electricity Market (NEM) as a Metering Coordinator (MC) - Initial Type 5, 6, and Type 7, relying on its internal Metering Provider (MPB) and Metering Data Provider (MDP) to fulfil all the required metering services obligations.

In fulfilling its obligations as a Metering Coordinator, JEN ensures that tests on metering installations are carried out in accordance with the requirements of the (NER) and to the applicable Australian standards and, where applicable, in accordance with this asset management strategy that defines an alternative testing practice (other than time-based), which is determined by the MC and approved by AEMO.

This Metering Asset Management Strategy (MAMS) ensures JEN's compliance with all regulatory bodies' requirements that have jurisdiction over electricity metering installations within Jemena Electricity Networks' area, including:

- Australian Energy Market Operator (AEMO)
- Essential Services Commission of Victoria (ESC)
- National Measurement Institute (NMI)
- Australian Energy Market Commission (AEMC)
- Australian Energy Regulator (AER)

Metering equipment condition is monitored by either sample testing or time-based testing, using relevant Australian Standards. All Low Voltage Current Transformer (LVCT) testing, as a minimum, is performed in accordance with AEMO's guidelines (ref 8: Alternative Testing and Inspection Guidelines for Metering Installations in the NEM, Version 2.0). All metering installations and associated metering data, passwords and access are managed with strict adherence to NER, Metrology Procedures and related jurisdictional obligations.

Metering Equipment associated with High Voltage (HV) installations is tested in accordance with Schedule S7.6 of NER.

Note:

- This MAMS is only applicable to metering assets for which JEN is registered as the MC, with participant identification SOLARISP, and does not include the metering assets associated with the former Jemena contestable Meter Provider business.

The following table provides a summary of in-service compliance maintenance activities and references to how it is performed on JEN metering assets.

Table 1: In-service Compliance Maintenance Activities Performed

Activity Type	Strategy	Strategy Reference	Plan Reference	Resource
Meter Test (Direct Connect)	Sample	AS/NZ 1284.13	Section 4.3.3	JEN MPB
Meter Inspection (Direct Connect)	According to NER	Table S7.6.1.3	Section 4.2	JEN MPB
Meter Test (Transformer Connected)	According to NER	Table S7.6.1.2	Section 4.3.2	JEN MPB
Meter Inspection (Transformer Connected)	According to NER	Table S7.6.1.3	Section 4.2	JEN MPB
VT Test	According to NER	Table S7.6.1.2	Section 4.3.1	JEN MPB/External Provider
VT Inspection	According to NER	Table S7.6.1.3	Section 4.2	JEN MPB/External Provider
HVCT Test	According to NER	Table S7.6.1.2	Section 4.3.1	JEN MPB/External Provider
HVCT Inspection	According to NER	Table S7.6.1.3	Section 4.2	JEN MPB/External Provider
LVCT Test (<750MWh)	Sample	AEMO's guidelines (Alternative Testing And Inspection Guidelines For Metering Installations In The NEM, VERSION 2.0)	Section 4.3.5	JEN MPB
LVCT Test (>750MWh)	Sample	AEMO's guidelines (Alternative Testing And Inspection Guidelines For Metering Installations In The NEM, VERSION 2.0)	Section 4.3.5	JEN MPB
LVCT Inspection	100%	AEMO's guidelines (Alternative Testing And Inspection Guidelines For Metering Installations In The NEM, VERSION 2.0)	Section 4.2 and 4.3.5	JEN MPB
Remote Monitoring of AMI Meters	All AMI meters (98.5% of population)	AEMO Position Paper: Whole Current Meter Testing and Inspection, October 2019	Section **Error! Reference source not found.**	JEN MPB
Meter Data Management	According to NER	AEMO's Meteorology Procedures	Section 4.4	JEN MDP

2. Jemena Asset Management Policy

2.1 Policy Statement

Jemena is committed to creating sustainable energy solutions with communities.

2.2 Policy Objectives

To deliver on this commitment, it is the policy of Jemena to:

- Actively engage with customers and key stakeholders to understand and respond to their requirements to ensure outcomes are achieved that are in their long term interests,
- Manage our assets without compromising the safety of our employees, contractors and public and in an environmentally sustainable manner as per the Jemena Health, Safety and Environmental Policy,
- Comply with all relevant regulatory and legislative requirements,
- Provide strong leadership to the asset management discipline, incorporating sound governance for the Asset Management System and maintaining open communications,
- Develop the skills and knowledge of our people to sustain, re-enforce and extend our asset management capabilities and competencies,
- Make best practice asset management an aspirational goal to incorporate within our “business as usual” approach, and measure it against an internationally recognised asset management framework,
- Establish a consistent, collaborative and integrated approach to the lifecycle management of our asset portfolio, thus ensuring optimised outcomes are delivered in a reliable and sustainable way across Jemena,
- Ensure our asset management decision making is balanced by incorporating criteria that considers performance, cost, risk and our net-zero emissions target by 2050,
- Develop a suite of asset management documents whose deliverables complement the Jemena Business Plan in achieving relevant corporate and asset management objectives,
- Adhere to effective project management and contract management frameworks which support effective delivery decisions and activities throughout the asset lifecycle by adopting a standardised approach that considers time, cost and quality parameters,
- Facilitate innovation and continual improvement in the safety and performance of the assets, through the establishment, maintenance and governance of effective asset and safety management systems,
- Develop and maintain asset information systems which support asset management decisions and activities throughout the asset lifecycle,
- Apply the Jemena risk management and assurance approach to asset management activities.

3. Strategy

Jemena Electricity Networks' Metering Asset Management Strategy defines the approach to planning and execution of works to ensure that the condition and performance of metering assets and infrastructure is maintained in compliance with all market and regulatory obligations.

The focus of the strategy is on the ongoing analysis of Jemena Electricity Networks' (VIC) metering and associated systems and continuous improvement of the management of these assets.

The strategy outlines the requirements and process of procurement, maintenance and replacement requirements, which are intended to maintain the operating capability of the metering assets and infrastructure over the long term.

The strategy intends to ensure:

- regulatory compliance
- asset and operational safety for staff and public
- customer service outcomes
- asset reliability and economic efficiency.

3.1 Metering Asset Quantities and Age Profile

Jemena Electricity Networks' Metering assets include:

- Direct Connected Meters (AMI and legacy)
- CT-connected Meters (AMI and HV meters)
- High and Low Voltage Current and Voltage Transformers.

The quantities of meter assets are stated in Table 2 and Table 3. JEN AMI meters (remotely read interval meters) are classed as Type 5 for the purpose of this strategy.

JEN supplies Low Voltage Current Transformers (LVCT) for new connections and for fault replacement of any existing LVCTs within its Distribution Network. Asset quantities will vary over time with network growth, abolishments, maintenance and replacement of accumulation meters with AMI meters. The quantities presented are as of June 2024.

Table 2: Meter Installation Types

Meter Type	Description	Approximate Quantities
Type 1	>1000 GWh p/a	0
Type 2	≥100GWh pa or <1000 GWh p/a	8 Installed Zone Substations
Type 3	≥750MWh pa or <100 GWh p/a	10 Installed Zone Substations
Type 4	<750MWh	2
Type 5	<160MWh(including AMI Meters)	376,496
Type 6	<160MWh	4,140

Table 3: Metering Asset Quantities

Metering Sites/Assets	Approximate Quantities
Voltage Transformers (HV)	20
Current Transformers (HV)	24
High Voltage Installation meters	18
Current Transformers (LV)	6,330
Direct Connect Single Phase Accumulation meters	2,751
Direct Connect Multi Phase Accumulation meters	1,371
Low Voltage CT Installations Accumulation meters	0
Direct Connect Single Phase Interval (non-AMI) meters	25
Direct Connect Multi Phase Interval (non-AMI) meters	10
Low Voltage CT Installations Interval (non-AMI) meters	2
Direct Connect Single Phase AMI meters	323,000
Direct Connect Multi Phase AMI meters	51,385
Low Voltage CT Installation AMI meters	2,110

Figure 1: Meter Asset Age Profile

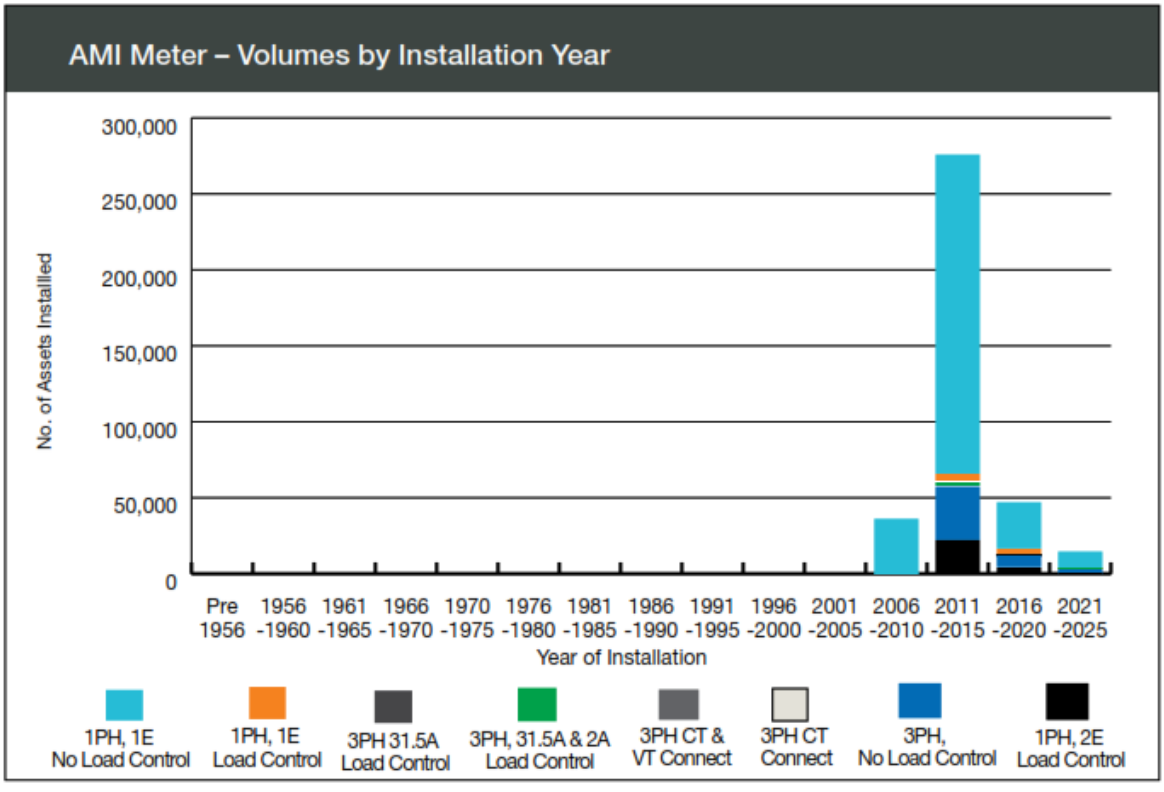

Figure 1 provides the age profile of JEN's meters. Due to the mandatory AMI rollout in Victoria the majority of JEN's meters were installed as part of the rollout from 2010 and 2014. 99% of all JEN meters are now AMI (smart) meters.

3.2 Organisational Structure & Resources

JEN's business organisation provides well-defined responsibilities to support different functions and a clearly delineated organisational structure accountabilities, with dedicated teams focused on the fulfilment of various facets of metering responsibilities.

JEN also has at its disposal access to external Meter Service Providers to assist JEN's internal MPB where it lacks expertise or resources to complete the required volume of work on time. The external service providers are regularly audited against contractual arrangements to ensure the quality of work and required compliance is maintained.

This section presents the key teams involved in managing metering assets at Jemena.

3.2.1 Metering Coordinator (MC) and JEN Electricity Metering Strategy

The Network Assets team is accountable for the development of Jemena's Electricity Metering Strategy and for the fulfilment of the role of Initial MC and MC for Type 7 on JEN.

JEN MC role responsibilities are aligned with the responsibilities outlined in NER Chapter 7 and AEMO's Guide to The Role of Metering Coordinator.

3.2.2 Metering Provider (MPB) and Metering Data Provider (MDP)

JEN's Metering Operation & Billing team is accountable for the roles of Metering Provider Category B (MPB) and Meter Data Provider (MDP) for JEN's Type 7, 6 and 5 meters. This team is accountable for all meter operations and billing functions within JEN's network area.

3.2.2.1 JEN MPB Responsibilities

JEN's MPB responsibilities are fully aligned with the responsibility of the Meter Providers as outlined in NER Chapter 7 and AEMO's Service Level Procedure: Metering Provider Services.

JEN MPB continually reviews and maintains its AEMO accreditation. All meter service provider personnel conducting work associated with metering installations, commission tests and/or maintenance tests - all have the appropriate technical experience and appropriate training.

JEN requires that training and Occupational, Health and Safety (OH&S) matrices are maintained. A register identifying all the personnel conducting any type of work on JEN's metering installations and training courses attended is maintained.

3.2.2.2 JEN MDP Responsibilities

JEN MDP responsibilities are fully aligned with the responsibility of the MDPs as outlined in NER Chapter 7 and AEMO's Service Level Procedure: Metering Data Provision Services.

JEN MDP continually reviews and maintains its AEMO accreditation. All JEN MDP personnel involved in dealing with metering data are appropriately skilled, trained and well-versed in applicable and regulations, including privacy and ring-fencing obligations. MDP regularly assess the capabilities of its personnel against obligations and capabilities outlined in NER S7.3 and related AEMO guidelines.

3.3 Testing Capability

JEN utilises external contractors with appropriate testing capabilities to conduct tests of metering installations per JEN's test plan and procedures.

External meter test service contractors typically provide the following services:

- Sample testing for direct connect meter installations
- Sample testing of LVCT's
- Meter/Examinations test for both direct-connected and current transformer-connected meter installations
- Commission tests for new current transformer-connected meter installations
- Tests associated with refurbished meters
- Tests associated with second-hand meters
- HV installation compliance testing.

3.3.1 Testing Equipment

In order to conduct the meter tests described above, external meter service providers and testing contractors shall have all necessary field and lab equipment available to do so.

- All field-based test equipment shall have NATA traceable certification and only be used while within the valid certification period.
- Laboratory services shall be provided via NATA-accredited laboratories.

3.3.2 Management of Test Equipment

JEN requires metering personnel to be provided (as per the previous section) with the necessary testing equipment prior to the commencement of any type of metering work.

All testing equipment issued to personnel is recorded within a database. The database also contains the following information:

- Initial calibration test
- Next scheduled calibration tests
- Equipment type
- Serial number
- The name and identification (ID) number of personnel issued with test equipment.

Office and field audits are conducted on a regular basis to review test equipment and ensure that personnel have been issued with the necessary test equipment. Further to this, calibration dates are also reviewed to ensure that personnel are not operating with any test equipment that has lapsed the next calibration test date.

Serial numbers are also reviewed and cross-referenced with the equipment database and personnel issued with the test equipment. This ensures the traceability of the test equipment as well as all the field or lab work conducted with the particular item in question.

When introducing any new test equipment, JEN requires that uncertainty levels are determined and that they fall within NER requirements. Test equipment that does not fall within these NER specifications will not be approved for use.

3.4 MAMS Review Period

The Metering Asset Management Strategy is reviewed annually. Major material changes made to this document will also be provided to AEMO for approval.

Note: Approval is required from the relevant parties, as listed on the cover sheet of this strategy before an update to this strategy can be re-issued.

3.5 Asset Management Systems

Key asset records (such as meter location, meter type, meter category, test results etc.) are maintained across the following systems:

- SAP ERP – Customer information system database that contains data on all direct connected non-AMI meters. SAP ERP also includes the Current Transformer Metering Manager Database (CTMM). This database is used to manage all instrument transformers connected to non-AMI meters and their associated CT's and VT's.
- AMI SAP ISU – AMI SAP is the database for Type 5 AMI Meters. AMI SAP also includes LV CT database that contains details of low-voltage current transformers for all CT-connected AMI meters. It includes test and inspection programs for this class of metering installation.

3.6 Asset Management Improvement Plan

Jemena Electricity Networks' asset management approach is based on evaluating the following key areas of life cycle asset management:

- Processes and practices
- Data and knowledge
- Organisational / people issues
- Information support systems
- Asset management plans.

3.7 Specifications, Procedures and Manuals

Jemena has a set of manuals for use by contractors, that provides information to contractors on specifications, installation procedures, levels of competency, network and access to sites.

There are also completed mandatory procedures for contractors to carry out work on JEN's network.

3.8 Metering Asset Procurement

Jemena's asset procurement is in line with the asset management strategy and vision to achieve the best value for money and an efficient procurement system. Our aim is to apply a good business risk management practice. Other key business issues and philosophies that drive our plan include:

- Complying with all current and future regulatory requirements and mandated programs such as Advanced Metering Infrastructure (AMI)
- Foreseeing the future of metering technological advancements and adopting a proficient methodological approach to minimise the future impact and prevent revisiting the asset for the purpose of upgrade and technology adoption and finally to ensure an efficient life cycle

- Providing technologies and feedback to our customers regarding their consumption (whether in real-time or periodically) that will be utilised to facilitate better energy usage practices.

All new meters are purchased with pattern approval and/or type testing in accordance with the requirements of the National Measurement Institute via the “National Measurements Act” as referenced in the “Electricity Customers Metering Code”, NER and the NEM Metrology Procedure. Copies of approvals and associated type tests certificates will be provided with the first of any new meter population delivered and maintained in accordance with the NER. All new metering equipment will be delivered with initial accuracy test results or verification test results.

4. Metering Asset Management Plan

4.1 Pre-Installation Testing

4.1.1 Aim

To ensure that all metering equipment is tested to an appropriate standard before installation and is fit for purpose.

4.1.2 Requirements

An accuracy test is performed on all new metering equipment to ascertain whether the new equipment meets the relevant minimum standards either:

- prior to installation on each energy meter, current transformer and voltage transformer; or
- at the time of commissioning on the installed metering equipment.

4.1.3 Operations Procedure

All new metering equipment shall be purchased with pattern approval and/or type testing in accordance with the requirements of the National Measurement Institute for Utility Meters (NMI M6), NER and the NEM Metrology Procedure.

All new metering equipment will be delivered with initial accuracy test results or verification test results.

4.1.4 Methodology

Copies of approvals and associated type tests certificates shall be provided with the first of any new metering equipment.

Records of all test results shall be maintained for as long as the metering equipment remains in service or for seven years, whichever is the longer period.

4.2 Metering Installation Inspections.

4.2.1 Aim

To ensure safe and correct operations of all metering installations; all metering installations are inspected in accordance with the requirements of NER Schedule 7.6, table S7.6.1.3 and the relevant AEMO's guidelines and procedures.

4.2.2 Requirements

A metering installation inspection will include checking the metering installations condition including: connection's safety and security, integrity and condition of all seals, verification of metering parameters and physical connections and CT ratios and connections where applicable.

4.2.2.1 Type 1-3 metering installations

All Type 2 & 3 CT and VT-connected metering installations are to be inspected in accordance with NER Schedule 7.6, table S7.6.1.3.

4.2.2.2 Type 4-6 installations

All Type 4, 5 and 6 metering installations are to be inspected at the time of testing in accordance with NER Schedule 7.6, table S7.6.1.3. A qualified meter technician shall inspect all metering installations as per the inspection procedure at the time of meter testing. Furthermore, all meters remaining in service for more than 15 years will be 100% inspected within the 5 years following their 15-year anniversary of installation.

CT meters:

All JEN CT meters are subject to time-based periodic testing (as per Schedule 7.6 of NER, and Section 4.3 of this strategy, with the maximum period between the tests of 5 years). Hence, all JEN CT metering installations shall be inspected at least once every 5 years.

Whole current meters:

Whole current (also known as direct-connected) meters are sample tested and are technically inspected at the time of such test.

However, in addition to the inspections at the time of testing, Jemena also provides a system of ongoing, remote monitoring of meter performance and conditions, leveraging the AMI capabilities of these meters (refer to Section 4.2.5.2 Enhanced Remote Monitoring & Inspections of JEN AMI meters of this MAMS).

Furthermore, to address AEMO guidelines relating to physical site visits (ref AEMO's Position Paper Whole Current Meter Testing and Inspection, October 2019), Jemena further supplements 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 five-year period following the 15-year anniversary of the meter installation and every 15 years thereafter.

The order and the route of the scheduled time-based inspections within the inspection period shall be optimised with consideration to the order of the installation dates, records of previous visits, and site condition analysis based on remotely collected meter data and plans for meter replacements. The order of the inspections shall also be optimised for cost efficiency and minimised customer disturbance.

4.2.3 Operations Procedure

The following guides and procedures are used in fulfilling inspections:

- Jemena Meter Inspection procedure: ELE-999-PR-TI-004 Metering Site Inspection Procedure
- AEMO Position Paper: Whole Current Meter Testing and Inspection, October 2019
- AEMO: Alternate Testing and Inspection Guidelines for Metering Installations in the NEM V2.0 Final, 2019.

4.2.4 Methodology

A time-based inspection program will be conducted in accordance with the requirements of NER Schedule 7.6, table S7.6.1.3 and AEMO's guidelines.

Inspections shall be limited to those installations where JEN holds the role of the Metering Coordinator.

The verification of physical parameters such as CT ratios will be restricted based on the need to ensure a safe approach to live apparatus without de-energising customer load.

Advanced remote condition monitoring capabilities utilising AMI meters will be used to further enhance the inspection regime with regular reviews of the state of the entire AMI metering installations population.

The ongoing remote monitoring of AMI meters is used to identify and investigate issues relating to the integrity and safety of the metering installations (e.g. suspected tampering or faults) that are not easily identifiable by visual

inspections or occurring in the period between the inspections. This enables Jemena to attend to suspected tampering, faults, installation integrity and safety issues proactively and far earlier than would otherwise be possible through time-based traditional inspections alone.

4.2.5 Inspection Plan

4.2.5.1 Time-based Inspection of Whole Current Meters

In addition to inspection at the time of testing (e.g. during sample testing of meter accuracy) and the ongoing remote monitoring, all JEN meter installations shall also be subject to periodic time-based inspections.

Specifically, all current metering installations will be physically visited and technically inspected within the five years following the 15-year anniversary of their original installation (unless the meter is scheduled to be replaced in that 5-year period) and every 15 years thereafter. Table 4 outlines the timeframe for inspections, given that the population of JEN's AMI meters began its operational life in 2010 when Jemena began installing AMI meters as part of the state-wide AMI Rollout project.

Table 4: Jemena Inspection Plan for 2025-2035 (Whole Current Meters)

Meter Types	Connection Type	Installation Year	Volume	Inspection Years
Electronic/Interval	1ph & 3Ph	2010	35,689	2026 – 2031
Electronic/Interval	1ph & 3Ph	2011	50,044	2027 - 2032
Electronic/Interval	1ph & 3Ph	2012	63,277	2028 - 2032
Electronic/Interval	1ph & 3Ph	2013	115,956	2029 - 2033
Electronic/Interval	1ph & 3Ph	2014	34,708	2030 - 2035
Electronic/Interval	1ph & 3Ph	2015	9,731	2031 - 2036
Electronic/Interval	1ph & 3Ph	2016	9,116	2032 - 2037
Electronic/Interval	1ph & 3Ph	2017	9,398	2034 - 2038
Electronic/Interval	1ph & 3Ph	2018	9,100	2035 - 2039
Electronic/Interval	1ph & 3Ph	2019	9,503	2036 - 2040
Electronic/Interval	1ph & 3Ph	2020	9184	2037 - 2041

Note: This plan will be revised and updated annually to ensure all changes in meter populations, performance, asset condition, safety and operational factors are duly considered and reflected accordingly.

4.2.5.2 Enhanced Remote Monitoring & Inspections of JEN AMI meters

JEN enhances its meter inspection process with ongoing remote monitoring of its AMI meters. Close to 99% of all JEN meters are now AMI meters and capable of push notifications that inform of conditions relating to the integrity of the metering installation and the site. JEN is continuing to use its best endeavours to replace the remaining non-AMI meters.

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 factors), as well as meter-generated conditions alerts (e.g. unauthorised opening of the terminal cover, meter reboots, last gasp, over temperature alerts. This system is pivotal not only to Jemena's ability to identify faulty meters proactively 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 JEN's AMI meters include alerts and data relating to:

- Meter tamper events even during periods when a meter are powered off (e.g. unauthorised opening of terminal covers, unauthorised opening of meter main cover)
- 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)
- Meter reboots, reboots of meter comms modules, meter last gasp (e.g. indicating supply loss/disconnection).
- The ongoing monitoring of instantaneous supply characteristics (e.g. voltage, current, power factor and temperature sensing) by AMI meters and the real-time correlation of this data with the data collected from neighbouring meters and other upstream JEN 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 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 estimate
  - 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.

The occurrence of the above events will generate 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.

4.2.5.3 Transformer-connected metering installations

Inspection of transformer-connected metering installations will be as per the NER for Types 1, 2, 4, 5 and 6, and as listed in Table 5 below.

Table 5: Meter Installation Inspection Period

Meter Type	CT Ratio	GWhrs	Maximum Inspection Period
Electronic/Induction	150/5	< 2 GWh	5 years
Electronic/Induction	200/5	< 2 GWh	5 years
Electronic/Induction	300/5	< 2 GWh	5 years
Electronic/Induction	400/5	< 2 GWh	5 years
Electronic/Induction	600/5	2 - 10 GWh	2.5 years
Electronic/Induction	800/5	2 - 10 GWh	2.5 years
Electronic/Induction	1000/5	2 - 10 GWh	2.5 years
Electronic/Induction	1200/5	2 - 10 GWh	2.5 years
Electronic/Induction	2000/5	2 - 10 GWh	2.5 years

Electronic/Induction	3000/5	10 GWh +	2.5 years (2 years for Type 3)
Electronic/Induction	All HV ratios	10 GWh +	2.5 years (2 years for Type 3)

4.3 Metering Installation Testing

4.3.1 High Voltage Current / Voltage Transformer Testing

4.3.1.1 Aim

To test all HV CT's and VT's as per NER schedule 7.6. HV installations are classified as high risk due to the large energy consumption involved and, therefore, should not be sample tested.

4.3.1.2 Requirements

HV CT's and VT's are to be accuracy tested using a primary injection test, or other test procedure approved by AEMO at least once every 10 years. In addition, the burden and wiring loss measurements are to be undertaken at these installations whenever the associated meters are tested or when changes are made to the metering installations.

All reference/calibrated test equipment shall be tested to ensure full tractability to Australian National Measurements Standards through verifying authorities or directly referenced to the National Measurement Laboratory.

In the event that high-voltage instrument transformers or connected meters fail, JEN will stock suitable spare units and replace the malfunctioning equipment.

4.3.1.3 Operations Procedure

Management Procedure: ELE-999-PR-TI-001 HV Energy Metering Test Procedure

4.3.1.4 Methodology

- MPB officer and the MC develop a budget and test plan
- MPB officer subcontracts a NATA-accredited test house to perform on-site primary injection tests on behalf of JEN
- These tests are to be coordinated with other planned interruptions of the associated customers
- MPB officer arranges access to the site
- Tests are undertaken to the relevant Australian Standard and the NER requirements
- Test results are stored in a shared drive on JEN's Network to reflect the condition of the equipment
- MPB officer analyses the results and takes necessary action, like replacement if required
- MPB officer reports to the MC on test plan completion and budget.

4.3.2 HV & LV Instrument Transformer (CT/VT) Connected Meter Testing

4.3.2.1 Aim

To test all HV CT/VT and LV CT connected Meters as per NER schedule 7.6. These installation meters are 100% time-based tested for accuracy in meters and instrument transformers.

4.3.2.2 Requirements

These meters are tested using a full-range accuracy test at least once every 5 years. In addition, burden and wiring loss measurements are to be undertaken at these installations whenever the meters are tested or when changes are made to the installations. JEN tests all transformer-connected interval meters as per the NER requirements.

The maximum allowable level of testing uncertainty for meters is as per Table S7.3.1 of NER Chapter 7. All reference/calibrated test equipment shall be tested to ensure full tractability to Australian National Measurements Standards through verifying authorities or directly referenced to the National Measurement Laboratory.

4.3.2.3 Operations Procedures

Management Procedures:

- ELE-999-PR-TI-001 HV Energy Metering Test Procedure
- ELE WI 1916 Sample Testing of LVCT's
- ELE PR 0512 LV CT Overall Error Calculation

4.3.2.4 Methodology

MPB officer and the MC develop a budget and a test plan.

- MPB officer writes an annual test plan and arranges suitably qualified resources to test the meters and ensures test equipment is calibrated to meet code requirements.
- SAP is configured to produce statistics for when the next test is due.
- Tests are undertaken using equipment that has been calibrated to ensure compliance.
- Copy of test results is stored in SAP and SAP is updated to reflect the condition of equipment.
- HV Metering test information will also be stored in shared network folders with limited access.
- MPB officer analyses results and reports to the MC by exception.
- MPB officer reports monthly to the MC on test plan completion and budget.

4.3.2.5 Test Plan

Testing at approximately 400 meters per year will be planned to ensure that the 5-year test cycle for these types of meters will be achieved.

4.3.3 Direct Connect Meter Testing

4.3.3.1 Aim

To test direct connect (also known as whole current) meters in accordance with AS1284.13 - Electricity Metering, In-Service Compliance Testing.

4.3.3.2 Requirements

Direct connected meters will be sampled and tested based on representative families (or populations) of meters. Meters are grouped into populations based on meter manufacturer and meter design or pattern or type. Sample sizes are determined in accordance with Table 1 of AS/NZS 1284.13 for testing by variables. Pass and fail levels are also in accordance with Table 1. Each meter in a sample shall be tested for accuracy, anti-creep function and register operation. Upper and lower meter errors for any meter in a sample shall be in accordance with Table 4 and Table 5 of AS/NZS 1284.13.

In the event that a sample of meters is deemed to have failed from a large family, further analysis of the population shall be conducted to determine if a sub population can be identified and meter replacement programs focussed on only the defective populations. Very small families of meters, however, will not be included in further sample testing and will be scheduled for replacement. This analysis shall be carried out in accordance with Clause 8.7.2 of AS/NZS 1284.13.

The populations of new meter patterns or types shall be sampled and tested for compliance during the first one to three years of being placed in service to determine the compliance period for that meter population. This shall be in accordance with Table 4 of AS/NZS 1284.13.

4.3.3.3 Operations Procedures

Refer to the Jemena Management Procedure: ELE-999-PR-TI-002 Sample Testing of Meters

4.3.3.4 Methodology

JEN identifies various direct connect meter families for sample testing and the designated sample size based on the size of each family.

JEN utilises metering information relating to meter type, number of phases, year of manufacture and meter design type to specify families for sample testing.

Meter sample testing is conducted in the field by the Testing Meter Service Provider, as per the contractual arrangements between JEN and the Testing Meter Service Provider. The Testing Meter Service Provider is required to provide all the necessary testing equipment required to conduct sample testing.

Furthermore, the Testing Meter Service Provider is contracted to have sufficient resources available to adhere to JEN sample testing regime and must have the necessary accreditation for test equipment.

Primarily JEN utilise variables for initial sample tests as per AS/NZS 1284.13 and rarely undertakes any secondary sample testing. Secondary sample testing will only occur if the data retrieved from the initial sample test is not normal or as per AS/NZS 1284.13 it is permitted to change to testing by attributes.

When changing to attributes testing from variables the procedure in AS/NZS 1284.13 is followed. That is, a further sample is randomly selected and added to the initial sample under variables to make up the larger sample required for attributes testing.

Refer to Jemena Management Procedure "ELE-999-PR-TI-002 Sample Testing of Meters" for operational procedures of JEN's meter sample testing methodology.

4.3.4 Family Failures

For sample-tested meters, the meter families that have failed the initial sample testing require a qualified JEN metering engineer to confirm that the data integrity of these initial tests is valid.

Upon validating data integrity, the JEN MC will be required to provide sign-off authority that the meter family has failed sample testing. An urgent project shall be initiated to replace the failed meter families in a way that minimises the cost and inconvenience to affected customers. Sign-off for the replacement will be obtained from personnel within the organisation with appropriate financial delegation levels. JEN will endeavour to replace failed meter families by the end of the following calendar year after sample testing has occurred.

Meter families that fail initial sample testing may require secondary sample tests. Upon completion of secondary sample tests using attributes, JEN metering engineers will assess and validate data from both the initial and secondary sample tests as per AS 1284:13.

Families of meters that pass secondary sample testing will be signed off by JEN MC and have their field life extended.

Families of meters that fail both primary and secondary sample testing will be signed off by the JEN MC as having failed sample testing. A business case is required to initiate the replacement of failed meter families, sign-off must be gained from personnel within the organisation with appropriate financial delegation levels. JEN will endeavour to replace failed meter families by the end of the following calendar year after sample testing has occurred.

JEN will invest resources and develop key strategic ties with Meter Service Providers to ensure that in the event of a large family failure, JEN has the systems and resources in place to initiate a large family replacement. JEN will endeavour to complete the replacement program by the end of the following calendar year after sample testing is signed off as failed.

Customers affected by a large family meter failure that requires replacement will be notified in accordance with JEN's customer notification obligations and procedures.. This will apply to all affected customers

Refer to Jemena Management Procedure "ELE-999-PR-TI-002 Sample Testing of Meters" and AEMO's guidelines (ref 8: *Alternative Testing And Inspection Guidelines For Metering Installations In The NEM*) for operational management of large family failures (as applicable).

4.3.4.1 Predicting Family Failures

The prediction of families is somewhat subjective. It is based on a combination of meter age, outcomes of the latest and previous sample tests, the design of the meter, and knowledge of that meter type.

The worst test point error in previous sample test results is used in the prediction. However, it is important to note that, in general, when dealing with relatively few sample tests carried out per meter family, it is often difficult to predict family failures. Therefore, it is important to take into account the type of design and technology of the meter. The three fundamental design/technology types used in manufacturing energy meters are:

- Ferraris disk meters without magnetic suspension (approximately pre the mid 1960's),
- Ferraris disk meters with magnetic suspension (approximately post mid-1960's), and
- Electronic meters (e.g. AMI meters), which are the dominant and soon to be the only type of meters on Jemena Electricity Networks.

Non-magnetic suspension meters use various types of bearings to support the spinning spindle holding the Ferraris disk. This is the highest wear bearing in the Ferraris meter and can fail, causing the meter accuracy to be more negative or the meter can completely fail. As these meters are now 45+ years old the failure of these bearings must be imminent. This is evidenced by the fact that failed meter families to this time have been the oldest versions of this meter design. A factor that may have led to these meters continuing in service for such an extended period is the poor quality of post-2nd World War brake magnet material. The brake magnet is known in at least one-meter type to have reduced its magnetic strength over time, which led to the meter accuracy being

more positive. There is no empirical evidence. However, it is possible that the negative effect of wearing bearings and the positive effect of loss of brake magnet strength may be cancelling each other to some degree.

Magnetic suspension meters use magnetic force to support the spinning spindle holding the Ferrari disk, eliminating the most obvious failure mechanism. These meters are still electromechanical devices with moving parts, so it can be expected that they will fail with age. Some of these meters' accuracy is moving toward the accuracy boundary and will eventually fall outside the allowable tolerance. Future sample testing will give a clearer understanding of the timing of these failures.

Electronic meters (e.g. JEN AMI meters) are based on solid-state semiconductor technology and have no moving parts used for measurement and/or recording of the consumed energy. This would imply better consistency in the performance of measurement over time, yet it could also mean a shorter natural lifespan of the used electronic component (memory chips, CPUs, internal batteries). JEN sample testing of its electronic meters has found these families of meters to be very accurate. The accuracy of these meters may deteriorate slowly with time due to the drying of some components & soldering joints. However, the majority of failures are expected to be discrete in their manifestation, driven by binary failures of various electronic components in the meter.

The life of the electronic components used in electronic meters is finite and affected by variations in operating temperature, humidity and other environmental factors relating to the type of metering enclosure, their placement and geography. Nearly all JEN's meters are electronic meters designed to withstand 15 years of operation. Hence, it is likely that JEN will face a number of family failures in the course of the next 5-10 years, given that most of JEN's AMI meters will be over their design life in the next 5 years. To mitigate this risk of unexpected family failure events, JEN is preparing for a limited proactive replacement program for the older meters in the JEN population.

4.3.4.2 Consideration for Small Families

Due to the manner in which meter family sizes are determined (e.g. a combination of age, previous sample test results, design of meter and general knowledge of particular meters), there may be a potential to have a scenario in which meter family sample sizes approach 100% of the actual meter family's population.

To avoid this scenario, JEN intends to bundle small meter families into other larger meter families that are of the same meter design and of similar age. Where small meter families cannot be bundled into other meter families, JEN will consider replacing these particular meters. Typically if the meter family is less than 20 meters and is not suitable to be bundled into another meter family, it will be considered for replacement rather than testing.

With respect to small meter families that can be bundled into larger meter families, JEN will conduct sample testing based on the sample size derived from the new tally of meters within the combined meter family.

4.3.4.3 Budgetary and Resource Allocation for Large Family Failure

JEN has implemented a program for monitoring and identifying potential family failures and a proactive replacement program to minimise the likelihood of exposure to family failures. The budget for the potential family failures and the proactive replacement program is included within JEN's asset investment plan for each year. This will ensure that JEN has the financial resources available to fund any identified family failures.

In terms of the physical resources required to replace large family failures, JEN issues tenders to prospective Meter Service Providers. Tenders are essential to determine which Meter Service Providers have the ability to adequately undertake the replacement program for large family failures.

Tenders are also issued to metering suppliers to determine which supplier has the ability to provide sufficient meter volumes to facilitate the replacement of large family failures.

The process described above has been implemented to ensure that JEN has sufficient financial resources available to replace a large family failure as well as obtain the resources required to facilitate the replacement program that is cost-effective.

If the number of meters that require replacement is much larger than can be accommodated by the standard process in a particular year, then JEN will prepare and seek approval of a rectification plan from the appropriate

regulatory body(s), including lodging any exemption as required under the Rules and AEMO exemption process (ref 22: Metering Installation Exemption Guideline, v1.1)

To mitigate this risk of resource constraints in the event of a large family failure event, JEN is preparing for a limited proactive replacement program for the older meters in the JEN population.

4.3.5 Low Voltage Current Transformer Testing

4.3.5.1 Aim

All LVCTs metering installations will be tested and inspected in accordance with AEMO's guidelines (**Error! Reference source not found.**, ref 8: AEMO: Alternate Testing and Inspection Guidelines for Metering Installations in the NEM V2.0 Final, 2019) and therein referenced metrology procedures.

4.3.5.2 Requirements

LVCT's are to be tested and inspected in accordance with NER requirements, or other test procedures and inspections approved by AEMO. In addition, burden, admittance and ratio tests are to be undertaken at these installations whenever the associated meters are tested or when changes are made to the installations.

All reference/calibrated test equipment shall be tested to ensure full tractability to Australian National Measurements Standards through verifying authorities or directly referenced to the National Measurement Laboratory.

4.3.5.3 Methodology

LVCT's are to be tested using a secondary injection test. LVCT's installations are to be inspected in accordance with the Alternative Testing and Inspection Guidelines for Metering Installations in the NEM, V2.0.

4.3.6 Installation Overall Error Calculation

4.3.6.1 Aim

To calculate overall installation error as per NER schedule 7.2.

4.3.6.2 Requirements

Overall installation error quantifies the error in the energy recorded by the meter as a result of errors in CTs, VTs (including wiring volt drops) and meters. These error limits were given in Schedule 7.2 of the NER. All HV and LV metering installations should meet overall error limits as per NER limits.

4.3.6.3 Operations Procedure

High Voltage installations

Refer to the Jemena Management Procedure: ELE-999-PR-TI-001 HV Energy Metering Test Procedure

Low Voltage installations

Refer to the Jemena Management Procedure: ELE-999-PR-TI-003 LV CT Overall Error Calculation

4.3.6.4 Methodology

Overall error of metering installation is the vector addition of the individual installation component errors. For LVCT installations, the overall error is the vector sum of meter error and CT error. The burden on LVCT installations is controlled by limiting the length of secondary current transformer cables. LVCT's tested under the AEMO sampling procedure "Alternative Testing Minimum Requirements: Low Voltage Current Transformer Metering Installations" do not require overall error determination. For any LVCT's not tested according to "Alternative Testing Minimum Requirements: Low Voltage Current Transformer Metering Installations" overall error will be calculated as per ELE-999-PR-TI-003 LV CT Overall Error Calculation.

For any Type 1, 2 and 3 high voltage installations, actual individual component test results are used to calculate the overall error as per Management Procedure: ELE-999-PR-TI-001 HV Energy Metering Test Procedure. CT/VT errors may be compensated in all new metering installations.

4.4 Meter Data Management

4.4.1 Aim

To ensure all meter data-related obligations for MC, MDP, MPB and local network service provider (LNSP) are meet as per NER and AEMO guidelines. This includes compliance with requirements specified under AEMO Metrology Procedures, Market Settlement and Transfer Solutions (MSATS) Procedures, and Consumer Administration and Transfer Solution (CATS) Procedures.

4.4.2 Key Obligations

Table 6: Agreed Performance Levels for Data Delivery, as based on Minimum AMI Functional Specification (Victoria)

Timeline	Quantity	Quality
6am	100%	95%
Day 1	N/A	99%
Day 10	N/A	99.90%

4.4.2.1 Retailer Transfer

Customer switching is processed according to AEMO metrology procedures, and exceptions are resolved within the required time frame.

4.4.2.2 Meter Health Checks

Daily meter health check report is produced and examined to ensure that potential malfunctions and/or tampering of metering installations are identified and investigated with the field team engaged as required to inspect further and/or resolve the issue.

4.4.2.3 Performance Measures

The weekly AEMO performance reports for compliance with CATS obligations are monitored, and the exceptions are actioned timely to ensure that JEN is compliant in the monthly AEMO performance reports for MDP, MPB, LNSP and MC.

4.4.2.4 Internal Reporting

Daily and Monthly health check reports are produced and assessed within the business to ensure proactive attendance to emerging issues that have the potential to impact JEN's compliance or operational performance.

Key Controls and compliance obligations shall be managed through Jemena's Compliance and Risk Management System (Omnia).

4.4.2.5 Operations Procedure

Jemena will follow the following internal meter data management procedures for consistent management of JEN metering data. The procedures are regularly reviewed and can be accessed through Jemena's Enterprise Content Management System (ECMS)

Table 7: Key Procedures

Key Procedures
JEM-P-6022_Receive_Meter_Data_Process_MD01
JEM-P-6023_Process_Meter_Data_MD02
JEM-P-6024_AMI_Publish_Meter_Data_MD03
JEN P6025_AMI Manage Missing Meter Data MD04
JEM-P-6026_AMI Manage Meter Data Queries_MD0507
JEM-P-6027_Manage_Meter_Data_Compliance_MD08
JEM-P-6028_AMI_CATS_for_MDM_MD09

4.4.2.6 Route Scheduling

The JEN cyclic read schedule is updated annually for both manually read and AMI meters. There are 20 monthly cycles and 62 quarterly cycles for manually read JEN meters.

The route management procedure is described in Jemena Business Process Management system (JEN ARIS) and can be located on ECMS (Route scheduling).

4.4.3 Methodology

4.4.3.1 MDM Performance Monitoring

MDM performance is monitored through regular internal review meetings with JEN MC, during which performance reports (including performance Dashboards and AEMO reports) are reviewed and MDP performance to this strategy is discussed.

System-generated dashboards are used to monitor the quality and quantity of meter data delivered to AEMO and Retailers in a timely manner and include adherence to various key performance indicators (KPIs) (e.g. Provide Meter Data requests are responded to within 24 hours and Verify Meter Data requests are responded to within 5 business days). Jemena's BI system (Business Objects) is used to monitor the day-to-day KPI for meter data management.

JEN MDP maintains its accreditation and is audited twice yearly.