Asset Management Plan

Zone Substations

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Authorisations

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Responsibilities

This document is the responsibility of the Asset Strategy Team, Tasmanian Networks Pty Ltd, ABN 24 167 357 299 (hereafter referred to as "TasNetworks").

Please contact the Asset Strategy Team Leader with any queries or suggestions.

- Implementation All TasNetworks staff and contractors.
- Compliance All group managers.

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Record of revisions

Revision	Details
1.0	Original issue
2.0	Document revised

Table of contents

1. Purpose

The purpose of this management plan is to define the management strategy for Zone Substations. The plan provides:

- TasNetworks' approach to asset management, as reflected through its legislative and regulatory obligations and strategic plans.
- The key projects and programs underpinning its activities.

2. Scope

This asset management plan covers both urban and rural zone substations and all the assets within the substations, with the exception of the secondary systems.

Secondary assets are covered by the Protection and Control Asset Management Plan.

3. Strategic alignment and objectives

This asset management plan has been developed to align with both TasNetworks' Asset Management Policy and Strategic Objectives.

The asset management policy, contained within the Strategic Asset Management Plan, states 'Consistent with our vision and purpose, we strive for excellence in asset management and are committed to providing a safe working environment, value for our customers, sustainable shareholder outcomes, care for our assets and the environment, safe and reliable network services, whilst effectively and efficiently managing our assets throughout their life-cycle'.

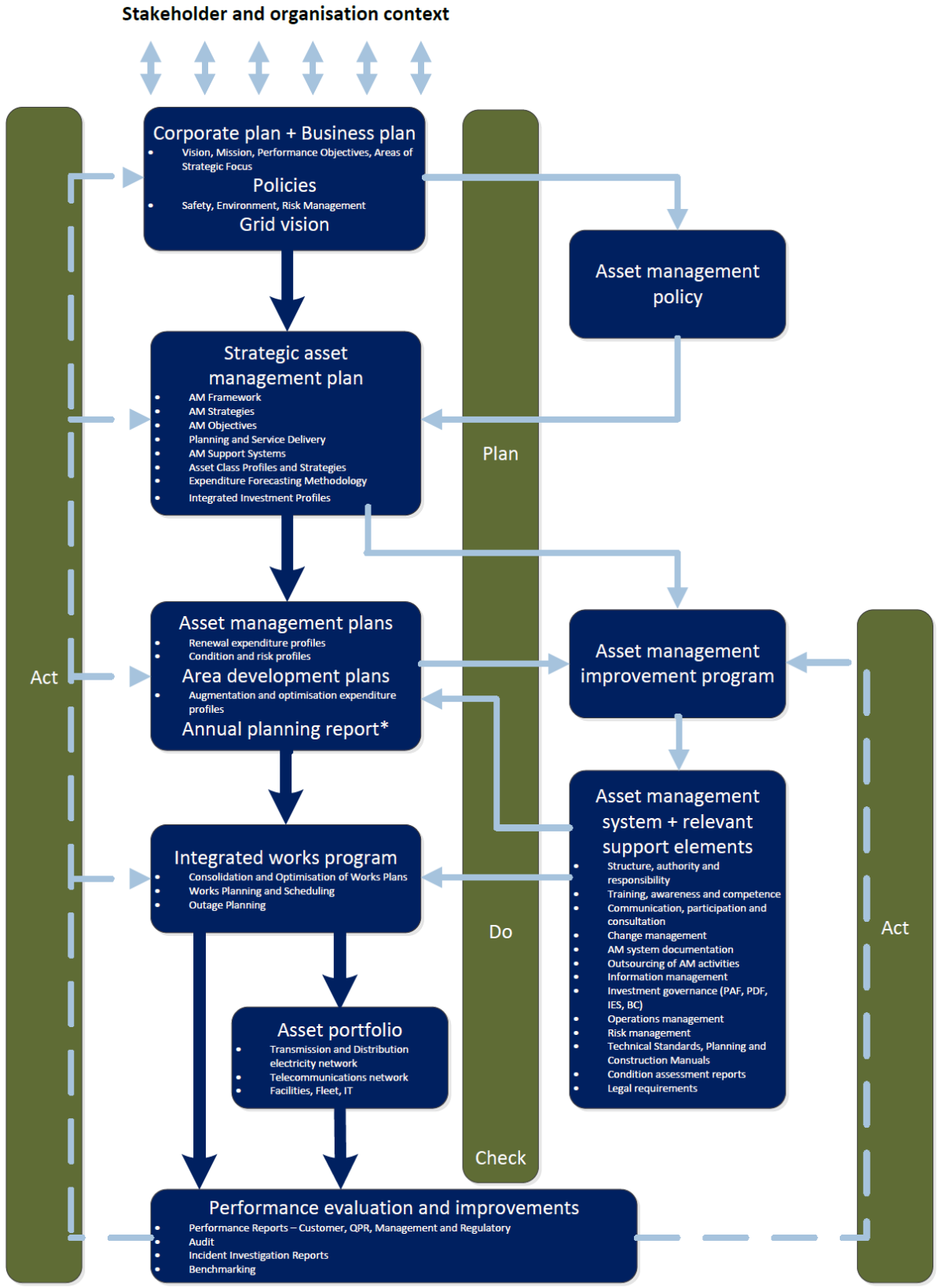
It is part of a suite of documentation that supports the achievement of TasNetworks strategic performance objectives and, in turn, its mission. The asset management plans identifies the issues and strategies relating to network system assets and detail the specific activities that need to be undertaken to address the identified issues.

Figure 1 represents TasNetworks' documents that support the asset management framework. The diagram highlights the existence of, and interdependence between, the Plan, Do, Check, Act components of good asset management practice.

For these assets the management strategy focuses on the following objectives:

- Safety will continue to be our top priority and we will continue to ensure that our safety performance continues to improve.
- Service performance will be maintained at current overall network service levels, whilst service to poorly performing reliability communities will be improved to meet regulatory requirements.
- Cost performance will be improved through prioritisation and efficiency improvements that enable us provide predictable and lowest sustainable pricing to our customers.
- Customer engagement will be improved to ensure that we understand customer needs, and incorporate these into our decision making to maximise value to them.
- Our program of work will be developed and delivered on time and within budget.

Figure 1 – TasNetworks asset management documentation framework



* The Annual Planning Report (APR) is a requirement of sections 5.12.2 and 5.13.2 of the National Electricity Rules (NER) and also satisfies a licence obligation to publish a Tasmanian Annual Planning Statement (TAPS). The APR is a compilation of information from the Area Development Plans and the Asset Management Plans.

4. Asset support systems

4.1 Systems

TasNetworks utilises asset management information systems to manage its asset information. These systems are maintained to contain up to date, detailed information with regard to the zone substation sites.

The asset information related to the zone substation is managed using a spatial data warehouse (G/Tech). This data base stores critical attributes for each site, including the site location and its interconnection to the network.

A works management system is used to manage asset management activities and for the recording of asset performance. TasNetworks is in the process of migrating from a WASP management system to a SAP management system. The transition to the new system is scheduled to occur in February 2018.

4.2 Asset information

Asset related information is stored and accessed through the asset management systems. Where asset information is insufficient, audits are undertaken to gather the required information.

5. Asset description

The major sub-components of the zone substations are:

- **Substation site:** the enclosure, switchyard, building security system and earthing system.
- **Power transformers:** used to step up or down voltage.
- **High voltage switchgear:** that provides isolation, disconnection and connection of the sub-transmission and distribution systems in order to maintain supply to the customer.
- **Ancillary systems:** station services supply and low voltage electrical reticulation within the site.

The following assets are excluded from the asset class:

- Incoming feeders, both overhead and underground
- Outgoing feeders, both overhead and underground
- Secondary systems
- Mobile generators for emergency purposes

Zone substations are established where significant bulk load points exist and there is a need to further distribute the capacity requirements of customer loads at high voltage (HV). This type of asset class forms a key component in the distribution system and requires close monitoring and regular maintenance.

Zone substations contain power transformers, switchgear, earthing systems, protection and control devices, with all infrastructure contained in purpose built enclosures for security and the prevention of unauthorised access.

The zone substations range in size (connected MVA) from 2 MVA to 90 MVA with outgoing high voltage feeders ranging from only one feeder up to sixteen feeders.

As of August 2017, there are eighteen zone substations within the distribution network. These substations are grouped into thirteen urban zone substations and five rural zone substations. Trial Harbour Zone whilst in a rural location is similar to that of an urban zone substation in design and so

included in urban zone classification. Tables 1 and 2 provide a summary of the urban and rural zones substations across the network.

Table 1: Urban zone substations

Substation	Rating (MVA)	Number of power transformers	Number of HV outgoing feeders	Year of construction
Bellerive	45	2	6	1971
Cambridge	40	2	12	2008
Claremont	45	2	10	1969
Derwent Park	45	2	10	1964
East Hobart	90	3	12	2004
Geilston Bay	45	2	8	1968
Howrah	50	2	6*	2011
New Town	45	2	8	1966
Rosny Park	25	1	7	2016
Sandy Bay	90	3	13	1967
Summerleas	25	1	5*	2014
West Hobart	90	3	14	2001
Trial Harbour	40	2	3	2007

* Capacity for 10 feeders

Table 2: Rural zone substations

Substation	Rating (MVA)	Number of power transformers	Number of HV outgoing feeders	Year of Construction
Gretna	2	2	2	1962
New Norfolk	10	4	3	1960
Richmond	5	2	3	1960
Tod's Corner	6	2	1	1971
Wayatinah	2	1	2	2014

All the urban zone substations, with the exception of Trial Harbour, are located within the greater Hobart area and are supplied by dedicated sub-transmission feeders. These substations take supply at a voltage of 33 kV and step the voltage down to a distribution voltage of 11 kV. Prior to a major redevelopment in 2003 in the Hobart area the substations were supplied at either 22 kV or 33kV.

Trial Harbour Zone is located on the west coast of Tasmania near Zeehan. It is supplied at 44 kV and steps the voltage down to a distribution voltage of 22 kV.

The rural zone substations are located throughout rural areas and are also supplied from rural distribution feeders. Three of the substations, Gretna, New Norfolk and Richmond are supplied at a voltage of 22 kV and step down the voltage to the local distribution voltage of 11 kV. Wayatinah zone substation is supplied at 11 kV and steps the voltage up to a distribution feeder voltage of 22 kV. Tod's Corner zone substation is supplied at 6.6 kV and steps the voltage up to a distribution feeder voltage of 22 kV.

5.1 Substation site

Prevention of unauthorised access and security a highly dangerous area is paramount with zone substations, especially when located close to populated areas.

The zone substation enclosures are purpose-built for each substation and may comprise a building, fence or combination of the two. The enclosures are designed for safety and security, and in the case of building-types enclosures they also provide a weatherproof environment for the equipment.

These enclosures may also provide noise mitigation and provide a more aesthetically pleasing site to meet local requirements.

All zone substations contain an earthing system. The earthing system is designed to ensure that under fault conditions people are not exposed to a hazardous voltage. To achieve this it provides a low impedance return path for fault currents. Earthing systems are made of a conductive grid, typically copper and buried below ground level. All non-energised conductive material in the substation is bonded to the earthing system.

The integrity of the earthing system is paramount for maintaining operational personnel and public safety and for correct operation of protection equipment. The fault level, fault clearing time and site conditions dictate the extent of earthing system required.

5.2 Transformers

The power transformers at the zone substations step the supply voltage down to the required high voltage for the distribution feeders. The transformers at the urban zones have a nominal voltage ratio of 33 kV to 11 kV and range in size from 20 to 30 MVA.

The power transformers at the rural zones are significantly smaller and range in size from 1 to 3 MVA and comprise a variety of voltage ratios.

Table 3: Urban zone substations power transformers

Substation	Designation	Voltage Ratio (kV/kV)	Manufacturer	Rating(MVA)	Year of Manufacture
Bellerive	T1	33/11	Wilson	15/22.5	1970
Bellerive	T2	33/11	Wilson	15/22.5	1970
Cambridge	T1	33/11	Wilson	15/20	2008
Cambridge	T2	33/11	Wilson	15/20	2008
Claremont	T1	33/11	Wilson	15/22.5	1964
Claremont	T2	33/11	Wilson	15/22.5	1964
Derwent Park	T1	33/11	Wilson	15/22.5	1964
Derwent Park	T2	33/11	Wilson	15/22.5	1964
East Hobart	T1	33/11	ALSTOM	20/30	2004
East Hobart	T2	33/11	ALSTOM	20/30	2004
East Hobart	T3	33/11	ALSTOM	20/30	2004
Geilston Bay	T1	33/11	Wilson	15/22.5	1968
Geilston Bay	T2	33/11	Wilson	15/22.5	1968
Howrah	T1	33/11	ALSTOM	15/25	2011
Howrah	T2	33/11	ALSTOM	15/25	2011
New Town	T1	33/11	AREVA	15/22.5	2005
New Town	T2	33/11	ALSTOM	15/22.5	1999
Rosny Park	T1	33/11	ALSTOM	15/25	2011
Sandy Bay	T1	33/11	ALSTOM	20/30	2004
Sandy Bay	T2	33/11	ALSTOM	20/30	2004
Sandy Bay	T3	33/11	ALSTOM	20/30	2004
Summerleas	T1	33/11	ALSTOM	15/25	2011
West Hobart	T1	33/11	ALSTOM	20/30	2001
West Hobart	T2	33/11	ALSTOM	20/30	2001
West Hobart	T3	33/11	ALSTOM	20/30	2001
Trial Harbour	T1	66/44/22	AREVA	22.5/30 at 66 kV 15/20 at 44 kV	2007
Trial Harbour	T2	66/44/22	AREVA	22.5/30 at 66 kV 15/20 at 44kV	2007

Table 4: Rural zone substations power transformers

Substation	Designation	Voltage Ratio (kV/kV)	Manufacturer	Rating(MVA)	Year of Manufacture
Gretna	T1	22/11	Wilson	1	1962
Gretna	T2	22/11	Wilson	1	1962
New Norfolk	T1	22/11	English Electric	2.5	1960
New Norfolk	T2	22/11	English Electric	2.5	1960
New Norfolk	T3	22/11	English Electric	2.5	1960
New Norfolk	T4	22/11	English Electric	2.5	1960
Richmond	T1	22/11	English Electric	2.5	1960
Richmond	T2	22/11	English Electric	2.5	1960
Tod's Corner	T1	6.6/22	English Electric	3	1971
Tod's Corner	T2	6.6/22	English Electric	3	1971
Wayatinah	T1	11/22	Schneider	2	2014

5.3 High voltage switchgear

Zone substation switchgear consists of circuit breakers, switch-fuses, earth switches and isolator-switch devices. They are primarily used to provide isolation, disconnection or connection of the sub-transmission incoming feeders and the outgoing distribution feeders. Tables 5 and 6 provide further details of the switchgear at these substations.

The switchgear at the urban zones is metal clad and housed indoors in the control building. The switchgear consists of a range of types and vintages. With the exclusion of Trial Harbour Zone all the switchgear is rated at 11 kV.

At five of the older zones due the safety risks associated with the existing oil filled circuit breakers, asset replacement was undertaken. Instead of a complete switchboard replacement, vacuum circuit breakers were retrofitted into the original Reyrolle LMT switchboards.

At the majority of the rural zone substations pole mounted reclosers are used for the high voltage switchgear. The switchgear is mounted overhead on poles. Wayatinah zone is the one exception where the switchgear is ground mounted.

Table 5: Urban zone substation switchgear

Substation	Type	Insulating medium	Installation/Retrofit dates
Bellerive	Reyrolle LMT / RPS LMVP	Vacuum	1971 / 2012
Cambridge	ABB Uni Gear type ZS1	Vacuum	2008
Claremont	AREVA HWX	Vacuum	2006
Derwent Park	Reyrolle LMT / RPS LMVP	Vacuum	1964 / 2014
East Hobart	ALSTOM HWX	Vacuum	2004
Geilston Bay	Reyrolle LMT / RPS LMVP	Vacuum	1968/2012
Howrah	AREVA PIX12	Vacuum	2011
New Town	Reyrolle LMT / RPS LMVP	Vacuum	1966 / 2016
Rosny Park	ABB Uni Gear type ZS1	Vacuum	2016

Substation	Type	Insulating medium	Installation/Retrofit dates
Sandy Bay	Reyrolle LMT / RPS LMVP	Vacuum	1967/2013
Summerleas	AREVA PIX12	Vacuum	2014
West Hobart	ALSTOM HWX	Vacuum	2001
Trial Harbour	AREVA DT1 72.5 F1 at 66 kV AREVA PIX24 at 22 kV AEM DB72 72.5kV disconnector HSG72 72.5kV earth switch	SF_6 Vacuum Air Air	2007

Table 6: Rural zone substation switchgear

Substation	Manufacturer	Insulating medium	Installation Date
Gretna	Nulec, N series	SF6	2006
New Norfolk	Nulec, N series	SF6	2001
Richmond	Nulec, N series	SF6	2003
Tod's Corner	Nulec, N series	SF6	2016
Wayatinah	Schneider SM6 and RM6	SF6	2014

5.4 Ancillary systems

In addition to the major components with in a zone substations there are a variety of systems required to support its operation.

The low voltage reticulation is supplied from a local switchboard. The switchboard supply is provided from an onsite station services transformers, with a low voltage street supply usually used as an alternate backup supply.

Batteries and battery charger systems are required to provide the backup DC supply to critical equipment such as protection and SCADA systems and switchgear in case of interruption of normal AC supply.

A protection system contains protection relays and protection devices to identify faults in the system and isolate the system automatically when required. Protection systems are critical for minimising asset damage, network disruption and ensuring risks to public safety are minimised.

Supervisory Control and Data Acquisition (SCADA) contains intelligent electronic equipment and devices to provide valuable data regarding the condition of the system and site equipment to a centralised control room. This also enables remote system operation from a centralised control room.

Examples of SCADA data available to TasNetworks that can assist in the asset management of zone substations, includes transformer tap changer position, circuit breaker status, opening and closing of circuit breakers and transformer oil and winding temperature.

The DC system and protection and control assets are covered by the Protection and Control Asset Management Plan.

5.5 Asset type age profile

The zone substation age profiles reveal a cluster of substations below fifteen years of age and a second cluster above forty years old. This reflects the original installation of the older zone substations in the 1960s and the upgrade and redevelopment of the urban zones in the mid-1990s.

Figure 2 – Urban zone substation age profile

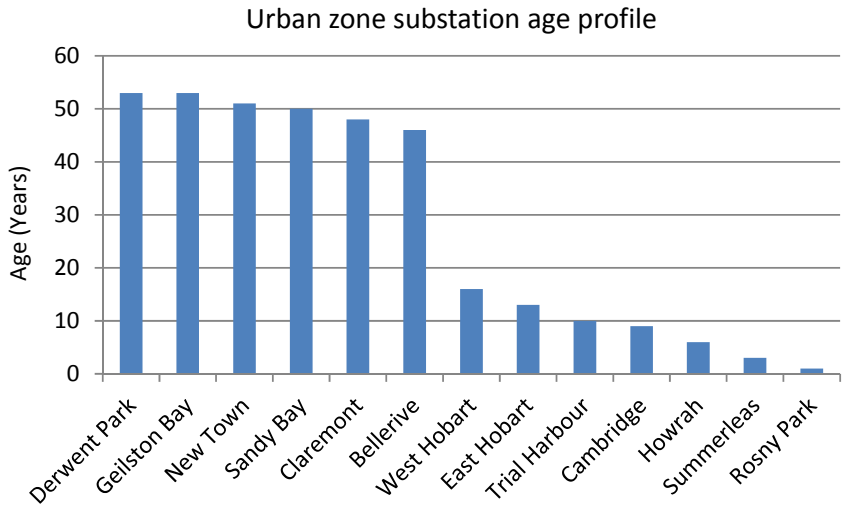
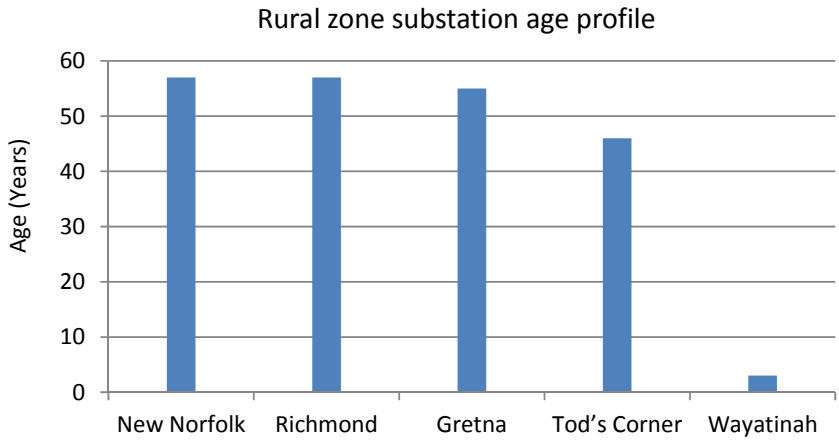
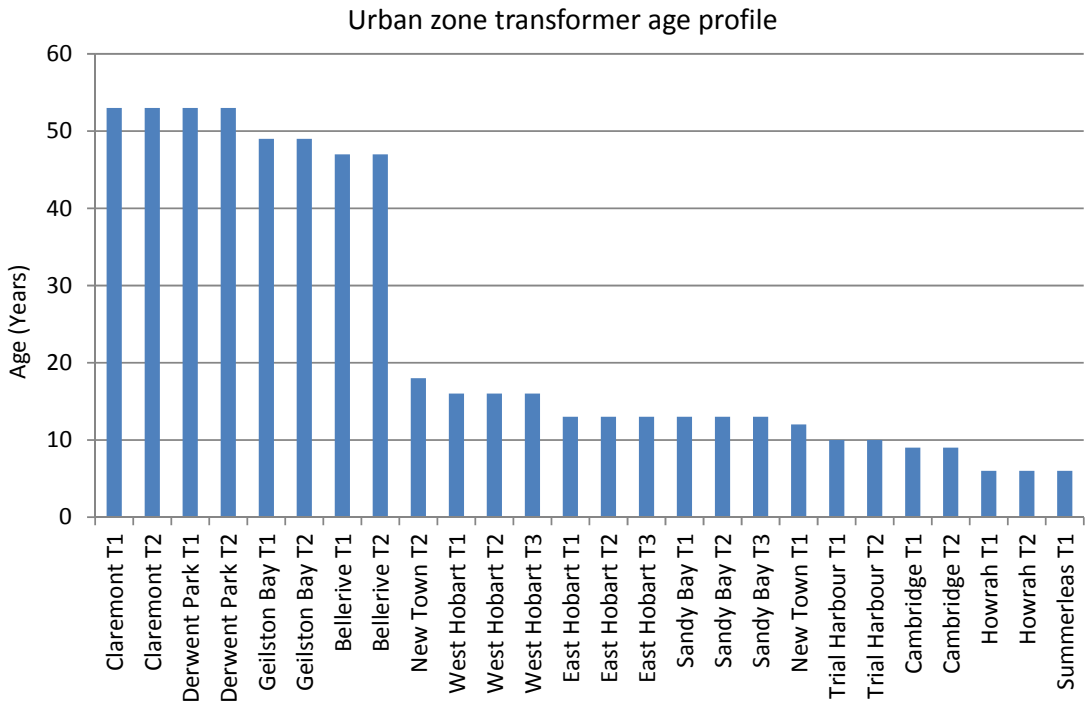


Figure 3 – Rural zone substation age profile



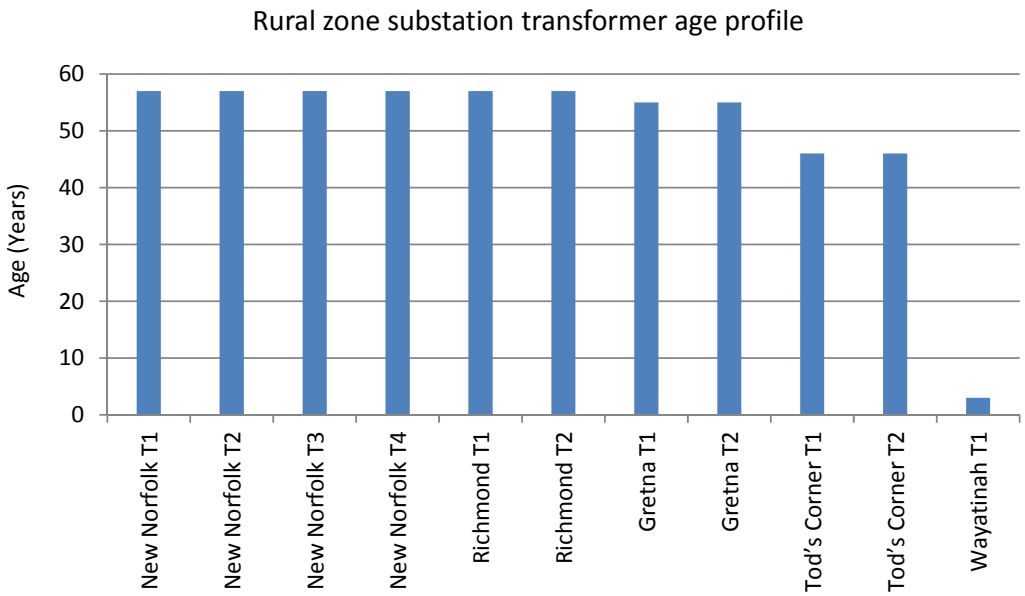
The urban zone substation transformer age profile is provided in figure 4. The age profile is similar to that of the urban zone substation age profile, with two notable age groups i.e. a group of eight transformers in the 44 to 51 year age bracket and a second much younger group of eighteen transformers in the 2 to 16 year age bracket.

Figure 4 – Urban zone substation transformer age profile



The rural zone substation transformer age profile is provided in figure 5. With the exception of Wayatinah Zone which has undergone a recent redevelopment, the majority of the transformers at the rural zones are in excess of 50 years of age.

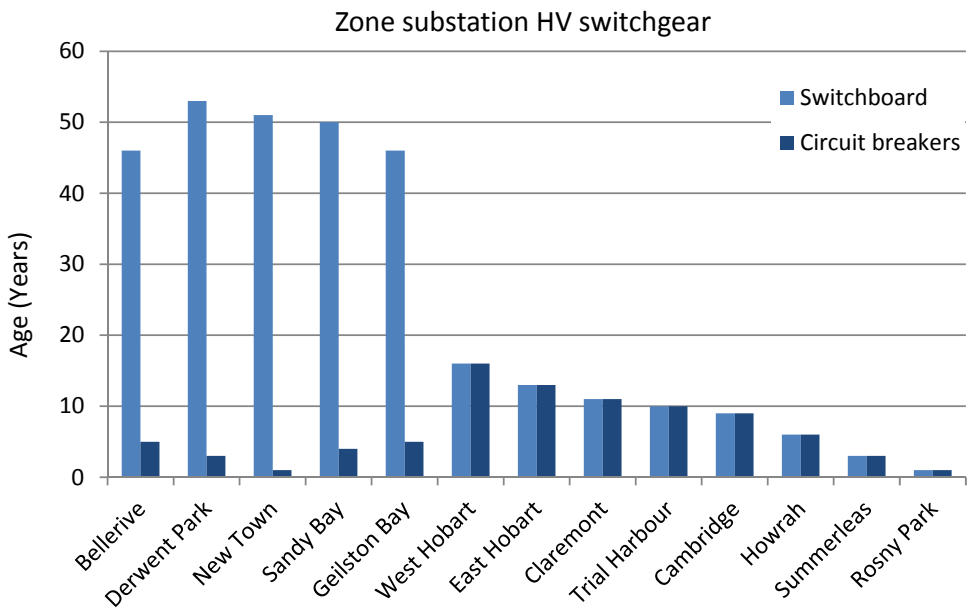
Figure 5 – Rural zone substation transformer age profile



The age profile of the HV switchgear in the zone substations is provided in figure 6. In some instances the age of the circuit breakers is different to the switchboards. This is because at five of the older substations when the oil filled circuit breakers had reached end of life rather than

complete switchboard replacement, the original switchboard was retained and new circuit breakers were installed within it.

Figure 6 – Urban zone substation switchgear/circuit breaker age profile



6. Associated risk

TasNetworks has developed a Risk Management Framework for the purposes of

- Demonstrating the commitment and approach to the management of risk – how it is integrated with existing business practices and processes and ensure risk management is not viewed or practiced as an isolated activity;
- Setting a consistent and structured approach for the management of all types of risk; and
- Providing an overview on how to apply the risk management process.

For the assets in the zone substations the risk assessment was based on:

- Condition of zone substation and its critical assets
- Criticality of zone substation and associated assets
- Probability of failure (not meeting business requirement)
- Consequence of failure
- Performance
- Safety risk
- Environmental risk
- Customer

The quantification of risk is undertaken using the Condition Based Risk Management (CBRM) framework. This approach allows the risks of individual assets to be quantified against the defined assessment.

Due to the level of risk identified in some of the assessment criteria a requirement to actively manage these risks has been identified.

6.1 Asset risks

6.1.1 Site security

Periodic inspections and routine maintenance of the zone substation sites has ensured that the substations sites i.e. external fences, buildings and switchyards are in sound condition and secure from unauthorised entry.

With the exception of Trial Harbour, the elimination of live electrical equipment within the urban zone switchyards greatly reduces the safety risks to personnel within the yard. Unlike the urban zones, the rural zones do contain live and exposed electrical equipment. In some instances the installations are not compliant with current standards. This risk is managed through training, administrative controls and the use of personal protective equipment.

At all sites signage is provided to notify people of the hazards that exist within the sites.

6.1.1 Condition of assets

6.1.1.1 Switchgear

Periodic inspections and routine maintenance programs indicate that the switchgear and enclosures are in good condition.

The urban zones contain a variety of switchgear types and ages. At five of the older substations contain Reyrolle LMT switchboards that contained oil filled circuit breakers, due to the risks associated with this type of circuit breakers they were replaced with modern vacuum circuit breakers. Arc fault containment capability was also added at this time to reduce the risk to operational personnel. The installation of these modern circuit breakers will maintain the reliability of the site and greatly reduces the risks that were associated with an asset failure. Due to the original switchboard being retained, including some critical components e.g. current and voltage transformers, some additional asset replacement will be required at these sites in the next five to ten years.

At four of these substations the high voltage switchgear used to connect the station services transformer to the switchboard is still the original equipment installed when the substation was first commissioned. This switchgear is ‘Statter’ oil filled switchgear. Due to the risks associated with this type of switchgear and lengthy service life, there is a plan in place for the replacement of it and the station service transformer that it supplies.

6.1.1.2 Transformers

Condition monitoring of the urban zone transformers has shown the urban zone transformers to be in a satisfactory condition, although some deterioration is evident in some of the older transformers.

Condition monitoring of the rural zone transformers has indicated notable deterioration in some of the transformers. The poor condition could result in a failure occurring that results in a notable supply disruption to the customers supplied from the substations. The condition of the transformers supplied from the rural transformer condition is summarised in table 7.

Table 7: Rural zone substation – transformer oil condition

Site	Condition
Gretna	The acidity and interfacial tension indicates poor oil quality i.e. deterioration of the insulating oil. Increased furan levels indicating cellulose is in deteriorating condition. Asset replacement is planned for 2016/2017.
New Norfolk	Transformers T1, T2, T3 and T4 have high moisture levels and have high acidity indicating poor oil quality i.e. deterioration of the insulating oil. Increased furan levels indicate the cellulose is in a deteriorated condition. Asset replacement is planned for 2018/19.
Richmond	Transformers T1 and T2 have high moisture levels. T2 has high acidity indicating poor oil quality i.e. deterioration of the insulating oil. Increased furan levels indicate the cellulose is in a deteriorated condition. Replacement proposed in 2016/2017.
Tod's Corner	Transformers T2 and T3 have high moisture levels.

6.1.2 Fire

Fires within substations and the consequences of them can be a significant risk. A fire can result in loss of customer supply, significant financial cost, and they also have the potential to result in harm or death to operational staff and the public.

These risks are mitigated through compliance with standards, fire containment and suppression systems and routine inspections.

6.1.2.1 Compliance with fire standards

TasNetworks ensures that its design and management practices are compliant with legislative requirements and relevant standards.

All new substations are compliant with the requirements of AS 2067 : Substations and high voltage installations exceeding 1 kV a.c. All new building and vault type substations are also compliant with the Building Code of Australia (BCA).

6.1.2.2 Inspection and maintenance

Fire detection and suppression systems in substations are routinely inspected and tested in compliance with Australian standard AS 1851. Inspections are also routinely undertaken on all external access ways, ventilation and building penetrations.

6.1.2.3 Containment and suppression

Fire containment measures are incorporated into the design of substations to minimise the risk of a substation fire to surrounding property.

The design of the substation is required to provide containment of a fire within the confines of the substation for a minimum period of two hours. This time period is designed to provide sufficient time for a fire authority to attend to a fire before it can spread outside of the substation.

The fire containment is achieved through the use of fire resistant materials in the external walls, floor and ceiling of the substation, the installation fire rated doors and fire barriers across all external openings.

At East Hobart Zone substation due to the transformers being installed and enclosed within the substation building, a fire suppression system has been installed to mitigate the risk of a transformer fire damaging other infrastructure within the substation.

6.1.3 Asbestos

TasNetworks is required to comply with Work Health and Safety Act and Regulations 2012 and the Workplace Standards Tasmania: How to Manage and Control Asbestos in the Workplace Code of Practice 2012 (Reference 8 and 13) with regards to the management of sites containing asbestos.

The zone substations constructed prior to 1980 are likely to contain asbestos. These sites include:

- Bellerive
- Claremont (old buildings only)
- Derwent Park
- Geilston Bay
- New Town
- Sandy Bay

Equipment that may contain asbestos includes switchboards, metering panels, roof lining, conduits and doors. An audit was completed in 2013/2014 of these zone substations to determine which equipment contains asbestos. As a result of this audit, labelling of equipment and the completion of a zone substation asbestos register is to be undertaken. This information is used to assist the routine asbestos inspections as detailed in section 7.3.1.5.

6.1.4 Confined spaces

All confined spaces within substations e.g. cable trenches must comply with the Building Code of Australia (BCA). TasNetworks is required to routinely inspect and maintain these areas in accordance with the requirements of the Code.

To reduce the safety risk presented by these areas, access to them is restricted, with entry only by trained personnel working in accordance with TasNetworks' confined space work practice.

6.1.5 Emergency and exit lighting

Zone substations do not contain any natural lighting which makes evacuation of them more hazardous under blackout conditions. To mitigate against this risk emergency and exit lighting is installed in the substations.

The installation of emergency and exit lighting within substations is a requirement of the BCA. The inspection and maintenance requirements of the lighting systems are covered under AS/NZS 2293.2 Emergency evacuation lighting for buildings – Inspection and maintenance.

6.1.6 Criticality of asset

Zone substations are essential for providing customer supply and network performance, particularly in the greater Hobart area. With zone substations acting as bulk supply points an asset failure or reduction in performance can result in measurable impact to network performance and statistics e.g. SAIDI and SAIFI.

To reduce the risks of an asset failure in the zone substations a level a level of redundancy is provided for in the substations. For the urban zone substations there is 'n-1' redundancy on the incoming 33kV supplies and transformers. The interconnectivity of the distribution network in the greater Hobart area also means that asset failures in urban zone substations can usually be covered with minimal disruption to the network. This is achieved through reconfiguration of the network.

Unlike urban zones, with rural zones there is often limited means to provide alternative supplies to them and the network supplied from the zone. For this reason asset failures at rural zones can result in extended network disruptions.

6.1.7 Probability of failure

TasNetworks experiences a number of high voltage failures each year due to unprecedented faults, however asset failures with zone substations are not common. The probability of failures for assets within the zone substations is considered to be low and at an acceptable risk level in accordance with TasNetworks' risk framework.

6.1.8 Consequence of failure

The results of Zone substation failures can be categorised under the following main groups:

- Performance on Power Quality
- Safety Risk due to loss of oil
- Environmental hazards due to oil spills.
- Disruption to Customer Supply

7. Management plan

7.1 Historical

TasNetworks' asset management practices for these assets have been stable for a number of years and are generally considered to be providing a well-balanced trade-off between maintenance and capital expenditure. In particular, TasNetworks believes the practices of condition based renewal, driven by asset inspection and maintenance practices are enabling the development of sound asset management strategies.

Due to the critical nature of this asset class, frequent maintenance is required to defer unnecessarily early capital expenditure. TasNetworks believes that the existing frequency of maintenance is reasonable and that the practices are capturing the issues appropriately.

Capital expenditure has been low historically due to adequate performance and condition of the equipment, however, this will change going into the future with the deteriorating condition of some of the assets.

Changes to the Occupational Licensing Act 2005 that became effective on the 19 January 2009 have required TasNetworks to be compliant with The Occupational Licencing Code of Practice 2013. This code of practice sets the minimum standards for electrical work in Tasmania.

Incorporated into this Code of Practice is the requirement to comply with:

- AS 2067 (Substations and high voltage substations)
- AS/NZS 3000 (Wiring Rules)
- AS/NZS 7000
- Any additional obligations imposed by AS 2067, AS/NZS 3000 and AS/NZS 7000 referring to further Australian Standards or documents, including any amendments or revisions of those Australian Standards or documents from time to time.

The Code of Practice requires that any person performing electrical work within Tasmania to comply with these Australian Standards.

These changes have mandated the requirement to comply with the regulatory, contractual and legal responsibilities outlined in section 7.2.1.

7.2 Strategy

The four key principles of TasNetworks' asset management strategy are:

- Minimising the cost of supply to the customer to the lowest sustainable level.
- Maintaining network performance.
- Managing the business operating risks at an appropriate level.
- Complying with regulatory, contractual and legal responsibilities.

The factors relevant to the management of the zone substation assets that influence each principle are listed in the following sections.

Minimising cost of supply to the customers to the lowest sustainable level:

- Ensuring cost effective trade-offs are made between pro-active and reactive maintenance practices.
- Ensuring all reasonable routine maintenance (as per manufacturer's recommendations) precautions are implemented to protect the asset for the duration of its service life.
- Capturing adequate information on the assets to facilitate informed decision making.

Maintaining network performance:

- Ensuring contingency procedures (redundant capacity and portable generators) are in place for any (n-1) events, as the impact of failures is significant and exact failure is difficult to predict even after frequent condition monitoring.
- Ensuring appropriate spares are maintained as the lead-time for some of the assets (specifically transformers) is very long.
- By identifying trends in asset performance to target future likely failures.

Managing business operating risks at an appropriate level:

- Ensuring adequate fencing and protection of building enclosures at all zone substations to comply with legislation and ensure public safety as these sites contain dangerous voltages in areas generally frequented by the public.
- Failure of transformers and switchgear can cause explosive failure and needs to be avoided where practical.
- Ensuring all equipment is suitably secured and earthed.
- Ensuring adequate monitoring and inspection activities cover legislative compliance obligations and duty of care safety obligations.
- Ensuring all risks are identified and have adequate management plans integrated into the business' practices.
- Ensure adequate monitoring and inspection activities cover regulatory, contractual and legislative compliance requirements and duty of care safety obligations.

Complying with regulatory, contractual and legal responsibilities:

- Ensure adequate monitoring and inspection activities cover regulatory, contractual and legislative compliance requirements and duty of care safety obligations.

Some of the identified compliance requirements are detailed below:

- Ensuring oil (with or without Polychlorinated Biphenyl (PCB)) spill risks are managed in compliance with TasNetworks' Health, Safety, Sustainability and Environment policy.
- Ensuring confined space entry signage and records are in accordance to AS 2865: 2009, Confined Spaces and Work, Health and Safety Regulations 2012.
- Ensuring installations of assets (including earthing) are compliant to:
  - AS 2067: Substation and high voltage installations exceeding 1kV a.c.
  - AS1940: The storage and handling of flammable and combustible liquids.
  - Electricity Network Association (ENA) guidelines.
  - Building Code of Australia
    - Protection of Openings C3.5 Doorways in firewalls
    - Part E1, Fire fighting equipment
  - Part E2 Smoke Hazard Management generally and in particular, with clause E2.2 and E2.3 regarding air handling, smoke detection and alarm, and special hazards of fire risk.
  - Part E4 Emergency lighting, Exit signs and warning systems
- Ensuring inspection and monitoring are compliant to:
  - AS 1851 Maintenance of fire protection system and equipment.
  - AS/NZS 2293.2 Emergency evacuation lighting for buildings – Inspection and maintenance.
  - Workplace Standards Tasmania: How to Manage and Control Asbestos in the Workplace Code of Practice 2012.

7.2.1 Routine maintenance

To meet the asset management strategy there is a need to undertake routine maintenance on these assets. Routine maintenance maximise the service life and reliability of the assets and ensures they remain fit for service.

The absence of routine maintenance would result in a reduction in reliability for these assets and an unacceptable safety risk if their condition was not actively managed.

7.2.2 Routine maintenance versus non-routine maintenance

Failures of most of the assets in zone substations have the potential for serious or catastrophic damage to both other zone substation assets and to nearby areas, as well as a substantial impact on reliability. Due to the critical nature of these assets, reactive corrective maintenance is avoided where possible due to the generally high costs involved. Routine maintenance programs represent a cost effective alternative.

7.2.3 Refurbishment

Where zone substation primary equipment is removed from the network in good operating condition by drivers such as capacity and power quality drivers, these assets are assessed for redeployment back into the network where it is an economic proposition.

7.2.4 Planned asset replacement versus reactive asset replacement

A reactive asset replacement program is not an attractive alternative to planned asset replacement due to the significant supply disruption that would occur if assets were allowed to run to failure. Lead times for replacement zone substation equipment can be significant and in excess of six

months, depending on the availability of supply and manufacture, and results in a higher cost than planned asset replacement.

TasNetworks' urban zone substations supply high density urban, commercial and CBD communities where extended periods of outages are unacceptable. The distribution system has adequate connectivity to reconfigure the network in the event of a zone substation failure, but the extent to which supply can be restored is restricted by the current load on the network. Due to the significant reliability and system security risk that leaving the distribution system in these contingency arrangements for extended periods of time poses, reactive asset replacement is avoided where possible.

The use of temporary mobile generation substations is a possible option for providing network support following asset failures. Leasing arrangements are also in place with external service providers for the supply of additional units if required.

7.2.5 Non network solutions

Zone substations are a fundamental requirement of the network with very limited alternatives available for providing the functionality. Network loading and security is usually the driver for the need to install additional zone substations on the network. Demand side management such as smart meters and ripple control serve to defer, but not fully remove the need for investment.

7.2.6 Network augmentation impacts

TasNetworks' requirements for developing the power transmission system are principally driven by five elements:

- Demand forecasts
- New customer connection requests
- New generation requests
- Network performance requirements
- National electricity rules (NER) compliance

7.3 Routine maintenance

7.3.1 Asset inspection (Visual, load check and condition monitoring) (AIZSM)

The asset inspection program has five components:

- Visual inspections and load check
- Confined space inspections
- Oil testing
- Thermal inspections
- Asbestos inspections

7.3.1.1 Visual inspections and load checks

A visual inspection of each zone substation is conducted every three months. The objective of the inspection is to ensure that the condition of the assets and site is sound, and that the site remains secure. The frequency is based on the manufacturer's recommendation for the different assets and TasNetworks' previous experience regarding the site enclosures and signage etc.

TasNetworks monitors load on all the urban zone substations through its SCADA system. Most of the transformers operate well below their full continuous load capacity. This ensures that the total substation load is maintained under the firm capacity of the substation.

Integrity checks of the SCADA systems are conducted every six months in conjunction with the visual inspection at all urban zones.

7.3.1.2 Confined space inspections

The aim of the confined space inspections is to ensure that the information contained in the confined space register is correct and all on-site labelling is in place.

The definition of a confined space is contained in Regulation 5 of the Work Health and Safety Regulations 2012.

An audit was undertaken in 2010 to identify confined spaces within TasNetworks' sites. The following assets were classified as confined spaces as part of the audit:

- The cable trenches in the urban zone substations.
- The oil containment tanks at the urban zone substations, including Trial Harbour Zone Substation.

These inspections are undertaken every four years and are conducted at the same time as the asbestos inspections.

7.3.1.3 Oil testing

Regular testing of oil samples from transformers is important to monitor the moisture content of the transformer oil and the dissolved gas content as well to capture any indication of any internal faults, such as partial discharge, overheating or arcing, within the transformer.

The aim of the transformer oil-testing program is:

- Understand ageing and deterioration of the insulating oil and cellulose by analysing number of physical and electrical properties of the oil.
- Monitor for fault conditions and operational problems in the transformer by performing dissolved gas analysis.

Transformer oil sampling and testing is undertaken annually for all zone substations. Where specific issues are identified treatment plans are developed to manage the situation. These plans may include increased monitoring or remedial work to prevent a failure occurring.

The testing and analysis of oil samples is undertaken by an external NATA certified laboratory.

7.3.1.4 Thermal inspections

The aim of the thermal inspections is to inspect all accessible equipment to detect any hot spots, which may be an indicator of a developing failure.

Thermal inspections are conducted once every two years at each rural zone substation site.

More frequent thermal inspections may be required at particular sites in the event of abnormal test results.

This work is conducted at the same time as the partial discharge testing routine.

7.3.1.5 Asbestos inspections

To address the issues associated with asbestos (Refer Section 6.1.1) TasNetworks has a program of asbestos inspections.

The aim of periodic asbestos inspections is to ensure that the information in TasNetworks' asbestos register is correct, all on-site labelling is in place and there is no elevation in the associated safety risk.

These inspections are undertaken every four years by qualified personnel and are conducted at the same time as the confined space inspections (refer Confined Space Inspections above).

7.3.1.6 Urban zone substations – Fire system inspections

This program comprises the following components:

- Fire and exit door inspections
- Emergency and exit lighting inspections
- Fire extinguisher inspections
- Fire system inspections/maintenance – panels and smoke detectors
- East Hobart deluge system testing

Fire and exit doors

The installation of fire doors and doorways in firewalls are governed by the requirements of the Building Code of Australia (BCA) Volume 1, Protection of Openings C3.5 Doorways in firewalls.

The requirements for the maintenance of fire doors are set out in AS 1851 Maintenance of fire protection systems and equipment (Reference 6).

The older urban zone substations do not meet current standards with regards to fire doors and emergency exits, which poses a risk to operator safety.

The fire and exit doors at each urban zone substation, where compliant fire doors are installed, are inspected every six months, as required by AS 1851.

Emergency and exit lighting

Substation buildings can be classified as a class 8 building as part of the Building Code of Australia (BCA). The installation of emergency lighting, exit lights and warning systems are governed by the requirements of the BCA Volume1 (Part E4 Emergency lighting, Exit signs and warning systems).

TasNetworks has emergency lighting installed in all its urban zones including Trial Harbour Zone substation. Although some of the older urban zone substations do not meet current standards with regards to exit lights, which poses a risk to operator safety. These substations will be brought up to the current standard in the 2015/2016 financial year.

The maintenance requirements for emergency lighting in zone substation buildings are specified in AS/NZS 2293.2 Emergency evacuation lighting for buildings – Inspection and maintenance (Reference 10).

The emergency and exit lighting at each urban zone substation is inspected every six months, as required by AS/NZS 2293.2. This work is scheduled at the same time at the visual inspections.

Fire extinguishers

Substation buildings can be deemed a class 8 building as part of the BCA and as a requirement of this the fire fighting system is required to comply with BCA Volume 1, Part E1 'Fire Fighting Equipment' (Reference 5).

To comply with the BCA, TasNetworks has fire extinguishers installed in all urban zone substations.

The requirements for the maintenance of fire extinguishers are set out in AS 1851 Maintenance of fire protection systems and equipment (Reference 5).

The fire extinguishers at each urban zone substation are inspected every six months, as required by AS 1851.

Panel and smoke detectors
Substation buildings can be deemed a class 8 building as part of the BCA. The installation of fire detection and alarm systems is governed by the requirements of the BCA Volume1 (Part E2 Smoke Hazard Management generally and in particular, with clause E2.2 and E2.3 regarding air handling, smoke detection and alarm, and special hazards of fire risk) (Reference 5).

The requirements for the maintenance of fire systems are set out in AS 1851 Maintenance of fire protection systems and equipment (Reference 5).

The fire panels and smoke detectors at each urban zone substation are inspected once per month and once per year respectively, as required by AS 1851.

East Hobart deluge system testing
The transformers at East Hobart Zone Substation are fully enclosed and so a deluge system was installed to enable fires to be extinguished in the event of a fire in a transformer enclosure.

The deluge system at East Hobart Zone Substation is maintained every 12 months as per the manufacturer's recommendation.

Table 8: Inspection and monitoring

Classification	Frequency
Visual and load checks	4 months (Based on manufacturers recommendations)
Confined space and asbestos	4 yearly
Oil testing	1 yearly
Thermal inspections	2 years
Urban zone substation fire system maintenance	Fire doors/Emergency lightning/extinguisher - 6 months Panels – monthly Smoke detectors – 1 yearly Deluge system – 1 yearly

7.3.2 Zone substation routine maintenance (RMZSR)

This work program consists of five components:

- Zone substation – Routine maintenance
  - Switchgear maintenance
  - Transformer tapchanger maintenance
  - Civil maintenance
- Zone substation – Earthing system injection testing
- Urban zone substation – Partial discharge testing
- Trial Harbour – 66 kV disconnector, fault throw switch minor maintenance

Each of these sub-programs is described in the following sections.

7.3.2.1 Switchgear maintenance

Switchgear maintenance is routinely undertaken to ensure that the equipment is maintained in a serviceable condition.

The switchgear maintenance is undertaken on a four year cycle for the oil filled switchgear and six year cycle for vacuum switchgear. The frequency is developed based on historical performance of the assets and manufacturer's recommendations. Oil filled switchgear only remains as part of the station services supply at four of the older substations.

In addition to maintenance activities, circuit breaker timing tests are also undertaken.

The aim of circuit breaker timing tests is to detect any developing issues in the mechanical tripping systems and provide an indication of the health of the unit.

These tests are conducted as part of the switchgear maintenance prior to the switchgear being taken out of service to enable the 'first trip' to be captured, as this provides the most useful information as to the condition of the circuit breaker timing.

Timing tests are currently performed by tripping and measuring total opening time via auxiliary contacts on the circuit breaker. If individual contacts are sticking, then performing a full timing test on individual phase primary contacts can be used to provide a more accurate indication of the health of the circuit breaker.

7.3.2.2 Tapchanger maintenance

Transformer on load tap-changer maintenance is undertaken every two years (Approximately 10 000 taps) to ensure that the transformer tap-changer and transformer are maintained in a serviceable condition.

Transformer tap changing equipment accounts for a substantial proportion of transformer failures. It is estimated within the industry that the annual cost ratio of preventative maintenance programs versus emergency maintenance and equipment replacement is 1:3.

The tap-changers maintenance frequency is in line with other distribution network service providers (DNSPs).

7.3.2.3 Civil maintenance

Third party damage and vandalism can be an issue with zone substation buildings and enclosures.

As parts of these sites are outdoors there are also issues with weed and vegetation growth that require ongoing attention.

To manage these issues a periodic civil maintenance program is in place to ensure the safety, cleanliness and security of the substations are maintained and to conduct maintenance tasks such as weed spraying, vermin control, painting and other minor building maintenance activities.

The civil maintenance is undertaken at each substation four times per year.

7.3.2.4 Zone substation – Earthing system injection testing

Testing of the earthing systems is undertaken every ten years to ensure that the integrity of the earthing system is maintained.

The earthing system of the zone substations is required to ensure personnel and public safety and the correct operation of protection equipment in the event of system faults and external events such as lightning.

Maintaining the earthing system is critical for ensuring public safety and for the correct operation of protection devices under fault conditions. Infrastructure connected to the zone substations is also reliant on the earthing system.

Earth potential rise (EPR) is the rise in voltage of earth (including all the metallic enclosures attached to earth) under fault conditions. This voltage rise can be hazardous to people and so minimisation of this voltage rise is critical.

Routine testing of the earthing system is required to ensure that these voltage rises are within the limits set in the Energy Networks Association (ENA), EG1-2006 Substation Earthing Guide (Reference 14). ENA also recommends a risk-based approach to earthing designs based on ENA EG-0 Power System Earthing Guide Part 1: Management Principles (Version 1) – May 2010 [15].

As TasNetworks does not have the capability to conduct this specialised testing external service providers are engaged to conduct these tests once every ten years

7.3.2.5 Urban zone substation – Partial discharge testing

Partial discharge testing is to undertaken on high voltage assets within the substations to detect levels of partial discharge within these assets. Partial discharge can be an indication of problems within the insulation and an indicator of an impending failure.

Partial discharge testing of the switchgear is conducted once every two years at each urban zone substation site. More frequent partial discharge testing may be required at particular sites in the event of abnormal test results.

This work is conducted at the same time as the thermal inspections (Refer Section 7.3.1).

7.3.2.6 Trial Harbour – 66 kV disconnector and fault throw switch minor maintenance

This routine maintenance is undertaken to ensure the equipment remains in a serviceable condition. The frequency and scope is undertaken in accordance with the manufacture's recommendations.

This work is currently performed by an external service provider.

Table 9: Routine maintenance frequencies

Classification	Frequency
Zone substation asset inspection (Visual, load check and condition monitoring)	Every 4 months
Switchgear maintenance	Oil filled – 4 yearly Vacuum – 6 yearly
Disconnector and fault throw switch maintenance (Trial Harbour)	2 yearly
On-load tapchanger maintenance	2 yearly (or 10 000 taps)
Partial discharge testing	2 yearly
Civil maintenance	Every 3 months
Earth system injection testing	10 yearly

7.4 Non routine maintenance (ARZSR)

7.4.1 Minor and major asset repairs

Defects identified through during asset inspections and routine maintenance or through other ad-hoc site visits or customer reports, are prioritised and rectified through the general asset defects management process and specifically identified maintenance programs.

7.5 Asset refurbishment/replacement

7.5.1 Replacement of high voltage circuit breakers (REUZS)

The metal-clad switchgear within urban zone substations is designed for indoor use and installed within building-type enclosures. The switchgear at all of the zones use air as the insulating medium.

At five of the older zones substations oil insulated switchgear was used in the switchboards. These circuit breakers have now all been replaced with modern air-insulated vacuum-interrupter switchgear. Arc fault containment doors and panels were also installed on the switchboards at this time to improve operator safety at the sites.

At Bellerive, Geilston Bay, Derwent Park and New Town zones oil filled switchgear (Statter) is still used to connect the HV bus of the main switchboard to the station service transformer.

Although there are currently no concerns with this switchgear as it is nearing end of life it will be replaced in the 2019/20 to 2023/34 regulatory period when the station service transformers are replaced.

7.5.2 Replace urban zone (Other) (REUZO)

At four of the older substations Bellerive, Geilston Bay, Derwent Park and New Town Zone the station services supply comes from the original transformer that was installed in the 1960s. As these transformers are used for critical supplies in the substation i.e. protection and control systems the transformers will be replaced prior to an in-service failure occurring. The schedule for their replacement is provided in Table 7.

Table 7: Replacement schedule of urban zone station services transformers

Site	Scheduled replacement year (Financial year)
Derwent Park	2019/20
Geilston Bay	2019/20
New Town	2021/22
Bellerive	2025/26

7.5.3 Replace urban zone transformers (REUZT)

Over thirty percent of the urban zone substation transformers are over fourty years old, with half of these having reached fifty years of age. Although oil testing indicates signs of deterioration, in general these transformers are in acceptable condition for their age.

A condition assessment of the older urban zone transformers in 2015 has revealed that the transformers at these older zones are approaching end of life due to their prolonged time in service and are in a deteriorated condition. Replacement of the transformers at these zones is planned to occur in next three to ten years. The replacement schedule is provided in table 7.

As transformers age and their internal condition deteriorates, they become noisier. At two of the older zone substations the increased transformer noise level has resulted in complaints from people in adjacent properties. Testing at these sites has indicated that they do not comply with the noise limits for a transformer of that size as per AS 2374 Part 6 1994: Power Transformers – Determination of Transformer and Reactor Sound level (reference 13).

At one of these substations a noise barrier has been installed to reduce the noise level down to an acceptable level.

Table 7: Replacement schedule of urban zone transformers

Site	Scheduled replacement year (Financial year)
Claremont	2018/19
Derwent Park	2020/21
Geilston Bay	2022/23
Bellerive	2023/24

Condition monitoring of the transformers will continue to occur to ensure that the replacement schedule is appropriate. If the condition of the transformers deteriorates at a faster rate, then replacement may occur sooner, and conversely if the condition remains stable then replacement may be deferred.

There is no strategic spare held for the urban zone transformers. If a transformer failure occurred at one of these zones then one of the transformers at Howrah Zone would be used for network support. The transformer from Howrah Zone would be relocated to the zone where the failure occurred. A replacement transformer would be procured at this time.

7.5.4 Replace rural zone transformers (RERZT)

A condition assessment of Gretna, New Norfolk and Richmond was undertaken in early 2015 and it determined that the assets at these sites are nearing end of life. The assessment also identified non-compliances at the site and hazards that had the presented a safety risk for both personnel and members of the public if unauthorised site entry occurred.

Due to the criticality of the sites a replacement program has been developed to refurbish the sites and undertake asset replacement prior to asset failure occurring. Table 8 provides the scheduled replacement dates for the refurbishments at Gretna, New Norfolk and Richmond zones.

Table 8: Rural zone substation refurbishment/replacement schedule

Site	Action	Scheduled replacement year
New Norfolk	Replace substation	2016/17 to 2017/18
Richmond	Refurbish substation	2017/18 to 2018/19
Gretna	Refurbish substation	2019/20 to 2020/21

Condition monitoring of the assets at these sites will continue to occur to ensure that the replacement schedule is appropriate. If the condition of the assets deteriorates at a faster rate, then asset replacement may be brought forward.

A spare 22/11 2.5MVA transformer is held to accommodate a transformer failure in a rural zone.

7.6 Investment evaluation

Where investment is required to achieve compliance with TasNetworks' business objectives an options analysis is undertaken to determine the most appropriate solution.

Economic analysis is undertaken using TasNetworks' investment evaluation tool.

7.7 Spares management

Strategic spares for zone substations are managed in accordance with the Spares Management Strategy[1].

7.8 Disposal plan

Materials that pose a risk to human health as well as being a possible environmental hazard are disposed of in accordance with the Environmental Management Pollution Control Act 1994, TasNetworks' internal safety and environmental management plan and ANZECC.

7.9 Summary of programs

Table provides a summary of all of the programs described in this management plan.

Table 9: Summary of zone substation programs

Work program	Work category	Project/Program
Routine maintenance	Zone substation inspection and monitoring (AIZSM)	Asset Inspection (Visual, load check and condition monitoring)
		Urban zone substations – Fire system maintenance
	Zone substation routine maintenance (RMZSR)	Zone substation – Routine maintenance (Switchgear, tap changer, civil Maintenance)
		Urban zone substations – Partial discharge testing
		Zone substation – Earth system injection testing
		Trial Harbour – 66 kV disconnector and fault throw switch minor maintenance
Non-routine maintenance	Zone substation asset repair (ARZSR)	Minor and major asset repairs
Reliability and quality maintained	Replace urban zone switchgear (REUZS)	Replace urban/CBD zone substation switchgear
	Replace urban zone transformers (REUZT)	Replace urban zone transformers
	Replace rural zone transformers (RERZT)	Replace rural zone transformers
	Replace rural zones other (RERZO)	Replace rural zones other
Regulatory obligations	Replace urban/CBD zones (Other) (REUZQ)	Replace zone substation equipment (Safety)

[1] Spares management strategy – Distribution substations R247679

8. Program delivery

TasNetworks' makes a concerted effort to prepare a considered deliverability strategy based on the planned operational and capital programs of work for distribution network assets. A number of factors contribute to the successful delivery of the program of work. These factors are utilised as inputs to prioritise and optimise the program of work and to ensure sustainable and efficient delivery is maintained. This program of work prioritisation and optimisation can impact delivery of individual work programs in favour of delivery of other programs. Factors considered include:

- Customer-driven work we must address under the National Electricity Customer Framework (NECF).
- Priority defects identified through inspection and routine maintenance activities.
- Identified asset risks as they relate to safety, the environment and the reliability of the electrical system.
- Adverse impacts of severe storms and bushfire events.
- System outage constraints.
- Changes to individual project or program delivery strategy.
- Size and capability of its workforce.
- Support from external contract resources and supplementary service provision.
- Long lead equipment and materials issues.
- Resolution of specific technical and functional requirement issues.
- Complex design/construct projects with long lead times.
- Approvals, land acquisition or wayleaves.
- Access issues.

Specific to zone substations asset management plan, these factors have had minimal impact on the delivery of the operational programs of work, but have resulted in delayed delivery of the capital programs of work.

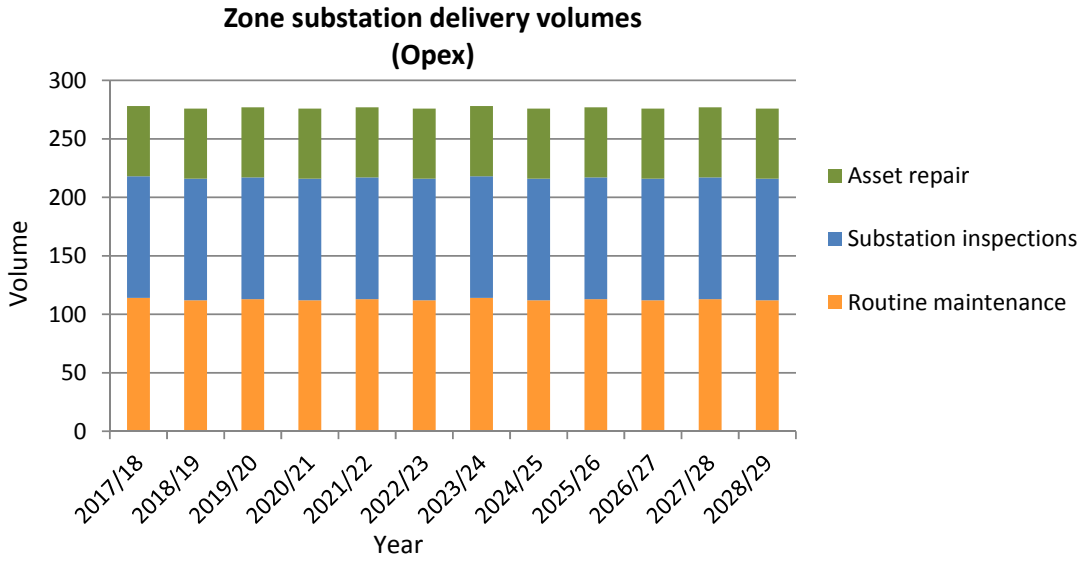
8.1 Proposed Opex plan

The operational programs identified in this management plan are necessary to manage the operational and safety risks and maintain network reliability in compliance with business objectives.

TasNetworks is satisfied that its current practices are meeting business requirements. In-service failures are rare and the assets are achieving and exceeding their expected service life.

Due to the critical nature of these assets and the need to ensure their reliable operation the current routine maintenance programs will continue at their current frequency.

Figure 7: Total Opex delivery volumes, with forecast to the 2028/29 financial year



8.2 Proposed Capex delivery plan

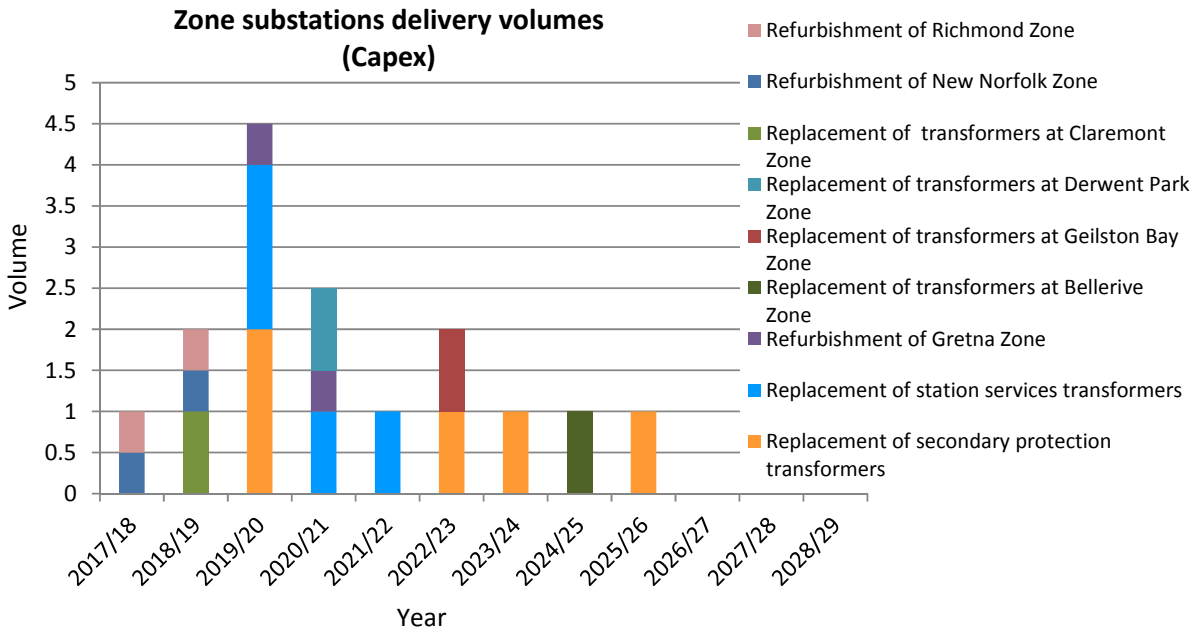
The capital programs and expenditure identified in this management plan are necessary to manage operational and safety risks and maintain network reliably in compliance with business objectives. All capital expenditure is prioritised based on current condition data, field failure rates and prudent risk management.

The significant future capital expenditure is provided in Table 10.

Table 10: Significant capital expenditure from 2017/18 to 2025/26

Zone	Scheduled replacement year	Scheduled replacement year
New Norfolk	Refurbishment of substation	2016/17 to 2017/18
Richmond	Refurbishment of substation	2017/18 to 2018/19
Claremont	Replacement of power transformers	2018/19
Gretna	Refurbishment of substation	2019/20 to 2020/21
Derwent Park	Replacement of power transformers	2020/21
Geilston Bay	Replacement of power transformers (Includes final section of oil filled sub-transmission cable)	2022/23
Bellerive	Replacement of power transformers	2024/25
Various urban zones	Replacement of secondary protection transformers	2019/20 to 2025/26

Figure 8: Total Capex delivery volumes, with forecast to the 2028/29 financial year



8.2.1 Capex - Opex trade offs

The operating expenditure programs are essential for identifying assets that require replacement for condition-based reasons. An example of this is the routine oil testing of zone substation transformers to detect signs of ageing and deterioration of the transformer oil. The results of the oil test can be used to monitor the condition of the transformer and identify when capital expenditure is required.

There is a positive relationship between these two categories in that regular inspection programs gather continuous condition information of the assets to better target asset replacements and identify any asset trends. Maintenance and repair activities also defer the requirement for capital expenditure and increase the likelihood of achieving a reasonable service life from the asset.

9. Responsibilities

Maintenance and implementation of this management plan is the responsibility of the Asset Strategy team.

Approval of this management plan is the responsibility of the Asset Strategy Team Leader.

10. Related standards and documentation

The following documents have been used to either in the development of this management plan, or provide supporting information to it:

1. TasNetworks Strategic Asset Management Plan (R248812)
2. AS 2067: Substation and high voltage installations exceeding 1kV a.c.
3. AS1940: The storage and handling of flammable and combustible liquids, Appendix H
4. Building Code of Australia
5. AS 1851 Maintenance of fire protection system and equipment
6. AS/NZS 2293.2 Emergency evacuation lighting for buildings – Inspection and maintenance
7. Workplace Standards Tasmania: How to Manage and Control Asbestos in the Workplace, Code of Practice 2012.
8. AS/NZS 2293.2 Emergency evacuation lighting for buildings – Inspection and maintenance
9. Oil Data Analysis (R237031)
10. Work Health and Safety Act and Regulations 2012
11. Energy Networks Association EG1-2006 Substation Earthing Guide
12. Energy Networks Association EG-0 Power System Earthing Guide Part 1: Management Principles (Version 1) – May 2010
13. AS 2374 Part 6 1994: Power Transformers – Determination of Transformer and Reactor Sound levels