Asset Management Plan

Substation Site Infrastructure

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Authorisations

Action	Name and title	Date
Prepared by	Michael Verrier – Senior Asset Strategy Engineer	25/10/2017
Reviewed by	Greg Hall – Senior Asset Strategy Engineer	30/10/2017
Authorised by	Darryl Munro - Asset Strategy Team Leader	01/11/2017
Review cycle	2.5 Years	

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").

The approval of this document is the responsibility of the General Manager, Strategic Asset Management.

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

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

Record of revisions

Section number	Details
All sections	*General update for R19 submission and to align with latest TasNetworks AMP template*

Table of Contents

1 Purpose

The purpose of this asset management plan is to define the management strategy relating specifically to substation site infrastructure. 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; and
- Forecast CAPEX and OPEX, including the basis upon which these forecasts are derived.

2 Scope

This document covers all substation switchyards and building site infrastructure applicable to transmission related assets. It includes switchyards, roads, fences, buildings, drainage and oil containment and security systems for a ten year rolling period. TasNetworks transmission infrastructure includes 49 substations, six switching stations and three transition sites. The objective of this plan is to maintain business risk to within acceptable limits by achieving reliable asset performance at minimal life-cycle cost.

The strategies included in this asset management plan have been developed taking into account past asset performance, good electricity industry practice and the need for prudent investment to minimise life cycle costs.

Whilst substation site infrastructure assets typically have a long life span and are relatively static in terms of maintenance needs, they perform a critical role in the protection and facilitation of transmission system electrical infrastructure.

The term used to describe substation infrastructure and facilities will be referred to as 'substation site infrastructure' in this document.

3 Strategic Alignment and Objectives

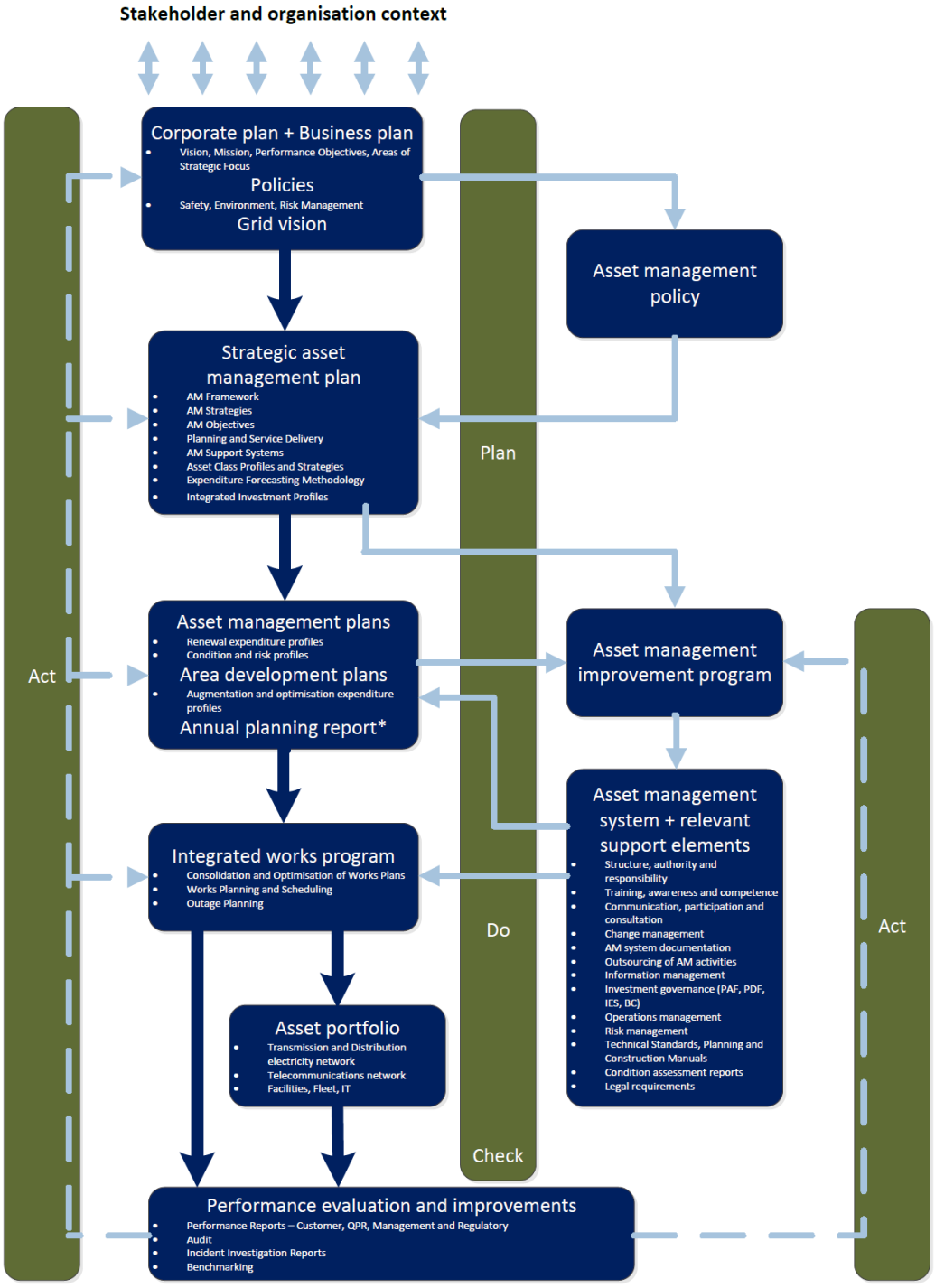
This asset management plan has been developed to align with both TasNetworks' Asset Management Policy and Strategic Objectives. This management plan describes the asset management strategies and programs developed to manage substation site infrastructure, with the aim of achieving these objectives.

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

The asset management policy and strategic objectives are outlined within the Strategic Asset Management Plan. Figure 1, from the Strategic Asset Management Plan, 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.

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 Information Systems

4.1 Systems

TasNetworks maintains an Asset Management Information System (AMIS) that contains detailed information relating to the substation switchyard and building assets. AMIS is a combination of processes, technology and people applied to provide the essential outputs for effective asset management, such as:

- Reduced risk;
- Enhanced transmission system performance;
- Enhanced compliance, effective knowledge management;
- Effective resources management; and
- Optimum infrastructure investment.

It is a tool that interlinks asset management processes through the entire asset life cycle and provides a robust platform for extraction of relevant asset information.

Substation site infrastructure asset classes were only recently created within AMIS. Data is yet to be collated. As a result, detailed asset information and condition is not readily available. TasNetworks plans to add all substation site infrastructure data within the next two years.

A number of AMIS standards provide additional information relevant to substation site infrastructure. These are all available through TasNetworks AMIS intranet site.

4.1.1 AM8 Condition data

An initiative within the Asset Performance and Strategy team was completed in 2016 to review key asset condition and maintenance regimes to assess their capability for asset condition being the basis for setting spending priorities. This initiative was referred to as AM8.

Condition based assessments provide a quantitative means to assess asset condition, their risk and failure probabilities and a basis to justify mitigation measures. Condition assessments are used to produce risk indices for assets and / or asset classes and provide a basis for asset expenditures.

Condition data is gathered through asset inspection and maintenance activities and is used along with defect, failure and performance data to formulate asset management strategies. Condition assessment relies on asset knowledge capable of being modelled using numerical analysis.

A number of observations were concluded as part of the review including the need to obtain condition data consistently across all asset types and in electronic form. The need for storage and collection would align with other business initiatives such as the AJILIS project.

5 Description of the Assets

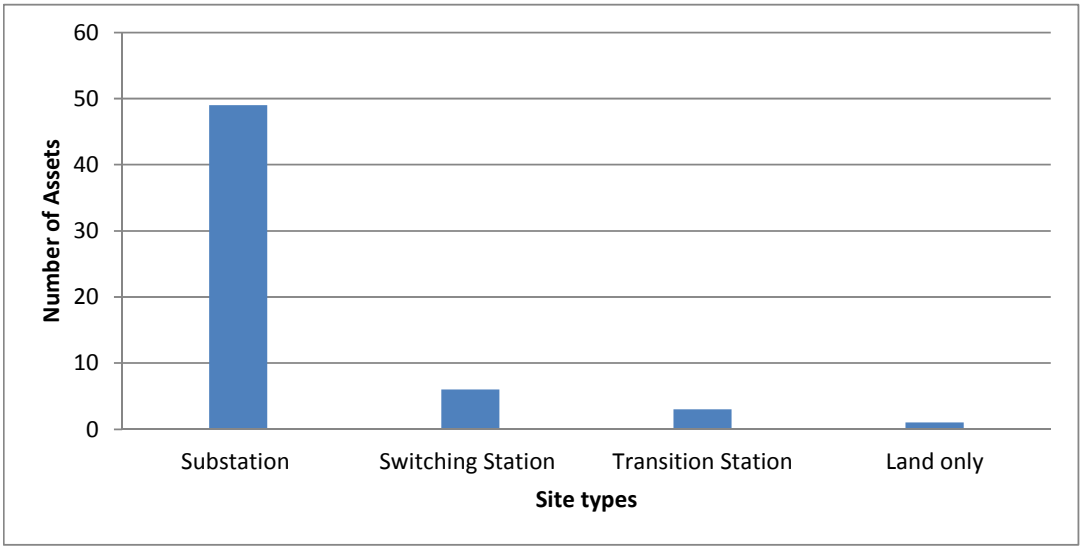
5.1 General

TasNetworks owns and manages 49 substations, six switching station sites and three transition stations.

TasNetworks sites can be defined by their use.

- Land only – vacant sites that are owned by TasNetworks for future development.
- Substation sites – sites that supply customers and typically contain power transformers.
- Switching stations – sites that contain switchgear to interconnect the network but do not supply customers directly.
- Transition stations – sites that contain equipment to transition from an overhead transmission line to an underground cable.

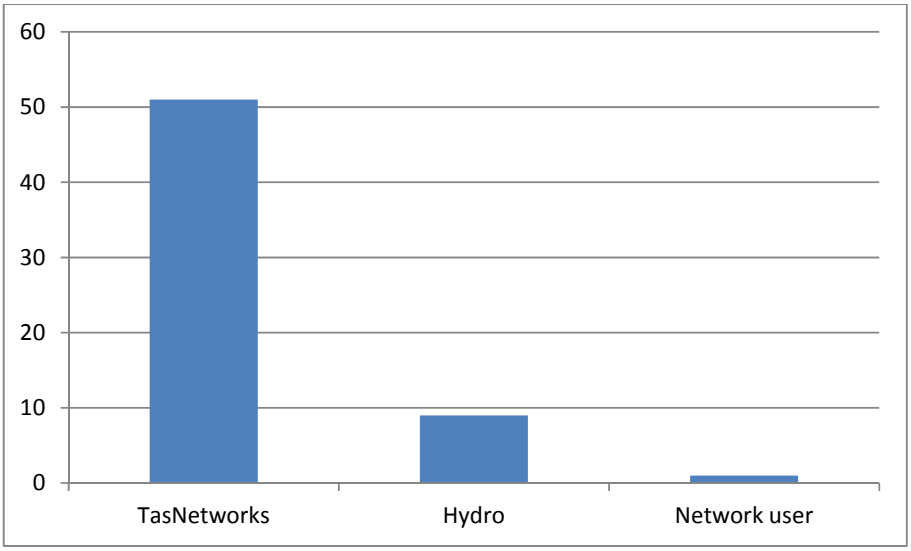
Figure 2 – Substation site types (as at October 2016)



Site infrastructure and facilities are designed to provide a safe and secure environment for the permanent installation of electrical equipment and establish the physical environment in which electrical assets can be effectively, efficiently and economically managed.

Some TasNetworks owned and operated sites share common infrastructure with other connected customers. Figure 3 shows how the 58 sites are shared and with whom.

Figure 3 – Number of sites shared with customers or wholly TasNetworks occupied



Substation site infrastructure assets typically have an economic asset life of 60 years. The substation site infrastructure can be divided into several main categories, consisting of:

- The site itself;
- Buildings located onsite;
- The switchyards contained onsite;
- Roadways on and into the site;
- Site security;
- Electrical components; and
- Oil containment systems.

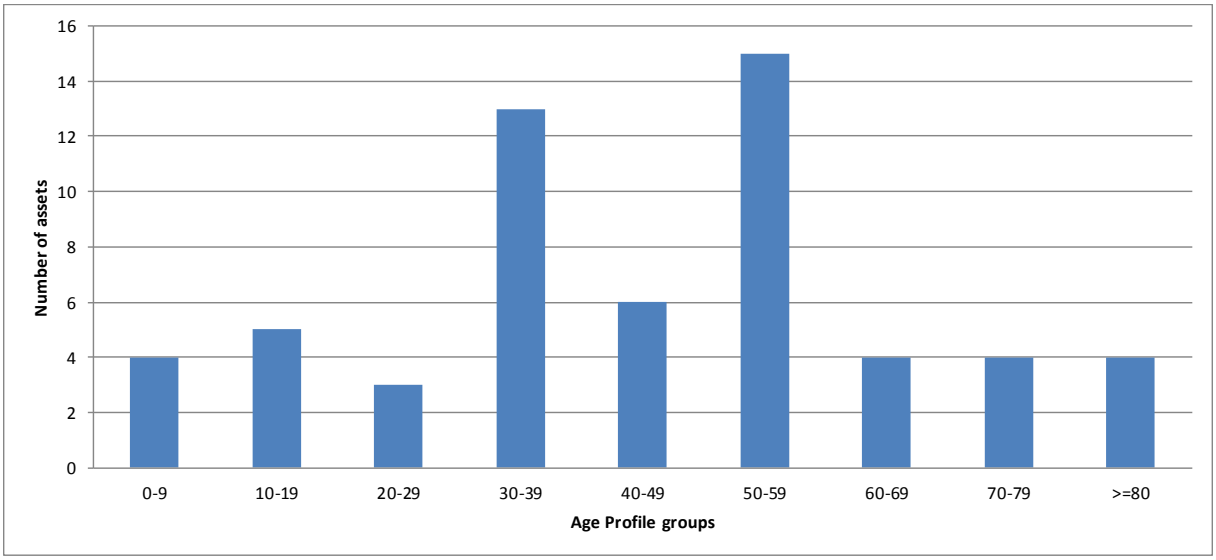
Electrical components are included within their own asset management plan.

5.2 Sites

5.2.1 Age

The average age of TasNetworks owned substation sites, from initial establishment is 46 years. Figure 4 presents the age profile of substation sites.

Figure 4 – TasNetworks owned substation age profile from initial establishment (as at October 2017)



5.2.2 Usage

TasNetworks owns vacant parcels of land at Bothwell and Mount Nelson, which may be used for future substation location.

George Town and Rokeby transition stations house a transition from overhead to cable network.

Other than the vacant site, all of the sites provide a restricted area where electrical energy is generated, converted, transmitted, transformed or switched.

In addition these sites provide a geographical and strategic location for the operation and control of TasNetworks electrical transmission grid in Tasmania, inclusive of an interconnection link with the Australian national electricity market. Such nodes therefore provide the necessary infrastructure and facilities for the safe and secure installation and operation of electrical primary plant and control gear.

5.2.3 Location

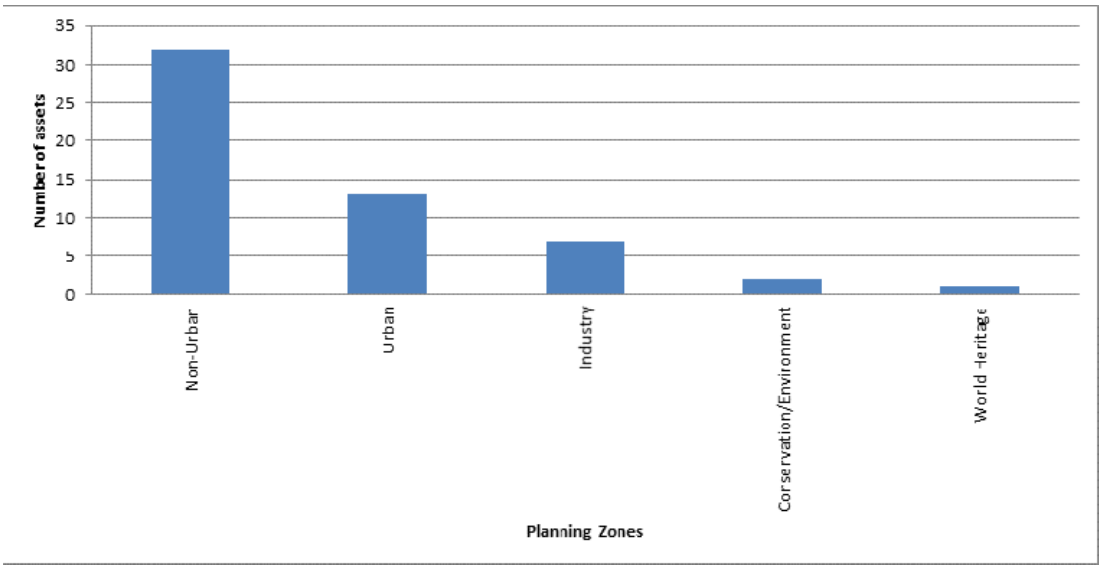
TasNetworks substation sites can be broken down into the types of locations they are installed and what the site is used for.

TasNetworks substations are located in five location types:

1. Conservation/Environment zones include National parks or other environmentally sensitive areas.
2. Industry zones include substations located within or close to heavy industry.
3. Non-urban zones are rural or semi-rural areas that are not considered to have high levels of environmental protection.
4. Urban zones are areas with a high percentage of residential population.

5. World heritage zones are those areas officially listed as World Heritage by the United Nations.

Figure 5 – TasNetworks owned sites by zone type



5.2.4 Selection Criteria

In selecting sites, TasNetworks will normally try to retain full site ownership to ensure that future site needs and management responsibilities are clearly defined.

In addition, the selected site will ideally be free of other infrastructure such as water and gas mains, again to reduce the likelihood of future conflict between utilities.

The identification and selection of a new substation site is normally undertaken with a view to optimising:

- Customer needs;
- Cost;
- Engineering;
- Performance;
- Ongoing maintenance needs;
- Constructability;
- Accessibility;
- Planning, including,
  - Ease of obtaining development approval
  - Land use zoning
- Environment, including
  - Vegetation clearing
  - Protected and threatened species
  - Water courses
- Heritage, including
  - Effect on residential areas
  - Road/rail crossings

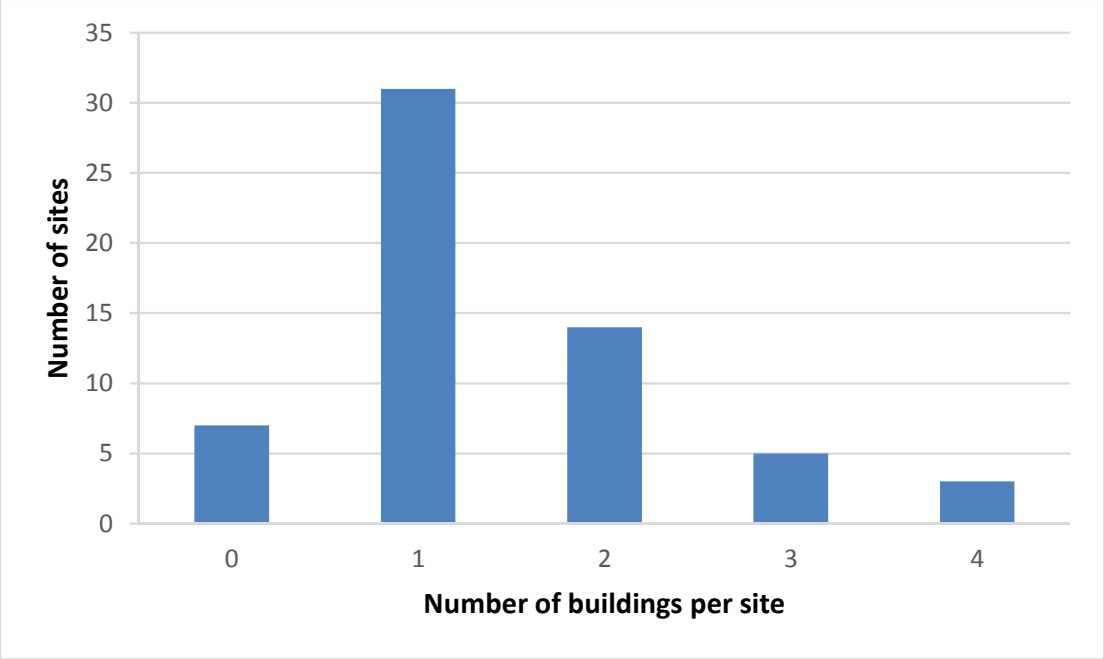
- High amenities areas
- Aboriginal and European heritage

5.3 Buildings

TasNetworks substation buildings normally contain switchgear and protection and control equipment. They are specified and built primarily considering fire and intruder protection whilst aiming to create an environment which prolongs the life of the contained electrical equipment.

TasNetworks owns 86 different substation buildings. Of the 86 buildings, 13 are multi story buildings. Figure 6 shows the number of sites broken down by number of buildings on site.

Figure 6 – Number of sites by number of buildings per site



5.3.1 Construction

Substation buildings are constructed using masonry or precast concrete, with steel trussed colour bond roofs. Windows are not normally installed due to fire rating requirements.

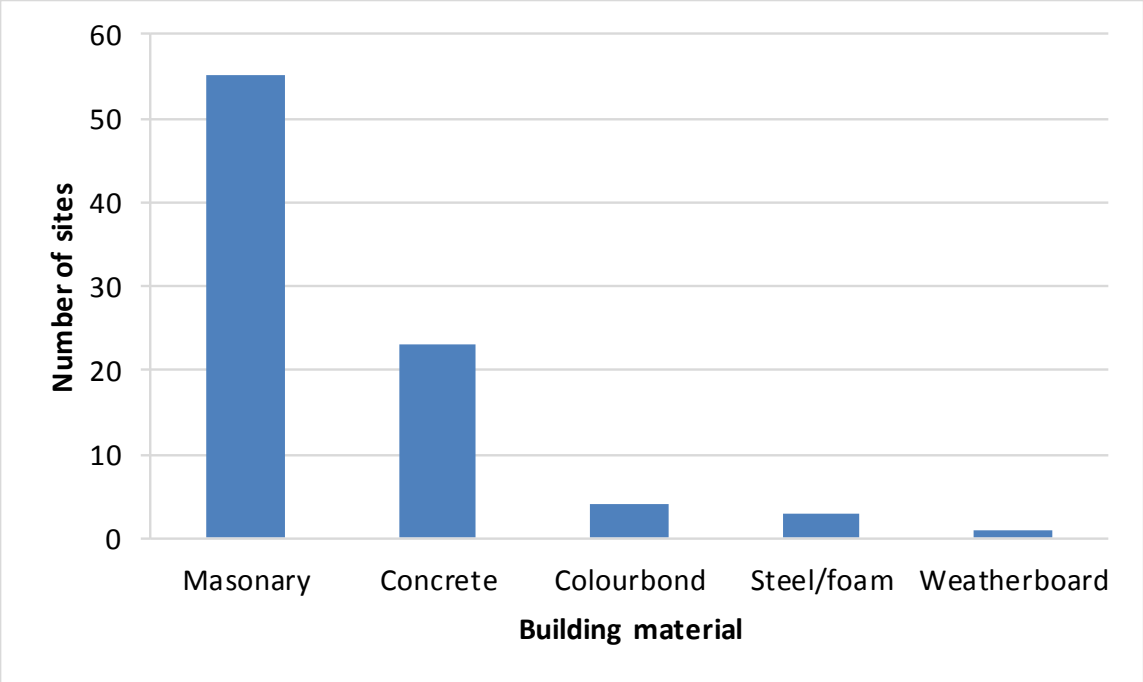
The building location and materials are selected to prevent external fires from affecting the internal equipment and to prevent an internal fire from spreading around the building. In addition the building construction will prevent or limit any unauthorised access such as vandalism or burglary within the building.

The buildings are also designed and constructed to try to prevent moisture ingress through cable conduits and other penetrations.

Buildings are also typically fitted with a small lavatory for use by onsite personnel. Other rooms such as crib and meeting rooms are not normally included in new installations.

The following chart shows the main construction material for the population of buildings.

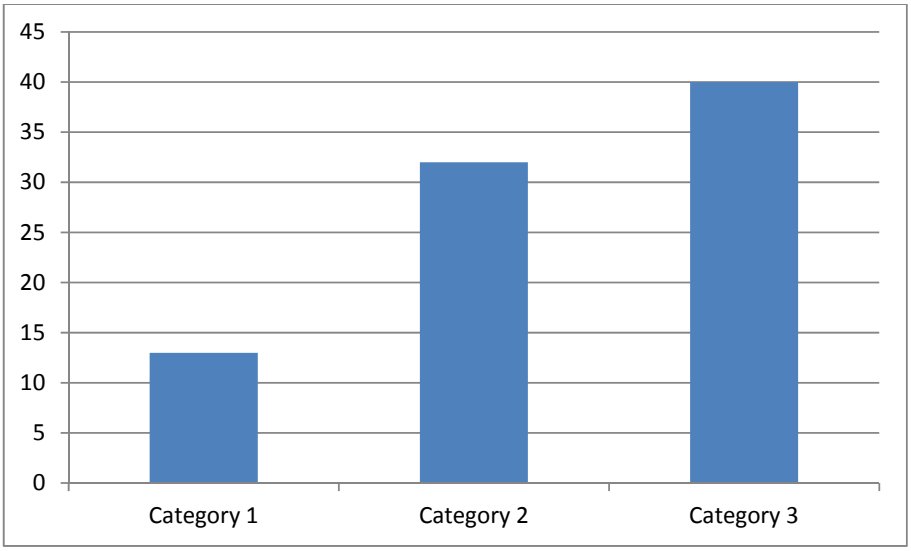
Figure 7 – Number of buildings by construction



TasNetworks fleet of substation building can be broadly grouped into three main categories.

- Category 1 – Multistorey, double brick construction with glass windows built prior to 1970.
- Category 2 – Single storey brick construction, windowless, flat roofed, built between 1970 and 1990.
- Category 3 – Single storey concrete based construction, windowless, trussed roofed built since 1990.

Figure 8 – Number of buildings by category allocation



5.3.2 Fire systems

The design of fire systems in substation buildings has been historically difficult in Australia. The Building Code of Australia (BCA) provides a nationally accepted and uniform set of technical requirements for all areas of building, from design to construction for both residential and commercial buildings. It covers such topics as structure, fire resistance, health and amenity, building access and egress and building services and equipment.

The BCA defines 10 different classes of building, and specifies different design requirements for each. Substation buildings did not easily fit into any of these classes.

In 2012, TasNetworks developed a comprehensive fire management strategy for substations as a whole. The Substation Fire Management Strategy identifies the fire prevention and loss management techniques and systems that should be used in the future.

TasNetworks has standardised on the use of Very Early Smoke Detection Apparatus (VESDA) for fire detection within substation buildings. The VESDA systems are connected to a local fire indication panel which then sends all fire alarms back to TasNetworks network control centre, which is permanently manned.

An outcome from the fire management strategy was to further investigate the implementation of a fire suppression/prevention system at strategic high-risk substations. TasNetworks commenced a program in the 2014-19 regulatory period to install major fire suppression systems into strategic locations. At present the following stations have a Hypoxic system installed.

- Burnie,
- Chapel St,
- Creek Rd,
- Liapootah, and
- Lindisfarne

The effectiveness of these installation is currently being reviewed.

5.3.3 Climate Control

TasNetworks also specifies other building fittings and systems such as climate control for the stabilisation of temperature and humidity to maximise life and operation of electrical equipment and for onsite personnel comfort.

5.3.4 Lighting

Standard AC lighting and emergency lighting is covered by the BCA, but TasNetworks also specifies other lighting systems to be installed which are not interrupted by the loss of AC supply to the station.

5.4 Switchyards

5.4.1 Surface

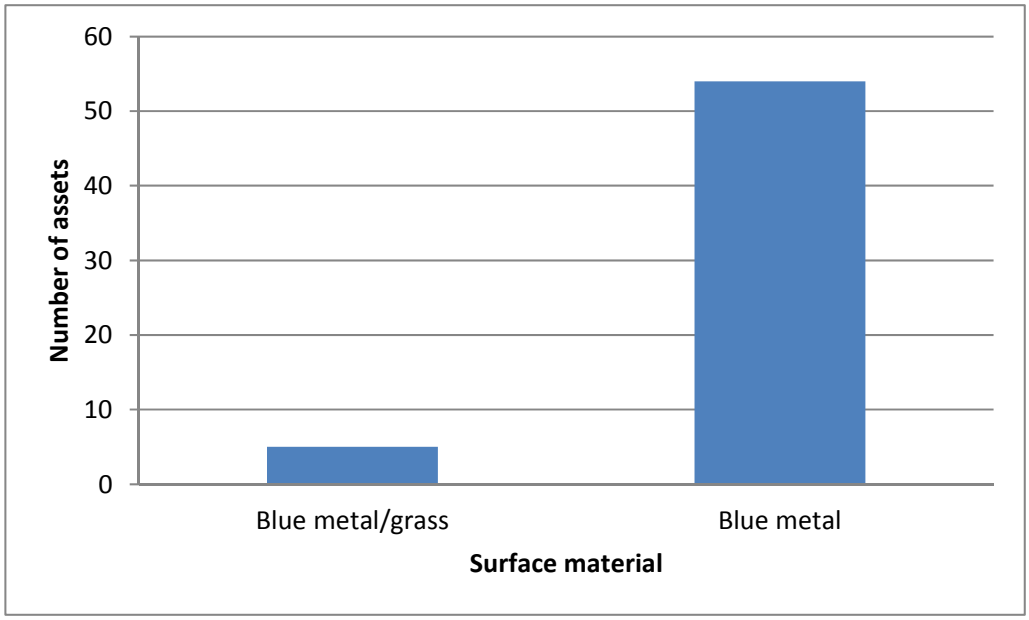
The switchyard basically consist of the land inside the substation fence. Most switchyard surfaces consist of a combination of concrete, bitumen or gravelled roadways and the remainder of the switchyard is gravelled with crushed rock.

A number of substations that were constructed in the 1950s and 60s maintained grass as the switchyard surface. This poses a small fire threat during summer and require ongoing care and maintenance such as mowing. In addition to the fire risk, vegetation growth reduces the

effectiveness of surface insulation for earthing performance and can result in potential hazards above the designed safety limits.

All new substations use blue stone aggregate as the switchyard surface to increase the substation earthing performance and to reduce ongoing mowing and fire risk.

Figure 9 – Number of switchyards by surface covering



Switchyard layouts and designs typically maximise future expansion capability and provide space for ongoing maintenance activities such as manoeuvring of vehicles and cranes.

5.5 Roads

5.5.1 Access Roads

TasNetworks specifies the vehicle axle loadings and expected number of vehicle movements which apply to all TasNetworks owned roads.

Roadways into substations are ideally constructed with a suitable road base and sealed. Often though, the cost of sealing is prohibitive, and roads are left unsealed.

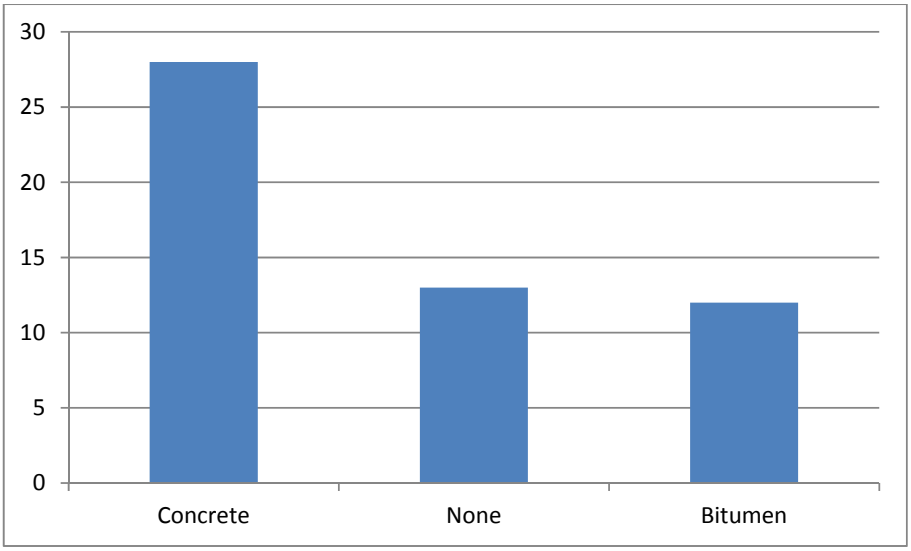
Roadways within substations are used to provide maintenance and construction vehicle access. Modern substations are installed with sealed roadways.

5.5.2 Transformer Tracks

TasNetworks specifies the use of concrete transformer tracks and aprons where heavy vehicles and lifting equipment will be used when power transformers are moved. The transformer track is designed for significantly higher point and axle loads when compared to other roadways.

Bitumen based transformer tracks are unlikely to withstand the loading and vehicle movements associated with transformer transportation and construction.

Figure 10 – Number of transformer tracks by construction



5.6 Site Security

5.6.1 Fences

TasNetworks typically specifies the use of weld mesh fencing, complete with concrete plinths and barbed wire cranks.

In all cases, fencing is installed considering the future possible installation of electronic security systems.

TasNetworks has also introduced non-lethal electrical fences at all substation sites except switching and transition substations. Such electric fence installations are aimed at mitigating the security risks associated with critical electrical infrastructure.

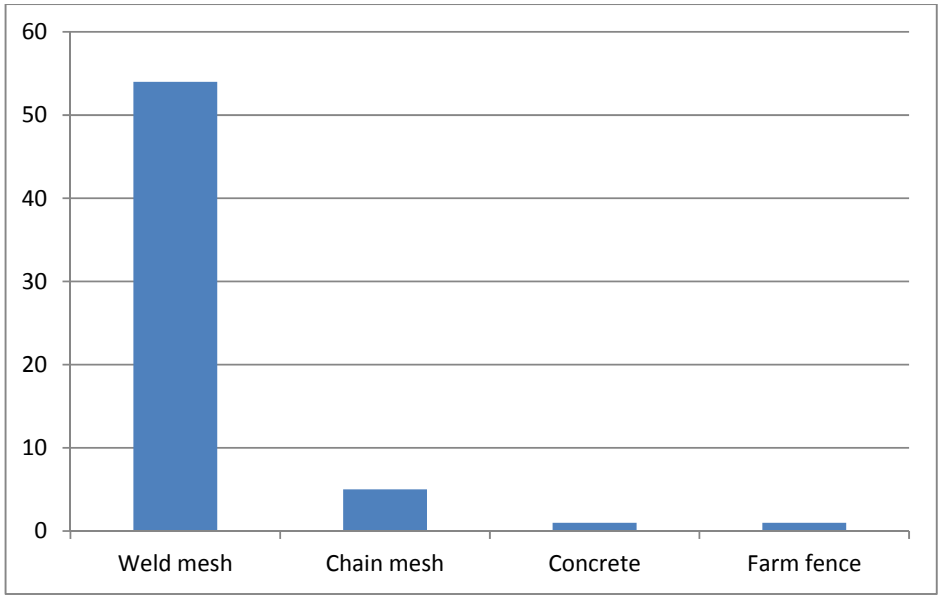
The electric fence is powered and controlled by a Gallagher/Cardax Power Fence Trophy FT energiser. These are generally located in external field cabinets located around the security fence perimeter. There are a small number of energisers internal to the control building, these are mounted in steel cabinets and located such that minimum electric fence lead out cable runs internally.

The external energisers communicate with the Electric Fence Keypad (also known as the Power Fence Remote Access Terminal (RAT)) and the Cardax controller, both located in the Electronic Security Cubicle (ECS), via the Local Area Network. The Cardax controller also controls operation of the security lighting.

The electric fence itself is a Gallagher Power Fence.

Security fencing is provided to all sites and the types of fences installed are shown in the following figure.

Figure 11 – Site security fencing type

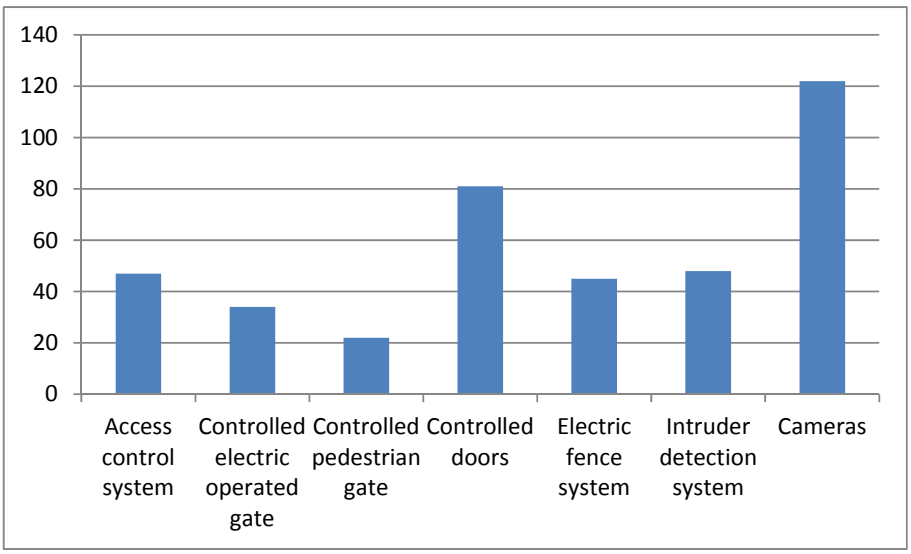


5.6.2 Electronic Security

The Substation Security System installed to protect TasNetworks substation site infrastructure can be broken down into a number of subsystems. The subsystems installed at each site are selected based upon a risk assessment. A summary of the systems installed is shown in Appendix B – Security major components by site.

Electronic security is provided to all sites and the types of components installed are shown in the following figure.

Figure 12 – Electronic security component type



For the electronic security components, the equipment supplied is specified to achieve the following design lives:

- Electric security fencing: 15 years;
- Access control systems: 10 years;
- Intruder detection systems: 10 years;
- Visual monitoring systems: 5 years.

TasNetworks specifies the majority of its site infrastructure requirements in the Substation Civil Design and Construction Standard, D01/7216. The main items required by the standard are outlined in the following sections.

The substation security system was installed by BAE Systems Australia in accordance with TasNetworks Substation Security Standard during 2010. The security system consists of the following components:

- Central Security Controllers (CSC);
- Electronic Security Cubicles (ESC);
- Access Control subsystem and devices;
- In Building Intruder detection subsystem and devices;
- Electric Fencing and Security Lightning Control Subsystem and devices;
- Visual Monitoring and Public Announcement Subsystem and devices; and
- Telecommunications Network Interface.

Not all subsystems have been installed at every substation site. However, the Substation Security System is capable of monitoring all of TasNetworks operational sites, some of which include multiple buildings, and can be expanded to include all subsystems at every site as required.

TasNetworks will specify the various components of the security system using a risk based approach in line with:

- The ENA (Energy Networks Association) “National guidelines for prevention of unauthorised access to electricity infrastructure”;
- A business continuity risk assessment in accordance with TasNetworks Business Impact Assessment; and

- Security fence condition and building intruder resistance audits.

5.6.3 Electronic Security Cubicle

The Electronic Security Cubicle (ECS) is the cabinet that contains the control equipment for the subsystems that are provided at each substation, and are located within the control room. Apart from the subsystem equipment the ECS contains the inverter power supply, and may also contain a modem switch, ethernet switch and some of the Local Area Network equipment which is used to communicate with the remote / field devices.

5.6.4 Central Security Controller

The Central Security Controller (CSC) consists of two Dell Servers and a number of software packages that provide the overall functionality of the CSC.

5.6.5 Intruder Detection Subsystem

The BAE Systems implementation of TasNetworks Substation Security System includes an integrated Access Control and In-building Intruder Detection subsystem; this is the Cardax FT 3000 Controller, together with the Access Control Keypad and any access control expansion ports which are housed in the ESC.

The Cardax controller is a microprocessor based system containing firmware which requires updates from time to time. The Cardax firmware is updated over the network from the CSC whenever an upgrade of the Cardax Command Centre is undertaken. This is covered under the Software Support agreements in place for Cardax.

External to the ESC, the Access Control and Intruder Detection system also includes:

- Access Card Readers and interface devices;
- Door and Gate controls;
- Intruder Detection devices (PIRs);
- Sirens; and
- Power supplies

5.6.6 Visual Monitoring and Public Announcements Systems

The Visual Monitoring subsystem, which is located in the ESC, is a Network Video Recorder (NVR). Also located in the ESC are the Digital Message Announcer and Amplifier.

The NVR comprises a Dell server and software that provides the functionality of the Visual Monitoring system.

An unrestricted Software Access Agreement for the visual monitoring system is in place.

As with all IT equipment, the NVR server should be updated periodically as part of the subsystem replacement program.

External to the ESC, the Visual Monitoring and Public Announcement System also includes:

- Cameras, camera bases and video encoders; and
- Power Supplies.

5.6.7 Telecommunications Network Interface

The primary telecommunications network configuration was chosen to optimise the available bandwidth into each of the sites. The typical applications categorised by the telecommunications service data interface were:

- 64 kb/s interface – Access control, intruder detection, occasional single view camera use and other*;
- 128 kb/s interface – Access control, intruder detection, predominantly single camera view, but occasional simultaneous multi camera view (up to 2 cameras) and other*; and
- 256 kb/s interface – Access control, intruder detection, simultaneous multi camera view (up to 4 cameras) and other*;

Note*: 'other' includes any background tasks that may be required including but not limited to system alarm monitoring, remote system configuration, housekeeping, and remote diagnostics.

The primary telecommunications network is a Layer 2 Virtual Private Network telecommunications service. Each site was provided with a nominated committed data rate interface which was initially 64 kb/s, 128 kb/s or 256 kb/s for sites. Each of the two central sites operates with a minimum committed data rate interface of 100 Mb/s.

Dial-up access is required for some sites where the primary telecommunications network is not provided. The typical application of the dial-up PSTN telephone line to sites shall be for access control, intruder detection, occasional single view camera use and includes any background tasks that may be required including system alarm monitoring, remote system configuration, housekeeping, and remote diagnostics.

The telephone line is a shared line with an existing voice/fax service to the site. The telephone line may be a private PABX network line or a Telstra telephone line. Modem equipment and line sharing devices are used to discriminate between a security system call into the site and the other uses including a normal voice/fax call.

All dial-up PSTN telephone line sites are capable of working over the primary telecommunications network and TasNetworks wide area IP network, if this is required in the future.

5.7 Oil Containment

TasNetworks installs oil containment systems to limit impact of oil spills emanating from power transformers. Fire separation walls, bunds, flame traps and interconnecting pipework are all constructed from concrete and steel. The systems are then connected to an oil/water separator tank which is large enough to contain the oil spiltlfrom the largest single unit (+10%) on site.

5.7.1 Bunds

TasNetworks has 51 separate transformer bund installations. Of these, 50 are constructed from concrete.

One installation, at St Marys Substation, still uses a Hypalon system. The Hypalon system is a temporary layer of chlorosulphonated polyethylene sheeting laid in a transformer bund. In the event of an oil spill, the Hypalon system directs the oil to an oil containment system at the substation and not through the porous bund floor or wall.

The Hypalon system was installed during 1997 and 1998 as a risk mitigation measure to defer higher capital expenditure. Since then, all but St Marys Hypalon systems have been replaced with permanent concrete systems.

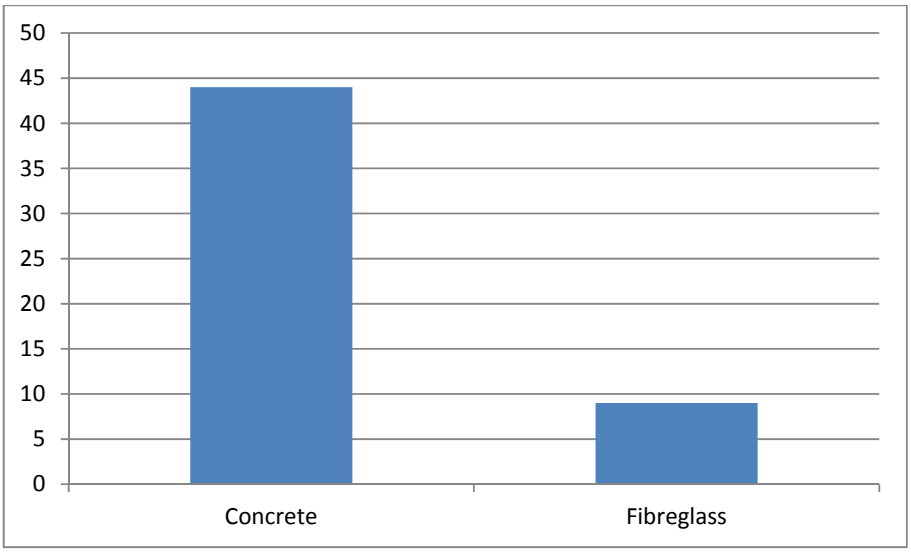
5.7.2 Tanks

In the late 1990s, TasNetworks commenced a major upgrade program to install oil containment systems to all power transformers. All sites were installed with concrete tanks to provide oil and water separation capability.

In the past five years, TasNetworks has standardised on the use of precast fibreglass 'Puraceptor' type oil containment tanks. The tanks are not porous like concrete and include a coalescent filter to meet the discharge requirements of Environmental Protection Act (10 ppm hydrocarbons). The tank and filter are type tested.

The following figure shows the breakdown of fibreglass to concrete tanks.

Figure 13 – Oil containment tank construction material



5.8 Cranes

TasNetworks maintains four operating overhead gantry cranes that are capable of major equipment works. The cranes are located within the high bays at Palmerston, Risdon, Trevallyn and Creek Road Substations.

Un-used cranes are located within the high bay at Chapel Street, Emu Bay and Boyer Substations; however they are no longer fit for service. They will remain in situ until no longer safe or suitable building modifications are undertaken to allow the removal.

6 Standard of Service

6.1 Technical Standards

To address potential design issues, TasNetworks has developed a comprehensive, prescriptive standard specification for the design of substation components. The specification requirements vary in detail and have been developed to clarify the specific needs TasNetworks requires for each component. The specifications have been aligned for compliance with Australian and international standards.

6.2 Performance Objectives

To mitigate the risk of inadequate quality control during design and installation, TasNetworks has developed a suite of technical standards and specifications for the design and installation of site infrastructure and requires manufacturers to have AS/NZ ISO 9001 accreditation. Further, TasNetworks has developed standard drawings for security fencing which maintains the uniformity and quality control for installation on site.

TasNetworks also has nominated several items of equipment to ensure standard installations for items such as electronic security equipment, climate control and fire systems and oil containment tanks.

6.3 Key Performance Indicators

TasNetworks undertakes two broad classes of performance monitoring, namely internal and external performance monitoring.

6.3.1 Internal Performance Monitoring

TasNetworks monitors and assesses performance related issues and non-conformances based on a defect reporting methodology. This identification and reporting system takes the form of routine inspections, compliance audits and quality assurance inspections. These processes involve the identification and recording of a defect and the rectification or remedial actions subject to an appreciation of the impact on safety, the environment and system performance and integrity. Defects resulting from the inspection and audit regimes will be registered and managed accordingly.

6.3.2 External Performance Monitoring

TasNetworks participates in various formal benchmarking forums to benchmark asset management practices against international and national transmission companies. Key benchmarking forums include:

- International Transmission Operations & Maintenance Study (ITOMS); and
- Australian and New Zealand chief executive officer's benchmarking forum, which provides information to the Energy Supply Association of Australia (ESAA) for its annual industry performance report.

In addition, TasNetworks works closely with transmission companies in other key industry forums, such as CIGRE (International Council on Large Electric Systems), to compare asset management practices and performance.

6.3.2.1 ITOMS Benchmarking

Substation site infrastructure maintenance is benchmarked through ITOMS. The international benchmarking exercise covers scheduled inspections and maintenance of the following into a single category:

- Scheduled inspections and maintenance of switchyards, security fences, security systems and alarm systems;
- Drainage, snow removal, weed and pest control;
- Landscaping and general building conditions work;
- Civil inspection and maintenance;
- Roadway and access inspection and maintenance; and
- Inspection and maintenance of lighting and services trenches, fire equipment, ladders and other special tools.

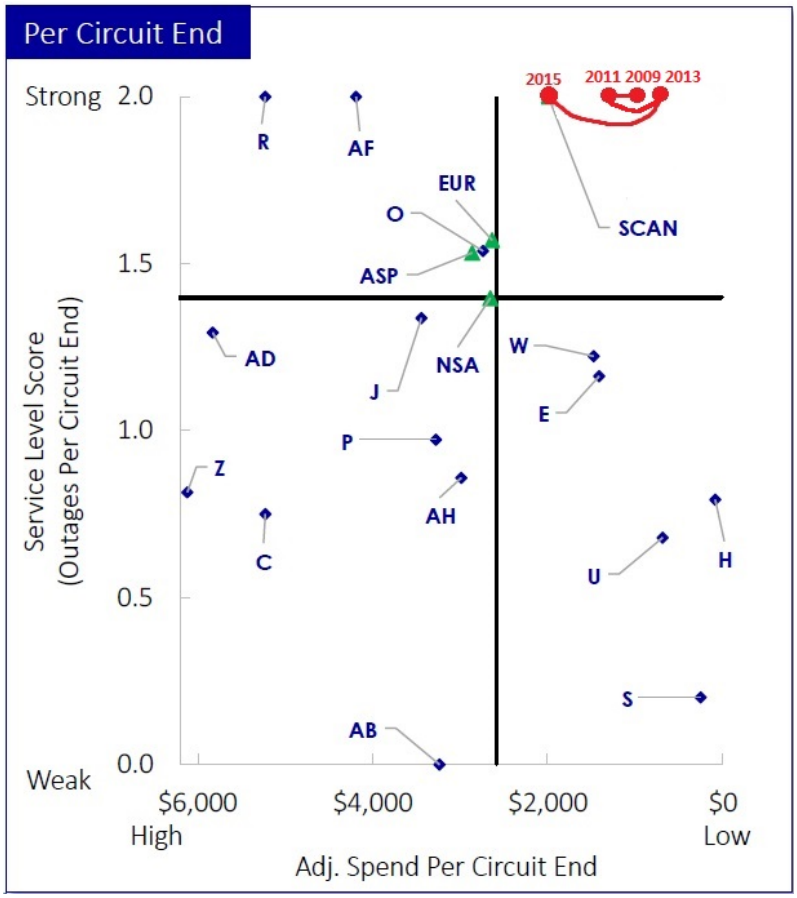
Further discussions relating to the ITOMS studies are discussed in the ITOMS reports which are held by TasNetworks Network Performance and Asset Strategy group.

TasNetworks performance is favourable to that of other utilities in the study. There has been a positive trend in maintaining relatively low maintenance expenditure with a corresponding high service level. TasNetworks has also been able to sustain this high level of performance over a period of time. It is however expected that costs will increase marginally as the focus on improving data integrity and accuracy increases.

The ITOMS results are typically presented in a scatter plot which enables comparison between participant utilities. The international benchmarked averages (cost & service) are shown as the centre crosshairs, with diamond shapes representative of surveyed participant utilities and regional averages shown as triangles marked NA (North America), EUR (Europe), ASP (Australia South Pacific), and SCAN (Scandinavia). The optimal performance location on the scatter plot is located in the upper right hand quadrant because, in this quadrant, service level is at its highest at the least cost. TasNetworks has been consistently higher than the international benchmarked average over the last reporting periods as shown in Figure 14.

Figure 14 illustrates TasNetworks benchmarked substation site infrastructure assets performance against all other ITOMS participants for the last four reporting periods on a per circuit end basis. It shows the performance, in terms of maintenance expenditure and fault outages of TasNetworks substation infrastructure, has largely maintained above average low service costs when compared to other transmission companies in the study. It demonstrates that in all reporting periods TasNetworks has managed its service cost performance to be considerably better than the benchmarked average. Note that 2 = strong service level, 0 = weak service level.

Figure 14 – ITOMS substation site maintenance benchmarked performance chart



6.3.2.2 ESAA Benchmarking

TasNetworks' reporting to the ESAA covers Transmission network data of system minutes unsupplied, energy delivered and transmission circuit availability. For ESAA benchmarking network data is limited to Transmission circuits.

7 Associated Risk

7.1 Risk Management Framework

TasNetworks has developed a Risk Management Framework for the purposes of assessing and managing its business risks, and for ensuring a consistent and structured approach for the management of risk is applied.

The Risk Management Framework requires that each risk event is assessed against all of the following consequence categories:

- Safety and People
- Financial
- Customer
- Regulatory Compliance
- Network Performance
- Reputation
- Environment and Community

An assessment of the risks associated with substation site infrastructure has been undertaken in accordance with the Risk Management Framework. For each asset in this class the assessments have been made based on:

- Condition of substation site infrastructure in service across the network
- Criticality of substation site infrastructure and associated assets
- Probability of failure (not meeting business requirement)
- Consequence of failure
- Performance
- Safety risk
- Environmental risk
- Customer

The quantification of risk is supported by 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. A general summary of condition assessment for each substation is provided in appendix B.

7.1.1 Condition

Failing condition of substation civil infrastructure assets is generally determined by the assets inability to perform as required or demonstrates signs of degradation that could lead to undesirable performance. A variety of condition assessment methodologies are used to determine substation switchyard and building asset condition, including:

- Routine inspections;
- Standardised inspection templates;
- Compliance audits; and
- Quality assurance inspections.

Current asset condition is assessed on a site-by-site basis using a combination of the above condition monitoring techniques. Any serious abnormalities are required to be registered as non-conformance reports (NCR) within three working days. The combination of the various condition assessment techniques, together with TasNetworks asset management personnel and contracted Service Providers ensures a collective and thorough approach to managing the condition of the substation site infrastructure assets.

Although formal condition assessments and analysis is still in its infancy, periodic inspections and defect identification are managed by Service Providers and TasNetworks asset management personnel. Defects are reported by exception and consolidated into a 'work planning module' from which work is scheduled and defects managed.

The most common condition issue for site infrastructure is corrosion and degradation due to weather and UV exposure. As a result, concrete and masonry structures begin to allow water ingress and metallic equipment such as fences, door frames and cladding fail.

Age is not a key determinant of useful life of the asset, but it remains an indicator for the remaining life expectancy of the equipment and serves as a trigger for further focussed condition assessments.

Degradation and/or deterioration of substation security system assets are influenced by certain factors, which include:

- The quality of original equipment;
- The availability of spare parts and software support;
- Technology change;
- The quality of maintenance programs; and
- The exposure to various environmental factors for extended periods.

In addition, substation security system asset life-cycle can be shortened by:

- Significant improvements in the available features of new products;
- Operational, maintenance and serviceability constraints of obsolete products; and
- Non-compliance and/or increased regulatory and statutory requirements.

The shorter life expectancy of electronic products, which is expected to be predominately driven through innovation, technology advancement and customer demand, will require a continuous cycle of asset replacements every 5–10 years, which commenced in 2015-2016.
Such factors are taken into consideration when making an assessment of the overall condition of substation security system assets.

7.1.2 Criticality

The main risks associated with substation infrastructure assets are those risks that have the potential to result in TasNetworks assets operational integrity being compromised, its performance to deteriorate, or poses an undue risk to equipment or human life, be that risk environmental, operational or security oriented.

7.1.3 Probability of Failure

The predominant causes of site infrastructure failure include:

- Undetected corrosion of metallic infrastructure such as fences and building roofing and cladding;
- The undetected failure of concrete structural components;
- Failure of the security system; and

- Inability of oil containment systems to work correctly.

TasNetworks considers these all to be rare events, based upon the low number of incidents to date.

7.1.4 Consequence of Failure

There are three major consequences that may eventuate due to a failure of substation site infrastructure:

- Loss of supply due to consequential damage to substation electrical equipment;
- Environmental damage caused by uncontained oil spills; and
- Harm to personnel or the public due to a failure of adequate site security.

7.1.5 Environmental Risks

TasNetworks' main environmental risks associated with substation sites relate to the insulating oils containment systems. This risk is mitigated with the use of SPEL type oil containment systems where any discharge has been filtered to contain <10 ppm of hydrocarbons which adheres to EPA legislation.

7.1.6 Special Operational and Design Issues

Substation site infrastructure capacity constraints are driven mainly by two areas: those restricted by the operational and/or the physical design characteristics of specific site infrastructure assets.

7.1.6.1 Operational issues

The following issues impact directly on TasNetworks ability to maintain substation assets:

- Design of substation buildings which allow water ingress, rodent interaction and increase risk of fire damage;
- Lack of, or poorly designed, transformer tracks to facilitate emergency transformer replacement resulting in replacement times exceeding those expected by the Electricity Supply Industry (Network Performance Requirements) Regulations 2007; and
- Lack of adequate transformer bunding facilities to house spare or early procured units in the event of transformer failure or replacement.

7.1.6.2 Substation design issues

Design is an important factor that can influence both asset and transmission system performance levels. In addition, design issues have a direct impact on maintenance practices and expenditure. Common design issues across TasNetworks substation site infrastructure include:

- Design of substation buildings to allow appropriate installation of fire suppression systems, climate control and security;
- Constant re-evaluation to confirm compliance with regulations and standards such as BCA and other Australian standards;
- Grassed switchyards which encourage animals such as rabbits and potential non-compliance for substation earthing due to a lack of high resistivity crushed rock for earthing improvement;
- Location of sites with high land use issues such as world heritage areas;
- Concrete tanks not meeting hydrocarbon discharge limit of 10 ppm under Environmental Management and Pollution Control Act (EMPCA).

7.2 Sites related risks

The property (real estate) that contains TasNetworks primary and civil assets defines a switchyard. Switchyards is a term that describes the various civil infrastructure assets such as fencing, gates, fire walls, oil containment and storage structures and switchyard fire protection systems.

7.2.1 Risk Assessment

A condition based risk assessment of the 'Site' subclass of the substation site infrastructure asset class which are regarded as marginal is summarised in Table 1.

Table 1 – Risk Assessment – Sites

Asset and Risk	Criticality	Probability of Failure	Consequence of Failure	Risk Rating	Treatment Plan
Boyer Substation Condition assessment indicates marginal condition.	Moderate (1 Industrial)	Unlikely	Moderate	Medium	
Gordon Substation Condition assessment indicates marginal condition.	Major (Network Performance)	Unlikely	Major	Medium	
Rosebery Substation Condition assessment indicates marginal condition.	Minor	Unlikely	Minor	Low	

7.3 Buildings related risks

On the 19th December 2011, leaking water from an overhead air vent caused a 22 kV switchgear fault at Sorell Substation.

Exposure to the elements compounded by antiquated and obsolete designs and other age related degradation factors constitute the 'poor' and 'marginal' condition. Sites are evaluated on a site-by-site basis and maintenance, refurbishment or replacement implemented. General maintenance such as painting is conducted on a periodic basis based on regular site inspections.

Septic tanks, French drains and water storage tanks at certain sites, where municipal service is not available, require periodic attention and maintenance to ensure correct and satisfactory operation and condition. The condition of these assets is therefore in an 'acceptable' condition, but they consume a large portion of the annual expenditure requirements.

Water storage facilities at site such as Palmerston Substation are considerable as they serve as the water source for fire protection and therefore require particular attention.

7.3.1 Climate Control

It is assumed that air conditioners of less than five years of age would be classified as being in 'acceptable' condition. This assumption has however masked that fact that air conditioners defects are high and are a large source of defects for other electrical assets. This could be partly attributed to residential type units being using in industrial type applications and incorrect

capacity to manage the room environment within the specified limits. A substantial number of failures have also occurred as a result of project activities at sites where the units have been subjected to high workloads. A detailed investigation is presently being conducted to determine the root cause of defects so that the appropriate strategies can be employed to improve performance.

7.3.2 Cable Entry and Exit

Cable entries/exits that are buried or are easily assessable (security risk) through trench covers, plates or wall mounting are classified as 'poor' or 'marginal'. More than 50 per cent of cable entries/exits fall into this category and a detailed assessment is required to produce an accurate scope of work. This rating also caters for, and incorporates, those isolated sites where high water tables or storm water run-off contribute to water ingress into cable trenches, ducts and the likes.

7.3.3 Risk Assessment

A condition based risk assessment of the 'Buildings' subclass of the substation site infrastructure asset class which are regarded as poor or marginal is summarised in Table 2**.**

Table 2 – Risk Assessment – Buildings

Asset and Risk	Criticality	Probability of Failure	Consequence of Failure	Risk Rating	Treatment Plan
Boyer Substation Condition assessment indicates marginal condition (roof)	Moderate	Unlikely	Moderate	Medium	
Burnie Substation Condition assessment indicates marginal condition	Minor	Unlikely	Minor	Low	
Derwent Bridge Substation Condition assessment indicates marginal condition.	Minor	Unlikely	Minor	Low	
Emu Bay Substation Condition assessment indicates marginal condition.	Minor	Unlikely	Minor	Low	
St Marys Substation Condition assessment indicates marginal condition.	Minor	Unlikely	Minor	Low	

Asset and Risk	Criticality	Probability of Failure	Consequence of Failure	Risk Rating	Treatment Plan
<u>Ulverstone Substation</u> Condition assessment indicates marginal condition.	Moderate	Unlikely	Moderate	Medium	

7.4 Switchyards related risks

In the past ten years, no compliance breaches have been recorded for this type site infrastructure.

Degradation due to cracks, fungal growth, flaking, etc. that affects the integrity and strength of the constructions is regarded as 'poor' or 'marginal', dependent on the severity.

There are also isolated cases where transformer plinths are in good order but in the event of the existing transformer failure will be unable to accommodate the footprint or load requirements of a spare or new transformer.

7.4.1 Risk Assessment

A condition based risk assessment of the 'Switchyards' subclass of the substation site infrastructure asset class which are regarded as poor or marginal is summarised in Table 3**.**

Table 3– Risk Assessment – Switchyards

Asset and Risk	Criticality	Probability of Failure	Consequence of Failure	Risk Rating	Treatment Plan
Burnie Substation Condition assessment indicates marginal condition.	Minor	Unlikely	Minor	Low	
Chapel Street Substation Condition assessment indicates marginal condition.	Major	Unlikely	Major	Medium	
Liapootah Substation Condition assessment indicates marginal condition.	Moderate	Unlikely	Moderate	Medium	
Rosebery Substation Condition assessment indicates marginal condition.	Minor	Unlikely	Minor	Low	
Sheffield Substation Condition assessment indicates marginal condition.	Major	Unlikely	Major	Medium	

7.5 Roads

In the past ten years, no compliance breaches have been recorded for this type site infrastructure.

The roads category includes all site access and internal roads, including transformer tracks.

Sites are listed as marginal if there are load limits applied to access roads, or if transformer tracks are absent.

7.5.1 Risk Assessment

A condition based risk assessment of the 'Roads' subclass of the substation site infrastructure asset class which are regarded as marginal is summarised in Table 4**.**

Table 4– Risk Assessment - Roads

Asset and Risk	Criticality	Probability of Failure	Consequence of Failure	Risk Rating	Treatment Plan
Avoca Substation Condition assessment indicates marginal condition.	Minor	Unlikely	Minor	Low	
Bridgewater Substation Condition assessment indicates marginal condition.	Moderate	Unlikely	Moderate	Medium	
Boyer Substation Condition assessment indicates marginal condition.	Moderate	Unlikely	Moderate	Medium	
Palmerston Substation Condition assessment indicates marginal condition.	Moderate	Unlikely	Moderate	Medium	
Tungatinah Substation Condition assessment indicates marginal condition.	Major	Unlikely	Major	Medium	
Waddamana Substation Condition assessment indicates marginal condition.	Moderate	Unlikely	Moderate	Medium	

7.6 Security related risks

Restricted and controlled access to TasNetworks substations is paramount to site and the transmission network security. Although access is managed through assigned access levels and controlled by a key system, swipe cards and readers are going to be introduced as part of the security upgrade project. The substation sites have therefore been graded as 'marginal' until such a time that the system has been commissioned and fully integrated into the security access system.

Breaches in security fencing, which did not result in further damage, occurred at Sheffield and George Town substations.

Security breaches that resulted in equipment being stolen occurred at Avoca, Derby, Electrona, Sheffield and Tungatinah substations.

7.6.1 Fences

Substation security forms the basis for the present substation security upgrade strategy for which various capital project packs have been assigned.

Those graded as 'marginal' comply with AS 2067 "Substations and high voltage installations exceeding 1 kV a.c." standard, and those graded as 'acceptable' have been upgraded to comply with TasNetworks standard , which surpasses the AS 2067 standard. Substation security fencing replacement and upgrade projects have been identified to address the sub-standard fencing and other security requirements.

Access gates are progressively being modified from a leaf-type to a sliding-type which is either manually or automatically operated.

7.6.2 Risk Assessment

A condition based risk assessment of the 'Security' subclass of the substation site infrastructure asset class which are regarded as poor or marginal is summarised in Table 5.

Table 5 – Risk Assessment – Security

Asset and Risk	Criticality	Probability of Failure	Consequence of Failure	Risk Rating	Treatment Plan
Avoca Substation Condition assessment indicates marginal condition.	Minor	Unlikely	Minor	Low	
Boyer Substation Condition assessment indicates marginal condition.	Moderate	Unlikely	Moderate	Medium	
Burnie Substation Condition assessment indicates marginal condition.	Major	Unlikely	Major	Medium	

7.7 Transformers and Oil containment systems related risks

In the past ten years, no compliance breaches have been recorded for this type site infrastructure.

7.7.1 Transformer Noise and Fire Walls

Not all transformers require fire walls. Detailed assessments for new sites are conducted on an as needs basis and consideration is also afforded the installation of walls/barriers around a transformer as a means of noise suppression. Noise pollution measurements are conducted on an as needs basis.

7.7.2 Oil Management and Containment

Oil containment catchpits are designed to restrict and contain any transformer oil spillage from contaminating unprotected areas and is designed to drain into suitable primary containment tank/s. TasNetworks is presently upgrading hypalon systems to the bund walled catchpit system in accordance with the standard. This factor, together with those sites where either the oil catchpit or containment system is in an unsatisfactory condition, contributes to the low condition assessment.

Bulk oil management for equipment service and maintenance purposes are held in storage off site by external contractors. This arrangement is to be reviewed and costs are, in future, to be directly attributed to equipment rather than the storage and management of bulk oil.

7.7.3 Risk Assessment

A condition based risk assessment of the 'Oil Containment System' subclass of the substation site infrastructure asset class which are regarded as poor or marginal is summarised in Table 6.

Table 6 – Risk Assessment - Oil Containment Systems

Asset and Risk	Criticality	Probability of Failure	Consequence of Failure	Risk Rating	Treatment Plan
Chapel Street Substation Condition assessment indicates poor condition	Major	Possible	Major	High	Oil containment being replaced in 2018
Risdon Substation Condition assessment indicates poor condition	Major	Possible	Minor	Medium	Oil containment tank included for replacement in 2019-24 period.
St Marys Substation Condition assessment indicates poor condition	Minor	Possible	Minor	Low	Hypalon system to be replaced when transformer replaced.

7.7.4 Risdon Substation Oil Containment

An audit conducted at Chapel Street Substation found that the existing oil containment system is in poor condition and does not comply with environment hydrocarbon discharge regulations. The existing system utilises precast concrete tank, linked in series by stainless steel and concrete pipework, to provide adequate oil retention volume.

TasNetworks must ensure that hydrocarbon discharges from the oil containment tanks are less than 10 parts per million to meet the requirements of EMPCA. The present system cannot be proven to meet this requirement, and only modern systems fitted with coalescent type filters can.

The concrete pipework is cracked, leaks, and is likely to crack further in the event that burning or hot oil from a transformer fire enters the containment tanks.

Figure 15– Risdon oil containment tank – above golf course

7.7.5 St Mary's Substation Oil Containment

The St Mary's Substation Hypalon oil containment system condition assessment report, D13/10135, has identified that:

- There is a single bund area for both transformers T1 and T2. Due to the common bund area, in the event of an oil fire, the oil can spread to the adjacent transformer;
- The Hypalon bund area does not have a flame trap installed increasing the chances of a transformer fire spreading to the oil containment tank;
- A crushed rock layer covers the Hypalon bund in order to ensure a non-slip surface. A number of issues are then introduced by the crushed rock layer;
  - (i) The crushed rock layer limits the flow of insulating oil in the bund and increases the risk of a high-intensity fire around the transformer;
  - (ii) The crushed rock layer reduces the visibility of the Hypalon layer when carrying out routine condition assessments. Any cracks or damage to the Hypalon layer will not be identified during these condition assessments;
  - (iii) The existence of the crushed rock layer may not provide sufficient drainage for the oil and the water introduced during firefighting. This could lead to overflow of the oil from the bund area.

Any major oil leaks to the environment from the Hypalon bund due to any of the design issues could result in high environmental consequences.

7.8 Cranes

In the past ten years, no compliance breaches have been recorded for this type of infrastructure.

It is proposed that where cranes may still be installed in "high-Bay" locations that there use is reviewed and if deemed not needed are targeted for removal. An example of this is at Emu bay Substation.

8 Management Plan

8.1 Historical

Historically, management of substation site infrastructure has been undertaken based primarily on condition and condition assessments.

Condition Based Risk Management (CBRM) program will also be applied to assess asset condition and which aligns with direction provided in TasNetworks Strategic Asset management Plan (SAMP). Figure 16 provides an overview as to which management techniques are applied by TasNetworks in managing the risks of each asset category in our asset base as detailed in the SAMP.

Figure 16 – TasNetworks asset category management overview

How are assets managed?																							
Assets	Past							Present							Future								
	Run to failure	Subject Matter Expert (SME)	Time based (Age)	Reliability centered maintenance (RCM)	Condition based	CBRM		Run to failure	Subject Matter Expert (SME)	Time based (Age)	Reliability centered maintenance (RCM)	Condition based	CBRM		Run to failure	Subject Matter Expert (SME)	Time based (Age)	Reliability centered maintenance (RCM)	Condition based	CBRM	
Substations																							
Transformers (power)			✓							✓ (maintenance)		✓	✓ (renewed)				✓			✓	
EHV circuit breakers			✓							✓ (maintenance)			✓ (renewed)				✓			✓	
HV circuit breakers			✓							✓ (maintenance)			✓ (renewed)				✓			✓	
EHV Disconnectors & Earth switches			✓							✓ (maintenance)			✓ (renewed)				✓			✓	
EHV CT's			✓							✓ (maintenance)			✓ (renewed)						✓	✓	
EHV VT's			✓							✓ (maintenance)			✓ (renewed)						✓	✓	
Power cables			✓							✓ (maintenance)		✓	✓ (renewed)						✓	✓	
Site infrastructure					✓							✓							✓	✓	

All substation site infrastructure is managed in accordance with Local and National legislation, standards and codes of practice, such as the BCA and EMPCA.

There are no NER specific compliance requirements for substation site infrastructure.

8.2 Strategy

The substation site infrastructure asset class strategy management techniques include routine maintenance and non-routine maintenance. Other strategy management techniques such as refurbishment, planned/unplanned replacement, non network solutions and network augmentation impact assessment may be incorporated as the level of performance is required.

Practices are reviewed on a regular basis taking into account:

- Past performance;
- Manufacturer's recommendations;
- Industry practice (derived from participation in technical forums, benchmarking exercises and discussions with other transmission companies); and
- Availability of new technology.

8.2.1 Routine Maintenance

Routine or preventative maintenance is a planned and scheduled maintenance activity that is completed to a predetermined scope, and can be broken down into two areas:

- Condition assessment via routine inspection, testing and monitoring of assets to ascertain their condition.

- Maintenance (routine and condition based). With routine and condition based maintenance, assets are maintained either on pre-determined frequency basis (time-based) or require planned maintenance following condition assessments.

TasNetworks overall maintenance philosophy is to engineer and promote a shift away from time-based and reactive type maintenance to maintenance methodologies centred around condition-based activities in order to proactively manage the assets.

This strategy is reflected in TasNetworks composite operational expenditure where it is expected that higher condition assessment and preventative maintenance costs will result in lower corrective maintenance costs. It is also expected that maintenance frequencies, inspection cycles and monitoring regimes will be adapted and aligned with this strategy to best suit business requirements.

8.2.2 Routine Maintenance versus Non Routine Maintenance

Non routine or corrective maintenance is, by its nature, an emergency and or fault repair/replacement of assets or component parts. Corrective maintenance is typically as a result of unpredictable events that compromise or damages the integrity of the asset.

Failures within substation site infrastructure may cause serious or catastrophic damage to the asset. Some of these assets are located in close proximity to the public, so allowing failures to occur represents a real risk to the public and surrounding infrastructure. These assets also have a high unit value, so a preventative corrective maintenance program represents a cost effective alternative to a reactive corrective maintenance program.

8.2.3 Network Augmentation Impacts

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

1. Demand forecasts;
2. New customer connection requests;
3. New generation requests;
4. Network performance requirements; and
5. National electricity rules (NER) compliance.

Details of planned network augmentation works can be found in TasNetworks Regional Development Plans, which are updated on an annual basis

8.2.3.1 Asset Specific Implications

Proposed network augmentation projects identified in the Regional Development Plans will have a marginal economic impact on the substation infrastructure population. Additional costs associated with new, replacement or refurbishment substation switchyards and building installations as part of network augmentation projects will not materially impact on the ten-year projected operational expenditure detailed in section of this asset management plan.

8.2.3.2 Proposed New Installations

Previous significant site upgrade works have in recent years been completed at Creek Rd, Tarraleah, Newton and Avoca substations.

A new building had previously been proposed for Gordon Substation to house protection, control and other substation auxiliary equipment. This building has been deemed not required as access arrangement into the current building has been improved during 2017 to allow un-accompanied access which greatly improved the previous situation.

No other significant developments are proposed at this time although with current discussions related to increased connection applications for renewable generation may drive future need. At present enhancements to the electrical infrastructure at Port Latta, Burnie and Waddamana substations to facilitate renewables may occur which will potentially have an impact on the site infrastructure.

8.3 Non Network Solutions

As reported in previous AMP, TasNetworks presently constructs substations using two dimensional drawings. The drawings are extracted from multilayered sheets of a single drawing. As a result, civil, primary and secondary drawings are all developed independently and conflicts often arise.

Three dimensional scanning of substations uses a mixture of traditional surveying equipment and modern laser scanning technology to create a three dimensional image of the substation. The image can then be used to:

- Develop a single manipulable object which can be altered using modern computer aided drafting (CAD) software;
- Create virtual substation tours, reducing the need for office staff to visit remote sites;
- Provide a record of the internal substation components and the substation surrounds.

TasNetworks expects substation design to fundamentally become a ‘plug and play’ type process by which a designer may take a substation CAD model and begin to replace both electrical and site infrastructure components.

Substation components are highly standardised across the world and database of components that can derive electrical and physical connections automatically are already being developed. Three dimensional substation designs then flow easily into quantity calculations such as cabling routes and procurement lists.

TasNetworks presently has three dimensional images from ten substations as detailed in table 7 and plans to continue conducting the scans as part of the as built documentation following substation capital works where appropriate.

Table 7 – Substations with three dimensional images

Arthurs Lake	Creek Rd	Knights Rd	Liapootah	Meadowbank
Mornington	Railton	Rosebery	St Leonards	Wesley vale

Images will then be held until such times as the conversion to a CAD model is necessary. Until that time, virtual substation tours remain available.

TasNetworks expects full three dimensional design of substations to be commonplace prior to 2020.

8.4 Routine Maintenance

Table 8 provides a summary of all of the programs described in this management plan.

Table 8 – Maintenance regimes

Classification	Frequency
Visual inspections	Coordinated with substation quarterly inspections
Grass cutting and weed control	Summer (monthly) Winter (bi-monthly)
Oil containment inspections and cleaning	Every two years
Electric fence inspection and maintenance	Twice per year
Building repairs and maintenance	As required
Fire equipment inspections and maintenance	Twice per year
Fire suppression/prevention systems	Annually
Climate control maintenance	Annually
Security system inspections and maintenance	Twice per year
Crane inspections and maintenance*	Annually
Electronic capturing of condition data#	In conjunction with annual programs

*TasNetworks outsources crane inspection and maintenance to an external competent service provider as TasNetworks does not have the capability to conduct this specialised inspection.

The proposed additional line item is to be released post the AJILIS project.

8.4.1 Visual Inspections

TasNetworks undertakes to manage the inspection and maintenance activities through employing the services of an experienced external asset service provider.

TasNetworks inspection methodology combines primary electrical plant inspections with that of substation infrastructure inspections to take advantage of inspection efficiencies. Inspections are performed as per 'Transmission Assets Maintenance Task Guide – Switchyard Inspections' and information collection will be completed as per a standard check list. Although this checklist is designed to cater primarily for substation electrical plant and apparatus, it also serves to capture the relevant information relating to substation security system assets and to report defect conditions by exception.

8.4.2 Grass cutting and Weed Control

TasNetworks grass cutting and vegetation management practices are conducted in accordance with environmental practices, and performed by an external contractor.

8.4.3 Electric Fencing Maintenance

Agreements are in place to provide support and maintenance as follows:

- The Electric Security Fence Support and Maintenance agreement includes:
    - 6 monthly inspection and testing of electric security fencing at all sites to manufacturers specification sufficient to retain manufacturer certification; and
    - Spares Management.
- This agreement ensures that the electric security fencing retains Gallagher certification, and provides management of spare parts for the electric fence.

Following its installation, Gallagher inspected the Power Fence to certify that the system was installed in accordance with the Gallagher Security Management Systems' Code of Practice for Power Fence systems. Gallagher certified systems are designed to meet the requirements of high-risk security installations.

In order to retain this certification a six monthly preventative maintenance program is required as certified by the manufacturer, Gallagher. TasNetworks has a Support Agreement with a Power Fence approved agent, to provide the required maintenance.

The preventative maintenance program includes inspections as follows:

- Fence zones clear of vegetation, debris, rubbish;
- Correct fixing of each post and straining point;
- Every wire for correct tension;
- All wire termination and connections are tight and free from corrosion;
- All connections from fence earth grid to chain mesh are tight and free from corrosion;
- Linking correctly positioned to prevent climb points;
- Rigidity and adequate air gap from any earth;
- Insulators and contact points for residue and contamination;
- Signage clearly displayed on fence;
- Gate contacts are correctly aligned and functional;
- Fence zones voltages;
- Live light operation;
- Lightning protection devices;
- Fence alarm zone operation; and
- Fence controller battery operation.

Corrective works on the electric fence will be conducted should the need be identified during a preventative maintenance visit.

8.4.4 Fire equipment, suppression/prevention and detection systems

Suitable preventative and maintenance activities are in place for managing TasNetworks suite of fire management assets which includes, hydrants, extinguishers, fire prevention such as Hypoxic system and VESDA.

8.4.5 Security Systems Maintenance

Preventative maintenance of security system components is a planned and scheduled maintenance activity that is completed to a predetermined scope.

Any issues identified during the preventative maintenance routines, or at any other times, can be reported through the BAE System Support Portal and will be rectified under respective Corrective Maintenance agreements. The BAE System Support Portal process involves the creation of a fault incident record, TasNetworks maintains a defect management system that enables internal performance monitoring and trending of all substation security system faults. Fault incidents may arise from conditions found during preventative maintenance checks or operational issues found.

Tables of proposed preventative maintenance checks are contained in the Site Operations and Maintenance Manuals located on the BAE System Support Portal which is available online with password access. This documentation contains a comprehensive Procedure for Site System Maintenance every 6 months.

TasNetworks has incorporated a subset of the proposed site maintenance procedures into the system support and maintenance agreements, to ensure an appropriate, but cost effective, support regime.

8.4.5.1 Software maintenance agreements

Preventive software maintenance comprises the regular update of software and firmware in the system to ensure that the system can continue to be maintained and that new features are provided when available. Software patches and bug fixes may also be required.
Prior to the implementation of any software updates, patches or bug fixes, it is important to evaluate the new software and demonstrate the compatibility with the substation security system as it has been installed, as there is some system specific software that interacts with it.

Two agreements are in place to provide system software support and maintenance as follows:

- Software Support and Upgrade Agreement with BAE Systems, including:
    - Software Support and Upgrade Agreements Systems for the CSC Software
    - Software Access Agreement for SVS Suite of Software
- Asset Security Support Agreement with BAE Systems, including:
    - Preventative Maintenance
        - Software Maintenance
        - CSC Server Maintenance
        - ESC Maintenance
        - Intruder Detection Subsystem
    - Corrective Maintenance
    - Access to BAE Support Portal
    - Spares Management

This agreement ensures that software upgrades are fully tested prior to implementation on the operational system, and that the required CSC server software maintenance is undertaken at 12 month intervals, provides access to BAEs support portal for system information and reporting of maintenance incidents and provides management of spare parts.

8.4.5.2 Asset Security Support Agreement

The Asset Security Support Agreement also with BAE for a period aligns with the Software Support and Upgrade Agreement, and provides routine scheduled maintenance for various software, including:

- Management and provision of annual software updates;
- Evaluation and testing of software version updates, patches or bug fix updates on an annual basis, to evaluate compatibility with the Asset Security System;
- Management and implementation of software version updates, or bug fix updates on an annual basis, where the prior software evaluation has demonstrated compatibility with the Asset Security System;
- Implementation of software updates on the two CSC servers, Workstations and controllers. It is estimated that the three planned software updates will be implemented at approximately 12 month intervals; and
- Notification to TasNetworks of any critical software patches or bug fix updates.

This agreement also covers the following general server and software maintenance items, to be performed every 12 months:

- Event log inspection, report, archive and clear;
- Disk fragmentation inspection and report;
- Installed devices and drivers inspection and report;
- Memory and CPU usage of running process inspection and report;
- Rugged NMS log inspection, report, archive and clear;
- Internal inspection of server; and
- Verify performance of fail-over and fail-back procedure

As with all IT equipment, the CSC servers and Operator Workstations should be updated periodically as part of the subsystem replacement program.

Together these two agreements ensure that the software packages that are used in the system are upgraded as new releases become available, and that they are fully tested prior to implementation on the operational system. BAE Systems will provide a suitable Software Test Environment for testing the software prior to installation on the production Substation Security System. BAEs support portal is available online with password access.

Agreements are also in place to provide system software support and maintenance as follows:

- Existing Substation Maintenance Services contracts includes the requirement to ensure that camera lenses are cleaned periodically and that vegetation is kept clear of the electric fence.
- An internal Service Level Agreement with TasNetworks IT includes the requirement to ensure that the operating software, and data base software, is kept up to date and that appropriate anti-virus software is implemented on the servers.
- An internal Service Level Agreement with TasNetworks Communications Services includes the requirement to provide remote maintenance services of system hardware via the Ruggedcom Network Management System (NMS) and on-site preventative and corrective maintenance services of the CSC servers under the direction of BAE.

8.5 Non Routine Maintenance

Minor and major asset defects that are specifically identified during asset inspections and routine maintenance or through other ad-hoc site visits are prioritised and rectified as per the recommendations set out in TasNetworks condition assessment report and general asset defects management process.

The methodology used to develop manage non routine maintenance is adjusted to meet the option analysis completed specific for the defect to meet the performance criteria set out in the risk framework, with the objective to return to service and prevent asset failure.

8.6 Regulatory Obligations

Performance levels of substation switchyards and building assets are assessed using a combination of internal performance monitoring measures and external benchmarking.

Substation site infrastructure assets have an indirect impact on TasNetworks overall network service obligations, which include specific performance requirements for both regulated and connection transmission assets.

8.6.1 Service Obligations for Regulated Assets

Failure to secure or provide a safe operational environment for primary assets and control plant could contribute to system performance. This includes the containment, restrictions and preventions of any consequential equipment damage that could have an adverse effect on system performance and security.

TasNetworks' performance incentive (STIPIS) scheme has been produced in accordance with the Australian Energy Regulator's Service Standards Guideline is based on plant and supply availability. The STIPIS scheme includes the following specific measures:

- Plant availability:
    - Transmission line circuit availability; and
    - Transformer circuit availability.
- Supply availability:
    - Loss-of-supply event frequency index
    - Number of events in which loss of supply exceeds 0.1 system minute; and
    - Number of events in which loss of supply exceeds 2.0 system minutes.

Details of the STIPIS scheme and performance targets are managed by TasNetworks Asset Performance group and are listed in TasNetworks Corporate and Business plans.

8.6.2 Service Obligations for Non-regulated Assets

8.6.2.1 Hydro Tasmania

TasNetworks has a Performance Incentive (PI) scheme in place with Hydro Tasmania under its Connection and Network Service Agreement (CANS 2) for connection assets between the two companies. The PI scheme includes the connection asset availability measure.

An overview of Hydro Tasmania PI scheme and performance targets can be found in the associated connection agreement.

8.6.2.2 Tamar Valley Power Station (TVPS)

TasNetworks has a PI scheme in place with TVPS under its Generator Connection Agreement for connection assets between the two companies. The PI scheme includes the connection asset availability measure. An overview of TVPS PI scheme and performance targets can be found in the associated Connection Agreement.

8.6.2.3 Major Industrial direct customer connections

TasNetworks have a number of direct connections to major industrial customers through EHV and HV substations. The following sites have asset category assets providing these direct connections:

- Boyer Substation (6.6 kV);
- George Town Substation (220 kV & 110 kV);
- Huon River Substation (11 kV);
- Newton Substation (22 kV);
- Port Latta Substation (22 kV);
- Que Substation (22 kV);
- Queenstown Substation (11 kV);
- Risdon Substation (11 kV);
- Rosebery Substation (44 kV); and
- Savage River Substation (22 kV);

The individual connection agreements describe the level of service and performance obligations required from the associated connection assets.

8.7 Replacement

TasNetworks substation site infrastructure capital investment strategy has been developed taking into consideration the design-related issues, condition, performance issues and risks associated with the population of site infrastructure assets.

Furthermore, TasNetworks has capitalised a number of specific programs aimed at improving safety and environment issues, and reducing operational expenditure. These include:

- Building upgrades;
- Security upgrades;
- Fire suppression installations;
- Oil containment upgrades; and
- Switchyard and road upgrades.

TasNetworks will typically undertake site infrastructure capital works in conjunction with other works on site to achieve better economy of scale. Where immediate risk or operational expenditure reductions can be achieved, projects will be considered as individual works.

8.7.1 Buildings

Building upgrades come in many forms, but they can be categorised into two main categories:

- New construction or extension; and
- Refurbishment.

New buildings or building extensions will be undertaken as a direct response to planned electrical infrastructure being installed. Some examples include building new switch houses in which to locate new high voltage switchboards. Buildings are often extended in order to facilitate

protection and control equipment replacements because the existing is required to remain in service, therefore in situ replacement becomes unviable.

Building refurbishments are undertaken to address failing building condition where waterproofing or security can no longer be assured. Some buildings will also be augmented to release operational restrictions such as lack of visual access to high voltage capacitor banks.

Major building upgrade works are normally undertaken as part of a wider project. Minor works will typically be undertaken as stand-alone works.

8.7.2 Security Systems

Substation security fences and systems were retrofitted to nearly all TasNetworks sites in 2010.

In the future, it is expected that major security system upgrades or installations will be combined with other site works.

Ongoing minor component replacements will occur on an 'as required' basis.

8.7.3 Fire Suppression Systems

TasNetworks employs Very Early Smoke Detection Apparatus (VESDA) system. The generation of VESDA system installed is old and needs to be replaced with a later version of VESDA. A capital replacement program has been initiated to install, replace and upgrade fire detection and fire suppression systems within TasNetworks.

The Substation Fire Management Strategy has identified that TasNetworks substation buildings are not fitted with permanent fire suppression systems. Fire suppression systems may be required in high risk substations due to the catastrophic consequences associated with potential loss of a substation building due to fire.

TasNetworks will install fire suppression systems to its critical high risk sites as a part of a dedicated fire suppression rollout program.

New substation buildings identified as critical high risk will be constructed with fire suppression systems installed.

8.7.4 Oil Containment

Ideally, transformer oil containment system upgrades are undertaken as part of transformer replacement works. This is especially true for transformer bund and firewalls where working around in service transformers is costly and risky.

Where the risks associated with the oil containment are deemed to be higher than the need to replace the transformer, oil containment replacement may be undertaken as stand-alone works.

8.7.5 Switchyard and Road

The installation, or upgrade, of substation roads and transformer tracks or the replacement of grass switchyards with crushed rock is typically undertaken to allow other electrical apparatus work to occur. As such, these works are typically carried in conjunction with other capital work.

8.8 Program Delivery

The needs assessment and options analysis for undertaking an asset management activity is documented in the Investment Evaluation Summary for that activity.

The delivery of these activities follows TasNetworks' end to end (E2E) works delivery process.

8.9 Spares Management

Substation site infrastructure is commonly available and repairable by most qualified tradesmen. As such, TasNetworks does not maintain a dedicated suite of spares.

8.10 Technical Support

Other operational costs which are not able to be classified under the above categories are allocated to technical support. These tasks include:

- System fault analysis and investigation;
- Preparation of asset management plans;
- Standards management;
- Management of the service providers;
- Training;
- Group management; and
- General technical advice.

8.11 Disposal Plan

Disposal of any substation switchyards and building assets and or materials will be done in accordance with the relevant standards and procedures. Major items for consideration would include asbestos and contaminated soil.

8.12 Summary of Programs

Table 9 provides a high level summary of the work programs described in this management plan.

Table 9 - Summary of substation site infrastructure programs

Work Program	Work Category	Project/Program
Routine Maintenance	Preventative Maintenance	Visual Inspections
		Grass and Vegetation Management
		Oil Containment Maintenance
		Electric Fence Maintenance
		Building Repairs
		Fire Equipment Inspections
		Climate Control Maintenance
		Security Systems Inspections
		Crane Inspections
	Technical Support	Technical Support
Non-Routine Maintenance	Corrective Maintenance	Corrective Maintenance

Work Program	Work Category	Project/Program
Replacement	Asset Replacement	Building Upgrades
		Security System
		Fire Suppression Systems
		Oil Containment Upgrades
		Switchyard and Road Upgrades
Technology and Innovation		Three Dimensional Scanning of Substations

Tables 10 and 11 provide a more concise summary of all of the programs/projects described in this management plan.

Table 10: Summary of OPEX substation site infrastructure programs / projects

Work Program	Work Category	Work Category	Project/Program
Routine Maintenance	CMSBB	Corrective maintenance	S629-Environmental Compliance, 1154 - Environmental
	CMSBB	Corrective maintenance	S537-Rodent Control
	CMSBB	Corrective maintenance	S085-SUBS-Corrective-Fences and Gates
	CMSBB	Corrective maintenance	S549-Station Cleaning & Grass Cutting
	CMSBB	Corrective maintenance	S573-SUBS Building Repairs and Materials
	CMSBB	Corrective maintenance	S481-Ground & Building Maintenance
	CMSBB	Corrective maintenance	S557-Station Fire Suppression Maintenance
	CMCRN	Corrective maintenance	S441-Crane Maintenance
	CMBCE	Corrective maintenance	S561- SUBs- Structures Maintenance
	PMSBB	Preventative maintenance	S457-Drainage, Water Supply and Sewerage Preventive
	PMSBB	Preventative maintenance	S513-OMS Oil Management, 1152 - Oil management
	PMSBB	Preventative maintenance	S581-SUBS Power Charges
	PMSBB	Preventative maintenance	S509-Oil Containment Preventive
	PMSBB	Preventative maintenance	S389-Air Conditioning Preventive
	PMSBB	Preventative maintenance	S469-Fire Detection Preventive
	PMSBI	Preventative maintenance	S301-SUBS-Structures Inspection
	PMSBI	Preventative maintenance	S345-Switchyard Inspections
	PMSTX	Preventative maintenance	S593-Supply Transformer Clean Oil Bunds
	PMSBB	Preventative maintenance	S541-Security and Access Preventive

Table 11: Summary of CAPEX substation site infrastructure programs / projects

Work Program	Work Category	Project title	Project/Program details
Capital	PSCSB	Substation on-site condition monitoring inspection tools (portable)	Investigate potential for use of and implement as needed: 1. DRONE technology as a tool for asset condition inspection. Outcome could be to procure 2x DRONE for use South and North with potential roll-out into overhead lines. 2. PD hawk (or similar) hand held PD/ultrasonic detector for yard based and overhead line assets
	RENSB	Substation site infrastructure programs (security systems)	Improve reliability and security of electricity supply by ensuring substation buildings and yards have adequate security systems as appropriate for the substation. Initial identification has highlighted the following substations for Installation of security cameras: 1. Arthurs Lake Substation Security 2. Avoca Substation Security 3. Bridgewater Substation Security 4. Boyer Substation Security 5. Derby Substation Security 6. Emu Bay Substation Security 7. Electrona Substation Security 8. Huon River Substation Security 9. Kermandie Substation Security 10. Knights Road Substation Security 11. Meadowbank Substation Security 12. Mowbray Substation Security 13. Port Latta Security 14. Que Substation Security 15. Rosebery Substation Security 16. Scottsdale Substation Security 17. St Marys Substation Security 18. Sorell Substation Security 19. Savage River Substation Security 20. Smithton Substation Security 21. Triabunna Substation Security 22. Ulverstone Substation Security 23. Wayatinah Tee Switching Station Security
	RENSB	Substation site infrastructure programs (fire prevention, suppression and detection)	Investigate each substation and review need for new, updated or enhanced systems following on from work conducted in the 2014-19 regulatory period. Included with this project is the initiative

Work Program	Work Category	Project title	Project/Program details
			to investigate potential to install "sniffer tubes" off VESDA systems. This will involve modifying existing VESDA systems and have flexible tubes drop down from ceiling to top of panels. Panels to be targeted include: 1. P&C panels, 2. Battery chargers, 3. AC distribution 4. DC distribution If risk analysis supports, complete all 220 kV substations with suitable system. If Hypoxic is option progressed then look to move operator equipment (HMI, Earth leads) to non protected area, ie build a wall and new access door.

Work Program	Work Category	Project title	Project/Program details
	RENSB	Substation site infrastructure programs (civil component)	From initial investigation, two projects have been identified requiring renewal or replacement in the 2019-24 regulatory period. Further projects may be initiated as on-going site inspections occur and deteriorating asset condition are identified. Substation fencing - Burnie Substation Transformer oil containment systems - Risdon Substation
	RENSB	Substation gantry/bus renewal work (corrosion control)	Undertake a condition review of all terminal substations to identify if any are in need of remedial works on gantry or external bus work typically due to corrosion. One station already identified is Rosebery Substation. Allowance to provide corrosion control on bus-work and landing gantries or replace if required, at various substations. Several substations to be further reviewed include: • Rosebery 110 kV and 44 kV. • Farrell 220 kV and 110 kV. • Emu Bay 110 kV (bolts). • Savage River 110 kV (Franklin Rods) • Wesley Vale 110 kV (Franklin Rods) • George Town 220 kV F1 & G1 landing gantries. • Waratah tee (operating rods and tower cross-arms)

9 Financial Summary

9.1 Proposed OPEX Expenditure Plan

Requirements for operating expenditure are a function of the defined periodic condition monitoring regimes, defined maintenance requirements and expected minor and major site infrastructure works.

In the event that increased maintenance levels are required, the decision to replace equipment may be justified depending on the impact on preventive maintenance expenditure and transmission system performance.

The developed works plan is held and maintained in the works planning tool in AMIS. It contains details such as planning dates, task types, specific assets and planned costs.

9.2 Proposed CAPEX Expenditure Plan

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

Each project is then subjected to a detailed investment evaluation.

The site infrastructure capital works are typically combined with other works to optimise system performance and mitigate network and business risk.

To address the design, condition and performance risks associated with the asset category population, equipment highlighted in this asset management plan will be programmed for capital replacement.

Table 13 outlines the planned asset category replacement projects for the period 2019-29 and those previously targeted in the 2014-19 period. Note that this information needs to be reviewed after project prioritisation and this table may not include all augmentation works that may become apparent over time.

Table 12 – Site infrastructure capital plan

Category	Site	Works		Period
Buildings	Sorell	Reroofing	Completed	2014/19
	Ulverstone	Reroofing	Completed	2014/19
	Kingston 11 kV	Reroofing	Completed	2014/19
	Rokeby	Reroofing	Completed	2014/19
	St Marys	Reroofing	Completed	2014/19
	Emu Bay 11kV	Reroofing	Completed	2014/19
	Huon River	Reroofing	Review	2014/19
	Electrona	Capacitor bank room access upgrade	Review	2014/19
	Knights Road	Capacitor bank room access upgrade	Review	2014/19
	Chapel Street	Capacitor bank room access upgrade	Review	2014/19
	Mowbray	Capacitor bank room access upgrade	Review	2014/19
	Trevallyn	Capacitor bank room access upgrade	Review	2014/19
	Port Latta	Capacitor bank room access upgrade	Review	2014/19

Category	Site	Works		Period
	Railton	Capacitor bank room access upgrade	Review	2014/19
	Hadspen	Capacitor bank room access upgrade	Review	2014/19
	Ulverstone	Capacitor bank room access upgrade	Review	2014/19
Fence	George Town	Replace	Completed 2016	2014/19
	Burnie	Replace	Proposed	2019/24
Fire suppression	George Town	Install new system	Review	2014/19
	Palmerston	Install new system	Review	2014/19
	Hadspen	Install new system	Review	2014/19
	Sheffield	Install new system	Review	2014/19
	Lindisfarne	Install new system	Completed 2016	2014/19
	Farrell	Install new system	Review	2014/19
	Waddamana	Install new system	Review	2014/19
	Liapootah	Install new system	Completed 2016	2014/19
	Chapel St	Install new system	Completed 2016	2014/19
	Burnie	Install new system	Completed 2017	2014/19
	Creek Rd	Install new system	Completed 2017	2014/19
	Smithton	Install new system	Review	2019/24
	Port Latta	Install new system	Review	2019/24
	Savage River	Install new system	Review	2019/24
	Queenstown	Install new system	Review	2019/24
	Emu Bay	Install new system	Review	2019/24
	Ulverstone	Install new system	Review	2019/24
	Wesley Vale	Install new system	Review	2019/24
	Railton	Install new system	Review	2019/24
	Devonport	Install new system	Review	2019/24
	Mowbray	Install new system	Review	2019/24
	Norwood	Install new system	Review	2019/24
	Scottsdale	Install new system	Review	2019/24
	Derby	Install new system	Review	2019/24

Category	Site	Works		Period
	Avoca	Install new system	Review	2019/24
	St Marys	Install new system	Review	2019/24
	Tungatinah	Install new system	Review	2019/24
	New Norfolk	Install new system	Review	2019/24
	Bridgewater	Install new system	Review	2019/24
	Kingston	Install new system	Review	2019/24
	Electrona	Install new system	Review	2019/24
	Kermandie	Install new system	Review	2019/24
	Sorell	Install new system	Review	2019/24
	Triabunna	Install new system	Review	2019/24
Oil containment	Chapel Street	Tank replacement	Planned 2018	2014/19
	Risdon	Tank replacement	proposed	2019/24

9.3 CAPEX – OPEX trade offs

The operating expenditure programs are essential for identifying assets that require replacement for condition-based reasons. 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 the asset operating for as long as possible within the network.

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. This is not intended to be a full list of all of the standards, code and regulations used but only the key documents.

In the case of in variances of the requirements of the standards and specifications, the most stringent requirement will be applicable.

TasNetworks documents:

1. Strategic Asset Management Plan R248812
2. Annual Planning Report 2017 R689487
3. Engineering and Asset Services operational expenditure planning methodology D11/102320
4. AM8 Asset Condition Review – project report June16 FINAL R503361

Technical requirements for the supply and installation of new current transformers are detailed in the following TasNetworks standards:

5. Substation Civil Design and Construction Standard, R590634
6. General Substation Requirements Standard, R522687
7. Security Fences and Gates Standard, R579297
8. Substation Intruder Detection and Deterrence Standard, R579295
9. Substation Fire Management Strategy, R517369

Other standards and documents:

10. Australian Standard AS 1418, Cranes, hoists and winches – (suite of standards) - 2002
11. Australian Standard AS 2759, Steel wire rope – use, operation and maintenance – 2004
12. Australian Standard AS 3777, Shank hooks and large eye hooks – 2008
13. Australian Standard AS 2550.3, Cranes, hoists and winches safe use – (suite of standards) - 2002
14. Australian Standard AS 1670.1, Fire detection, warning, control and intercom systems - System design, installation and commissioning - Fire
15. Australian Standard AS 1670.3, Fire detection, warning, control and intercom systems - System design, installation and commissioning - Fire alarm monitoring
16. Australian Standard AS 1670.4, Fire detection, warning, control and intercom systems - System design, installation and commissioning - Sound systems and intercom systems for emergency purposes
17. Australian Standard AS 1670.6, Fire detection, warning, control and intercom systems - System design, installation and commissioning - Smoke alarms
18. Australian Standard AS/NZS 1668.1, The use of ventilation and airconditioning in buildings - Fire and smoke control in multi-compartment buildings
19. Australian Standard AS 1668.2, The use of ventilation and airconditioning in buildings - Mechanical ventilation in buildings
20. Australian Standard AS 1883, Guide to maintenance and supervision of insulating oils in service
21. Australian Standard AS 2067, Substations and high voltage installations exceeding 1 kV a.c

22. Australian Standard AS 2941, Fixed fire protection installations - Pumpset systems
23. Australian Standard AS/NZS ISO31000, Risk management – Principles and guidelines
24. Australian Standard AS/NZS 3000, Electrical installations (Australian/New Zealand Wiring Rules)
25. Sinclair Knight Merz, 'Assessment of Economic Lives for Transend Regulatory Asset Classes', 2013. R192773

11 Appendix A – Summary of Programs and Risk

Description	Work Category	Risk Level	Driver	Expenditure Type	Residual Risk
S629-Environmental Compliance, 1154 - Environmental	CMSBB	Medium	Customer Financial Safety	Opex	Low
S537-Rodent Control	CMSBB	Medium	Customer Financial Network performance Safety	Opex	Low
S085-SUBS-Corrective-Fences and Gates	CMSBB	Medium	Customer Financial Network performance Safety	Opex	Low
S549-Station Cleaning & Grass Cutting	CMSBB	Medium	Customer Financial Safety	Opex	Low
S573-SUBS Building Repairs and Materials	CMSBB	Medium	Customer Financial Safety	Opex	Low
S481-Ground & Building Maintenance	CMSBB	Medium	Customer Financial Safety	Opex	Low
S557-Station Fire Suppression Maintenance	CMSBB	Medium	Customer Financial Network performance Regulatory Reputation Safety	Opex	Low
S441-Crane Maintenance	CMCRN	Medium	Customer Financial Safety	Opex	Low

Description	Work Category	Risk Level	Driver	Expenditure Type	Residual Risk
S561- SUBs- Structures Maintenance	CMBCE	Medium	Customer Financial Safety	Opex	Low
S457-Drainage, Water Supply and Sewerage Preventive	PMSBB	Medium	Customer Financial Safety	Opex	Low
S513-OMS Oil Management, 1152 - Oil management	PMSBB	Medium	Customer Financial Safety	Opex	Low
S581-SUBS Power Charges	PMSBB	Medium	Customer Financial Safety	Opex	Low
S509-Oil Containment Preventive	PMSBB	Medium	Customer Financial Safety	Opex	Low
S389-Air Conditioning Preventive	PMSBB	Medium	Customer Financial Network performance Safety	Opex	Low
S469-Fire Detection Preventive	PMSBB	Medium	Customer Financial Network performance Regulatory Reputation Safety	Opex	Low
S301-SUBS-Structures Inspection	PMSBI	Medium	Customer Financial Safety	Opex	Low
S345-Switchyard Inspections	PMSBI	Medium	Customer Financial Network performance Safety	Opex	Low

Description	Work Category	Risk Level	Driver	Expenditure Type	Residual Risk
S593-Supply Transformer Clean Oil Bunds	PMSTX	Medium	Customer Financial Safety	Opex	Low
S541-Security and Access Preventive	PMSBB	Medium	Customer Financial Network performance Safety	Opex	Low
Substation on-site condition monitoring inspection tools (portable)	PSCSB	Medium	Customer Financial Safety	Capex	Low
Substation site infrastructure programs (security systems)	RENSB	Medium	Customer Financial Network performance Safety	Capex	Low
Substation site infrastructure programs (fire prevention, suppression and detection)	RENSB	Medium	Customer Financial Network performance Regulatory Reputation Safety	Capex	Low
Substation site infrastructure programs (civil component)	RENSB	Medium	Customer Financial Safety	Capex	Low
Substation gantry/bus renewal work (corrosion control)	RENSB	Medium	Customer Financial Safety	Capex	Low

12 Appendix B–Site infrastructure condition assessment

Description	Site	Buildings	Yards	Roads	Security	Oil containment
Arthurs Lake Substation	Acceptable	Marginal	Acceptable	Acceptable	Acceptable	Acceptable
Avoca Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Marginal
Butlers Gorge Tee Switching Station	Acceptable	Not Applicable	Acceptable	Acceptable	Acceptable	Not Applicable
Burnie Substation	Acceptable	Marginal	Marginal	Acceptable	Acceptable	Acceptable
Bridgewater Substation	Acceptable	Acceptable	Acceptable	Marginal	Acceptable	Acceptable
Boyer Substation	Marginal	Marginal	Acceptable	Marginal	Marginal	Acceptable
Castle Forbes Bay Tee Switching Station	Acceptable	Not Applicable	Acceptable	Acceptable	Acceptable	Not Applicable
Creek Road Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Chapel Street Substation	Acceptable	Acceptable	Marginal	Acceptable	Acceptable	Poor
Derwent Bridge Substation	Acceptable	Marginal	Acceptable	Acceptable	Acceptable	Acceptable
Derby Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Devonport Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Emu Bay Substation	Acceptable	Marginal	Acceptable	Marginal	Acceptable	Acceptable
Electrona Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Farrell Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Gordon Substation	Marginal	Acceptable	Marginal	Acceptable	Acceptable	Acceptable
George Town Substation	Acceptable	Acceptable	Acceptable	Acceptable	Marginal	Acceptable
George Town Transition Station	Acceptable	Not Applicable	Acceptable	Acceptable	Acceptable	Not Applicable
Hadspen Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Marginal
Hampshire Switching Station	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Not Applicable
Huon River Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Kermandie Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Kingston Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Knights Road Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Lindisfarne Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Marginal

Description	Site	Buildings	Yards	Roads	Security	Oil containment
Liapootah Switching Station	Acceptable	Acceptable	Marginal	Acceptable	Acceptable	Not Applicable
Lake Echo Tee	Acceptable	Not Applicable	Acceptable	Acceptable	Acceptable	Not Applicable
Meadowbank Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Marginal
Mount Nelson Sub Station (land Only)	Acceptable	Not Applicable	Not Applicable	Acceptable	Not Applicable	Not Applicable
Mornington Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Mowbray Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
North Hobart Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Marginal
New Norfolk Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Newton Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Norwood Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Port Latta Substation	Acceptable	Acceptable	Marginal	Acceptable	Acceptable	Acceptable
Palmerston Substation	Acceptable	Acceptable	Acceptable	Marginal	Acceptable	Acceptable
Queenstown Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Que Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Railton Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Rosebery Substation	Marginal	Acceptable	Marginal	Acceptable	Acceptable	Acceptable
Risdon Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Rokeby Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Rokeby Transition Station	Acceptable	Not Applicable	Acceptable	Acceptable	Acceptable	Not Applicable
Scottsdale Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Sheffield Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
St Leonards Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
St Marys Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Poor
Sorell Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Savage River Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Smithton Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Triabunna Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable

Description	Site	Buildings	Yards	Roads	Security	Oil containment
Trevallyn Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Tungatinah Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Ulverstone Substation	Acceptable	Marginal	Acceptable	Acceptable	Acceptable	Acceptable
Waddamana Substation	Acceptable	Acceptable	Acceptable	Marginal	Acceptable	Acceptable
Waratah Tee Switching Station	Acceptable	Not Applicable	Acceptable	Acceptable	Acceptable	Not Applicable
Wesley Vale Substation	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Wayatinah Tee Switching Station	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Not Applicable

Assessment methodology is details in section 7.

13 Appendix C – Security major components by site

Site (Substation)	Access Control System	Controlled Electric Operated Sliding Gates	Controlled Pedestrian Gates	Controlled Doors	Electric Fence System	Intruder Detection System	Cameras
Arthurs Lake*	1		1	1	1	1	
Avoca*	1	1		1	1	1	
Boyer	1			4		1	
Bridgewater	1	2	1	1	1	1	
Burnie	1	1		3	1	1	5
Chapel Street	1	2	1	4	1	1	11
Creek Road*	1			3		1	
Derby	1	1	2	1	1	1	
Derwent Bridge	1		1	1	1	1	
Devonport	1	1		1	1	1	3
Electrona	1	1		1	1	1	
Emu Bay	1			2	1	1	
Farrell	1	2		1	1	1	5
George Town	1	1	1	7	1	1	12
Gordon	1				1	1	5
Hadspen	1	1	1	1	1	1	9
Kermandie	1	1	1	1	1	1	
Kingston	1		1	1	1	1	2
Knights Road	1	1	1	2	1	1	
Liapootah	1	1	1	2	1	1	5
Lindisfarne	1	1		1	1	1	6
Meadowbank	1	1		1	1	1	
Mowbray	1	1	1	2	1	1	
New Norfolk	1			1	1	1	3
Newton*					1	1	
North Hobart	1	1		1	1	1	2
Norwood	1	1		1	1	1	2
Palmerston	1	3	1	2	1	1	10
Port Latta	1		1	1	1	1	2
Que	1			1	1	1	
Queenstown	1	1	1	1	1	1	2
Railton	1	1		1	1	1	5
Risdon	1	1	1	7	1	1	5
Rokeby	1	1	1	1	1	1	2
Rosebery	1		1	2	1	1	
Savage River	1			1	1	1	
Scottsdale	1			1	1	1	
Sheffield	1	3	1	3	1	1	10
Smithton	1			1	1	1	
Sorell	1			1	1	1	
St Leonards	1	1	1	2	1	1	4
St Marys	1			1	1	1	
Trevallyn	1		1	2	1	1	2
Triabunna	1	1	1	1	1	1	
Tungatinah	1	1	1	1	1	1	6
Ulverstone	1		1	1	1	1	
Wayatinah Tee	1		1		1	1	
Wesley Vale	1			1	1	1	4
TOTALS	47	35	24	81	45	48	122

* Upgrade works presently underway. Numbers reflect the present, and not the proposed installation.