Asset Management Plan

Overhead Switchgear - Distribution

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Authorisations

Action	Name and title	Date
Prepared by	David Eccles - Asset Strategies Engineer, Asset Strategy	04/08/2017
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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").

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

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

Record of revisions

Section number	Details
	New Document
3 ,4	Revised to include Bushfire Mitigation Overlay; Performance data updated Appendices added
All	Full review

Table of contents

The purpose of this document is to describe for distribution overhead switchgear assets:

- 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

This document covers all mechanical overhead switchgear in the distribution network including:

- low voltage switch fuses;
- low voltage links;
- high voltage links;
- expulsion drop out fuses; and
- air break switches.

The scope of this Overhead Switchgear - Distribution Asset Management Plan also includes the primary components of gas or vacuum enclosed:

- High voltage switches;
- sectionalisers;
- automatic circuit reclosers (reclosers); and
- capacitors.

It does not include secondary components of gas or vacuum enclosed high voltage switches, sectionalisers, automatic circuit reclosers and capacitors.

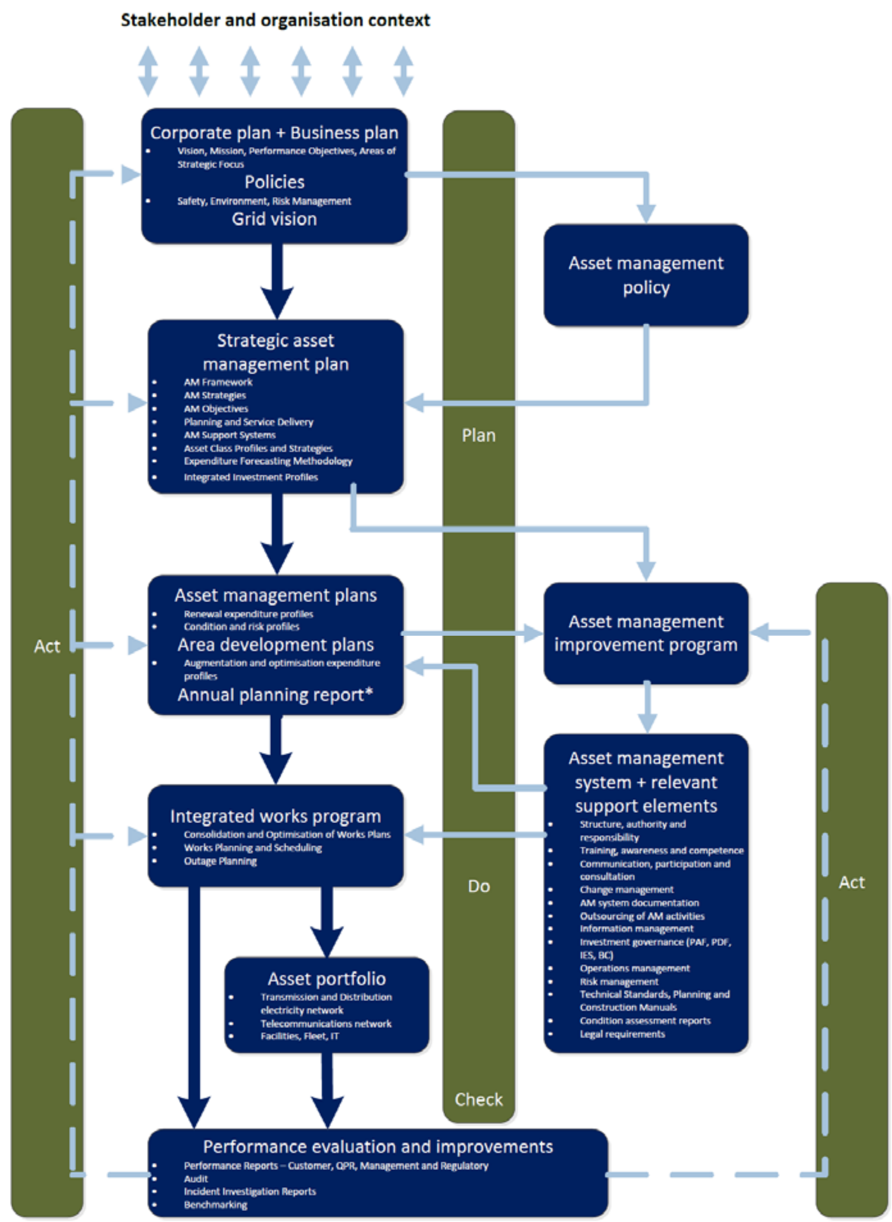
This asset management plan has been developed to align with both TasNetworks' Asset Management Policy and strategic objectives. This management plan describes the asset management strategies and programs developed to manage the distribution overhead switchgear assets, with the aim of achieving these 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

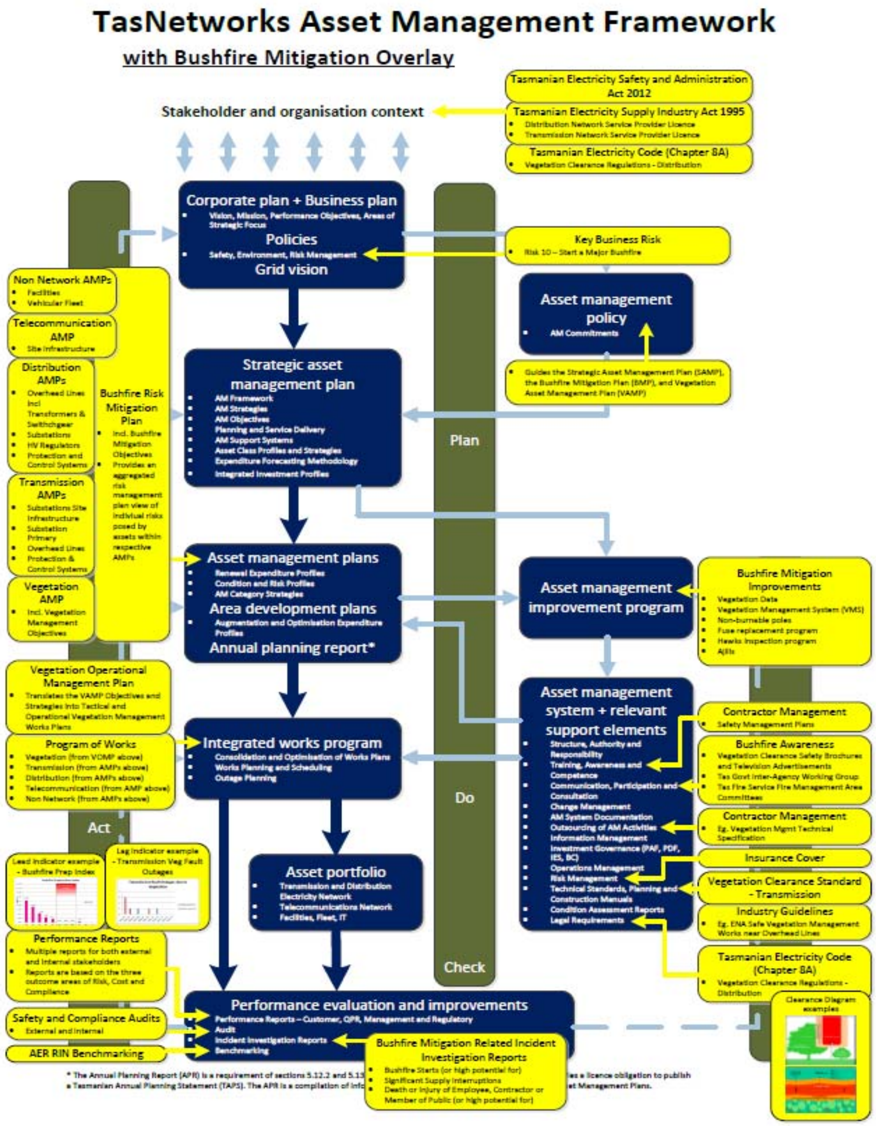


* The Annual Planning Report (APR) is a requirement of sections 5.12.2 and 5.13.2 of the National Electricity Rules (NER) and also satisfies a licence obligation to publish a Tasmanian Annual Planning Statement (TAPS). The APR is a compilation of information from the Area Development Plans and the Asset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

1.1 Bushfire Mitigation Framework

Many TasNetworks assets, including distribution overhead switchgear is located within areas of the state affected by bushfire. TasNetworks' bushfire mitigation framework has been overlaid onto the TasNetworks Asset Management framework to show the direct relationship between the two, and is shown in Figure 2. The Bushfire Mitigation Asset Management Plan provides guidance to other stakeholders in the preparation of asset management plans, ensuring effective bushfire risk mitigation outcomes are achieved, while also summarising some key bushfire risk mitigation outcomes and commitments made within those asset management plans.

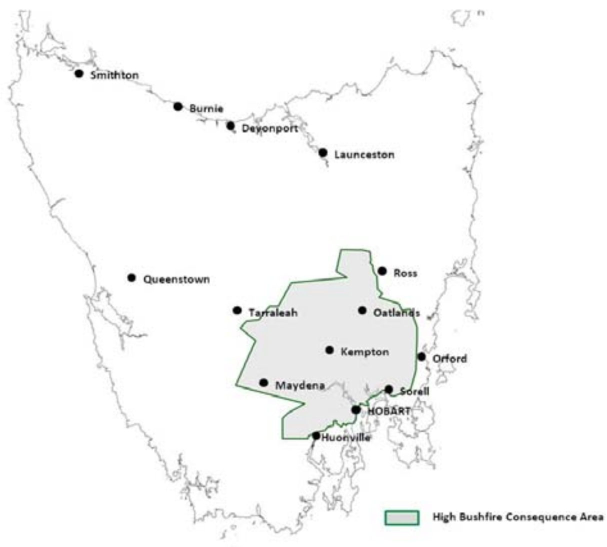
Figure 2: TasNetworks Asset Management Documentation Framework with Bushfire Mitigation Framework Overlay



TasNetworks is also internally benchmarking for the bushfire risk mitigation management which is updated periodically with year to date performance reporting in TasNetworks.

The definition of the High Bushfire Consequence Area is flexible, however, and can change periodically, in that TasNetworks has the option of extending the area covered by its pre-summer inspection and cutting program. If conditions leading into the bushfire season pose sufficient risk TasNetworks may warrant additional work to be undertaken. Such risks and additions to the program are developed in consultation with the Tasmania Fire Service and the Bureau of Meteorology. Map of the current High Bushfire Risk Consequence Area is shown in Figure 3.

Figure 3: Current high bushfire consequence areas



1.2 Business Objectives

Strategic and operational performance objectives relevant to this project are derived from TasNetworks 2017-18 Corporate Plan, approved by the board in 2017. This project is relevant to the following areas of the corporate plan:

We understand our customers by making them central to all we do;

We enable our people to deliver value; and

We care for our assets, delivering safe and reliable networks services while transforming our business.

1.3 Business initiatives

The business initiatives reflected in TasNetworks Transformation Roadmap 2025 publication (June 2017) for transition to the future that have synergy with this project is as follows:

Voice of the customer: We anticipate and respond to your changing needs and market conditions.

Network and operations productivity: We'll improve how we deliver the field works program, continue to seek cost savings and use productivity targets to drive our business.

Electricity and telecoms network capability: To meet your energy needs and ensure power system security, we'll invest in the network to make sure it stays in good condition, even while the system grows more complex.

Predictable and sustainable pricing: To deliver the lowest sustainable prices, we'll transition our pricing to better reflect the way you produce and use electricity.

Enabling and harnessing new technologies and services: By investing in technology and customer service, we'll be better able to host the technologies you're embracing.

1.4 Systems

TasNetworks maintains an asset management information system (AMIS) that contains detailed information relating to distribution overhead switchgear assets. AMIS is a combination of people, processes, and technology applied to provide the essential outputs for effective asset management. AMIS data integrity standards provide additional information relevant to each asset class. Data integrity standards have been developed for transmission assets, however they have not yet been developed for distribution assets.

Distribution asset information is recorded and stored in TasNetworks Geographic Information System (GIS) data systems. The location in which data is stored and maintained is dependent on the particular nature of the data, but systems are often configured to enable the flow of changes in one system to be reflected in the other. These systems will be replaced or updated in 2018 as part of the Ajilis Transformation program.

1.5 Asset management information improvement initiative

To realise this capability at TasNetworks, the AMIS improvement program is delivering a rigorous and methodical series of targeted initiatives designed to build capability. When implemented, this program will deliver trusted, timely and high quality asset information that supports the strategic and operational asset management processes required for best-practice asset management. This program is complimentary with the current upgrade data system project and will rely on and benefit from the integrated asset and works management system provided by that project.

The AMIS improvement program is currently delivering the foundations of a mature asset management system including the establishment of:

- asset hierarchies
- asset data integrity standards and
- asset nomenclature standards

The establishment of a contemporary asset condition inspection system for network assets (including, but not limited to distribution poles) has also been identified as a priority initiative within the scope of the AMIS improvement program. TasNetworks currently relies on an out dated and unsupported product for pole mounted transformer inspections. Whilst this tool captures rudimentary pole mounted transformer condition data, the application is no longer supported and cannot be enhanced to take account of altering asset management practices, changing work practices or varying asset configurations. Options for an enhanced, extensible and future-proofed solution are currently being investigated by TasNetworks.

1.6 Asset information

Distribution overhead switchgear asset information which is recorded includes: geographical location, kVA rating, number of connected customers, nameplate information and number of connected life support customers. This information is generally well documented however it is acknowledged that improvements to information accuracy, data integrity and quality are required in some cases.

Overhead switchgear is installed to provide isolation or disconnection of sections of high voltage or low voltage overhead lines for the purposes of maintenance, management of load or protection.

TasNetworks manages over 76,000 overhead switchgear assets.

Overhead switchgear can be sub-categorised, based on functionality as follows:

- reclosers
- sectionalisers
- enclosed arcing load break switches (or 'gas switches')
- air break switches
- high voltage links
- high voltage fuses
- high voltage capacitors and
- low voltage links

Technological innovation can create need for new overhead switchgear sub-categories from time to time, for example trial use of digital sectionalisers in drop-out fuseholders or cut-outs.

1.7 Reclosers

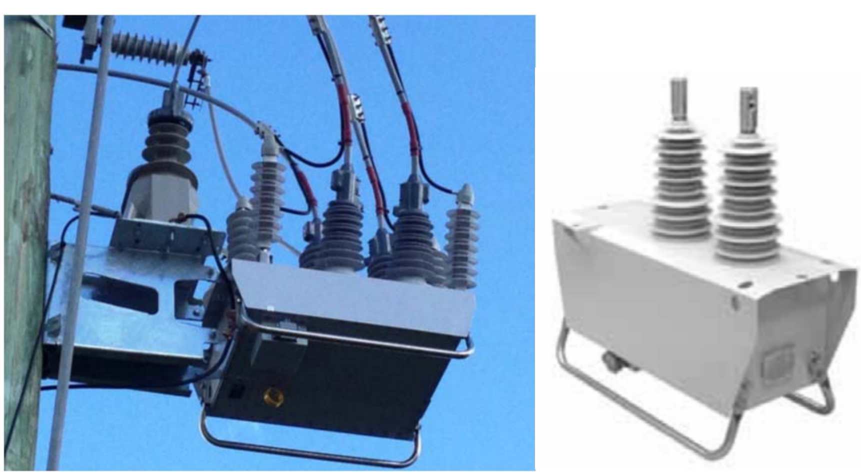
Reclosers are rated fault current breaking devices that operate to clear temporary faults and reclose but when necessary isolate permanent faults.

When a fault is detected by a recloser, after a defined period of time, the recloser will open to isolate the fault. A number of attempts will be made to re-energise the network section downstream of the recloser. If the fault was temporary, the reclose process will be successful, and supply will be restored to that section of network. If the fault was permanent, after the defined number of attempts, the recloser will open and remain open, isolating the faulted network from supply.

TasNetworks' asset base comprises gas-insulated, solid dielectric (vacuum) and oil-filled reclosers, which are manufactured by Schneider-Nulec, Noja Power and Reyrolle OYT respectively. TasNetworks recently removed Reyrolle OYT reclosers from service due to the units being oil filled, under failure the oil creates a safety and environmental risk, where other non-oil filled types of recloser perform in a similar manner without this risk.

As part of the bushfire risk mitigation program two Noja Single Wire Earth Return (SWER) reclosers are already installed to replace SWER EDO fuselinks, three more are underway and there are plans to expand the program.

Figure 4: A three phase Noja recloser with Voltage transformer and a Noja SWER recloser



These reclosers include a more sensitive protection innovation after the Victorian Bushfire Mitigation R&D program was announced in late 2015. More Noja SWER reclosers are to be progressively installed in TasNetworks 64 SWER isolator systems based on the assessed risk of each system. Current contract three phase reclosers from Noja will now also contain protection innovation from the 2015 Victorian Bushfire Mitigation R&D program with the RC10 relay with firmware version 1.15

1.8 Sectionalisers

Sectionalisers are off-load devices that work in conjunction with reclosers to disconnect sections of the network under fault conditions, to attempt to isolate faulted sections of the network.

Sectionalisers are located downstream of reclosers and monitor the fault current and circuit interruption of the up-stream devices. After a pre-programmed number of recloser re-energisation attempts, the sectionaliser will open during the open period of the recloser. If the fault was on the section of line that the sectionaliser disconnected, the next reclose attempt will result in the successful re-energisation of network section downstream of the recloser.

With the exception of the Nulec RL27 gas switches, seen in Figure 5 when configured as a sectionaliser), sectionalisers are not rated for breaking load current, and must be opened during the open cycle of the upstream recloser.

Any remaining oil-filled sectionalisers are being replaced in service due to the units being oil filled, as under failure the oil creates a safety and environmental risk, where other non-oil filled types of sectionaliser perform in a similar manner without this risk.

Figure 5: Nulec RL27 enclosed load break switch can be reconfigured as a sectionaliser

TasNetworks has installed in its network a variety of ABB (thermal) sectionalisers that, due to inconsistent operation reliability, are been actively removed from the distribution network. There have also been performance issues identified with AK Power sectionalisers and a program to remove these devices from service has also been undertaken.

1.9 Gas switches (or Enclosed Load Break switches)

Gas or vacuum filled enclosed switches are three phase switching devices with the ability to make and break load currents. They are generally not rated for breaking fault current. Gas or vacuum filled enclosed switches are installed where there is a requirement to open or close switchgear when feeders are energised and have load current on, such as during paralleling operations. Assets such as Nulec NL27 devices, as seen in Figure 5, can be reconfigured as gas switches and/or sectionalisers. Although commonly called Gas Switches, now, with several new alternative vacuum filled enclosed load break switches makes available, a more generic functional name in future would be Enclosed Load Break Switches (or ELB).

1.10 Air breaks switches

Also known as ganged isolators, air break switches are high voltage switching assets that allow the connection and disconnection of sections of the high voltage network under load. A single operating lever that is located 5m up the pole is used to operate the device. This lever is normally accessed using a ladder and requires a physical force to operate air break switches are typically rated to withstand faults up to 16 kA, however older units may have experienced some reduction in fault withstand capacity as a result of damage and deterioration over the life of the asset.

Figure 6: Horizontally operated air break switch

TasNetworks' spatial asset information stored on air break switches was limited to the device plate identification numbers and the geographical location of the device.

Until 2014/15 there was no attribute or condition data stored for air break switches installed in the network, however a lengthy field audit inspection of all 4,200 air break switches concluded in 2015/16 was implemented to collect and store this information to better manage air break switch programs.

1.11 High voltage links

High voltage links are single phase switching devices and have a single break action, as shown in Figure 7. High voltage links are generally installed as a set of three for use on three phase circuits, or sets of two on single phase circuits. High voltage links are not rated for breaking load current but allow the connection and disconnection of energised network elements.

High voltage links may be mounted vertically, horizontally upright or under slung. In

Table **21: Volumes of specific assets in their respective categories**

Category	Description	Total (2015/16)	Total (2016/17)
Inspan Digital Sectionaliser	Fusesaver	29	29
Reclosers	Unknown	3	7
	NOJA	1	39
	NOJA SWER		3
	Nulec N-Series	342	333 as remote controlled and 13

			manual operation =346
	Reyrolle OYT	9	0
	Sub Total	**384**	**421**
Sectionalisers	Unknown	7	7
	Sectionaliser	84	60
	NOJA as Sectionaliser (but configured as recloser)		4
	Sectionaliser ABB	1	1
	Sectionaliser AK	52	43
	Sectionaliser Nulec RL 27	32	42 as remote controlled
	Sub Total	176	**157**
Gas Switches (Enclosed Load Break Switches)	Unknown	2	2
	NOJA as switch (but configured as recloser)		3
	Gas switch NGK Stanger	1	1
	Gas switch Nulec N-Series	3	3
	Gas switch Schneider/Nulec RL27	143	139 remote controlled plus 26 manual operation =165
	Sub Total	**149**	**173**
Category	**Description**	**Total (2015/16)**	**Total (2016/17)**
Air break switches	Air break switch	4183	4512
	Fuse/air break switch	33	29
	Sub Total	**4216**	**4541**
High voltage links	Link	1,710	1658
	Link + arc break	285	380
	Sub Total	**1,995**	**2038**
HV fuse links	HV Fuse/air break switch	33	29
	Expulsion drop out fuse with solid Link	694	694
	HV Fuse (counts 3phase & 1phase set as one site)	7,048	7141
	HV Fuse/link	3	2
	No switchgear	1,972	1972
	Unknown	19	19
	Sub Total	**9769**	**9857**
High voltage capacitors	ABB, 3 phase, 390 kvar	1	1
	ABB, 3 phase, 900 kvar	1	1
	Sub Total	**2**	**2**
Low voltage switchgear	Low voltage fuse links	25,499	25,499
	Low voltage links	3,610	3,610
	No switchgear	896	896
	Unknown	1,221	1,221
	Sub Total	**31,226**	**31,226**

Network total 2016/17 is 48,034 overhead switchgear assets.

The remaining 29 FuseSavers will be progressively decommissioned from permanent in service feeder locations. Decommissioned FuseSavers have been converted for repeated temporary use as HV live Line Switches to facilitate HV Live Line Procedure work site safety with emergency tripping. They are used in programs such as replacing cracked insulator Air Break Switches with minimised customer interruptions.

, the term “Link + Arc Break” refers to links that have arc break devices installed, but are not ganged, as is the case with air break switches.

Location-specific and loading–specific ferroresonance effect overvoltage risk from actioning unganged single phase switching of links can require augmentation to three phase switching operation switches.

Figure 7: Typical high voltage link vertical arrangement in its closed position

1.12 High voltage fuses

TasNetworks overhead high voltage fuses occur most commonly as expulsion drop out fuses (EDOs) and consist of a porcelain insulator with a hinged fibre tube held in place by a fusible link. When the expulsion drop out fuses experiences a fault current that exceeds the curve rating for the device, the fusible link melts, causing the fuse to drop open to isolate the equipment or section of network that it is protecting.

EDOs are mostly used to protect pole mounted transformers and spur lines, although some are used for protecting HV cable risers, and there are still a number of feeder trunks that use them as in-line fusing.

Network Planning policy initiates uprating of EDO sets for network growth in load current and /or fault current.

Figure 8: Boric acid drop out Fuselink needs a larger fuse mounting assembly to replace an EDO

The risk management plan for high bushfire consequence areas is for continued introduction of a more sophisticated enclosed fuse, namely the boric acid drop out fuse, in replacement of the EDO. While the operation of this device is similar to the EDO, in that when operated the fuse tube falls through an arc to break the circuit, the actual fuse is a powder filled fuse arc and a spring loaded striker actuates the solid boric acid to extinguish the arc internally.

The benefits are that under high fault operation only a small amount of plasma is released and no molten particles unlike EDOs. The probability of a 'hang-up' is removed because the fuse is released by a dedicated mechanical action not reliant on a tension release and gravity, as with the EDO. The boric acid fuse tube is also not open to the weather.

The boric acid fuse element is made from pure silver and is thus not susceptible to surges on the line to the same extent that affect expulsion drop out fuse elements.

TasNetworks HV fuse operation with respect to bushfire ignition risk was historically tested to SAA AS 1033 before it was superseded by an IEC standard publication. As that IEC standard is without a matching test for Australian bushfire risk, TasNetworks retained reference to SAA superceded SAA AS 1033 for bushfire performance test for use on TasNetworks' network.

1.13 High voltage capacitors

Where TasNetworks experiences poor voltage regulation as a result of reactive losses from long feeder lengths and heavy loading, reactive support can be utilised to maintain the voltage within acceptable limits. TasNetworks has installed two pole mounted ABB HV capacitor banks in the Meander Valley to provide reactive support for the highly inductive agricultural loads on these feeders. More of these devices are expected to be introduced to the distribution network in the short term. These ABB Capacitor banks are EDO protected, and have a single phase LV supply arrangement.

Figure 9: Pole mounted ABB capacitor bank

1.14 Low voltage fuse links & links

The purpose of LV switchgear is to provide protection of the LV network and allow LV network reconfiguration for fault restoration and maintenance. LV switch fuses can be used as both a link and a fuse. They are used as isolation points at transformers and to protect LV circuit from faults.

LV links are used as isolation points at transformers and as a connection/disconnection point between low voltage circuits. Low voltage links can be used to parallel LV circuits when sections of network or assets must be taken out of service, to maintain supply to LV customers.

5.9 SWER Isolating Transformer Fuses

Of the total of 64 isolating transformers installed on Single Wire Earth Return (SWER) lines, there are;

- 25% fused with EDOs,
- 3% fused with EDOs with solid link,
- 30% No switchgear, and
- 42% Unknown.

The majority of data for these sites is unknown.

Based upon post 2009 Bushfire Royal Commission and Victorian Government subsidised Victorian Distributor Bushfire Risk Mitigation research and development information published in 2015, improved HV arcing fault detection schemes have become available in new SWER reclosers. Apart from replacement of SWER spur systems with Remote Area Power Supply (RAPS) or single phase or three phase spur line due to load increase, the strategy for the removal of the remaining SWER isolating transformers to retrofit SWER EDO fuses replacement with SWER reclosers. The first priority is to replace units located within the HBLCA. The replacement cost to replace all 64 SWER systems with single or three phase supply augmentation is likely to exceed $90 million. Hence a more cost effective solution is planned to replace the remaining SWER EDO with SWER reclosers, embodied with the new protection scheme.

In 2016/17, two Noja SWER reclosers have been installed at locations within the HBCA, with another three are in process of being installed.

5.10 EDO replacement trials with digital sectionalisers in fuse cut-out

TasNetworks is currently reviewing technology options for the replacement of EDOs to improve safety and the reliability of the network.

In particular this is for EDO spur fuse or series in line feeder locations for enclosed arc switching, improved protection grading, meeting rising annual EDO or Bushfire risk replacement Boric Acid fuse operations count, rising fault current, and /or smart grid circuit configuration changes, fuse performance risk management improvement regrading reason , to control newly arising Ferro resonance risk or single phasing risks, some EDO fuses can now be upgraded or replaced by alternative new switch digital era technology. That can be conventional upgrading to sectionalisers, or reclosers by Network Planning review.

There is also a Smart Network, Distributed Generation/Distributed Energy Storage evolving need for more SCADA sensor connectivity in now more strategically located existing EDO switch sites. A new intermediate cost switch type is the digital sectionaliser replacement into an EDO fuse mounting assembly or fuse cut-out mounting. To develop local network in service experience with new technology switch assets understanding in real world service life competitively there needs to be workplace HAZOP for new EDO-replacement alternatives trials. Trials are planned for assessing new technologies in digital sectionalisers in “cut-outs” that can replace EDO fuselinks in same or similar fusemounting assemblies to minimise change out cost.

1.15 Overhead switchgear population

1.15.1 Population volumes

Table 2 lists the types of overhead switchgear that were in place in the network in 2015/16 and 2016/17.

Table 21: Volumes of specific assets in their respective categories

Category	Description	Total (2015/16)	Total (2016/17)
Inspan Digital Sectionaliser	Fusesaver	29	29
Reclosers	Unknown	3	7
	NOJA[1]	1	39
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	Sub Total	**149**	**173**

1 NOJA can be software reconfigured either sectionalisers or reclosers
2 Schneider Nulec RL series configured either as sectionalisers or as Gas Switches (Enclosed Load Break Switches)
Note-two Reyrolle OYT may remain as private owned assets.

Category	Description	Total (2015/16)	Total (2016/17)
Air break switches[3]	Air break switch	4183[i]	4512
	Fuse/air break switch	33	29
	Sub Total	**4216**	**4541**
High voltage links	Link	1,710	1658
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The remaining 29 FuseSavers will be progressively decommissioned from permanent in service feeder locations. Decommissioned FuseSavers have been converted for repeated temporary use as HV live Line Switches to facilitate HV Live Line Procedure work site safety with emergency tripping. They are used in programs such as replacing cracked insulator Air Break Switches with minimised customer interruptions.

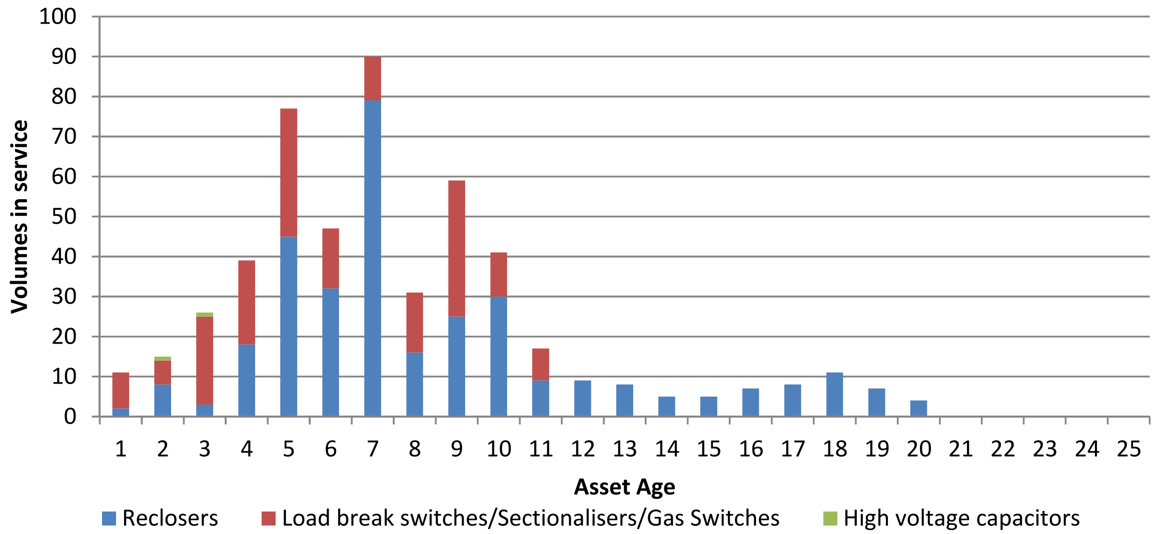
[3] Note: Switch type of fuse/air break switch refers to a fuse/air break switches parallel combination to allow the bypass of the fuse elements where needed.

[4] Volumes of low voltage protection from overhead transformers

1.15.2 Population age trend

The below figure 10 shows the current ages and in service volumes for Nulec and Noja: gas switches, sectionalisers and reclosers; and ABB high voltage capacitor banks.

Figure 10: Primary components installed volumes, by year.



There are no age records stored on the age of: LV links & LV fuse links, HV links & HV fuses and air break switches. There are no age records stored on non Nulec or Noja: gas switches, sectionalisers and reclosers. Recently field audit inspections have been undertaken to gather asset condition, and onsite detail of all air break switches and about 10% of all EDO's.

2 Standard of service

2.1 Technical Standards

Standards applying to distribution overhead switchgear assets include:

- AS/NZS 7000:2010 – Overhead line design – Detailed procedures
- GS30 - Distribution Pole Mounted Automatic Circuit Reclosers, Sectionalisers and Load Break Switches
- GS40 - Distribution Pole Mounted Switchgear
- GS35 – Low Voltage Fuses, Fuse Holders & Circuit Breakers & high Voltage Fuses
- Pole Mounted Load Break Enclosed Switches (R303648)

2.2 Key Performance Indicators

TasNetworks monitors distribution assets for major faults through its outage and incident reporting processes.

Asset failures resulting in unplanned outages are recorded in the “InService” outage management tool by field staff, with cause and consequence information being subsequently made available to staff for reporting and analysis. Those outages with a significant enough consequence are also recorded in Risk Management Safety System (RMSS) software and are investigated by the business to establish the root cause of the failure and to recommend remedial strategies to reduce the likelihood of reoccurrence of the failure mode. Reference to individual fault investigation reports can be found in RMSS.

TasNetworks also maintains a defect management system that enables internal performance monitoring and statistical analysis of asset faults and/or defects that either may not result in unplanned outages, or whose failure may only result in a minor consequence not requiring full investigation.

TasNetworks’ Service Target Performance Incentive Scheme (STPIS), which meets the requirements of the Australian Energy Regulator’s (AER’s) Service Standards Guideline, imposes service performance measures and targets onto TasNetworks with a focus on outage duration and frequency. While the STPIS does not target specific asset classes, good asset performance will have a significant impact on TasNetworks’ ability to meet the STPIS targets.

STPIS parameters include:

- System Average Interruption Duration Index (SAIDI) and
- System Average Interruption Frequency Index (SAIFI)

Details of the STPIS scheme and performance targets can be found in reference.

Figure 21: Conductor and hardware as a proportion of all overall overhead asset events breakdown

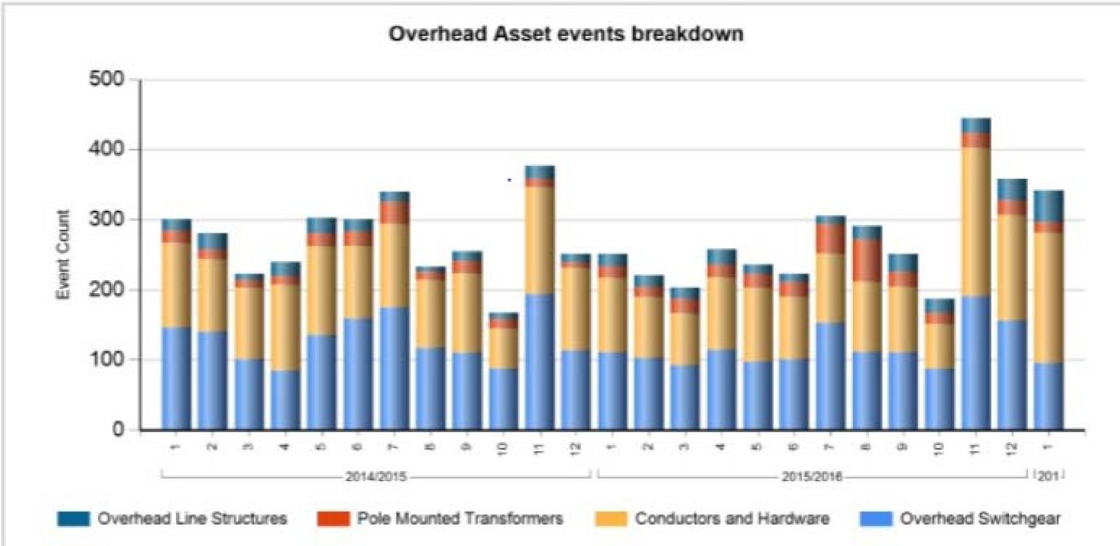


Figure 22: A monthly asset performance report fault trend in pole mounted switchgear types

Repoting Month : 2017 - May

Asset Performance by System Level

Asset Category	Asset Type	Event Count												
		2015/2016	2016/2017											Fault Trend
		Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	
Overhead Switchgear	AIR BREAK SWITCH	1	0	1	0	3	0	2	1	0	2	2	0	↑
	EDO	99	117	76	90	75	117	186	162	147	116	133	102	↑
	RECLOSER	1	1	0	0	0	0	0	0	0	1	0	0	↓
	SECTIONALISER (GAS)	0	0	0	0	0	0	0	0	0	0	0	0	↑
	SECTIONALISER EDO	2	4	6	3	6	3	10	6	3	6	2	5	↑

2.2.1 Benchmarking

TasNetworks participates and works closely with distribution companies in key industry forums such as CIGRE (International Council on Large Electric Systems), IEEE, ANSI, AS/NZ and Energy Networks Australia (ENA), to compare asset management practices and performance to ensure we keep abreast of industry good practice and contemporary asset management. In addition, affiliation and representation on Australian Standard and other international standards bodies helps TasNetworks maintain influence on designs and standards and ensure that TasNetworks maintains a strong asset management focus with the objective being continually improvement.

3 Risk

TasNetworks has developed a Risk Management Framework for the purposes of

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

Assessment of the risks associated with the distribution overhead switchgear has been undertaken in accordance with the Risk Management Framework. The risk assessment involves:

- Identification of the individual risks including how and when they might occur
- Risk analysis of the effectiveness of the existing controls, the potential consequences from the risk event and the likelihood of these consequences occurring to arrive at the overall level of risk.
- Risk evaluation where risks are prioritised based on their ratings and whether the risk can be treated) or managed at the current level.

The likelihood and consequence of risk events occurred are assessed using the following risk rating matrix in figure 2:

Figure 2; Risk Ranking Matrix

		CONSEQUENCE				
LIKELIHOOD		1 NEGLIGIBLE	2 MINOR	3 MODERATE	4 MAJOR	5 SEVERE
• ≥ 99% probability • Impact occurring now • Could occur within “days to weeks”	5 ALMOST CERTAIN	MEDIUM	MEDIUM	HIGH	VERY HIGH	VERY HIGH
• 50% - 98% probability • Balance of probability will occur • Could occur within “weeks to months”	4 LIKELY	LOW	MEDIUM	HIGH	HIGH	VERY HIGH
• 20% - 49% probability • May occur shortly but a distinct probability it won’t • Could occur within “months to years”	3 POSSIBLE	LOW	LOW	MEDIUM	HIGH	HIGH
• 1% - 19% probability • May occur but not anticipated • Could occur in “years to decades”	2 UNLIKELY	LOW	LOW	MEDIUM	MEDIUM	HIGH
• ≤1% probability • Occurrence requires exceptional circumstances • Only occur as a “100 year event”	1 RARE	LOW	LOW	LOW	MEDIUM	MEDIUM

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

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

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

This asset management plan describes the major risks associated with overhead switchgear and the current or proposed treatment plans.

3.1 Reclosers

The key risks associated with reclosers in the network is that if the fault is not cleared and the circuit is closed multiple times it can create secondary faults which effects reliability, safety and the environment.

The last known Reyrolle OYT oil-filled recloser with oil related risks have been decommissioned and replaced in 2015/16.

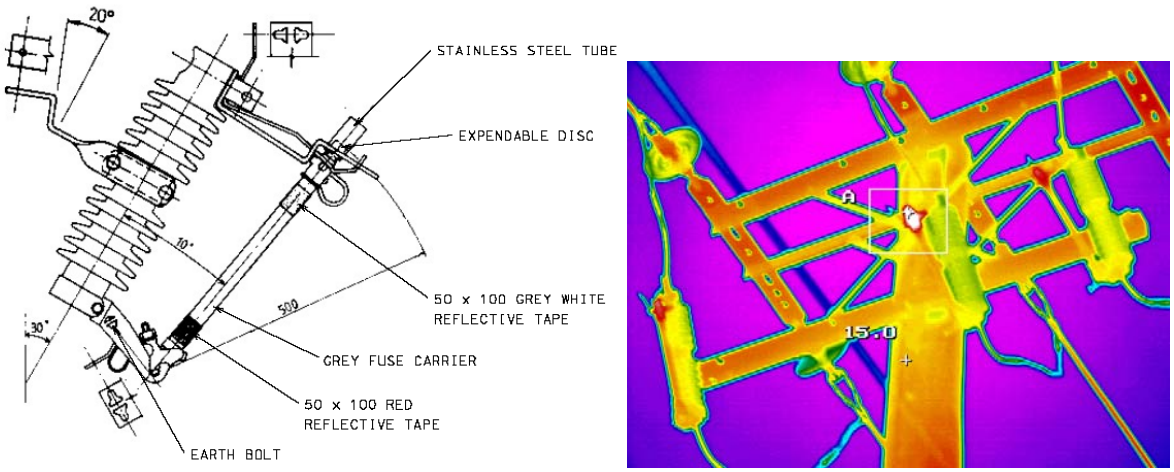
One of the issues identified with Nulec reclosers is a small trend in relation to the electronic circuitry failing in the recloser tank (blown componentry). The issue is being managed in consultation with the manufacturer.

Some reclosers include a solid insulation HV transformer to be risk assessed by partial discharge testing periodically. Newer rural recloser innovations include the use of digital sectionalisers on spur lines to help spur protection and spur switch service life.

3.2 Ganged Fuse Sectionalisers

The key risks associated with sectionalisers in the network are that EDO sectionalisers have not been operating under fault conditions on occasion or when operating correctly have the potential to start fires due to operation creating sparks. This effects reliability and safety due to the increased likelihood of conductors exceeding their safe operating temperatures and failing because of mal operation of the fuses. TasNetworks has approximately fifty-two EDO fuse sectionalisers manufactured by AK Power that have been identified as unreliable.

Figure 12: EDO fuse side view explanatory diagram and a fuse contact hotspot defect example



One option for replacement of the fuses is EDO fuse sectionalisers which are cheap and effective methods for providing isolation capability for large volumes of distribution feeder spurs. However, the necessity for field crews to be dispatched onsite for the fault restoration process incurs significant cost to the business. Additionally, while sectionalisers and load break switches are effective at providing single shot protection, their inability to reclose limits their capability to fault clearance, and slows fault restoration. (By comparison, 80% of faults on reclosers are momentary and auto reclose successfully).

3.3 Air break switches

The main risks associated with air break switches are defective units where there is mechanical failure of the switch under operation or loading. It poses a safety risk due to the increased likelihood of falling conductors and insulators; this type of failure can lead to bushfires and injury.

Since 2011, TasNetworks have seen a number of mechanical failures in the porcelain insulator pins of certain air break switches while the devices are being operated. The most likely mode of failure is a function of moisture ingress through the end connections of the porcelain insulators, resulting in pin corrosion and sulphur cement expansion. These forces are sufficient to compromise the structural integrity of the insulator causing the insulator unit to crack fail before or when the device is next operated; an example of a failure is shown in Figure 13. Under failure the pin insulator can disintegrate, sending shards of broken porcelain falling to the ground and to the field service operator on the ladder below. This presented an unacceptable health and safety risk to TasNetworks' personnel.

The majority of air break switch units that have failed are "S-series" units that are manufactured by ABB, prior to November 2005 and "USB" unit types manufactured by NGK Stanger. Units manufactured by ABB after November 2005 have a stainless steel insulator pin, and are believed to not be as susceptible to the same failure mode as those manufactured prior to this date. Other units that are believed to be unaffected by the issue are "Morlynn Stanger" units (model unknown) and a variety of unit colloquially known as "Old School" (manufacturer and model unknown) of greater in service age. The primary failure mode in the older ABB S-series is now understood to be a function of metal pin corrosion and sulphur cement expansion.

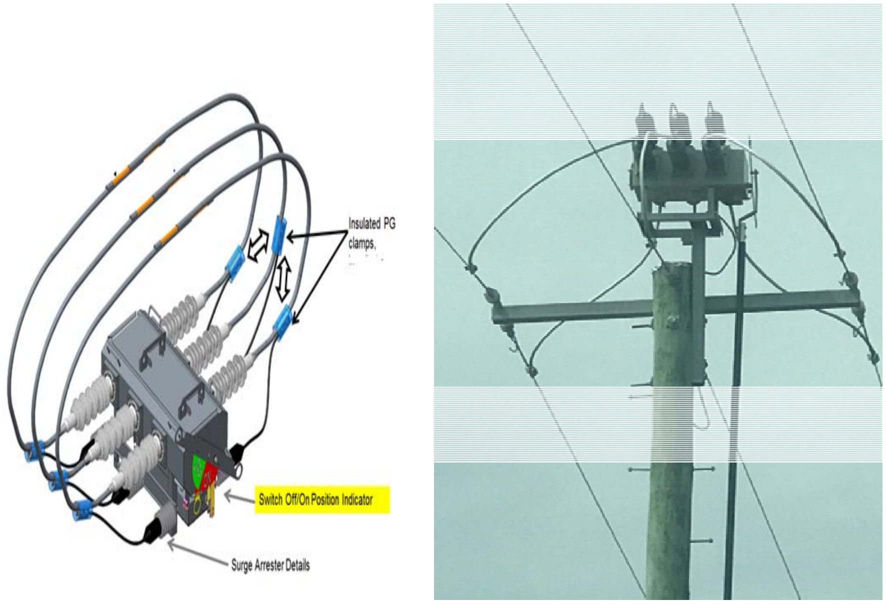
Australian distribution utilities have been contacted to try to determine what the industry wide approach to the management of air break switches has been, responses have only been received from a few to establish TasNetworks benchmark for service life expectation.

Figure 13: Air break switch porcelain insulator pin failure examples found in service

Figure 14: examples of cut- safe secured cracked insulators replaced in 2015/16.

The need to replace a pole mounted air break switch on a planned works project basis, is an opportunity to review the whole of service life comparison for alternative switch technology such as the pole mounted enclosed switch for manual operation only, or for future SCADA remote operation. Appendix 21 illustrates an example of an NPV Service life comparison with an RL27 gas insulated enclosed load break switch.

Figure 15: a 22kV Schneider RL27 SF6 gas insulated load break switch and droppers kit



3.4 High voltage links

The main risk associated with HV links is the unnecessary disconnection of load, through network reconfigurations, where load is too great to be switched phase-by-phase and the next upstream ganged device must be used. This will have an adverse impact on TasNetworks' unplanned outage performance. The occurrence of Ferroresonance over voltage in single phase switchings with high voltage links may be managed in operational procedures; typically maximising resistive loading during switching. However, the preferred option to eliminate this risk is to install a three phase switching device.

3.5 High voltage fuses

The main risk associated with HV fuses is associated with the potential of bushfires starting through EDO fuses that are not appropriately sized and rated for the network/assets that they protect. Fuse selection is risk managed with accordance with TasNetworks Protection Philosophy, and the associated Fusing Table.

A high bushfire risk consequence area risk management review is underway to replace expulsion drop out fuses with Boric Acid Fuses or digital sectionalisers such as dropout reclosers, noting ongoing research conducted by Victorian Distribution Networks.

3.6 High voltage capacitors

The key risk associated with high voltage capacitors is capacitor bank device failure, such as arcing faults within the capacitor bank, resulting in a reduction in network performance and possibly loss of supply. Some faults may be undetectable if there is no signal unbalance detection.

3.7 Low voltage fuse links / switchgear

The key risk with low voltage links is that a transformer with LV links instead of LV fuse links will not be capable of clearing low voltage faults, which may result in conductors melting and falling to the ground, dropping molten metal in the process. If fault current is insufficient to damage the conductor, then the transformer will be significantly overloaded, which may result in the failure of the unit. LV links therefore do not provide appropriate protection of LV circuits.

3.8 Other risks

Theft of copper from pole mounted switchgear poles may result in a safety risk from an open circuit or damaged pole copper earths. One mitigation strategy that TasNetworks have adopted to address this risk is to retrofit stolen pole earths with copper clad steel electrodes, as shown in Figure 16.

Figure 16: Pole copper earth theft risk prevention using copper clad steel

3.9 Summary of risks

The following table 3 summarises the main distribution overhead switchgear risks, their mitigation strategy and residual risk levels.

Table 3: The main distribution overhead switchgear risks, their mitigation strategy and residual risk levels

RISK IDENTIFICATION		RISK ANALYSIS				RISK MITIGATION	
Risk	**Detail**	**Likelihood**	**Consequence**	**Risk Rank**	**Highest Risk Category rankings**	**Elimination or Mitigating Action(s)**	**Residual Risk Rank (if not eliminated)**
A recloser doesn't clear a fault and the circuit is closed multiple times.	Secondary faults occur which can cause interruption of supply	Likely	Negligible	Low	Customer	Replacement of inadequate reclosers with new OH switchgear	Low
		Likely	Minor	Medium	Network Performance		Low
		Possible	Moderate	Medium	Safety		Low
EDO sectionalisers not operating under fault conditions on occasion	Fault is not cleared causing risks to equipment, larger outages and a safety risk to the general public	Likely	Negligible	Low	Customer	Replacement of EDOs with enclosed load break switches as sectionalisers (eg RL 27) or a Noja sectionaliser	Low
		Likely	Minor	Medium	Network Performance		
		Possible	Moderate	Medium	Safety		
EDO sectionalisers creating sparks when operating	The sparks have the potential to start a bushfire causing damage to equipment and environment , network outages and potential harm to the general public	Unlikely	Negligible	Low	Customer	Replacement of EDOs with enclosed load break switches as sectionalisers (eg RL 27) or a Noja sectionaliser	Low
		Unlikely	Minor	Medium	Network Performance		
		Unlikely	Major	Medium	Safety		
		Unlikely	Major	Medium	Environment		
		Unlikely	Major	Medium	Reputation		
Defective air break switches where there is mechanical failure of the switch under operation or loading.	Increased likelihood of falling conductors and insulators; this type of failure can lead to bushfires and injury and failure to comply with the Work and Safety Act 2012	Unlikely	Minor	Low	Regulatory Compliance	Replacement of defective air break switches with new OH switchgear	Low
		Unlikely	Negligible	Low	Customer		
		Unlikely	Minor	Medium	Network Performance		
		Unlikely	Major	Medium	Safety		
		Unlikely	Major	Medium	Environment		

		Unlikely	Major	Medium	Reputation		
The network load is too great to use HV links to switch phase by phase for disconnection of load due to network reconfigurations	The next upstream ganged device must be used resulting in larger planned outages	Possible	Negligible	Low	Customer	To eliminate this risk install a three phase switching device.	Low
		Likely	Negligible	Low	Network Performance		
		Possible	Negligible	Low	Reputation		
High voltage capacitor bank failure such as arcing faults.	Reduction in network performance and possibly loss of supply.	Likely	Negligible	Low	Network Performance	Introduce signal unbalance detection where feasible	Low
Transformers with LV links instead of LV fuse links will not be capable of clearing low voltage faults	This may result in conductors melting and falling to the ground, dropping molten metal in the process	Likely	Negligible	Low	Financial	Replace LV links with LV Fuselinks or switchgear where feasible	Low
		Possible	Negligible	Low	Network Performance		
		Rare	Major	Moderate	Environment and Community		
		Rare	Major	Moderate	Safety and People		
Theft of copper from pole mounted switchgear poles	A safety risk from an open circuit or damaged pole copper earths. HV energised earth if on SWER substation	Unlikely	Major	Medium	Safety	Retrofit stolen pole earths with copper clad steel electrodes	Low
EDO fuses not operating under fault conditions on occasion (Lock up)	Fault is not cleared causing risks to equipment, larger outages and a safety risk to the general public	Possible	Moderate	Medium	Safety and People	Replace EDO and mounting assembly with new Boric acid Fuselinks and mounting assembly	Low
EDO fuses operating under fault conditions on occasion in high fuel bushfire risk day	Fault is cleared causing arc melts fire safety risk to the general public	Possible	Moderate	Medium	Environment and Community	Replace EDO and mounting assembly with new Boric acid Fuselinks and mounting assembly or a trial digital sectionaliser in cut out/ mounting assembly	Low

4 Management plan

4.1 Historical

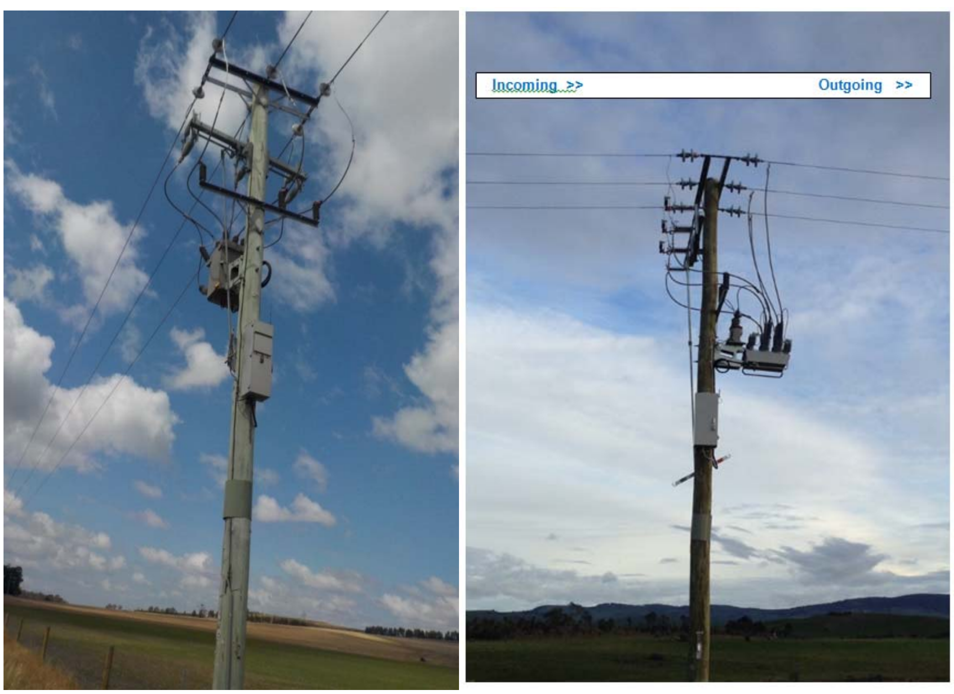
Most overhead switchgear assets have historically been managed on a periodic inspection condition assessment approach based on asset type, operations, and failure modes risk mitigation experience and the maintenance advice of the switchgear supplier.

Assets have either been visually assessed before and after manual switching operations or on a periodic cycle. Defects were then rectified or the switching asset replaced or upgraded, depending on condition and network demands.

To minimise supply interruptions to customers, a number of pole mounted switchgear types are used in Network Standard drawing poletop designs fitted with bypass switches, and /or are dressings suited to be maintained by high voltage live line procedures to SAA AS5804-2010 HV live line working.

In order to more effectively manage distribution pole mounted transformers through their life TasNetworks has introduced asset management strategies. These strategies are described in the following section.

Figure 17: Remote controlled pole mounted recloser for isolation or temporary HV live line bypass bridging, or with in series Air Break Switch for safety isolation



4.2 Strategy

The management of overhead switchgear and primary components is based on achieving robust network flexibility, with the ability to reliably switch between circuits for the purposes of: fault finding, back feeding, planned and unplanned maintenance and repair whilst ensuring lowest cost to customers.

Routine inspections were conducted prior to 2011/12. Since this period the suspension of inspections has led to an increase in reactive maintenance often driven by periodic asset inspector line inspection and switch operator defect reports. Using a condition based maintenance assessment approach, there will now be a reintroduction of asset lifecycle management with an emphasis on streamlined processes and targeting assets to best utilise resources with appropriate inspection cycles. Concurrent asset replacement programs are improving asset condition, such as the EDO replacement program for bushfire risk mitigation, and the cracked insulator air break switch program, the ongoing fused sectionaliser replacement program and the concluded pole mounted oil-filled recloser program. Appendix G summarises condition based maintenance priorities.

Benchmarking of Inspection and Maintenance Approaches

TasNetworks have reviewed the maintenance and inspections approaches of a number of other distribution networks.

Jemena’s line inspection process involves evaluating the condition of all assets on the pole including: surge arrestors, switchgear and transformers. The inspections are performed in conjunction with pole base inspections every 3 years for high bushfire risk areas and 4 years for low bushfire risk areas; and the inspection is conducted according to a utility defined asset inspection manual.

High voltage fuses are considered maintenance free and replacement is based on age and performance requirements. Air break and remote controlled switches are inspected on a 5 yearly basis cycle whilst manual gas switches are inspected on a 10 yearly basis.

Jemena have been storing high-quality images of their pole tops for office based visual inspection of pole top assets and condition trending over time. The purpose of this is to assist maintenance planners on the appropriate rectification of defects. The prioritisation is based on the magnitude of the impact on reliability and safety which ensures the best cost/benefit trade-off.

The condition data recorded feeds into a condition based condition based risk management (CBRM) model; to better predict future asset replacements to maintain network reliability.

It is important to note the size of Jemena’s network as it consists of approximately 100,000 poles and approximately 2,000 overhead switchgear assets.

Energex inspect their poles and all ancillaries on a 5 yearly cycle after the pole has been in service for 10 years. Pre-storm season inspections are undertaken by vehicles and helicopter of their 33 and 11 kV network annually. The inspection program gives input to their CBRM based repair methodology which is used to forecast quantities for proactive replacement.

ETSA Utilities have ramped up expenditure for air break switches and inoperable switchgear and their assets will be inspected more frequently. This ensures that their asset management practices reflect the appropriate strategies for the network condition.

Ergon Energy has a Network Optimisation Standard for Preventative Maintenance Programs 2015/16 to 2019/20 inspecting Air break switches and load break gas switches every 6 years; pole mounted reclosers manual or electronic not remotely monitored are inspected every 12 months, and remotely monitored pole mounted reclosers are inspected every 3 years.

Current Inspection, maintenance and renewal frequencies

TasNetworks current planned inspections, maintenance and renewal frequencies are summarised in Table 4 below:

Table 4: Inspection, maintenance and renewal intervals on overhead switchgear

Asset class	Inspection interval[5]	Maintenance interval	Renewal interval
Reclosers	5 yearly	Reactively on condition or failure	Condition based
Sectionalisers	5 yearly	Reactively on condition or failure	Condition based
Gas switches	5 yearly	Reactively on condition or failure	Condition based
Air break switches	5 yearly	Reactively on condition or failure	Condition based
High voltage links	5 yearly	Reactively on condition or failure	Condition based
High voltage fuses	Nil	Reactively on condition or failure	Age based
High voltage Capacitors	5 yearly	Reactively on condition or failure	Condition based
Low voltage links + fuse links	Nil	Reactively on condition or failure	Age based

4.2.1 Routine maintenance

Routine maintenance on overhead switchgear is performed on all overhead switchgear to ensure that minor defects and issues with these assets are identified before further degradation of the asset occurs. This work is performed through the work category AROSW, overhead Switchgear routine maintenance. Further to this the work category AROSW will be continued in the forthcoming regulatory period and complemented by the AIOSW category.

Where an asset defect is identified through routine maintenance, routine inspection or other means and the defect severity is beyond rectification, to prevent the negative impacts of asset failure, that asset should be replaced in a timely manner. This renewal work will be performed through the work category REOHS, Replace overhead switchgear, or for reclosers in particular, RERER.

4.2.2 Routine maintenance versus non routine maintenance

Failures within distribution overhead switchgear may cause serious or catastrophic damage to the asset. These assets are generally located in close proximity to the public, so allowing failures to occur represents a real risk to the public and surrounding infrastructure. A preventative corrective

[5] Inspection intervals reflect the nominal inspection period, this does not include, that as a part of TasNetworks procedures switchgear is visually inspected prior to switching operations.

maintenance program represents a cost effective alternative to a reactive corrective maintenance program.

4.2.3 Refurbishment

Where distribution overhead switchgear assets are removed from the network in good operating condition by activities such as capacity and power quality drivers, these assets are assessed for redeployment back into the network where such refurbishment is deemed to be an economic proposition.

4.2.4 Planned asset replacement versus reactive asset replacement

Replacement is generally only preferred when this is a more economic proposition compared to ongoing maintenance costs over the estimated remaining service life of the asset. These are identified from the maintenance and inspections activities and feed into the list of proposed capital expenditure projects for prioritisation.

4.2.5 Non Network Solutions

Non network solutions are not a viable option for distribution overhead switchgear.

4.2.6 Network augmentation

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

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

Where distribution network augmentation is required, it may be appropriate to install new overhead switchgear in that new network section. The definition of overhead switchgear requirements for network augmentations is the responsibility of the network planning, asset engineering, and design teams.

4.3 Routine maintenance

The following programs are untaken as part of TasNetworks' routine maintenance of overhead distribution switchgear.

4.3.1 AIOSW overhead switchgear asset inspection and monitoring

The driver for this program is to effectively manage the overhead switchgear population through contemporary risk and condition based practices. The focus is on the following asset classes:

- reclosers;
- sectionalisers;
- gas switches;
- air break switches;
- high voltage links; and,

- high voltage capacitors;

Air break switches are targeted as they are the most at risk of mal-operation if not maintained.

The inspections are conducted on a 5 year basis. As part of the inspections important asset information will be verified or recorded to aid in further strategic asset decision making. The information documented will include: switchgear manufacturer and model, geographical location and various condition measures.

The collection of this attribute and condition information will provide detail that allows the effective management of these asset populations into the future. The assets are inspected with live line techniques which make for less planned outages and efficient inspections.

4.3.2 AIOFD Overhead system aerial inspections

TasNetworks introduced aerial inspection for overhead structures in 2014/15 which included the inspection of distribution pole mounted transformers. Initial trials found that aerial helicopter inspections provided a cost effective and efficient method of assessing defects and condition not possible through ground patrols. The aerial patrols have been targeted in the following areas:

- High Bushfire Consequence Areas (HBCAs),
- High Soil Dryness Index areas (HSDIA), and
- Worst performing feeders.

The patrols targeting the HBCA and HSHIA should be planned well prior to the start of the bush fire season to allow for any defects to be rectified.

Aerial inspection program are to be expanded to cover 20 per cent of the network on an annual basis with targeted aerial patrols planned for HBCAs pre bush fire session annually.

4.3.3 AIOTI Thermal Imaging

The AIOTI program was implemented in 2013/14 FY as an outcome of reliability centred maintenance (RCM) review. The RCM review found that the taking no action to identify hot joins within the distribution network resulted in the exposure of the business to an unacceptable level of risk, with regards to bushfires which is consistent with TasNetworks corporate risk appetite. A review of this program was recently undertaken, to determine the program’s effectiveness, and recommendations were made on changes that could be made to improve value.

The original program required 1000 kVA of load to be connected downstream of an asset, for that asset to be to be inspected, to ensure that there is sufficient loading at that point in the network for defective connections to produce detectable heat. Through analysis of the locations in the network that hot joints have been found to date, it has been identified that further value may be developed by refining this connected kVA requirement to:

- 1000 kVA in high bushfire consequence areas, and on the “worst performing feeders”; and
- 4000 kVA in all other network areas.

Additionally, feeders should be excluded from analysis, where the loading is below 20 A for the vast majority of time.

The original program has been amended to ensure that inspections take place when loading is as high as possible, typically in the mornings and evening peak periods (7am-10am and 4pm-7pm).

The frequency of inspection to remains at three years which included the thermal inspection of distribution pole mounted transformer terminal bushing and overhead line connections.

4.3.4 AROSW overhead switchgear asset repair

The driver for this program is to manage the business risk and maintain network performance by performing maintenance on overhead switchgear.

Due to requirements for reductions in operational expenditure there was a large decrease in spend in this category over the 2013/14 and 2014/15 financial years. In 2016/17, the inspection and maintenance of overhead switchgear was reinstated as a standard program.

The aim of this program will be to maintain the existing overhead switchgear and primary components appropriately, with the program of work largely defined by the outcomes of overhead inspections. The key drivers for this targeted maintenance regime are to extend the switchgear asset life whilst maintaining network performance.

4.3.5 Assessment by secure remote engineering access to reclosers

TasNetworks has recently deployed secure remote engineering access to their NOJA Power RC10 Series controlled Automatic Circuit Reclosers. TasNetworks has provided their engineers with improved capability to assess recloser maintenance needs, analyse faults and quicken response times. Employing this capability for remote engineering limits the costs traditionally associated with deployment of field teams. This cost saving allows TasNetworks to make the best investments to ensure that the TasNetworks' customers are provided with the essential service of electricity supply in the most economic and efficient way.

4.4 Non-routine maintenance

General corrective maintenance is performed on overhead switchgear as a part of the Asset Replacement Overhead Switchgear (AROSW) work category, with general overhead work performed through the AROCO work category. This corrective maintenance is performed where asset defects have been identified through routine overhead inspection (visual or thermal), incidental identifications (through asset area managers) or under fault. Corrective maintenance is generally only performed on assets where defects have been identified as problematic, which usually only occurs when the condition of the asset has degraded significantly.

4.5 Replacement programs

4.5.1 SIFIC replace EDO HV fuses

To mitigate bushfire risk, Expulsion Dropout (EDO) fuselinks will be replaced with Boric Acid Fuselinks and digital sectionaliser cut-outs (dropout reclosers), Enclosed Load Break Switches, sectionalisers or reclosers. The initial EDOs replaced will be the devices located within the HBCA sites.

4.6 Reliability and quality maintained

4.6.1 REOHS replace overhead switchgear

The primary driver for this program is to manage safety operating risks whilst also maintaining network performance.

This program has two components:

- replace air break switches/high voltage links; and
- replace overhead switchgear.

There are no major changes to this program although the budget has been reduced to better reflect historical spend.

Replace air break switches/high voltage links

The aim of this program is to replace air break switches and high voltage links that are in poor condition as identified during TasNetworks' asset inspection programs, replace devices that fail in service or replace devices where other business drivers require a three phase switching device or high current switching.

Appendix B includes example of cracked insulator Air Break Switch Safety Risk Mitigation asset replacements year to date reporting of program. This is also an item in the Bushfire Risk Mitigation Program. The Program is Air Break Switches condition assessment based after a field inspection of all TasNetworks installed Air Break Switches. An NPV assessment identified some location scenarios where the 30 year service life replacement switch should be an enclosed switch. An ongoing insulator cracking risk review may require further Air Break switch types to need replacement.

This work category was previously in REOHQ due to the replacement of low voltage links with fuse links as it was a regulatory obligation. The updated category is a better fit as it suits maintaining the reliability and quality of the network. The type of work actioned within each category has not changed.

Replace overhead switchgear

This program involves the replacement of switchgear that is considered to be unsuitable to remain in service because of condition and/or risk, specifically expulsion drop out type sectionalisers manufactured by AK Power and ABB for example.

Replacement of sectionalisers that are found to be defective is necessary as they are key components in the overhead distribution system that disconnects specific sections of high voltage line when a fault occurs. Mal-operation of the equipment may result in increased duration and number of outages for customers requiring greater resources to restore supply.

In 2014/2015 there were three separate line items included to replace expulsion drop out sectionalisers with pole-mounted automatic reclosers at specific locations, namely Geeveston, Mawbanna and Cressy. Recloser replacement continues on a limited basis on asset condition.

In 2016/17 Noja SWER reclosers with conductor down harmonic detection were installed in several locations to replace SWER fuses as part of enhanced bushfire risk mitigation as safe work change management transition permitted (sites near Bosworth, Tor Hill, Springdale).

4.6.2 RERER replace reclosers

This program covers the replacement of reclosers in TasNetworks' overhead system due to the condition of the asset. TasNetworks' current reclosers only have a manufacturer assessed asset life of 20 years. Replacement of reclosers will be undertaken based on condition assessments or as required.

The budget for this program will be developed in response to any identified recloser replacement jobs that have been identified from the 2015/16, and 2016/17 Programs of Work.

Nulec reclosers

Nulec N-series reclosers are primarily replaced due to the failure of the tanks. Common causes are lightning strikes or bushfire. As TasNetworks now has a recloser supply contract with Noja Power, any recloser requiring replacement in its entirety will be replaced with a Noja recloser.

There is also a Nulec N-series tank issue which relates to the failure of the SCEM card, this requires the tank to be temporarily removed from service so the card may be replaced.

Upgrading reclosers

TasNetworks' fleet of OYT reclosers was actively being replaced due to age and condition. The modern replacement has many added advantages including:

- improved protection functionality and accuracy;
- remote monitoring and control capability; and
- improved product support.

The last of the known in service Reyrolle OYT oil-filled polemounted reclosers were replaced in 2015/16, so reducing risks of oil explosion diesel jet ignition from internal arcing faults venting.

4.7 Regulatory Obligations

4.7.1 REOHQ replace low voltage links with fuses

The driver for this program is managing business operating risks.

This program involves replacing low voltage links with fuses to enable faster clearance of low voltage faults and thus reducing the risk of equipment damage and public harm.

This program has been in place for a number of years but has not been actively managed so progress has been minimal. Significantly more detail has been provided in the scope for the 2015/16 program, so activity under this program is planned to increase.

This program transitioned into REOHS as of the start of 16/17.

4.8 Investment evaluation

Investment evaluation is undertaken using TasNetworks' Investment Evaluation Summary (IES) template. The template includes:

- a brief description of the asset(s)
- a description of the issues and investment drivers
- alignment with regulatory objectives

- alignment with TasNetworks' corporate objectives
- alignment with TasNetworks' corporate risks
- impacts to customers
- analysis of options to rectify the issues including operational and capital expenditures
- a summary of NPV economic analysis for the identified options
- the preferred option and why
- the timing of the investment and
- the expected outcomes and benefits

4.9 Spares management

Spares holding are assessed during the asset management plan review cycle and minimum and maximum stock levels and spares holdings are amended in alignment with TasNetworks' spares policy.

When overhead switchgear either fails prematurely during service, and repair is not economically feasible, or the electrical and mechanical condition of the overhead switchgear deteriorates to such an extent, then it is considered appropriate to retire particular overhead switchgear. Replacement switchgear is sourced from the stock pool.

4.10 Disposal plan

Overhead switchgear that is de-commissioned and removed from the network and are disposed. Required assets are retained for system spares. Environmental Risk Management guidelines applied for disposal relate to waste materials such as oil or SF6 gas.

4.11 Summary of programs

The following table 5 provides a summary of all of the programs described in this management plan.

Table 5: Summary of Overhead Switchgear Programs

Work Program	Work Category	Project/Program
Routine Maintenance	AIOSW	Overhead switchgear inspection and monitoring
	AIOFD	Overhead system aerial inspections
	AIOTI	Thermal imaging inspection
	AROSW	Overhead switchgear asset minor repair/maintenance
Replacement	SIFIC	Replace EDO with Boric Acid Fuses, or dropout reclosers
Reliability and Quality Maintained	REOHS	Replace overhead switchgear
		Replace air break switches
		Replace low voltage links with fuse links
		Replace AK Power sectionaliser with recloser
		Upgrade fuses/sectionaliser to recloser
	RERER	Upgrade reclosers

Work Program	Work Category	Project/Program
		Replace reclosers
Regulatory Obligations	REOHQ	Replace low voltage links with fuse links

5 Responsibilities

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

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

6 Related standards and documentation

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

Other related standards and documentation:

- TasNetworks Transformation Roadmap 2025 https://www.tasnetworks.com.au/customer-engagement/submissions/
- TasNetworks Corporate Plan – Planning period: 2017-18 http://reclink/R0000745475
- Electricity distribution network service providers - Service target performance incentive scheme - November 2009.
- Distribution Protection and Control Asset Management Plan (R301645)
- Bushfire Risk Mitigation Plan (R303735)
- EDO Replacement Program (R0000606155)
- Review of the Victorian Network AER Submissions on Bushfire Risk Management Plans
- Distribution Protection and Control Manual (R231574)
- Reliability-centred Maintenance, second edition, John Moubray, Elsevier, Oxford
- Jemena Electricity Networks (Vic) Ltd, 2016-20 Electricity Distribution Price Review Regulatory Proposal, Attachment 7-5, Asset Management Plan 2016-2020, ELE PL 0004
- ETSA Utilities Regulatory Proposal 2010-2015, 1 July 2009
- Ergon Energy Network Optimisation Standard for Preventative Maintenance Programs 2015/16 to 2019/20