Asset Management Plan

Transmission Substation High Voltage Switchgear

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Authorisations

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Responsibilities

This document is the responsibility of the Substation 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 Asset Strategy Team Leader.

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

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

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Reference documents

R954721 – TasNetworks Strategic Asset Management Plan

R40766 – TasNetworks Asset Management Policy

R909655 – TasNetworks Risk Management Framework

Record of revisions

Revision	Details	Date
5.0	Re-write from Transend format into TasNetworks format and update of data	10/2017
6.0	Re-write into new TasNetworks template	10/2022

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1 Purpose

The purpose of this document is to describe for HV Switchgear and related 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
- Forecast capital (**Capex**) and operational (**Opex**) expenditure, including the basis upon which these forecasts are derived.

2 Scope

This document covers HV Switchgear that is installed inside the TasNetworks transmission system.

3 Management strategy and objectives

This asset management plan has been developed to align with TasNetworks' Asset Management Policy, Strategic Asset Management Plan and Strategic Objectives. This management plan describes the asset management strategies and programs undertaken to manage HV switchgear.

The asset management objectives are to:

- manage and meet the strategic goals, measures and initiatives outlined in the TasNetworks Business Plan;
- comply with relevant legislation, licences, codes of practice, and industry standards; and
- continually adapt, benchmark, improve asset management strategies and practices, and apply contemporary asset management techniques, consistent with industry best practices.

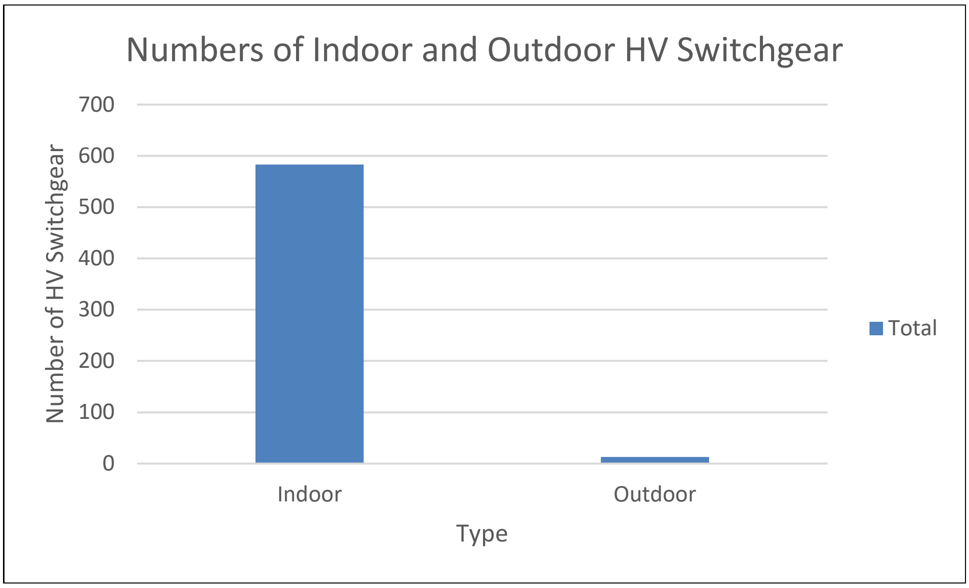
4 Description of the asset portfolio

High voltage (**HV**) switchgear performs a critical function in the reliable operation of the transmission system, connecting substations to the distribution network and, in some cases, directly to major industrial customers. TasNetworks has high voltage systems operating at 44, 33, 22, 11 and 6.6 kV. The predominant operating voltages are 33, 22 and 11 kV.

HV switchgear includes circuit breakers, disconnectors, earthing switches, instrument transformers, supporting structures, cubicles and cable terminations. HV switchgear falls into two broad categories – outdoor type and indoor type – with the indoor type mainly consisting of metal-clad switchgear. This asset management plan covers all indoor and outdoor high voltage switchgear operating at 44, 33, 22, 11 and 6.6 kV within TasNetworks' owned substations.

Table 1 (below) shows the population of both indoor and outdoor HV switchgear in service in TasNetworks' owned substations, as at October 2022.

Figure 1: Numbers of indoor and outdoor HV switchgear



HV switchgear must be kept in good operating condition to ensure the reliability and stability of the network. TasNetworks runs programs and projects to maintain and replace these assets. TasNetworks strives to provide the best overall solution to our customers whilst supporting the network. There are a number of drivers behind maintenance, inspection, testing and replacement programs. Assets are replaced when inspection and testing indicate that maintenance will no longer preserve the asset's performance. As assets age their condition invariably deteriorates.

The drivers behind replacement programs are various and relate to:

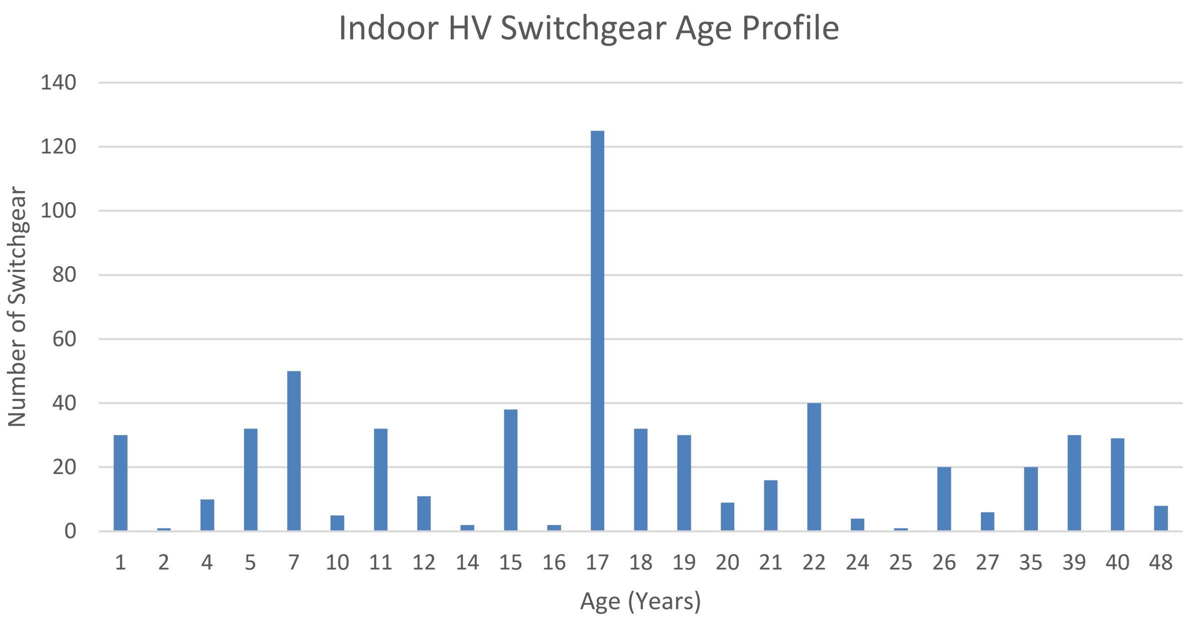
- age;
- condition;
- in-service failure;
- network performance improvement or augmentation; and
- TasNetworks' strategic objectives, such as intelligent asset management, better customer service and risk.

4.1 Indoor HV switchgear

Indoor HV switchgear is considered to have an average service life of 45 years. The economic life of switchgear is 45 years, as detailed in the *Assessment of Proposed Regulatory Assed Lives* report prepared by Sinclair Knight Mertz (**SKM**) in August 2013. The HV switchgear replacement program has resulted in many of the outdoor installations being replaced with modern indoor metal-clad switchgear and the establishment of new connection sites.

There are 583 indoor HV switchgear bays. The age profile (from manufacture) for TasNetworks' indoor HV switchgear population is shown in **Figure 2** (overleaf).

Figure 2: Age profile of Indoor high voltage switchgear (as at October 2022)

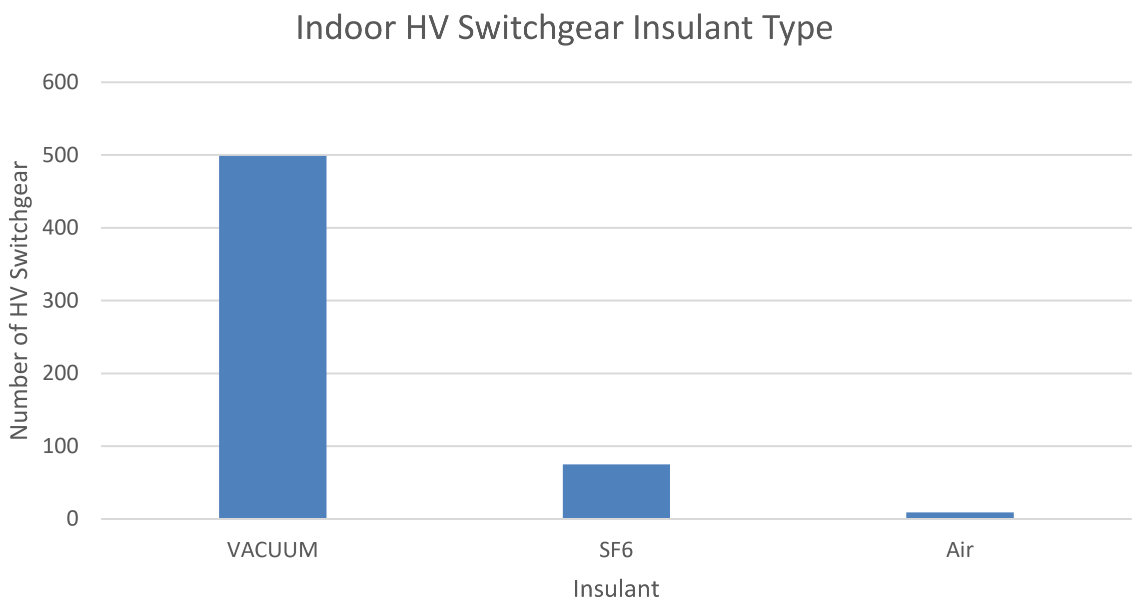


TasNetworks' HV switchgear can be categorised based on the insulating medium used. The categories for indoor HV Switchgear include:

- air (9 switchbays)
- sulphur hexafluoride gas (**SF6**) (75 switchbays)
- vacuum (499 switchbays)

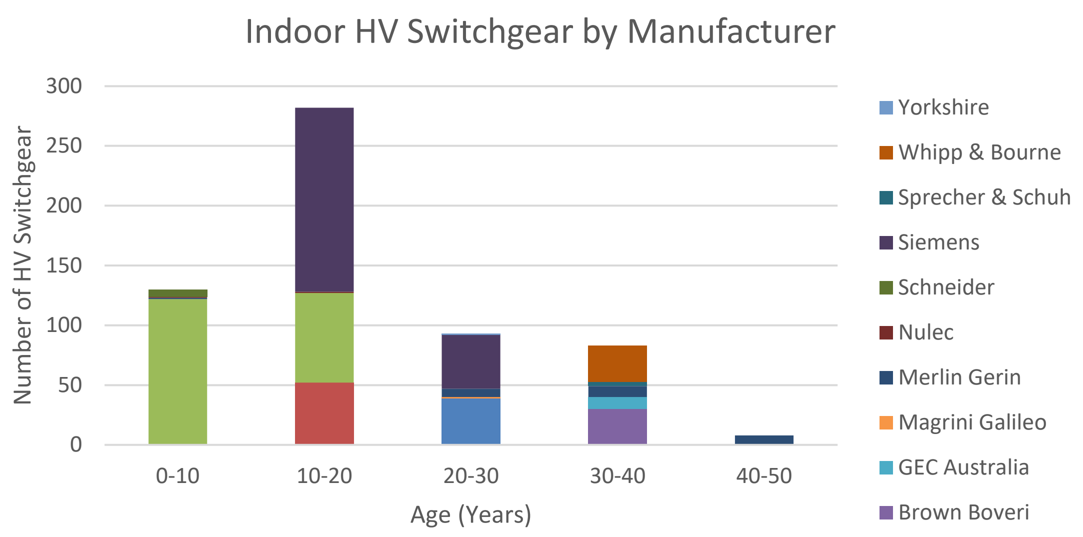
Figure 3 (below) shows TasNetworks' population of indoor-types of HV switchgear.

Figure 3: Indoor HV switchgear insulant type (as at October 2022)



The population of indoor HV switchgear includes units produced by 10 different manufacturers and comprises 40 different types. **Figure 4** illustrates the distribution of indoor HV switchgear by manufacturer and age.

Figure 4: Indoor HV switchgear manufacturer (as at October 2022)



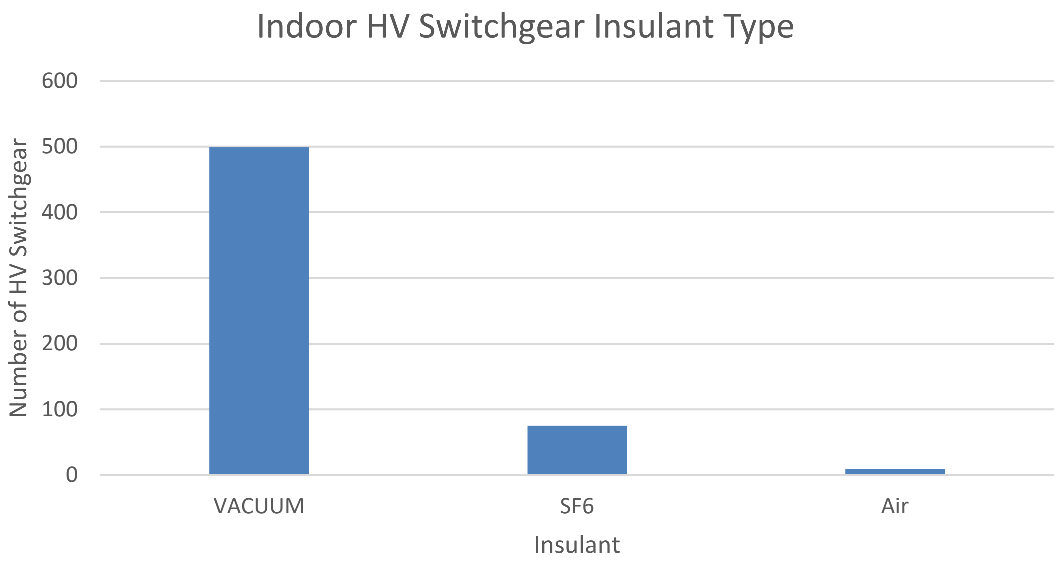
TasNetworks is actively seeking to standardise on a smaller number of HV switchgear models to reduce the overheads associated with maintaining a diverse range of equipment. Other models may be accepted where these models have been used within the wider TasNetworks network and spares are already available, however, the exact same model of device will be specified so as to maintain acceptable numbers of spares.

To mitigate the risks associated with a major failure of HV switchgear, TasNetworks has standardised on the use of vacuum type indoor HV switchgear for new or replacement installations. While the failure rates for all types of indoor switchgear are relatively low, TasNetworks' preference is to use vacuum type switchgear for the additional benefit of minimised environmental impacts. The standardisation of HV switchgear also addresses population issues identified over the long term. One major advantage of the standardisation is the lessened burden on spares management.

Condition monitoring results for each of the types can vary, as different design and construction methods are used for each type. The differences in physical design and construction characteristics between types, increases the complexity of contingency planning and spares management.

Figure 5 illustrates the number of each type of switchgear within the population by insulant type. This shows that the vast majority (499) of TasNetworks' indoor HV switchgear population is vacuum insulated switchgear.

Figure 5: Indoor HV switchgear population by insulant type (as at October 2022)



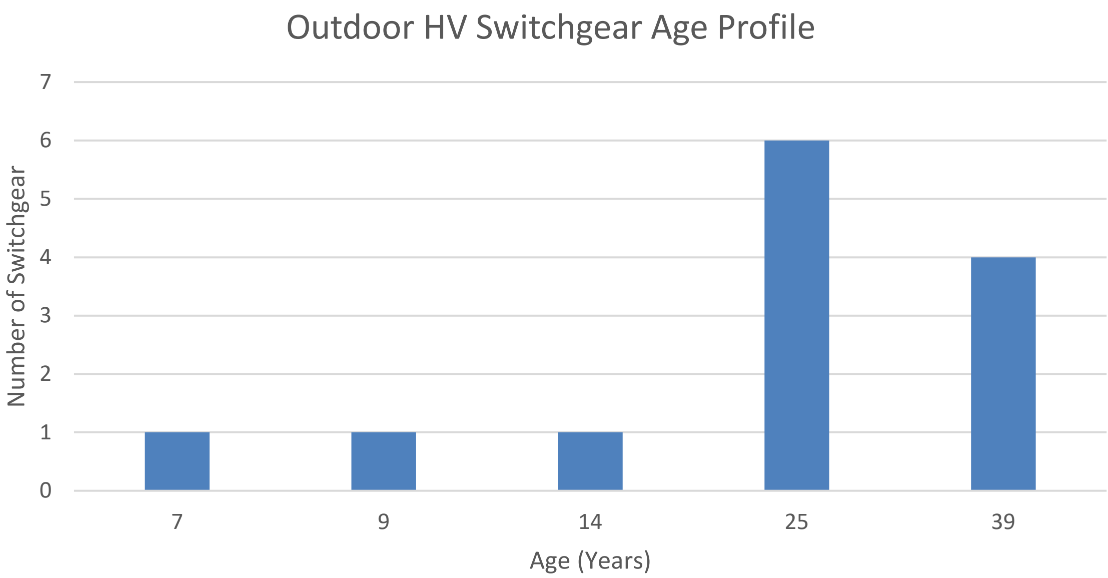
To address any potential design issues, TasNetworks has developed a comprehensive, prescriptive standard specification for the purchase of new HV switchgear units. TasNetworks' current design requirements for HV switchgear are specified in TasNetworks' High Voltage System Standard. The standard requires HV switchgear to be of indoor type. Compared to outdoor switchgear, indoor switchgear is compact, more reliable, has minimum interaction with environment (weather, wild life, vegetation, etc.) and is easier to operate and maintain.

The full requirements for HV switchgear are specified in the High Voltage System Standard document R565983.

4.2 Outdoor HV switchgear

Outdoor HV switchgear is considered to have an average service life of 45 years. The economic life of switchgear is 45 years, as detailed in the *Assessment of Proposed Regulatory Assed Lives* report prepared by Sinclair Knight Mertz. The age profile (from manufacture) for TasNetworks' outdoor HV switchgear population is shown in **Figure 6**.

Figure 6: Age profile of outdoor high voltage switchgear (as at October 2022)

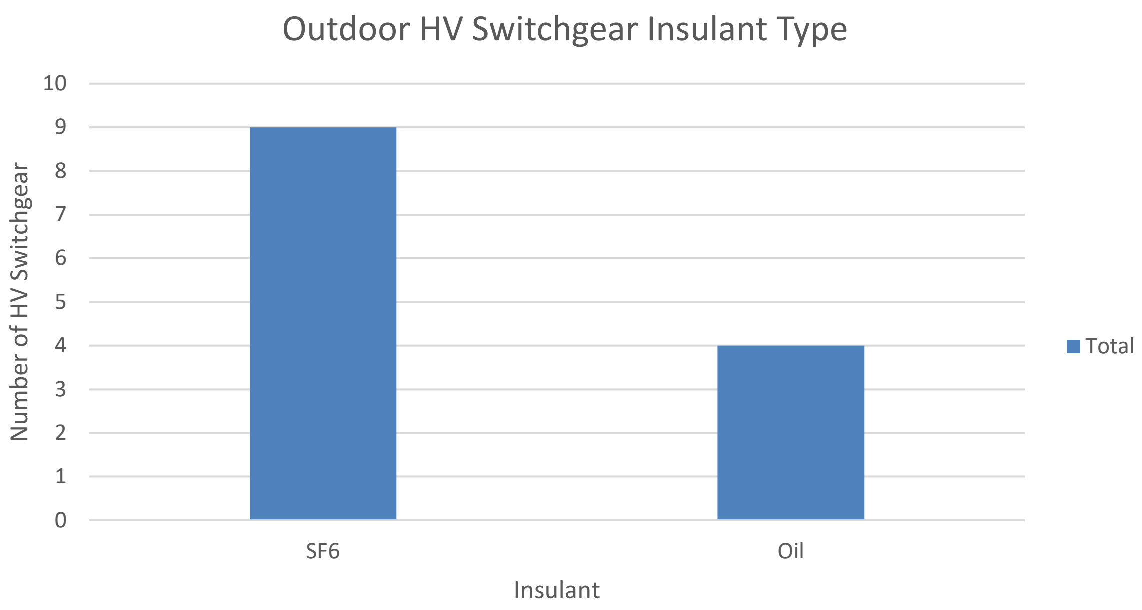


TasNetworks' HV switchgear can be categorised based on the insulating medium used. The categories for outdoor HV Switchgear include:

- oil (4 switchbays)
- sulphur hexafluoride gas (SF6) (9 switchbays)

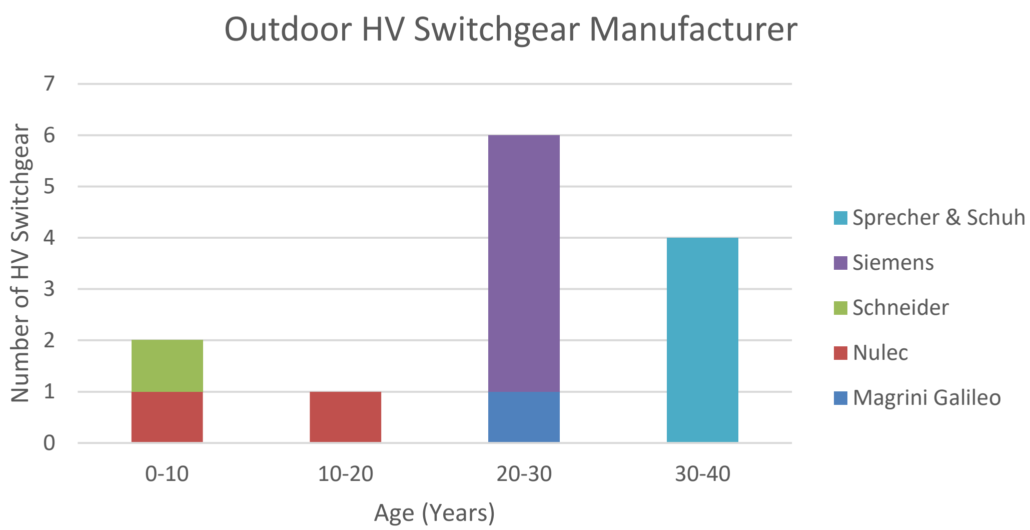
Figure 7 illustrates the number of each type of outdoor switchgear within the population by insulant type. This shows that the majority (9) of TasNetworks HV outdoor switchgear population is SF6 insulated switchgear.

Figure 7: Outdoor HV switchgear insulant type (as at October 2022)



The population of outdoor HV switchgear includes units constructed by 5 different manufacturers, comprising 13 different types. **Figure 8** illustrates the distribution of outdoor HV switchgear by manufacturer and age.

Figure 8: Outdoor HV switchgear manufacturer (as at October 2022)



Condition monitoring results for each of the types can vary, as different design and construction methods are used for each type. The differences in physical design and construction characteristics between types increases the complexity of contingency planning and spares management.

5 Associated risk

5.1 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. An assessment of the risks associated with HV switchgear has been undertaken in accordance with the Risk Management Framework.

TasNetworks has introduced a Health Based Risk Management (**HBRM**) framework for the quantification of asset risks.

The asset management drivers are:

- safety of our people and customers;
- reliability of supply to our customers;
- security of supply to our customers; and
- value of supply to our customers.

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

5.2 Performance data

TasNetworks monitors equipment performance by recording a defect notification against the equipment record in the SAP Enterprise Asset Management system. These records are interrogated by asset engineering personnel, who action or note the defect as is appropriate. Some defects require immediate attention whilst others will be monitored for trends or deterioration. TasNetworks is currently working to improve the data collected to enable better interrogation and analysis. This analysis will be used to feed HBRM tools and drive better customer outcomes.

TasNetworks also carries out condition monitoring programs. The goal of these programs is to proactively gather data regarding the condition of assets. A variety of condition assessment methods are used to determine HV switchgear electrical and operational condition. The methods include:

- electrical testing, including testing of insulation and contact resistance measurement;
- infra-red thermography;
- mechanism timing tests;
- sulphur Hexafluoride (SF6) gas pressure monitoring; and
- partial discharge measurements.

HV switchgear electrical and operational condition is determined using a combination of the above condition monitoring methods, which are selected depending on the design and construction principle of specific types of switchgear. For example, outdoor switchgear constructed using different design and construction principles than indoor switchgear results in different failure modes and, hence, needs different condition assessment methods. The combination of test methods enables a collective and thorough approach to determine the condition of the HV switchgear population.

It has been identified that the below indoor HV switchgear do not have internal arc fault containment (IAC) features:

- Merlin Gerin Type DSC46 Air insulated at Emu Bay Substation;
- Whipp & Bourne CV31 at Chapel Street Substation;
- Merlin Gerin Fluair F100 at Boyer Substation;
- Yorskhire YSF6 at Boyer Substation;
- GEC Australia SBV2 at Knights Road Substation;
- Brown Boveri HSB24 at Boyer and Sorell Substation; and
- Areva PIX24 at Port Latta, Devonport, Savage River and Wesley Vale substations.

5.3 Asset risks

There are two main drivers for risk outcomes related to HV switchgear – failure to operate and catastrophic failure. Failure to operate results in the asset not being able perform its intended function. A failure to operate may impact the networks' ability to deliver power to customers. Catastrophic failure occurs when HV switchgear explodes or catches fire. A catastrophic failure may result in one or all of the following:

- loss of power supply;
- injury to persons;
- impact to the environment;
- equipment damage; and
- un-planned replacement.

Loss of power supply and the duration of the outage will impact the safety of our people and customers, reliability of supply to our customers, security of supply to our customers and value of supply to our customers.

All electrical equipment in a substation is earthed to the earth mat. If the earthing conductor becomes damaged then the earthing protection is no longer present. The exterior of the equipment such as the metal cladding could become electrically charged.

TasNetworks develops its HV switchgear program taking into consideration asset condition, legal and regulatory obligations, performance and reliability requirements, business strategies and synergies with other work programs. The aim is to, as far as is reasonably practicable, extend the life of assets and replace before failure occurs.

Condition monitoring of HV switchgear allows for risk assessments of that asset's ability to operate reliably and efficiently. These risk assessments determine whether to maintain, refurbish or replace HV switchgear and the optimal timing of these actions. Due to the critical nature of these assets, HV switchgear identified as requiring maintenance, refurbishment or replacement is proactively planned to mitigate the risk of in-service failure.

5.3.1 Loss of power supply

HV switchgear is installed in transmission substations to allow for the protection, monitoring, switching and isolation of assets. If a component of the HV switchgear has failed it may impact on the ability of a substation to supply power to the feeders or transformers.

When HV switchgear fails the switchgear needs to be taken out of service to replace or repair the fault. This may have an impact on supply, require an outage and/or switching. During replacement time the N-1 arrangement is lost. All the supply is now reliant on the one circuit.

The risk of loss of power supply is significantly increased where HV switchgear is not functioning.

There are a number of controls in place to mitigate the likelihood of these risks. These controls include:

- N-1 arrangement;
- condition monitoring; and
- preventative maintenance.

5.3.2 Injury to persons

The safety issues associated with TasNetworks' HV switchgear relate mainly to a lack of arc fault containment features at a number of sites. All new indoor switchgears are designed with internal arc containment features to make them safe to operate and maintain.

Older switchgear that does not have the internal arc containment capability can potentially impose an arc flash hazard. The safety concern is the possibility of harm to employees working in and around the switchgear which is not arc fault contained. Another risk is explosive failure.

Further details on TasNetworks' Arc Flash Risk Management Assessment can be found in R152836.

Failed switchgear will impact planned works on associated assets and even assets in other bays.

There are a number of controls in place to mitigate the likelihood of these risks, including:

- preventative maintenance;
- condition monitoring;
- work practices; and
- use of personal protective equipment (PPE).

5.3.3 Environmental impact

With HV switchgear there is a risk of explosive failure. This is particularly problematic with oil insulated switchgear. The oil can quickly catch fire and spread. Damage to neighbouring switchgear and cabling is likely to occur. Fire can also spread along the insulation of cables into other equipment. TasNetworks has replaced all oil filled indoor switchgear with the vacuum type in the last five years.

Further environmental risks are posed by SF6 gas. SF6 gas is a potent greenhouse gas and is damaging to the environment.

Controls to mitigate the risks associated with SF6 gas include:

- preventative maintenance;
- condition monitoring; and
- fire alarms and sniffers.

5.3.4 Equipment damage

As discussed in section 5.3.3, a failure that results in explosion or fire may impact neighbouring equipment. There are a number of controls in place to mitigate the risk or explosion or fire, including:

- preventative maintenance;
- condition monitoring;
- standardising on using internal arc contained design equipment; and
- fire alarms and sniffers.

5.3.5 Un-planned replacement

There is a significant difference between the planned and unplanned replacement of assets. Planned replacements of assets allows for the equipment to be purchased in advance, planned switching to occur and interruption to customers to be minimised. In the event of an unplanned failure none of these happen. Instead the process for replacement begins at the time of failure. Unplanned switching could take much longer than planned switching, increasing the time customers are without or have reduced supply.

The lead time for acquiring assets is over eight months. Once procured, installation of the replacement asset is done at the earliest possible time. During the time it takes to procure and install the new HV switchgear the network is potentially left without an N-1 capacity in that location. This means that the supply for entire areas can be dependent on one supply line. Should this line fail the communities and businesses supplied from this substation will be without power until the line is repaired or the asset is installed.

There a number of controls in place to mitigate the likelihood of these risks. These controls include:

- spares holdings;
- preventative maintenance;
- condition monitoring; and
- N-1.

Table 1: Summary of asset risks

Risk Identification		**Risk Analysis (Inherent)**				
Asset	**Risk Description**	**Category**	**Likelihood**	**Consequence**	**Risk Rank**	**Treatment Plan Yes / No**
HV switchgear	Failure to operate/ catastrophic failure	Safety and People	Rare	Severe	Medium	Yes
		Financial	Unlikely	Minor	Low	
		Customer	Unlikely	Minor	Low	
		Regulatory Compliance	Unlikely	Minor	Low	
		Network Performance	Unlikely	Minor	Low	
		Reputation	Unlikely	Minor	Low	
		Environment & Community	Rare	Severe	Medium	

6 Whole of life management plan

6.1 Preventive and corrective maintenance (Opex)

TasNetworks undertakes inspection programs and routine maintenance. Routine maintenance refers to any maintenance task that is done on a planned and ongoing basis to identify and prevent problems before they result in reduced asset performance or equipment failure. These programs are undertaken to monitor condition. Condition data is used to identify where risk of equipment failure is increasing or where performance is reducing.

Risks are managed and mitigated by taking timely action to rectify defects or implement controls. Routine maintenance addresses the identified risks of equipment failure or reduced performance. In addition to routine maintenance, minor repairs may be undertaken. Minor repairs are repairs that are one-off repairs that are undertaken on an as needed basis, not on a planned or ongoing basis. Minor repairs also address the risk of in service failure or reduced performance.

TasNetworks captures the results and insights from condition and maintenance activities in a document known as a condition assessment report (**CAR**). The CARs shall be reviewed and updated each time reduction in condition is noted in maintenance or inspection. This is to ensure trends are identified and reported in a timely manner to ensure action can be taken to maximise the value of assets.

Condition asset reports also review asset failure history. This history is used to inform likelihood of consequences. The Total Qualified Risk (**TQR**) tool has been developed by the business to quantify risk. This tool converts the risk and consequence into a risk value.

Below are descriptions of the service obligations and programs currently undertaken in relation to HV switchgear. These programs cover off the **Opex** component of HV switchgear management and maintenance.

6.2 Service obligations for non-regulated assets

6.2.1.1 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.

6.2.1.2 Major industrial direct customer connections

TasNetworks has 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);

Hampshire Substation (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.

6.3 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' CAR and general asset defects management process.

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

6.4 Future of maintenance

As technology continues to improve TasNetworks recognises that the methods of proactively approaching life-cycle asset management may need to modernise. TasNetworks keeps abreast of new and upcoming technologies through TasNetworks' participation in various benchmarking and best practice activities. TasNetworks is an active member of CIGRE and ITOMS. TasNetworks participates in industry conferences both locally and internationally.

TasNetworks is a relatively small transmission network when compared to mainland Australian and international companies. Larger entities are able to trial new technology with a lower overall risk as the risk of one asset failure is a much smaller proportion of their network. In comparison a single asset failure on a small network has a large impact on overall performance. For this reason, TasNetworks takes a conservative approach to new technology. When technology is proven in the field and the risks are known, it is then adopted. This protects our customers and the communities from higher prices and unreliable service. Initiatives that are likely to be pursued in the future are represented below.

6.4.1 Online monitoring of circuit breaker fault operations

To ensure optimal performance of a circuit breaker it is necessary to make sure that the interrupting capability is maintained at its optimum level at all times and has not been compromised due to fault operations. A maintenance regime based only on a fixed time interval does not guarantee the optimum condition of the switchgear. Such schemes could lead to excessive maintenance if there have been no fault operations during that period or leave the contacts in a deteriorated condition for an extended period if there were a large number of fault operations and the maintenance interval is too long.

A new installation of modern protection relays (such as Alstom MiCom P143 and Siemens 7SJ82) have already been in TasNetworks since last 10 years. These relays are capable of recording various statistics related to each circuit breaker fault operation, allowing a more accurate assessment of the circuit breaker’s condition to be made.

6.4.2 Summary of Opex expenditure

Table 2: Summary of Opex programs and expenditure

Project/Program	Functional Area	Expenditure ($)										
		Financial year	**FY20**	**FY21**	**FY22**	**FY23**	**FY24**	**FY25**	**FY26**	**FY27**	**FY28**	**FY29**
Condition monitoring circuit breaker HV	CMCBH	**Expenditure ($)**	$38,144	$50,113	$40,042	$40,076	$40,000	$40,042	$40,042	$40,042	$40,042	$40,042
Condition monitoring Current transformer HV	CMCTH	**Expenditure ($)**	$9,668	$0	$0	$0	$0	$1,000	$1,000	$1,000	$1,000	$1,000
Condition monitoring disconnector and earth switch HV	CMDEH	**Expenditure ($)**	$9,445	$0	$0	$0	$0	$1,000	$1,000	$1,000	$1,000	$1,000
Condition monitoring voltage transformer	CMVTH	**Expenditure ($)**	$9,668	$0	$0	$0	$2,500	$1,792	$1,792	$1,792	$1,792	$1,792
Preventative maintenance circuit breaker	PMCBH	**Expenditure ($)**	$214,722	$114,058	$121,885	$115,013	$115,000	$121,885	$121,885	$121,885	$121,885	$121,885
Preventative maintenance current transformer	PMCTH	**Expenditure ($m)**	$24,266	$4,509	$25,000	$15,012	$4,500	$25,000	$25,000	$25,000	$25,000	$25,000
Preventative maintenance disconnector	PMDEH	**Expenditure ($m)**	$3,737	$3,005	$4,500	$3,009	$3,000	$4,500	$4,500	$4,500	$4,500	$4,500
Preventative maintenance voltage transformer	PMVTH	**Expenditure ($)**	$0	$0	$0	$0	$12,000	$12,000	$12,000	$12,000	$12,000	$12,000

6.5 Reliability and quality maintained (Capex)

Capital expenditure (**Capex**) is work that significantly increases the life of an asset or is for the replacement of an asset.

HV switchgear is critical to the safety, reliability, security and value to our customers. The criticality of these assets increases the risk associated with in-service failures and reduced performance. Where routine maintenance is no longer able to ensure the performance or safety of the assets, those assets are prioritised for replacement prior to an in-service failure occurring.

The drivers for asset replacement are usually either from a deterioration in their condition, or other specific issues that present risks that cannot be addressed through other means. These risks are defined in Section 5. Asset failures can also result in a need for asset replacement.

6.5.1 HV switchgear replacement program (RENSW)

The HV switchgear program (**RENSW**) relates to the replacement of HV switchgear. HV switchgear are replaced based on condition, performance or in-service failure. The approach to asset replacements is value based. The risk of asset failure (likelihood and consequence) is balanced against the value of other programs proposed by the business. In this way the business can deliver the best return on expenditure for its customers.

Every potential replacement is prioritised based on an assessment against the following criteria:

- risk to safety i.e. level of exposure e.g. internal arc contained design, enclosure type, location;
- criticality of the installation and consequences if a failure occurred;
- condition;
- likelihood of failure;
- compliance; and
- ability to maintain the asset.

This approach has identified the following HV switchgear replacements to be undertaken in the 2024-2029 regulatory control period.

Boyer Substation has 6.6 kV switchgear which do not have internal arc containment. There is no plan to replace these switchgear despite not being arc contained, as these switchgear supply power to a dedicated customer and the Connection Agreement with the customer is up to 2029. When the agreement is renewed in future the need for switchgear replacement needs to be considered. Risk mitigation such as wearing category 4 PPE is mandatory whilst operating the switchgear.

Table 3: HV switchgear change out program, 2024-2029

Location	HV Switchgear
Chapel Street Substation	30
Knights Road	11
Rosebery Substation	4
Sorell Substation	11
Burnie Substation	8

TasNetworks approaches asset replacement by considering all viable options available. For HV switchgear there are a number of basic options considered. Other options are also considered if and where practicable to do so. Because of the different arrangements at different substations not all options may be applicable to all situations.

The basic options considered are outlined below.

6.5.1.1 Option 0 – do nothing

Option effectively takes no action beyond routine maintenance and inspection routines. This means that, although these preventative maintenance programs are no longer enough to sustain performance, no replacement will take place. With this strategy the HV switchgear would remain in service until failure occurs. This option demonstrates the current risk and potential consequences. This is the baseline option that all other options are compared against. The benefit of other options can be demonstrated through the difference between the base Option 0 and the option being discussed. In this way the least risk option can be identified.

6.5.1.2 Option 1 – replace HV switchgear

Option 1 considers replacing all HV switchgear which have been determined through condition monitoring as being at their end of life. This option is the lowest risk option.

6.5.1.3 Option 2 – delay replacement HV switchgear

This option is identical to option 1, where the investment is to occur in 5 years later. Effectively this option tests the timing of replacements between two future reset periods. This compares the value of replacing the assets now versus into the future. When compared to other work in the business this option may be preferential as the capital is best spent on the highest value projects and/or programs.

6.5.1.4 Option 3 – replace fewer HV switchgear

Option 3 describes a smaller set of HV switchgear than Option 1, with assets selected for replacement based on risk. When compared to other options this option may be preferred as the capital is best spent on the highest value projects and/or programs.

6.5.1.5 Option 4 – refurbish

Option 4 is the removal and refurbishment of HV switchgear. This involves the removal of the asset or its component parts, refurbishing and reinstating the assets. This may be the best option where components can be replaced efficiently. Some component may be difficult to replace in a timely manner. Where replacement is inefficient there may be long durations of bay outages. Whilst the refurbishment is taking place the bay will be out of service.

6.5.1.6 Option 5 – replace and refurbish

This option involves a series of steps, beginning with replacing an asset with new or spare asset. The removed asset is then refurbished. The refurbished asset is then used to replace another asset in the network. This process continues until all the end of life assets are replaced. This approach can be slower than other options and may not deliver the best value.

6.5.2 Details of future Capex projects/programs

The business uses the Copperleaf software program to compare projects and programs across the business, to drive the best value for our customers. Copperleaf does this by comparing investment and risk to give a balanced business expenditure over the coming regulatory control period. The output of Copperleaf in relation to HV switchgear is summarised in **Table 3**, which outlines the HV switchgear projects proposed for the 2024-2029 regulatory control period.

Table 3: Program/project details

Project/Program description	Functional area	Link to HBRM initiative
Renew HV Switchgear	RENSW	PRJ000629

6.6 Spares management

TasNetworks' approach to spares management is outlined in the System Spares Policy R517373. At a minimum there shall be:

- One complete circuit breaker of each type;
- Three current transformers of each type; and
- Three voltage transformers of each type.

This list acts as a base-line minimum over and above the recommendations by the manufacturer.

Where equipment is common among several installations it is not necessary to hold the minimum for each substation, but a policy of an additional 0.5 times the recommended spares should be kept. This means the full quantity for the first installation and an additional half of that number for each.

Where spares are used they must be booked to the project that installed them. Booking a spare to the project is the same as booking any item to a project from the warehouse. The spare switchgear (circuit breaker, CTs or VTs) catalogue cost must be booked to the project and a replacement spare ordered. The catalogue cost is the value associated with the spare in the SAP inventory catalogue. If a value doesn't exist the replacement cost should be used as the catalogue value. A replacement spare must be ordered immediately to replace the spare used.

6.7 End of life management

The SKM assessment of proposed regulatory asset lives is the point of reference for asset life and references 45 years for HV switchgear. The life of HV switchgear as defined by the AER is 45 years. TasNetworks strives to maximise asset life where it is in the best interests of the customer.

Once an asset has reached the end of its useful life it is removed from service and decommissioned. The capital replacement project is responsible for the removal and disposal of decommissioned assets. Where assets are useful as spares or can be effectively refurbished they are identified before the project is estimated. Associated refurbishment costs are associated with the capital replacement project.

Where an asset is to be disposed of it is done so under the replacement project. The project is responsible for the timely, safe and environmentally sound disposal of assets. Wherever possible recycling of assets or component parts is encouraged.

All asset management and information systems must be updated. Data relating to the decommissioned asset must be updated to reflect the removal of the asset. Similarly, data relating to any and all installed assets must also be updated. SAP is currently the computer managed maintenance system used at TasNetworks and is the source of truth for asset information. It is imperative that this is kept current and accurate. It is the responsibility of the project to ensure all data is updated as part of the project closeout.

7 Related standards and documentation

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

TasNetworks documents:

1. System Spares Policy R517373
2. Strategic Asset Management Plan R248812
3. Annual Planning Report 2022 R689487
4. Asset Condition Review – project report June16 FINAL R503361
5. PD survey of TasNetworks Substations, EA Tech report 2016 R503098
6. Risk Management Assessment – Substation High Voltage Switchgear Arc Hazard Risk Management Assessment R152836

Technical requirements for HV voltage switchgear are detailed in the following standards/specifications:

7. High Voltage System Standard R565983
8. Sulphur Hexafluoride Gas Management Procedure, Transend Networks, 2005 D10/4141

Other standards and documents

9. Sinclair Knight Merz, 'Assessment of Economic Lives for Transend Regulatory Asset Classes', 2013 R192773
10. Australian Standard AS 4360 'Risk Management', Standards Australia, 2004