Asset Management Plan

EHV Disconnector and Earth Switch

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Authorisations

Action	Name and title	Date
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Authorised by		30/11/2022
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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
6.0	Re-write from Transend format into TasNetworks Format and update of data	10/2017
7.0	Re-write into new TasNetworks template	10/2022

Table of contents

1 Purpose

The purpose of this document is to describe for EHV Disconnectors and Earth Switches 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 (**Capex**) and (**Opex**), including the basis upon which these forecasts are derived.

2 Scope

This document covers air-insulated 110 kV and 220 kV disconnectors and earth switches.

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 disconnectors and earth switches.

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

This portfolio covers disconnectors and earth switches as they are both large mechanical switches in transmission substations. Disconnectors and earth switches are critical parts of the overall transmission network.

Disconnectors and earth switches must be kept in good condition to ensure the reliability of operation. 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 indicates that maintenance will no longer preserve an asset's performance.

As assets age their condition invariably deteriorates. The economic life of disconnectors and earth switches is 45 years, as detailed in the *Assessment of Proposed Regulatory Assed Lives* report prepared by Sinclair Knight Mertz.

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 Disconnectors

Disconnectors provide a means of either physically isolating a transmission element from the network (disconnecting), or the ability to transfer transmission circuit loads from one busbar to another or bypass circuit breakers (used for operational or maintenance purposes).

There are approximately equal numbers of manually operated and motorised disconnectors. As the network evolves the number of motorised disconnectors is expected to increase. The population of disconnectors is presented in Table 1.

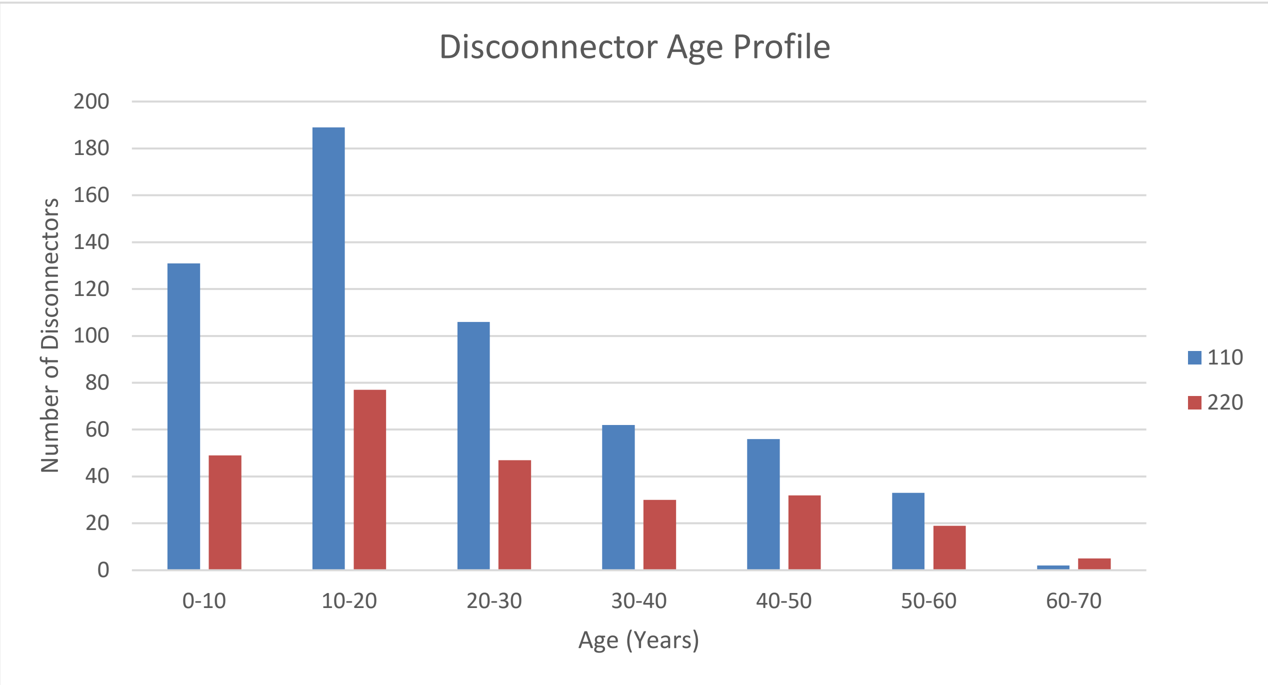
The disconnector population records are applicable as at Oct 2022.

Table 1: Disconnector population

Description	Voltage	Number of units
Disconnectors	110 kV	579
	220 kV	259
	Total	**838**

The age profile of the disconnector fleet is shown below in **Figure 1**.

Figure 1: Disconnector age profile



Disconnectors can be further categorised by operational voltage. Below in **Figures 2** and **3** are the age profiles of TasNetworks' 110 and 220 kV disconnectors.

Figure 2: 110 kV disconnector age profile

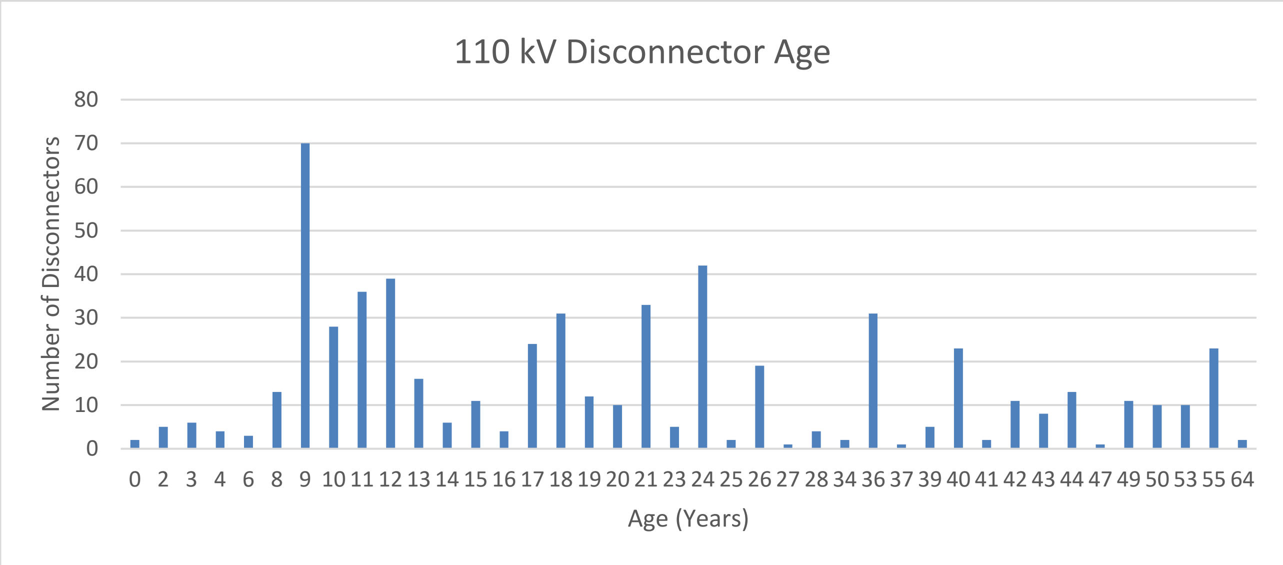
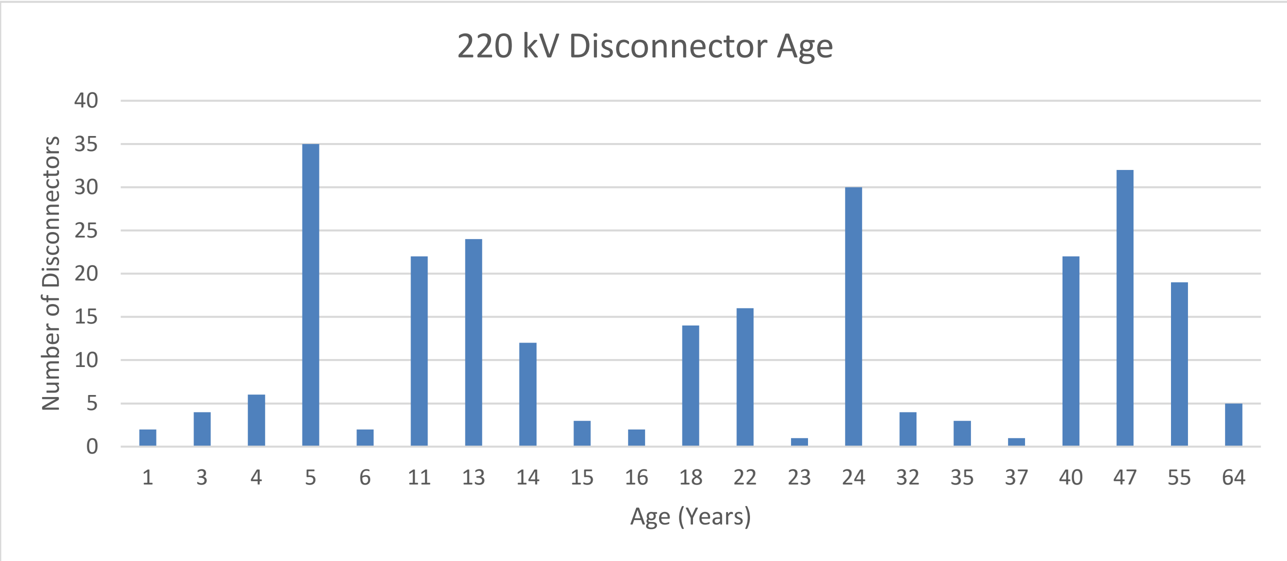


Figure 3: 220 kV disconnector age profile



TasNetworks' fleet of disconnectors includes assets from many different manufacturers. **Figures 4** and **5** (below) describe the disconnectors in service from different manufacturers.

Figure 4: 110 kV disconnectors by manufacturer

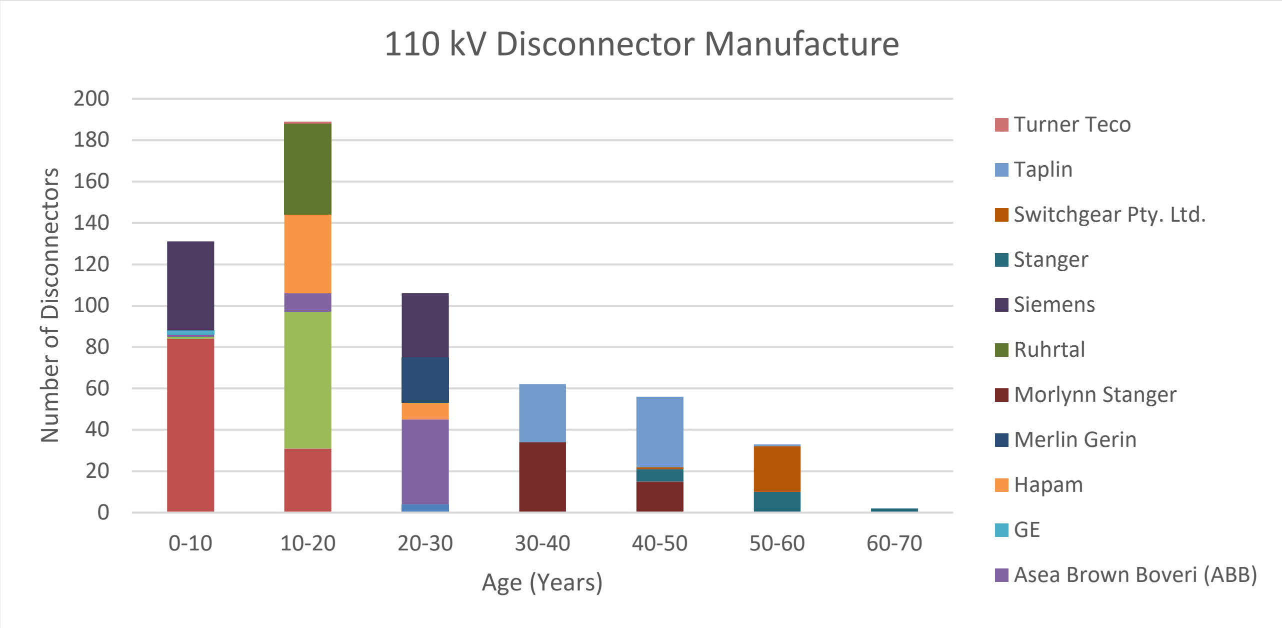
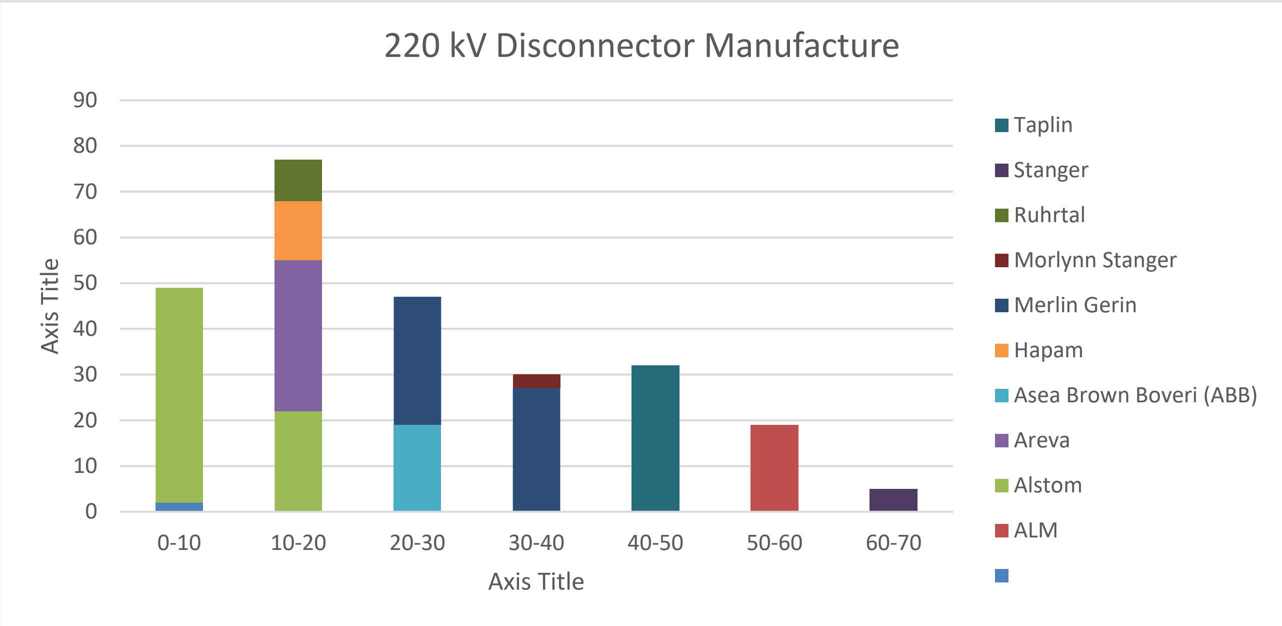


Figure 5: 220 kV disconnectors by manufacturer



The disconnectors can be further categorised by design type as presented in **Figure 6**. It should be noted that the 110 kV population of disconnectors consists primarily of double break disconnectors, whilst the 220 kV disconnector population mostly consists of centre break configurations.

TasNetworks' disconnector standard calls for the double break design type for new disconnectors because operational experience has shown that these provide greater reliability and have less operational issues. TasNetworks' disconnector population includes units constructed by 15 manufacturers comprising 42 different manufacturer types. Of these types, 26 have a population of less than 20 units, which adds complexity to spares management and maintenance practices for the different design types. TasNetworks' replacement strategy incorporates addressing the issues presented by a diverse asset population base.

A summary of disconnectors across the different manufacturers and design types for both 110 kV and 220 kV disconnectors is provided in **Figures 6** and **7**, respectively.

Figure 6: 110 kV disconnector configuration and manufacture

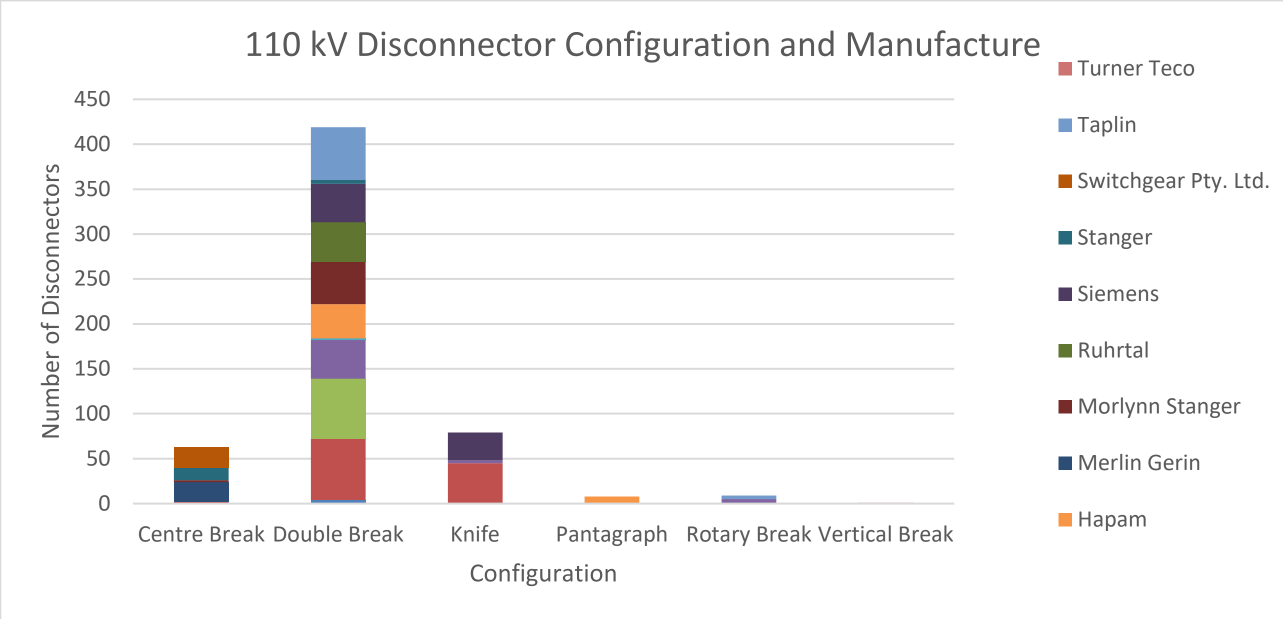
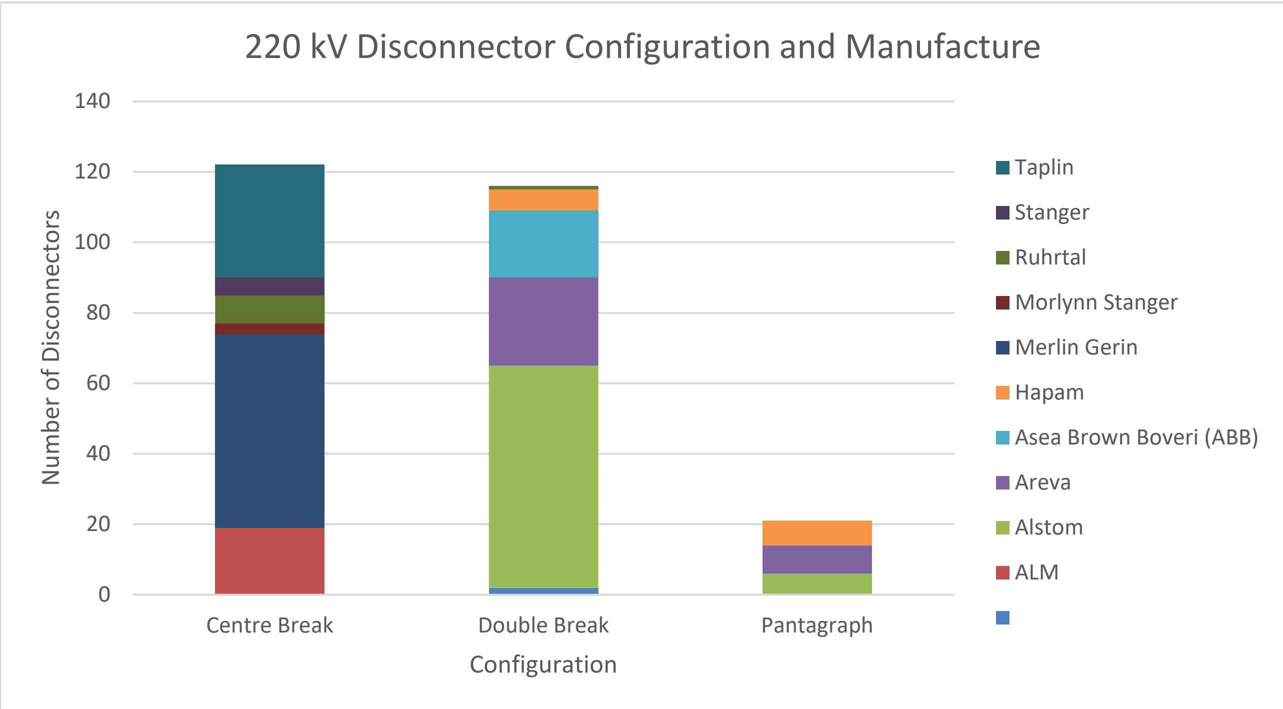


Figure 7: 220 kV disconnector configuration and manufacture



4.2 Earth switches

Earth switches are typically attached to disconnectors. The purpose of earth switches is to discharge electrical energy in an isolated transmission line or busbar to the general mass of earth, thereby making the conductors safe to work on. The population of earth switches is presented in **Table 2** (below).

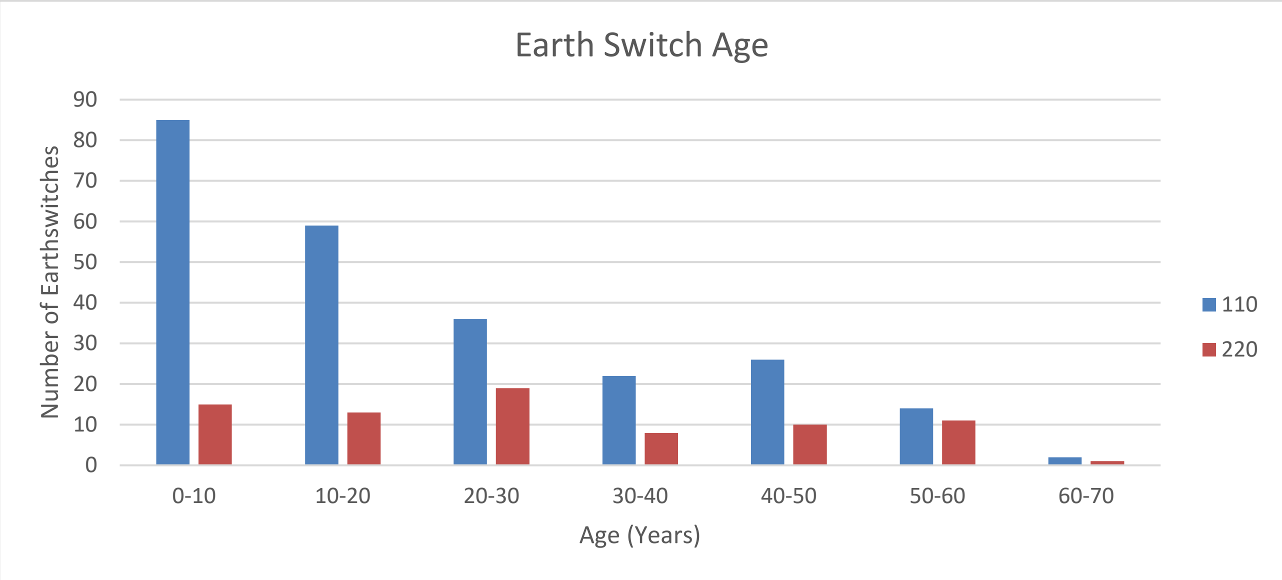
The earth switch population records are applicable as at Oct 2022.

Table 2: Earth switch population

Description	Voltage	Number of units
Earth switch	110 kV	244
	220 kV	77
	Total	**321**

The age profile of the earth switch fleet is shown below in **Figure 8**.

Figure 8: Earth switch age profile



Earth switches can be further categorised by operational voltage. Below in **Figures 9** and **10** are the age profiles of the 110 and 220 kV earth switches.

Figure 9: 110 kV earth switch age profile

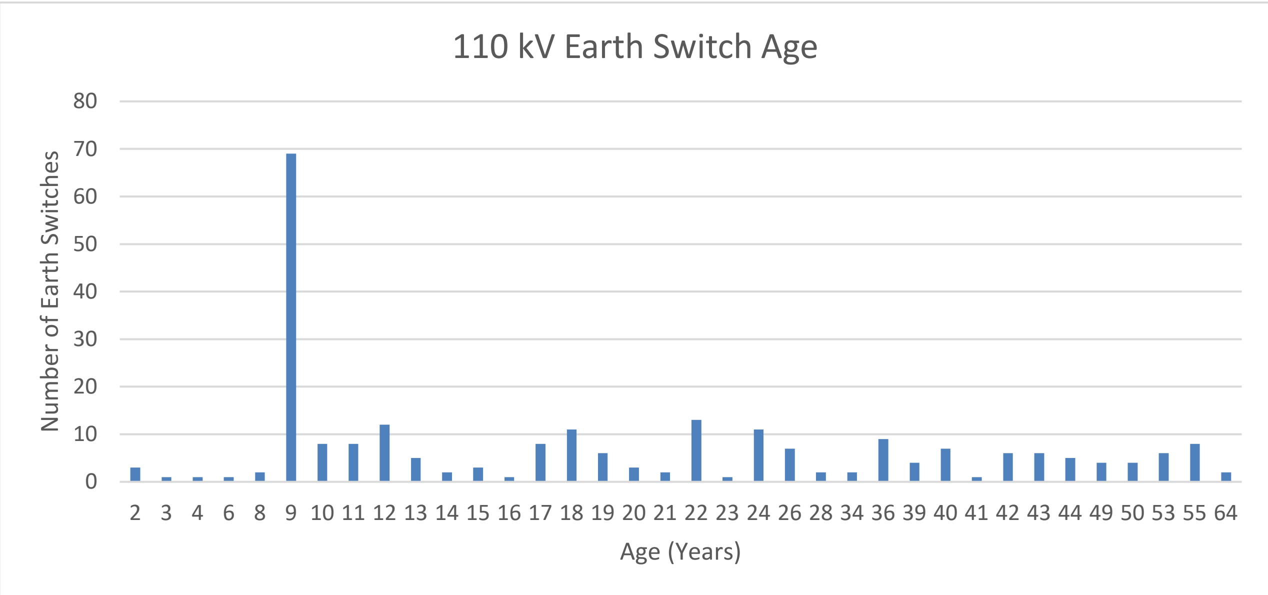
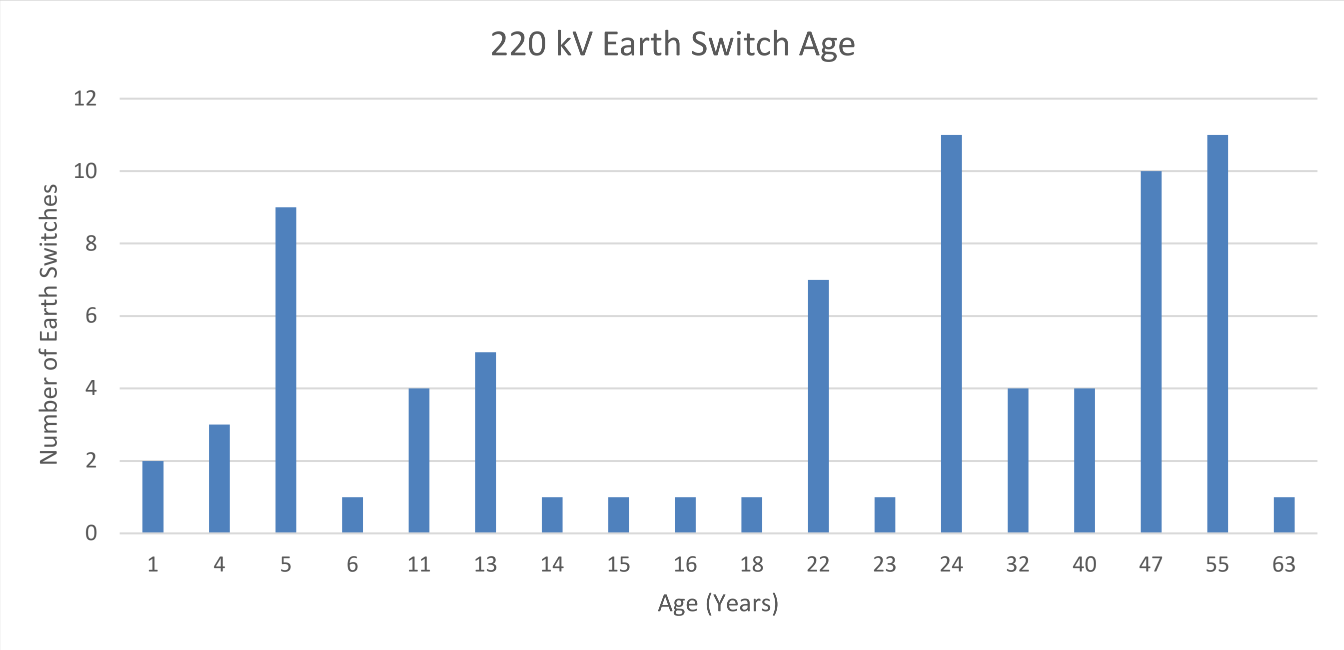


Figure 10: 220 kV earth switch age profile



TasNetworks' fleet of earth switches contains assets from many different manufacturers, as shown in **Figures 11** and **12** (below).

Figure 11: 110 kV earth switch age and manufacturer

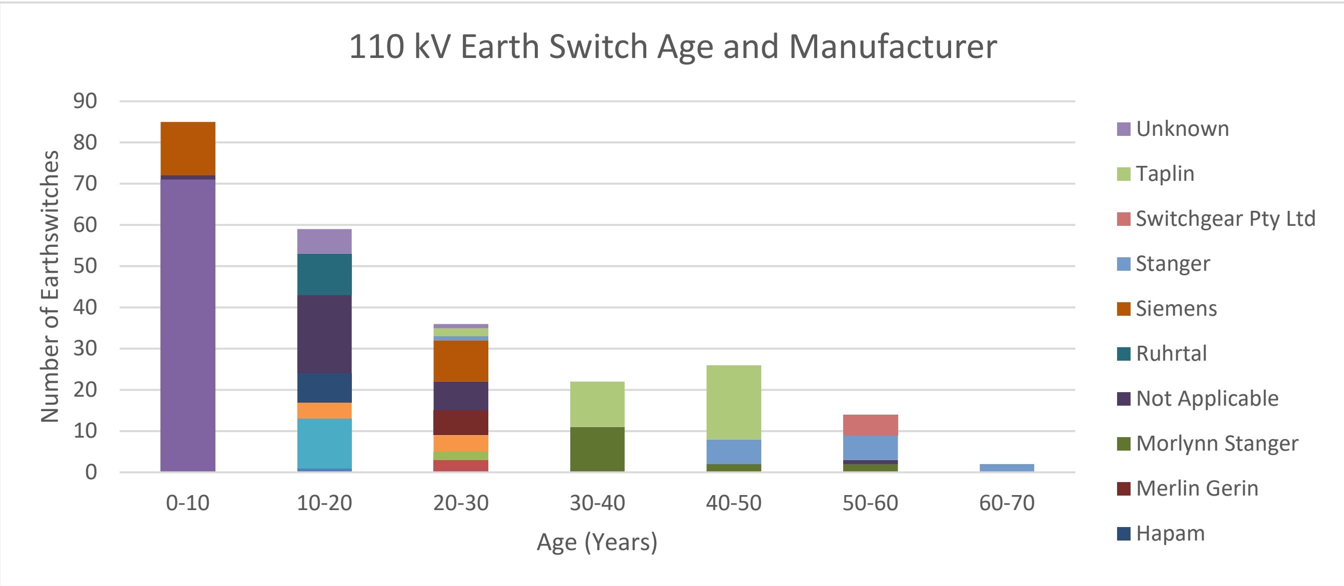
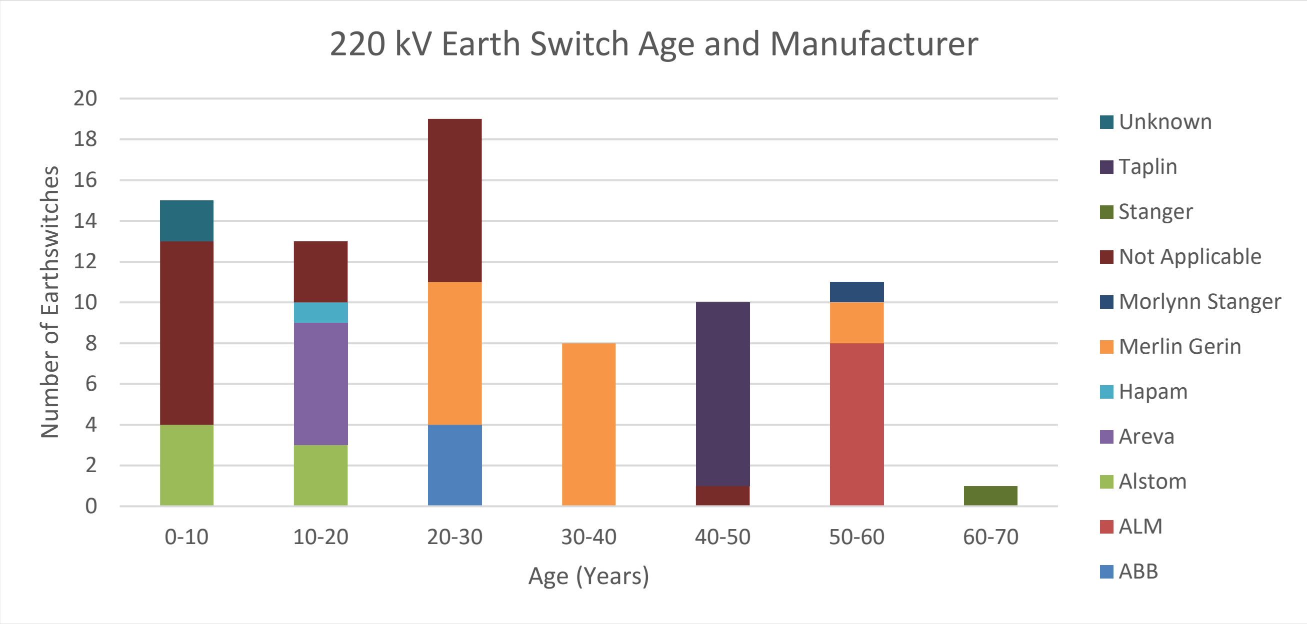


Figure 12: 220 kV earth switch age and manufacture



The earth switches can be further categorised by design type. It should be noted that the 110 kV and 220 kV population of earth switches consists primarily of knife earth switches.

4.3 Component parts

The design and installation requirements for disconnectors are described in detailed specifications. There are several key components to disconnectors, including;

- earth switches;
- post insulators;
- interlocks; and
- mode of operation.

The following sections detail these various components:

4.3.1 Earth switches

Earth switches are used to earth the circuits so that the circuits can be safely approached and have work performed. Earth switches have all three phases mechanically coupled and are normally installed on line disconnectors and bus coupler disconnectors in order to earth transmission lines and busses, respectively.

4.3.2 Post insulators

Post insulators are required to provide the necessary electrical clearance from the disconnector to the support structure in order to prevent a flashover. They must be mechanically suitable to withstand every operating and fault situation that could be encountered.

4.3.3 Interlocks

A solenoid interlock is required on disconnectors to allow electrical interlocking with the associated circuit breaker(s) to prevent the disconnector from making or breaking load. Where an earth switch is fitted, the disconnector must be interlocked with the earth switch to only allow the earth switch to be closed when all poles of the disconnector are open and only allow the disconnector to be closed when all poles of the earth switch are open.

4.3.4 Mode of operation

Disconnectors are either manual or motorised. Motorised disconnectors can be operated remotely or locally. Motorised disconnectors can also be operated manually if the motor ever fails. All three poles are mechanically coupled for both modes of operation to ensure that all poles open or close at the same time.

4.4 Technology types

For the purposes of this analysis, disconnector technologies are split into four main categories:

- double break;
- centre break;
- vertical break/vertical make; and
- pantograph/semi-pantograph.

4.4.1 Double break

Double break disconnectors have contacts at both ends and a support in the centre of the disconnector arm that rotates the arm and breaks the contacts at both ends at the same time.

4.4.2 Centre break

Centre break disconnectors have contacts at the centre of the disconnector arm and hinges at both ends. The supports at each end rotate and cause both halves of the disconnector arm to rotate outwards.

4.4.3 Vertical break/vertical make

Vertical break/vertical make disconnectors have contacts at one end of the disconnector arm and a hinge at the other end. The arm lifts upwards to either break or make the circuit. Vertical break disconnectors are no longer installed in the Transmission system.

4.4.4 Pantograph/semi-pantograph

Pantograph disconnectors utilise a scissor action that cause one contact to lift up and close onto a stationary contact. The stationary contact can either be an attachment to the conductor like a stirrup or it can be a solid bus. It is noted that some pantograph disconnectors are single pole operation, i.e.: not mechanically ganged for 3 pole switching.

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 the disconnector and earth switch 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 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 the assets. Disconnectors are routinely inspected and tested. Infra-red imaging is used to identify any hot spots on the disconnectors.

Disconnectors and earth switches installed in TasNetworks' transmission substations are prone to specific failure modes. Failure modes most commonly relate to:

- thermal failure of conductive braids or contacts;
- operating linkage and pivot joints seizing;
- contact misalignment and un-synchronised operation;
- weak springs and worn pivot joint assemblies;
- auxiliary switch failure; and
- post insulator electrical (leakage currents) and mechanical failure.

5.3 Operational and design issues

5.3.1 Operational Issues

One type of disconnector has been identified as constraining the current rating associated with the transmission circuit. This disconnector is expected to be replaced as a part of redevelopment works planned for this site. These two disconnectors are being proposed to be replaced in FY23-24.

Table 3: Disconnector with capacity limitations

Manufacturer	Voltage	Substation	Issue
Stanger DR1	110 kV	Chapel Street, B729A and B729B	These disconnectors limit the bay loading to 800 A.

5.3.2 Design issues

Disconnector design issues are key considerations in developing an asset management strategy for the population. Design considerations are separated into two areas, specific design issues and TasNetworks' general substation design philosophy.

Disconnector design is an important factor that can influence both asset and transmission system performance levels. In addition, design issues have a direct impact on maintenance practices and expenditure. Common design issues across TasNetworks' disconnector population are discussed in the following sections.

5.3.2.1 Contact misalignment

Centre break, vertical make and pantograph disconnectors are susceptible to contact misalignment. Even through contact alignment is verified at installation and/or after maintenance, contact misalignment sometimes occurs after the disconnectors are operated. TasNetworks' disconnector standard now specifies double-break disconnectors, which are not as susceptible to contact misalignment.

5.3.2.2 Motorised operations

Currently, there are 444 disconnectors that utilise motorised operation. 128 of the 444 disconnectors operate at 220 kV and the rest operate at 110 kV. Manual operation of disconnectors can lead to delays in implementing switching programs, higher switching costs and less flexibility in operation. This can also cause delay in restoring the transmission network to normal operating state following a system or fault event.

These issues can be minimised through the motorisation and remote operation capability of disconnectors that are used for bus selection. This will allow for remote switching to be performed prior to outages and manage contingencies without the need for field operator attendance.

TasNetworks will evaluate the benefits of motorising specific manual disconnectors already in the system and, provided it is justified, will produce a program of implementation in conjunction with other substation works. TasNetworks has specified that for all new installations, disconnectors will be motorised and capable of being controlled locally at the disconnector or remotely, via a supervisory control and data acquisition (**SCADA**) system.

5.3.2.3 Manufacturer support and spares availability

A number of older disconnectors are no longer supported by the manufacturer. Some of these units are maintained using units of the same type that have been retained from the transmission system, which results in spares management and contingency planning issues. Also, using decommissioned units for spare parts is usually not an option because the parts that normally need replacing (such as contacts or swivel joints) will be in a similar condition on the decommissioned unit.

Apart from the logistical constraints associated with the lack of manufacturer support and spares availability, obsolete designs inevitability present themselves as system reliability issues and operational constraints.

5.3.2.4 Earth switches within bus zone protection coverage

Earth switches are installed on a number of disconnectors on the busbar side of transmission line current transformers (**CTs**) throughout the system. Due to induction from a fault on an adjacent transmission line in service, fault current could flow into the CTs on the line out-of-service, which could lead to operation of the bus zone protection. TasNetworks had identified disconnectors installed inside the bus zone protection and a program to re-position such disconnectors prioritised based on the transmission system reliability risk and coordinated with other works program where appropriate and practical has been undertaken.

5.3.2.5 Status of earth switches – indication

Most earth switches have the capability for position indication to the Network Operation Control System (**NOCS**) or to the local operating panels in the substations. The few that do not have led to difficulties in maintaining a clear overview of switching operations, with consequent safety and system security implications. New installations have addressed this shortcoming.

5.3.2.6 Health and safety

Significant physical effort is required to operate certain types of disconnector, presenting an occupational health and safety risk to operational staff.

5.4 Asset risks

There are two main drivers for risk outcomes related to disconnectors: failure to operate and catastrophic failure. Failure to operate results in the asset not being able perform its intended function. A failure to operate will impact the network's ability to deliver power to customers. Failure to operate can also prevent switching and isolation. Catastrophic failure occurs when the contact collapses or its insulation fails. A catastrophic failure may result in one or all of the following:

- loss of power supply;
- extension of outages;
- isolation point lost;
- switching limited; 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 is damaged then the earthing protection is no longer present. The exterior of the equipment such as the base of the disconnector could become electrically charged.

TasNetworks develops its disconnector and earth switch 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 disconnectors allows for risk assessments of that asset's ability to operate reliably and efficiently. These risk assessments determine whether to maintain, refurbish or replace disconnectors and the optimal timing of these actions. Due to the critical nature of these assets, disconnectors identified as requiring maintenance, refurbishment or replacements are proactively planned to mitigate the risk of in-service failure.

5.4.1 Loss of power supply

Disconnectors are installed in transmission substations to allow for switching and isolation of assets. If a disconnector has failed it may impact the ability of a bay in the yard to supply power to the lines.

When a disconnector fails to operate it usually locks in either an open or closed position. More rarely, the disconnector will become locked in an intermediate position. If the disconnector is locked in the closed position the power will continue to flow through this disconnector. Isolation of assets on either side of the disconnector is impossible until the disconnector can be opened. This would involve taking the line out of service to replace or repair the disconnector.

If the disconnector is locked in the open position then the power cannot flow through this bay. Should the assets on the other line fail or need preventative maintenance, the power supply will be interrupted. This means that the N-1 arrangement has effectively been lost.

The risk of loss of power supply is significantly increased where disconnectors are not functioning.

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

Controls include:

- N-1 arrangement; and
- preventative maintenance.

5.4.2 Extension of outages

Where work is done on a substation bay an outage is often required. Outages are negotiated with stakeholders such as customers and suppliers. Customers and suppliers are negatively impacted by outages and, as such, they are minimised.

When a disconnector fails to operate during an outage it can extend the outage time or even cause another outage to be required.

For example, a disconnector that is required to form part of the isolation is locked in the closed position. This will need to be rectified before the work planned in the outage can continue. If the issue cannot be rectified quickly, a second outage may be needed to fix the disconnector and then a third to carry out the initial works.

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

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

5.4.3 Isolation point lost

As discussed in section 5.4.1, when a disconnector is locked in the closed positon it can no longer perform the function of an isolation point. This 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; and
- spares holdings.

5.4.4 Switching limited

As discussed in section 5.4.1, if a disconnector is locked in the open position then power cannot flow through the bay. Should the assets on the other line fail or need preventative maintenance the power supply will be interrupted. This means that the N-1 arrangement has effectively been lost.

The risk of loss of power supply is significantly increased where disconnectors are not functioning.

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

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

5.4.5 Unplanned replacement

There is a significant difference between planned and unplanned replacement of assets. Planned replacements of assets allows for the equipment to be purchased in advance, planned switching to occur and interruptions to customers minimised. In the event of an unplanned failure none of these happen. Instead the process for replacement begins at the time of failure. As discussed in 5.4.1, 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 ten months. Installation of the asset once procured is done at the earliest possible time. During the time it takes to procure and install the disconnector, the network is potentially left without an N-1 capacity in that location. This means that the supply for entire areas are 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. Further, the stability of the network may become increasingly marginal during this time.

There are protocols and switching available to mitigate any loss of capacity and stability. Depending on the location of equipment failure, the network may be constrained. This might impact the ability for the network to support exports to mainland Australia.

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

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

Table 4 Summary of asset risks

Risk Identification		**Risk Analysis (Inherent)**				
Asset	**Risk Description**	**Category**	**Likelihood**	**Consequence**	**Risk Rank**	**Treatment Plan Yes / No**
Disconnectors and Earth Switches	Failure to operate/ catastrophic failure	Safety and People	Rare	Severe	Medium	Yes
		Financial	Unlikely	Minor	Low	
		Customer	Possible	Minor	Low	
		Regulatory Compliance	Possible	Minor	Medium	
		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**).

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.

Below are descriptions of the programs currently undertaken in relation to disconnectors. These programs cover off the **Opex** component of disconnectors and earth switches management and maintenance.

The maintenance performed on disconnectors is generally consistent across all manufacturers and types. The maintenance plan requires work on the disconnector including insulators and the operating mechanism.

6.1.1 Current carrying assembly

Disconnector condition monitoring involves a contact resistance test being performed across the entire arm of the disconnector (dropper to dropper) prior to and following maintenance being performed. A reading exceeding the benchmark value, as stated in the disconnector maintenance procedure, must be reported and a follow-up investigation performed.

Maintenance involves checking the integrity of disconnector contacts for condition and alignment, and then re-greasing. The alignment of the operating arms during operation is also checked and corrected where required.

Maintenance also involves checking and adjusting the alignment of the three operating arms to ensure that all three poles close and open in a synchronised fashion. Synchronised operation must be ascertained visually on site.

6.1.2 Insulators

Insulator failure can cause major failures of disconnectors, with the shattering porcelain insulating discs. Therefore, insulator inspection and maintenance is performed. The insulators are cleaned and a visual inspection for cracks, chips, surface degradation, rusting or other foreign materials performed.

6.1.3 Operating mechanism

The maintenance of the operating mechanism involves the inspection and cleaning of auxiliary connections and switches, lubrication of all moving parts, ensuring integrity of appropriate water proofing, inspecting the cabinet for corrosion and ensuring correct earth bonding and heater circuit is intact.

6.1.4 Other maintenance

Remaining disconnector maintenance involves the inspection of the integrity of steelwork and foundations of the disconnector structure and the testing of operation of the solenoid and that correct status and alarms are being received through **NOCS**.

6.2 Non-routine maintenance

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

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

6.2.1 Summary of Opex expenditure

Table 5: Summary of Opex programs and expenditure

Project/ Program	Functional Area	Program Data										
		Financial year	**FY20**	**FY21**	**FY22**	**FY23**	**FY24**	**FY25**	**FY26**	**FY27**	**FY28**	**FY29**
Corrective-Disconnector EHV	CMDEE	**Expenditure ($)**	$463,42	$45,422	$49,985	$45,013	$45,000	$49,985	$49,985	$49,985	$49,985	$49,985
Disconnector Maintenance EHV	PMDEE	**Expenditure ($)**	$89,223	$75,208	$92,541	$141,018	$75,000	$92,541	$92,541	$92,541	$92,541	$92,541

6.3 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.

Disconnectors are 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 assets, they are prioritised for replacement prior to an in-service failure occurring.

The drivers for asset replacement are usually either 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.

6.3.1 Disconnector and earth switch replacement program (RENDE)

The disconnector and earth switch replacement program (**RENDE**) relates to the replacement of disconnectors and earth switches. Disconnectors and earth switches 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 public safety (i.e. level of exposure, enclosure type, location);
- criticality of the installation and consequences if failure occurs;
- condition;
- likelihood of failure;
- compliance; and
- ability to maintain the asset.

This approach has identified the following disconnector/earth switch replacements to be undertaken in the 2024-2029 regulatory control period (see **Table 6**).

Table 6: Change out program, 2024-2029 regulatory control period

Location	Disconnectors	Earth switches
George Town Substation	0	2
Sheffield Substation	32 (13-220 kV, 19-110 kV)	13

TasNetworks approaches asset replacement by considering all viable options available. For disconnector and earth switches there are a number basic options considered. Other options are also considered if and where practicable to do so.

6.3.1.1 Option 0 – do nothing

Option 0 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 transformers 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.

6.3.1.2 Option 1 – replace disconnector/earth switch

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

6.3.1.3 Option 2 – delay replacement disconnector/earth switch

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.

6.3.1.4 Option 3 – replace fewer disconnectors/earth switch

Option 3 describes a smaller set of disconnectors/earth switches 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.

6.3.1.5 Option 4 – refurbish

Option 4 is the removal and refurbishment of disconnectors/earth switches. This involves the removal of the asset, refurbishing off site and reinstating the asset later. This is the slowest option and includes long durations of bay outages. Whilst the refurbishment is taking place the bay will be out of service.

6.3.1.6 Option 5 – replace and refurbish

This option involves a series of steps, beginning with replacing an asset with a 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.

6.3.2 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 cost and risk to give a balanced business expenditure over the coming reset period.

The output of Copperleaf in relation to disconnectors/earth switches is summarised in **Table 7**. **Table 7** outlines the disconnector/earth switch replacement projects proposed for the 2024-2029 regulatory control period.

Table 7: Program/project details

Project/Program description	Functional area	Link to HBRM initiative
Disconnector and Earth Switch Replacement Program	RENDE	PRJ000622

6.4 Spares management

TasNetworks' approach to spares management is outlined in the System Spares Policy R517373. At a minimum there shall be one available spare for any critical disconnector/earth switch in the network. Critical assets are those that will result in bay outages if they fail in service. **Table 8** presents the spares of complete disconnector units. These spares may be used to replace faulty disconnectors if needed.

Table 8: Spare disconnector units

Voltage	Manufacturer	Type	Design Action	Location	No. of Units
110 kV	Alstom	S3C		Primary Store	2
	ABB	DBRP 123	Double Break	Primary Store	1
	Stanger	T.T.T		Primary Store	1
	Taplin	D751/B182	Double Break	Primary Store	1
		D751/B180	Double Break	Primary Store	2
220 kV	ABB	DBRP 245	Double Break	Primary Store	1

For a detailed listing of the disconnector and earth switch spares parts see TasNetworks' asset management system.

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 asset 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 does not exist the replacement cost should be used as the catalogue value. A replacement spare must be ordered immediately to replace the spare used.

6.5 End of life management

The Sinclair Knight Mertz (**SKM**) assessment of proposed regulatory asset lives, August 2013, is TasNetworks' point of reference for asset lives and references 45 years for disconnectors/earth switches. The life of disconnectors/earth switches as defined by the AER is 45 years. TasNetworks strives to maximise asset life where it is in the best interests of the customer to do so.

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 the 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 of 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 to it:

System Spares Policy	R517373
Strategic Asset Management Plan	R248812
Annual Planning Report 2022	R689487
Extra High Voltage Disconnector and Earth Switch Standard	R586396
Sinclair Knight Merz, 'Assessment of Economic Lives for Transend Regulatory Asset Classes', 2013	R192773