Asset Management Plan

Extra High Voltage Disconnector and Earth Switch

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Authorisations

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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").

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

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

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

Record of revisions

Section number	Details
All sections	*Re-write from Transend format into TasNetworks format and update of data.*

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1 Purpose

The purpose of this asset management plan is to define the management strategy relating specifically to EHV disconnectors and earth switches and related assets. The plan provides;

- TasNetworks' approach to asset management, as reflected through its legislative and regulatory obligations and strategic plans;
- The key projects and programs underpinning its activities; and
- Forecast CAPEX and OPEX, including the basis upon which these forecasts are derived.

2 Scope

This document covers all air-insulated 110 kV and 220 kV disconnectors and earth switches. This document is TasNetworks network asset management plan for its population of extra high voltage (EHV) disconnectors (hereafter referred to as disconnectors) for a ten year rolling planning period.

3 Strategic Alignment and Objectives

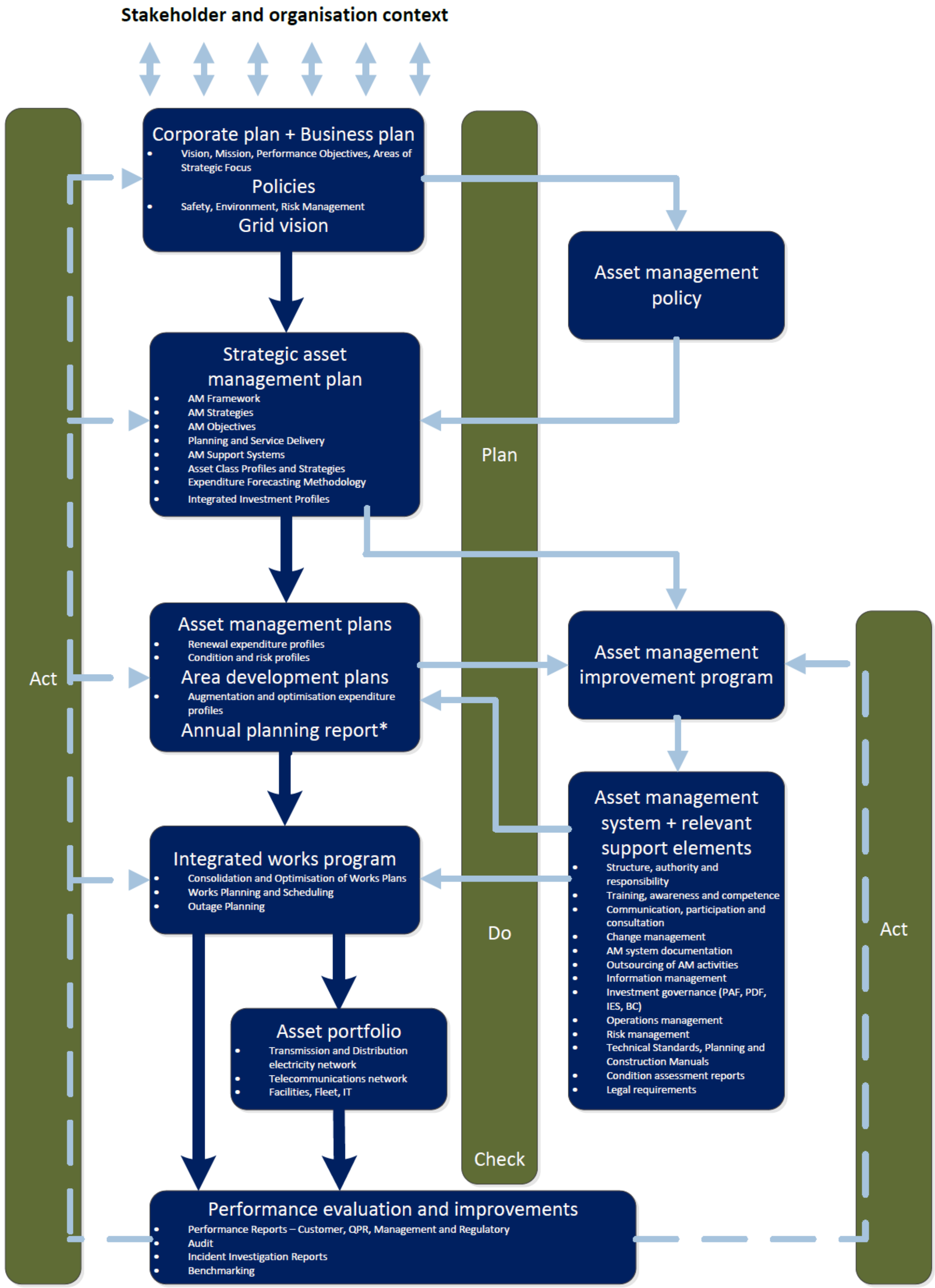
This asset management plan has been developed to align with both TasNetworks' Asset Management Policy and Strategic Objectives. This management plan describes the asset management strategies and programs developed to manage the EHV disconnectors and earth switches, with the aim of achieving these objectives.

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

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

The asset management policy and strategic objectives are outlined within the Strategic Asset Management Plan. Figure 1, from the Strategic Asset Management Plan, represents TasNetworks documents that support the asset management framework. The diagram highlights the existence of, and interdependence between the, Plan, Do, Check, Act components of good asset management practice.

Figure 1: TasNetworks asset management documentation framework



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

4 Asset Information Systems

4.1 Systems

TasNetworks utilises Asset Management Information Systems to manage asset records for its network. The systems are maintained to contain up to date, detailed information for the GIS installations.

AMIS is a combination of processes, technology, and people applied to provide the essential outputs for effective asset management, such as:

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

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

Asset defects are recorded directly against the asset registered in the asset management information system (WASP).

The defect information is readily accessible through TasNetworks' business intelligence reporting system and in future may feed directly into the development of probability of failure and consequences in the Condition Based Risk Management tool.

It is noted that a new Asset Management system (SAP) will be commissioned early in 2018 to replace WASP.

4.2 Asset Information

The following AMIS standards provide additional information relevant to disconnectors:

- R16963 WASP Asset Register – Data Integrity Standard – Disconnector; and
- R16975 WASP Asset Register – Data Integrity Standard – Earth Switch.

4.2.1 AM8 Condition Data

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

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

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

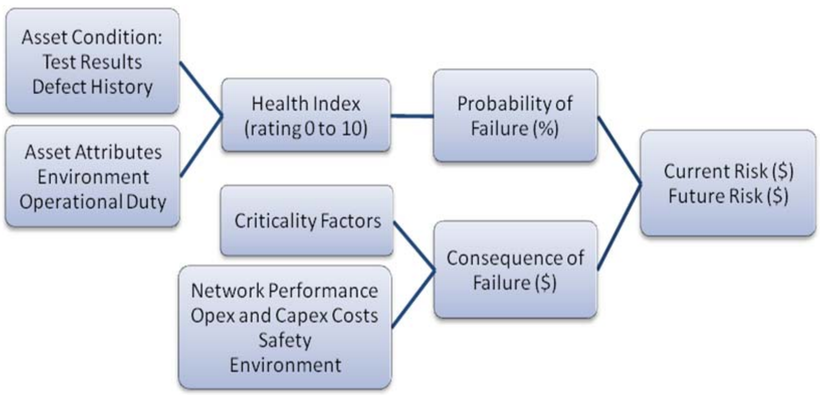
A number of observations were concluded as part of the review including the need to obtain condition data consistently across all asset types and in electronic form. The need for storage and collection would align with other business initiatives such as the AJILIS project.

4.3 Condition Base Risk Management

In 2010 TasNetworks engaged EA Technologies to implement a condition based risk methodology tool known as CBRM. EA Technologies is a UK based consultancy company with decades of asset management experience within the electricity industry.

TasNetworks uses a Condition Based Risk Management (CBRM) tool to analyse a fleet of assets and determine the effects of risk and cost trade-offs when considering asset replace and refurbish type decisions. Most of the final analysis is based on asset health index and cost.

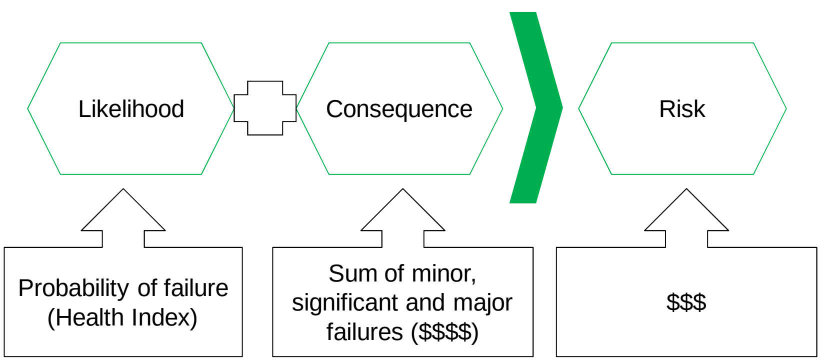
Figure 2: Asset risk framework



As with every risk decision, there are two main inputs, being likelihood and consequence.

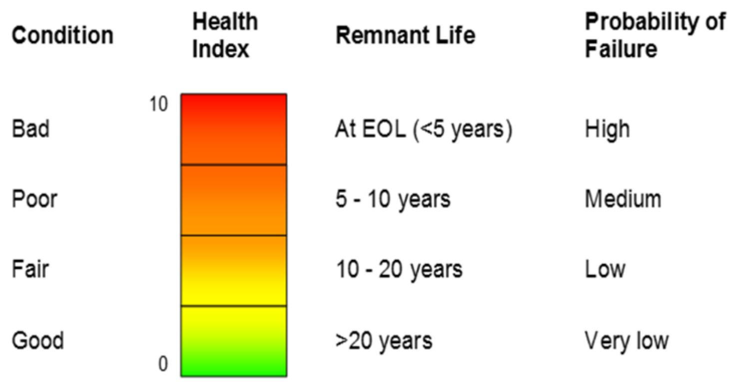
Figure 3 shows what CBRM considers as the two risk inputs.

Figure 3: Risk derivation for CBRM



CBRM calculates the likelihood, or the probability, of failure of an asset by deriving a health index (HI). The health index of an asset is a means of combining information that relates to its age, environment and duty, as well as specific condition and performance information to give a comparable measure of condition for individual assets in terms of proximity to end of life (EOL) and probability of failure (POF).

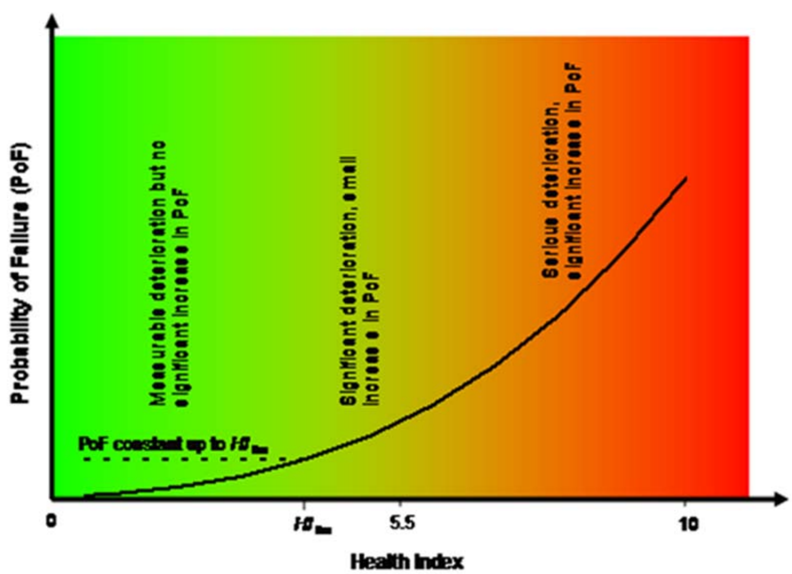
Figure 4: Health index interpretation



Notionally, any asset that has a HI of above 7 is expected reach end of life in less than five years. Any asset with a HI above five is expected to reach end of life in the coming ten years.

Once a health index for an asset is derived, a probability of failure can be found. Notionally, the POF is an exponential function as shown in Figure 5.

Figure 5: Deriving a probability of failure



It can be seen that assets with a low HI, even up to five, have quite a low probability of failure, but that increases dramatically at higher HIs. The equation and steepness of this curve is calculated independently for each asset based on input data.

The consequences of a failure for each asset are calculated by considering the effects of safety, environment, repairs effort, replacement difficulty and potential loss of load. The consequences are all evaluated in dollar terms which allow the consequences to be summed together.

The combination of the probability of failure and the consequences provides the calculated risk, in dollar terms, for each asset.

In addition, the health index and probability of failure can be predicted for future years. Consequently, risk can also be recalculated for future years.

The analysis of present versus future health and risk is the real power of the CBRM tool.

At present only power transformers have been integrated fully into the CBRM tool. Several other asset classes have been partially setup. It is expected that EHV CTs may be added into the CBRM tool in the near future.

5 Description of the Assets

Disconnectors perform a critical role in the reliable operation of the transmission system. Depending on their location, disconnectors provide a means of either physically isolating a transmission element from the network (disconnecting), or providing ability to transfer transmission circuit loads from one busbar to another, or bypassing circuit breakers (used for operational or maintenance purposes).

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.

Predominantly the disconnectors are manually operated, but as the network evolves the number of motorised disconnectors is expected to increase.

TasNetworks has a population of 812 disconnectors and 311 earth switches. This chapter provides high level information on the disconnector and earth switch population.

5.1 Disconnector Types

The population of disconnectors and earth switches are presented in Table 1. The validity of the disconnector and earth switch population records are applicable as at Oct 2017.

Table 1: Description of disconnectors (as at October 2017)

Description	Voltage	Number of units
Disconnectors	220 kV	245
	110 kV	567
	Total	**812**
Earth switches	220 kV	72
	110 kV	239
	Total	**311**

Disconnectors can be further categorised by design type as presented in Table 2. 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 design types.

Table 2: Disconnector design types (as at October 2017)

Design types	Number of units
Double break	471
Centre break	221
Vertical break/ vertical make	3
Pantograph/ semi-pantograph	29
Knife	79

Rotary break	9
Total	**812**

TasNetworks' disconnector standard calls for double break to be the design type of new disconnectors because operational experience has shown that these provide greater reliability and have less operational issues. TasNetworks' disconnector population includes units constructed by 14 manufacturers comprising 41 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 the 110 kV and 220 kV disconnectors is provided in Figure 6 and Figure 7, respectively.

Figure 6: 110 kV disconnectors by manufacturer and design principle (as at May 2017)

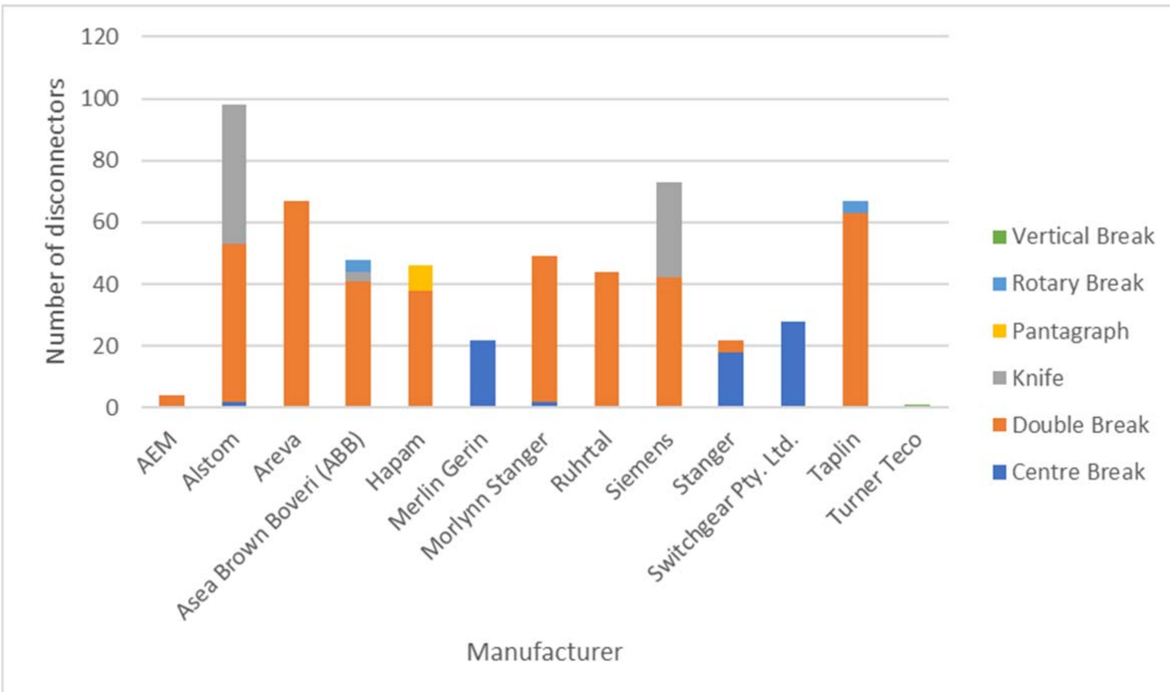


Figure 7: 220 kV disconnectors by manufacturer and design principle (as at May 2017)

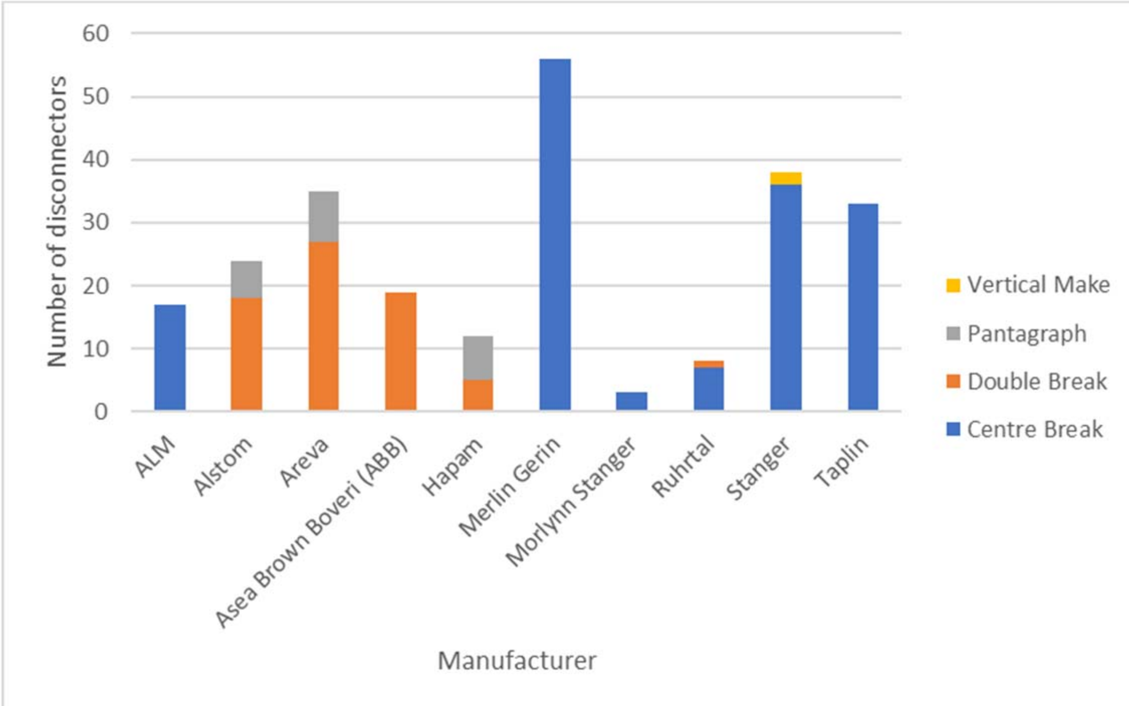


Table 2, Figure 6 and Figure 7 represent the quantities of each type of technology installed across the transmission system. Appendix C – 110 kV Disconnector Condition Assessments and Appendix D – 220 kV Disconnector Condition Assessment show the different technology types and where they are located.

As can be seen in Appendix C – 110 kV Disconnector Condition Assessments and Appendix D – 220 kV Disconnector Condition Assessment, most of the disconnectors installed since 2002 are double break and are motorised.

5.2 Asset Specification

The design and installation requirements for new TasNetworks 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.

5.2.1 Earth Switches

Earth switches are used to ground 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.

5.2.2 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 also have a suitably high mechanical withstand for every operating and fault situation that could be encountered. The two types of post insulator design are single piece and multi piece.

5.2.3 Interlocks

A solenoid interlock is required on the disconnector to allow electrical interlocking with the associated circuit breaker(s) to prevent the disconnector from making or breaking of load. Where an earth switch is fitted, the disconnector must also 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.

5.2.4 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 normally mechanically coupled for both modes of operation to ensure that all poles open or close at the same time.

5.3 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.

5.3.1 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.

5.3.2 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.

5.3.3 Vertical Break/Vertical Make

Vertical break/vertical break 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.

5.3.4 Pantograph/semi-pantograph

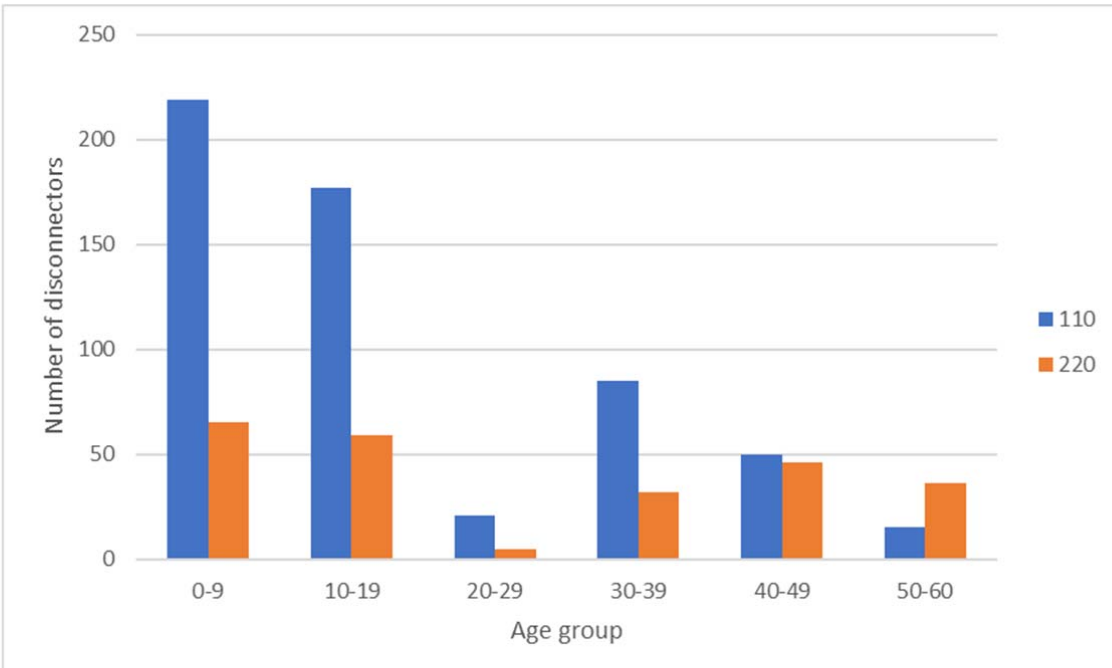
Pantograph disconnectors utilise a scissor action that cause one contact to lift up and close onto a stationary contact. The stationary contact can either be an attachment to the conductor like a stirrup or it can be a solid bus. It is noted that some pantograph disconnectors are single pole operation,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

5.4 Age Profile

Disconnectors are considered to have an assigned average economic service life of 45 years. Although the age of any primary equipment is not a primary driver for replacement of the asset, it can lead to an increase in the likelihood of failure and the required maintenance intervals through age-related issues. Reliability and life-cycle costs, which are compounded by spares obsolescence and maintainability constraint issues, are therefore considered to be significant drivers for asset replacement.

All disconnectors replaced to date have been replaced because of design constraints, failing condition, poor performance, obsolete design and high maintenance costs. The age profile for TasNetworks' disconnector population is shown in Figure 8.

Figure 8: Age profile of disconnectors (as at May 2017)



6 Standard of Service

6.1 Technical Standards

To address potential design issues, TasNetworks has developed a comprehensive, prescriptive standard specification for the purchase of new disconnector units. The specification requires new units to be designed and type-tested to Australian and international standards. In addition, disconnectors that have at least three year proven service history within the Australian electrical industry are stipulated when purchasing new units.

6.2 Performance Objectives

To mitigate the risk of inadequate quality control during manufacturing, TasNetworks requires disconnector manufacturers to have AS/NZ ISO 9001 accreditation and conform to its requirements. TasNetworks also requires routine tests to be performed on each disconnector unit to prove the quality of manufacture prior to dispatch from the manufacturer's works.

6.3 Key Performance Indicators

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

6.3.1 Internal Performance Monitoring

While TasNetworks only have a sufficiently accurate record of failure or defect rates dating back to 2001 for its population of disconnectors, the combination of enhanced design capability, improved manufacturing quality and control processes, and comprehensive production testing usually ensures that disconnector performance levels remain high throughout their service lives.

Documented investigations into the root cause of failure are conducted by technical staff for every major failure.

TasNetworks monitors disconnector performance for major faults through its incident reporting process. The process involves the creation of a fault incident record in the event of a major disconnector failure that has an immediate impact on the transmission system (eg causes an immediate trip of a transmission circuit or element). The fault is then subjected to a detailed investigation that establishes the root cause of the failure and recommends remedial strategies to reduce the likelihood of reoccurrence of the failure mode within the disconnector population. Reference to individual fault investigation reports can be found in TasNetworks' Reliability Incident Management System (RIMSys).

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

- Plant availability:
    - Transmission line circuit availability (critical and non-critical); and
    - Transformer circuit availability.
- Supply availability:
    - Number of events in which loss of supply exceeds 0.1 system minute; and
    - Number of events in which loss of supply exceeds 1.0 system minute.

Details of the STPIS scheme and performance targets can be found in TasNetworks' Strategic Asset Management Plan (SAMP).

The availability of EHV disconnectors has an impact on the performance measures reported regularly to the AER and directly impacts on TasNetworks' performance incentive scheme.

TasNetworks has evaluated its EHV disconnector fleet performance against external benchmarks, such as International Transmission Operations & Maintenance Study (ITOMS), and the various performance incentive schemes which measure availability and loss of supply events.

6.3.2 External Performance Monitoring

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

- International Transmission Operations & Maintenance Study (ITOMS); and
- Transmission survey, which provides information to the Electricity Supply Association of Australia (ESAA) for its annual Electricity Gas Australia report.

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

6.3.2.1 ITOMS Benchmarking

ITOMS provides a means to benchmark disconnector and earth switch averages (maintenance cost & service levels) between related utilities from around the world. The benchmarking exercise combines all EHV disconnector and earth switch assets into a single category. Further details relating to the ITOMS studies are provided in appropriate ITOMS reports which are held by TasNetworks Network Performance and Asset Strategy group.

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

Figure 9 illustrates TasNetworks' benchmarked disconnector and earth switch performance against all other ITOMS participants for the last four reporting periods. It shows the performance, in terms of maintenance expenditure and fault outages of TasNetworks' EHV disconnector and earth switches, has largely maintained average service costs when compared to other transmission companies in the study. It demonstrates that since '07 TasNetworks has improved its service cost performance to be considerably better than the benchmarked average, while service performance has in the two latest reporting periods,'09 and '11, been around the benchmarked average. This trend improvement to strong service level score from '07 to '09 is largely attributed to the revised maintenance strategies implemented in 2008.

Whilst the results from '09 to '11 still remain in the targeted strong service with low maintenance costs region it does show a slight increase in maintenance spend.

Notwithstanding the fact that TasNetworks is meeting the benchmarked average there is a strong need to ensure maintenance processes and procedures are continually reviewed to ensure optimum financial and service benefits. The slight increase in maintenance costs per disconnector / earth switch is not expected to continue as continuous improvements of maintenance procedures and processes are identified and implemented.

It is clearly evident in subsequent years 2013 – 2015 that the maintenance costs have been reduced further but there has been a severe drop in service level, to way below the Australian average (ASP) and on par with the North American results (NSA). There needs to be follow up investigation into why this has occurred. Details shown in figure 10 show the outages attributed to switches in the 2014-15 period, which appear minimal (1) so why the poor service level score? Could be just that other TNSPs with strong service level score have no or very small percentage of outages in respect to their fleet size.

Figure 9: ITOMS disconnector and earth switch benchmarked performance chart

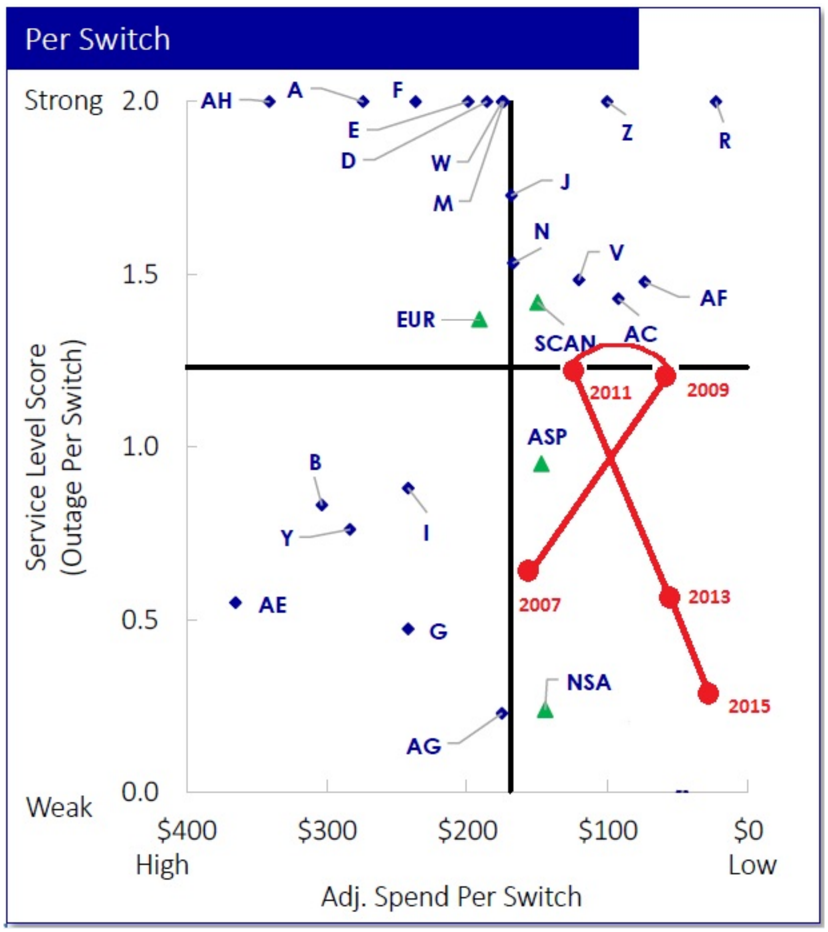
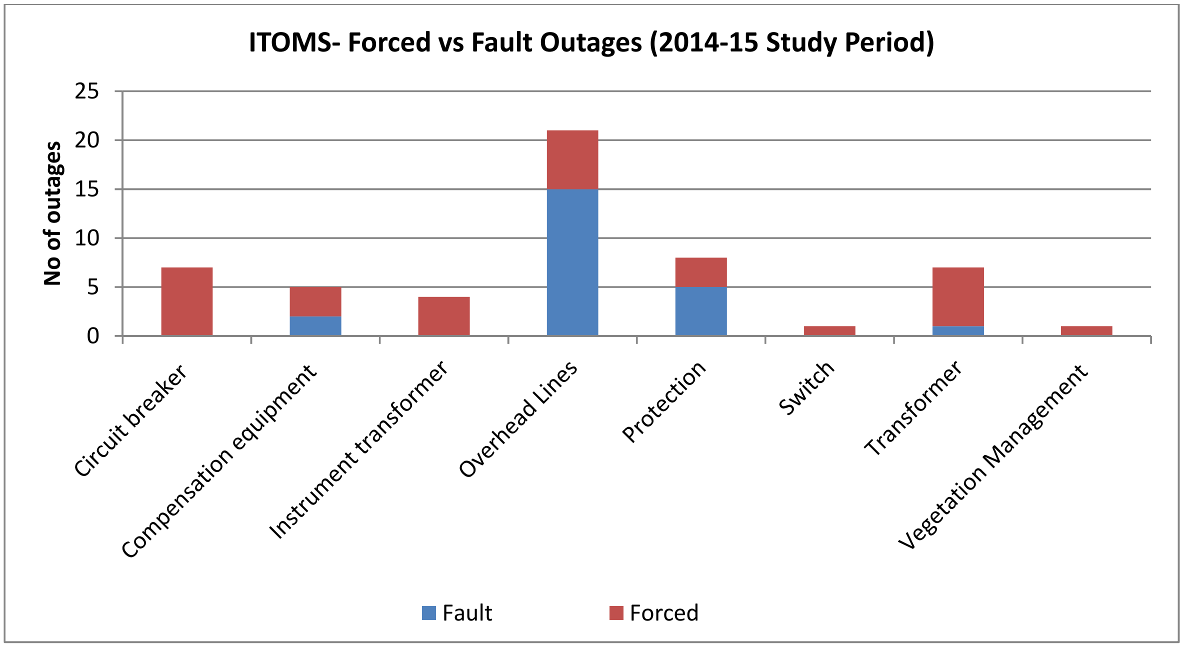


Figure 10: ITOMS reportable asset classes outage summary



6.3.2.2 ESAA Benchmarking

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

7 Associated Risk

7.1 Risk Management Framework

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

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

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

An assessment of the risks associated with the EHV disconnector and earth switch has been undertaken in accordance with the Risk Management Framework. For each asset in this class the assessments have been made based on:

- Condition of EHV disconnectors and earth switches in service across the network
- Criticality of EHV disconnectors and earth switches and associated assets
- Probability of failure (not meeting business requirement)
- Consequence of failure
- Performance
- Safety risk
- Environmental risk
- Customer

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

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

7.1.1 Condition

As disconnectors are a mechanical operating device, condition is based primarily on failure modes of the disconnector parts as opposed to other substation equipment where degradation of the insulating medium is one of the primary drivers for replacements. The prevailing failure modes across the disconnector population include:

- 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.

The failure modes suggest a relationship with the operational duty cycle of disconnectors, exposure to the environmental factors and design deficiencies. The root cause of failure is identified through a regime of visual, thermal imaging, mechanical and electrical maintenance and testing protocols as detailed in Table 6 of this asset management plan, which are performed in accordance with the disconnector maintenance procedures detailed in Appendix B – Condition Assessment and Maintenance Practices.

The overall integrity of disconnectors is monitored through electrical testing. The electrical test used on disconnectors is the 'resistance test', measuring the resistance across the disconnector contacts (commonly referred to as the ductor test), and insulators (commonly referred to as a megger test). These tests are performed on all disconnector types and serves to confirm the electrical integrity and identify contact misalignment issues. In addition, TasNetworks assess the condition integrity of the disconnector through visual inspection and current carrying sections through thermal imaging.

7.1.1.1 110 kV Disconnector Condition Summary

A detailed assessment of the condition of the 110 kV disconnector population is provided in Appendix C – 110 kV Disconnector Condition Assessments.

7.1.1.2 220 kV Disconnector Condition Summary

The condition assessment of 220 kV disconnectors, as presented in Appendix D – 220 kV Disconnector Condition Assessment.

7.1.2 Consequence of Failure

The main risk associated with the disconnector population is major asset failure. It is noted that some failures, although minor in nature, could have a major impact on system performance.

A major failure of a disconnector is identified as a key risk for the disconnector asset class as it has the potential to impact on safety and transmission system performance. The predominant causes of a major disconnector failure or defect include:

- Design issues including contact misalignment and contact assembly;
- Substandard electrical clearances;
- Failure of multi-piece post insulators associated with disconnectors;
- Failures of operating linkages, conductive braids or pivot joints in deteriorating disconnectors; and
- Failure of auxiliary switches, which could compromise system performance.

TasNetworks has categorised disconnector failures into three types:

- Major failures - failure events that cause an immediate emergency system outage or trip;
- Minor failures - failure events that require an urgent system outage (eg within one hour); or
- Defects - incidents that require a non-urgent (planned) outage to repair or replace the disconnectors.

7.1.3 Safety Risk

The occupational health and safety risks associated with the physical operating of manual disconnectors.

7.1.4 Environmental Risk

There are no environmental risks directly associated with TasNetworks' disconnector population

7.2 Special Operational and Design Issues

7.2.1 Operational Issues

The following disconnectors have been identified as constraining the current rating associated with the transmission circuit. All of these disconnectors are expected to be replaced as a part of redevelopment works planned for each site.

Table 3: Disconnector with capacity limitations

Manufacturer	Voltage	Substation	Issue
Stanger DR1	110 kV	Chapel Street	These disconnectors limit the line loadings to 800 A. The current line loadings under contingency are currently sufficient for this circuit.

7.2.2 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.

The design considerations for the specific disconnectors are assessed in detail in Appendix C – 110 kV Disconnector Condition Assessments and Appendix D – 220 kV Disconnector Condition Assessment.

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 as follows with measures to address the issues in Section 8.

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.

Multi-piece post insulators leading to insulator failure

There are numerous disconnectors installed with insulators of a multi-piece design, as detailed in the respective condition assessments by manufacturer. Multi-piece insulators comprise individual insulators bolted together to achieve the required voltage rating. The multi-piece design insulators are susceptible to mechanical failure where, as a result of moisture ingress between the porcelain and metal fitting, the water freezes causing the porcelain component to crack and inevitably fail. The mechanical failure has the potential to cause physical injury to personnel as the mechanical strength and/or electrical integrity will have been compromised.

TasNetworks standard now specifies insulators to be of single-piece design.

Lack of motorised operations

Currently, there are 188 disconnectors that utilise motorised operation. Seventy-five of the 188 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.

Manufacturer supported 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.

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.

Status of earth switches - indication

With the exception of most transmission line earth switches, earth switches do not have the capability for position indication to the Network Operation Control System (NOCS). Further, many do not have indication facilities to the local operating panels in the substations. This has led to difficulties in maintaining a clear overview of switching operations, with consequent safety and system security implications. New installations will address this shortcoming.

Physical effort

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

7.3 Summary of Risk

The major issues identified in the review of the disconnector population include the following:

- The poor or aging condition of the following 110 kV disconnector types:

  - Stanger DR1, DR2.
  - Stanger HCB and HDB.
- The poor or aging condition of the following 220 kV disconnector types:
  - ALM CB; and
  - Stanger DR1, DR2, HCB and TTRV.
- The status of some earth switches is not communicated to local SCADA and NOCS;
- The design issues associated with various disconnector types, including:
  - Contact misalignment;
  - Unreliable multi-piece post insulators leading to mechanical and resulting electrical failure;
  - Complex current carrying assemblies requiring intensive maintenance; and
  - Many disconnectors lack manufacturer’s support.
- The lack of standardisation throughout the disconnector population.

Disconnectors will be evaluated for replacement based primarily on condition, performance and system security factors. Economic efficiency will also be evaluated and opportunities pursued to enhance system security and performance.

8 Management Plan

8.1 Historical

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

This method will be continued into the future when appropriate. Condition Based Risk Management (CBRM) program will also be applied to assess asset condition and which aligns with direction provided in TasNetworks Strategic Asset management Plan (SAMP). Figure 11 provides an overview as to which management techniques are applied by TasNetworks in managing the risks of each asset category in our asset base as detailed in the SAMP.

Figure 11 – TasNetworks asset category management overview

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

8.2 Strategy

The performance of disconnectors is sustained by the implementation of regular condition monitoring and preventive maintenance activities. Maintenance practices are reviewed on a regular basis taking into account:

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

Disconnector maintenance practices and frequency is presented in Table 4. The maintenance plan methodology is described in Appendix B – Condition Assessment and Maintenance Practices.

Based on condition monitoring data, the frequency of maintenance intervals may increase. In the event that increased maintenance levels are required, the decision to replace a disconnector may be justified depending on the impact on preventive maintenance expenditure and the impact of the relevant disconnector on transmission system performance.

Table 4: Condition monitoring and preventive maintenance

Disconnector design type	Task	Frequency
All	Visual inspections and routine condition monitoring	Coordinated with substation quarterly inspections
	Thermal imaging	Coordinated with substation annual thermal imaging program
	Maintenance (with self-lubricating contacts)	Every 18 years
	Maintenance (without self-lubricating contacts)	Every 12 years[1]

[1]This has changed from 6 years on advice from Transmission Services substations group around 2012 due to history with current maintenance practice not identifying any issues. Visual inspection and thermal imaging will identify any condition based issues if occur between time based maintenance. Due to recent ITOMs results these maintenance frequencies are to be reviewed.

8.2.1 Routine Maintenance

There is a fundamental requirement for TasNetworks to periodically inspect the assets to ensure their physical state and condition does not represent a hazard to the public. Other than visiting the assets, there is no other economic solution to satisfy this requirement.

8.2.2 Routine Maintenance versus Non Routine Maintenance

Failures within EHV disconnectors and earth switches 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. These assets also have a high unit value, so a preventative corrective maintenance program represents a cost effective alternative to a reactive corrective maintenance program.

8.2.3 Refurbishment

Where EHV disconnectors and earth switches 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.

8.2.4 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

The failure of any part of a disconnector may be very difficult to predict and historical analysis along with industry statistics are often considered when predicting these events. At any one time there may be several minor repair projects including, eg the repair of a hot connection. Costs associated with such minor repairs can be catered for in-situ, however extensive disconnector damage needs to be managed on an asset-by-asset basis when it occurs and the associated costs are expected to be extensive

8.2.5 Non Network Solutions

The role of the EHV disconnectors and earth switch generally cannot be cost effectively substituted via upgrading other infrastructure on the network.

8.2.6 Network Augmentation Impacts

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

1. Demand forecasts;
2. New customer connections;
3. New generation projects;
4. Network performance obligations defined in Electricity Supply Industry (ESI) regulations; and
5. NER compliance.

Details of planned network augmentation works can be found in TasNetworks regional development plans, which are updated on an annual basis.

Proposed network augmentation projects will have a minimal impact on the disconnector population from an asset management perspective. Additional costs associated with new disconnectors that are installed as part of network augmentation projects will increase the impact on the projected operating expenditure, detailed in Section 9.1 of this plan.

8.2.7 On-line monitoring

TasNetworks has separate programs for protection equipment upgrades and a rollout of a wide area network (WAN). The combination of these two projects and the associated increasing capability of supervisory control and data acquisition (SCADA) are providing the opportunity to implement a number of on-line monitoring schemes.

A program will be developed to formalise the on-line condition monitoring requirements for the EHV disconnector population. The likely items for monitoring will include disconnector operating time and motor drive current draw.

8.3 Routine Maintenance

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

- Condition assessment. Condition assessment is routine inspection, testing and monitoring of assets to ascertain their condition.
- Maintenance (routine and condition based). With routine and condition based maintenance, assets are maintained either on pre-determined frequency basis (time-based) or require planned maintenance following condition assessments.

During the life of a disconnector a program of continuous monitoring is employed to detect any early signs of degradation beyond what would normally be expected. The use of thermal imaging is the most effective and least intrusive method of disconnector condition monitoring.

When a problem is indicated by the thermal imaging a higher level of testing is specified which usually includes electrical testing of the disconnector in order to more fully define the nature of any fault.

8.3.1 Potential future maintenance practices

TasNetworks recognises that a proactive approach to life-cycle management of its assets is an established and accepted practice within the electrical industry. This is evident through TasNetworks' participation in various benchmarking and best practice activities, locally and internationally. As part of this participation, TasNetworks may make provision for, identify, develop, participate and or pilot various initiatives in the normal course of business. Initiatives are likely to be made and pursued in the areas as represented in Table 5.

Table 5: Technology and innovation initiatives

Initiative	Rationale	Driver
PD testing	• Early identification of insulation degradation. (Ultrasonic using PD Hawk or similar)	• Improved assessment of asset condition.
Asset Inspection	• DRONE technology as a tool for asset condition inspection.	• Improved assessment of asset condition by being able to view from above as well as from the ground.
On-line condition monitoring	• To facilitate the condition assessment process, an initiative to remotely interrogate the operating motor current draw and disconnector operating timing has been proposed to be added into the condition monitoring enhancement program. A program is expected to be researched and implemented to formalise the on-line condition monitoring requirements for the disconnector population.	• Identify units which have "sticky" contacts by observance of opening times and motor draw current characteristic changes.

8.4 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 meet the option analysis completed specific for the defect to meet the performance criteria set out in TasNetworks' risk framework, with the objective to return to service and prevent asset failure.

8.5 Reliability and Quality Maintained

8.5.1 Standardisation

There are a number of different disconnector makes and models installed throughout TasNetworks sites. Installations that are unique and dissimilar to the remainder of the fleet are difficult to maintain, since lack of familiarity with the different disconnectors increases the effort required to maintain them.

TasNetworks is actively seeking to standardise on a smaller number of disconnector 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 risk of failure of a disconnector, TasNetworks has standardised on the use of double-break disconnectors for new or replacement installations. Double-break disconnectors are of a more robust design and are less prone to contact misalignment. The use of single-piece solid-core post insulators has also been included as standard, mitigating the risks associated with multi-piece post insulators. In addition, standardisation enables the reduction in the system spares required and also addresses population type issues, identified in Section 7.2, in the long term.

8.5.2 Contingency planning

To mitigate the risk of inadequate response in the event of a disconnector failure, TasNetworks has developed a contingency plan to minimise the impact on the reliability and availability of electricity supply in the event of a disconnector failure. Contingency planning considerations specific to disconnectors are documented in TNM-PL-809-0553, Substation Primary Equipment Contingency Plan. In addition, TasNetworks' system spares policy details the minimum requirements for maintaining spare disconnector units. This includes:

- One three-phase set of current carrying components for each disconnector type;
- Auxiliary switches;
- Appropriate interlocking solenoids; and
- Motor-drive and control components.

Also, given the special nature of pantograph disconnectors, one complete spare pole of each type is required to be maintained in the store at all times, in addition to the manufacturer's recommended spare parts.

A list of TasNetworks' spare 110 kV and 220 kV disconnector and earth switch units is provided in Appendix E- Spare Parts. TasNetworks are in the process of rationalising the spares holding pertaining to the disconnector and earth switches population to determine the optimal minimum and maximum levels to maintain the population.

8.6 Regulatory Obligations

All new disconnectors and earth switches are compliant with TasNetworks' EHV Disconnector and Earth Switch Standard, and all relevant Australian Standards including AS 2650 and AS 62271.102

8.6.1 Service Obligations for Network Assets

Disconnector performance impacts on TasNetworks' overall network service obligations, which include specific performance requirements for both regulated and connection transmission assets.

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

- Plant availability:
    - Transmission line circuit availability; and
    - Transformer circuit availability.
- Supply availability:

- Loss-of-supply event frequency index
- Number of events in which loss of supply exceeds 0.1 system minute; and
- Number of events in which loss of supply exceeds 2.0 system minutes.

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

There are currently no specific service level obligations for disconnectors but they do have an impact on transmission lines and transformer circuit availability.

8.6.2 Service Obligations for Non-regulated Assets

8.6.2.1 Hydro Tasmania

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

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

8.6.2.2 Tamar Valley Power Station (TVPS)

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

8.6.2.3 Major Industrial direct customer connections

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

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

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

8.7 Replacement

The replacement and enhancement program for disconnectors is integrated into the overall TasNetworks works program and includes the following:

- The rationalisation of the disconnector and earth switches design to be of the double-break type. All disconnectors that have deteriorated to a condition that is below an acceptable standard and that cannot be repaired are planned for replacement;

- Disconnectors that are used for routine operational purposes will be progressively replaced with motorised units;
- New disconnectors that are used for on-load transfer of transmission circuit loads from one busbar to another be procured with commutating contacts to decrease their maintenance requirements;
- All new disconnectors to be motorised;
- earth switch status for all earth switches will be connected to local and remote control systems;
- Earth switches on transformers, bus couplers and busbars will be rationalised when associated equipment upgrades are performed;
- A program for installation of transmission-line-side earth switches will be planned in conjunction with other works; and
- Further investigation is to be conducted into the health and safety implications associated with the physical effort required to operate disconnectors.

The proposed replacement requirements, redundancy programs and design philosophy will rationalise the requirement of disconnectors and earth switches over the planning period.

8.7.1 110 kV Disconnector Replacements

The assessment of the 110 kV disconnector population in Appendix C – 110 kV Disconnector Condition Assessments recommends the replacement of approximately 43 units in a systematic manner. Where practicable, disconnector replacements will be coordinated with other substation works.

Table 6 presents a summary of the units to be replaced.

Table 6: 110 kV disconnector replacements

Manufacturer	Type	Location	Disconnectors	Replacement numbers
Stanger	HCB	Various	17 units in total. Installed at Burnie, Sheffield, St Marys and Wesley vale.	17
Stanger	HDB	Various	53 units currently commissioned. Using an updated CAR identify any in need of replacement, assume half of fleet. 26 to be replaced.	~26
Total				**~43**

8.7.2 220 kV Disconnector Replacements

The assessment of the 220 kV disconnector population detailed in Appendix D – 220 kV Disconnector Condition Assessment, recommends the replacement of 17 ALM make disconnectors. Table 7 provides a summary of the units to be replaced. Where practicable, disconnectors will be replaced in coordination with other substation works.

Table 7: 220 kV disconnector replacement program

Manufacturer	Type	Location	Disconnectors	Replacement numbers
ALM	CB	George Town	All population	4
	CB	Sheffield	All population	13
Total				**17**

8.7.3 Disconnector Refurbishment Program

TasNetworks standard specifies the use of single-piece post insulators and has a strategy to replace multi-piece post insulators. Multi-piece insulators are a major failure mode to these disconnectors. TasNetworks has experienced a significant number of mechanical and electrical failures of EHV multi-piece post insulators since 1998. The consequences of failure have ranged from considerable disruption to electricity supply, to the requirement for unplanned outages to facilitate replacement of the post insulators. It is not possible to undertake improvements or extend the life of multi-piece post insulators.

Of the 94 disconnectors identified several years ago with multi-piece post insulators in the transmission system, the majority have been replaced or decommissioning. Post insulators will be replaced on the remaining 2 disconnectors in conjunction with the planned replacement works on the P bay at Palmerston planned for to be completed in 2018.

Table 8: 110 kV disconnector refurbishment program

Manufacturer	Type	Location	Device Number	Replacement numbers
Stanger	DR2	Palmerston	P129B, P129L	2
Total				**4**

8.8 Program Delivery

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

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

8.9 Spares Management

TasNetworks currently has a total of 12 spare disconnectors available for use at locations in the transmission network. Of these 12 disconnectors, 7 are designed for operation at 110 kV and the remaining 5 are designed for operation at 220 kV (refer to Appendix E- Spare Parts).

Three of the nine disconnectors designed for operation at 110 kV are reserved stock. Two of the ABB type DBRP 123 are reserved for Chapel Street Substation and a third ABB type DBRP 123 is reserved for Creek Road Substation. The remaining six 110 kV disconnectors along with the five designed for operation at 220 kV are available for use anywhere in the system as required based upon their suitability, including at the sites of major industrial connections. Any of these disconnectors are also available for installation, at a newly created or expanded site, on a permanent basis should the need arise as covered by the system spares policy.

8.10Technical Support

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

- System fault analysis and investigation;
- Preparation of asset management plans;
- Standards management;
- Management of the service providers;
- Training;

- Group management; and
- General technical advice.

8.11 Disposal Plan

Prior to disposing of decommissioned disconnectors, the condition of the units will be reviewed to determine their suitability as system spare units (in accordance with TasNetworks System Spares Policy or redeployment elsewhere in the transmission system.

8.12 Summary of Programs

Tables 9 and 10 provide a summary of all of the programs/projects described in this management plan.

Table 9: Summary of EHV disconnector OPEX programs / projects

Work Program	Work Category	Work Category	Project/Program
Routine Maintenance	CMINE	Corrective maintenance	S097-SUBS-Corrective-Insulators EHV
	CMDEE	Preventative maintenance	S069-SUBS-Corrective-Disconnector EHV
	PMDEE	Preventative maintenance	S449-Disconnector Maintenance EHV

Table 10: Summary of EHV disconnector CAPEX programs / projects

Work Program	Work Category	Project title	Project/Program details
Capital	RENSB	Disconnectors replacement - 220 kV ALM type CB	Replace 220 kV ALM type CB 17 units in total 14 units at Sheffield 3 units at George Town
	RENSB	Disconnectors replacement - 110 kV Stanger type HDB	Replace aged 110 kV Disconnectors - Stanger type HDB. 53 units currently commissioned, assume half of fleet. 26 to be replaced.
	RENSB	Disconnectors replacement - 110 kV Stanger type HCB	Replace aged 110 kV Disconnectors - Stanger type HCB 17 units in total. Installed at Burnie, Sheffield, St Marys and Wesley vale.

9 Financial Summary

9.1 Proposed OPEX Expenditure Plan

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

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

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

9.2 Proposed CAPEX Expenditure Plan

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

A comprehensive capital investment strategy has been developed to address the design and performance issues associated with the disconnector population and to improve transmission system performance. This plan recommends that approximately 60 disconnectors be replaced, where appropriate in conjunction with other capital works. The replacement program will mitigate the business risks presented by the existing disconnector population and reduce future maintenance and repair costs. In addition, the program will rationalise the number of disconnector types and designs through equipment standardisation, enabling more efficient maintenance practices, a reduction in the disconnector spares inventory and simplified contingency planning and fault response process.

A further recommendation of this asset management plan is to continue the retro-fitting of selected disconnectors for motorised operation and installing new units with motorised operation. This will be done to disconnectors utilised for bus selection of transmission lines, transformers and circuits connected to generation. The motorisation of these units reduces the reliance on field operators for routine switching operations.

In addition a proposal to implement on-line condition monitoring technology has been included for the 2019-29 period. This monitoring includes for research and development for the implementation of devices to remotely interrogate the operating motor current draw and disconnector operating timing.

9.3 CAPEX – OPEX trade offs

The operating expenditure programs are essential for identifying assets that require replacement for condition-based reasons. There is a positive relationship between these two categories in that regular inspection programs gather continuous condition information of the assets to better target asset replacements and identify any asset trends. Maintenance and repair activities also defer the requirement for capital expenditure and increase the likelihood of the asset operating for as long as possible within the network.

10 Related Standards and Documentation

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

TasNetworks documents:

1. System Spares Policy R517373
2. Strategic Asset Management Plan R248812
3. Annual Planning Report 2017 R689487
4. Engineering and Asset Services operational expenditure planning methodology D11/102320
5. AM8 Asset Condition Review – project report June16 FINAL R503361
6. WASP Asset Register – Data Integrity Standard – Disconnector R16963
7. WASP Asset Register – Data Integrity Standard – Earth Switch R16975

Technical requirements for new EHV disconnectors and earth switch are detailed in the following standards/specifications:

8. Extra High Voltage Disconnector and Earth Switch Standard R586396

Other standards and documents:

9. Sinclair Knight Merz, 'Assessment of Economic Lives for Transend Regulatory Asset Classes', 2013. R192773

11 Appendix A – Summary of Programs and Risk

Description	Work Category	Risk Level	Driver	Expenditure Type	Residual Risk
S097-SUBS-Corrective-Insulators EHV	CMINE	Medium	Customer Financial Network performance Regulatory Compliance Reputation Safety	Opex	Low
S069-SUBS-Corrective-Disconnector EHV	CMDEE	Medium	Customer Financial Network performance Regulatory Compliance Reputation Safety	Opex	Low
S449-Disconnector Maintenance EHV	PMDEE	Medium	Customer Financial Network performance Regulatory Compliance Reputation Safety	Opex	Low
Disconnectors replacement - 220 kV ALM type CB	RENSB	Medium	Customer Financial Network performance Regulatory Compliance Reputation Safety	Capex	Low

Description	Work Category	Risk Level	Driver	Expenditure Type	Residual Risk
Disconnectors replacement - 110 kV Stanger type HCB	RENSB	Medium	Customer Financial Network performance Regulatory Compliance Reputation Safety	Capex	Low
Disconnectors replacement - 110 kV Stanger type HDB	RENSB	Medium	Customer Financial Network performance Regulatory Compliance Reputation Safety	Capex	Low
On line condition monitoring (an initiative to remotely interrogate the operating motor current draw and disconnector operating timing. Includes work associated with EHV CBs)	RENSB	Medium	Customer Financial Network performance Regulatory Compliance Reputation Safety	Capex	Low

12 Appendix B – Condition Assessment and Maintenance Practices

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.

Current carrying assembly

Disconnector condition monitoring involves a 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 that the alignment of the three operating arms be checked and adjusted to ensure that all three poles close and open in a synchronised fashion. Synchronised operation must be ascertained visually on site.

Insulators

Insulator failure can cause a major failure 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.

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.

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.

13 Appendix C – 110 kV Disconnector Condition Assessments

Table 11: ABB 110 kV in service disconnectors listing

Type	Location	Device number	Age	Average age	Number of units	Mode of Operation	Design Action	Mounting Type	Condition	Design
DBRP 123	Boyer	BY-A429	21	21	2	Manual	Double Break	Pedestal		
DBRP 123	Boyer	BY-B429	21			Manual	Double Break	Pedestal		
DBRP 123	Chapel Street	CS-A629A	14	11	24	Motorised	Rotary Break	Pedestal		
DBRP 123	Chapel Street	CS-A629B	14			Motorised	Rotary Break	Pedestal		
DBRP 123	Chapel Street	CS-B529A	13			Manual	Double Break	Girder Mounted		
DBRP 123	Chapel Street	CS-B629A	14			Motorised	Rotary Break	Pedestal		
DBRP 123	Chapel Street	CS-B629B	14			Motorised	Rotary Break	Pedestal		
DBRP 123	Chapel Street	CS-BK129	13			Manual	Double Break	Girder Mounted		
DBRP 123	Chapel Street	CS-C529A	13			Manual	Double Break	Girder Mounted		
DBRP 123	Chapel Street	CS-CE529	13			Manual	Double Break	Girder Mounted		
DBRP 123	Chapel Street	CS-D129A	4			Motorised	Double Break	Pedestal		
DBRP 123	Chapel Street	CS-D129B	4			Motorised	Double Break	Pedestal		
DBRP 123	Chapel Street	CS-D129C	4			Motorised	Double Break	Pedestal		
DBRP 123	Chapel Street	CS-D529A	13			Manual	Double Break	Girder Mounted		
DBRP 123	Chapel Street	CS-DF529	13			Manual	Double Break	Girder Mounted		
DBRP 123	Chapel Street	CS-H129A	4			Motorised	Knife	Pedestal		
DBRP 123	Chapel Street	CS-H129B	4			Motorised	Knife	Pedestal		
DBRP 123	Chapel Street	CS-H129C	4			Motorised	Knife	Pedestal		
DBRP 123	Chapel Street	CS-J129A	13			Manual	Double Break	Girder Mounted		

DBRP 123	Chapel Street	CS-J129B	13			Manual	Double Break	Girder Mounted		
DBRP 123	Chapel Street	CS-J129C	13			Manual	Double Break	Girder Mounted		
DBRP 123	Chapel Street	CS-K129B	13			Manual	Double Break	Girder Mounted		
DBRP 123	Chapel Street	CS-K129C	13			Manual	Double Break	Pedestal		
DBRP 123	Chapel Street	CS-L129A	12			Manual	Double Break	Pedestal		
DBRP 123	Chapel Street	CS-L129B	12			Manual	Double Break	Pedestal		
DBRP 123	Chapel Street	CS-L129C	12			Manual	Double Break	Pedestal		
DBRP 123	George Town	GT-A629A	17	14	6	Motorised	Double Break	Pedestal		
DBRP 123	George Town	GT-A629B	18			Motorised	Double Break	Pedestal		
DBRP 123	George Town	GT-IH129A	8			Motorised	Double Break	Pedestal		
DBRP 123	George Town	GT-IH129B	8			Motorised	Double Break	Pedestal		
DBRP 123	George Town	GT-T129B	20			Manual	Double Break	Pedestal		
DBRP 123	George Town	GT-T129C	20			Manual	Double Break	Pedestal		
DBRP 123	Meadowbank	MB-A429	20	20	1	Manual	Double Break	Underhung		
DBRP 123	Que	QU-A129	12	12	1	Manual	Double Break	Pedestal		
DBRP 123	Triabunna	TB-A429	18	18	2	Manual	Double Break	Pedestal		
DBRP 123	Triabunna	TB-B429	18			Manual	Double Break	Pedestal		
DBRP 123	Trevallyn Substation	TR-A129	18	17	11	Manual	Double Break	Pedestal		
DBRP 123	Trevallyn Substation	TR-AK429	17			Manual	Double Break	Pedestal		
DBRP 123	Trevallyn Substation	TR-B129	18			Manual	Double Break	Pedestal		
DBRP 123	Trevallyn Substation	TR-B729B	19			Manual	Double Break	Pedestal		
DBRP 123	Trevallyn Substation	TR-B729C	18			Manual	Double Break	Pedestal		
DBRP 123	Trevallyn Substation	TR-BJ429	19			Manual	Double Break	Pedestal		
DBRP 123	Trevallyn Substation	TR-C129	17			Motorised	Double Break	Pedestal		

DBRP 123	Trevallyn Substation	TR-D729A	17			Manual	Double Break	Pedestal		
DBRP 123	Trevallyn Substation	TR-D729D	18			Manual	Double Break	Pedestal		
DBRP 123	Trevallyn Substation	TR-H429	17			Motorised	Double Break	Pedestal		
DBRP 123	Trevallyn Substation	TR-LM429	18			Manual	Double Break	Pedestal		
DBRP 123	Ulverstone	UL-A129C	8	8	1	Motorised	Double Break	Girder Mounted		
Total number of units in service					**48**					

Condition

ABB disconnectors are in an acceptable condition.

Design

ABB disconnectors are of double break design. The majority of these units are of manual type, with the exception of A629A, A629B, B629A and B629B at Chapel Street Substation, A629A, A629B, H129A and H129B at George Town Substation, C129 and H429 at Trevallyn Substation, and A129C at Ulverstone Substation, which are motorised.

A number of these disconnectors are mounted on girders and/or underhung approximately 10 metres above ground level. These units require additional equipment to maintain.

Future management strategy

Recommended maintenance practices should be continued on these disconnectors.

Areva

Table 12: Areva 110 kV in service disconnector listing

Type	Location	Device number	Age	Average age	Number of units	Mode of Operation	Design Action	Mounting Type	Condition	Design
S3C-121625M/N	Burnie	BU-F629	12	12	3	Motorised	Double Break	Pedestal		
S3C-121625M/N	Burnie	BU-F629A	12			Motorised	Double Break	Pedestal		
S3C-121625M/N	Burnie	BU-FK129	12			Motorised	Double Break	Pedestal		
S3C	Derby	DE-D129A	4	4	2	Motorised	Double Break	Pedestal		
S3CT	Derby	DE-D129C	4			Motorised	Double Break	Pedestal		
S3C-121625M/N	Devonport	DP-A129A	10	10	11	Motorised	Double Break	Pedestal		
S3C-121625M/N	Devonport	DP-A129C	10			Motorised	Double Break	Pedestal		
S3C-121625M/N	Devonport	DP-A429	10			Motorised	Double Break	Pedestal		
S3C-121625M/N	Devonport	DP-A729A	10			Motorised	Double Break	Pedestal		
S3C-121625M/N	Devonport	DP-A729B	10			Motorised	Double Break	Pedestal		
S3C-121625M/N	Devonport	DP-B129B	11			Motorised	Double Break	Pedestal		
S3C-121625M/N	Devonport	DP-B129C	11			Motorised	Double Break	Pedestal		
S3C-121625M/N	Devonport	DP-B429	10			Motorised	Double Break	Pedestal		
S3C-121625M/N	Devonport	DP-B729A	10			Motorised	Double Break	Pedestal		
S3C-121625M/N	Devonport	DP-B729B	10			Motorised	Double Break	Pedestal		
S3C-121625M/N	Devonport	DP-C429	10			Motorised	Double Break	Pedestal		
S3CT	Emu Bay	EB-A729A	6	8	8	Motorised	Double Break	Pedestal		
S3CT	Emu Bay	EB-A729B	6			Motorised	Double Break	Pedestal		
S3CT	Emu Bay	EB-B129B	-			Motorised	Double Break	Pedestal		
S3CT	Emu Bay	EB-B129C	-			Motorised	Double Break	Pedestal		
S3CT	Emu Bay	EB-B429B	6			Motorised	Double Break	Pedestal		

S3CT	Emu Bay	EB-C129A	6			Motorised	Double Break	Pedestal		
S3CT	Emu Bay	EB-C129C	16			Motorised	Double Break	Pedestal		
S3CT	Emu Bay	EB-C429A	6			Motorised	Double Break	Pedestal		
S3C	Lindisfarne	LF-D529A	6			Motorised	Double Break	Pedestal		
S3C	Lindisfarne	LF-E529A	6			Motorised	Double Break	Pedestal		
S3C	Lindisfarne	LF-EH529	6	6	5	Motorised	Double Break	Pedestal		
S3C	Lindisfarne	LF-H129B	6			Motorised	Double Break	Pedestal		
S3CT	Lindisfarne	LF-H129C	6			Motorised	Double Break	Pedestal		
S3CT	Mornington	MT-A129	6			Motorised	Double Break	Pedestal		
S3CT	Mornington	MT-A129A	6			Motorised	Double Break	Pedestal		
S3CT	Mornington	MT-A429A	6			Motorised	Double Break	Pedestal		
S3CT	Mornington	MT-A729A	6			Motorised	Double Break	Pedestal		
S3CT	Mornington	MT-A729B	6	6	8	Motorised	Double Break	Pedestal		
S3CT	Mornington	MT-B129	6			Motorised	Double Break	Pedestal		
S3CT	Mornington	MT-B129B	6			Motorised	Double Break	Pedestal		
S3CT	Mornington	MT-B429B	6			Motorised	Double Break	Pedestal		
S3CT	Port Latta	PL-A129C	6			Motorised	Double Break	Pedestal		
S3CT	Port Latta	PL-A429A	6	6	4	Motorised	Double Break	Pedestal		
S3CT	Port Latta	PL-B129C	6			Motorised	Double Break	Pedestal		
S3CT	Port Latta	PL-B429B	6			Motorised	Double Break	Pedestal		
S3C	Palmerston	PM-A529A	4			Motorised	Double Break	Pedestal		
S3C	Palmerston	PM-AP529	4			Motorised	Double Break	Pedestal		
S3C	Palmerston	PM-B729A	5	5	24	Motorised	Double Break	Pedestal		
S3C	Palmerston	PM-B729B	5			Motorised	Double Break	Pedestal		
S3C	Palmerston	PM-C429A	5			Motorised	Double Break	Pedestal		

S3C	Palmerston	PM-C429B	5			Motorised	Double Break	Pedestal		
S3C	Palmerston	PM-D429A	5			Motorised	Double Break	Pedestal		
S3C	Palmerston	PM-DR429	5			Motorised	Double Break	Pedestal		
S3C	Palmerston	PM-M129A	5			Motorised	Double Break	Pedestal		
S3C	Palmerston	PM-M129L	5			Motorised	Double Break	Pedestal		
S3C	Palmerston	PM-MN129	5			Motorised	Double Break	Pedestal		
S3C	Palmerston	PM-N129B	5			Motorised	Double Break	Pedestal		
S3C	Palmerston	PM-N129L	5			Motorised	Double Break	Pedestal		
S3C	Palmerston	PM-O129A	4			Motorised	Double Break	Pedestal		
S3C	Palmerston	PM-O129B	4			Motorised	Double Break	Pedestal		
S3C	Palmerston	PM-O129L	4			Motorised	Double Break	Pedestal		
S3C	Palmerston	PM-R129B	4			Motorised	Double Break	Pedestal		
S3C	Palmerston	PM-R129C	4			Motorised	Double Break	Pedestal		
S3C	Palmerston	PM-R129L	4			Motorised	Double Break	Pedestal		
S3C	Palmerston	PM-Y129A	5			Motorised	Double Break	Pedestal		
S3C	Palmerston	PM-Y129L	5			Motorised	Double Break	Pedestal		
S3C	Palmerston	PM-YZ129	5			Motorised	Double Break	Pedestal		
S3C	Palmerston	PM-Z129B	5			Motorised	Double Break	Pedestal		
S3C	Palmerston	PM-Z129L	5			Motorised	Double Break	Pedestal		
S3CT	Sheffield	SH-A629A	10	10	2	Motorised	Double Break	Pedestal		
S3C-121625H/N	Sheffield	SH-A629B	10			Motorised	Double Break	Pedestal		
Total number of units in service					**67**					

Condition

Areva disconnectors are in an acceptable condition.

Design

Areva disconnectors are of double break design and are motorised.

Future management strategy

Recommended maintenance should be continued on these disconnectors.

Alstom

Table 13: 110 kV Alston in service disconnector listing

Type	Location	Device number	Age	Average age	Number of units	Operation	Design Action	Mounting	Condition	Design
S3CT	Arthurs Lake	AL-A129C	3	3	1	Motorised	Double Break	Pedestal		
S3CT	Avoca	AV-A129C	3	3	1	Motorised	Double Break	Pedestal		
DES4	Creek Road Substation	CR-A129	3	3	41	Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-A129A	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-A129B	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-A729A	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-A729B	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-AC729	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-B129	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-B129A	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-B129B	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-B429	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-B429A	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-B429B	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-B729C	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-B729D	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-BD729	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-C129	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-C129A	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-C129B	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-C429	3			Motorised	Knife	Internal Switchgear		

DES4	Creek Road Substation	CR-C429A	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-C429B	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-CE729	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-D129	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-D129A	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-D129B	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-D429	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-D429C	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-D429D	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-DF729	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-E129	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-E129C	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-E129D	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-F129	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-F129C	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-F129D	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-G129	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-G129C	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-G129D	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-H129	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-H129C	3			Motorised	Knife	Internal Switchgear		
DES4	Creek Road Substation	CR-H129D	3			Motorised	Knife	Internal Switchgear		
S3C	George Town	GT-B529A	2	2	13	Motorised	Double Break	Pedestal		
S3C	George Town	GT-CM529	2			Motorised	Double Break	Pedestal		
S3C	George Town	GT-D429A	2			Motorised	Double Break	Pedestal		

S3C	George Town	GT-D429B	2			Motorised	Double Break	Pedestal		
S3C	George Town	GT-E429A	2			Motorised	Double Break	Pedestal		
S3C	George Town	GT-ET429	2			Motorised	Double Break	Pedestal		
S3C	George Town	GT-M129B	1			Motorised	Double Break	Pedestal		
S3CT	George Town	GT-M129C	1			Motorised	Double Break	Pedestal		
S3C	George Town	GT-N129A	2			Motorised	Double Break	Pedestal		
S3C	George Town	GT-N129B	2			Motorised	Double Break	Pedestal		
S3CT	George Town	GT-N129C	2			Motorised	Double Break	Pedestal		
S3C	George Town	GT-R729A	2			Motorised	Double Break	Pedestal		
S3C	George Town	GT-R729B	2			Motorised	Double Break	Pedestal		
S3C-121625M/H	Kingston	KI-A429A	5	5	6	Motorised	Double Break	Pedestal		
S3C-121625M/H	Kingston	KI-A729A	5			Motorised	Double Break	Pedestal		
S3C-121625M/H	Kingston	KI-A729B	5			Motorised	Double Break	Pedestal		
S3C-121625M/H	Kingston	KI-B429B	5			Motorised	Double Break	Pedestal		
S3C-121625M/H	Kingston	KI-C429A	5			Motorised	Double Break	Pedestal		
S3C-121625M/H	Kingston	KI-D429B	5			Motorised	Double Break	Pedestal		
S3C	Knights Road	KR-A129A	5	4	13	Motorised	Double Break	Pedestal		
S3C	Knights Road	KR-A129B	5			Motorised	Double Break	Pedestal		
S3C	Knights Road	KR-A129C	5			Motorised	Double Break	Pedestal		
S3C	Knights Road	KR-A429B	5			Motorised	Double Break	Pedestal		
S3C	Knights Road	KR-B429B	4			Motorised	Double Break	Pedestal		

S3C	Knights Road	KR-BC429	4			Motorised	Double Break	Pedestal		
S3C	Knights Road	KR-C129A	4			Motorised	Double Break	Pedestal		
S3C	Knights Road	KR-C129C	4			Motorised	Double Break	Pedestal		
S3C	Knights Road	KR-J129A	4			Motorised	Double Break	Pedestal		
S3C	Knights Road	KR-J129C	4			Motorised	Double Break	Pedestal		
S3C	Knights Road	KR-J129D	4			Motorised	Double Break	Pedestal		
S3C	Knights Road	KR-JD729B	4			Motorised	Double Break	Pedestal		
S3C	Knights Road	KR-JD729C	4			Motorised	Double Break	Pedestal		
S3C	Meadowbank	MB-A129A	2	2	4	Motorised	Knife	Pedestal		
S3CT	Meadowbank	MB-A129C	2			Motorised	Knife	Pedestal		
S3C	Meadowbank	MB-B129A	2			Motorised	Knife	Pedestal		
S3CT	Meadowbank	MB-B129C	2			Motorised	Knife	Pedestal		
S-Series	Norwood	NW-C129B	4	4	2	Motorised	Centre Break	Pedestal		
S-Series	Norwood	NW-C129C	4			Motorised	Centre Break	Pedestal		
S3C	Rosebery	RB-A129A	4	4	7	Motorised	Double Break	Pedestal		
S3C	Rosebery	RB-A129C	4			Motorised	Double Break	Pedestal		
S3C	Rosebery	RB-A429	4			Motorised	Double Break	Pedestal		
S3C	Rosebery	RB-A729A	4			Motorised	Double Break	Pedestal		
S3C	Rosebery	RB-A729B	4			Motorised	Double Break	Pedestal		
S3C	Rosebery	RB-B429	4			Motorised	Double Break	Pedestal		
S3C	Rosebery	RB-C129C	4			Motorised	Double Break	Pedestal		
S3CT	St Leonards	SL-A129	4	4	10	Motorised	Double Break	Pedestal		
S3C	St Leonards	SL-A129A	4			Motorised	Double Break	Pedestal		
S3C	St Leonards	SL-A429B	4			Motorised	Double Break	Pedestal		
S3C	St Leonards	SL-A729A	4			Motorised	Double Break	Pedestal		

S3C	St Leonards	SL-A729B	4			Motorised	Double Break	Pedestal		
S3C	St Leonards	SL-AA429	4			Motorised	Double Break	Pedestal		
S3CT	St Leonards	SL-B129	4			Motorised	Double Break	Pedestal		
S3C	St Leonards	SL-B129A	4			Motorised	Double Break	Pedestal		
S3C	St Leonards	SL-B429B	4			Motorised	Double Break	Pedestal		
S3C	St Leonards	SL-BB429	4			Motorised	Double Break	Pedestal		
Total number of units					**98**					

Condition

Alstom disconnectors are in an acceptable condition.

Design

Alstom disconnectors are of double break design and are motorised.

Future management strategy

Recommended maintenance should be continued on these disconnectors.

AEM

Table 14: 110 kV AEM in service disconnector listing

Type	Location	Device number	Age	Average age	Number of units	Operation	Design Action	Mounting	Condition	Design
DB 123	Hampshire	HM-A129A	21	21	4	Manual	Double Break	Lattice Structure		
DB 123	Hampshire	HM-A129B	21			Manual	Double Break	Lattice Structure		
DB 123	Hampshire	HM-B129A	21			Manual	Double Break	Pedestal		
DB 123	Hampshire	HM-B129B	21			Manual	Double Break	Lattice Structure		
Total number of units					**4**					

Condition

AEM disconnectors are in acceptable condition.

Design

AEM disconnectors are of double break design and are not motorised.

Future management strategy

Recommended maintenance should be continued on these disconnectors. There is no requirement to motorise these disconnectors.

Hapam

Table 15: Hapam 110 kV in service disconnector listing

Type	Location	Device number	Age	Average age	Number of units	Operation	Design Action	Mounting	Condition	Design
SSBIII-AM-170	Electrona	EL-A129	8	8	8	Motorised	Double Break	Pedestal		
SSBIII-AM-170	Electrona	EL-A129C	8			Motorised	Double Break	Pedestal		
SSBIII-AM-170	Electrona	EL-A429	8			Motorised	Double Break	Pedestal		
SSBIII-AM-170	Electrona	EL-A729A	9			Motorised	Double Break	Pedestal		
SSBIII-AM-170	Electrona	EL-A729B	9			Motorised	Double Break	Pedestal		
SSBIII-AM-170	Electrona	EL-B129	8			Motorised	Double Break	Pedestal		
SSBIII-AM-170	Electrona	EL-B129C	8			Motorised	Double Break	Pedestal		
SSBIII-AM-170	Electrona	EL-B429	8			Motorised	Double Break	Pedestal		
SSBIII-AM-170	George Town	GT-A529A	9	8	8	Motorised	Double Break	Pedestal		
SSBIII-AM-170	George Town	GT-A529B	9			Motorised	Double Break	Pedestal		
SSBIII-AM-170	George Town	GT-B529B	7			Motorised	Double Break	Pedestal		
SSBIII-AM-170	George Town	GT-C529A	7			Motorised	Double Break	Pedestal		
SSBIII-AM-170	George Town	GT-H129B	7			Motorised	Double Break	Pedestal		
SSBIII-AM-170	George Town	GT-H129C	7			Motorised	Double Break	Pedestal		
SSBIII-AM-170	George Town	GT-I129A	7			Motorised	Double Break	Pedestal		
SSBIII-AM-170	George Town	GT-I129C	7			Motorised	Double Break	Pedestal		
SSBIII-AM-170	Hadspen	HA-C429A	11	11	4	Motorised	Double Break	Pedestal		
SSBIII-AM-170	Hadspen	HA-CM429	11			Motorised	Double Break	Pedestal		
SSBIII-AM-170	Hadspen	HA-D429A	11			Motorised	Double Break	Pedestal		
SSBIII-AM-170	Hadspen	HA-DL429	11			Motorised	Double Break	Pedestal		
SSBIII-AM-170	Lindisfarne	LF-A129A	11	11	16	Motorised	Double Break	Pedestal		

SSBIII-AM-170	Lindisfarne	LF-A129C	11			Motorised	Double Break	Pedestal		
SSBIII-AM-170	Lindisfarne	LF-A729A	11			Motorised	Double Break	Pedestal		
SSBIII-AM-170	Lindisfarne	LF-A729B	11			Motorised	Double Break	Pedestal		
SSBIII-AM-170	Lindisfarne	LF-AE129	11			Motorised	Double Break	Pedestal		
SSBIII-AM-170	Lindisfarne	LF-B129A	11			Motorised	Double Break	Pedestal		
SSBIII-AM-170	Lindisfarne	LF-B129C	11			Manual	Double Break	Pedestal		
SSBIII-AM-170	Lindisfarne	LF-B429B	11			Motorised	Double Break	Pedestal		
SSBIII-AM-170	Lindisfarne	LF-BF129	11			Manual	Double Break	Pedestal		
SSBIII-AM-170	Lindisfarne	LF-C129A	11			Motorised	Double Break	Pedestal		
SSBIII-AM-170	Lindisfarne	LF-C129C	11			Motorised	Double Break	Pedestal		
SSBIII-AM-170	Lindisfarne	LF-C429B	11			Motorised	Double Break	Pedestal		
SSBIII-AM-170	Lindisfarne	LF-CB429	11			Motorised	Double Break	Pedestal		
SSBIII-AM-170	Lindisfarne	LF-DC429	12			Motorised	Double Break	Pedestal		
SSBIII-AM-170	Lindisfarne	LF-E129B	11			Motorised	Double Break	Pedestal		
SSBIII-AM-170	Lindisfarne	LF-E129C	11			Motorised	Double Break	Pedestal		
SSBIII-AM-170	New Norfolk	NN-G629A	11	11	2	Motorised	Double Break	Pedestal		
SSBIII-AM-170	New Norfolk	NN-G629B	11			Motorised	Double Break	Pedestal		
GSSB-123	Trevallyn Substation	TR-A129A	18	18	8	Manual	Pantagraph	Pedestal		
GSSB-123	Trevallyn Substation	TR-B129A	19			Manual	Pantagraph	Pedestal		
GSSB-123	Trevallyn Substation	TR-C729C	17			Manual	Pantagraph	Pedestal		
GSSB-123	Trevallyn Substation	TR-C729D	18			Manual	Pantagraph	Pedestal		
GSSB-123	Trevallyn Substation	TR-J429B	17			Manual	Pantagraph	Pedestal		

GSSB-123	Trevallyn Substation	TR-K429B	17			Manual	Pantagraph	Pedestal		
GSSB-123	Trevallyn Substation	TR-L429B	17			Manual	Pantagraph	Pedestal		
GSSB-123	Trevallyn Substation	TR-M429A	17			Manual	Pantagraph	Pedestal		
Total number of units					**46**					

Condition

Hapam disconnectors are in an acceptable condition.

Design

Hapam GSSB-123 and SSB III disconnectors are of pantograph and double break design respectively. All the SSB III disconnectors are motorised, except for B129C and BF129 at Lindisfarne Substation. The GSSB-123 type has a complex lower operating mechanism that requires additional man-hours to perform maintenance.

Future management strategy

Recommended maintenance should be continued on these disconnectors.

Merlin Gerin

Table 16: Merlin Gerin 110 kV in service disconnector listing

Type	Location	Device number	Age	Average age	Number of units	Operation	Design Action	Mounting	Condition	Design
DR	Hadspen	HA-A529	17	17	22	Motorised	Centre Break	Pedestal		
DR	Hadspen	HA-A729A	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-A729B	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-B529A	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-BN529	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-D729A	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-D729B	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-E129A	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-E129C	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-EK129	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-FJ529	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-G129A	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-G129C	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-GH129	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-H129B	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-H129C	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-J129B	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-J129C	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-K129B	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-K129C	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-N129B	17			Manual	Centre Break	Pedestal		

DR	Hadspen	HA-N129C	17			Manual	Centre Break	Pedestal		
Total number of units					**22**					

Condition

Merlin Gerin disconnectors are in an acceptable condition.

Design

Merlin Gerin disconnectors are of centre break design. They are of manual type except for A529 at Hadspen Substation, which is motorised. Bus disconnectors A729A and D729B do not have associated earth switches.

The amount of loading that can be handled by the swivel joints on the Merlin Gerin disconnectors is questionable. Bus disconnectors A729A and D729B have had additional post insulators installed on the circuit breaker side to take the loading off the swivel joint.

Future management strategy

Associated earth switches should be installed on disconnectors A729A and D729B if the bus is not to be earthed via alternative means. The recommended maintenance practices should be continued on these disconnectors.

Morlynn Stanger

Table 17: Morlynn Stanger 110 kV in service disconnector listing

Type	Location	Device number	Age	Average age	Number of units	Operation	Design Action	Mounting	Condition	Design
HDB	Avoca	AV-B129C	32	32	1	Manual	Double Break	Pedestal		
HDB	Boyer	BY-C429	29	29	2	Manual	Double Break	Pedestal		
HDB	Boyer	BY-D429	28			Manual	Double Break	Pedestal		
HDB	Knights Road	KR-A429A	29	29	1	Manual	Double Break	Pedestal		
HDB	North Hobart	NH-A429	42	42	2	Manual	Double Break	Pedestal		
HDB	North Hobart	NH-B429	42			Manual	Double Break	Pedestal		
HDB	New Norfolk	NN-A429B	29	30	24	Manual	Double Break	Pedestal		
HDB	New Norfolk	NN-A729A	29			Manual	Double Break	Pedestal		
HDB	New Norfolk	NN-A729B	30			Manual	Double Break	Pedestal		
HDB	New Norfolk	NN-AD429	29			Manual	Double Break	Pedestal		
HDB	New Norfolk	NN-B429B	29			Manual	Double Break	Pedestal		
HDB	New Norfolk	NN-BE429	30			Manual	Double Break	Pedestal		
HDB	New Norfolk	NN-D129A	29			Manual	Double Break	Pedestal		
HDB	New Norfolk	NN-D129C	30			Manual	Double Break	Pedestal		
HDB	New Norfolk	NN-E129A	29			Manual	Double Break	Pedestal		
HDB	New Norfolk	NN-E129C	30			Manual	Double Break	Pedestal		
HDB	New Norfolk	NN-F129A	29			Manual	Double Break	Pedestal		
HDB	New Norfolk	NN-F129C	30			Manual	Double Break	Pedestal		
HDB	New Norfolk	NN-FP129	30			Manual	Double Break	Pedestal		

HDB	New Norfolk	NN-HR129	30			Manual	Double Break	Pedestal		
HDB	New Norfolk	NN-J129A	29			Manual	Double Break	Pedestal		
HDB	New Norfolk	NN-J129C	30			Manual	Double Break	Pedestal		
HDB	New Norfolk	NN-JK129A	30			Manual	Double Break	Pedestal		
HDB	New Norfolk	NN-JK129B	30			Manual	Double Break	Pedestal		
HDB	New Norfolk	NN-K129B	29			Manual	Double Break	Pedestal		
HDB	New Norfolk	NN-K129C	30			Manual	Double Break	Pedestal		
HDB	New Norfolk	NN-P129B	29			Manual	Double Break	Pedestal		
HDB	New Norfolk	NN-P129C	30			Manual	Double Break	Pedestal		
HDB	New Norfolk	NN-R129B	29			Manual	Double Break	Pedestal		
HDB	New Norfolk	NN-R129C	30			Manual	Double Break	Pedestal		
HDB	Queenstown	QT-A129A	42	48	9	Manual	Double Break	Pedestal		
HDB	Queenstown	QT-A129C	44			Manual	Double Break	Underhung		
HDB	Queenstown	QT-A429	42			Manual	Double Break	Pedestal		
HDB	Queenstown	QT-AB129	44			Manual	Double Break	Pedestal		
HDB	Queenstown	QT-B129A	42			Manual	Double Break	Pedestal		
HDB	Queenstown	QT-B129C	44			Manual	Double Break	Girder Underhung		
HDB	Queenstown	QT-B429	58			Manual	Double Break	Pedestal		
HDB	Queenstown	QT-C429	58			Manual	Double Break	Pedestal		
HDB	Queenstown	QT-D429	58			Manual	Double Break	Pedestal		
HDB	Railton	RA-A429A	34	40	4	Manual	Double Break	Girder Underhung		
HDB	Railton	RA-A729A	45			Manual	Centre Break	Pedestal		
HDB	Railton	RA-A729B	45			Manual	Centre Break	Pedestal		
HDB	Railton	RA-B429B	34			Manual	Double Break	Girder Underhung		
HDB	Sheffield	SH-N129A	30	31	6	Manual	Double Break	Pedestal		

HDB	Sheffield	SH-N129C	31			Manual	Double Break	Pedestal		
HDB	Sheffield	SH-NV129A	31			Manual	Double Break	Pedestal		
HDB	Sheffield	SH-NV129B	31			Manual	Double Break	Pedestal		
HDB	Sheffield	SH-V129B	30			Manual	Double Break	Pedestal		
HDB	Sheffield	SH-V129C	31			Manual	Double Break	Pedestal		
Total number of units					**49**					

Stanger

Table 18: Stanger 110 kV in service disconnector listing

Type	Location	Device number	Age	Average age	Number of units	Operation	Design Action	Mounting	Condition	Design
HCB	Burnie	BU-F429B	46	46	2	Manual	Centre Break	Lattice Structure		
HCB	Burnie	BU-G429B	46			Manual	Centre Break	Lattice Structure		
DR1	Chapel Street	CS-B729A	57	57	2	Manual	Centre Break	Lattice Structure		
DR1	Chapel Street	CS-B729B	57			Manual	Centre Break	Lattice Structure		
DR2	Palmerston	PM-P129B	53	53	2	Manual	Centre Break	Concrete Pedestal		
DR2	Palmerston	PM-P129L	53			Manual	Centre Break	Concrete Pedestal		
HDB	Railton	RA-C129A	45	45	4	Manual	Double Break	Pedestal		
HDB	Railton	RA-C129C	45			Manual	Double Break	Pedestal		
HDB	Railton	RA-D129B	45			Manual	Double Break	Pedestal		
HDB	Railton	RA-D129C	45			Manual	Double Break	Pedestal		
HCB	St Marys	SM-A429C	43	43	2	Manual	Centre Break	Pedestal		
HCB	St Marys	SM-B429C	43			Manual	Centre Break	Pedestal		
HCB	Wesley Vale	WV-A129B	47	47	10	Manual	Centre Break	Pedestal		
HCB	Wesley Vale	WV-A129C	47			Manual	Centre Break	Pedestal		
HCB	Wesley Vale	WV-A129D	46			Manual	Centre Break	Girder Mounted		

HCB	Wesley Vale	WV-A729A	46			Manual	Centre Break	Pedestal		
HCB	Wesley Vale	WV-A729B	47			Manual	Centre Break	Pedestal		
HCB	Wesley Vale	WV-B129A	47			Manual	Centre Break	Pedestal		
HCB	Wesley Vale	WV-B129C	47			Manual	Centre Break	Pedestal		
HCB	Wesley Vale	WV-B129D	46			Manual	Centre Break	Girder Mounted		
HCB	Wesley Vale	WV-C429B	49			Manual	Centre Break	Pedestal		
HCB	Wesley Vale	WV-D429A	49			Manual	Centre Break	Pedestal		
Total number of units					**22**					

Condition

Stanger / Morlynn disconnectors are generally in acceptable or marginal condition depending upon the age and model.

Design

Stanger HCB disconnectors have some inherent design issues.

Stanger DR1, DR2, HCB type disconnectors are of centre break design. Types HDB are double break. These disconnectors are of manual type.

A number of these disconnectors are mounted on girders and underhung approximately 10 metres above ground level, requiring additional resources to maintain.

The current rating of the Stanger DR1 disconnectors is 800 A, making disconnectors H129A, H129B and H129C at Chapel Street Substation the circuit limiting equipment.

Future management strategy

The units at Palmerston substation will be replaced in conjunction with the proposed substation works.

Type DR1 disconnectors at Burnie Substation should be replaced with the associated circuits breaker works. The bypass disconnectors at Burnie Substation should be decommissioned.

Recommended maintenance should be continued on these disconnectors until they are replaced.

Switchgear Pty Ltd

Table 19: Switchgear Pty Ltd 110 kV in service disconnector listing

Type	Location	Device number	Age	Average age	Number of units	Operation	Design Action	Mounting	Condition	Design
DBR-4	Derwent Bridge	DB-A429	41	41	1	Manual	Centre Break	Lattice Structure		
DBR-4	Lindisfarne	LF-A629A	50	50	3	Manual	Centre Break	Lattice Structure		
DBR-4	Lindisfarne	LF-A629C	50			Manual	Centre Break	Lattice Structure		
DBR-4	Lindisfarne	LF-AG629	50			Manual	Centre Break	Lattice Structure		
DBR-4	Port Latta	PL-A729A	60	55	2	Manual	Centre Break	Lattice Structure		
DBR-4	Port Latta	PL-A729B	50			Manual	Centre Break	Lattice Structure		
DBR-4	Sheffield	SH-A529A	48	49	19	Manual	Centre Break	Pedestal		
DBR-4	Sheffield	SH-A529C	49			Manual	Centre Break	Pedestal		
DBR-4	Sheffield	SH-AQ529	49			Manual	Centre Break	Pedestal		
DBR-4	Sheffield	SH-B729A	48			Manual	Centre Break	Pedestal		
DBR-4	Sheffield	SH-B729B	49			Manual	Centre Break	Pedestal		
DBR-4	Sheffield	SH-BR529	48			Manual	Centre Break	Pedestal		
DBR-4	Sheffield	SH-CT529	49			Manual	Centre Break	Pedestal		
DBR-4	Sheffield	SH-Q129B	48			Manual	Centre Break	Pedestal		
DBR-4	Sheffield	SH-Q129C	49			Manual	Centre Break	Pedestal		
DBR-4	Sheffield	SH-R129B	48			Manual	Centre Break	Pedestal		
DBR-4	Sheffield	SH-R129C	49			Manual	Centre Break	Pedestal		
DBR-4	Sheffield	SH-S129A	48			Manual	Centre Break	Pedestal		
DBR-4	Sheffield	SH-S129B	49			Manual	Centre Break	Pedestal		
DBR-4	Sheffield	SH-S129C	49			Manual	Centre Break	Pedestal		
DBR-4	Sheffield	SH-T129B	48			Manual	Centre Break	Pedestal		

DBR-4	Sheffield	SH-T129C	49			Manual	Centre Break	Pedestal		
DBR-4	Sheffield	SH-U129A	48			Manual	Centre Break	Pedestal		
DBR-4	Sheffield	SH-U129B	49			Manual	Centre Break	Pedestal		
DBR-4	Sheffield	SH-U129C	49			Manual	Centre Break	Pedestal		
DBR-4	Savage River	SR-A129B	50	54	3	Manual	Centre Break	Lattice Structure		
DBR-4	Savage River	SR-B429B	56			Manual	Centre Break	Lattice Structure		
DBR-4	Savage River	SR-C429B	56			Manual	Centre Break	Lattice Structure		
Total number of units					**28**					

Condition

Switchgear Pty Ltd disconnectors are in acceptable condition.

Design

Switchgear disconnectors are of centre break design and are of manual type.

Future management strategy

Recommended maintenance should be continued on these disconnectors until replaced.

Taplin

Table 20: Taplin 110 kV in service disconnector listing

Type	Location	Device number	Age	Average age	Number of units	Operation	Design Action	Mounting	Condition	Design
D751/B180	Avoca	AV-B129	32	32	1	Manual	Double Break	Pedestal		
D751/B181	Bridgewater	BW-A429A	36	36	8	Manual	Rotary Break	Pedestal		
D751/B181	Bridgewater	BW-A729A	36			Manual	Rotary Break	Pedestal		
D751/B181	Bridgewater	BW-A729B	36			Manual	Rotary Break	Pedestal		
D751/B181	Bridgewater	BW-B429B	36			Manual	Double Break	Pedestal		
D751/B181	Bridgewater	BW-G129B	36			Manual	Double Break	Pedestal		
D751/B180	Bridgewater	BW-G129C	36			Manual	Double Break	Pedestal		
D751/B181	Bridgewater	BW-H129A	36			Manual	Rotary Break	Pedestal		
D751/B180	Bridgewater	BW-H129C	36			Manual	Double Break	Pedestal		
D751/B181	Chapel Street	CS-A529A	35	35	9	Manual	Double Break	Pedestal		
D751/B180	Chapel Street	CS-AF129	35			Manual	Double Break	Pedestal		
D751/B181	Chapel Street	CS-E429B	33			Manual	Double Break	Pedestal		
D751/B181	Chapel Street	CS-F129B	35			Manual	Double Break	Pedestal		
D751/B180	Chapel Street	CS-F129C	35			Manual	Double Break	Pedestal		
D751/B181	Chapel Street	CS-F429B	33			Manual	Double Break	Pedestal		
D751/B180	Chapel Street	CS-G129A	35			Manual	Double Break	Pedestal		

D751/B181	Chapel Street	CS-G129B	35			Manual	Double Break	Pedestal		
D751/B180	Chapel Street	CS-G129C	35			Manual	Double Break	Pedestal		
D751/B180	Farrell	FA-A529	33	34	16	Manual	Double Break	Pedestal		
D751/B180	Farrell	FA-AB529	33			Manual	Double Break	Pedestal		
D751/B180	Farrell	FA-B529	33			Manual	Double Break	Pedestal		
D751/B181	Farrell	FA-B729A	33			Manual	Double Break	Pedestal		
D751/B181	Farrell	FA-B729B	35			Manual	Double Break	Pedestal		
D751/B181	Farrell	FA-N129B	34			Manual	Double Break	Pedestal		
D751/B180	Farrell	FA-N129C	35			Manual	Double Break	Pedestal		
D751/B183	Farrell	FA-N129D	35			Manual	Double Break	Girder Underhung		
D751/B180	Farrell	FA-NS129	35			Manual	Double Break	Pedestal		
D751/B181	Farrell	FA-P129B	34			Manual	Double Break	Pedestal		
D751/B180	Farrell	FA-P129C	35			Manual	Double Break	Pedestal		
D751/B180	Farrell	FA-PT129	35			Manual	Double Break	Pedestal		
D751/B181	Farrell	FA-S129A	34			Manual	Double Break	Pedestal		
D751/B180	Farrell	FA-S129C	34			Manual	Double Break	Pedestal		
D751/B181	Farrell	FA-T129A	34			Manual	Double Break	Pedestal		
D751/B180	Farrell	FA-T129C	34			Manual	Double Break	Pedestal		
D751/B180	Kingston	KI-A129A	36	36	4	Manual	Double Break	Pedestal		
D751/B180	Kingston	KI-A129C	36			Manual	Double Break	Pedestal		
D751/B180	Kingston	KI-B129A	36			Manual	Double Break	Pedestal		
D751/B180	Kingston	KI-B129C	36			Manual	Double Break	Pedestal		
D751/B181	Lindisfarne	LF-F129B	35	22	4	Manual	Double Break	Pedestal		

D751/B181	Lindisfarne	LF-F129C	32			Manual	Double Break	Pedestal		
D751/B182	Lindisfarne	LF-G129B	11			Manual	Double Break	Lattice Structure		
D751/B182	Lindisfarne	LF-G129C	11			Manual	Double Break	Lattice Structure		
D751/B180	Newton	NT-B129	34	34	1	Manual	Double Break	Pedestal		
D751/B181	Norwood	NW-A129A	36	33	9	Manual	Double Break	Pedestal		
D751/B180	Norwood	NW-A129C	36			Manual	Double Break	Pedestal		
D751/B181	Norwood	NW-A429B	36			Manual	Double Break	Pedestal		
D751/B180	Norwood	NW-A729A	36			Manual	Double Break	Pedestal		
D751/B180	Norwood	NW-A729B	36			Manual	Double Break	Pedestal		
D751/B181	Norwood	NW-B129A	36			Manual	Double Break	Pedestal		
D751/B180	Norwood	NW-B129C	36			Manual	Double Break	Pedestal		
D751/B181	Norwood	NW-B429B	36			Manual	Double Break	Pedestal		
D751/B181	Norwood	NW-D129B	36			Manual	Double Break	Pedestal		
D751/B180	Rokeby	RK-A429	35	35	2	Manual	Double Break	Pedestal		
D751/B180	Rokeby	RK-B429	35			Manual	Double Break	Pedestal		
D751/B181	Sheffield	SH-B529A	48	48	1	Manual	Double Break	Pedestal		
D751/B180	Sorell	SO-A429C	32	32	2	Manual	Double Break	Pedestal		
D751/B180	Sorell	SO-B429C	32			Manual	Double Break	Pedestal		
D751/B180	Ulverstone	UL-A129A	48	36	7	Manual	Double Break	Pedestal		
D751/B180	Ulverstone	UL-A429A	33			Manual	Double Break	Pedestal		
D751/B180	Ulverstone	UL-A729A	34			Manual	Double Break	Pedestal		
D751/B180	Ulverstone	UL-A729B	35			Manual	Double Break	Pedestal		
D751/B180	Ulverstone	UL-B129B	34			Manual	Double Break	Pedestal		
D751/B180	Ulverstone	UL-B129C	35			Manual	Double Break	Pedestal		
D751/B180	Ulverstone	UL-B429B	33			Manual	Double Break	Pedestal		

D751/B180	Waratah Tee	WT-A129	36	36	3	Manual	Double Break	Lattice Structure		
D751/B180	Waratah Tee	WT-B129	36			Manual	Double Break	Lattice Structure		
D751/B180	Waratah Tee	WT-C129	36			Manual	Double Break	Lattice Structure		
Total number of units					**67**					

Condition

Taplin disconnectors are in an acceptable condition.

Design

Taplin disconnectors are of double break design and are of manual type. Disconnector N129D at Farrell Substation is mounted on girders and underhung approximately 10 metres above ground level, requiring additional resources to maintain.

Future management strategy

Recommended maintenance should be continued on these disconnectors.

Turner Teco

Table 21: Turner Teco 110 kV in service disconnector listing

Type	Location	Device number	Age	Average age	Number of units	Operation	Design Action	Mounting	Condition	Design
TMX-11520	Castle Forbes Bay Tee	CF-A129	10	10	1	Motorised	Vertical Break	Girder Mounted		
Total number of units					1					

Condition

This disconnector is in an acceptable condition.

Design

The Turner Teco disconnector is of vertical break design and of manual type. This disconnector is girder mounted and can be operated under load.

Future management strategy

Recommended maintenance should be continued on this disconnector.

14 Appendix D – 220 kV Disconnector Condition Assessment

ABB

Table 22: ABB 220 kV in service disconnector listing

Type	Location	Device number	Age	Average age	Number of units	Operation	Design Action	Mounting	Condition	Design
DBRP 245	Chapel Street	CS-T129A	15	15	3	Manual	Double Break	Pedestal		
DBRP 245	Chapel Street	CS-T129C	15			Manual	Double Break	Pedestal		
DBRP 245	Chapel Street	CS-T129D	15			Manual	Double Break	Pedestal		
DBRP 245	George Town	GT-XB629B	17	17	1	Motorised	Double Break	Pedestal		
DBRP 245	Liapootah	LI-BF129	15	15	8	Manual	Double Break	Pedestal		
DBRP 245	Liapootah	LI-C129A	15			Manual	Double Break	Pedestal		
DBRP 245	Liapootah	LI-C129C	15			Manual	Double Break	Pedestal		
DBRP 245	Liapootah	LI-CG129	15			Manual	Double Break	Pedestal		
DBRP 245	Liapootah	LI-F129B	15			Manual	Double Break	Pedestal		
DBRP 245	Liapootah	LI-F129C	15			Manual	Double Break	Pedestal		
DBRP 245	Liapootah	LI-G129B	15			Manual	Double Break	Pedestal		
DBRP 245	Liapootah	LI-G129C	15			Manual	Double Break	Pedestal		
DBRP 245	Palmerston	PM-A729A	16	16	7	Manual	Double Break	Pedestal		
DBRP 245	Palmerston	PM-A729B	16			Manual	Double Break	Pedestal		
DBRP 245	Palmerston	PM-E729A	17			Motorised	Double Break	Concrete		

								Pedestal		
DBRP 245	Palmerston	PM-E729B	18			Motorised	Double Break	Concrete Pedestal		
DBRP 245	Palmerston	PM-G129C	16			Manual	Double Break	Pedestal		
DBRP 245	Palmerston	PM-K129C	16			Manual	Double Break	Pedestal		
DBRP 245	Palmerston	PM-L129C	16			Manual	Double Break	Pedestal		
Total number of units					19					

Condition

ABB disconnectors are in an acceptable condition.

Design

ABB disconnectors are of double break design. They are of manual type with the exception of B629A and B629B at George Town Substation and E729A and E729B at Palmerston Substation, which are motorised.

ABB disconnectors are designed with a moving contact that rotates inside the fixed contact to lock the moving contact in place. This leads to a failure mode where the moving contact does not properly rotate inside the fixed contact but the interlock shows that the disconnector is closed. The poor connection leads to sparking, arcing and an overheated connection where the moving contact is damaged and requires replacement. This type of failure has occurred on K129C at Palmerston Substation and B629B at George Town Substation.

Future management strategy

Recommended maintenance should be continued on these disconnectors.

ALM

Table 23: ALM 220 kV in service disconnector listing

Type	Location	Device number	Age	Average age	Number of units	Operation	Design Action	Mounting	Condition	Design
CB	George Town	GT-F129C	49	49	4	Manual	Centre Break	Lattice Structure		
CB	George Town	GT-F729B	48			Manual	Centre Break	Lattice Structure		
CB	George Town	GT-G129A	48			Manual	Centre Break	Lattice Structure		
CB	George Town	GT-G129C	49			Manual	Centre Break	Lattice Structure		
CB	Sheffield	SH-B129A	48	49	13	Manual	Centre Break	Pedestal		
CB	Sheffield	SH-B129C	49			Manual	Centre Break	Pedestal		
CB	Sheffield	SH-BD429	49			Manual	Centre Break	Pedestal		
CB	Sheffield	SH-C129C	49			Manual	Centre Break	Pedestal		
CB	Sheffield	SH-CE429	49			Manual	Centre Break	Pedestal		
CB	Sheffield	SH-D129A	48			Manual	Centre Break	Pedestal		
CB	Sheffield	SH-D129C	49			Manual	Centre Break	Pedestal		
CB	Sheffield	SH-E129A	48			Manual	Centre Break	Pedestal		
CB	Sheffield	SH-E129C	49			Manual	Centre Break	Pedestal		
CB	Sheffield	SH-F129A	48			Manual	Centre Break	Pedestal		
CB	Sheffield	SH-F129C	49			Manual	Centre Break	Pedestal		
CB	Sheffield	SH-J129B	48			Manual	Centre Break	Pedestal		
CB	Sheffield	SH-J129C	49			Manual	Centre Break	Pedestal		
Total number of units					**17**					

Condition

ALM disconnectors have had issues with contact misalignment during operation. The disconnectors are in acceptable condition.

Design

The ALM CB disconnectors are of centre break design and are of manual type. Units F129A and K129B at Sheffield Substation are fitted with Morlynn Stanger current carrying parts.

Future management strategy

Recommended maintenance should be continued on these disconnectors. Until their targeted replacement in 2014-29 regulatory period.

Alstom/ Areva

Table 24: Alstom/ Areva 220 kV in service disconnector listing

Type	Location	Device number	Age	Average age	Number of units	Operation	Design Action	Mounting	Condition	Design
S3C	George Town	GT-A129B	5	5	22	Motorised	Double Break	Pedestal		
S3CT	George Town	GT-A129C	5			Motorised	Double Break	Pedestal		
SX	George Town	GT-A129F	5			Motorised	Pantagraph	Pedestal		
S3C	George Town	GT-A729B	5			Motorised	Double Break	Pedestal		
S3C	George Town	GT-A729F	5			Motorised	Double Break	Pedestal		
S3C	George Town	GT-B129B	4			Motorised	Double Break	Pedestal		
S3CT	George Town	GT-B129C	4			Motorised	Double Break	Pedestal		
SX	George Town	GT-B129F	4			Motorised	Pantagraph	Pedestal		
SX	George Town	GT-B629F	-			Motorised	Pantagraph	Pedestal		
S3C	George Town	GT-B729B	4			Motorised	Double Break	Pedestal		
S3C	George Town	GT-B729F	4			Motorised	Double Break	Pedestal		
S3C	George Town	GT-C129B	5			Motorised	Double Break	Pedestal		
S3CT	George Town	GT-C129C	5			Motorised	Double Break	Pedestal		
SX	George Town	GT-C129F	5			Motorised	Pantagraph	Pedestal		
S3C	George Town	GT-C729B	5			Motorised	Double Break	Pedestal		
S3C	George Town	GT-C729F	5			Motorised	Double Break	Pedestal		
S3C	George Town	GT-D129B	4			Motorised	Double Break	Pedestal		
S3CT	George Town	GT-D129C	4			Motorised	Double Break	Pedestal		
SX	George Town	GT-D129F	4			Motorised	Pantagraph	Pedestal		
S3C	George Town	GT-D729B	4			Motorised	Double Break	Pedestal		
S3C	George Town	GT-D729F	4			Motorised	Double Break	Pedestal		

SX	George Town	GT-V129B	5			Motorised	Pantagraph	Pedestal		
SX	Lindisfarne	LF-D429A	6	6	10	Motorised	Pantagraph	Pedestal		
SX	Lindisfarne	LF-D429B	6			Motorised	Pantagraph	Pedestal		
SX	Lindisfarne	LF-D729A	6			Motorised	Pantagraph	Pedestal		
SX	Lindisfarne	LF-D729B	6			Motorised	Pantagraph	Pedestal		
SX	Lindisfarne	LF-E429A	6			Motorised	Pantagraph	Pedestal		
SX	Lindisfarne	LF-E429B	6			Motorised	Pantagraph	Pedestal		
SX	Lindisfarne	LF-E729A	6			Motorised	Pantagraph	Pedestal		
SX	Lindisfarne	LF-E729B	6			Motorised	Pantagraph	Pedestal		
S3CT	Lindisfarne	LF-Y129C	6			Motorised	Double Break	Pedestal		
S3CT	Lindisfarne	LF-Z129C	6			Motorised	Double Break	Pedestal		
S3CT	Sheffield	SH-A429B	8	7	15	Motorised	Double Break	Pedestal		
S3CT	Sheffield	SH-A429E	8			Motorised	Double Break	Pedestal		
S3CT	Sheffield	SH-B129E	8			Motorised	Double Break	Pedestal		
S3CT	Sheffield	SH-C129A	8			Manual	Double Break	Pedestal		
S3CT	Sheffield	SH-C129E	8			Motorised	Double Break	Pedestal		
S3CT	Sheffield	SH-E729E	8			Motorised	Double Break	Pedestal		
S3CT	Sheffield	SH-E729S	8			Motorised	Double Break	Pedestal		
S3CT	Sheffield	SH-F129E	8			Motorised	Double Break	Girder Mounted		
S3CT	Sheffield	SH-F729A	8			Manual	Double Break	Pedestal		
S3CT	Sheffield	SH-F729S	8			Motorised	Double Break	Pedestal		
S3CT	Sheffield	SH-G729S	8			Motorised	Double Break	Pedestal		
S3CT	Sheffield	SH-J129E	8			Motorised	Double Break	Pedestal		
S3C	Sheffield	SH-K129B	0			Motorised	Double Break	Pedestal		
S3CT	Sheffield	SH-K129C	0			Motorised	Double Break	Pedestal		

S3CT	Sheffield	SH-K129E	8			Motorised	Double Break	Girder Mounted		
S3CT	Waddamana	WA-J129C	6	6	12	Motorised	Double Break	Pedestal		
S3CT	Waddamana	WA-M129A	6			Motorised	Double Break	Pedestal		
S3CT	Waddamana	WA-M129B	6			Motorised	Double Break	Pedestal		
S3CT	Waddamana	WA-M129C	6			Motorised	Double Break	Pedestal		
S3CT	Waddamana	WA-M729A	6			Motorised	Double Break	Pedestal		
S3CT	Waddamana	WA-M729B	6			Motorised	Double Break	Pedestal		
S3CT	Waddamana	WA-N129A	6			Motorised	Double Break	Pedestal		
S3CT	Waddamana	WA-N129B	6			Motorised	Double Break	Pedestal		
S3CT	Waddamana	WA-N129C	6			Motorised	Double Break	Pedestal		
S3CT	Waddamana	WA-N729A	6			Motorised	Double Break	Pedestal		
S3CT	Waddamana	WA-N729B	6			Motorised	Double Break	Pedestal		
S3CT	Waddamana	WA-Q129C	-							
Total number of units					**59**					

Condition

Alstom / Areva disconnectors are in an acceptable condition.

Design

Alstom / Areva disconnectors are of double break and pantograph design and are motorised, except for C129A and F729A at Sheffield Substation, which are manual.

Future management strategy

Recommended maintenance should be continued on these disconnectors.

Hapam

Table 25: Hapam 220 kV in service disconnector listing

Type	Location	Device number	Age	Average age	Number of units	Operation	Design Action	Mounting	Condition	Design
GSSB-245	George Town	GT-A429B	9	10	11	Motorised	Pantagraph	Pedestal		
GSSB-245	George Town	GT-A429F	9			Motorised	Double Break	Pedestal		
GSSB-245	George Town	GT-B429B	12			Motorised	Pantagraph	Pedestal		
SSBIII-AM-245	George Town	GT-B429F	8			Motorised	Double Break	Pedestal		
GSSB-245	George Town	GT-B629B	12			Motorised	Pantagraph	Pedestal		
GSSB-245	George Town	GT-B629FB	8			Motorised	Pantagraph	Pedestal		
GSSB-245	George Town	GT-C429B	12			Motorised	Pantagraph	Pedestal		
SSBIII-AM-245	George Town	GT-C429F	4			Motorised	Double Break	Pedestal		
GSSB-245	George Town	GT-F129B	12			Motorised	Pantagraph	Pedestal		
EAF	George Town	GT-F729F	8			Motorised	Double Break	Pedestal		
GSSB-245	George Town	GT-G129B	12			Motorised	Pantagraph	Pedestal		
SSBIII-AM-245	Sheffield	SH-G729B	8	8	1	Motorised	Double Break	Girder Mounted		
Total number of units					**12**					

Condition

Hapam disconnectors are in an acceptable condition.

Design

Hapam disconnectors are of pantograph and double break design and are motorised.

Future management strategy

Recommended maintenance should be continued on these disconnectors.

Merlin Gerin

Table 26: Merlin Gerin 220 kV in service disconnector listing

Type	Location	Device number	Age	Average age	Number of units	Operation	Design Action	Mounting	Condition	Design
DR	Farrell	FA-A129A	28	33	20	Manual	Centre Break	Pedestal		
DR	Farrell	FA-A129C	27			Manual	Centre Break	Pedestal		
DR	Farrell	FA-A429B	33			Manual	Centre Break	Pedestal		
DR	Farrell	FA-A729A	33			Manual	Centre Break	Pedestal		
DR	Farrell	FA-A729B	35			Manual	Centre Break	Pedestal		
DR	Farrell	FA-AB429	33			Manual	Centre Break	Pedestal		
DR	Farrell	FA-B129A	28			Manual	Centre Break	Pedestal		
DR	Farrell	FA-B129C	27			Manual	Centre Break	Pedestal		
DR	Farrell	FA-B429A	33			Manual	Centre Break	Pedestal		
DR	Farrell	FA-B429B	35			Manual	Centre Break	Pedestal		
DR	Farrell	FA-D129A	33			Manual	Centre Break	Pedestal		
DR	Farrell	FA-D129C	35			Manual	Centre Break	Pedestal		
DR	Farrell	FA-DH129	35			Manual	Centre Break	Pedestal		
DR	Farrell	FA-E129A	33			Manual	Centre Break	Pedestal		
DR	Farrell	FA-E129C	35			Manual	Centre Break	Pedestal		
DR	Farrell	FA-EJ129	35			Manual	Centre Break	Pedestal		
DR	Farrell	FA-H129B	33			Manual	Centre Break	Pedestal		
DR	Farrell	FA-H129C	35			Manual	Centre Break	Pedestal		
DR	Farrell	FA-J129B	33			Manual	Centre Break	Pedestal		
DR	Farrell	FA-J129C	35			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-A429B	17	17	17	Manual	Centre Break	Pedestal		

DR	Hadspen	HA-AV429	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-B429	17			Motorised	Centre Break	Pedestal		
DR	Hadspen	HA-B729A	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-B729B	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-BW729A	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-BW729B	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-P129B	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-P129C	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-PU129	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-Q129B	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-Q129C	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-QT129	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-T129A	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-T129C	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-V129A	17			Manual	Centre Break	Pedestal		
DR	Hadspen	HA-V129C	17			Manual	Centre Break	Pedestal		
DR	Liapootah	LI-D129	17	18	7	Motorised	Centre Break	Pedestal		
DR	Liapootah	LI-D129A	19			Manual	Centre Break	Pedestal		
DR	Liapootah	LI-D129C	19			Manual	Centre Break	Pedestal		
DR	Liapootah	LI-D129D	17			Manual	Centre Break	Pedestal		
DR	Liapootah	LI-H129B	17			Manual	Centre Break	Pedestal		
DR	Liapootah	LI-H129C	19			Manual	Centre Break	Pedestal		
DR	Liapootah	LI-H129D	19			Manual	Centre Break	Pedestal		
DR	Palmerston	PM-E729E	18	18	4	Manual	Centre Break	Pedestal		
DR	Palmerston	PM-J129A	19			Manual	Centre Break	Pedestal		

DR	Palmerston	PM-J129B	18			Manual	Centre Break	Pedestal		
DR	Palmerston	PM-J129C	18			Manual	Centre Break	Pedestal		
DR	Sheffield	SH-B429B	30	34	8	Manual	Centre Break	Pedestal		
DR	Sheffield	SH-B429C	32			Manual	Centre Break	Pedestal		
DR	Sheffield	SH-WZ129	35			Manual	Centre Break	Pedestal		
DR	Sheffield	SH-XY129	35			Manual	Centre Break	Pedestal		
DR	Sheffield	SH-Y129A	33			Manual	Centre Break	Pedestal		
DR	Sheffield	SH-Y129C	35			Manual	Centre Break	Pedestal		
DR	Sheffield	SH-Z129A	33			Manual	Centre Break	Pedestal		
DR	Sheffield	SH-Z129C	35			Manual	Centre Break	Pedestal		
Total number of units					**56**					

Condition

Merlin Gerin disconnectors are in an acceptable condition.

Design

The Merlin Gerin DR type disconnectors are of centre break design. They are of manual type with the exception of B429 at Hadspen Substation and D129 at Liapootah Substation, which are motorised.

Future management strategy

Recommended maintenance should be continued on these disconnectors.

Ruhrtal

Table 27: Ruhrtal 220 kV in service disconnector listing

Type	Location	Device number	Age	Average age	Number of units	Operation	Design Action	Mounting	Condition	Design
DBF4-245	George Town	GT-G729F	11	11	8	Motorised	Centre Break	Pedestal		
DBRP 245	George Town	GT-H729B	11			Motorised	Centre Break	Pedestal		
DBF4+AEBF2	George Town	GT-H729E	11			Motorised	Centre Break	Pedestal		
DBF4+AEBF2	George Town	GT-X129C	8			Motorised	Double Break	Pedestal		
DBF4-245	George Town	GT-X129F	11			Motorised	Centre Break	Pedestal		
DBF4-245	George Town	GT-Y129F	11			Motorised	Centre Break	Pedestal		
DBF4-245	George Town	GT-Z129C	11			Motorised	Centre Break	Pedestal		
DBF4-245	George Town	GT-Z129F	11			Motorised	Centre Break	Pedestal		
Total number of units					**8**					

Condition

Ruhrtal disconnectors are in an acceptable condition.

Design

Ruhrtal disconnectors are of centre break and double break design and are motorised. The DBF4 245+AEBF2 and ZBF4 245+AEBF2 type disconnectors are the same as DBF4-245 and ZBF4-245, respectively, with the addition of an earth switch.

Future management strategy

Recommended maintenance should be continued on these disconnectors.

Stanger/ Morlynn Stanger

Table 28: Morlynn Stanger 220 kV in service disconnector listing

Type	Location	Device number	Age	Average age	Number of units	Operation	Design Action	Mounting	Condition	Design
HCB	Sheffield	SH-GL129	30	30	3	Manual	Centre Break	Pedestal		
HCB	Sheffield	SH-L129B	29			Manual	Centre Break	Lattice Structure		
HCB	Sheffield	SH-L129C	30			Manual	Centre Break	Lattice Structure		
Total number of units					**3**					

Stanger

Table 29: Stanger 220 kV in service disconnector listing

Type	Location	Device number	Age	Average age	Number of units	Operation	Design Action	Mounting	Condition	Design
DR1	Burnie	BU-A129C	57	57	2	Manual	Centre Break	Lattice Structure		
DR1	Burnie	BU-AB129	57			Manual	Centre Break	Lattice Structure		
DR1	Chapel Street	CS-A429A	57	57	4	Manual	Centre Break	Lattice Structure		
DR1	Chapel Street	CS-A429B	57			Manual	Centre Break	Lattice Structure		
DR1	Chapel Street	CS-B429A	57			Manual	Centre Break	Lattice Structure		
DR1	Chapel Street	CS-B429B	57			Manual	Centre Break	Lattice Structure		
TTRV	Gordon	GO-A129D	39	39	2	Manual	Vertical Make	Pedestal		
TTRV	Gordon	GO-B129D	39			Manual	Vertical Make	Pedestal		
DR1	Liapootah	LI-729A	58	57	5	Manual	Centre Break	Concrete Pedestal		

DR1	Liapootah	LI-729B	56			Manual	Centre Break	Concrete Pedestal		
DR1	Liapootah	LI-AE129	56			Manual	Centre Break	Concrete Pedestal		
DR1	Liapootah	LI-E129B	58			Manual	Centre Break	Concrete Pedestal		
DR1	Liapootah	LI-E129C	56			Manual	Centre Break	Concrete Pedestal		
DR2	Palmerston	PM-A129A	53	53	23	Manual	Centre Break	Concrete Pedestal		
DR2	Palmerston	PM-A429A	53			Manual	Centre Break	Concrete Pedestal		
DR2	Palmerston	PM-A429B	54			Manual	Centre Break	Concrete Pedestal		
DR2	Palmerston	PM-AD129	53			Manual	Centre Break	Concrete Pedestal		
DR2	Palmerston	PM-B129A	54			Manual	Centre Break	Concrete Pedestal		
DR2	Palmerston	PM-B129C	53			Manual	Centre Break	Concrete Pedestal		
DR2	Palmerston	PM-B129L	53			Manual	Centre Break	Concrete Pedestal		
DR2	Palmerston	PM-BC129	53			Manual	Centre Break	Concrete Pedestal		
DR2	Palmerston	PM-C129B	53			Manual	Centre Break	Concrete Pedestal		
DR2	Palmerston	PM-C129C	53			Manual	Centre Break	Concrete Pedestal		
DR2	Palmerston	PM-C129L	53			Manual	Centre Break	Concrete Pedestal		

DR2	Palmerston	PM-D129B	54			Manual	Centre Break	Concrete Pedestal		
DR2	Palmerston	PM-D129C	54			Manual	Centre Break	Concrete Pedestal		
DR2	Palmerston	PM-D129L	54			Manual	Centre Break	Concrete Pedestal		
DR2	Palmerston	PM-F129A	54			Motorised	Centre Break	Concrete Pedestal		
DR2	Palmerston	PM-F129C	53			Manual	Centre Break	Concrete Pedestal		
DR2	Palmerston	PM-F129E	53			Motorised	Centre Break	Concrete Pedestal		
DR2	Palmerston	PM-G129B	54			Manual	Centre Break	Concrete Pedestal		
DR2	Palmerston	PM-G129E	53			Manual	Centre Break	Concrete Pedestal		
DR2	Palmerston	PM-K129A	54			Motorised	Centre Break	Concrete Pedestal		
DR2	Palmerston	PM-K129B	53			Motorised	Centre Break	Concrete Pedestal		
DR2	Palmerston	PM-L129A	54			Motorised	Centre Break	Concrete Pedestal		
DR2	Palmerston	PM-L129B	53			Motorised	Centre Break	Concrete Pedestal		
DR1	Wayatinah Tee	WY-A129	55	56	2	Manual	Centre Break	Concrete Pedestal		
DR1	Wayatinah Tee	WY-B129	57			Manual	Centre Break	Concrete Pedestal		
Total number of units					**38**					

Condition

Stanger HCB and TTRV type disconnectors have all had issues with contact misalignment. Types DR1 and DR2 are also susceptible to this. Stanger disconnectors are also having issues with hot joints and interlock solenoids seizing. Overall, Stanger disconnectors are in a marginal condition.

Design

Type DR1, DR2 and HCB disconnectors are of centre break design. Type TTRV are vertical make. These disconnectors are of manual type except for F129A, F129E, K129A, K129B, L129A and L129B at Palmerston Substation, which have been retrofitted with motors.

The TTRV disconnectors are poorly designed with the contact arrangement and overall weight of these disconnectors making them difficult to operate. Types TTRV are bypass disconnectors and are normally kept in the open position.

Future management strategy

Type DR1 disconnectors at Chapel Street, Liapootah and Wayatinah Tee substations should be replaced as standalone projects or in conjunction with other projects.

Type DR2 disconnectors at Palmerston substation are being targeted for replacement by 2019.

Recommended maintenance should be continued on these disconnectors.

Taplin

Table 30: Taplin 220 kV in service disconnector listing

Type	Location	Device number	Age	Average age	Number of units	Operation	Design Action	Mounting	Condition	Design
220RCE/B113	Chapel Street	CS-A729A	40	40	21	Manual	Centre Break	Lattice Structure		
220RCE/B114	Chapel Street	CS-A729B	40			Manual	Centre Break	Lattice Structure		
220RC/B114	Chapel Street	CS-A729E	40			Manual	Centre Break	Lattice Structure		
220RC/B113	Chapel Street	CS-A729S	40			Manual	Centre Break	Lattice Structure		
220RCE/B114	Chapel Street	CS-B129A	40			Manual	Centre Break	Lattice Structure		
220RCE/B113	Chapel Street	CS-B129C	40			Manual	Centre Break	Lattice Structure		
220RC/B113	Chapel Street	CS-B129D	40			Manual	Centre Break	Lattice Structure		
220RC/B113	Chapel Street	CS-BC429	40			Manual	Centre Break	Lattice Structure		
220RCE/B114	Chapel Street	CS-C129A	40			Manual	Centre Break	Lattice Structure		
220RCE/B113	Chapel Street	CS-C129C	40			Manual	Centre Break	Lattice Structure		
220RC/B114	Chapel Street	CS-C129D	40			Manual	Centre Break	Lattice Structure		
220RC/B114	Chapel Street	CS-C429B	40			Manual	Centre Break	Lattice Structure		
220RC/B113	Chapel Street	CS-CD429	40			Manual	Centre Break	Lattice Structure		

220RCE/B114	Chapel Street	CS-D429B	40			Manual	Centre Break	Lattice Structure		
220RC/B114	Chapel Street	CS-S729A	40			Manual	Centre Break	Lattice Structure		
220RCE/B113	Chapel Street	CS-S729B	40			Manual	Centre Break	Lattice Structure		
220RC/B113	Chapel Street	CS-T129B	40			Manual	Centre Break	Lattice Structure		
220RCE/B114	Chapel Street	CS-U129A	40			Manual	Centre Break	Lattice Structure		
220RC/B113	Chapel Street	CS-U129B	40			Manual	Centre Break	Lattice Structure		
220RCE/B113	Chapel Street	CS-U129C	40			Manual	Centre Break	Lattice Structure		
220RC/B114	Chapel Street	CS-U129D	40			Manual	Centre Break	Lattice Structure		
220RC/B117	Gordon	GO-A129A	40	40	10	Manual	Centre Break	Pedestal		
220RC/B117	Gordon	GO-A129C	39			Manual	Centre Break	Pedestal		
220RCE/B117	Gordon	GO-A429	40			Manual	Centre Break	Pedestal		
220RC/B117	Gordon	GO-A729A	40			Manual	Centre Break	Pedestal		
220RC/B117	Gordon	GO-A729B	39			Manual	Centre Break	Pedestal		
220RC/B117	Gordon	GO-B129A	40			Manual	Centre Break	Pedestal		
220RCE/B117	Gordon	GO-B129C	39			Manual	Centre Break	Pedestal		
220RC/B117	Gordon	GO-C729A	40			Manual	Centre Break	Pedestal		
220RC/B117	Gordon	GO-C729B	39			Manual	Centre Break	Pedestal		
220RC/B117	Gordon	GO-S729	40			Manual	Centre Break	Pedestal		
220RC/B113	Palmerston	PM-A129C	41	41	2	Manual	Centre Break	Pedestal		
220RCE/B113	Palmerston	PM-A129L	41			Manual	Centre Break	Pedestal		

Total number of units	**33**					

Condition

Taplin disconnectors are in an acceptable condition.

Design

Taplin disconnectors are of centre break design and are of manual type.

Future management strategy

Recommended maintenance should be continued on these disconnectors.

15 Appendix E- Spare Parts

Spare disconnector units

Table 31 presents the spares of complete disconnector units. These spares may be used to replace faulty disconnectors if needed.

Table 31: 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
	Merlin Gerin	SSP	Semi- Pantograph	Primary Store	3
	Stanger	TTRV	Vertical Make	Primary Store	1

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