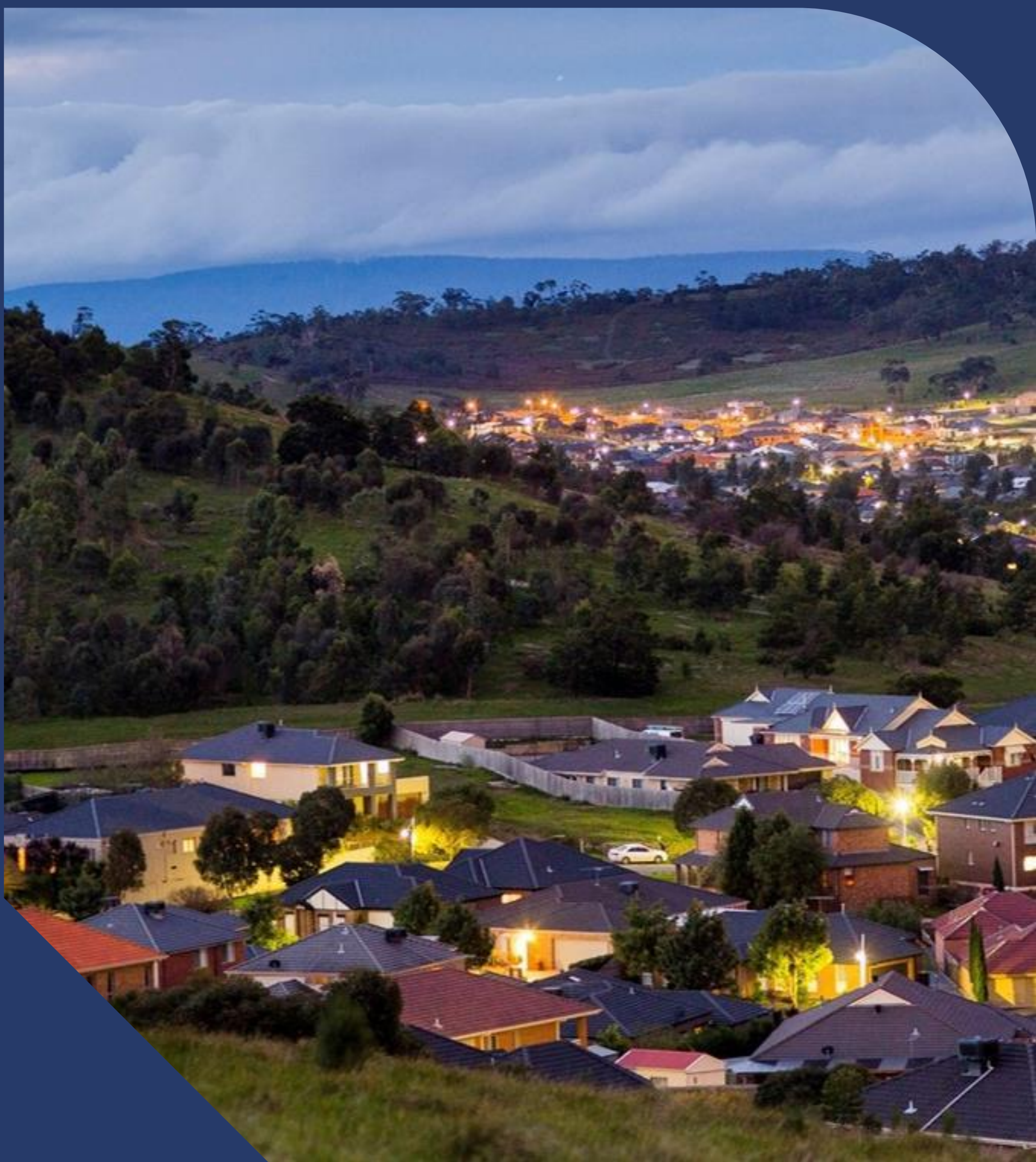
AusNet

MV Switches and ACRs

AMS – Electricity Distribution Network



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1. Executive Summary

This document is part of the Asset Management Strategies related to AusNet's electricity distribution network. The purpose of this strategy is to outline the inspection, maintenance, replacement, and monitoring activities identified for the effective economic lifecycle management of Medium Voltage Switches and Automatic Circuit Reclosers (ACRs). This encompasses all associated switchgear, instrumentation, and control components.

The primary function of MV switches and ACRs is to isolate sections of the network either for operational purposes or in response to fault events. MV switches may be pole- or ground-mounted, and use oil, SF6 gas, vacuum or air as the insulating and/or breaking medium.

ACRs and a small proportion of MV Switches known as Sectionalisers (a type of automated gas switch), are able to operate both autonomously, and manually via remote or local controls. These devices form the basis of distribution feeder automation (DFA) systems that minimise customer outages in case of network fault events. ACRs and Sectionalisers represent approximately 20% of the total population of MV switches and ACRs. Bushfire mitigation protection philosophies, including REFCL technologies, continues to drive replacement and the installation of new ACRs and Sectionalisers.

The majority of MV switches can only be operated locally (at the switch location) by trained staff as required to facilitate network operations. Proactive management will continue to be required to optimise 22kV network and reduce safety risk associated with certain type of gas switches. The subset of MV Switches considered critical to network operability and reliability are known as "key switches" and can change as the network evolves. As maintenance of pole-mounted switches is a labour-intensive activity, ad hoc and corrective maintenance of non-key switches, as required to facilitate safe and efficient network operations, is considered the most economic management approach.

1.1. New Assets

- Continue to design and install new and replacement assets in accordance with Standard Design Manual 4142
- ACR and sectionaliser control box configurations shall comply with current control configuration standards

1.2. Inspections and Monitoring

- Inspection to be completed as per the Asset Inspection Manual 4111-1, and compliance with the Energy Safe Victoria requirements and Electricity Safety (Bushfire Mitigation Regulations).

1.3. Maintenance

- Maintain MV Switches and ACRs as per the Asset Inspection Manual 4111-1 and SOP 70-03

1.4. Spares

- Continue to maintain adequate spares to ensure ongoing availability of key switches, as per the distribution critical spares strategy SOP 28-02
- Continue to salvage obsolete spares from replacement to ensure ongoing availability of MV switches, ACRs, Sectionalisers and their control boxes.

1.5. Replacement

- In accordance with the outcomes of asset inspections and individual feeder reliability reviews, selectively retire or replace air break switches
- Prioritise proactive replacement of poor and/or unsafe to operate key switches
- Continue to replace oil insulated ACR and gas insulated sectionalisers, prioritising the highest risk assets
- Continue to replace obsolete control box with current control configuration standard, prioritising the highest risk assets
- Replace failed or poor condition non-key switches only if required to facilitate network operations
- ACR and sectionaliser control box configurations shall comply with current control configuration standards

1.6. Research and Development

- Continue to trial, monitor and improve REFCL technologies on ACRs and Sectionaliser to maintain network reliability
- Continue to search the market for alternative manufacturers for ACRs and MV switch
- Establish guidelines for economic replacement of MV Switches and ACRs when other assets are being replaced.
- Investigate, develop and implement new modelling techniques to predict MV Switches and ACRs failures
- Investigate, develop and implement economic new life extension techniques for MV Switches and ACRs

2. Introduction

2.1. Purpose

The purpose of this document is to outline the inspection, maintenance, replacement and monitoring activities identified for economic life cycle management of MV Switches and ACRs in AusNet's Victorian electricity distribution network. This document is intended to be used to inform asset management decisions and communicate the basis for activities.

In addition, this document forms part of our Asset Management System for compliance with relevant standards and regulatory requirements. It is intended to demonstrate responsible asset management practices by outlining economically justified outcomes.

2.2. Scope

This Asset Management Strategy applied to all Pole-top MV Automatic Circuit Reclosers (ACRs) including all switchgear, instrumentation and control components, MV manual and automatic switches, including remotely controlled and automated sectionalisers and fuse Savers.

Excluded from this strategy is primary or secondary infrastructure located within zone substation boundaries, communications infrastructure beyond the installed switch location (AMS 20-81), Power Quality and Revenue Meters (AMS 20-15), pole infrastructure including the pole, conductors, insulators, cross-arms, transformers, fuses and other non-switching related equipment, SCADA systems, Non-Regulated assets, LV switching infrastructure including LV pillars, MV Fuse Switch Disconnectors (AMS 20-61).

2.3. Asset Management Objectives

The high-level asset management objectives are outlined in AMS 01-01 Asset Management System Overview.

The electricity distribution network objectives are stated in AMS 20-01 Electricity Distribution Network Asset Management Strategy.

3. Abbreviations and definitions

TERM	DEFINITION
ABS	Air-break switches
ACR	Automatic circuit reclosers
CoF	Cost of Failure
DFA	Distribution Feeder Automation
DNSP	Electricity Distribution Network Service Provider
EDDAM	Enhanced Data-Driven Asset Management
FLISR	Fault Location Isolation and Service Restoration
LoC	Likelihood of Consequence
MV	Medium Voltage
PoF	Probability of Failure
REFCL	Rapid Earth Fault Current Limiters
RTU	Remote terminal units
SCADA	Supervisory Control and Data Acquisition
SEF	Sensitive Earth Fault
SRC	Scheme Replacement Cost
SWER	Single Wire Earth Return
URC	Unit Replacement Cost
VUE	Value of unserved energy
ZA	Conditional Based Maintenance Notification
ZK	Fault Notification

4. Asset Description

4.1. Function

The electricity distribution network in eastern Victoria utilises various types of medium voltage (MV) switches to support network operations. The primary purpose of these switches is to isolate specific sections of the network for operational reasons or in the event of faults. MV switches may be mounted on poles or on the ground and use oil, SF6 gas, vacuum, or air as the insulating and/or interrupting medium. Certain MV switches possess the ability to break load and/or fault currents, while others can only be operated once the network has been de-energized.

Automatic Circuit Reclosers (ACRs) and a small percentage of MV Switches, referred to as sectionalisers (automated gas switches), are capable of operating both autonomously and manually through remote or local controls. The automatic and remote operation of these devices is supported by a control box installed at the switch locations. These devices are fundamental components of distribution feeder automation (DFA) systems, which are designed to reduce customer outages in the event of network faults.

The majority of Medium Voltage (MV) Switches are designed for manual operation. They are operated on-site by trained personnel as necessary to support network operations.

A specific subset of MV Switches and Automatic Circuit Reclosers (ACRs) is classified as critical to network switching needs, referred to as "key switches." Switches deemed necessary for operational purposes but not critical to network switching are categorized as "auxiliary switches." Additionally, some switches are identified as surplus to network switching requirements and are termed "redundant switches." It is important to note that the classification of a switch location as "key," "auxiliary," or "redundant" may change as the network evolves.

4.2. Population

4.2.1. Population Considerations

The population profile for MV Switches is crucial for effective lifecycle management. This profile includes detailed data on the quantity, types, locations, and specifications of these assets within the electrical distribution network.

A comprehensive understanding of the population profile allows asset managers to:

- **Identify critical assets**: Determine which MV switches are essential for maintaining the integrity and reliability of the network. For example, an Automatic Circuit Recloser (ACR) on a key feeder serving a critical industrial area might be deemed essential and require more frequent inspections to ensure uninterrupted service.
- **Allocate resources efficiently**: Plan and allocate maintenance resources effectively by knowing the exact number and location of assets. For instance, knowing that a certain region has a high concentration of gas-insulated sectionalises can help in scheduling maintenance activities more efficiently
- **Risk management:** Assess and manage risks associated with different assets. For example, if the population profile indicates that certain sections of pole-mounted air break switches are in bushfire-prone areas, additional protective measures can be implemented in those areas.
- **Optimise maintenance schedules**: Develop optimised maintenance schedules based on the distribution and condition of assets. For instance, ground-mounted switches in underground distribution networks might be scheduled for more frequent inspections and maintenance to prevent any potential failures.
- **Enhance reliability and safety**: Ensure that all components, including ACRs, manual gas switches, and Fuse Savers, meet the required standards for reliability and safety. For example, if the profile reveals that certain gas-insulated switches have outdated control modules that no longer meet safety standards, these can be prioritised for replacement.
- **Support strategic planning**: Inform long-term strategic planning and investment decisions. For instance, the population profile might show that a significant portion of MV switches in a rapidly developing suburban area need upgrading to support increased demand, guiding future investment in that region.

4.2.2. Geographic Impact Areas

The AusNet's electrical distribution network covers a significant portion of Victoria, including Melbourne's northern and eastern suburbs, and extends across eastern and north-eastern Victoria. This region encompasses a diverse range of geographic locations, each with specific environmental impacts on MV switches. Understanding these impacts is essential for effective asset management within the AusNet's electrical distribution network.

Notable examples include:

- **High Wind Areas**: High wind areas, particularly in elevated regions and open plains, subject MV switches to significant stress and fatigue. Example: The structural integrity of pole-mounted air break switches in the elevated regions of the Dandenong Ranges must be robust enough to withstand high wind speeds, ensuring they remain securely in place and do not fail under stress.
- **Corrosive Areas**: Coastal areas and industrial regions where salt and pollutants are prevalent can cause corrosion of metallic components in MV switches. Example: Regular maintenance and the use of corrosion-resistant materials are crucial to prolong the lifespan of these switches. MV switches in coastal towns like Wonthaggi require regular inspections and maintenance to mitigate the effects of salt-induced corrosion.
- **Bushfire Areas**: Bushfire-prone areas, common in many parts of Victoria, pose a risk of fire damage to MV switch infrastructure. Example: Fire-resistant materials and strategic vegetation management around switch installations are essential for reducing this risk. In the bushfire-prone regions of the Yarra Valley, MV switches must be designed to withstand high temperatures, and installations must be cleared of nearby vegetation to prevent fire spread.
- **Flood-Prone Areas**: Areas prone to flooding can impact the performance and integrity of MV switches, especially those that are ground-mounted. Example: Proper waterproofing and drainage systems are essential to protect these assets. In regions like Gippsland, where flooding is more frequent, ground-mounted MV switches must be installed with robust waterproofing measures to prevent water ingress and subsequent failures.
- **Seismic Zones**: Though less common, areas with potential seismic activity may require MV switches to be constructed with flexibility and resilience to absorb and dissipate seismic forces, reducing the risk of structural failure. Example: In areas near fault lines, MV switches may need to incorporate seismic-resistant features to ensure stability during earth tremors.

4.2.3. Population by Type

Automatic Circuit Reclosers (ACRs)

- **Form**: Automatic Circuit Reclosers (ACRs) are pole-mounted or ground-mounted devices designed to automatically interrupt and reclose a circuit. They are equipped with switchgear, instrumentation, and control components.
- **Function**: ACRs are used to detect and interrupt fault currents and automatically restore power after temporary faults, reducing the duration of outages.
- **Purpose within Asset Class**: ACRs provide protection, control and instrumentation on distribution feeders and enhance the reliability and operational efficiency of the MV switch asset class by providing automated fault detection and isolation capabilities, enabling rapid reconfiguration of the network in response to faults.
- **Purpose within Network Design**: ACRs play a critical role in the design of an electrical distribution network by providing feeder protection, maintaining continuity of supply and minimising the impact of transient faults. They are the main component in distributed feeder automation (DFA) systems to improve network resilience.
- **Process Function**: ACRs continuously monitor the current in the circuit and, upon detecting a fault, open to interrupt the fault current, they automatically reclose to restore power if the fault is temporary. If the fault persists, they lock out to prevent further damage.

Pole Mounted Air Break Switches (ABS)

- **Form**: Pole Mounted Air Break Switches (ABS) are mechanical switches mounted on poles, using air as the insulating medium. They are manually operated to interrupt or reroute power flow in overhead lines.
- **Function**: ABS are used to isolate sections of the network for maintenance.
- **Purpose within Asset Class**: In network design ABS provide a cost-effective solution for manual switching operations within the MV switch asset class. They are essential for network segmentation and isolation during maintenance and emergency operations.

- **Purpose within Network Design**: In network design, ABS are strategically placed to allow for the manual isolation of sections of the distribution network. This facilitates maintenance activities and fault management, especially in less critical or remote areas.
- **Process Function**: ABS are manually operated by field personnel to open or close the circuit. This process involves the physical movement of switch components to interrupt or resume the flow of electricity.
- **Historical Application**: Historically, ABS were widely used due to their simplicity and reliability. However, their use has decreased with the introduction of more advanced and automated switch types, although they remain in service in many parts of the network.

Gas Insulated Switches

- **Form**: Gas Insulated Switches use SF6 gas as the insulating medium. They come in two types: manual gas switches and remotely controlled or automated gas switches (sectionalisers).
- **Function**: These switches provide high insulation and arc-quenching capabilities, making them suitable for use in environments where space is limited, or high reliability is required.
- **Purpose within Asset Class**: Gas insulated switches contribute to the asset class by offering enhanced performance and reliability compared to traditional air break switches. They are critical for modernisation efforts within the MV switch population.
- **Purpose within Network Design**: These switches are integral to the design of compact and reliable switching. They are often used in distribution feeder automation systems to enable rapid fault isolation and network reconfiguration.
- **Process Function**: Manual gas switches are operated by field personnel, while automated gas switches can be operated remotely. The gas medium provides superior insulation and arc-quenching properties, ensuring safe and efficient switching operations.
- **Historical Application**: Initially introduced to replace older air break switches, gas insulated switches have become the standard for new installations due to their compact size and high performance. Their use has increased significantly in the past decade.

Ground Mounted Switches

- **Form**: Ground Mounted Switches are typically installed in indoor or kiosk substations. They use various insulating media, including SF6 gas, air, and oil.
- **Function**: These switches manage the connection and disconnection of underground cables and provide a connection point between overhead and underground network sections.
- **Purpose within Asset Class**: Ground mounted switches are essential for the safe and efficient operation of underground distribution networks. They support the MV switch asset class by enabling reliable switching operations in confined spaces.
- **Purpose within Network Design**: In network design, ground mounted switches are used to facilitate the transition between overhead and underground networks. They provide flexibility in network configuration and enhance the reliability of underground cable systems.
- **Process Function**: These switches can handle load currents and are used to switch and isolate underground cables. They are typically operated locally or remotely, depending on the specific design and installation requirements.
- **Historical Application**: Ground mounted switches have evolved from bulk-oil and air break types to modern SF6 gas insulated units. Their application has expanded with the growth of underground distribution networks and the need for more compact and reliable switchgear.

Fuse Savers

- **Form**: Fuse Savers are self-powered, electronically controlled devices designed to work in conjunction with fuses to protect lateral or spur lines from faults.
- **Function**: They detect and interrupt faults faster than traditional fuses, preventing unnecessary fuse operations and improving service continuity.
- **Purpose within Asset Class**: Fuse Savers enhance the performance of the MV switch asset class by providing quick and effective fault interruption, reducing the impact of transient faults on the network.

- **Purpose within Network Design**: In network design, Fuse Savers are mainly used to protect spur lines and laterals, reducing the frequency of fuse replacements and improving overall network reliability.
- **Process Function**: These devices detect faults and interrupt the circuit before the fuse operates. This process helps maintain continuity of service and reduces the need for manual fuse replacement.
- **Historical Application**: Fuse Savers have been introduced relatively recently and are used sparingly across the network. Their application is expected to increase as the technology proves its effectiveness in reducing service interruptions and maintenance costs.

4.2.4. Population Profile

MV Switches and automatic circuit reclosers (ACRs) are considered (distribution) line assets. They are installed on 6.6 and 22kV (MV) feeders, usually as pole top devices but also as part of indoor, ground mounted or kiosk substations.

For strategic purposes, MV Switches and ACRs may be separated into operational types: ACRs, air break switches, gas switches (including manual gas switches and automatic sectionalisers), indoor or ground mounted switches and Fuse Savers. Each of the operational types represent distinct operational technologies and constructions, display different functions, performance characteristics and risk profiles, and as a result incur slightly different management strategies. Figure 1 provides an overview of the in-service population, separated into operational types.

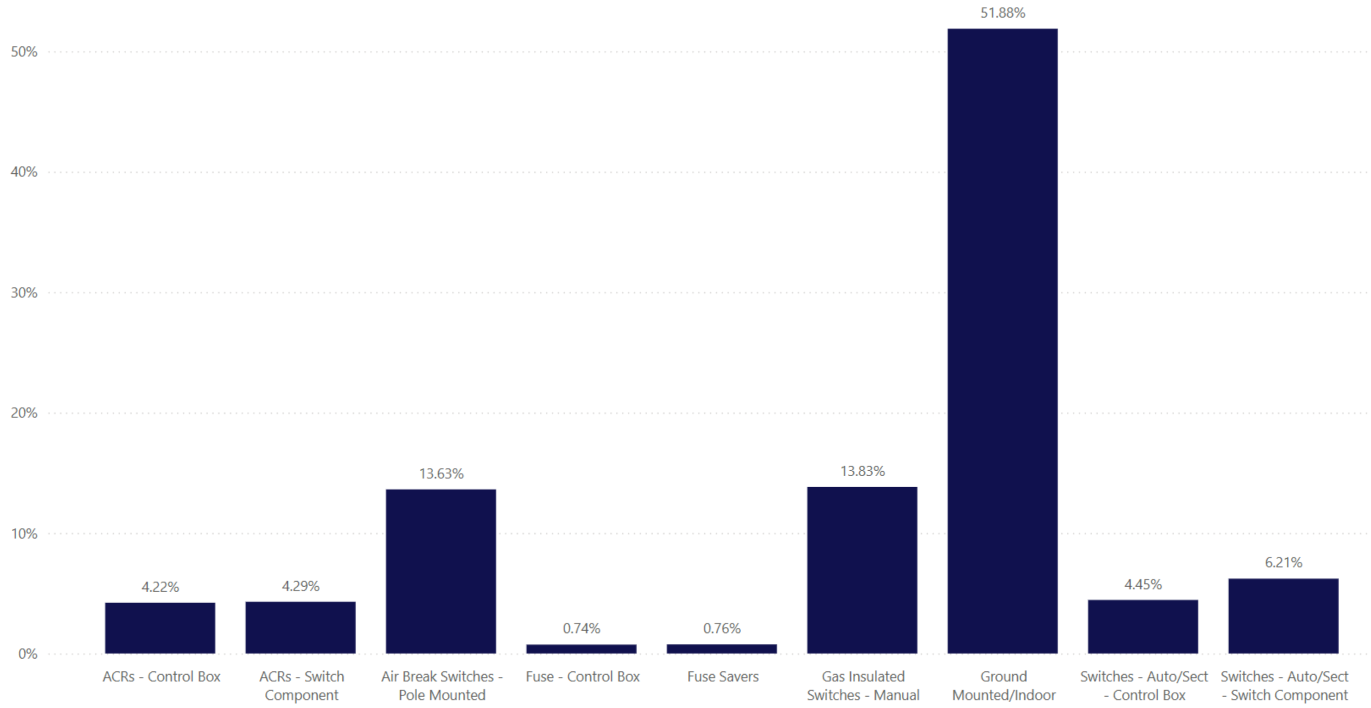

Figure 1 MV Switches by Category

ACRs account for 4.3% (approximately 1596) of the listed assets. ACR and sectionaliser control boxes are account for 8.7% (almost 2909) of the listed assets.

ABS is approximately 13.6% of the list asset and continue to reduce as they are no longer installed and replaced with newer technology switches as network evolved.

Gas switches (manual and automatic) is approximately 20% of the list asset and expected increasing as they are replacement choice of ABS for the next few years until alternative insulated medium is viable to reduce the effect of SF6 in current gas switches.

Ground mounted and indoor switches currently represent 51.9% of MV switches in service throughout the AusNet Services distribution network. More than 90% of these switches are SF6 gas insulated RM6 units and continue to increase in the next few years similar to gas switch.

4.3. Age

4.3.1. Age Considerations

An in-depth understanding of the age profile of MV switches is crucial for effective asset management and lifecycle planning. Knowing the age distribution of these assets helps in predicting their remaining useful life and planning maintenance, upgrades, or replacements accordingly.

- **Automatic Circuit Reclosers (ACRs):** As ACRs age, they may experience issues related to the wear and tear of mechanical components and degradation of control systems. Older ACRs, particularly those over 20 years old, may require more frequent inspections and potential upgrades. For instance, updating the control units of older ACRs can enhance fault detection and isolation capabilities, ensuring they remain reliable in the face of increasing network demands.
- **Pole Mounted Air Break Switches (ABS)**: ABS, with an average service age of 28 years, often suffer from mechanical wear and insulation degradation as they age. This can lead to increased risk of mechanical failures and operational inefficiencies. Replacing older ABS with gas insulated switches, which offer superior performance and reliability, can significantly improve network resilience. For example, an older ABS in a high-wind area might be replaced pre-emptively to prevent mechanical failure during storms.
- **Gas Insulated Switches**: Gas insulated switches, typically younger and installed within the last 12 years, are less prone to immediate age-related issues. However, over time, the SF6 gas used for insulation may require monitoring for leaks, and the control modules might need updates or replacements. Regular maintenance ensures continued high performance. For instance, periodic checks and maintenance of the SF6 gas insulation can prevent leaks and maintain switch efficiency.
- **Ground Mounted Switches**: These switches, mostly under 15 years old, are generally in good condition. However, as they age, the gas insulation system, especially SF6, may need careful monitoring to prevent leaks and ensure efficient operation. Proactive maintenance, such as inspecting the gas levels and integrity of the insulation system, is essential. For example, a 12-year-old ground-mounted switch might be scheduled for a detailed inspection to ensure its SF6 levels are optimal.
- **Fuse Savers**: Fuse Savers, with an average service age of 6 years, are relatively new but still require regular performance assessments to ensure their fault detection capabilities remain effective. Over time, electronic components may degrade, necessitating updates or replacements to maintain their functionality. For example, routine testing of Fuse Savers in areas prone to transient faults can ensure they continue to protect the network effectively.

4.3.2. Age Profile

MV switches and automatic circuit reclosers (ACRs) are classified as distribution line assets. They are typically installed on 6.6kV and 22kV (MV) feeders, primarily as pole-mounted devices, but can also be integrated into indoor, ground-mounted, or kiosk substations. Figure 2 and Figure 3 show the age profile of MV switch asset class and control boxe.

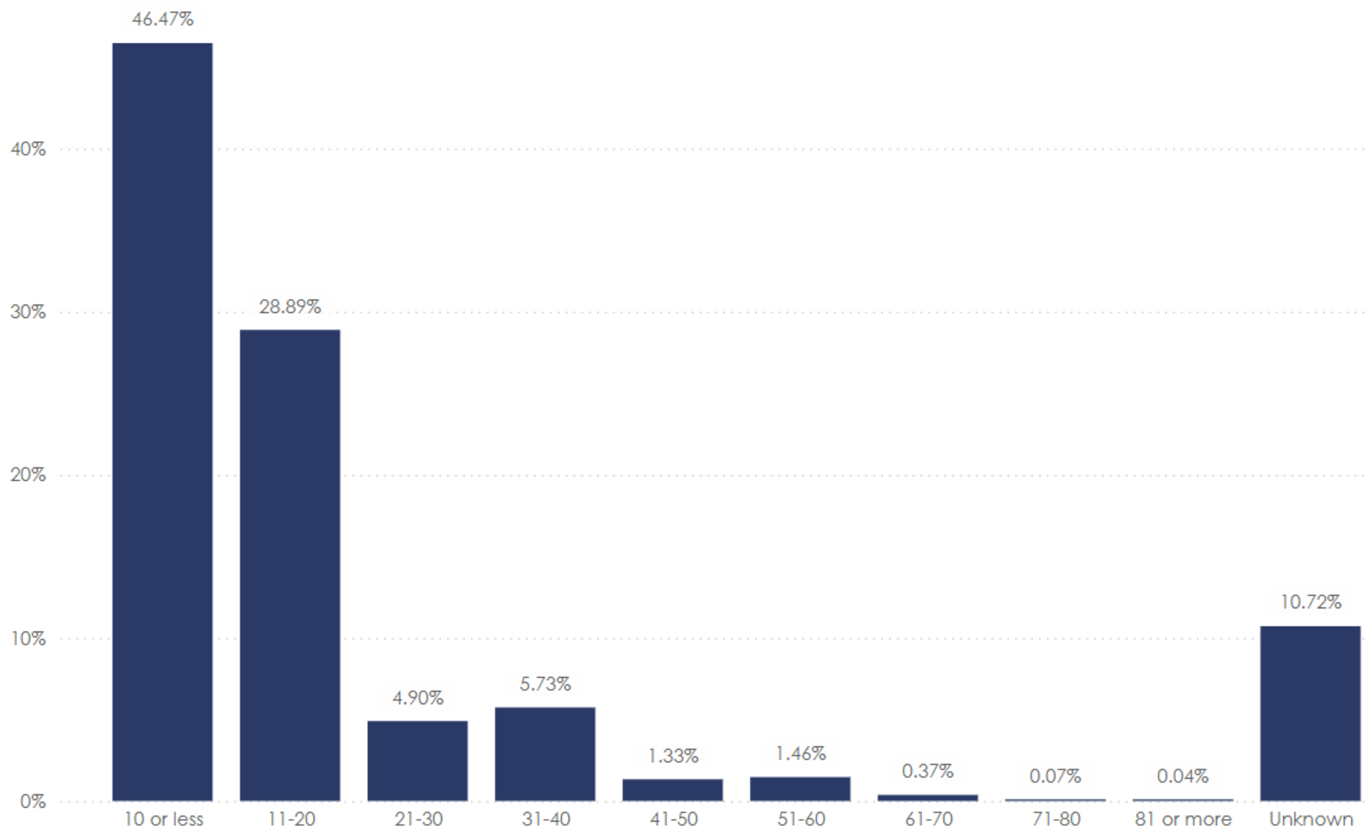

Figure 2 MV Switch Service Age Profile

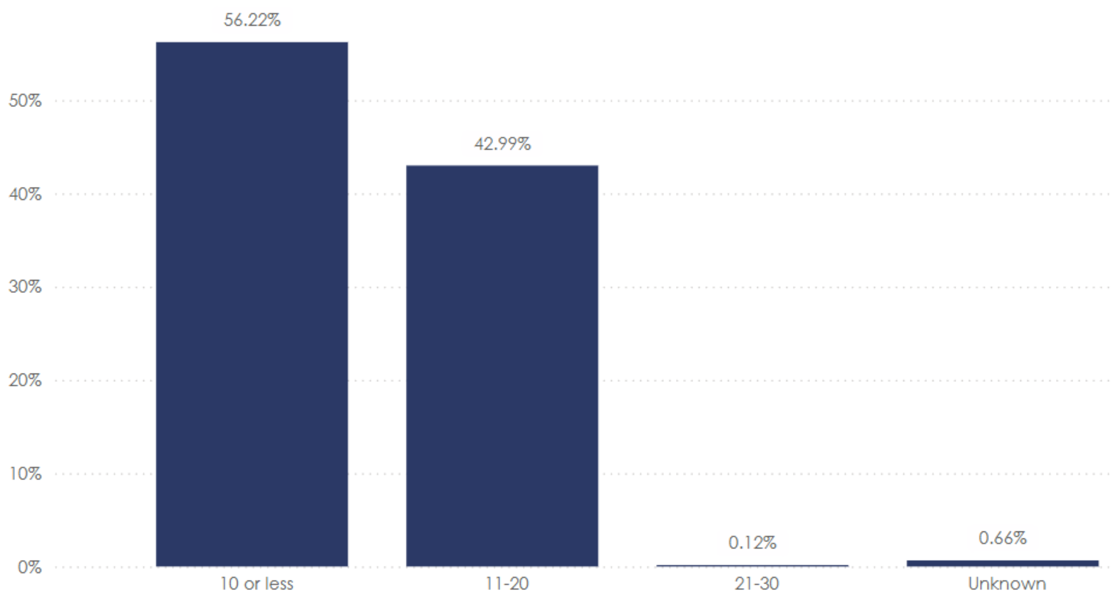

Figure 3 Control Box Service Age Profile

4.3.2.1. Automatic Circuit Reclosers (ACRs)

ACRs are installed on both three-phase feeder backbones and single wire earth return (SWER) circuits perform protection and switching operations for the distributed feeder automation (DFA) system. These devices enhance remote operation and reconfigurability of the network, with the additional capability of automatic fault detection and isolation. When combined with automated sectionalisers, ACRs enable rapid and automated network reconfiguration in response to faults, thereby minimizing the duration of supply outages.

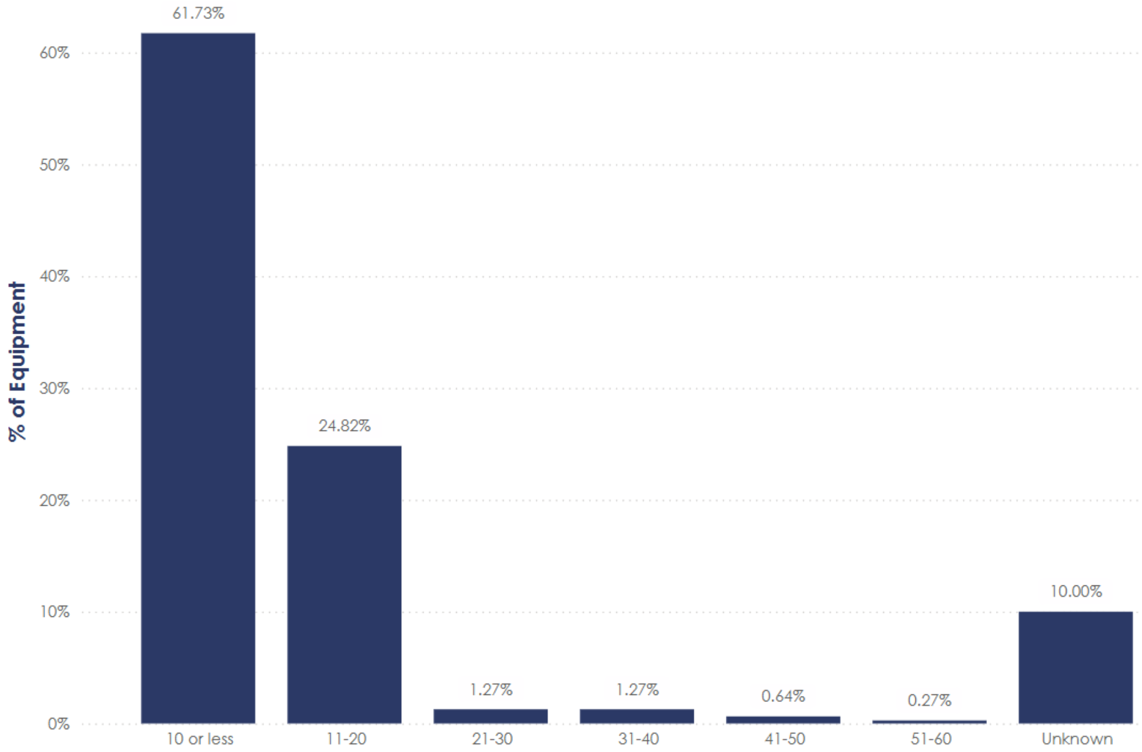

Figure 4 Recloser Switch Age Profile

The ACR control boxes can be replaced or managed independently of the primary switch components; however, it is important to ensure compatibility between the control unit and the primary equipment. More advanced control functions, such as those utilized in conjunction with REFCL technologies for fault isolation, require that the switch component be equipped with corresponding, calibrated current transformers (CTs) to implement higher-resolution sensitive earth fault (SEF) protection compared to traditional methods. Consequently, there is a strong correlation between the age profiles of ACR control boxes and switch components.

In the past decade, a significant number of three-phase ACRs have been installed or replaced as part of DFA systems. The implementation of improved bushfire mitigation protection strategies, including the adoption of REFCL technologies, continues to drive the bulk upgrade, replacement, and installation of new units. The ACR control box age profile is presented in figure 2.

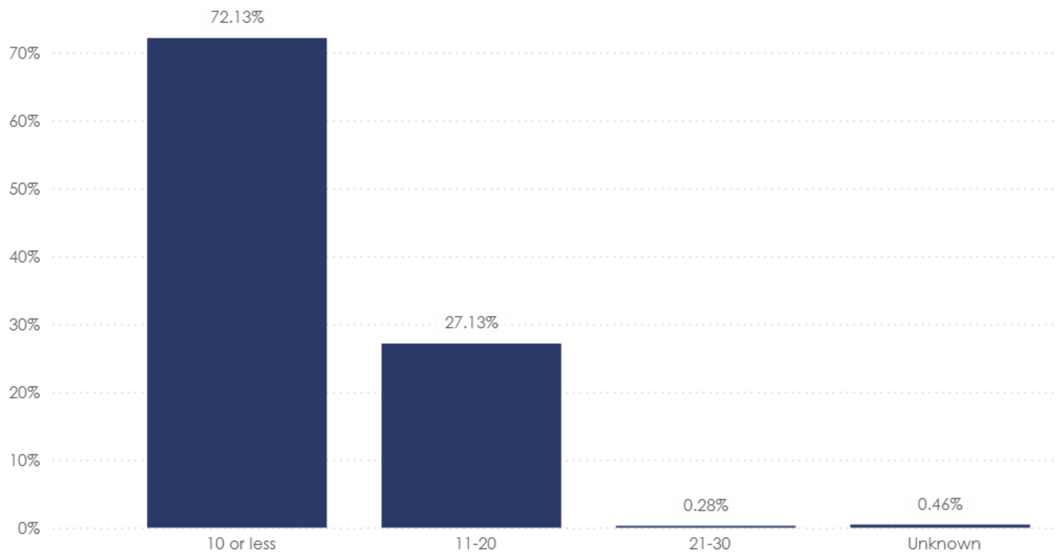

Figure 5 ACR Control Box Age Profile

4.3.2.2. Pole Mounted Air Break Switches (ABS)

Air-break switches (ABS) are used on the overhead distribution network to provide manual switching functionality. These types of switch use air as the insulating medium and, with an average service age of 28 years, are one of the oldest in-service switch types.

Currently, pole-mounted air break switches, including isolators, represent 10% of the medium voltage switch inventory. However, the overall number of air break switches is declining due to ongoing replacement initiatives. A minimal percentage of these switches are classified as key switches. As new installations of air break switches have ceased, and with the exception of key switches, they are not subject to active maintenance or operation. Instead, gas switches are routinely replacing them as necessary to support network operations.

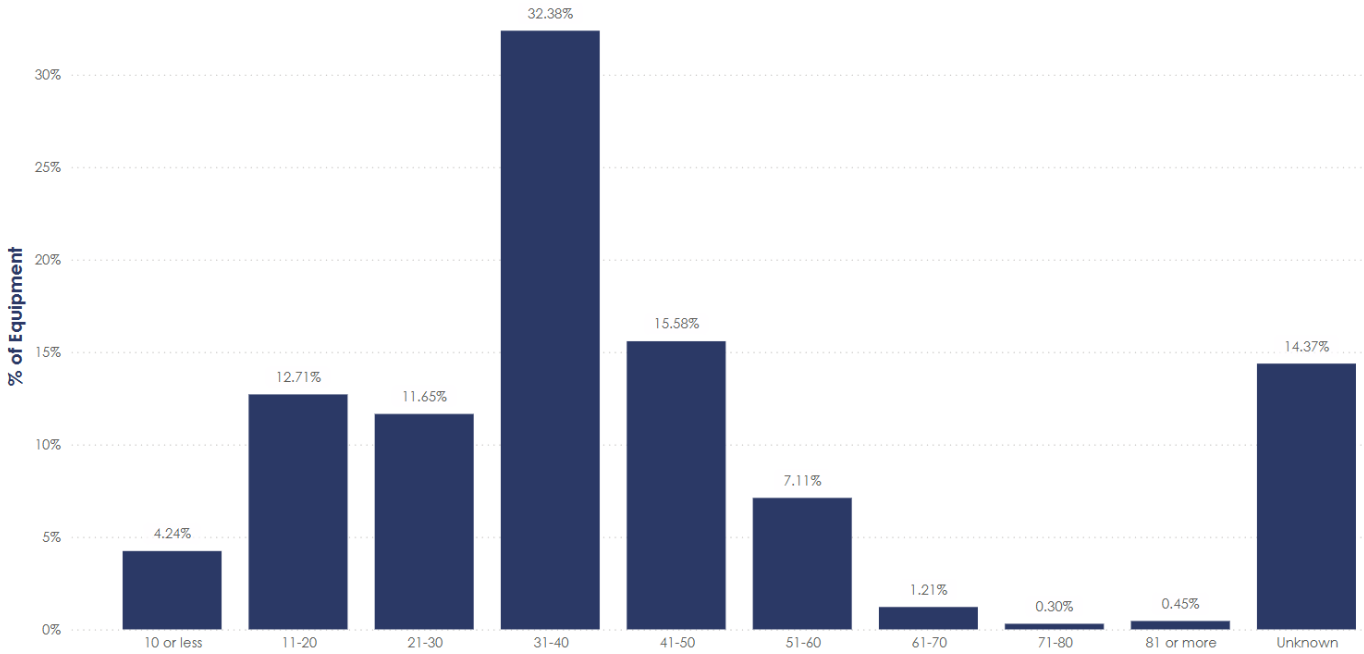

Figure 6 Pole Mounted Air Break Switch Age Profile

4.3.2.3. Gas Insulated Switches

There are two (2) types of gas-insulated switches currently in service: manual gas switches, and remotely controlled or automated gas switches (also referred to as sectionalisers). Both manual and remotely controlled or automatic gas switches use SF6 as the insulating medium. The only difference between the two types is that remotely controlled gas switches and sectionalisers are equipped with an auxiliary control box to facilitate automatic and remotely controlled operation. The only difference between sectionalisers and remotely controlled gas switches is the complexity of the applied controller settings.

Gas switches are relatively young compared to other switch types. Although the first generation of gas switches were installed in 1994, the majority of switches currently in service have been in operation for less than 20 years. Significant volume of gas-insulated switches have been installed to facilitate distribution feeder automation.

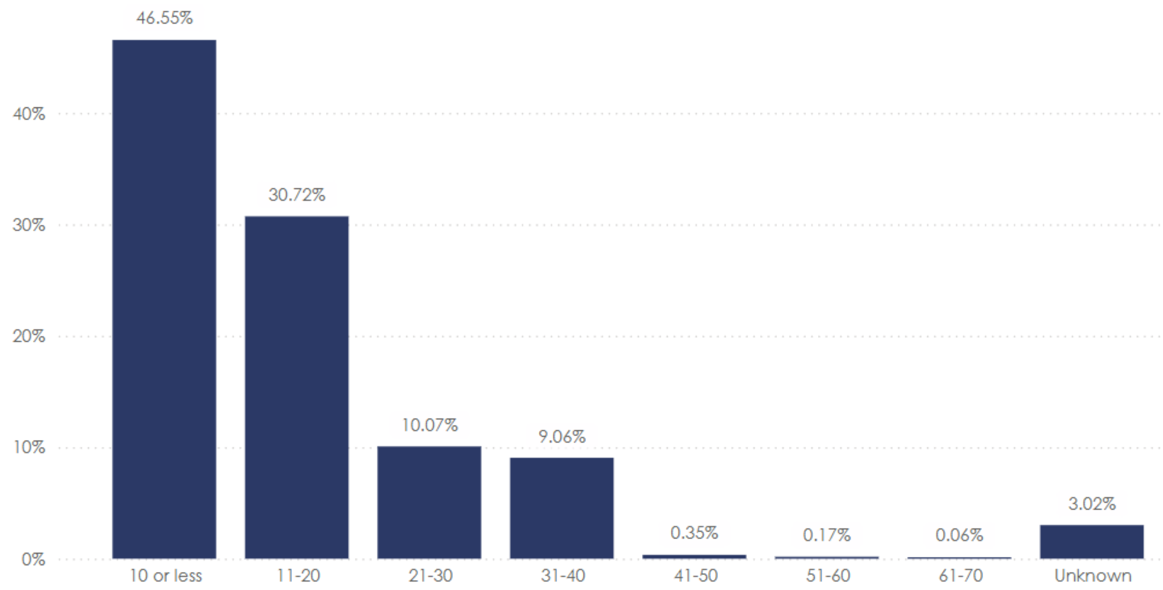

Figure 7 Gas Switch Age Profile

Manual gas switches account for almost 15% of the MV switch population. The proportion of manual gas switches will continue to increase as aging switches are replaced.

Sectionalisers, in conjunction with ACRs, are used to rapidly reconfigure the network in case of fault to restore supply to customers. They are designed to operate in the “dead time” between fault and subsequent reclose operations. The sectionaliser counts the number of attempted recloses upon the circuit and will “lock out” (i.e. isolate the downstream network) once the ACR has attempted a designated number of reclose operations. This allows for the safe re-energisation of the upstream network pending line works to clear the downstream fault.

All gas sectionalisers currently in service consist of two components: a standard, gas-insulated MV switch and a control module supplied. The control module, as an electronic component, has a significantly reduced service life expectation compared to the switch component. The control module may be replaced independent of the primary switch, however compatibility of the control unit and primary equipment does need to be considered. The 71% of control boxes older than 10 years.

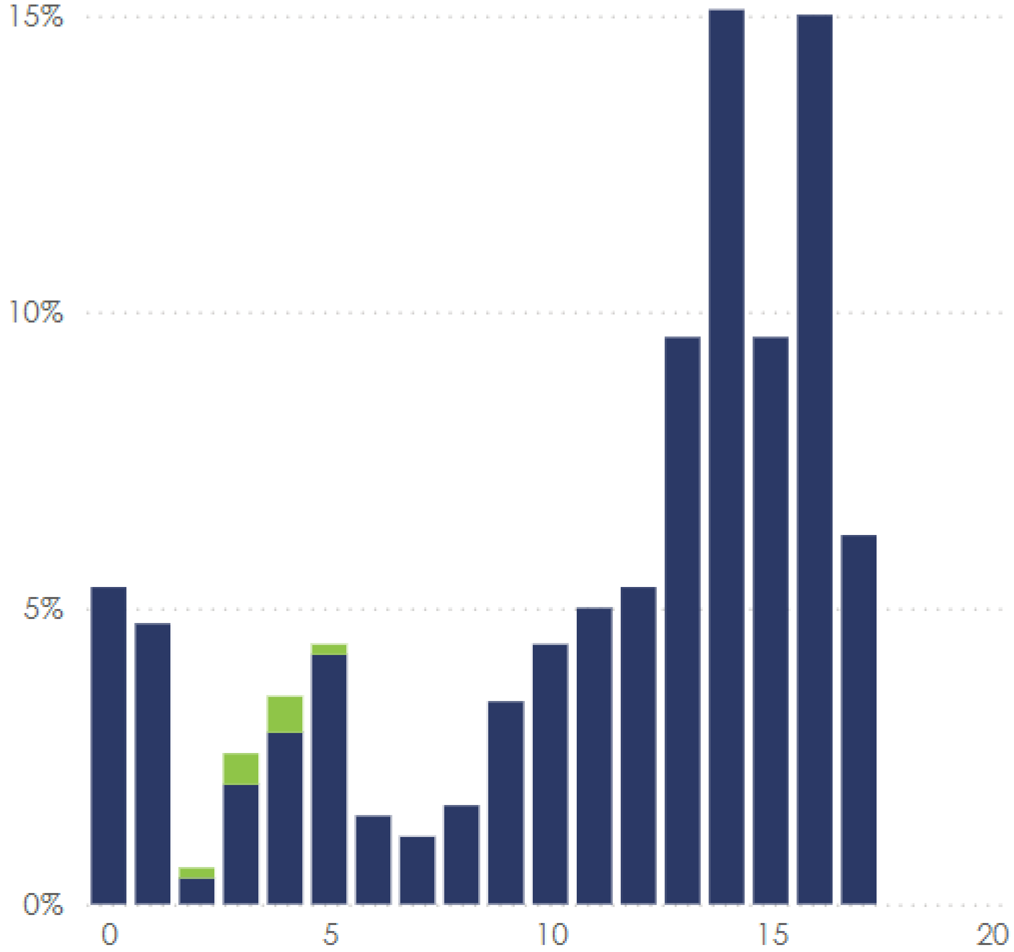

Figure 8 Sectionaliser Control Box Age Profile

Remotely controllable gas switches are mostly installed on network open points. They have local and remote open/close functionality, which represents a step up from manual gas switches, but do not use the same complex logic implemented on gas sectionaliser.

4.3.2.4. Ground Mounted Switches

Ground mounted and indoor switches currently represent just over 50% of MV switches in service throughout the AusNet's distribution network. Typically located within indoor or kiosk substations, they are used both to switch the underground cable network, and as a connection point between underground and overhead network sections.

The majority of these switches are installed in "ring-main" and "interconnector" configurations with the capability of making and breaking load currents on the underground distribution network.

More than 90% of these switches are SF6 gas insulated RM6 units, The remainder are a mix of air break and gas insulated from several different manufacturers including [CIC]

The majority of ground-mounted switches currently in service are less than 20 years old.

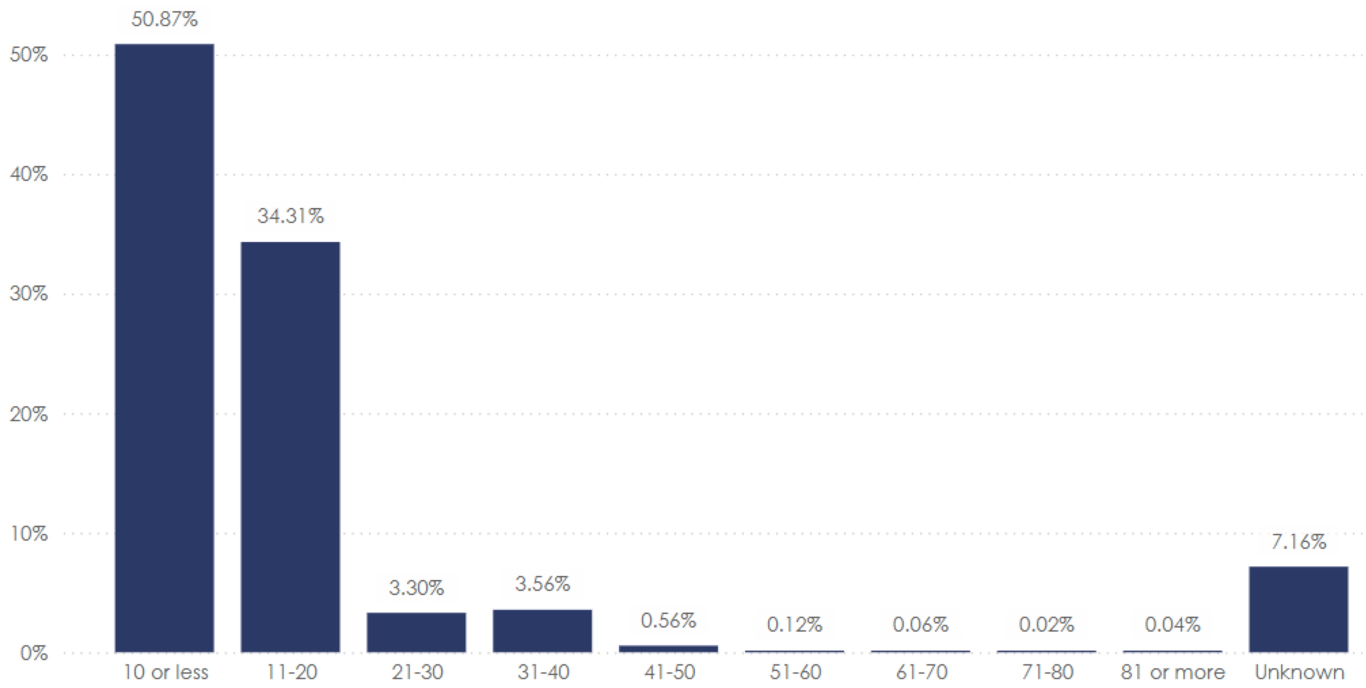

Figure 9: Ground mount/indoor switch age profile

4.3.2.5. Fuse Savers

A fuse saver is a self-powered, electronically controlled, single-phase fault-interrupting device that works in partnership with a fuse to protection a lateral or spur line from both transient and permanent faults. The fuse saver is capable of detecting, opening and clearing a fault in less time than it takes a fuse to melt. Fuse Savers are used sparingly on the distribution network, representing less than 1% of the MV switch population, and have an in service age of less than 10 years.

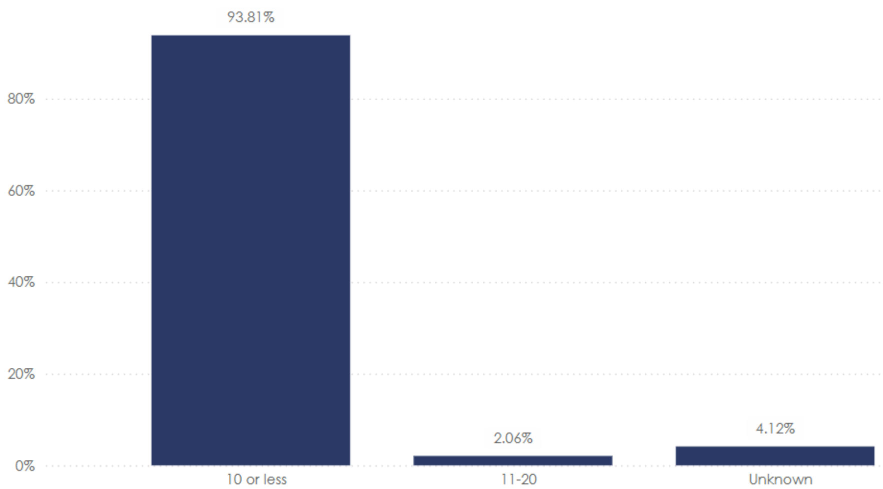

Figure 10 Fuse saver age profile

5. Asset Risk

AusNet maintains a risk management system designed in accordance with AS ISO 31000 Risk Management – Guidelines to ensure risks are effectively managed to provide greater certainty for the owners, employees, customers, suppliers, and the communities in which we operate.

The risk of each asset is calculated as the multiplication of probably of failure (PoF) of the asset and the consequence of failure (CoF). The risk is then extrapolated into the future accounting for forecast changes in PoF and CoF.

In the distribution network, AusNet aims to maintain risk. Risk treatments required to achieve this over time include replacement, refurbishment, and maintenance activities, and are developed based on current risk and extrapolated risk.

The overall approach to quantified asset risk management is detailed in AMS -01-09. Section 5.1, 5.2 and 5.3 of this document describe the considerations and methodologies to determine PoF, Cof, and risk treatments that are unique to MV Switches and ACRs.

5.1. Probability of Failure

Refer to AMS 01-09Asset Risk Assessment Overview, section 2.3.2.24 for probability of failure methodology. The analysis of each asset should include four categories: asset service life, asset utilisation/duty factor, location, and the measured or observed physical condition of the asset. However, MV switch probability of failure is only based on asset service life.

5.1.1. Failure Modes

Understanding failure modes is an important tool that supports measuring the criticality of assets, especially when assessing the risk of potential failures and their potential impact on the overall system. By identifying and analysing the various ways in which an asset can fail (including the root causes and mechanisms of failure), asset managers can better predict and mitigate risks. This understanding allows for a more accurate assessment of the probability of failure (PoF) and the consequence of failure (CoF), which, as noted above, is a core aspect of how AusNet approaches determining asset criticality.

General Failure Modes Common to MV Switches

- **Lightning Damage**: This refers to the impact of a direct lightning strike or transient over-voltage that exceeds the specified Lightning Withstand Impulse level of the insulation in (normally open) switches. For instance, a direct lightning strike may compromise the insulation of pole-mounted switches, resulting in operational failure.
- **Birds and Animals**: Initiation of arcing faults between or across MV bushings or connections resulting in thermal insulation damage. Example: Birds or animals bridging connections can cause arcing faults, damaging the insulation of the switchgear.
- **Vandalism**: Unauthorised operation or wilful damage by thrown projectiles or rifle fire. Example: Vandalism can result in physical damage to switches, impairing their functionality.
- **Mechanical Damage**: Impact of falling vegetation or motor vehicles can damage the switchgear. Example: A switchgear damaged by a fallen tree may require immediate replacement to restore functionality.
- **Low Insulating Gas**: Leakage of insulating gas (SF6) can reduce insulation effectiveness. Example: Leaking SF6 gas can compromise the insulating properties of gas switches, leading to electrical faults.
- **Environmental Degradation**: Rust or corrosion of switch components is a common age-related determinant of the end of economic life for pole-mounted switchgear. The rate of corrosion is dependent upon the location of the asset and is particularly problematic in coastal environments due to airborne salt spray, areas with increased atmospheric pollution such as the Latrobe Valley, where coal dust is a contributing factor, and in agricultural areas with high concentrations of fertiliser dust.
- **Corrosion in Coastal Areas**: Corrosion is accelerated by salt spray in coastal regions, compromising the structural integrity of switchgear. Example: Pole-mounted switches in coastal areas may require more frequent maintenance or replacement due to accelerated corrosion.

- **Corrosion in Polluted Areas**: Areas with high pollution levels, such as the Latrobe Valley, experience increased corrosion due to coal dust and other pollutants. Example: Switchgear in industrial areas may need additional protective measures to mitigate the effects of atmospheric pollution.
- **Fire Risk Management**: The potential for asset failure leading to fire start is analysed with reference to the number of fire starts that have occurred across all assets. The significant change in fire ignitions recorded since have been attributed to the replacement of oil-filled ACRs and ABS replaced under bushfire mitigation programs.
- **Fire Mitigation Measures**: Proactive replacement of high-risk components and ongoing bushfire mitigation programs have significantly reduced fire incidents. Example: Replacing oil-filled circuit breakers with more modern switchgear has helped reduce the risk of fire ignitions.

Failure Modes by Asset Class and Types

Automatic Circuit Reclosers (ACRs)

- **Control System Failure**: The control box, which is essential for automated operation, can fail or mal-operate due to software errors, hardware faults, or communication issues. Example: An ACR control box may fail to send the correct signal to operate the switch, leading to unplanned outages.
- **Mechanical Wear**: Frequent operations under fast operated curve and high overcurrent fault can cause wear on moving parts such as the arcing contacts and mechanisms, reducing reliability. Example: Continuous opening and closing of ACRs under fast operated curves and high overcurrent fault areas can lead to mechanical fatigue.
- **Environmental Degradation**: Exposure to harsh environmental conditions, such as salt spray or high humidity, can corrode components. Example: ACRs installed in coastal regions may suffer from accelerated corrosion, affecting their operational integrity.
- **Electronic Component Failure**: Failure of the electronic components such as the trip or close coil, controller electronic device, or low voltage supply/battery failures in the controller can prevent the ACR from operating in response to protection commands. Example: The controller may fail to actuate due to a software glitch or battery failure, leading to a non-responsive ACR during fault conditions and/or restoration.
- **Animal Damage**: Birds chewing on polymeric bushings can necessitate bushing replacement. Example: Polymeric bushings on ACRs may be damaged by birds, necessitating the installation of bushing covers to prevent future damage.

Pole Mounted Air Break Switches (ABS)

- **Mechanical Damage**: The air break switch and its components can be damaged by physical forces or corrosion, leading to operational failures. Example: A pole mounted ABS in a high-wind area may experience physical damage that impairs its switching capability.
- **Contact Degradation**: Over time, the contacts can degrade due to electrical arcing and mechanical wear. Example: Frequent manual operation of ABS can lead to wear on the contacts, resulting in poor electrical performance.
- **Environmental Exposure**: Exposure to pollutants and weather conditions can accelerate the degradation of the insulating components. Example: ABS units in industrial areas may suffer from accelerated degradation due to pollution.
- **Arc Chute and Flicker Blade Issues**: Cracked or mis-aligned arc chutes and flicker blades, bent pick-up and reset brackets or drive shafts, and burnt main contacts are common failure modes. Example: Mis-aligned arc chutes can cause improper arc extinguishing, leading to switchgear failure.
- **Insulator Damage**: Cracked or broken insulators can compromise the switch's insulating properties. Example: Damaged insulators may lead to electrical tracking or flashover, causing outages.
- **Gas Insulated Switches Gas Leakage**: SF6 gas, used as an insulating medium, can leak over time, reducing the insulating properties and leading to failures. Example: A gas insulated switch with a slow SF6 leak may eventually fail to insulate properly, causing electrical faults.
- **Moisture Ingress**: Water or moisture can penetrate the switch housing, leading to corrosion and insulation breakdown. Example: In high humidity areas, moisture ingress can corrode the internal components of gas switches.
- **Control Module Failure**: The electronic control modules can fail due to hardware or software issues. Example: A remotely controlled gas switch may fail to operate if its control module malfunctions.

- **Corrosion of Sealing Flanges**: Corrosion by-products can cause sealing flanges to jack apart, leading to SF6 gas leakage. Example: Corrosion-induced leakage necessitates corrective gas switch assembly replacements to maintain SF6 levels below 1% per annum.

Gas Switches

- **Gas Insulated Switches Gas Leakage**: SF6 gas, used as an insulating medium, can leak over time, reducing the insulating properties and leading to failures. Example: A gas insulated switch with a slow SF6 leak may eventually fail to insulate properly, causing electrical faults.
- **Moisture Ingress**: Water or moisture can penetrate the switch housing, leading to corrosion and insulation breakdown. Example: In high humidity areas, moisture ingress can corrode the internal components of gas switches.
- **Control Module Failure**: The electronic control modules can fail due to hardware or software issues. Example: A remotely controlled gas switch may fail to operate or operate incorrectly if its control module malfunctions.
- **Corrosion of Sealing Flanges**: Corrosion by-products can cause sealing flanges to jack apart, leading to SF6 gas leakage. Example: Corrosion-induced leakage necessitates corrective gas switch assembly replacements to maintain SF6 levels below 1% per annum.

Ground Mounted Switches

- **Insulation Breakdown**: The insulation material can degrade over time due to thermal aging and environmental exposure. Example: Ground mounted switches in underground substations may experience insulation breakdown due to prolonged thermal stress.
- **Mechanical Wear**: Components such as springs and contact mechanisms can suffer from wear and fatigue. Example: Regular switching operations can cause mechanical wear in ground mounted switches.
- **Environmental Factors**: Exposure to moisture and pollutants can lead to corrosion of metal components. Example: Ground mounted switches in damp environments may suffer from accelerated corrosion.

Fuse Savers

- **Component [Removed]**: Reduced capacity of non-rechargeable battery can cause spurious or non-tripping
- **Moisture Ingress**: Water or moisture can enter the fuse unit, leading to corrosion and degradation of internal components. Example: Fuse Savers installed in high humidity areas may experience moisture ingress, compromising their reliability.
- **Control System Failure**: The control box communication, where it is installed as part of Fuse saver can fail due to line of sight or weather condition. Example: Fuse saver unit can fail to command Fuse saver to switch to Bush Fire Setting during summer period.

5.1.2. Probability of Failure Assessment

Refer to AMS 01-09 section 2.4 for methodology of likelihood assessment. MV Switch and ACR is analysed using only asset service life data for likelihood assessment. Weibull distribution is then used to determine parameters for calculating probability of failure (PoF) and its remaining life.

5.1.3. Likelihood Profile

The likelihood profile across the asset categories in figure 11.

Automatic Circuit Reclosers (ACRs) dominate the level 1 this reflects the device age and recent programs upgrading these devices in response to the replacement of technology to perform with REFCL.

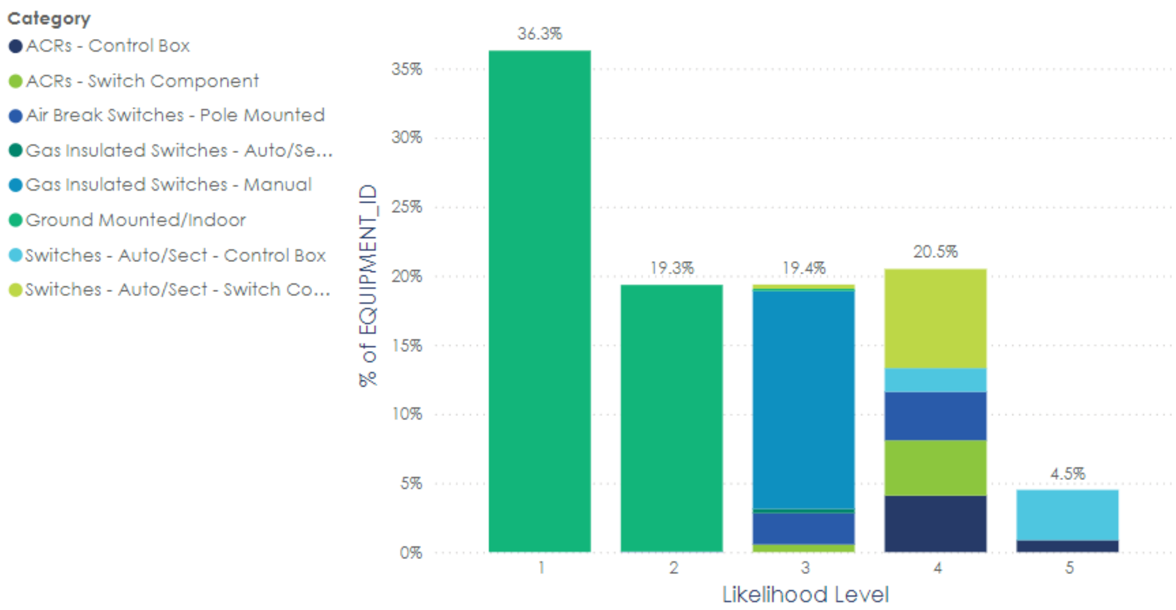

Figure 11 MV Switch Likelihood of Level

Auto switch and sectionaliser control boxes constitute the majority of devices within level 5. The increased prevalence of control boxes can be linked to their shorter service life relative to switches, as well as the age and performance characteristics of these assets.

5.2. Consequence of Failure

Refer to AMS 01-09 section 2 for methodology of consequence of failure.

A malfunction in a medium voltage (MV) switch or automatic circuit recloser (ACR) can lead to an increased number of customers impacted by faults or scheduled outages, as well as a prolonged duration of these incidents. Additionally, there is a potential safety risk associated with MV switches or ACRs that could endanger employees or the public and negatively affect the environment. For example, a failure in an automated switch or ACR that results in an explosion could potentially lead to fatalities or injuries to employees or members of the public.

The costs related to the failure of MV switches or ACRs are generally evaluated from three key perspectives: Safety, Environmental Impact, and Customer Impact, as applicable. Each type of MV switch or ACR may be associated with one or more of these consequence categories. A summary of each perspective is presented in Table 2.

TABLE 2: CONSEQUENCE LENSES

SAFETY	Threat to health and safety of public and employees
ENVIRONMENT	Bushfire damage
CUSTOMER	Loss of Supply to Customer Loss of primary plant

5.2.1. Safety Cost of Consequence

The safety cost associated with the consequences of medium voltage switches and automatic circuit reclosers is assessed based on their impact on human safety. The consequence of a low-force explosion and pressure release for an item in a pole top location. Event tree analysis is employed to determine the safety consequences.

Refer to *AMS 01-09-02* for event tree diagram of relay safety consequence of failure.

5.2.2. Environmental Cost of Consequence

The environmental costs and implications associated with MV switches and ACRs are assessed in the context of their geographical locations, taking into account prevailing weather patterns that may increase the risk of bushfires, land use classifications, and housing density considerations. Event tree analysis is employed to determine the environmental consequences.

Refer to *AMS 01-09-02* for event tree diagram of relay environmental consequence of failure.

5.2.3. Customer Cost of Consequence

The customer costs associated with supply interruptions are financial implications arising from customers not receiving energy. For Medium Voltage (MV) switches and Automatic Circuit Reclosers (ACRs), these costs are calculated based on the output of the Zone Substation, which reflects the value of customer risk. The load is then evenly distributed across the number of wire sections separated by an MV switch or ACR. This calculation takes into account the outage duration and the number of sections impacted, adopting a staged approach to approximate the restoration process.

5.3. Risk Treatment

Risk treatments are required to maintain risk by targeting reduction of PoF or CoF depending on the nature of the risk. Treatment measures include asset replacement, asset refurbishment, inspections, testing or system redesign, and are achieved through capital projects or operational expenditure. Risk treatment options are described in the section on 'Risk Treatment' in AMS 01-09.

Capital replacement is a major component of asset risk management. The prerequisites for replacing assets:

- replacement of an asset will result in a material risk reduction
- risks can't be feasibly managed through maintenance or refurbishment
- monetised risk exceeds the replacement cost – ie replacement is economic.

6. Performance

6.1. Performance Analysis

In the context the management of MV switches and ACR) within an Electrical Distribution Networks, assessing asset performance is a vital tool for effective lifecycle management. Performance information provides a comprehensive understanding of how these assets behave under various conditions, enabling asset managers to make informed decisions that enhance the reliability, safety, and efficiency of the infrastructure.

Performance data helps identify trends and patterns in asset behaviour, which are crucial for making strategic decisions regarding maintenance, upgrades, and replacements. Understanding how assets perform over time allows for proactive management, reducing the risk of unexpected failures. The assessment employed by AusNet involves analysing failure trends and any significant impacts resulting from failure, which provides valuable insights into the health and reliability of the assets.

6.2. Performance Profile

Figure 12 presents the volume of ZA and ZK notifications from 2016 to 2024. It is essential to note that the declining trend in notifications observed between 2022 and 2024 does not fully reflect the total number of notifications during that period. In response to a safety concern (refer to Section 12, Appendix A) regarding [CIC] manual gas switches, we have observed that the number of notifications issued under an alternative notification code ZD surpasses the total volume recorded in all prior years.

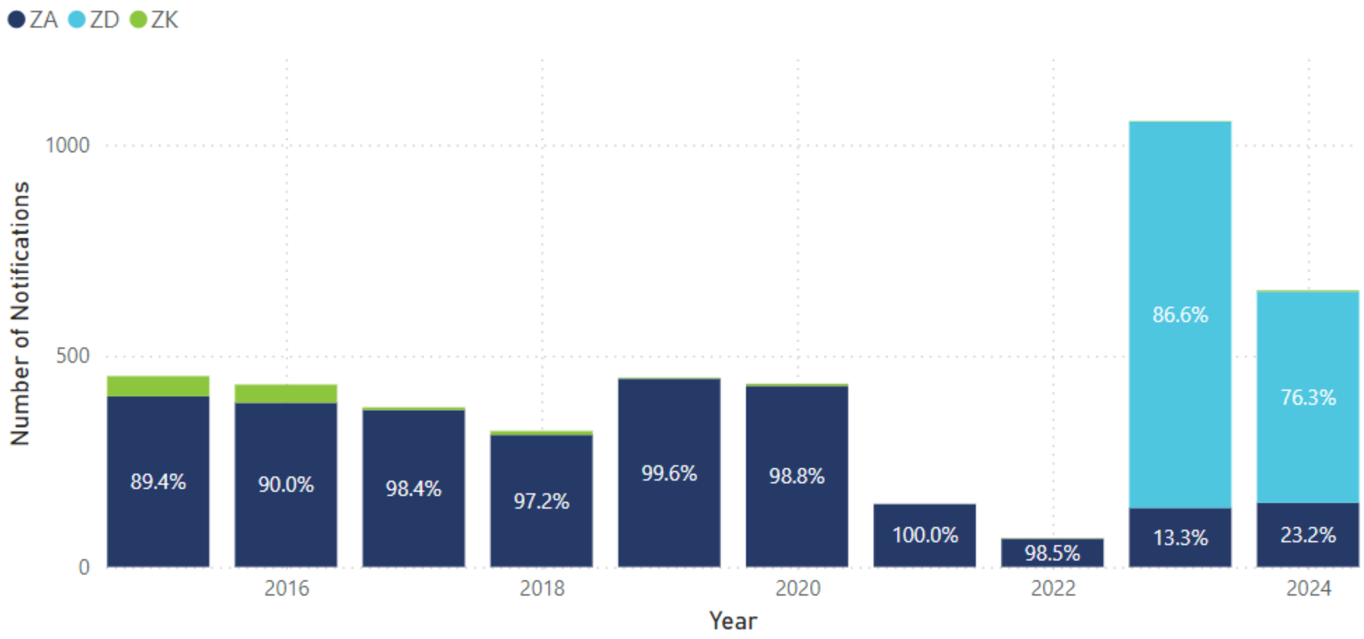

Figure 12 notification types 2016-2024

Figure 13 shows the distribution of notifications across device types during the period of 2016-2024. It can be seen from the graph that the distribution of notifications is predominantly associated with control boxes across both ACRs and sectionaliser device types.

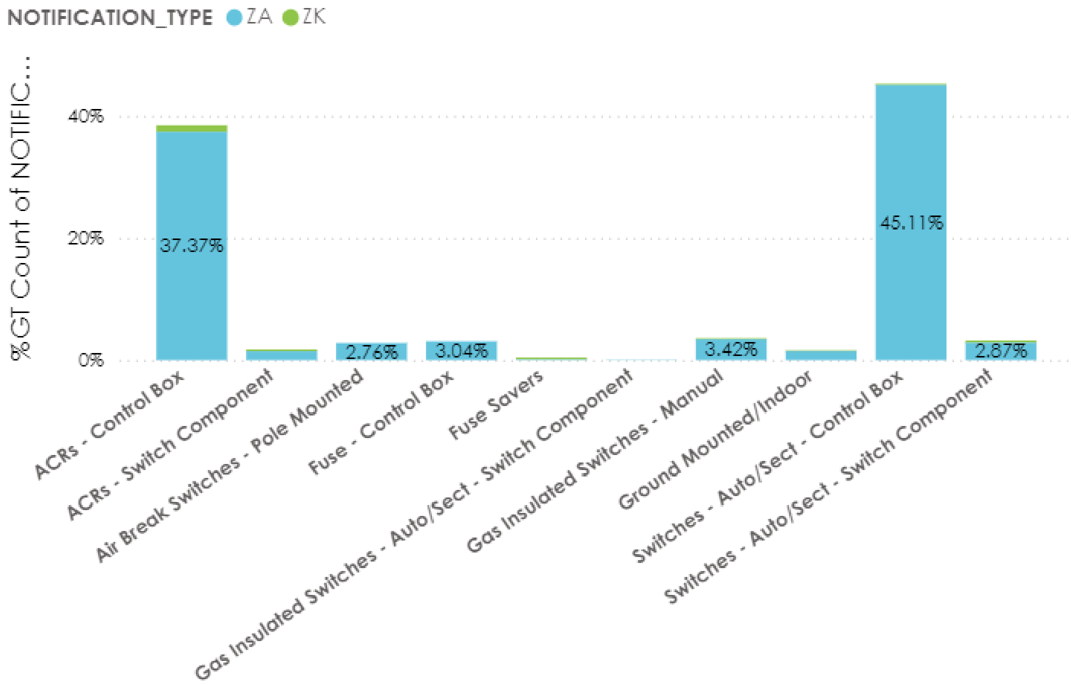

Figure 13 Notifications by device type

Figure 14 displays the most frequent damage type for control boxes is deterioration while deterioration and failure account for approximately 40% of the damage types listed. Additional damage types for control boxes include inappropriate setting at 19% of the damage types listed. Inappropriate settings may also contribute to maloperation classification for damage type

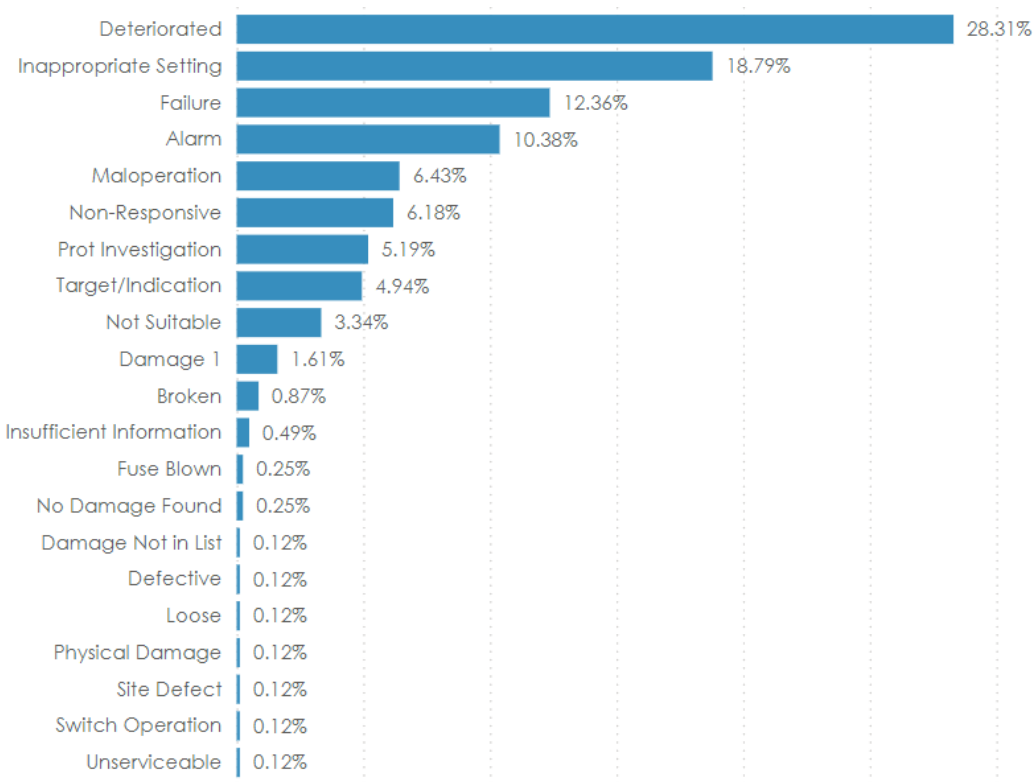

Figure 14 Notification by Damage Type for Control boxes

Control box maintenance activities are primarily associated with re-inspection or re-survey of the equipment however approximately 11% of the maintenance activities require replacement of the control box. Figure 15 depicts the maintenance activities performed on control boxes.

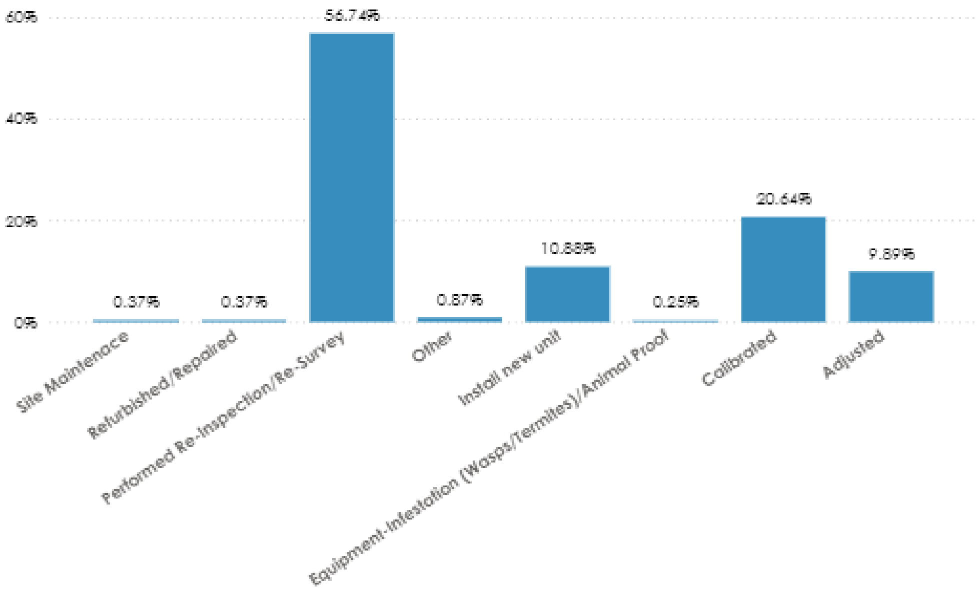

Figure 15 Maintenance Activities on Control Boxes

It is important to highlight that approximately 79% of the control box replacement activities involve Computrol devices, as demonstrated in Figure 16. These devices have been identified as having lower reliability. When evaluating the replacement of these units, it is imperative to consider the compatibility and functionality of the components. Any potential replacement devices must adequately align with the existing switch or recloser and the current automation systems. The functionality of control boxes plays a crucial role in network performance and directly influences customer satisfaction and network safety. Enhanced capabilities such as directional sensitive earth fault protection, bushfire settings, reverse power flow protection, and brownout control modes are also essential considerations.

[CIC]

Figure 16 2021-2024 Control Box Replacements by Manufacturer

The key types of damage identified in notifications for the MV switch and ACR switching components include defects, an inability to open or close, deterioration, breakage, and physical damage. These categories represent 88% of the reported causes of damage from 2021 to 2024. Additionally, Figure 17 illustrates that 41.5% of maintenance activities for these devices necessitate the installation of a new unit.

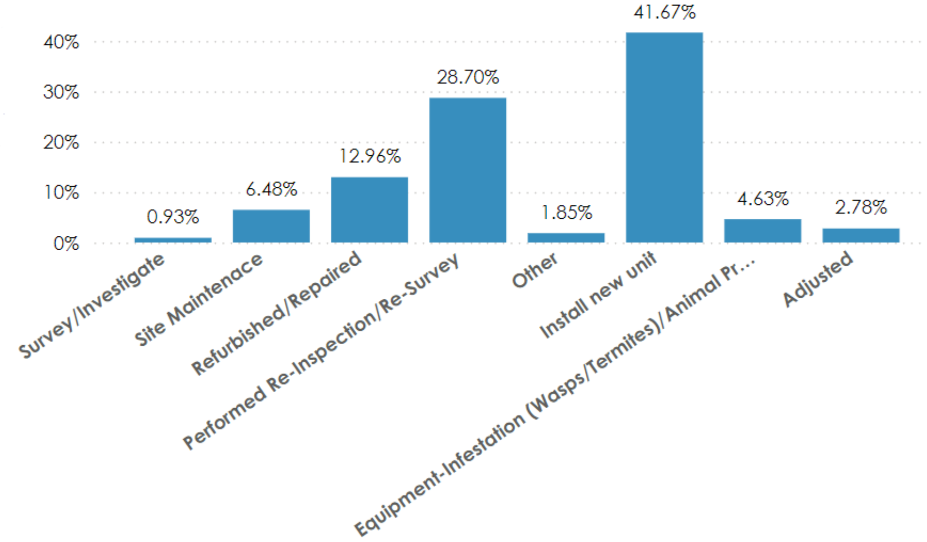

Figure 17 Maintenance Activities for MV switches & ACRs (Switch Component)

Ground-mounted and indoor switches comprise the largest category of assets by volume within the medium voltage switches. It is important to note that there is a data gap concerning the ground-mounted switches, with 7.2% of this population having an unknown age and 30% lacking manufacturer details. Notably, Figure 18 demonstrates that 25.53% of ZA activities result in the installation of a new unit. The primary types of damage observed for ground-mounted switches include defects, deterioration, and issues with being unable to open or close, which collectively account for 78.4% of the damage types observed.

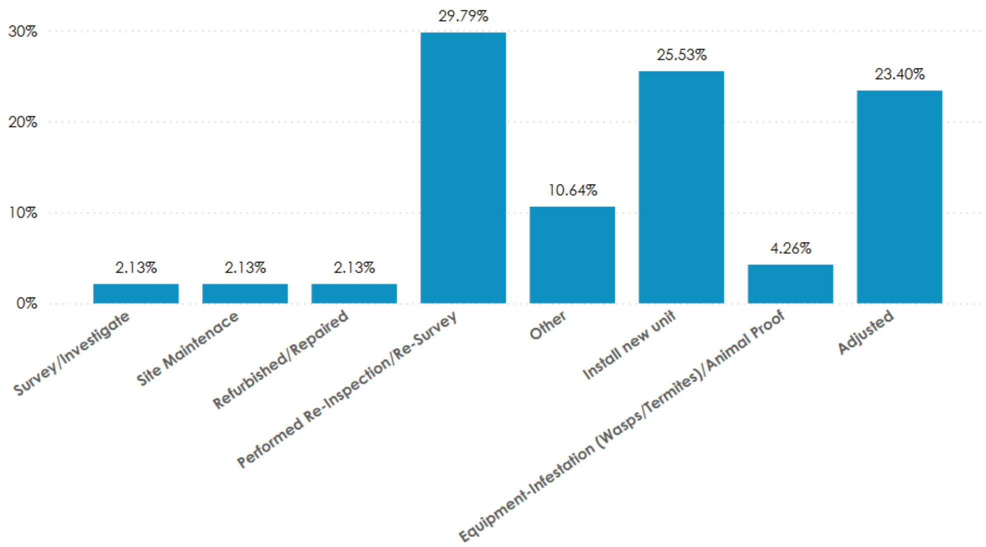

Figure 18 ZA Activity Type for Ground-Mounted & Indoor Switches

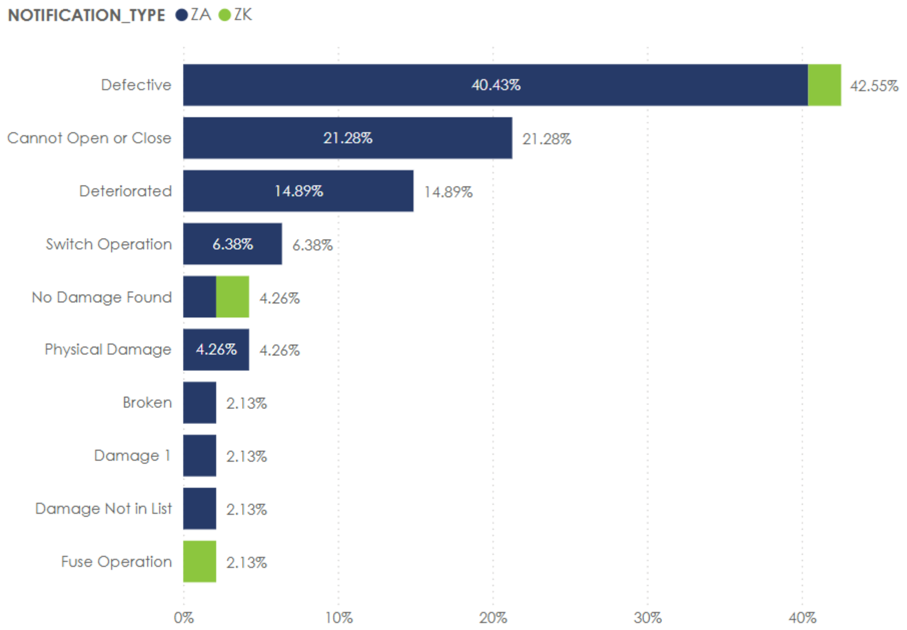

Figure 49 Damage Type for Ground-Mounted & Indoor Switches

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	Continue to maintain decommissioned assets in appropriate working condition as spares to ensure the ongoing serviceability of in-service obsolete assets
02	Proactively research and develop replacement for obsolete and failed control box and gas switch to maintain network performance
03	Continue to proactively replace failed control box and gas switches

7. Related Matters

7.1. Regulatory Framework

7.1.1. Compliance Factors

Regulatory and Legislative Reference

Effectively managing compliance obligations specific to legislation and policies is a core element of Asset Class Planning and supports the sustainable operation and management of Network Assets. Ensuring adherence to relevant laws, policies and codes helps prevent legal and regulatory breaches, which can lead to significant penalties, operational disruptions, and reputational damage.

Note: further to the above, **Section Nine (9)** provides a quick reference table for the legislative and regulatory laws, acts, and policies that are of material consideration for this Asset Class (with links to the reference material).

Technical Standards and Procedures

Effectively managing compliance with technical standards and operational procedures is an important element of Asset Class Planning. Adhering to these standards ensures that the assets are designed, constructed, maintained, and operated in a manner that meets industry best practices, enhances safety, and ensures reliability. Compliance with technical standards helps prevent asset failures, reduces risks, and ensures interoperability within the electrical distribution network. For example, ensuring that all components of various asset types are installed and maintained according to Australian Standards can prevent unplanned failure and operational faults, enhancing network reliability.

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	**Electricity Safety Act (Section 98(a))**
02	**Electricity Distribution Code (Section 3.3.1(b))**
03	**National Electricity Rule (Clause 6.5.7)**
04	**Electricity Safety (Bushfire Mitigation) Amendment Regulations 2016** Continue to follow dedicated strategy for undertaking REFCL-driven ACR replacements (REF 20-18: "Compatible Equipment – Automatic Circuit Recloser Strategy") and modifying existing DFA systems (REF 20-13: "Distribution Feeder Automation Strategy") to maintain network reliability. All new and replacement ACR units installed throughout the distribution network, regardless of whether the target feeder is supplied from a zone substation where REFCL has been installed, will comply with specifications and standards necessary for REFCL operation. This will ensure efficient spares management and streamline design (in particular, control configuration design) standardisation.

7.2. External Factors

7.2.1. Technical Factors

Understanding and managing the technical factors that can directly impact the lifecycle planning for Network Assets across all the AusNet Asset Classes is a core element of effective asset management. These factors encompass various design, engineering, and technical performance considerations that directly impact the ability to manage and maintain these assets efficiently. Ensuring that Network Assets meet specific technical performance standards is vital for maintaining the reliability and safety of the electrical distribution network. For example, selecting construction materials with appropriate durability and weather resistance is essential to prevent faults and ensure consistent performance under varying environmental conditions.

REF	DETAILS OF MATERIAL CONSIDERATIONS

01	**Systems and Processes** • Update key switch policy and introduce processes for regular review and update • Consolidate system data with key switch policy • Record asset condition in Asset Management System
02	New MV switch and control box shall meet all relevant Australian Standard specified in their relevant specification.

7.2.2. Environmental Factors

Effectively managing obligations specific to environmental management is a core element of Asset Class Planning and supports the sustainable operation and management of Civil Infrastructure. Ensuring adherence to relevant environmental laws and standards helps prevent legal and regulatory breaches, which can lead to significant penalties, operational disruptions, and reputational damage.

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	Monitor market for development of alternative to SF6 switch to comply with AusNet Environmental policy

7.2.3. Stakeholder/ Social Factors

Social Factors

Understanding social factors is essential for the effective management of critical network infrastructure assets. Social factors, including community expectations, public safety, and environmental impacts, play a significant role in shaping asset management strategies. Ensuring that these social considerations are addressed helps build public trust, maintain social license to operate, and enhance the organisation's reputation. For instance, ensuring that maintenance activities for Civil Infrastructure do not disrupt local communities or pose safety risks is crucial for maintaining public support and compliance with social responsibilities.

Stakeholder Factors

Understanding the requirements of stakeholders with a direct interest in the assets associated with the Civil Infrastructure] asset class is an important aspect of effective asset management. Key stakeholders, including customers, regulatory bodies, and industry partners, have specific expectations that influence asset management strategies and operational decisions. Ensuring clear communication and alignment with these requirements helps maintain regulatory compliance, enhance service reliability, and build robust partnerships. For example, customers expect reliable infrastructure and timely responses to issues, which requires minimal disruption during maintenance activities of Civil Infrastructure. Similarly, regulatory bodies impose standards that must be adhered to, such as safety requirements for buildings and environmental systems, to avoid legal penalties and ensure operational legitimacy.

7.3. Internal Factors

7.3.1. Training and Competency Factors

Effective training and competency development is a core element of asset class. Ensuring that asset managers, engineers, operational staff, and field personnel possess the necessary skills and knowledge is crucial for maintaining the reliability, safety, and efficiency of the asset network. Competent staff can effectively perform inspections, maintenance, and repairs, preventing asset failures and minimising downtime. Continuous training helps in keeping up with technological advancements, regulatory changes, and best practices, thereby enhancing overall asset management performance.

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	Continue to provide internal staff as well as Ausnet partner in training, education and industry knowledge management of ACR and Sectionaliser with REFCL technology

7.3.2. Resource Management Factors

Resource Management is a core element of asset class planning for Network Assets. Proper oversight ensures that the management of AusNet's resource bases meets stringent quality and performance standards, which is essential for preventing asset failures, managing risks, and maintaining compliance with regulatory requirements. Effective resource management contributes to cost efficiency via activities such as leveraging the expertise of specialised in-house skills and contractors while avoiding hidden costs associated with inefficiencies and non-compliance.

There are three sub-categories of consideration for this factor, which are:

- Resourcing strategies
- Outsourcing
- Supply Chain Management

7.3.3. Economic Factors

Economic factors significantly influence the lifecycle management of network assets, impacting financial stability, investment decisions, and overall network performance. Major contracts being tendered, such as those for infrastructure development, maintenance, and technology upgrades, can materially affect asset management. These contracts involve substantial investments, requiring rigorous management to align with long-term asset goals, mitigate risks, and control costs. Effective contract management ensures that service providers deliver value, supporting the network's reliability and performance while maintaining financial health.

Material developments and significant commercial agreements also play pivotal roles in the economic landscape of asset management. Commercial agreements, including customer service agreements, dictate service levels, performance metrics, and penalties, impacting operational priorities. Regular reviews of these agreements ensure adaptability to changing economic conditions, customer expectations, and regulatory landscapes. Additionally, planned renewal programmes and changes to asset types and purchasing strategies must be evaluated for their financial impact to ensure efficient resource allocation. By addressing these economic factors, AusNet can manage financial risks, optimise investments, and support robust lifecycle models, aligning financial planning with operational goals and regulatory requirements.

7.3.4. Safety Factors

Safety is a paramount concern in the management of electricity distribution network assets, as outlined in **ESMS 20-01**. Effective asset management planning and activities are crucial for protecting employees, contractors, the public, and the environment from potential hazards associated with electrical infrastructure. Ensuring adherence to safety regulations and standards through diligent asset management helps prevent accidents, minimise risks, and maintain the integrity of the network.

Targeted asset management activities include conducting regular safety audits and risk assessments, maintaining a robust Bushfire Mitigation Plan, providing ongoing safety training and competency assessments, regularly reviewing and updating emergency response plans, engaging with the community to raise awareness about electrical safety, and adopting new technologies and practices to enhance network safety. By integrating these safety-focused activities into asset management planning, AusNet can effectively minimise safety risks "as far as practicable," as outlined in the Electricity Safety Act 1998 and reflected in **ESMS 20-01**.

7.4. Future Developments

7.4.1. Technology and Innovation Factors

Effectively managing the process of tracking future technology developments and innovations is a core element of asset class planning. Staying informed about technological advancements ensures that asset management practices remain up-to-date, efficient, and competitive. Innovations can lead to improved materials, better monitoring systems, and enhanced maintenance techniques that increase the reliability, safety, and longevity of critical infrastructure. For example, advancements in diagnostic tools for detecting early signs of wear and the development of advanced materials for asset components can significantly enhance their performance and maintenance. For technology and innovation, this is a process that looks to existing technologies, processes, or practices that have been proven in the market and have already been taken to market.

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	Continue to monitor and trial of IEC61850 standard and associated technologies which are incorporated into ACR and Sectionaliser control box as this standard will continue to mature throughout the next 10 years, and its integration within increasingly "smart" electricity network and equipment will continue to increase.
02	Increasing pressure from distributed generators, combined with evolution in telecommunication technologies, is already necessitating research and development of 4G / 5G and NBN solutions for protection signalling applications as well as remote engineering access to control box.
06	Rapid technological evolution places increasing demands on staff capabilities, and ongoing investment in staff training and education, and industry knowledge management in general, will become increasingly critical.

7.4.2. Research and Development Factors

Effectively managing the process of investing in research and development (R&D) and seeking funds for R&D activities is a core element of asset class planning. R&D investment ensures that the organisation stays at the forefront of technological advancements, develops innovative solutions to emerging challenges, and enhances the reliability, safety, and efficiency of its assets. For example, developing new materials with improved structural properties for buildings or advanced monitoring systems for environmental systems can significantly extend their lifespan and reduce maintenance costs. Research and development are the process of researching and investing in an idea, process, practice, or technology that has not been realised in the market yet; it is a step before tracking innovation and technology because the investment to build and take the item to market still needs to be proven.

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	Monitor, trial and implement new technologies for MV Switches and ACRs for reduction of SF6
02	Establish guidelines for economic extension of MV Switch and ACR life
03	Establish guidelines for economic replacement of MV Switches and ACRs when other assets are being replaced.
04	Investigate, develop and implement new modelling techniques to predict MV Switches and ACRs failures
05	Investigate, develop and implement economic analysis techniques for automation of MV Switches
06	Continue to monitor, trial and implement REFCL technologies for ACRs and Sectionaliser for improvement on detection of SEF

8. Asset Strategies

8.1. New Assets

8.1.1. New Asset Considerations

A strategic asset strategy for the introduction of new assets provides high-level guiding principles and overarching goals for asset management, focusing on long-term planning and sustainability. This strategy outlines the aspects of asset upgrades or changes, detailing the conditions under which new assets may be introduced into the network. This is not a like-for-like replacement but rather a strategic change or upgrade to a different type of asset to enhance reliability, improve efficiency, and incorporate advanced technologies. It serves as a roadmap that is ideal to follow if possible, guiding the decision-making process for integrating new assets into the AusNet network.

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	Continue to design and install new and replacement assets in accordance with the Standard Design manual (4142)
02	ACR and sectionaliser control box configurations shall comply with current control configuration standards.

8.2. Inspection and Monitoring

A strategic plan for inspections and monitoring provides high-level guiding principles and overarching goals for asset management, focusing on long-term planning and sustainability. This strategy outlines the ideal framework and objectives for conducting inspections and monitoring activities, such as enhancing reliability, improving efficiency, and incorporating advanced technologies. It serves as a roadmap that is ideal to follow if possible, guiding the decision-making process for establishing comprehensive inspection and monitoring protocols within the AusNet network.

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	Inspection to be completed as per the Asset Inspection Manual 30-4111, and compliance with the Energy Safe Victoria requirements and Electricity Safety (Bushfire Mitigation Regulations.

8.3. Maintenance

A strategic plan for maintenance provides high-level guiding principles and overarching goals for asset management, focusing on long-term planning and sustainability. This strategy outlines the ideal framework and objectives for conducting maintenance activities, such as enhancing reliability, improving efficiency, and incorporating advanced technologies. It serves as a roadmap that guides the decision-making process for establishing comprehensive maintenance protocols within the AusNet network. This involves creating a structured approach to regular maintenance activities to ensure optimal performance and longevity.

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	Continue to maintain MV Switches and ACRs in as per Asset Inspection Manual 4111-1 and with SOP 70-03

8.4. Spares

A strategic plan for keeping spares provides high-level guiding principles and overarching goals for asset management, focusing on long-term planning and sustainability. This strategy outlines the ideal framework and objectives for keeping spare activities. This involves creating a structured approach to ensure sufficient spares for in-services relay especially for relays which are obsolete.

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	Continue to maintain adequate spares to ensure ongoing availability of key switches, as per the distribution critical spares strategy SOP 28-02
02	Continue to salvage obsolete spares from replacement to ensure ongoing availability of MV switches, ACRs, Sectionalisers and their control boxes

8.5. Replacement

A strategic asset strategy for renewals and replacements provides high-level guiding principles and overarching goals for asset management, focusing on long-term planning and sustainability. This strategy outlines the aspects of asset refurbishments or like-for-like replacements, detailing the conditions under which existing assets may be renewed or replaced within the network. This process ensures continued reliability and efficiency, manages obsolescence, and maintains adequate spares. It serves as a roadmap that is ideal to follow if possible, guiding the decision-making process for renewing or replacing assets within the AusNet network.

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	In accordance with the outcomes of asset inspections and individual feeder reliability reviews, selectively retire or replace air break switches with gas switches
02	Prioritise proactive replacement of-poor and/or unsafe to operate key switches
03	In accordance with SOP 70-03, replace failed or poor condition non-key switches only if required to facilitate network operations
05	Replacement of ACR and sectionaliser control box shall comply with current control configuration standards

8.6. Research and Development

A strategic asset strategy for research and development provides high-level guiding principles and overarching goals for asset management, focusing on long-term planning and sustainability. This strategy outlines the aspects of safely and efficiently introducing assets into service, detailing the conditions under which it may occur. It ensures that the process is conducted in a way that minimises disruption, manages environmental impacts, and complies with regulatory requirements. It serves as a roadmap that is ideal to follow if possible, guiding the decision-making process for decommissioning assets from within the AusNet network

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	Continue to trial, monitor and improve REFCL technologies on ACRs and Sectionaliser to improve network reliability
02	Continue to search the market for alternative manufacturers for ACRs and Sectionaliser
03	Establish guidelines for economic extension of MV Switch and ACR life
04	Establish guidelines for economic replacement of MV Switches and ACRs when other assets are being replaced

05	Investigate, develop and implement new modelling techniques to predict MV Switches and ACRs failures
06	Investigate, develop and implement economic new life extension techniques for MV Switches and ACRs
07	Research and development of 4G / 5G and NBN solutions for protection signalling applications as well as remote engineering access to control box.

9. Legislative References

NO	
1	Electricity Safety Act
2	Electricity Distribution Code
3	National Electricity Rule
4	Electricity Safety (Bushfire Mitigation) Amendment Regulations 2016

10. Resource References

DOCUMENT ID	DOCUMENT TITLE
4111	Asset Inspection Manual
4142	Standard Design Manual
AMS 01-01	Asset Management System Overview
AMS 01-09-02	Consequence Analysis - Addendum
AMS 20-01	Electricity Distribution Network - Asset management Strategy

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11. Schedule of revisions

ISSUE	DATE	AUTHOR	DETAILS OF CHANGE	APPROVED BY
1	29/08/07	T Page	Initial draft	
2	31/03/09	M Butson R Clark S DeSilva D Postlethwaite R Purcell	Included ACRs, Sectionalisers & Ring Main Units	G Towns
3	31/05/09	D Postlethwaite	Update of SCADA controlled devices	G Towns
4	26/11/09	D Postlethwaite	Add replacement volumes to executive summary	G Towns
5	18/07/10	P Bryant	BFM program - replace OCRs with ACRs	D Postlethwaite
6	28/01/15	P Seneviratne G Jegatheeswaran	Review and update	J Bridge
7	14/06/19	L Boustead	Review and update	P Ascione
8	31/01/25	B Ton	New template and Update	D McCrohan

12. Appendix – A

[CIC]

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