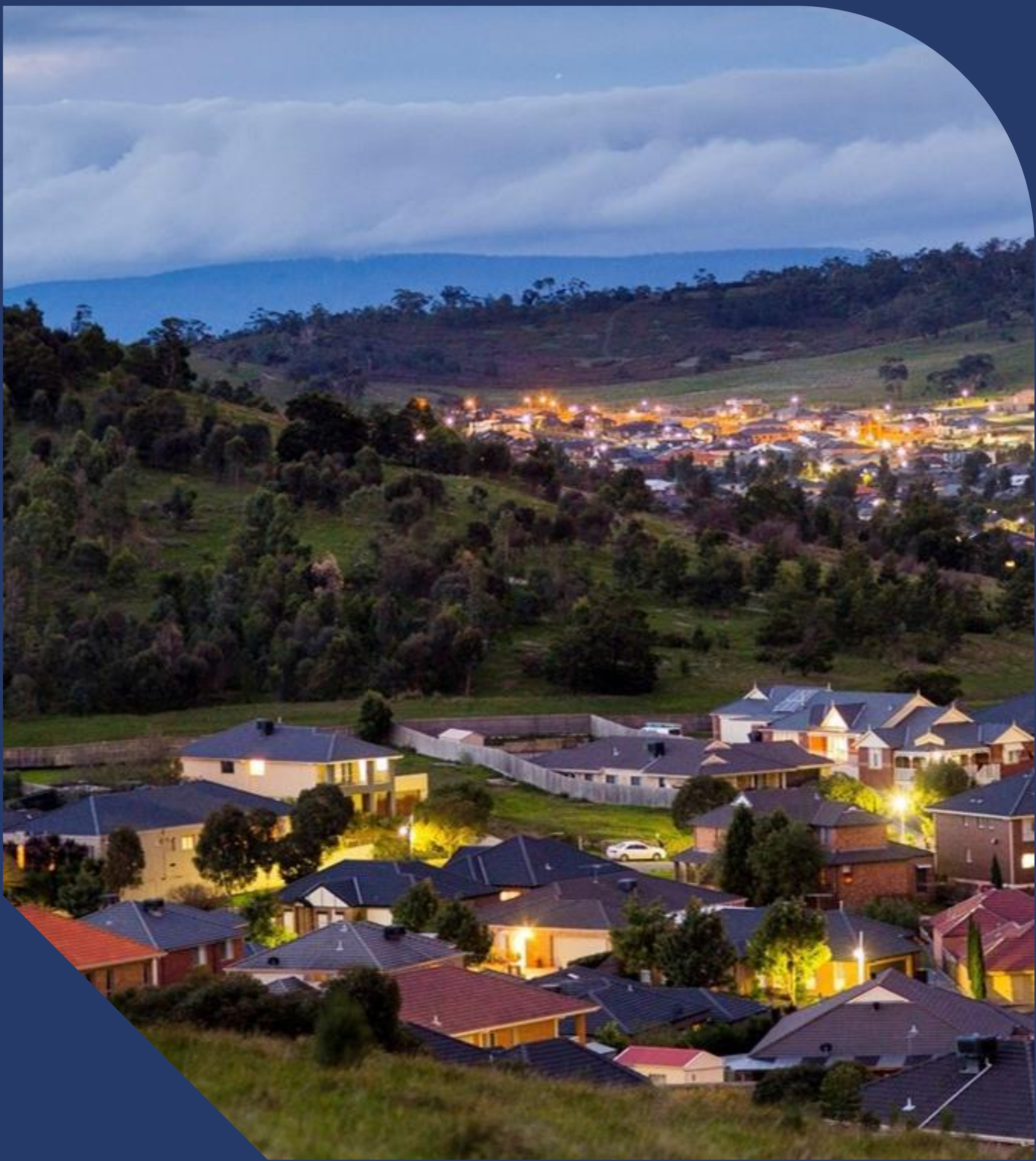
AusNet

Indoor Switchboards

AMS – Electricity Distribution Network



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1. Executive Summary

This document is part of the suite of Asset Management Strategies relating to the AusNet electricity distribution network. The purpose of this strategy is to outline the inspection, maintenance, replacement and monitoring activities identified for economic life cycle management of indoor switchboards in AusNet's Victorian electricity distribution network.

There are 93 indoor switchboard bus systems installed within the AusNet Zone substations. The majority of the switchboards operate at 22kV and are air insulated type. The older first and second-generation switchboards constitute approximately 30.1% of the total population. The third-generation switchboards constitute approximately 20.4% of the population and the fourth-generation switchboards built to latest AS and international Standard constitute approximately 49.5% of the population. The fourth generation are fully type tested switchgear for arc flash protection.

Risk of failure of an indoor switchboard predominantly determined by probability of a failure of its associated indoor circuit breakers which is covered by CB Strategy; AMS -20-54 Circuit Breakers.

The proactive management of switchboards inspection, condition monitoring and replacement practice is required to ensure that stakeholder expectations of cost, safety, reliability and environmental performance are met. The summary of proposed asset strategies is listed below.

1.1. Asset Strategies

1.1.1. New Assets

- Continue to specify fully internal arc fault contained compartmentalised indoor switchboards with external venting; consider motorised racking of vacuum circuit breakers for new installations.

1.1.2. Inspection

- Continue annual non-invasive condition monitoring scans ultrasonic and TEV /PD testing to evaluate any internal partial discharges in switchboards locations.
- Explore opportunities to install continuous on-line Partial Discharge (PD) monitoring at high-risk indoor switchboards and CB cubicles identified from yearly PD scans, to manage the failure risks until a refurbishment or replacement will be completed.

1.1.3. Maintenance

- Review scheduled preventative maintenance procedures, Standard Maintenance Instructions for each indoor switchboard type.
- Continue planned inspection of bus chambers of all indoor switchboards as per PGI 02-01-04.

1.1.4. Spares

- Maintain strategic spares holding for each indoor switchboard Make, consider modular spare options for emergency response.

1.1.5. Refurbishment

- Review arc flash risks and mitigation methods to reduce safety risk
- Consider options - install arc flash relays in second and third generation switchboards,
- Consider options - Retrofit replacement of minimum oil indoor CBs with indoor vacuum CBs
- Consider options - motorised CB racking for first- and second-generation indoor switchboards

2. Abbreviations and definitions

TERM	DEFINITION
CB	Circuit breaker
SWBD	Switchboard
Pof	Probability of failure
Cof	Consequence of failure
Zk	Work order Notifications associated with failures (unplanned power interruptions)
ZA	Work order Notifications associated with corrective actions from planned inspections

3. Introduction

3.1. Purpose

The purpose of this document is to outline the inspection, maintenance, replacement and monitoring activities identified for economic life cycle management of indoor switchboards in AusNet Victorian electricity distribution network. This document intends 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.

3.2. Scope

This Asset Management Strategy applies to all indoor switchboards operating at 22kV, 11kV and 6.6kV located in AusNet zone substations. The switchboard includes the busbar, cable entry, overall compartment and arc control design and isolation and earth switch facilities.

The following associated assets that are installed in indoor switchboard are covered by other strategies;

Circuit Breakers - refer to AMS-20 -54.

Instrument Transformers - refer to AMS 20-63

3.3. 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*.

4. Asset Description

4.1. Function

Indoor type switchboards are used as an alternative to outdoor medium voltage substation switchyards based on combination of factors such as economic, safety, environmental, aesthetic and availability of space in zone substations.

Metal enclosed switchgear is installed either in switch room buildings or modular indoor switch rooms along with the associated protection, control, and monitoring and communication equipment.

4.2. Population

Population Considerations

The population profile for indoor switchboards 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 indoor switchboards are essential for maintaining the integrity and reliability of the network. For example, a specific 22kV indoor switchboard located in a major zone substation 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 first- and second-generation indoor switchboards can help in scheduling maintenance activities more efficiently, focusing on areas with the highest need.
- **Risk management:** Assess and manage risks associated with different assets. For example, if the population profile indicates that certain indoor switchboards are located in substations prone to flooding, additional protective measures can be implemented in those areas to mitigate risk.
- **Optimise maintenance schedules:** Develop optimised maintenance schedules based on the distribution and condition of assets. For instance, indoor switchboards that are part of the backbone infrastructure in high-demand zones might be scheduled for more frequent inspections and maintenance to prevent potential failures.
- **Enhance reliability and safety:** Ensure that all components, including busbars, circuit breakers, and isolation switches, meet the required standards for reliability and safety. For example, if the profile reveals that certain first- or second-generation switchboards have outdated arc flash protection, these can be prioritised to provide engineering solutions to mitigate risk or total replacement to enhance operator safety.
- **Support strategic planning:** Inform long-term strategic planning and investment decisions. For instance, the population profile might show that a significant portion of second-generation indoor switchboards in a rapidly developing suburban area need upgrading to support increased demand, guiding future investment in that region.

Geographic Impact Areas

The AusNet 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 indoor switchboards. Understanding these impacts is essential for effective asset management within the AusNet electrical distribution network.

Notable examples include:

- **High Wind Areas:** While high wind areas generally affect outdoor equipment more, indoor switchboards located in buildings that might be exposed to strong winds still require consideration for structural integrity. Example: In the elevated regions of the Dandenong Ranges, the switch room buildings housing indoor switchboards must be robust enough to withstand high wind speeds, ensuring that the switchboards remain protected and operational.
- **Corrosive Areas:** Coastal areas and industrial regions where salt and pollutants are prevalent can cause corrosion of metallic components in indoor switchboards. Example: Regular maintenance and the use of corrosion-resistant materials are crucial. Indoor switchboards in coastal towns like Wonthaggi require regular inspections and maintenance to mitigate the effects of salt-induced corrosion on the switchgear enclosures and internal components.
- **Bushfire Areas:** Bushfire-prone areas pose a significant risk of fire damage to indoor switchboard infrastructure, especially if the switch rooms are not adequately protected. Example: Fire-resistant materials and strategic vegetation management around the switch room buildings are essential. In the bushfire-prone regions of the Yarra Valley, indoor switchboards must be installed in fire-resistant enclosures, and the surroundings should be kept sufficiently clear of vegetation to prevent fire spread.
- **Flood-Prone Areas:** Areas prone to flooding can impact the performance and integrity of indoor switchboards if the switch rooms are not adequately waterproofed. Example: Proper waterproofing and drainage systems are essential to protect these assets. In regions like Gippsland, where flooding is more frequent, indoor switchboards must be installed in elevated or well-drained buildings with robust waterproofing measures to prevent water ingress and subsequent failures.
- **Seismic Zones:** Areas with potential seismic activity may require indoor switchboards 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, indoor switchboards must be installed in buildings designed to withstand seismic activity, incorporating seismic-resistant features to ensure stability during earth tremors.

Asset Types

First Generation Switchboards

- **Form and Function:** First generation switchboards, installed prior to the 1970s, were built to older British Standards. They feature oil-type circuit breakers and are mostly open switchgear with no external arc venting.
- **Purpose in the Asset Class:** These switchboards serve as the primary distribution points for electrical power within zone substations, handling medium voltage levels.
- **Purpose in Network Design:** They are integral to the electrical distribution network, facilitating the safe and reliable transfer of power from higher voltage transmission systems to lower voltage distribution systems.
- **Process Function:** The main process function includes switching and protection of electrical circuits, ensuring that faults are isolated and preventing widespread outages.
- **Historical Application:** Due to their open design and lack of modern safety features, they present a high risk of arc flash injuries. Many of these switchboards are in poor condition, increasing the likelihood of failure, making replacement or retirement a priority.

Second Generation Switchboards

- **Form and Function:** Installed between the late 1970s and 1998, these switchboards were built to older versions of AS 2067 or AS 2068. They typically feature minimum oil type circuit breakers, fully metal enclosed with external arc venting.
- **Purpose in the Asset Class:** These switchboards continue to serve as essential distribution points, offering improved safety and reliability over first-generation types.

- **Purpose in Network Design:** They enhance the network's robustness by providing better arc flash protection and reliability, ensuring a more stable power supply.
- **Process Function:** They support more advanced switching operations and fault protection mechanisms, contributing to the overall efficiency and safety of the network.
- **Historical Application:** These switchboards are generally in good to average condition. They present a medium safety risk and have been a significant step up in terms of safety and operational efficiency compared to the first generation.

Third Generation Switchboards

- **Form and Function:** Installed between 1998 and 2008, these switchboards are built to IEC60298 (1998) standards. They feature vacuum type circuit breakers, with operations generally performed with closed cubicle doors.
- **Purpose in the Asset Class:** Third-generation switchboards provide enhanced arc fault containment, contributing significantly to operational safety.
- **Purpose in Network Design:** They support the modernisation of the electrical distribution network, allowing for better integration of new technologies and improved fault management.
- **Process Function:** These switchboards offer more reliable switching and protection functions, with lower maintenance requirements and improved safety for operators.
- **Historical Application:** Although some boards vent into the room, these switchboards have a comparatively lower safety risk and have improved operational safety and reliability.

Fourth Generation Switchboards

- **Form and Function:** Built to the latest AS62771.200 (2005) standard and installed after 2008, these switchboards are fully arc fault contained, type tested with external arc venting.
- **Purpose in the Asset Class:** Fourth-generation switchboards represent the latest in switchgear technology, offering the highest level of safety and operational efficiency.
- **Purpose in Network Design:** They are designed to meet current and future demands, providing robust protection and control capabilities within the network.
- **Process Function:** These switchboards facilitate advanced switching operations, fault detection, and isolation, ensuring minimal downtime and enhanced safety.
- **Historical Application:** These are the safest and most reliable switchboards in service, designed to operate safely with closed cubicle doors, minimising the risk to operators and improving overall network reliability.

Targeted Activities (Population by Type)

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	**Best Appropriate Practice:** Due to the extensive and varied network, a pragmatic approach is required, focusing on best appropriate practices rather than best or industry-leading practices to balance operational constraints and safety.
02	**Switchboard by Vintage Type and Service Voltage:** Classifying switchboards based on their vintage and the service voltage helps in understanding the distribution and condition of assets, which is crucial for planning maintenance and replacements.
03	**Switchboard by Vintage Type and Bus Bar Insulation:** This classification aids in assessing the insulation condition and potential failure risks associated with different types of busbar insulation.
04	**Switchboard by Vintage Type and Manufacturer:** Knowing the manufacturers and models of switchboards helps in managing spare parts, understanding common failure modes, and leveraging manufacturer-specific maintenance practices.

Population Profile

AusNet has a total population of 93 indoor switchboard bus systems installed in 47 zone substations. One bus typically has 4 to 8 cubicle bays.

Figure 1 to 5 illustrate indoor switchboards in service in zone substations in AusNet network by service voltage, by type, manufacturer and bus insulation.

Figure 1: Indoor switchboards in service in zone substations by service voltage

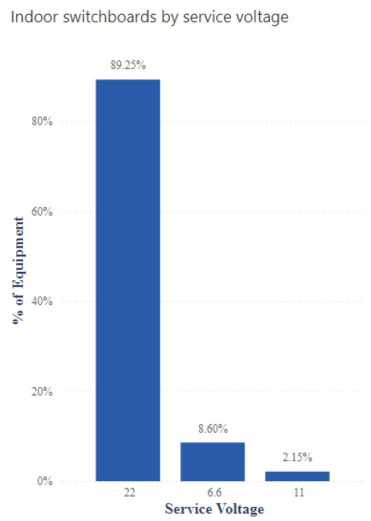


Figure 2: Indoor switchboards in service in zone substations by type and service voltage

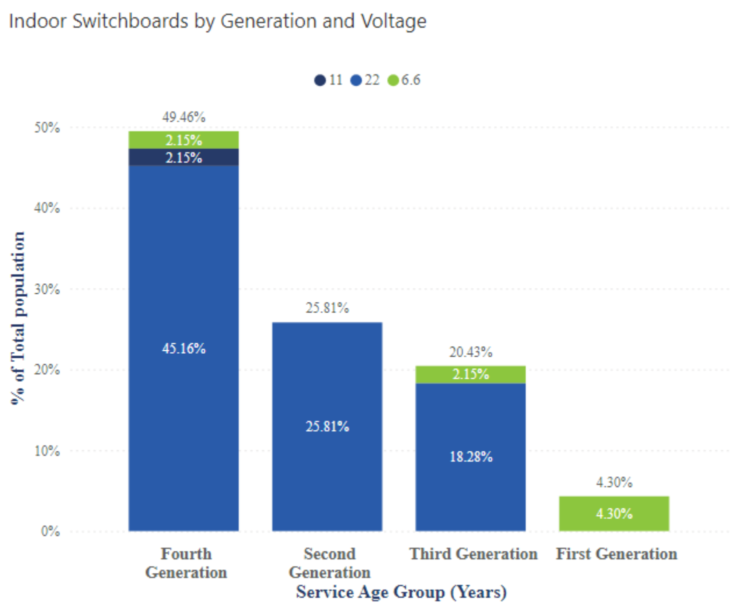


Figure 3: Indoor switchboards in service in zone substations by bus insulation

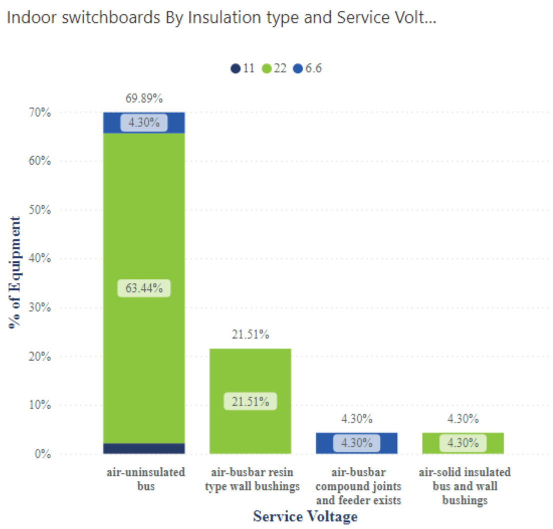


Figure 4: Indoor switchboards in service in zone substations by manufacturer and type

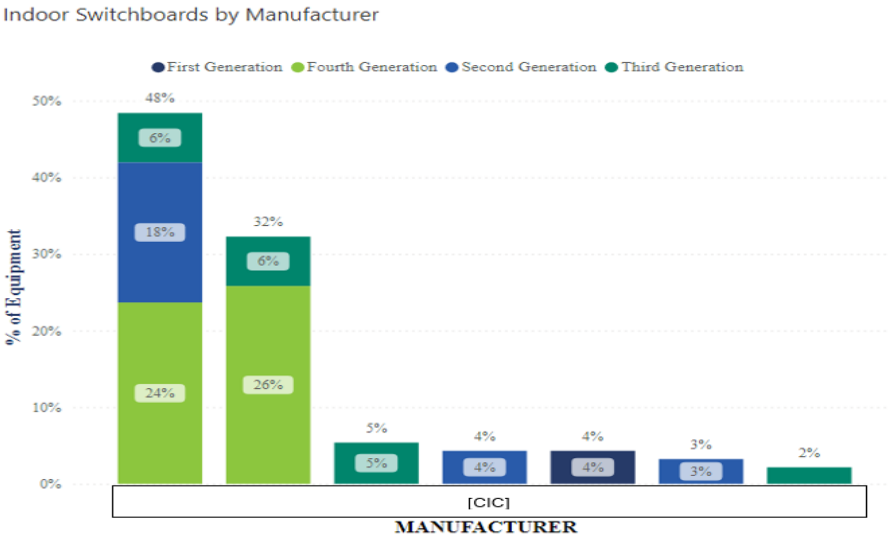
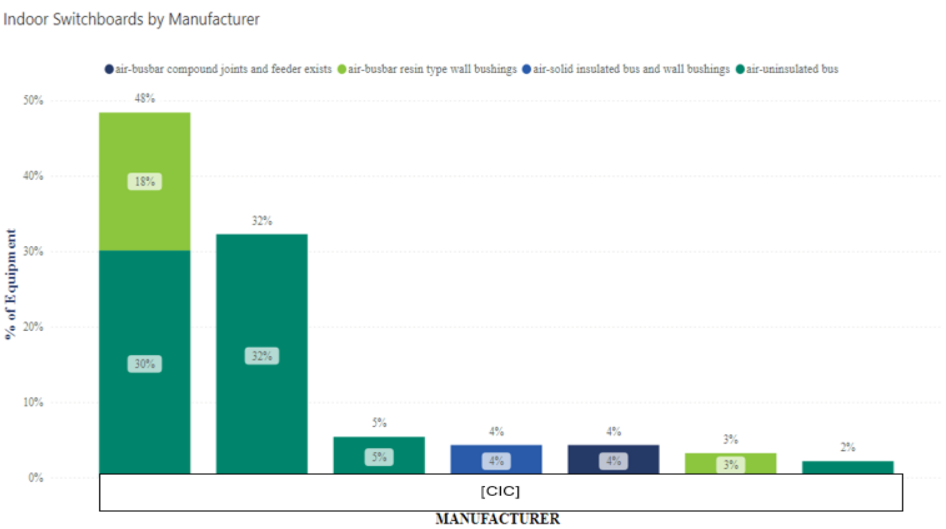


Figure 5: Indoor switchboards in service in zone substations by manufacturer and bus insulation



- It is noted that 89.2% of zone substation switchboards are operating at 22kV and approximately 45.1% are modern fourth generation type tested for arc fault containment to latest standards. Approximately 50% of the total indoor switchboard population (fourth generation type) are type tested for arc fault containment and note the remaining ones are not confirming to latest arc fault containment standard (refer figures 1 & 2)
- Air insulated bus bar systems contribute to 69.9% of the total switchboard population and majority (63.4%) are operating at 22kV. (refer figure 3)
- Approximately 80% of the indoor switchboards are either [CIC] or [CIC] and their bus bar insulation is either air insulated (62%) or air busbar with resin type wall bushings (18%) and they are either fourth generation (50%) or third generation type (30%). (refer figures 4 and 5)

4.3. Age Profile

Age Considerations

An in-depth understanding of the age profile of indoor switchboards 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.

First Generation Switchboards

- **Summary Explanation of Form and Function:** First generation switchboards, installed prior to the 1970s, feature oil-type circuit breakers and are mostly open switchgear with no external arc venting.
- **Purpose in the Asset Class:** These switchboards serve as primary distribution points within zone substations, handling medium voltage levels.
- **Purpose in Network Design:** Integral for facilitating the transfer of power from higher voltage sub transmission systems to lower medium voltage distribution systems.
- **Process Function:** Primarily involved in switching and protection of electrical circuits, ensuring faults are isolated to prevent widespread outages.
- **Age Profile Considerations:** Due to their age, these switchboards are in very poor or poor condition, posing a high risk of failure. Replacement or retirement is often the best option.

Second Generation Switchboards

- **Summary Explanation of Form and Function:** Installed between the late 1970s and 1998, these switchboards are typically fully metal enclosed with minimum oil type circuit breakers and external arc venting.
- **Purpose in the Asset Class:** Serve as essential distribution points with improved safety and reliability.
- **Purpose in Network Design:** Enhance network robustness by providing better arc flash protection and reliability.
- **Process Function:** Support advanced switching operations and fault protection mechanisms.
- **Age Profile Considerations:** Generally, in good to average condition, these switchboards present a medium safety risk and are still in active use with regular maintenance.

Third Generation Switchboards

- **Summary Explanation of Form and Function:** Installed between 1998 and 2008, built to IEC60298 (1998) standards, featuring vacuum type circuit breakers with operations generally performed with closed cubicle doors.
- **Purpose in the Asset Class:** Provide enhanced arc fault containment, contributing to operational safety.
- **Purpose in Network Design:** Support the modernisation of the electrical distribution network, allowing for better integration of new technologies.
- **Process Function:** Offer reliable switching and protection functions, with lower maintenance requirements and improved safety for operators.
- **Age Profile Considerations:** These switchboards have comparatively lower safety risks and have significantly improved operational safety and reliability.

Fourth Generation Switchboards

- **Summary Explanation of Form and Function:** Built to the latest AS62771.200 (2005) standard and installed after 2008, these switchboards are fully arc fault contained, and type tested with external arc venting.
- **Purpose in the Asset Class:** Represent the latest in switchgear technology, offering the highest level of safety and operational efficiency.
- **Purpose in Network Design:** Designed to meet current and future demands, providing robust protection and control capabilities.
- **Process Function:** Facilitate advanced switching operations, fault detection, and isolation, ensuring minimal downtime and enhanced safety.
- **Age Profile Considerations:** These are the newest and most reliable switchboards in service, designed to operate safely with closed cubicle doors, minimising the risk to operators and improving network reliability.

Age Profile

The average service age of indoor switchboard population is approximately 22 years and the oldest being 63 years. Figures 6 to 9 shows the service age profile against service voltage and bus bar insulation type and type.

Figure 6 – Indoor switchboards Age Profile by Service Voltage and generation type

Average service age of Indoor Switch...

Service_Voltage	Avg of AGE	% Switchboard Population
11	**3.00**	**2.15%**
Fourth Generation	3.00	2.15%
22	**21.07**	**89.25%**
Fourth Generation	8.45	45.16%
Second Generation	42.71	25.81%
Third Generation	21.71	18.28%
6.6	**35.75**	**8.60%**
First Generation	58.00	4.30%
Fourth Generation	10.00	2.15%
Third Generation	17.00	2.15%
Total	**21.95**	**100.00%**

Figure 7 – Indoor switchboards Age Profile by Service Voltage

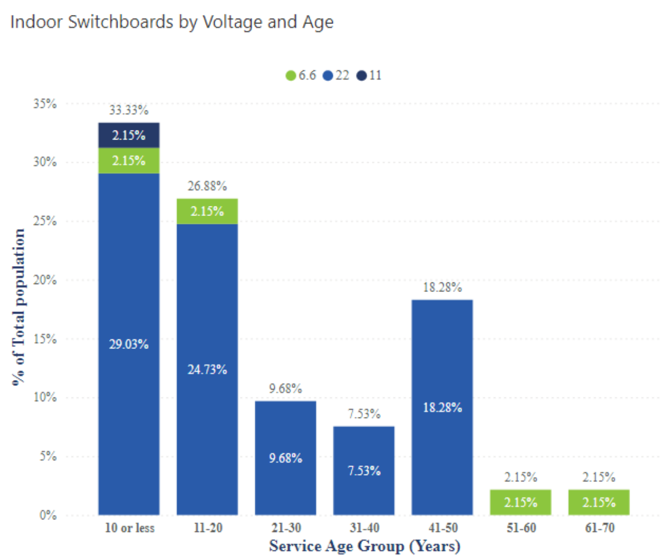


Figure 8 – Indoor switchboards Age Profile by type

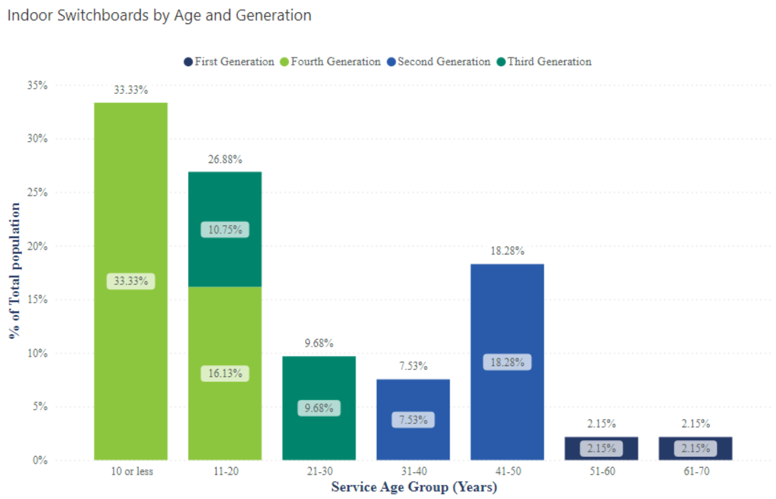
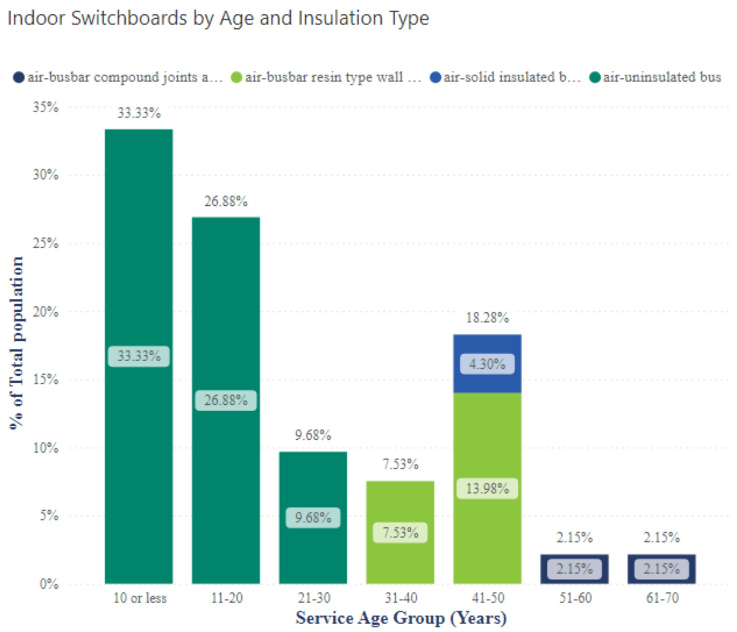


Figure 9 – Indoor switchboards Age Profile by bus bar insulation



- Approximately 77.4% of the total switchboard population are less than 40 years old and approximately 4.3% are older than 50 years which are operating at 6.6kV service voltage in open cut mines. (MWN & YN stations) (refer figure 8)
- First generation type switchboards are more than 50 years old and consist of air bus bar insulation with compound joints of feeder exists which are the oldest switchboards in service at zone substations. Second generation types fall into the age group of 30 -50 years while third generation type fall into 10 -20-year age group. Air uninsulated bus bar systems are relatively newer, and they are less than 30 years of age. (refer figure 8 & 9)

5. 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.

Risk of indoor circuit breakers in switchboards are taken into consideration in Circuit breaker AMS 20-54 where circuit breaker risk is the predominant factor for switchboard risk.

5.1. Probability of Failure

Probability of failure of an indoor switchboard predominantly determined by probability of failure of the associated indoor circuit breakers. Other failure modes are also described under section 5.1.1.

5.1.1. Failure Modes

Zone substation Indoor switchboards comprise of several components such as indoor circuit breaker, bus bar system, instrument transformers and underground feeder exit terminations installed in a compartmentalised air insulated environment. Indoor Circuit breaker is the key integral component in a switchboard which has the greater impact in general on switchboard failures. The type of circuit breakers in service in indoor switchboards are CBBO, CBMO and CBVU. Failure modes of associated circuit breaker types are explained in section 5.1.1. of AMS 20-54 Circuit breakers.

This strategy also describes other failure modes associated with indoor switchboards.

Other Failure Modes

There are other factors associated with switchboard failures other than the circuit breaker itself generally applicable to all types are explained below.

Typical Failure Modes

- **Insulation Degradation:** Insulation material can degrade over time due to thermal aging and environmental exposure, leading to reduced electrical performance and potential faults. Example: In older indoor switchboards, high temperatures can accelerate the degradation of insulation materials, compromising their ability to prevent electrical faults.
- **Moisture Ingress:** Moisture ingress can cause internal insulation materials to degrade, resulting in reduced dielectric strength and increased risk of electrical faults. Example**:** In a humid environment, moisture ingress into an indoor switchboard can lead to significant degradation of insulation materials, causing a phase-to-ground faults.
- **Mechanical Wear:** Components such as busbars, circuit breakers, and switches can suffer from wear and fatigue, affecting the device's ability to operate correctly. Example: Frequent operations of switchboards can wear down mechanical components, leading to slower or incomplete disconnection during faults.
- **Environmental Degradation:** Exposure to harsh environments, such as high humidity or corrosive atmospheres, can lead to corrosion of metal components and degradation of insulation. Example: Coastal regions can accelerate the corrosion of metal parts in indoor switchboards, leading to premature failure.
- **Thermal Overload:** Excessive current flow can cause components to overheat, leading to thermal degradation and potential failure. Example: Sustained high current can cause busbars and circuit breakers to overheat, leading to potential faults and failures.
- **Component Fatigue:** Repeated fault clearing can cause fatigue in the switchgear components, reducing their effectiveness over time. Example: Regular exposure to fault currents can wear out the internal components of circuit breakers, making them less reliable for future faults.

5.1.2. Probability of Failure Assessments

Probability of failure assessments of indoor switchboards is based on probability of failure (PoF) of circuit breakers located in the switchboard is explained in section 5.1.2 of AMS 20-54 Circuit breakers.

5.2. Consequence

Consequence of indoor switchboard failure (Cof) is based on failure of a circuit breaker located in the switchboard is explained in section 5.2 of AMS 20-54 Circuit breakers.

5.3. Risk Treatment

Risk Treatment of indoor switchboards is based on risk of failure of a circuit breaker located in the switchboard is explained in section 5.3 of AMS 20-54 Circuit breakers.

6. Performance

6.1.1. Performance Analysis

In the context of asset management for indoor switchboards, 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 electrical distribution network.

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.

6.1.2. Performance Profile

Figures 10 to 17 provide an analysis of notifications reported in SAP during the period 2020-2024.

Figure 10: ZA & Zk notifications during the period 2020 – 2024

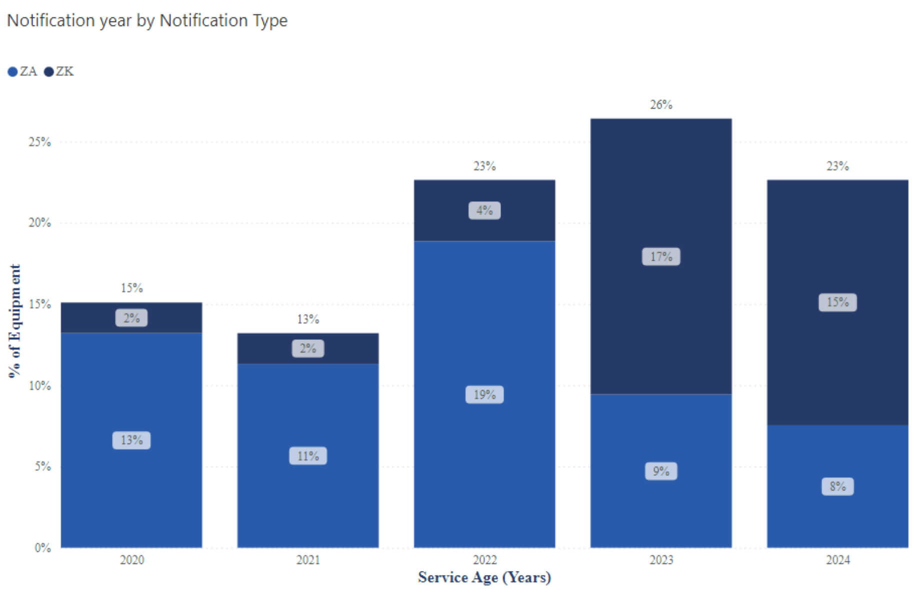


Figure 11: Zk notifications during the period 2020 – 2024 by service voltage

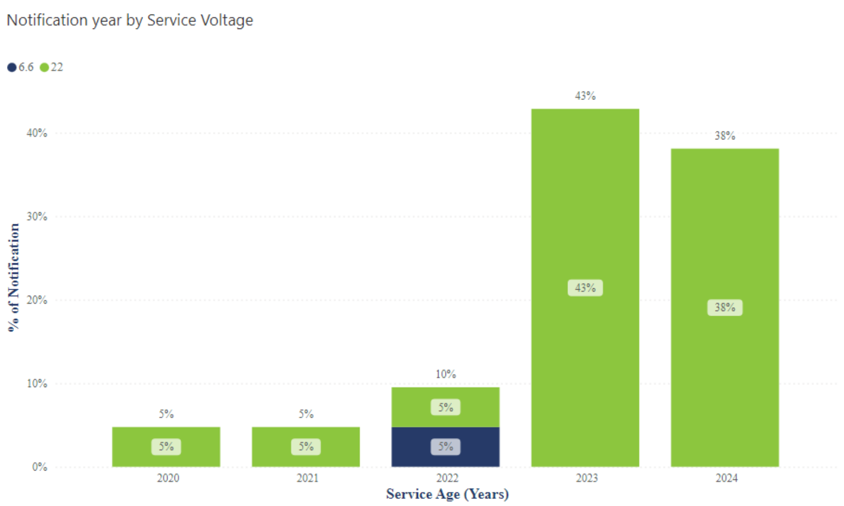


Figure 12: Zk notifications during the period 2020 - 2024 by type

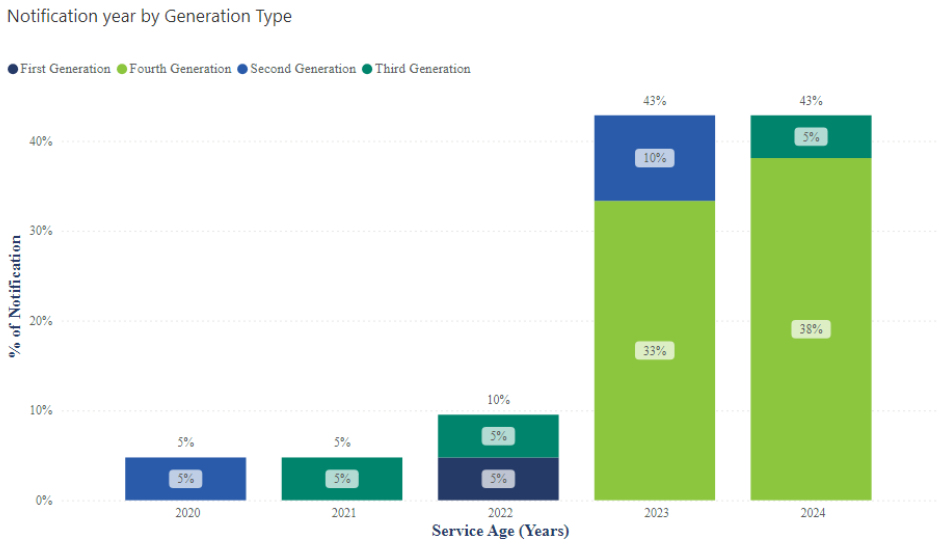


Figure 13: Zk notifications during the period 2020 - 2024 by age group

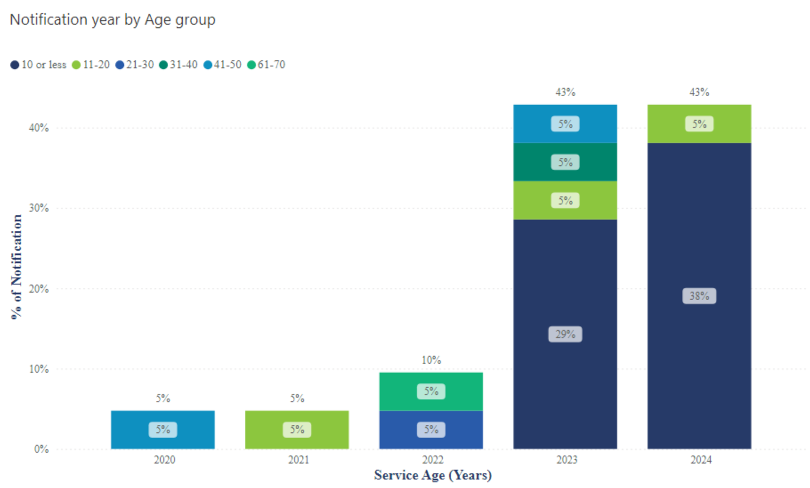


Figure 14: Zk notification rate during the period 2020 -2024 by type

ZK Notifications

Generation	Count of Notification	Total Count oF Busindoor and Switchboard	Notitifcations / year/Total population
Fourth Generation	15	76	8.1%
First Generation	1	8	1.1%
Second Generation	3	46	0.8%
Third Generation	3	42	0.8%

Figure 15: ZA notification rate during the period 2020 -2024 by type

ZA Notifications

Generation	Count of Notification	Total Count oF Busindoor and Switchboard	Notitifcations / year/Total population
Fourth Generation	15	76	4.0%
First Generation	4	8	2.2%
Second Generation	9	46	1.9%
Third Generation	5	42	1.3%

Figure 16: Zk notification by Manufacturer -Model during the period 2020-2024

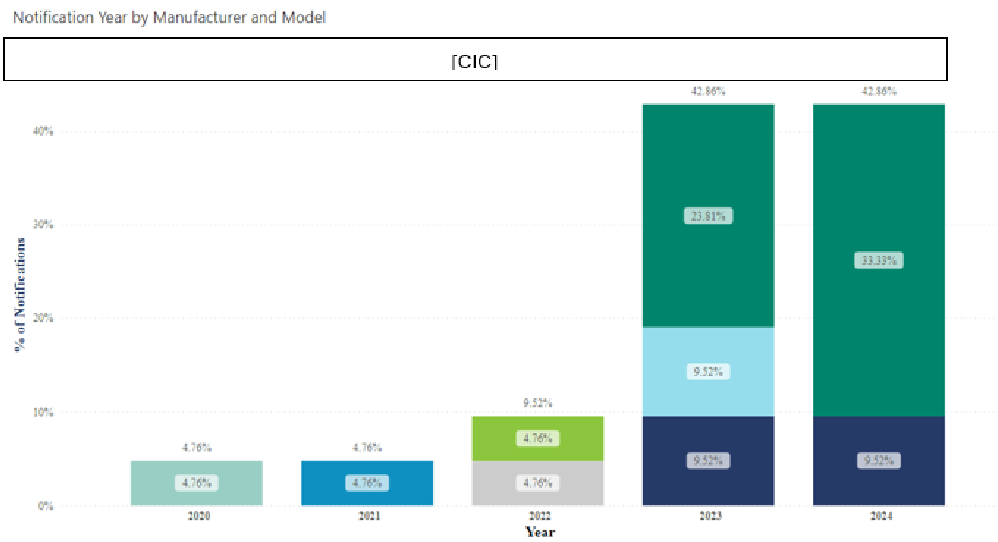
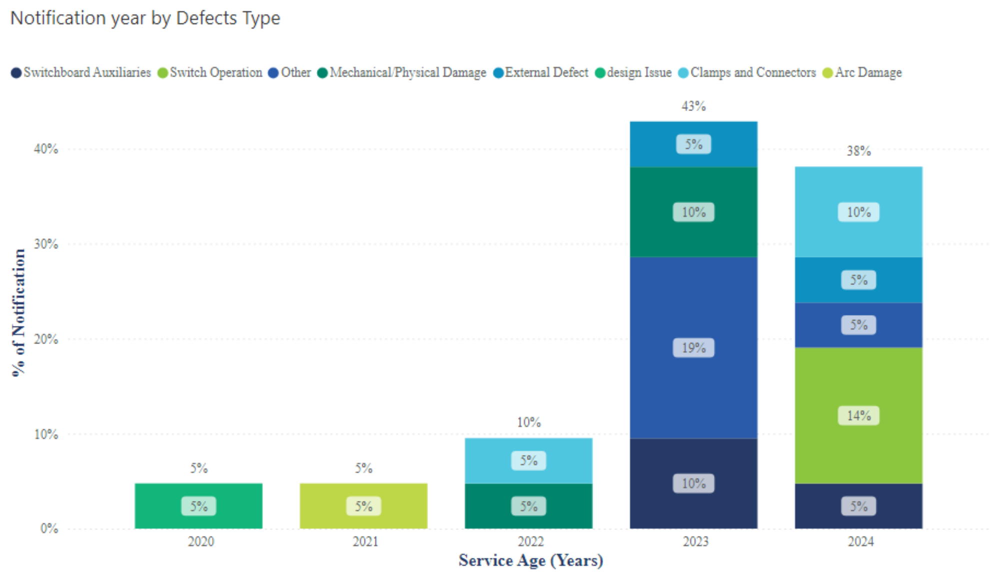


Figure 17: Zk failure notification by damage type during the period 2020-2024



Indoor switchboard notification analysis revealed following issues.

1. It is observed the Zk failure notifications are having an increasing trend over the period 2020-2024 mostly reported from 22kV switchboards. They are mainly reported from fourth generation (< 10 years age), third generation (11-20 years age) and second-generation (30-40 years age) type switchboards. (Refer figures 10 up to 13)
2. Zk and ZA notification rates are highest in fourth generation type (8.1%) and first-generation type (1.1%) switchboards. (refer figures 14 & 15)
3. It is noted the ZK notifications were mostly reported from [CIC](57.1%), [CIC] (19%) which are fourth generation type newer switchboards. Also noted the second highest reported from [CIC], second generation type switchboards (9.52 %). Together they contribute to approximately 85% of defects. (refer figure 16)
4. Reporting cause, object part and damage type recorded in notifications were not adequate to deduce the actual problems in switchboards. Root cause analysis will reveal detail causes and emerging issues. General overview of notification analysis indicates key defects in switchboards as mechanical damage in CB racking parts, switches and bus clamps and connectors (28.6%), switchboard auxiliaries (24%), design issues (5%), arc damages (5%) and other multiple issues. (refer figure 17) These defects may not require individual switchboard replacement but require review of current preventive and corrective maintenance management practices. It should be noted that only 50% of the indoor switchboards are type tested for internal arc flash (IAC) containment against arc flash risk hence maintenance of good health condition of switchboards is required for safety of personnel and reliability.

Above observations indicate the following:

1. Necessity of reviewing the planned maintenance regime of indoor type indoor switchboards and frequency of inspections in PGI 02-01-04. Refer section 8.3.
2. Process improvement is necessary for notification reporting coding categories mainly cause, object parts covered, damage type for accurate problem identification including root cause analysis for key issues. Refer section 7.4.

6.1.2.1. Catastrophic failures

There were no reported catastrophic failures reported during the period 2020-2024.

7. Related Matters

7.1. Regulatory Framework

Compliance Factors

No compliance consideration for station indoor switchboards involved.

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.

Refer to Section 9 for detailed guidance notes and references, supplied to support the assessment of this factor and the ways it impacts and influences the management of this Asset Class.

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.

Refer to Station Design Manual for detailed guidance notes and references, supplied to support the assessment of this factor and the ways it impacts and influences the management of this Asset Class.

7.2. External Factors

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.

Environmental Factors

Under the new Environment Protection Authority (EPA) regulation 2020, requires a prevention-based approach underpinned by general environment duty (GED) to minimise pollution impacts identifying and managing the risk by taking reasonable steps to eliminate them or minimise them. This involves management of oil pollution due to leaks from oil insulated circuit breakers. (CBBO & CBMO)

Environmental Management

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.

Stakeholder/ Social Factors

Not applicable.

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

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.

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

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.

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

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**.

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 is 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**.

Continuous Improvement

Continuous Improvement (CIP) is a critical lynchpin process in the overall application of asset management, particularly for managing Distribution Assets. CIP ensures that asset management practices remain effective, efficient, and adaptive to changing conditions and emerging challenges. By consistently seeking ways to enhance processes, technologies, and strategies, organisations can maintain high levels of performance, reliability, and safety. For example, regularly updating maintenance protocols for buildings, environmental systems, and security fences based on feedback and new insights can prevent issues before they become major problems, thereby extending the lifespan of critical infrastructure.

Best practice asset management promotes a culture of continuous improvement, encouraging organisations to regularly evaluate their asset management systems, identify areas for enhancement, and implement changes. This iterative process involves monitoring performance, analysing data, and applying lessons learned to refine practices. By focusing on CIP, organisations can ensure that their asset management activities remain dynamic, resilient, and aligned with best practices and strategic objectives. This approach not only enhances the overall efficiency and effectiveness of asset management but also supports long-term sustainability and success. **CIP differs from technology and innovation as well as R&D because it involves the ongoing enhancement of existing processes and**

practices based on real-world feedback and performance data, rather than the development and introduction of new technologies or the exploration of unproven ideas.

Targeted Activities (New Asset Strategies)

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	Process improvement is necessary for notification reporting coding categories mainly cause, object parts covered, damage type in SAP for accurate problem identification including root cause analysis for key issues. This is needed as a continuous improvement opportunity in enterprise management systems used for event recording.

8. Asset Strategies

8.1. New Assets

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.

Targeted Activities (New Asset Strategies)

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	Continue to specify fully internal arc fault contained compartmentalised indoor switchboards with external venting; consider motorised racking of vacuum circuit breakers for new installations.

8.2. Inspections 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.

Targeted Activities (Inspection and Monitoring Strategies)

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	Continue annual non-invasive condition monitoring scans ultrasonic and TEV /PD testing to evaluate any internal partial discharges in switchboards locations.
02	Explore opportunities to install continuous on-line Partial Discharge (PD) monitoring at high-risk indoor switchboards identified from yearly PD scans, to manage the failure risks until a refurbishment or replacement will be completed.

8.3. Maintenance Planning

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.

Targeted Activities (Inspection and Monitoring Strategies)

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	Review scheduled preventative maintenance procedures, Standard Maintenance Instructions for each indoor switchboard type in PGI 02-01-04.
02	Review planned inspection of bus chambers of all indoor switchboards in PGI 02-01-04

8.4. Renewals Planning

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.

Targeted Activities (Renewal Strategies)

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	Refurbishments: Review arc flash risks and mitigation methods to reduce safety risk
02	Refurbishments: Consider options - install arc flash relays in second and third generation switchboards,
03	Refurbishments: Consider options - Retrofit replacement of minimum oil indoor CBs with indoor vacuum CBs
04	Refurbishments: Consider options - motorised CB racking for first- and second-generation indoor switchboards
05	**Technical Obsolescence /Spares Management** Manufacturers generally cease to formally support when switchboards are older and could not normally obtain OEM spares parts beyond 30 years. Although serviceability can be improved midway through asset operational life, by increasing the level of spares held in stores just before the OEM ceases manufacture stores holding will deplete to the point that salvaging components and reverse engineering become the only means of supporting a fleet. As the switchboards become older, wear of parts of CB and earth trucks, malfunctioning of CB shutters, interlocks, damage or weakened parts of insulated components do occur. Poor HV and secondary insulation had been noticed in some first-generation switchboards. Also reused components cannot economically extend asset lives further and at this point it will become technically obsolete. In regard to indoor minimum oil circuit breakers, mainly [CIC], [CIC] and [CIC] circuit breakers located in first- and second-generation indoor switchboards are now technically obsolete, and no manufacturer support is available, and the availability of spares is very limited. Retrofitting these circuit breakers with indoor vacuum circuit breakers is an option but the retrofit solution needs customisation to match the existing switchboard technical requirements including further safety improvements are necessary.
06	Spares Management: Maintain strategic spares holding for each indoor switchboard Make, consider modular spare options

8.5. Decommissioning

A strategic asset strategy for decommissioning 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 removing assets from service, detailing the conditions under which decommissioning 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.

9. Legislative References

STATE	REGULATOR	REFERENCE
VIC	WorkSafe Victoria	Occupational Health and Safety Act 2004
VIC	Energy safe Victoria	Arc Flash Hazard Management Guideline July 2022
VIC	Environment Protection Authority	Section 25 -General environment Duty: Environment protection Act -2017

10. Resource References

NO.	TITLE	DOCUMENT TITLE
1	AMS 20 -54	Circuit Breakers
2	AMS 20-63	Instrument Transformers
3	QMS 20-04	Documented information Control
4	AMS 01-09	Asset Risk Assessment Overview
5	AS ISO 31000	Risk Management – Guidelines
6	AMS 01-01	Asset Management System Overview
7	AMS 20-01	Electricity Distribution Network Asset Management Strategy
8	PGI 02-01-04	Summary of Maintenance Intervals – Distribution Plant Guidance and Information
9	SDM	Station Design Manual

11. Schedule of revisions

ISSUE	DATE	AUTHOR	DETAILS OF CHANGE	APPROVED BY
1	27/08/2019	N Boteju	Original version	P Ascione
2	22/01/2025	N Boteju	Review and update	

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