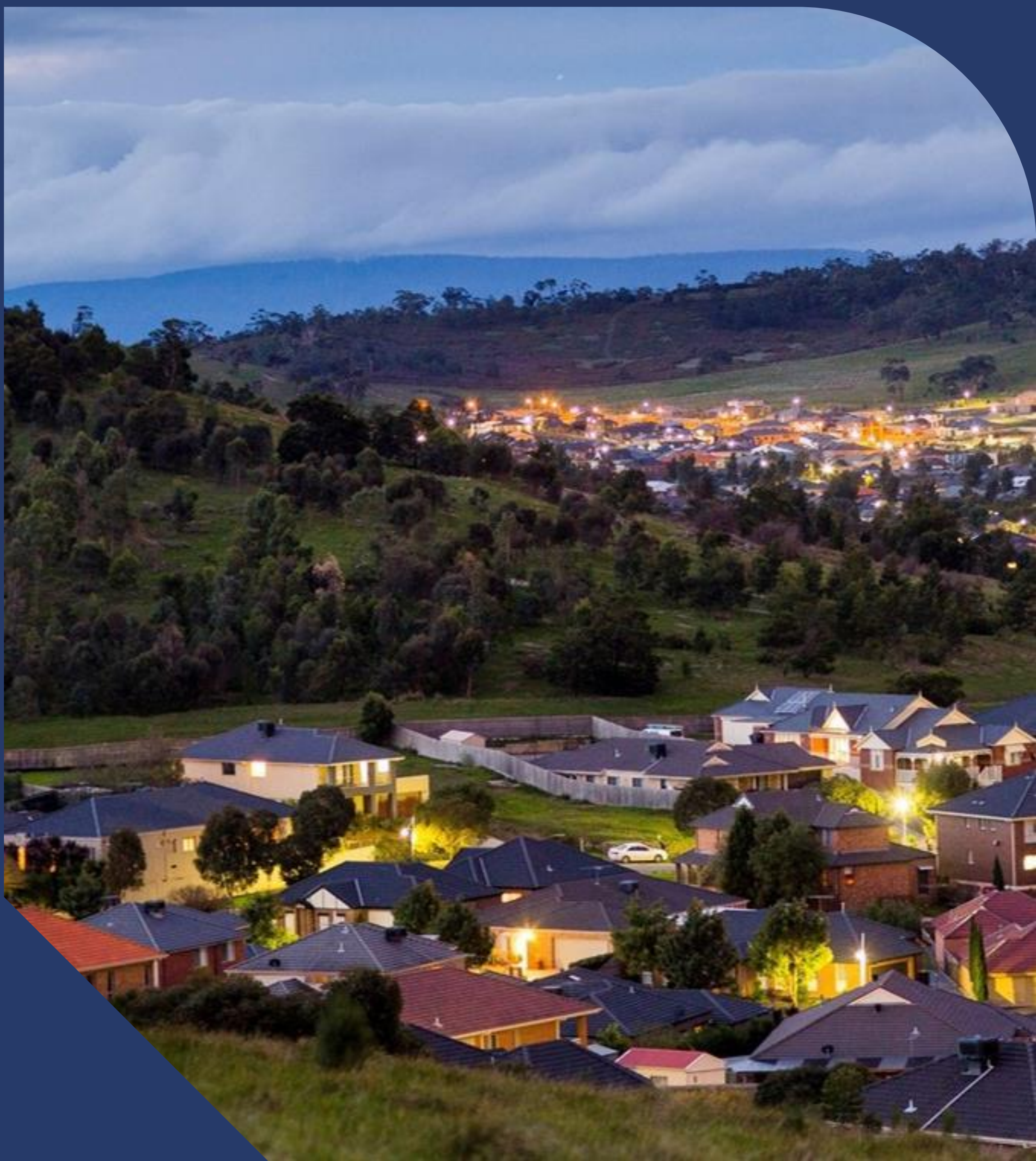
Lines Surge Arresters

AMS - Electricity Distribution Network



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1. Executive Summary

This document is part of the suite of Asset Management Strategies relating to AusNet Services' 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 line surge arresters in AusNet Services' Victorian electricity distribution network.

This strategy is focused on 155,000 line surge arresters protecting distribution substations; automatic circuit reclosers (ACRs) and gas-insulated switches; line voltage regulators; capacitors; and underground cable termination poles.

Line surge arresters have been installed on new medium voltage installations since the mid-1970s to limit electricity supply outages. After 1980, considerable numbers of surge arresters were replaced in order to reduce the risk of fire ignition from the network. Hence, the existing population of surge arresters is relatively young, with a mean service age of 20 years.

Since 2017, Rapid Earth Fault Current Limiter (REFCL) has been the major driver for the line surge arresters' replacement. Following the installation of REFCL technology, line surge arresters must cater for elevated phase to ground voltages up to 24.2kV (i.e. 22kV plus 10%). Line surge arresters that cannot withstand elevated voltages will need to be replaced.

A high-intensity lightning strike near a surge arrester can generate surge voltages and currents in excess of the ratings of the surge arrester. In some cases, the surge arrester cannot dissipate the energy of the lightning and will fail due to a combination of excessive internal pressures and arcing damage to the housing exterior. Sustained interruptions to electricity supplies, fire ignition and collateral damage usually accompany these failures.

Condition assessment shows that about 87% of line surge arresters are in "very good" (C1) condition mainly due to the REFCL driven surge arrester replacement project.

In order to manage the risk "as far as practicable" as per the Electricity Safety Act, it is recommended to proactively replace line surge arresters located in the high consequence effect and worst condition regions.

1.1. Asset Strategy Summary

1.1.1. New Assets

- Install metal oxide surge arresters with polymeric housing in accordance with AusNet Services' published standards
- Install animal proofing on Surge Arresters (Refer to ETB 005-2018)

  Install Class A arrester as per REFCL requirements (Refer to ETB 001-2019B)

1.1.2. Inspections and Monitoring

- Inspect line surge arresters in accordance with Asset Inspection Manual 30-4111

1.1.3. Maintenance Planning

- Maintain line surge arrester as per the Standard Maintenance Guidelines 70-03

1.1.4. Replacement Planning

- Progressively replace line surge arresters in high risk areas as per risk matrix
- Reactively replace defective or faulty line surge arresters

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 line surge arresters in AusNet Services' 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. This document demonstrates responsible asset management practices by outlining economically justified outcomes.

2.2. Scope

This Asset Management Strategy applies to all line surge arresters associated with the AusNet Services electricity distribution network that operate at 22 kV, 12.7kV, 11 kV and 6.6 kV.

Surge arresters in substations are not covered in this document. Asset management strategies for surge arresters in zone substations are described in AMS 20-77 "Surge Arresters in Zone Substations"

2.3. Asset Management Objectives

As stated in *AMS 01-01 Asset Management System Overview*, the high-level asset management objectives are:

- Operate to our risk appetite
- Optimise risk, cost and performance
- Improve network reliability
- Meet customer service objectives
- Reduce safety risks and meet our obligations
- Support the energy transition
- Increase community energy resilience
- Sustainability and modernisation of the network

As stated in *AMS 20-01 Electricity Distribution Network Asset Management Strategy*, the electricity distribution network objectives are:

- Improve network performance
- Leverage advances in technology and data analytics
- Reduce bushfire risk
- Reduce electric shocks from network assets
- Deliver REFCLs
- Meet metering compliance obligations
- Meet quality of supply obligations

3. Abbreviations and definitions

TERM	DEFINITION
ACR	Automatic Circuit Reclosers
AMS	Asset Management Strategy
MO	Metal Oxide
SiC	Silicon Carbide
IRU	Ignition Risk Units
RSL	Remaining Service Life
STPIS	Service Target Performance Incentive Scheme
REFCL	Rapid Earth Fault Current Limiter
PoF	Probability of Failure
CoF	Consequence of Failure

4. Asset description

4.1. Function

Line surge arresters are installed on AusNet Services electricity distribution network to protect distribution apparatus connected to the overhead network from impulse, over-voltage damage; typically, due to lightning strikes and switching surges.

4.2. Population

4.2.1. Population Considerations

The population profile for Line Surge Arresters 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 line surge arresters are essential for maintaining the integrity and reliability of the network
- **Allocate resources efficiently**: Plan and allocate maintenance resources effectively by knowing the exact number and location of assets.
- **Risk management**: Assess and manage risks associated with different assets.
- **Optimise maintenance schedules**: Develop optimised maintenance schedules based on the distribution and condition of assets.
- **Enhance reliability and safety**: Ensure that all components, including line surge arresters, meet the required standards for reliability and safety.
- **Support strategic planning**: Inform long-term strategic planning and investment decisions.

4.2.2. Geographic Impact Areas

The AusNet Services electrical distribution network feeds electricity to 802,000 customers across eastern and north-eastern Victoria, and in Melbourne's north and east. This region encompasses a diverse range of geographic locations, each with specific environmental impacts on line surge arresters. Understanding these impacts is essential for effective asset management within the AusNet Services electrical distribution network.

Notable examples include:

- **Elevated Regions and Open Plains** : Line surge arresters may subject to significant stress in high wind and lightning strike areas..
- **Corrosive Areas**: Coastal areas and industrial regions where salt and pollutants are prevalent can cause corrosion of metallic components in line surge arresters
- **Bushfire Areas**: Bushfire-prone areas, common in many parts of Victoria, pose a risk of fire damage to line surge arrester infrastructure.

4.2.3. Population by Type

4.2.3.1. Polymeric Housing with Metal Oxide (MO) Type

- **Summary Explanation of Form and Function**: Polymeric housing with MO type line surge arresters feature a gapless design and utilise modern technology. These arresters respond quickly to over-voltage transients, providing improved protection compared to older silicon carbide units. The design includes reduced failure modes due to the absence of seals and minimised moisture ingress.

- **Purpose within the Asset Class**: These surge arresters serve to protect distribution apparatus from impulse and over-voltage damage, especially in environments with elevated voltage requirements; typically due to lightning strikes and switching surges.
- **Purpose within the Network Design**: In the network design, polymeric housing MO type arresters are installed to ensure reliable over-voltage protection across various voltage ratings (22 kV, 12.7 kV, 11 kV, and 6.6 kV), making them suitable for modern distribution networks.
- **Process Function**: The arresters continuously monitor the network for over-voltage events and respond quickly to protect the distribution apparatus. Their design ensures minimal moisture ingress and a robust response to transient over-voltages.

4.2.3.2. Porcelain Housing with Silicon Carbide (SiC) Type

- **Summary Explanation of Form and Function**: Porcelain housing with SiC type line surge arresters utilise an older gapped design. These arresters have a slower response to over-voltage transients and are more susceptible to moisture ingress compared to polymeric housing units.
- **Purpose within the Asset Class**: These surge arresters are generally being phased out and replaced by newer technology due to their lower performance and higher susceptibility to failure modes.
- **Purpose within the Network Design**: In the network design, porcelain housing SiC type arresters are suitable for standard voltage requirements without the need for enhanced voltage protection. They cover nominal voltage ratings of 22 kV, 12.7 kV, 11 kV, and 6.6 kV.
- **Process Function**: The arresters operate by responding to over-voltage events, but their gapped design results in a slower response time. They are more prone to failure due to moisture ingress and other environmental factors.

Figure 1 below shows an old technology porcelain housed surge arrester (on the left) and Figure 2 shows the polymer housed surge arresters (on the right).

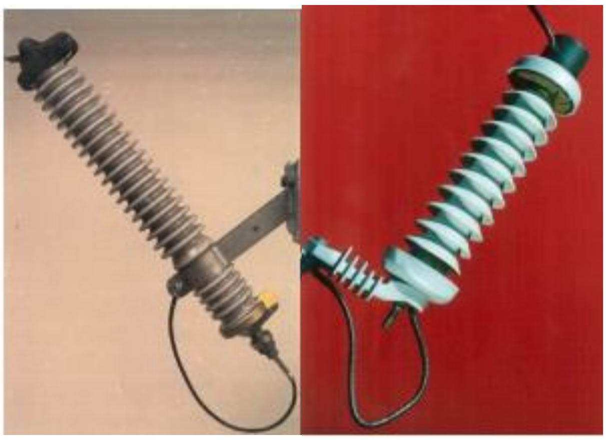

Figure 1(Left)- [CIC] porcelain housed surge arrester

Figure 2(Right)- [CIC] polymer housed surge arrester

A polymer housed surge arrester (marked in red circle) fitted to an isolating transformer is shown below:

Figure 3- Polymer housed surge arrester fitted to an isolating transformer

4.2.4. Population Profile

4.2.4.1. Population by Type

There are approximately 30 different types of surge arresters employed on medium-voltage installations, as illustrated in Table 1.

Table 1 - Surge Arrester by Type

SURGE ARRESTER TYPE	MANUFACTURE	% OF FLEET
A	Silicon Carbide [CIC] (1982-1988)	7.7%
B	Grey Silicon Carbide [CIC] (1980-1981)	<1%
C	Silicon Carbide [CIC] (1973-1978)	<1%
D	Silicon Carbide [CIC] (1978-1982)	<1%
E	Zinc Oxide [CIC] (1985-1989)	<1%
F	Zinc Oxide [CIC] (1988-1992)	<1%
G	SWER Silicon Carbide [CIC] (1980-1983)	<1%
H	SWER Silicon Carbide [CIC] (1973-1978)	<1%
I	Black Unacceptable [CIC] (1961-1962)	<1%
J	Brown Unacceptable	<1%
K	Grey Unacceptable [CIC] (1972)	<1%
L	Grey [CIC] Unacceptable XBE (1986-1987)	<1%
M	No Earth Lead Disco [CIC] (1985-1995)	<1%
N	Polymeric MVK [CIC] (1995-1999)	1.8%
O	Polymeric MWK [CIC] (1995-1999)	<1%
P	Polymeric EMP [CIC] (1991)	1.6%
Q	Polymeric EGB [CIC] (1995-1997)	<1%

R	Polymeric HEB [CIC] (1995-1997)	<1%
S	Polymeric HEA [CIC] (1995-1997)	<1%
T	H.D.A Polymeric [CIC] (1992)	<1%
V	Polymeric Varistar [CIC] (1992)	<1%
W	Polymeric Varigap [CIC] (1992)	<1%
X	[CIC] Class A (Fire) Cooper (1999-)	45.4%
Y	[CIC] Class C Coopers (1999-)	5.2%
[CIC] -A	3EK7 SD [CIC] (2008-)	3.6%
[CIC] -A	Polim D SD [CIC] (2009-)	<1%
[CIC]	Current Limiting Arcing Horn - [CIC] (2013-)	<1%
[CIC] -K	Polim K22-80 SD [CIC] (2015-)	<1%
[CIC] -C	[CIC] C8AA 24kV (2015-)	1.3%
[CIC]-27	[CIC] 27kV(UC 22kV [CIC]) (2017-)	10.6%
[CIC]-27	OHIO Brass 27kV(UV 22kV [CIC]) (2018-)	18.1%
[CIC]-27.5	[CIC] POLIM D 27.5kV(UC 22kV) (2018-)	1.5%

Approximately 45% of surge arresters are [CIC] Class A type with metal oxide semi-conducting blocks and a polymeric housing. The next most common surge arrester type formatting approximately 18% of the total fleet is the OHIO Brass 27kV. The [CIC] Brss arresters was approved Class A arrester for use on the Distribution Network since 2018, due to REFCL requirements and improvements to animal proofing structures

About 11 types have fewer than 100 surge arresters in service as they are being progressively replaced by newer polymer housing surge arresters.

4.2.4.2. Population by Housing Material

Since 2009, the proportion of polymeric housing line surge arresters has increased from 32% to 90%.

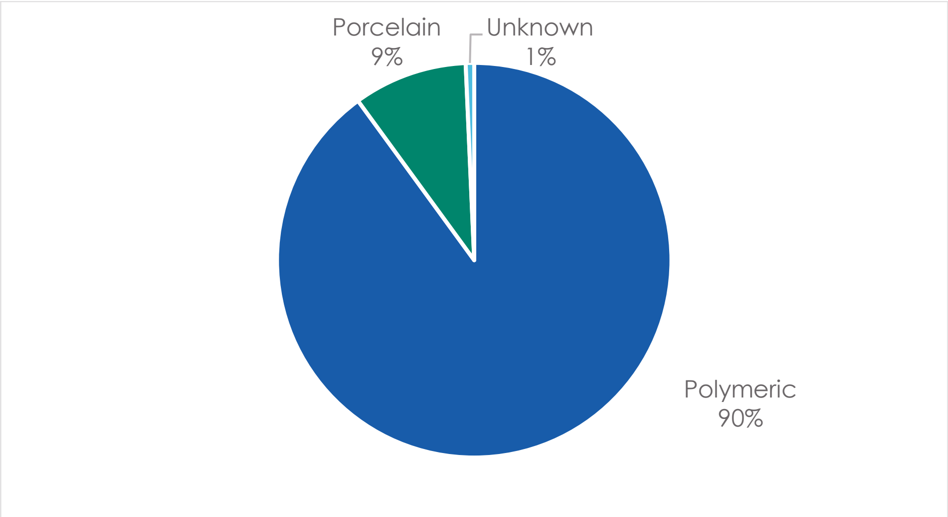

Figure 4 - Surge Arresters by Housing Material

4.3. Age

4.3.1. Age Profile

Surge Arresters that are currently in service have an average of 20 years with the standard deviation of 14 years.

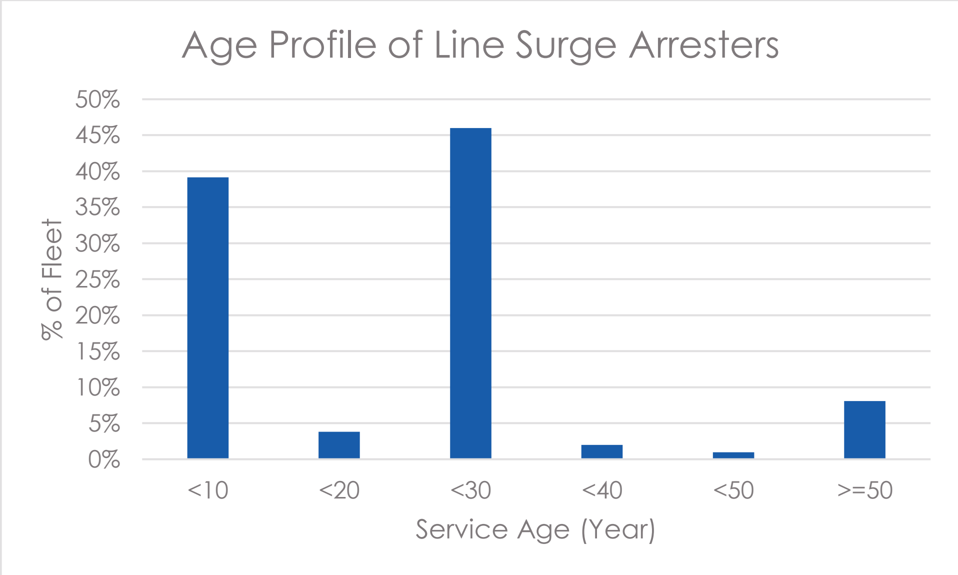

Figure 5 - Surge Arrester Age Profile

5. Strategic Asset Management

5.1. Condition

5.1.1. Condition Assessments

5.1.1.1. Condition Assessment Protocols

Condition assessments are a critical element of lifecycle management for line surge arresters. These assessments provide vital information on the current state and performance of the arresters, enabling informed decision-making regarding maintenance, repair, and replacement.

Condition assessments involve a systematic evaluation using specific benchmarks and a rating scale to describe the health and performance of line surge arresters. AusNet employs a standard approach to condition assessments that employs a 5-point rating scale to assign assets a condition rating score.

The AusNet 5-point rating scale categorises assets based on their current condition and performance:

- **Condition 1 (C1)**: A rating of Condition 1 indicates an asset in very good condition. Surge arrester is at new condition and incorporates the new metal oxide designs with polymer housings. They are in an acceptable visual condition with no signs or corrosion, tracking or damage and have no historical problems. The standard AusNet Asset Condition scoring card benchmarks the remaining useful life of Condition 1 (C1) assets at 95%.
- **Condition 2 (C2)**: A rating of Condition 2 reflects good condition. Surge arresters incorporate the new metal oxide designs with polymer housings and are in acceptable visual condition. There is none or very little historical problems. The standard AusNet Asset Condition scoring card benchmarks the remaining useful life of Condition 2 (C2) assets at 70%.
- **Condition 3 (C3)**: A rating of Condition 3 signifies average condition Surge arresters incorporate metal oxide designs with polymer housings. They are in an acceptable visual condition and may have some historical problem. The standard AusNet Asset Condition scoring card benchmarks the remaining useful life of Condition 3 (C3) assets at 60%.
- **Condition 4 (C4)**: A rating of Condition 4 indicates poor condition. Surge arresters incorporate silicon carbide designs with porcelain housings and some metal oxide designs with polymer housings. They are beginning to develop signs of deterioration on the insulator material, the housing, vending duct covers and/or diaphragm. The standard AusNet Asset Condition scoring card benchmarks the remaining useful life of Condition 4 (C4) assets at 45%.
- **Condition 5 (C5)**: A rating of Condition 5 represents assets in very poor condition. Surge arresters are typically the old technology type that incorporates silicon carbide designs with porcelain housings. The visual condition is unacceptable as major signs of deterioration on the insulator material, seals or caps are visible or tracking and mechanical damage to the housing. Surge arrester is experiencing advanced performance deterioration. Condition scoring card benchmarks the remaining useful life of Condition 5 (C5) assets at 25%.

The condition scoring methodology outlined above provides high-level scoring criteria that apply to line surge arresters within AusNet's electrical distribution network. These scoring criteria offer a broad framework for assessing the general condition and remaining life of assets, ensuring consistency and comparability across asset management activities.

5.1.1.2. Asset Specific Monitoring Considerations

To accurately evaluate the condition of each specific asset within a given asset class, it is essential to further refine the benchmarks associated with condition scoring. Each asset class, such as polymeric and porcelain housing surge arresters, has unique characteristics and operational requirements that necessitate more detailed benchmarks.

Developing these more granular benchmarks may involve considerations such as:

- **Customising Indicators**: Identifying specific indicators of wear, degradation, and performance relevant to each asset type.
- **Detailed Inspections**: Conducting thorough inspections tailored to the asset class, incorporating both visual assessments and technical measurements.

- **Historical Data Analysis**: Assessing historical performance and maintenance data to establish norms and thresholds for each condition score.
- **Environmental Factors**: Considering the impact of local environmental conditions, which can influence asset condition.

5.1.2. Condition Profile

5.1.2.1. Line Surge Arresters condition summary

Condition summary for line surge arrester is shown in Figure 6.

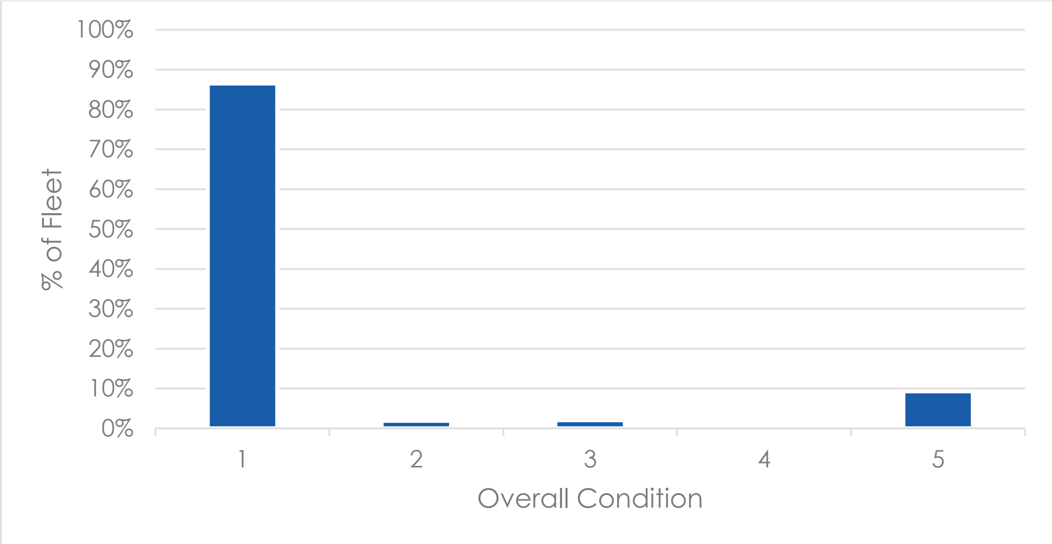

Figure 6 - Surge Arresters condition summary

Approximately 87% of line surge arresters are in "very good" (C1) condition mainly due to REFCL driven surge arrester replacement.

5.2. Criticality

5.2.1. Risk and Criticality

To effectively manage the lifecycle of line surge arresters, it is essential to understand the criticality of these assets. This involves evaluating the potential impact of failures. The criticality assessment is a key component of asset management as it helps prioritise maintenance, upgrades, and replacements.

To measure the criticality of assets, AusNet Services utilises a risk and criticality approach. This approach involves evaluating both the likelihood of failure and the potential impact of such failures. The process starts by identifying key risk factors, including environmental exposure, historical performance data, and the results from regular condition assessments.

The criticality of each asset is determined by considering two main factors: the probability of failure (PoF) and the consequence of failure (CoF). The PoF is influenced by factors such as environmental conditions (e.g. high winds, corrosion, bushfire risk) and historical failure rates. Advanced diagnostic tools and inspections help in quantifying this probability. The CoF is assessed based on the potential impact on network reliability, safety, and service continuity. This includes the number of customers affected, the strategic importance of the asset in the network, and the cost of repairs and downtime.

A criticality matrix is used to map these factors, with the PoF on one axis and the CoF on the other. Assets that fall into the high-risk category (high PoF and high CoF) are prioritised for maintenance, upgrades, or replacement. This approach ensures that resources are allocated efficiently, focusing on assets that pose the greatest risk to network reliability and safety. Details of the Asset Risk Matrix can be found in AMS 01-06-01.

The risk matrix, showing the combination of PoF and CoF of Line Surge Arrester locations, in non-REFCL areas is shown in Table 2. The greatest risk appears on the top right corner, whereas the lowest risks are at the bottom left corner.

Table 2 - Risk matrix of Line Surge Arresters (by location) in non-REFCL regions.

		Consequence				
		Insignificant	Minor	Moderate	Major	Catastrophic
Likelihood	5	0	3	23	9	3
	4	0	12	29	91	5
	3	0	105	774	8027	854
	2	2	232	917	2772	395
	1	6	2311	11996	30804	5953

5.2.2. Failure Modes

5.2.2.1. Application of 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.

5.2.2.2. Failure Modes by Asset Class

As noted above, assessing failure modes and utilising the detailed information about each mode plays a crucial role in various aspects of Asset Management Planning. Understanding failure modes enhances the effectiveness of risk management efforts and ensures the optimal performance and reliability of assets within the electrical distribution network. Some notable failure modes for line surge arresters are detailed below.

- **Leakage Currents Trigger Disconnection:** The predominant failure mode for surge arresters arises toward the end of their effective life when the internal silicon carbide or metal oxide blocks allow the passage of power frequency leakage currents to flow through the earth leakage disconnect (ELD) device to earth.

  Leakage currents trigger a pyrotechnic charge within the base of the surge arrester, generating high-pressure gasses to blow the earth lead clear of the lower end of the surge arrester. This action disconnects the surge arrester from its earth connection, rendering it inoperative. The surge arrester remains connected to the MV conductors. The new position of the ELD provides a signal for asset inspectors that the surge arrester is no longer operative.

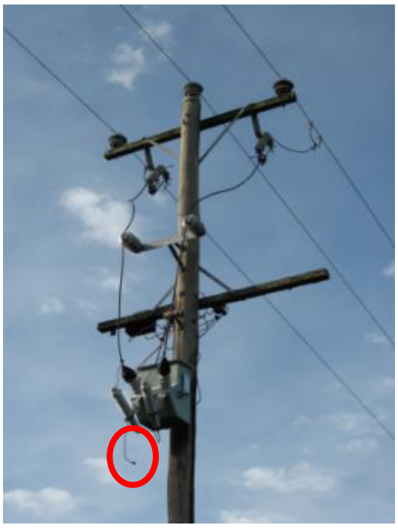

Figure 7 - Operation of an Earth Lead Disconnector

Seal Failure Allow Moisture Ingress: A common failure mode for silicon carbide surge arresters is the deterioration of the sealing medium between end caps and the housing allowing moisture ingress. The moisture is distributed between the outer face of the semi-conducting blocks and the inner face of the housing. Over time, the presence of moisture allows power frequency leakage currents to flow from the MV conductor to earth. These currents do not pass through the earth lead disconnect device but generate high-pressure steam between the blocks and the housing. This can rupture the surge arrester and may lead to an explosion. In the early 1980s, it became evident that under certain circumstances some classes of porcelain surge arresters could explode and shatter releasing hot metal fragments. This failure mode causes particular risks because the failure violently propels hot semi conducting blocks and porcelain shards from the surge arrester. This failure mode is usually accompanied by a sustained outage as upstream fuses, ACRs and CBs operate to interrupt power frequency follow-through currents. Fire ignition and collateral damage can result from failures of this type. To address this issue surge arresters were introduced in the network with explosion relief features and earth lead disconnect device, which automatically disconnects the surge arrester if power frequency current flows.

The polymeric housings moulded over the semi-conducting blocks of zinc oxide surge arresters can ignite under arcing faults, as illustrated in Figure 8. However, the absence of gaps between semi conductive blocks and the polymeric housing greatly reduces the probability of moisture ingress and consequences associated with explosive failures.

Figure 8 - Failure of Polymeric Surge Arrester Housing

- **External Arching Fault:** Surge arresters are installed close to the bushings and the earthed tank of transformers they are intended to protect. If the connections to the transformer are not fully insulated, birds or animals can bridge the energised conductor to earth.

The presence of a medium-voltage arc in close proximity to the transformer bushings can damage the housing of the surge arrester, the transformer bushings, the connections and any insulating covers. As with internal arcing faults, this mode of failure is accompanied by a sustained interruption to electricity supply as upstream protection operates to interrupt power frequency fault currents. Fire ignition and collateral damage can result from failures of this type.

- **Amplitude of Lightning Strike Exceed Surge Arrester Ratings:** A high-intensity lightning strike near a surge arrester can generate surge voltages and currents in excess of the ratings of the surge arrester. In some cases, the surge arrester cannot dissipate the energy of the lightning and will fail due to a combination of excessive internal pressures and arcing damage to the housing exterior. Sustained interruptions to electricity supplies, fire ignition and collateral damage usually accompany these failures.

5.3. Performance

5.3.1. Performance Analysis

In the context the management of assets and asset types 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.

5.3.2. Performance Profile

5.3.2.1. Surge Arresters Related Notifications

Since 2020, the causes of completed notification raised in Enterprise Asset Management System – SAP are shown in Figure 9. 44% of the cause of notification was related to Lightning.

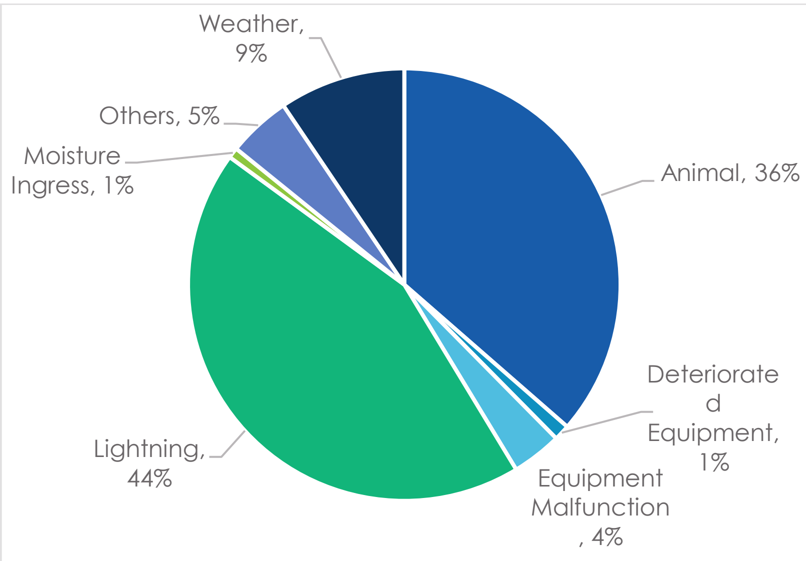

Figure 9 - Cause of Surge Arrester Related Notification recorded in SAP

5.3.2.2. Fire Ignition

There were no surge arresters related fires reported since FY17.

6. Regulatory Framework

6.1. Compliance Factors

The Victorian Government has mandated the rollout of Rapid Earth Fault Current Limiter (REFCL) installations across nominated zone substations in AusNet Services' network. Twenty-two zone substations and the associated 22kV feeders were modified to allow for resonant earthing. Line hardening work is one of the give work streams that comprise the REFCL installation program. Details of the line hardening strategy can be found in REF 20-07.

Surge Arresters that are fitted in the REFCL protected network (high impedance) must be capable of sustaining the elevated voltages which occur on healthy phases in response to a phase to ground fault. Sustained over-voltages will be experienced regularly during REFCL operation. Surge arrester types that are unsuitable for withstanding REFCL voltage rise were identified.

6.2. 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. Asset Strategies

7.1. New Assets

7.1.1. 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.

A list of targeted activities apply to new asset is shown in Table 3

Table 3 - Targeted Activities on New Assets

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	Install metal oxide surge arresters with polymeric housing in accordance with AusNet Services' published standards.
02	Install animal proofing on Surge Arresters (Refer to ETB 005-2018)
03	Install Class A arrester as per REFCL requirements (Refer to ETB 001-2019B)

7.2. Inspections and Monitoring

7.2.1. Inspections and Monitoring Planning Considerations

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.

Line surge arresters get inspected as part of the routine pole inspection as per the Asset Inspection Manual 30-4111. Inspection includes visual assessment of surge arresters and recording any defects such as failed lead, broken lead, chipped porcelain or missing surge arresters and fittings.

A list of targeted activities apply on inspection and monitoring is shown in Table 4.

Table 4 - Targeted Activities on inspection and monitoring on line surge arresters

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	Inspect line surge arresters in accordance with Asset Inspection Manual 30-4111

7.3. Maintenance Planning

7.3.1. Maintenance Planning Considerations

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.

The standard maintenance guideline for Line surge arresters is detailed in 70-03.

A list of targeted activities apply on maintenance planning is shown in Table 5.

Table 5 - Targeted Activity on Maintenance Planning

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	Maintain line surge arrester as per the standard maintenance guideline70-03.

7.4. Replacement Planning

7.4.1. Replacement Planning Considerations

A strategic asset strategy for replacements provide 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.

A list of targeted activities apply to surge arrester replacement is shown in Table 6.

Table 6 - Targeted activities on line surge arrester replacement

REF	DETAILS OF MATERIAL CONSIDERATIONS
01	Progressively replace line surge arresters in high risk areas as per risk matrix
02	Reactively replace defective or faulty line surge arrester

8. Risk and options analysis

8.1. Overview

Line Surge Arresters are essentially maintenance-free devices. If it is correctly installed, there is no maintenance during the life of a modern line surge arrester, except for targeted retrofitting of bird and animal insulating covers to reduce the incident of arcing faults over the surge arrester housing.

8.2. Replacement forecast

Replacement forecast is derived from a semi-quantitative risk assessment method using a consequence/likelihood matrix.

In order to manage risk “as far as practicable” as per Electricity Safety Act. It is recommended to address line surge arresters with the worst condition located in the highest consequence effect region as shown in Table 2.

Line surge arresters may also be replaced with other asset replacement works, for example, pole, switches and distribution transformer replacement. SAP notification analysis shows that an estimated one-third of the line surge arresters will be replaced due to this reason.

It is estimated that 299 line surge arresters will be targeted for replacement per annum during the EDPR period of 2026 to 2031.

Table 7 summarises the replacement forecast.

Table 7 - Replacement Forecast

IDENTIFIER	JUSTIFICATION	ESTIMATED CONTRIBUTION PER ANNUM
Replacement	Probabilistic replacement based on risk matrix, and due to defect or fault	299

9. Legislative references

STATE	STANDARD	REFERENCE
All	AS 2209-1994	Wood Poles for Overhead Lines
All	AS/NZS 4676-2000	Structural Design Requirements for Utility Services Poles

10. Resource references

NO.	ID (LINK)	TITLE
1	30-4111	Asset Inspection Manual
2	AMS 01-01	Asset Management System Overview
3	AMS 20-01	Electricity Distribution Network Asset Management Strategy
4	BFM 10-01	Bushfire Mitigation Plan- Electricity Distribution Network
5	BFM 21-79	Bushfire Mitigation Manual
6	ESMS 20-01	Electricity Safety Management Scheme: Electricity Distribution Network
7	DES 10-18	Wood Poles Specification
8	SOP70-03	Standard Maintenance Guidelines

11. Appendices

None

12. Schedule of revisions

ISSUE	DATE	AUTHOR	APPROVED BY	DETAILS OF CHANGE
1	19/09/2008	D Postlethwaite C Rathbone		Initial document
2	13/03/2009	J KenyonD Postlethwaite		Editorial by technical writer
3	26/05/2009	D Postlethwaite	G Towns	Clarified forecast is single phase units
4	13/10/2009	D Postlethwaite	G Towns	Update following review of RCM models by ARMs Reliability Engineer
5	12/11/2009	D Postlethwaite	G Towns	Review by Parsons Brinckerhoff
6	25/11/2009	D Postlethwaite	G Towns	Added replacement volumes to executive summary
7	18/11/2014	P Seneviratne G Jegatheeswaran	J Bridge	Review and update
8	04/06/2019	I Kwan	P Ascione	Review and update
9		I Kwan		Review and update

AusNet Services

Level 31
2 Southbank Boulevard
Southbank VIC 3006
T +613 9695 6000
F +613 9695 6666
Locked Bag 14051 Melbourne City Mail Centre Melbourne VIC 8001
www.AusNetservices.com.au

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