ASSET CLASS OVERVIEW

ZONE SUBSTATION SWITCHGEAR

PAL BUS 4.09 – PUBLIC

2026–31 REGULATORY PROPOSAL

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1. Overview

The management of our zone substation switchgear is critical to our ability to maintain network reliability and minimise safety risk as far as practicable.

We manage these assets on a least lifecycle cost basis, underpinned by the continuous refinement of our risk analysis and understanding of the asset condition and performance. We adjust our asset replacement and maintenance timing as inputs to our risk evaluation change, such as asset cost, reliability and failure consequence.

Our zone substation switchgear forecast is consistent with this detailed risk-based approach. It enables the identification of the highest net benefit solution to manage the substation, based on the identified failure modes of our switchgear and the corresponding probabilities, likelihoods, and consequences of failures.

Our approach is also consistent with the AER's asset replacement planning application note, and modelling accepted by the AER in previous regulatory decisions.

For the 2026–31 regulatory period, our focus is rural 66/22kV zone substations that are susceptible to station 'black' in the event of a fault or plant failure at the zone substation. This stems from a lack of sectionalisation, which is a legacy issue from the original construction of the substations. Consequently, these zone substations have a higher risk in case of a failure as they do not possess a level of redundancy typically expected for such substations.

These substations can also have high maintenance and defect repair costs, as the lack of redundancy impedes the ability to shut-down the substation as required (e.g. in some cases, generation is required to ensure continuity of supply for entire townships during maintenance works).

In total, our forecast comprises the replacement of five switchboards, with one of these projects expected to be in-flight prior to the start of the 2026–31 regulatory period.

Notwithstanding our proposed works, both our total switchgear and total overall zone substation level risks across our portfolio will increase between FY27 and FY31 (even after our proposed interventions). That is, our combined zone substation works program, including switchgear, transformers and protection, will still not maintain overall zone substation reliability.

A summary of our forecast projects and corresponding capital expenditure is shown in table 1.

TABLE 1 ZONE SUBSTATION SWITCHGEAR EXPENDITURE ($M, 2026)

EXPENDITURE	FY27	FY28	FY29	FY30	FY31	TOTAL
In-flight switchboard projects						
WBL switchboard replacement	4.4	-	-	-	-	**4.4**
Forecast switchboard projects						
Kyabram switchboard replacement	-	4.5	4.5	-	-	**9.0**
Portland switchboard replacement	-	-	4.4	4.4	-	**8.7**
Numurkah switchboard replacement	-	-	-	4.4	4.4	**8.7**
Mooroopna switchboard replacement	-	-	-		4.4	**4.4**
Total	**4.4**	**4.5**	**8.9**	**8.7**	**8.7**	**35.2**

Note: Expenditure reported in this category in our Reset RIN is materially lower than this amount, as major plant replacement works (such as switchboard replacements) are allocated across multiple RIN categories to reflect the nature of the work undertaken.

2. Background

Zone substation circuit breakers are mechanical switching devices designed to protect electrical circuits and associated components from damage caused by an overload or a fault, whilst ensuring continued service to unaffected circuits. Zone substation circuit breakers can be standalone, mounted in a gas insulated switchgear pressure vessel or in an indoor switchboard.

Circuit breaker operation is generally initiated by a signal from the protection and control system and can be operated remotely. When a circuit breaker operates, it disconnects a circuit and causes an arc to form, which is quenched by the circuit breaker insulating medium. Circuit breaker insulating medium can be mineral oil, air, sulphur hexafluoride (SF6) or vacuum.

This section provides an overview of our zone substation switchgear asset class, including a high-level summary of our compliance obligations, asset population and age profile.

2.1 Compliance obligations

We operate under a combination of national and state legislation which establish our obligations and the regulatory framework under which we operate.

The National Electricity Rules sets out reliability and safety obligations and the Electricity Distribution Code of Practice include performance requirements. We must also manage our network assets in accordance with the Electricity Safety Act 1998, the Electricity Safety (Management) Regulations 2019, the Electricity Safety (Bushfire Mitigation) Regulations 2023 and the Victorian Environment Protection Act 2017.

These obligations can be summarised as follows:

- Electricity Safety Act 1998 – requires us to minimise safety risk 'as far as practicable' including bushfire danger
- Electricity Distribution Code of Practice – requires us to manage our assets in accordance with principles of good asset management and to minimise the risks associated with the failure or reduced performance of assets
- National Electricity Rules – requires us to forecast expenditure to maintain the quality, reliability and security of supply of our networks and maintain the safety of the distribution system
- Victorian Environment Protection Act (2017) – requires us to reduce the risk of harm from our activities to human health and the environment and from pollution or waste.

In short, we must maintain reliability, minimise safety risk 'as far as practicable' including bushfire danger arising from our network, and reduce the risk of harm to the environment.

2.2 Asset population

Our zone substation switchgear asset class comprises circuit breakers at multiple voltages and insulating mediums. As shown in table 2, most of our switchgear are 22kV.

Our circuit breakers are predominantly outdoor circuit breakers, which is reflective of the nature of our network covering western regional Victoria.

TABLE 2 ZONE SUBSTATION CIRCUIT BREAKER POPULATION

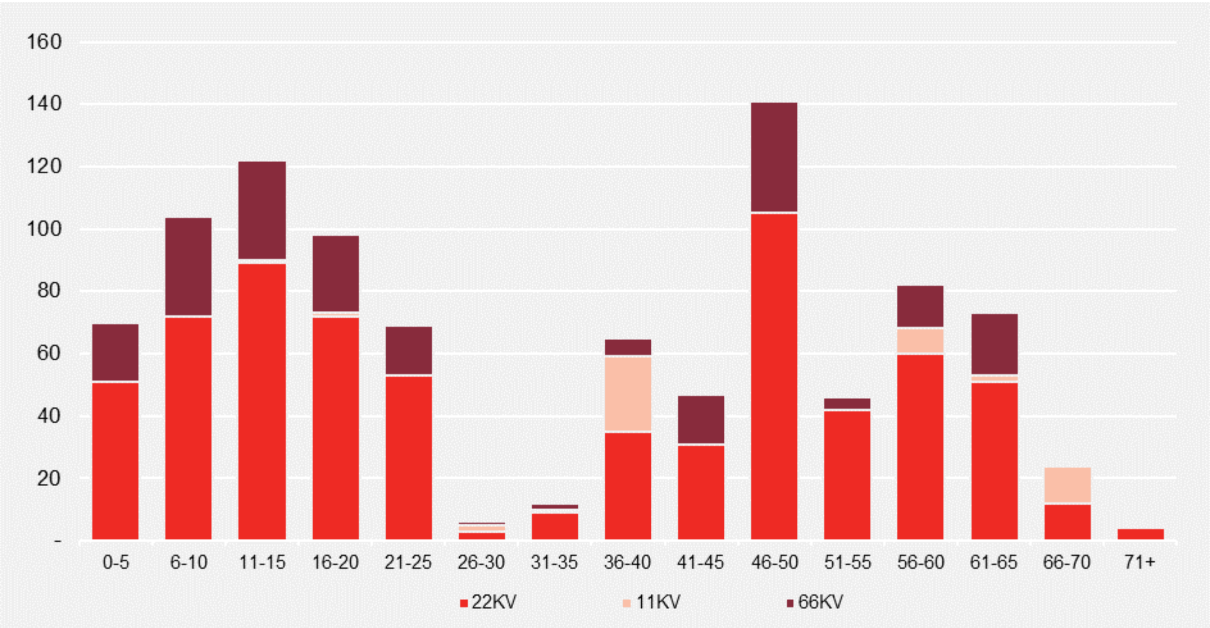
VOLTAGE TYPE	OIL	SF6	VACUUM	TOTAL
11kV	22	2	27	**51**
22kV	297	171	221	**689**
66kV	97	126	-	**223**
Total	**416**	**299**	**248**	**963**

2.3 Asset age profile

Our zone substation circuit breakers have an average life of 60 years. Average life refers to the average life span of circuit breaker, after which the asset is likely to be less reliable and require replacement. However, some circuit breaker require replacement before the average life due to type issues, environmental issues or deteriorated condition.

Figure 1 shows the age profile of our zone substation circuit breakers, with 101 of our circuit breakers having exceeded the age today, of which are mostly 22kV circuit breakers. Without intervention, this will increase to 229 (24%) by the end of the 2026–31 regulatory period.

FIGURE 1 NUMBER OF ZONE SUBSTATION CIRCUIT BREAKERS BY AGE (YEARS)



3. Identified need

The performance of our zone substation switchgear may impact our network service level, as failure may lead to a loss of supply for customers, pose safety risks to our personnel and the public and potentially catch on fire. This may also result in significant unplanned expenditure to restore supply to our customers.

The identified need, therefore, is to manage our zone substation switchgear asset class to maintain reliability and minimise safety risks as far as practicable, consistent with our regulatory and legislative obligations.

This section outlines the historical performance of our zone substation switchgear, which has informed how we assess (and respond, as required to) to this identified need.

3.1 Historical asset performance

We monitor the following two key indicators to inform our approach to meet the identified need:

- failures, which are functional failures that occur while the asset is in service
- high priority defects, which indicate deteriorating condition and are leading indicators of future failures.

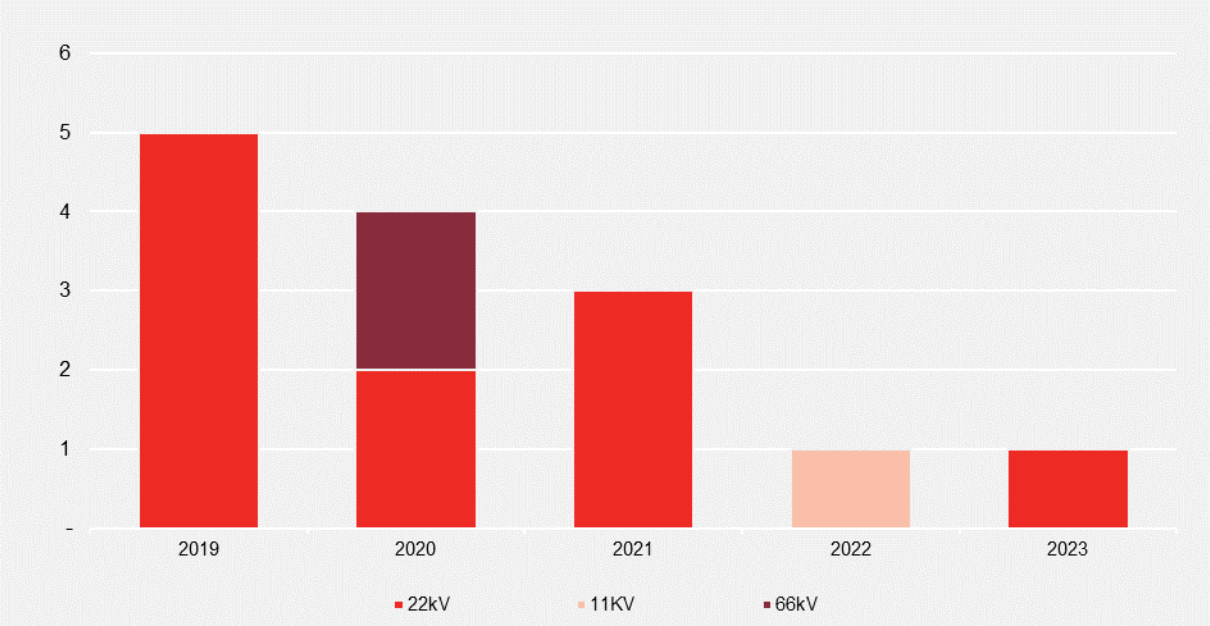
We use our historical asset performance, substation particulars and consequence information to inform and refine our risk evaluation for this asset class.

3.1.1 Historical asset failures

Zone substation switchgear are traditionally very reliable as evidenced by the low annual number of failures. However, we have experienced circuit breaker failures annually since 2019, as shown below shown below in figure 2.

Most of our failures are 22kV circuit breaker failures, with the potential consequences associated with zone substation circuit breaker failures rangin from minor to catastrophic depending on zone substation and network configurations.

FIGURE 2 ZONE SUBSTATION CIRCUIT BREAKER FAILURES



3.1.2 Historical asset defects

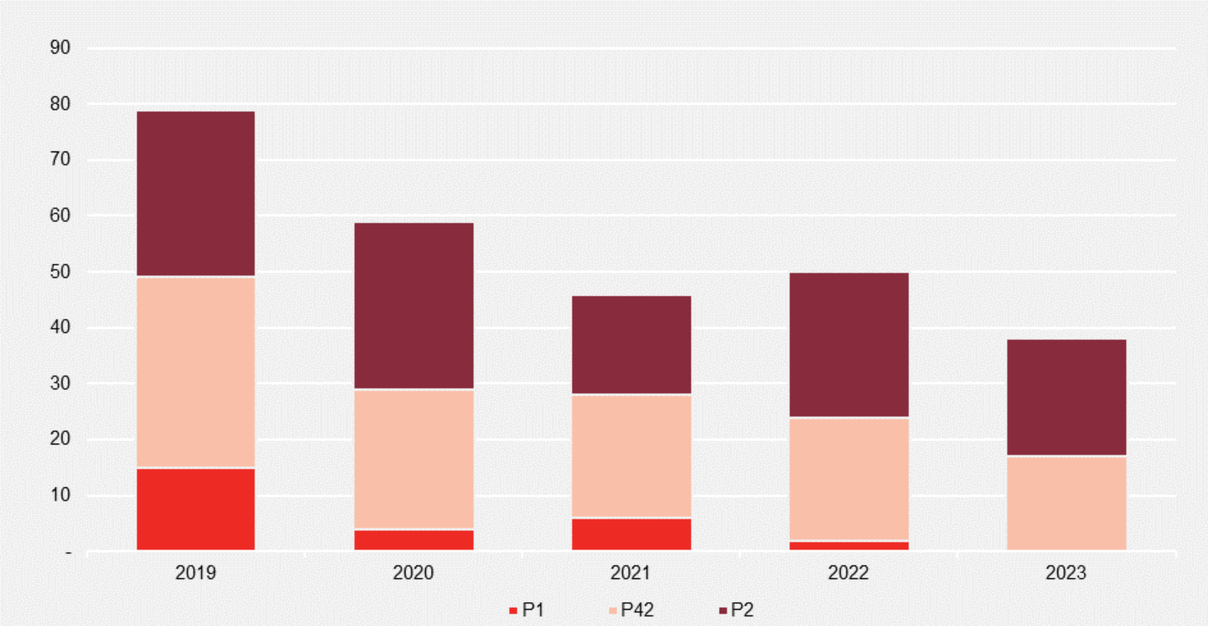
Defects are identified during cyclic asset inspections. Our response to identified defects depends on the nature and severity of the defect and may include more frequent re-inspections. High priority defects that result in intervention are shown in table 3.

TABLE 3 RESPONSE TIMEFRAME FOR HIGH PRIORITY DEFECTS

PRIORITY	TIMEFRAME FOR INTERVENTION
P1	Make safe within 24 hours of identification (replacements or repairs can occur beyond the initial 24 hours)
P42	Addressed within 42 days of identification
P2	Addressed within 32 weeks of identification

Our high priority defects since 2019 are shown in figure 3.

FIGURE 3 NUMBER OF HIGH PRIORITY DEFECTS



3.2 Demand growth

By 2031, the electrification of everything from homes to transport, along with ongoing population growth, will require our energy system to evolve.

As recently as December 2024, our network almost surpassed its previous highest peak demand (set in 2014). This near-peak event occurred far earlier in the summer season than previously experienced, and in the same month we also saw new record minimum demands (with our network acting as a net exporter of over 300MW in the middle of the day). These patterns of extremes are expected to grow with the increasing electrification of our customers' homes and businesses

Growth in demand increases the energy that would not be supplied to customers if our zone substation switchgear failed.

4. Forecast interventions

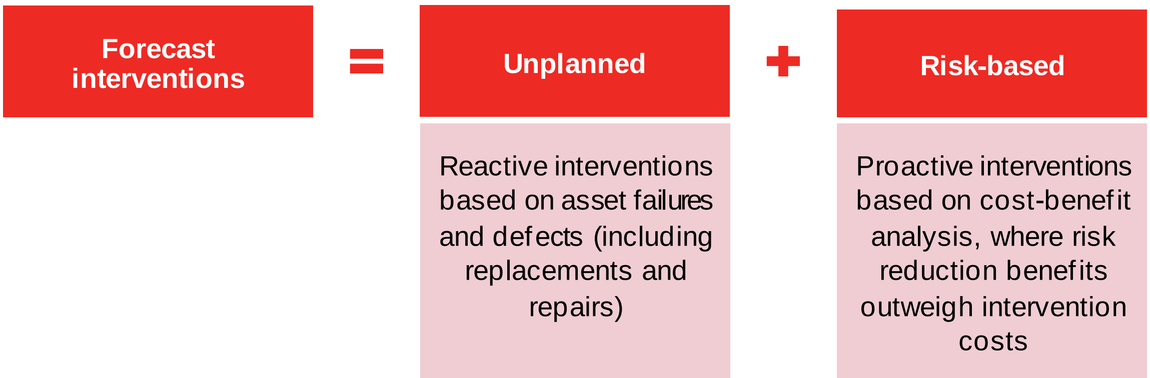
Our current asset management approach for our zone substation switchgear includes multiple options to meet our required service levels, consistent with our compliance obligations. Specifically, these options include the following:

- ongoing planned, preventative maintenance
- targeted replacement of specific components where technically feasible
- defer replacement of circuit breakers through online monitoring systems or other mitigation controls, including asset refurbishment
- asset replacement based on condition and risk assessments, including the impact of common-cause failures.

We constantly revise our plans based on the latest information regarding cost, reliability and risk of these assets to ensure that we are meeting our obligations. As these inputs and understandings change, our forecast will fluctuate accordingly. Our forecast is based on the two categories, as shown in figure 4.

- unplanned interventions are responses to asset failures and defects, which include replacements and repairs. These repairs are considered capital expenditure as they extend the life of the asset
- risk-based interventions are determined by a cost benefit analysis, where risk reduction benefits outweigh the intervention costs.

FIGURE 4 FORECAST CATEGORIES



4.1 Unplanned interventions

We forecast our unplanned interventions based on historical average of the previous five years. These typically comprise minor station works of low materiality.

4.2 Risk-based interventions

Our risk-based interventions are developed based on sophisticated risk modelling, consistent with the AER's asset replacement planning note.[1] This modelling is attached with our regulatory proposal and supported by our asset risk quantification guide.[2]

The focus of this modelling for the 2026–31 regulatory period are our rural 66/22kV zone substations that are susceptible to station 'black' in the event of a fault or plant failure at the zone substation. This risk stems from legacy design issues from the original construction of the substations.

Specifically, these substations have higher consequences of failure as they do not possess the inherent level of sectionalisation typically expected for such sites. A complete station outage could occur at these zone substations, for example, if one or a combination of the following occurs:

- 66kV incoming line fault
- 66kV bus fault
- 66/22kV transformer failure
- 22kV bus fault
- 22kV circuit breaker failure.

These substations can also have high maintenance and defect repair costs, as the lack of redundancy impedes the ability to shut-down the substation as required (e.g. in some cases, generation is required to ensure continuity of supply for entire townships during maintenance works).

4.2.1 Forecast methodology

Our risk assessment is underpinned by the risk monetisation approach summarised in figure 5. This approach ensures we invest only when the cost of replacing existing infrastructure exceeds the total value of the underlying risks.

FIGURE 5 RISK MONETISATION APPROACH

As our understanding of zone substation risks has improved, it has enhanced our risk evaluation (particularly for building and safety risks) and improved our risk control treatments. This has led to a holistic approach to assessing zone substation plant and equipment risks, such as peripheral equipment, to leverage synergies for simultaneous delivery of replacements.

Hence, in addition to assessing circuit breaker risks, we have also assessed the risks posed by the following zone substation plant and equipment—insulators and outdoor air-insulated buswork, relays,

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1 See, for example, the AER's final decision for our United Energy network; AER, United Energy distribution determination 2021 to 2026, Attachment 5, April 2021. This modelling approach has since been incorporated to support the asset management of our zone substation program across our three networks, including Powercor.

2 PAL MOD 4.06 - Parallel risk model - Jan2025 - Public; and PAL ATT 4.01 – Asset risk quantification guide – Jan2025 – Public.

control cables and station buildings. These risks are calculated individually (as outlined below), and aggregated together to compare against the cost of the proposed options.

Circuit breaker risk

Circuit breaker risks have been based on the energy at risk due to a fault or equipment failure, depending on the zone substation configuration. Energy at risk itself has been calculated based on the annual probability of a fault or failure, outage duration, demand forecast and the VCR of the zone substation.

Insulator risk

Insulator risks are also considered, as these are the most common causes of failure within outdoor switchyards.

Existing brown-pin type insulators in a zone substation from the 1960s are beyond their design life. They fail catastrophically, creating shrapnel that can damage plant and injure any personnel in the vicinity. Our failure rates are modelled based on recent performance, with the consequences of failure including energy at risk of a bus outage and safety risks.

Relay risk

Some of our relays in rural zone substations are well beyond their service life. Relay risks were assessed as per the methodology set out in the relay asset class overview.[3]

Control cable risk

The majority of the control cables have not been replaced since they were installed and are well beyond their service life. These aged control cables pose safety risks and reliability risks.

These cables can pose safety risks to our staff due to deteriorated insulation and tripping hazards with cable trenches in the switchyard, such as due to missing trench covers. The energy at risk due to control cable failure has been calculated based on the annual probability of failure, outage duration, demand forecast and the VCR of the zone substation.

Building risk

Many of our rural zone substation control buildings are well past their service life and showing visible signs of deterioration. They are largely constructed using asbestos-cement sheeting and have been subject to increasing costs associated with repairs and failures over the past five years.

In some cases, structural repairs are required, which may not be practicable to implement given the hazardous materials they are constructed with. The failure of an existing control building can impact the function of the protection and control equipment it houses and result in loss of protection, control and monitoring of the zone substation.

The building risks were assessed based on the annual probability of building failure and likelihoods and consequences of failure, which includes building repair costs and zone substation outage costs. The annual probability of building failure was underpinned by the Weibull curve of historical failures based on building age.

[3] PAL BUS 4.10 – Protection and control – Jan2025 – Public.

Flood risk

Three of our rural zone substations are located within the existing 1-in-100 year flood zone. While these substations have flood levees to protect the zone substation from inundation, there is still a likelihood the zone substation could be flooded in the future when climate change increases flood frequency and severity.

Recent flood events in western Victoria have affected our zone substations and have included cases where zone substations were turned off for safety reasons, impacting large geographic areas during times of distress. For example, in 2022, we de-energised Mooroopna (MNA) zone substation due to flooding from the Goulburn River.

We have quantified this flood risk based on the AER's 2024 final decision on the value of network resilience, the probability a flood will impact the zone substation, zone substation demand and historical flood outage duration. New buildings and assets replaced at these zone substations will be raised to comply with current design requirements with regard to flood zones and forecast inundation levels.

4.2.2 Options considered

Table 4 lists all the potential credible zone substation intervention options. The suitability of these options, however, depends on the zone substation. Individual site-based assessments and options analysis are set out appendix A, and in our corresponding risk model.[4]

TABLE 4 RISK-BASED INTERVENTION OPTIONS

OPTION	DESCRIPTION
Do-nothing different	No change to existing practices and no planned replacement
Replace relays in a new control building	Replace relays in a new control building and demolish the existing control building
Replace 22kV switchgear and relay in a new building	Replace the outdoor 22kV switchgear with a new indoor switchboard in a new building, replace the relays and demolish the existing control building
Refurbish 22kV circuit breakers	Refurbish aging circuit breakers to extend their life

We also considered the following intervention options, but these have been assessed as not credible and thus not subject to economic assessment:

- replacement of only one bus of an aged switchboard – this will not reduce the probability of failure on the remaining buses and associated circuit breakers, and raises physical and integration challenges with different switchgear technologies
- refurbishment of the switchboard – this is not technically practicable and in any event, would provide immaterial benefits

4 PAL MOD 4.05 - Transformer rebuild - Jan2025 – Public.

- non-network solutions – we are not aware of non-network solutions that will be able to replace the functionality of a zone substation circuit breaker. Our zone substation circuit breaker replacements are listed in our annual distribution asset planning report (DAPR) and to date, we have not received any non-network proposals for circuit breaker asset replacement.

4.2.3 Forecast risk-based interventions

Based on the risk monetisation approach summarised above, we assessed individual zone substations for potential interventions in the 2026–31 regulatory period. These sites were then reviewed against our broader station works portfolio to identify overlaps, synergies and deliverability considerations.

This further reviewed identified the following:

- synergies were identified with our protection relay replacements, whereby it is efficient to deliver both circuit breaker and relay replacements simultaneously. These synergies were identified for each zone substation switchboard, and as such, these relay replacements have been removed from our protection forecasts
- adjustments to project timing were made to align with other proposed works to ensure efficient and practical sequencing of projects.

We also recognise that the proposed works program to manage the risk associated with this switchgear is a step-up compared with the 2021–26 regulatory period. We are confident in the deliverability of these projects given the staggered timing of works (including in-flight projects) and the ability to leverage both our internal and external labour force.

A summary of our proposed zone substation circuit breaker replacements is set out in table 5. Further site-specific assessments are provided in appendix A.

TABLE 5 ZONE SUBSTATION SWITCHGEAR: FORECAST EXPENDITURE ($M, 2026)

EXPENDITURE	FY27	FY28	FY29	FY30	FY31	TOTAL
In-flight switchboard projects						
WBL switchboard replacement	4.4		-	-	-	**4.4**
Forecast switchboard projects						
Kyabram switchboard replacement	-	4.5	4.5	-	-	**9.0**
Portland switchboard replacement	-	-	4.4	4.4	-	**8.7**
Numurkah switchboard replacement	-	-	-	4.4	4.4	**8.7**
Mooroopna switchboard replacement	-	-	-		4.4	**4.4**
	4.4	**4.5**	**8.9**	**8.7**	**8.7**	**35.2**

Note: Corresponding circuit breaker volumes are reported in our Reset RIN on an as-commissioned basis (i.e. in the last year of expenditure).

Top-down portfolio review

In addition to the review of overlaps and synergies identified above, we also assessed the change in zone substation circuit breaker risks, and that at the zone substation overall (i.e. the sum of circuit breaker, transformer and protection risks).

A central theme of our stakeholder engagement program was reliability, with customers consistently highlighting the importance of a maintaining a reliable energy supply. This view was explored in the context of our customers' increasing dependence on electricity given forecast electrification. Our replacement program and asset management practices are critical to ensure reliability outcomes for customers as well as maintaining trust throughout the energy transition for our customers to electrify.

As shown in figure 6, our total zone substation switchgear risks are expected to increase without intervention. Our proposed interventions will not mitigate this increase in full.

Further, figure 7 shows that total zone substation level risks will also increase between FY27 and FY31, even after our proposed interventions (i.e. our combined zone substation works program will still not maintain overall zone substation reliability). In this context, we consider our proposed interventions are prudent and 'no-regrets' interventions to support reliability outcomes for our customers.

FIGURE 6 ZONE SUBSTATION RISK: SWITCHGEAR ($M, 2026)

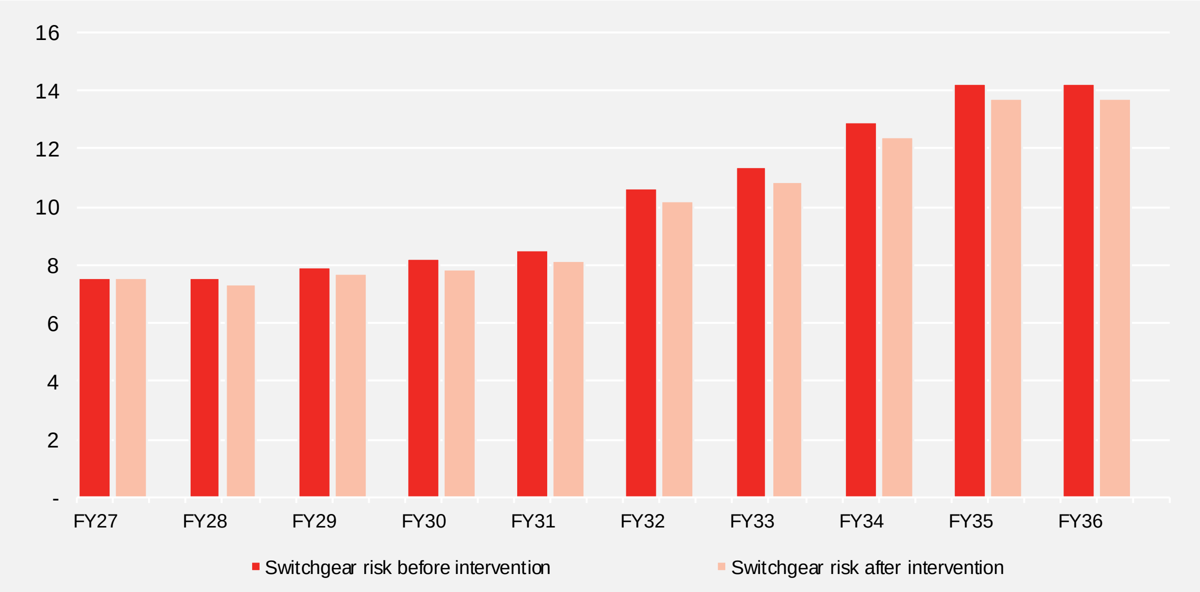
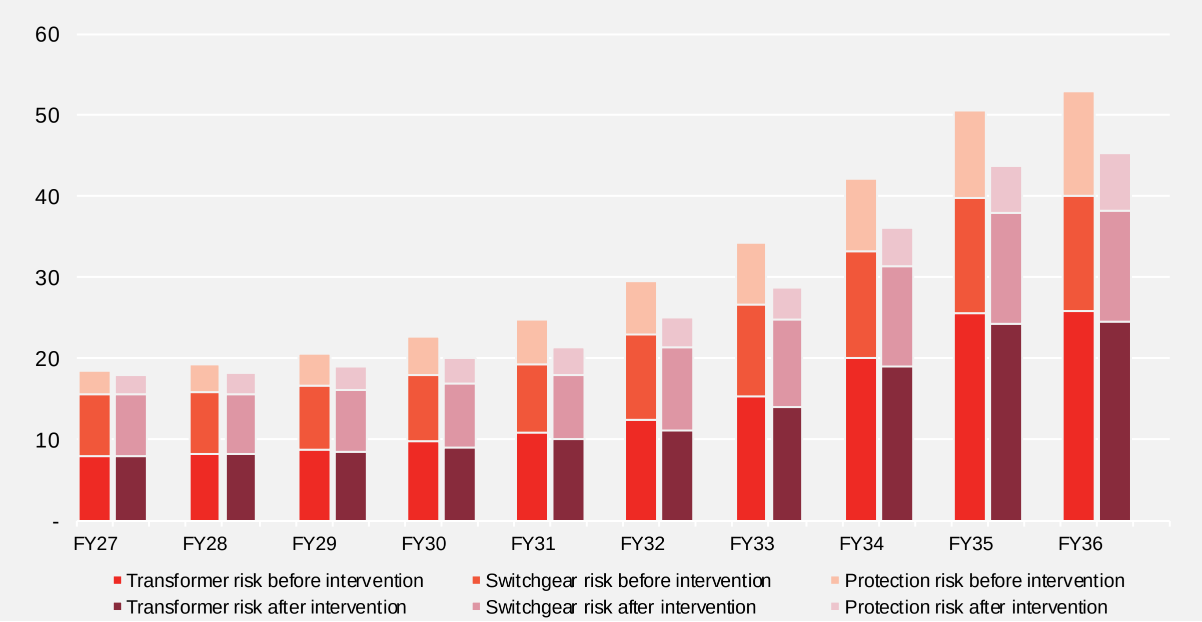


FIGURE 7 ZONE SUBSTATION RISK: COMBINED STATION ASSETS ($M, 2026)



A Switchgear replacements: site-based assessment

This appendix provides a summary of site-based assessments for our proposed risk-based zone substation switchgear replacements.

For each site, a full cost benefit analysis has been undertaken and is provided in the attached model.[5] The options considered are consistent with those outlined in the body of this asset class overview and are presented relative to the base case (i.e. a do-nothing different option).

A.1 WBL zone substation

Warrnambool (WBL) zone substation is a zone substation in southern Victoria and approximately 2.1km from the sea. It was built in 1948 and is supplied by sub-transmission 66kV lines from Terang (TRG) and Koroit (KRT) zone substations. It supplies approximately 18,100 customers across eight feeders.

A.1.1 Identified need

Due to the legacy lack of sectionalisation, WBL zone substation is at risk of station black in the event of a fault on any of its 22kV bus and any 22kV circuit breaker failure. This can result in loss of supply to customers.

WBL zone substation has approximately 500 brown-pin type insulators, which can fail catastrophically, creating shrapnel that can damage plant and injure any personnel in the vicinity.

Further, some of the digital protection relays at WBL are close to the end of their service life. The control building, which houses protection relays, has been in service since the substation was built. It is of weatherboard construction, in a deteriorated condition in a harsh coastal environment and is beyond its design life. Due to the nature of its construction, any work within the building is limited or not possible due to safety restrictions.

Hence, there is a need to address the 22kV circuit breaker and insulator failure risk to mitigate the station black risk at WBL zone substation. There is also an opportunity to simultaneously replace the existing relays and control building, given the age and deteriorated condition of the relays and building at the zone substation.

A.1.2 Options considered

The results of our analysis, relative to a do-nothing base case, are shown in table 6.

5 PAL MOD 4.05 - Transformer rebuild - Jan2025 - Public

TABLE 6 OPTIONS EVALUATION RELATIVE TO BASE CASE ($M, 2026)

OPTION		PV COSTS	PV BENEFITS	NET BENEFITS
2	Replace new relays in a new control building	(7.1)	21.8	14.7
3	Replace 22kV switchgear and relay in a new buildling	(5.7)	27.6	21.9
4	Refurbish 22kV circuit breakers	(0.7)	1.7	1.0

Preferred option

The preferred option is to simultaneously replace the 22kV switchgear and relays in a new building (option three) because it is the most economic option under the central scenario.[6]

Sensitivity analysis was also used to test the robustness of the central scenario result to potential variations in costs and benefits. The preferred option remained economic under all scenarios.

A.2 KYM zone substation

Kyabram (KYM) zone substation is a zone substation in northern Victoria built in the late 1940s and is supplied by sub-transmission 66kV lines from Echuca (ECA) zone substation, Stanhope (SHP) zone substation and Shepparton terminal station (SHTS). It supplies approximately 6,870 customers across six feeders.

A.2.1 Identified need

Due to the legacy lack of sectionalisation, KYM zone substation is at risk of station black in the event of a fault on its 66kV no. 1, no. 2 and no. 3 buses, failure of any of its three 66/22kV transformers, fault on any of its 22kV bus or any 22kV circuit breaker failure. This can result in loss of supply to customers.

KYM zone substation has approximately 300 brown-pin type insulators, which can fail catastrophically, creating shrapnel that can damage plant and injure any personnel in the vicinity.

Further, the electronic and electromechanical protection relays at KYM are aged and well beyond their service life with some still in service since the substation was built. The control building, which houses protection relays, has been in service since the substation was built. It is constructed of AC sheeting, is in a deteriorated condition and is well beyond its design life. Due to the nature of its construction, any work within the building is limited or not possible due to safety restrictions.

Hence, there is a need to address the 22kV circuit breaker and insulator failure risk to mitigate some of the station black risk at KYM zone substation. There is also an opportunity to simultaneously replace the existing relays and control building, given the age and deteriorated condition of the relays and building at the zone substation.

[6] PAL MOD 4.06 - Parallel risk model - Jan2025 – Public; PAL MOD 4.05 – Transformer rebuild – Jan2025 – Public

A.2.2 Options analysis

The results of our analysis, relative to a do-nothing base case, are shown in table 7.

TABLE 7 OPTIONS EVALUATION RELATIVE TO BASE CASE ($M, 2026)

OPTION		PV COSTS	PV BENEFITS	NET BENEFITS
2	Replace relays in a new control building	(5.3)	17.5	12.2
3	Replace 22kV switchgear and relay in a new buildling	(8.6)	20.2	11.6
4	Refurbish 22kV circuit breakers	(1.0)	0.7	-0.3

Preferred option

While option two has the highest NPV, it is not the preferred option as it will not address the station black risk at KYM zone substation. Hence, the preferred option is to simultaneously replace the 22kV switchgear and relays in a new building (option three).

This option is economic and will mitigate some of the station black risk at KYM zone substation.[7]

Sensitivity analysis was also used to test the robustness of the central scenario result to potential variations in costs and benefits. The preferred option remained economic under all scenarios.

A.3 PLD zone substation

Portland (PLD) zone substation is a zone substation in southern Victoria approximately 2km from the sea. It was built during the early 1960s and is supplied by sub-transmission 66kV lines from Koroit (KRT) zone substation. It supplies approximately 9,590 customers across six feeders.

A.3.1 Identified need

Due to the legacy lack of sectionalisation, PLD zone substation is at risk of station black in the event of a fault on its 66kV no. 2 bus, failure of any of its two 66/22kV transformers, fault on any of its 22kV bus or any 22kV circuit breaker failure. This can result in loss of supply to customers.

PLD zone substation has approximately 400 brown-pin type insulators, which can fail catastrophically, creating shrapnel that can damage plant and injure any personnel in the vicinity.

Further, the electromechanical protection relays at PLD are aged and well beyond their service life with some still in service since the substation was built. The building, which houses protection relays, has been in service since the substation was built. It is of AC sheet construction, in a deteriorated condition in a harsh coastal environment, and is beyond its design life. Due to the nature of its construction, any work within the building is limited or not possible due to safety restrictions.

[7] PAL MOD 4.06 - Parallel risk model - Jan2025 - Public; PAL MOD 4.05 – Transformer rebuild – Jan2025 – Public

Hence, there is a need to address the 22kV circuit breaker and insulator failure risk to mitigate some of the station black risk at PLD zone substation. There is also an opportunity to simultaneously replace the existing relays and control building, given the age and deteriorated condition of the relays and building at the zone substation

A.3.2 Options analysis

The results of our analysis, relative to a do-nothing base case, are shown in table 8.

TABLE 8 OPTIONS EVALUATION RELATIVE TO BASE CASE ($M, 2026)

OPTION		PV COSTS	PV BENEFITS	NET BENEFITS
2	Replace relays in a new control building	(5.1)	11.9	6.8
3	Replace 22kV switchgear and relay in a new buildling	(8.0)	12.7	4.7
4	Refurbish 22kV circuit breakers	(0.9)	0.3	-0.7

Preferred option

Our preferred option is to simultaneously replace the 22kV switchgear and relays in a new building (option three) because it is economic and will also mitigate some of the station black risk at PLD zone substation. [8]

Sensitivity analysis was also used to test the robustness of the central scenario result to potential variations in costs and benefits. The preferred option remained economic under all scenarios.

A.4 NKA zone substation

Numurkah (NKA) zone substation is a zone substation in northern Victoria, built in the 1960s which is supplied by sub-transmission 66kV lines from Cobram East (CME) zone substation and Shepparton terminal station (SHTS). It supplies approximately 7,800 customers across six feeders.

A.4.1 Identified need

Due to the legacy lack of sectionalisation, NKA zone substation is at risk of station black in the event of a fault on its 66kV no. 1, no. 2 and no. 3 buses, failure of any of its three 66/22kV transformers, fault on any of its 22kV bus or any 22kV circuit breaker failure. This can result in loss of supply to customers.

NKA zone substation has approximately 400 brown-pin type insulators, which can fail catastrophically, creating shrapnel that can damage plant and injure any personnel in the vicinity. Further, the electromechanical protection relays at NKA are aged and well beyond their service life with some still in service since the substation was built.

8 PAL MOD 4.06 - Parallel risk model - Jan2025 – Public; PAL MOD 4.05 – Transformer rebuild – Jan2025 – Public

Hence, there is a need to address the 22kV circuit breaker and insulator failure risk to mitigate some of the station black risk at NKA zone substation. There is also an opportunity to simultaneously replace the existing relays and aged control building to facilitate replacement, given the age and decreasing reliability of the aged assets at the zone substation.

A.4.2 Options analysis

The results of our analysis, relative to a do-nothing base case, are shown in table 8.

TABLE 9 OPTIONS EVALUATION RELATIVE TO BASE CASE ($M, 2026)

OPTION		PV COSTS	PV BENEFITS	NET BENEFITS
2	Replace relays in a new control building	(4.9)	9.1	4.2
3	Replace 22kV switchgear and relay in a new buildling	(7.7)	11.7	4.0

Preferred option

While option two has the highest NPV (marginally higher than option three), it is not the preferred option as it will not address the station black risk at NKA zone substation. Instead, the preferred option is to simultaneously replace the 22kV switchgear and relays in a new building (option three) because it is economic and will also mitigate some of the station black risk at NKA zone substation. [9]

Sensitivity analysis was also used to test the robustness of the central scenario result to potential variations in costs and benefits. The preferred option remained economic under all scenarios.

A.5 MNA zone substation

Mooroopna (MNA) zone substation is a zone substation in northern Victoria, originally built in the early 1960s which is supplied by sub-transmission 66kV lines from Shepparton (STN) zone substation and Shepparton terminal station (SHTS). It supplies approximately 10,840 customers across six feeders.

A.5.1 Identified need

Due to the legacy lack of sectionalisation, MNA zone substation is at risk of station black in the event of a fault on its 66kV no. 1, no. 2 and no. 3 buses, failure of any of its two 66/22kV transformers, fault on any of its 22kV bus or any 22kV circuit breaker failure. This can result in loss of supply to customers.

Further, the electromechanical and electronic protection relays at MNA are aged and well beyond their service life with some still in service since the substation was built. The building, which houses protection relays, has been in service since the substation was built. It is of AC sheet construction, in a deteriorated condition and is beyond its design life. Due to the nature of its construction, any work within the building is limited or not possible due to safety restrictions.

[9] PAL MOD 4.06 - Parallel risk model - Jan2025 – Public; PAL MOD 4.05 – Transformer rebuild – Jan2025 – Public

MNA zone substation is located in the 1-in-100 year flood zone and has previously flooded. When MNA zone substation was flooded by the Goulburn River in 2022, we de-energised MNA for safety reasons. This resulted in customers losing electricity supply and STN zone substation being on a radial supply. We have since built flood levees around MNA zone substation to protect it from future floods. However, there is still a likelihood the zone substation could be flooded in the future when climate change increases flood frequency and severity.

Hence, there is a need to address the 22kV circuit breaker failure risk to mitigate some of the station black risk at MNA zone substation. There is also an opportunity to simultaneously replace the existing relays and control building, given the age and deteriorated condition of the relays and building and flood risk at the zone substation.

A.5.2 Option analysis

The results of our analysis, relative to a do-nothing base case, are shown in table 10.

TABLE 10 OPTIONS EVALUATION RELATIVE TO BASE CASE ($M, 2026)

OPTION		PV COSTS	PV BENEFITS	NET BENEFITS
1	Replace relays in a new control building	(4.8)	8.4	3.7
3	Replace 22kV switchgear and relay in a new building	(7.5)	12.2	4.8

Preferred option

The preferred option is to simultaneously replace the 22kV switchgear and relays in a new building (Option three) because it is the most economic option under the central scenario and will mitigate some of the station black risk at MNA zone substation. [10]

Sensitivity analysis was also used to test the robustness of the central scenario result to potential variations in costs and benefits. The preferred option remained economic under all scenarios.

10 PAL MOD 4.06 - Parallel risk model - Jan2025 – Public; PAL MOD 4.05 – Transformer rebuild – Jan2025 – Public

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