Planning Report Warragul (WGL) Zone Substation

AMS – Electricity Distribution Network

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1 Executive Summary

AusNet Services is a regulated Victorian Distribution Network Service Provider (DNSP) that supplies electrical distribution services to more than 745,000 customers. Our electricity distribution network covers eastern rural Victoria and the fringe of the northern and eastern Melbourne metropolitan area.

As expected by our customers and required by the various regulatory instruments that that we operate under, AusNet Services aims to maintain service levels at the lowest possible cost to our customers. To achieve this, we develop forward looking plans that aim to maximise the present value of economic benefit to all those who produce, consume and transport electricity in the National Electricity Market (NEM).

This report presents our forward looking investment plans to manage the existing and emerging service level constraints in the Warragul (WGL) Zone Substation supply area to ensure that we maintain service levels to our customers over the short and long term. The report outlines how we quantify service risk, identifies and assesses the costs and benefits of potential options to mitigate the identified risks, and provides forward looking plans outlining the optimal service risk mitigation solutions, and timing of those solutions, to maintain service levels.

1.1 Identified Need

WGL commenced operation as a 66/22kV transformation station in 1962. Three 10/12.5MVA transformers were installed in 1962. A fourth 10/13.5MVA transformer was added in 1997 as a replacement for an existing 5/6.5MVA transformer, however this transformer was manufactured in 1965. A fifth 20/33MVA transformer was added in 2011. The 66kV switchyard was constructed in the 1960s, with the exception of an additional 66kV CB added in 2011 when the fifth transformer was installed. The 22kV switchyard was replaced by an indoor switchboard in 1997.

The physical and electrical condition of some assets has deteriorated and they are now presenting an increasing failure risk.

The station has a 66kV ring bus arrangement, but is partially switched with the four 1960's vintage transformers switched as a single group, and a normally open isolator in place of a 66kV circuit breaker between the two 66kV line entries from YPS.

The key service constraints at WGL are:

- Security of supply risk presented by the switching of four of the transformers in a single group;
- Security of supply risks presented by increased likelihood of asset failure due to the deteriorating condition of the assets;
- Health and safety risks presented by a possible explosive failure of bushings on a number of the assets;
- Plant collateral damage risks presented by a possible explosive failure of bushings on a number of the assets;
- Environmental risks associated with insulating oil spill or fire;
- Reactive asset replacement risks presented by the increasing likelihood of asset failure due to the deteriorating condition of the assets; and
- Health and safety risks presented by asbestos containing cement sheets or electrical switch boards in the main building and switchyard.

1.2 Proposed Preferred Option

The options analysis identifies that the preferred option, being the one that maximises the net economic benefit to all those that produce, consume and transport electricity in the NEM, is to:

- Replace the four 10/12.5MVA transformers with two 20/33MVA transformers, replace the existing capacitor bank and install two new 66kV circuit breakers by 2020, at an estimated capital cost of [C.I.C] (Real $2018). The existing C5 66kV circuit breaker is being replaced under a separate project before 2021.

Applying a discount rate of 6.44% per annum, this proposed preferred option has a net economic benefit of [C.I.C], relative to the Do Nothing Different option, over the forty-five-year assessment period.

While the optimal timing of the propsed preferred option is by 2020, to allow sufficient time to complete the regulatory investment test for distribution (RIT-D), and to smooth the overall network capital expenditure, AusNet Services plans to implement the proposed preferred option by 2023.

1.3 Next Steps

This planning report outlines the service level risk mitigation investment that AusNet Services has assessed as prudent, efficient and providing the optimal balance of supply reliability and cost.

While this report outlines AusNet Services' plans for maintaining service levels, and serves to support AusNet Services' revenue request for the 2022-26 EDPR period, the proposed investment is subject to the regulatory investment test for distribution (RIT-D).

As such, the proposed investment will be confirmed via the formal RIT-D process, which includes publication of up to three reports at the various RIT-D stages, and includes a formal consultation process where interested parties can make submissions that help identify the optimal solution.

2 Introduction

2.1 Purpose

This planning report outlines asset condition, asset failure risks and network development plans relevant to Warragul (WGL) Zone Substation for the period 2022-26.

It provides an analysis of viable options to address the identified risks and maintain the efficient delivery of electrical energy from WGL consistent with the National Electricity Rules (NER) and stakeholder's requirements.

It also summarizes the scope, delivery schedule and expenditures associated with the most economical solution to emerging constraints.

2.2 Scope

The scope of this planning report is limited to the equipment within Warragul (WGL) Zone Substation.

It excludes sub-transmission and distribution feeders entering and exiting the zone substation.

2.3 Asset Management Objectives

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

- Comply with legal and contractual obligations;
- Maintain safety;
- Be future ready;
- Maintain network performance at the lowest sustainable cost; and
- Meet customer needs.

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

- Improve efficiency of network investments
- Maintain long-term network reliability
- Implement REFCLs within prescribed timeframes
- Reduce risks in highest bushfire risk areas
- Achieve top quartile operational efficiency
- Prepare for changing network usage.

3 Background

3.1 Substation Description

Warragul (WGL) is located approximately 100km south east of Melbourne and is the main source of supply for the suburbs of Warragul, Drouin, Longwarry, Bunyip, Darnum, Noojee and surrounding areas.

WGL supplies approximately 23,300 AusNet Services' customers. The load at WGL includes mostly residential with some farming, commercial and industrial loads.

The Warragul zone substation area is in West Gippsland at an elevation of 143m above sea level.

WGL has summer average maximum temperatures of 24°C, winter average minimum temperatures of 6°C with extreme temperatures reaching 44°C in summer and -5°C in winter.

The average annual rainfall is 837mm in this area.

WGL is supplied at 66kV via two 66kV circuits that originate from Morwell Terminal Station (MWTS). These lines also serve YPS and MOE zone substations.

The location of WGL within the AusNet Services distribution network is as shown in Figure 1.

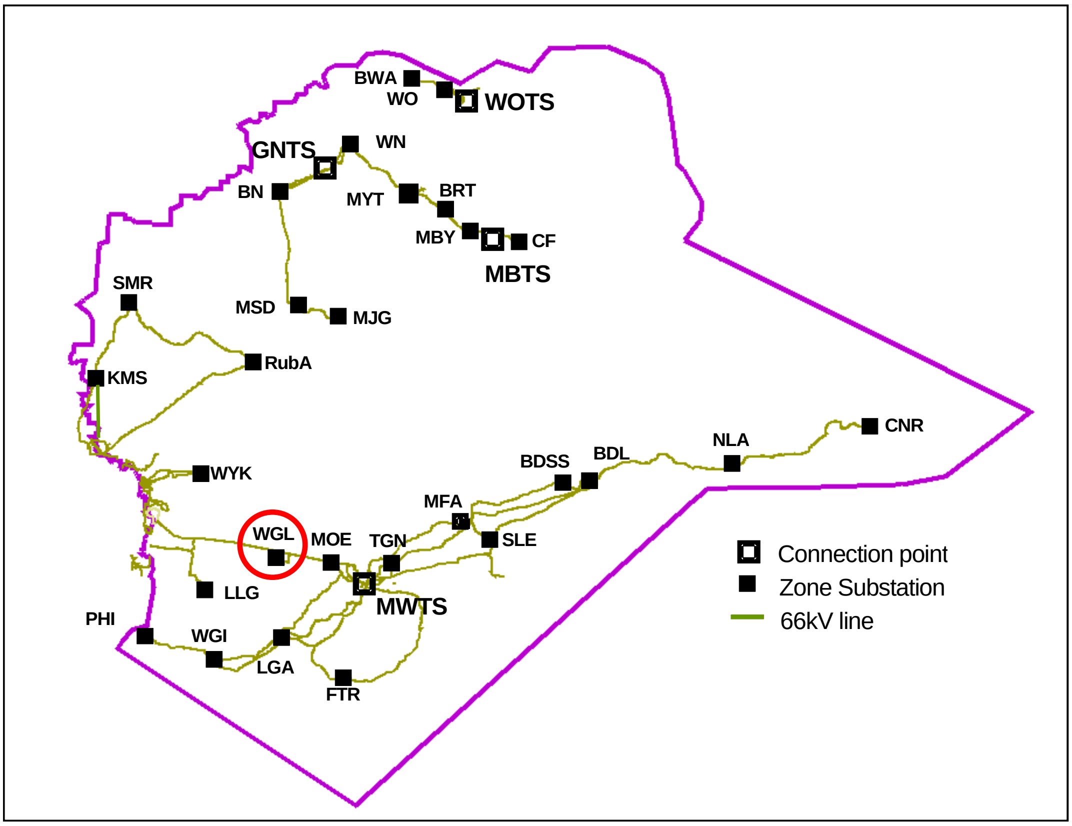

Figure 1: WGL location within AusNet Services distribution network

The configuration of primary electrical circuits within WGL is as shown in the single line diagram in Figure 2.

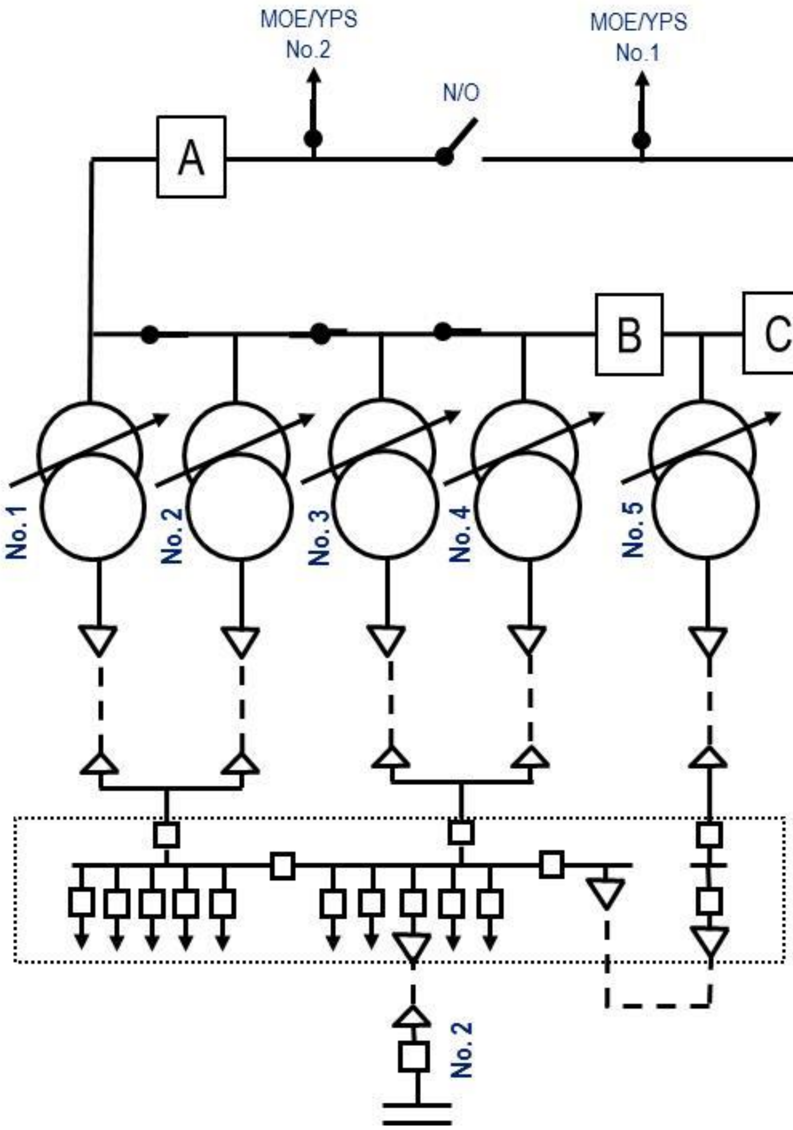

Figure 2: WGL Single Line Diagram

3.2 Customer Composition

WGL has nine 22kV feeders supplying AusNet Services' customers. Table 1 provides detail of the 22kV supply feeders.

Table 1: WGL feeder information

Feeder	Feeder Length (km)	Feeder description	Number of Customers	Type of Customers
WGL11	58	Summer peaking, short rural feeder	3,808	84% residential 5% commercial 1% industrial 10% farming
WGL12	325	Summer peaking, long rural feeder	3,501	75% residential 5% commercial 1% industrial 19% farming

Feeder	Feeder Length (km)	Feeder description	Number of Customers	Type of Customers
WGL13	150	Summer peaking, short rural feeder	3,899	90% residential 7% commercial 3% farming
WGL14	8	Summer peaking, urban feeder	1	100% commercial
WGL15	116	Summer peaking, short rural feeder	2,809	73% residential 18% commercial 1% industrial 8% farming
WGL21	227	Summer peaking, long rural feeder	4,813	88% residential 3% commercial 1% industrial 8% farming
WGL22	10	Summer peaking, urban feeder	1	100% commercial
WGL23	167	Summer peaking, short rural feeder	1,359	50% residential 17% commercial 3% industrial 30% farming
WGL24	423	Summer peaking, long rural feeder	3,116	64% residential 6% commercial 1% industrial 29% farming

The medium voltage feeders interconnect with medium voltage feeders from Pakenham, Moe and Leongatha Zone Substations but the distance to these stations and loading on these feeders means that only 3.4MVA of load is able to be transferred to these stations via 22kV feeders.

3.3 Zone Substation Equipment

3.3.1 Primary Equipment

WGL includes an air-insulated 66kV switchyard with eight 66kV buses separated by either bus-tie circuit breakers or isolators connected to two incoming 66kV lines from MWTS via YPS and MOE. CB “A” and CB “B” are minimum oil CB’s rated at condition C5.

There are two 22kV indoor switchboards. Bus 1 is connected to a bank of two 10/12.5MVA transformers via a single 22kV transformer CB. Bus 2 is connected to a bank of two transformers (1 x 10/12.5MVA and 1 x 10/13.5MVA) via a single 22kV transformer CB, and the newer 20/33MVA transformer via the Bus2-3 bustie CB. Nine 22kV feeders and one 6 MVAR and one 12 MVAR capacitor banks are connected to these 22kV busbars.

Transformation comprises one 10/13.5MVA 66/22kV transformer located at position No.1 manufactured by [C.I.C] at condition C4, three 10/12.5MVA 66/22kV transformers located in the No.2, No.3 and No.4 positions manufactured by [C.I.C] rated at C4 and installed in the 1960’s, and one 20/33MVA 66/22kV transformer located in the No.5 position manufactured by [C.I.C] rated at C1 installed in 2011.

3.3.2 Secondary Equipment

The two incoming 66kV lines are YPS/MOE No.1 and No.2 Lines. YPS/MOE No.1 Line is protected by an [C.I.C] distance protection of obsolete analogue electronic tyope as X protection and a [C.I.C] numerical current differential relay as Y protection. The former is being replaced with a modern numerical type current differential protection under a project in the prior EDPR period. YPS/MOE No.2 Line has X and Y protection that are both modern numerical relays.

The existing 66kV bus protection is an obsolete [C.I.C] analogue electronic relay. This will be replaced by numerical X ([C.I.C]) and Y ([C.I.C]) relays in a protection upgrade project in the prior EDPR period.

Auto Reclose(ARC) of 66kV CB's is presently handled by obsolete [C.I.C] relays. Built in ARC functions in numerical line protection relays will replace existing ARC relays when the protection upgrade project is completed.

Duplicated X and Y CB failure protection are provided for 66kV CBs using numerical [C.I.C] and early generation digital [C.I.C] relays.

Protection for Transformers No.1, No.2, No.3 and No.4 are not duplicated. Transformers No.1, No.2 and No.4 are protected by first generation digital type relays [C.I.C]. Transformer No.3 is protected by electromechanical type [C.I.C]. These relays will be replaced with duplicated X and Y biased differential protection of numerical type in the protection upgrade project. Modern numerical type biased differential relays are used for X and Y protection of Transformer No.5.

All transformers have numerical voltage regulating relays (VRR) using [C.I.C].

The 22kV bus protection consists of highimpedance bus protection using [C.I.C] relays and bus distance protection using [C.I.C] relays. The former will be replaced with numerical type [C.I.C] relays in the protection upgrade project.

Numerical type relays [C.I.C] and [C.I.C] are used for 22kV master earth fault (MEF) and backup earth fault (BUEF) protection respectively.

All 22kV feeders have numerical feeder protection using [C.I.C] relays.

The 22kV capacitor bank protection has overcurrent, earth fault and voltage balance schemes using a [C.I.C] relay.

The station has duplicated 240V AC systems and battery chargers that supply a 120V DC system for the protection relays and trip coils.

3.4 Asset Condition

AMS 10-13 Condition Monitoring describes AusNet Services' strategy and approach to monitoring the condition of assets.

Asset condition is measured with reference to an asset health index on a scale of C1 to C5. Table 2 provides a description of the asset condition scores.

Table 2: Asset condition Score and Remaining Service Potential

Condition Score	Condition	Condition Description
C1	Very Good	Initial service condition
C2	Good	Deterioration has minimal impact on asset performance. Minimal short term asset failure risk.
C3	Average	Functionally sound showing some wear with minor failures, but asset still functions safely at adequate level of service.
C4	Poor	Advanced deterioration – plant and components function but require a high level of maintenance to remain operational.
C5	Very Poor	Extreme deterioration approaching end of life with failure imminent.

The condition of the key assets at WGL is discussed in the Asset Health Reports for the key asset classes such as power transformers, instrument transformers and switchgear with information on asset condition rankings, recommended risk mitigation options and replacement timeframes. A summary of the condition is provided in Table 3 and discussed in the following sections.

Table 3: WGL Asset Condition Summary

Asset Type	Number of Assets				
	C1	C2	C3	C4	C5
66kV Circuit Breakers	1				2
66kV Current Transformers			6		
66kV Voltage Transformers					8
66/22kV Power Transformers	1			4	
22kV Circuit Breakers	3	15			
22kV Current Transformers	2	16	6	4	
22kV Voltage Transformers	1	5			

These condition scores are then used to calculate the asset failure rates using the Weibull parameters determined for each asset class.

3.5 Zone Substation Supply Capacity

WGL is a summer peaking station and the peak electrical demand reached 66.2MVA in the summer of 2017/18. The recorded peak demand in winter 2018 was 50MVA.

The demand at WGL is forecast to increase at a growth rate of approximately 3% per annum.

Figure 3 shows the forecast maximum demand and supply capacities (cyclic ratings) for WGL.

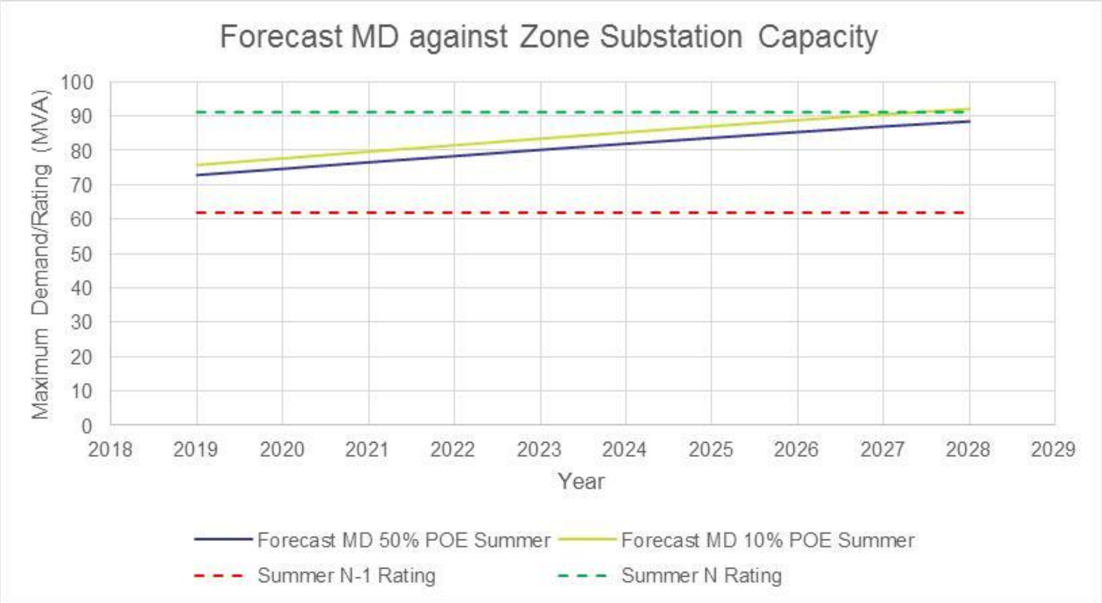

Figure 3: WGL Forecast Maximum Demand against Zone Substation Capacity

3.6 Load Duration Curves

The zone substation load duration curves that feed into the risk-cost assessment model are derived from historical actual demands between:

- 1 October 2016 and 31 March 2017 for the summer 50% probability of exceedance (POE) curves;
- 1 April 2017 and 30 September 2017 for the winter 50% POE curves;
- 1 October 2013 and 31 March 2014 for the summer 10% POE curves; and
- 1 April 2017 and 30 September 2017 for the winter 10% POE curves.

The historical hourly demands are separated by season and unitised based on the recorded maximum demand within that season (summer and winter) and time period, which allows the load duration curve to be scaled according to the seasonal forecast maximum demand for each year of the assessment period.

The 50% POE unitised load duration for WGL zone substation is presented in

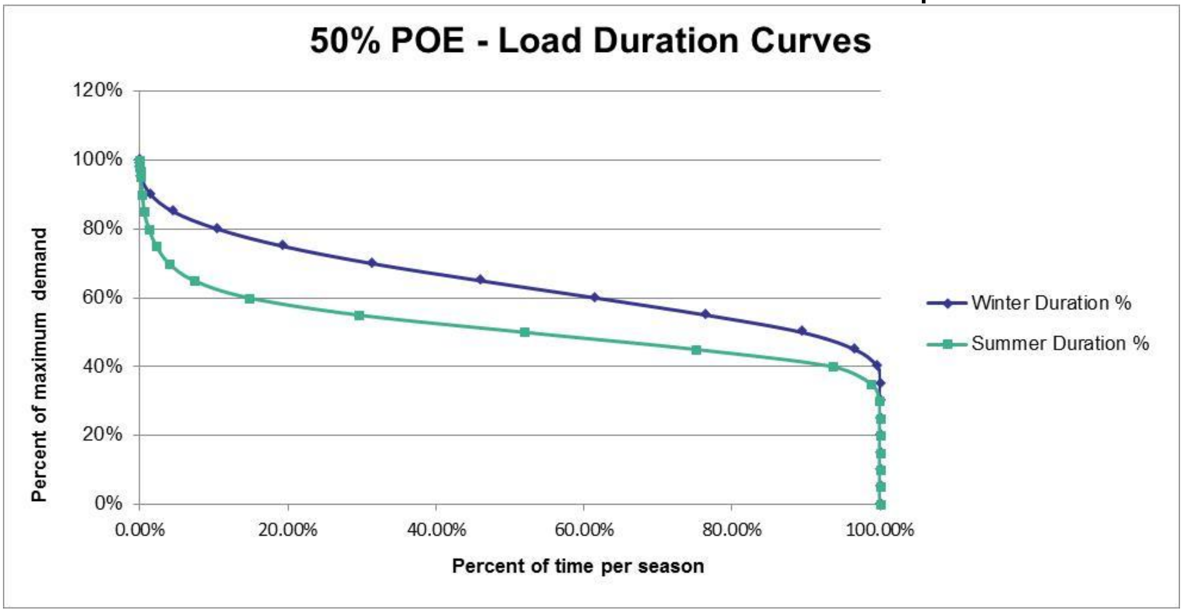

Figure 4, and the 10% POE unitised load duration for WGL zone substation is presented in Figure 5.

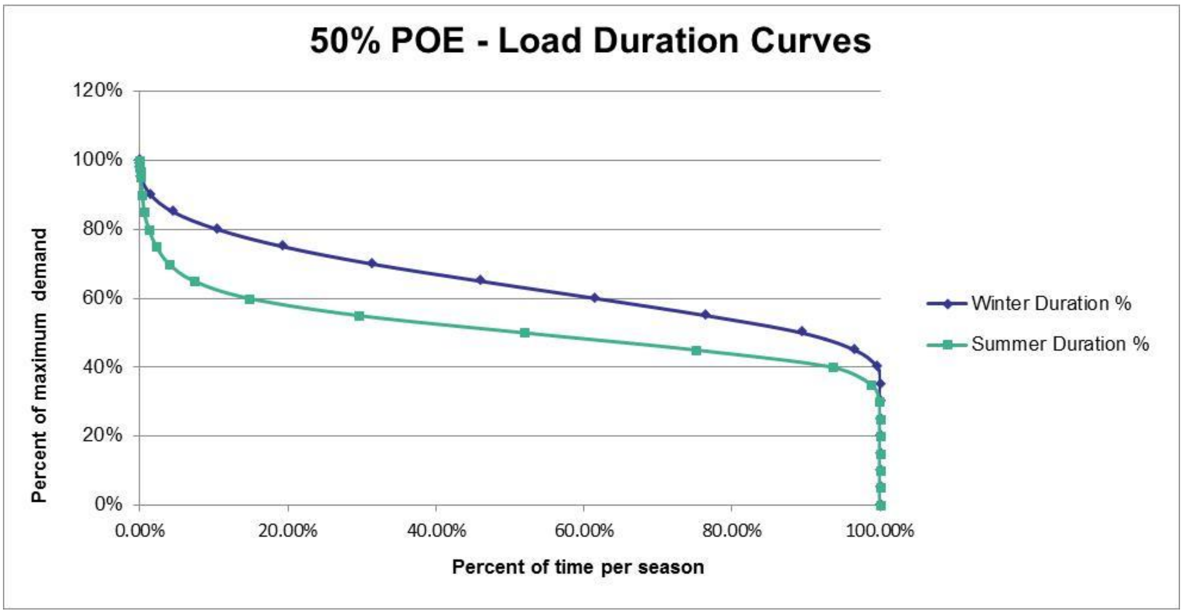

Figure 4: WGL 50% Load Duration Curves

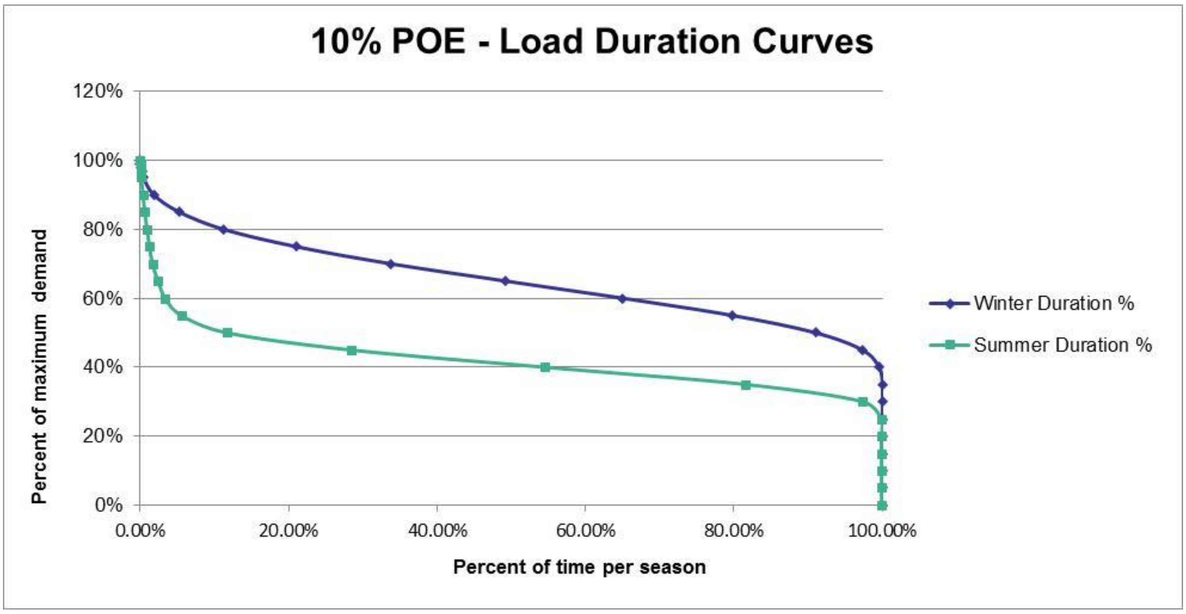

Figure 5: WGL 10% POE Load Duration Curves

3.7 Feeder Circuit Supply Capacity

A new feeder is planned for the WGL area within the next two years due to rapid load growth in the Drouin, Longwarry and Bunyip areas.

3.8 Load Transfer Capability

The Distribution Annual Planning Report (DAPR) provides the load transfer capability (in MW) of the feeder interconnections between WGL and its neighbouring zone substations.

This is then forecast forward in line with the forecast demand growth to give the forecast load transfer capability in Table 4.

Table 4: WGL Load Transfer Capability

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Load Transfer Capability (MW)	3.2	3.1	3.1	3.0	2.9	2.9	2.8	2.7	2.7	2.6

4 Other Issues

4.1 Regulatory Obligations

This planning report acknowledges AusNet Services obligations as a Distribution Network Service Provider under the National Electricity Rules with particular emphasis on:

Clause 6.5.7 of the National Electricity Rules requires AusNet Services to only propose capital expenditure required in order to achieve each of the following:

(1) meet or manage the expected demand for standard control services over that period;

(2) comply with all applicable regulatory obligations or requirements associated with the provision of standard control services;

(3) to the extent that there is no applicable regulatory obligation or requirement in relation to:

(i) quality, reliability or security of supply of standard control services; or

(ii) the reliability or security of the distribution system through the supply of standard control services

to the relevant extent:

(iii) maintain the quality, reliability and security of supply of standard control services, and

(iv) maintain the reliability and security of the distribution system through the supply of standard control services; and

(4) maintain the safety of the distribution system through the supply of standard control services.

Section 98(a) of the Electricity Safety Act requires AusNet Services to:

design, construct, operate, maintain and decommission its supply network to minimise as far as practicable –

(a) the hazards and risks to the safety of any person arising from the supply network; and

(b) the hazards and risks of damage to the property of any person arising from the supply network; and

(c) the bushfire danger arising from the supply network.

The Electricity Safety act defines ‘practicable’ to mean having regard to –

(a) severity of the hazard or risk in question; and

(b) state of knowledge about the hazard or risk and any ways of removing or mitigating the hazard or risk; and

(c) availability and suitability of ways to remove or mitigate the hazard or risk; and

(d) cost of removing or mitigating the hazard or risk.

Clause 3.1 of the Electricity Distribution Code requires AusNet Services to:

(b) develop and implement plans for the acquisition, creation, maintenance, operation, refurbishment, repair and disposal of its distribution system assets and plans for the establishment and augmentation of transmission connections:

(i) to comply with the laws and other performance obligations which apply to the provision of distribution services including those contained in this Code;

(ii) *to minimise the risks associated with the failure or reduced performance of assets; and*

(iii) *in a way which minimises costs to customers taking into account distribution losses.*

4.2 Station Configuration Supply Risk

Failure of some 66kV and 22kV equipment will result in supply outages to customers as backup circuit breakers operate to isolate the failed equipment.

This would be for an estimated duration of two hours, which is the typical time it takes operators to travel to site and manually re-configure circuits to isolate the failed equipment and sequentially restore supply to as many customers as possible.

Table 5 lists the estimated bus outage consequence factors for each major type of equipment based on the substation layout.

Table 5: WGL Bus Outage Consequence Factors

Equipment	Estimated Bus Outage Consequence
Transformer	0%
22kV circuit breaker	47%
66kV circuit breaker	33%
22kV current transformer	47%
66kV current transformer	33%
22kV voltage transformer	17%
66kV voltage transformer	0%

5 Identified Need

WGL commenced operation as a 66/22kV transformation station in 1962. Three 10/12.5MVA transformers were installed in 1962. A fourth 10/13.5MVA transformer was added in 1997 as a replacement for an existing 5/6.5MVA transformer, however this transformer was manufactured in 1965. A fifth 20/33MVA transformer was added in 2011. The 66kV switchyard is practically as it was constructed in the 1960s, with the exception of an additional 66kV CB added in 2011 when the fifth transformer was installed. The 22kV switchyard was replaced by an indoor switchboard in 1997.

The physical and electrical condition of these assets has deteriorated and they are now presenting an increasing failure risk.

The station has a 66kV ring bus arrangement, but is partially switched with the four 1960's vintage transformers switched as a single group, and a normally open isolator in place of a 66kV circuit breaker between the two 66kV line entries from YPS.

The key service constraints at WGL are:

- Security of supply risk presented by the switching of four of the transformers in a single group;
- Security of supply risks presented by increased likelihood of asset failure due to the deteriorating condition of the assets;
- Health and safety risks presented by a possible explosive failure of bushings on a number of the assets;
- Plant collateral damage risks presented by a possible explosive failure of bushings on a number of the assets;
- Environmental risks associated with insulating oil spill or fire;
- Reactive asset replacement risks presented by the increasing likelihood of asset failure due to the deteriorating condition of the assets; and
- Health and safety risks presented by asbestos containing cement sheets or electrical switch boards in the main building and switchyard.

6 Risk and Options Analysis

6.1 Risk-Cost Model Overview

AusNet Services' risk-cost model quantifies the benefits of potential investment options by comparing the service level risk of the Do Nothing (Counterfactual) option with the reduced service level risk assuming the credible option is place.

The investment cost to implement the credible option is then subtracted from the monetised benefit to compare credible options and identify the option that maximises the net economic benefit (the proposed preferred option).

The areas of service level risk costs, and risk cost reduction benefits, that AusNet Services considers include:

- Supply risk;
- Safety risk;
- Collateral damage risk;
- Reactive replacement risk;
- Environment risk;
- Operations and maintenance costs; and
- Losses.

Further details on the model can be found in AusNet Services' Risk-Cost Assessment Model Methodology paper.

6.2 Risk Mitigation Options Considered

The following options have been identified to address the risk at WGL:

1. Do nothing different (counterfactual)
2. Retire one transformer
3. Retire one transformer and sure up supply capacity via network support
4. Use network support to defer retirement and replacement
5. Replace four transformers with two transformers and replace capacitor bank
6. Replace four transformers with two transformers, replace the existing capacitor bank and install two new 66kV circuit breakers
7. Replace four transformers with four transformers and replace capacitor bank

An economic cost-benefit assessment is used to assess and rank the economic efficiency of each option.

The following sections provide a brief summary of each of these options.

6.2.1 Option 1: Do Nothing Different

The Do Nothing Different (counterfactual) option assumes that AusNet Services would not undertake any investment, outside of the normal operational and maintenance processes.

Under this option, increasing supply risk would be managed by increased levels of involuntary load reduction.

Increased non-supply risks, such as those associated with safety, collateral damage, reactive replacement and environmental impacts, would be accepted as unmanaged rising risk costs.

The Do Nothing Different (counterfactual) option establishes the base level of risk, and provides a basis for comparing potential options.

Since this option assumes no investment outside of the normal operational and maintenance processes, this is a zero investment cost option.

6.2.2 Option 2: Retire one transformer

This options tests whether the current installed capacity of the substation is still required to meet customer demand and whether equipment could be retired rather than replaced.

The capital cost for this option is [C.I.C], for associated decommissiong works.

6.2.3 Option 3: Retire one transformer and sure up supply capacity via network support

This option tests whether the current installed capacity of the substation is still required to meet customer demand and whether equipment could be retired and network support used rather than replacing poor condition assets.

The capital cost for this option is [C.I.C], for associated decommissiong works and setup of a 10MW network support agreement.

In addition to the capital cost, there is ongoing operational costs associated with this option that represent the network support availability and activation costs, and which vary year-by-year based on the network support expected under this option, as outlined in Table 6.

Table 6: Network support services annualised costs ($ million)

2021	2022	2023	2024	2025
C.I.C				

6.2.4 Option 4: Network support to defer retirement and replacement

This options tests whether network support can be used to defer the replacement of poor condition assets. This option addresses the supply risks associated with poor condition assets, but does not address the safety, environmental or collateral damage risks as the assets remain in service.

The capital cost of this option is [C.I.C], for setup of a 10MW network support agreement.

In addition to the capital cost, there is ongoing operational costs associated with this option that represent the network support availability and activation costs, and which vary year-by-year based on the network support expected under this option, as outlined in Table 7.

Table 7: Network support services annualised costs ($ million)

2021	2022	2023	2024	2025
C.I.C				

6.2.5 Option 5: Replace four transformers with two transformers and replace capacitor bank

In this option, the three 10/12.5MVA and one 10/13.5MVA transformers are replaced with two 20/33MVA transformers. The capacitor bank is also replaced.

This option has a capital cost of [C.I.C].

6.2.6 Option 6: Replace four transformers with two transformer, replace the existing capacitor bank and install two new 66kV circuit breakers

In this option, the three 10/12.5MVA and one 10/13.5MVA transformers are replaced with two 20/33MVA transformers. Two new 66kV circuit breakers are installed and the capacitor bank is replaced. The existing C5 66kV circuit breakers will be replaced under a separate project in the prior EDPR period.

This option has a capital cost of [C.I.C].

6.2.7 Option 7: Replace four transformers with four transformers and replace capacitor bank

In this option, the three 10/12.5MVA and one 10/13.5MVA transformers are replaced with four 10/15MVA transformers. The capacitor bank is also replaced.

This option has a capital cost of [C.I.C].

6.3 Risk-Cost Model Results

6.3.1 Existing Service Level Risk

Figure 6 shows the existing service level risk. The risk costs is dominated by supply risk with some non-supply risks (safety, environment, collateral damage and reactive replacement). The escalation in the risk costs over time is driven by a combination of deterioration in the condition of the assets and an increase in demand.

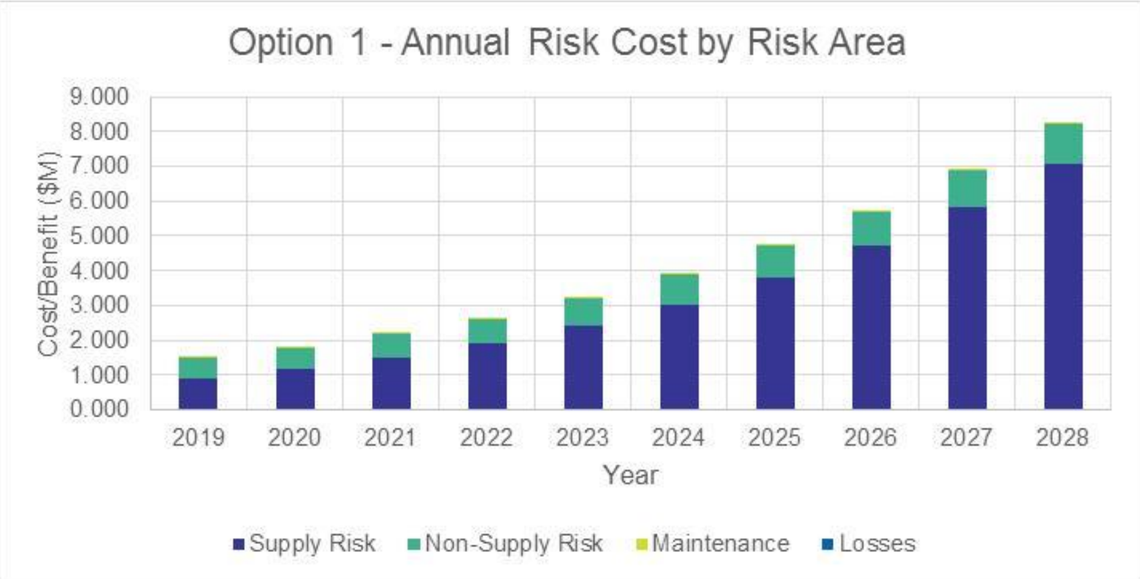

Figure 6: Do Nothing Different – Service Level Risk Cost

6.3.2 Economic Cost Benefit Analysis

The economic analysis allows comparison of the economic cost and benefits of each option to rank the options and to determine the economic timing of the preferred option.

It quantifies the capital, operational and maintenance costs along with service level risk reduction benefits for each option.

Table 8 lists the annualised net economic benefit of each option for each year, with the option that maximises this benefit highlighted.

Table 8: Annualised net economic benefit ($M)

	2020	2021	2022	2023	2024	2025	2026	2027	2028
Option 1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Option 2	C.I.C								
Option 3									
Option 4									
Option 5									
Option 6									
Option 7									
Option 8									

This indicates that Option 6 is the most economic option for the analysis period.

6.3.3 Sensitivity Analysis

Table 9 presents the net present value of net economic benefits under a variety of sensitivities. The net economic benefit assessment takes account of each option's total capital, operating and maintenance costs, compared to the reduction in service level risk cost that option is expected to deliver.

The robustness of the economic assessment is tested for the following sensitivities:

- Asset failure rates, varied at ±50% of the base failure rate;
- Maximum demand forecasts, varied to ±5% of the base forecast;
- Value of customer reliability (VCR), varied to ±25% of the base VCR;
- Proposed option costs, varied to ±15% of the base option cost;
- Value of statistical life (VoSL) of [C.I.C], varied from a [C.I.C] low case, to a [C.I.C] high case; and
- Discount rate of 6.44%, varied to ±2% per annum of the base discount rate.

The preferred option under each sensitivity is highlighted, and the option that maximises net benefits under the majority of sensitivities is considered the proposed preferred option.

Table 9: NPV of Net Economic Benefit Analysis

Scenario	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8
Base Case	$0.00	C.I.C						
High Asset Failure Rate	$0.00							
Low Asset Failure Rate	$0.00							
High Demand	$0.00							
Low Demand	$0.00							
High VCR	$0.00							
Low VCR	$0.00							
High Option Cost	$0.00							
Low Option Cost	$0.00							
High VoSL	$0.00							
Low VoSL	$0.00							

Scenario	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8
High Discount Rate	$0.00							
Low Discount Rate	$0.00							

The sensitivity analysis indicates the preferred option is Option 6, as it has the highest net benefit under the majority of sensitivities tested.

6.3.4 Economic Timing of Preferred Option

The annual benefit of implementing a credible alternative option to the Do Nothing Different (counterfactual) option is the difference between the total service level risk cost with a credible option in place, and the total service level risk cost of the Do Nothing Different option.

The optimal economic timing of the proposed option is the point in time when the annual benefit of implementing the proposed option outweighs the annualised cost to implement that option.

The optimal economic timing to implement the proposed preferred option is by 2020, as presented in Figure 7.

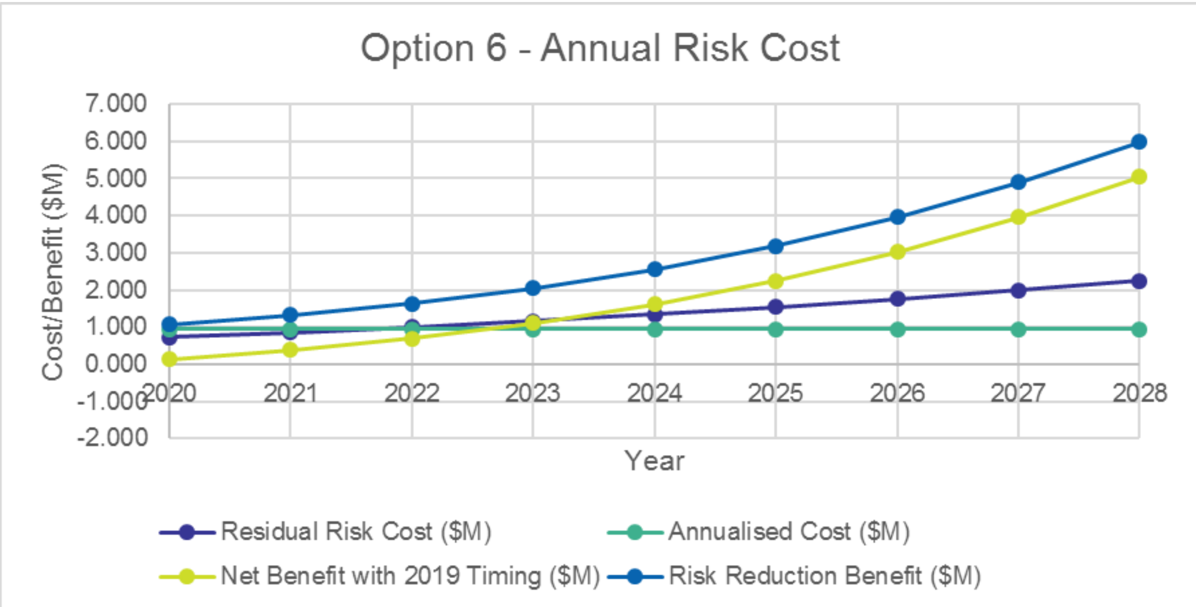

Figure 7: Economic timing of the proposed preferred option

7 Conclusion and Next Steps

The assessment outlined in this report shows that the service level risk to customers supplied from Warragul (WGL) Zone Substation is forecast to grow to unacceptable levels within the 2022-26 EDPR period.

The forecast increase in service level risk is driven by increasing supply and non-supply (safety, environmental, collateral damage and reactive replacement) risk driven by deterioration in the condition of the assets resulting in an increasing likelihood of asset failure.

7.1 Proposed Preferred Option

The options analysis identifies that the preferred option, being the one that maximises the net economic benefit to all those that produce, consume and transport electricity in the NEM, is to:

- Replace four transformers with two transformers, replace the existing capacitor bank and install two new 66kV circuit breakers by 2020, at an estimated capital cost of

  [C.I.C] (Real $2018).

Applying a discount rate of 6.44% per annum, this proposed preferred option has a net economic benefit of [C.I.C], relative to the Do Nothing Different option, over the forty-five-year assessment period.

While the optimal timing of the proposed preferred option is by 2020, to manage the deliverability, allow sufficient time to complete the required regulatory investment test for disctrubition (RIT-D), and to spread the capital expenditure throughout the 2022-26 EDPR, AusNet Services plans to implement the proposed preferred option by 2023.

7.2 Next Steps

This planning report outlines the service level risk mitigation investment that AusNet Services has assessed as prudent, efficient and providing the optimal balance of supply reliability and cost.

While this report outlines AusNet Services' plans for maintaining service levels, and serves to support AusNet Services' revenue request for the 2022-26 EDPR period, the proposed investment is subject to the regulatory investment test for distribution (RIT-D).

As such, the proposed investment will be confirmed via the formal RIT-D process, which includes publication of three reports at the various RIT-D stages, and includes a formal consultation process where interested parties can make submissions that help identify the optimal solution.

APPENDIX A PREFERRED OPTION DETAILS

A.1 Scope of Work

The high level scope of work for the preferred solution includes:

- Replace three 10/12.5MVA and one 10/13.5MVA 66/22kV transformers with two new 20/33MVA transformers,
- Install two new 66kV CB's "D" and "E" to complete fully switched ring bus,
- Replace eight 66kV VT's and one 22kV CT.
- Replace existing No.2 22kV Capacitor Bank with new 12MVar Capacitor Bank,
- Associated protection works
- New modular battery room and modular control building,
- Asbestos removal from existing buildings

A.2 Project Cost Summary

Design	C.I.C
SPA internal costs	
Sub-contractor indirects	
66kV equipment	
22kV equipment	
Transformers	
Line works	
Infrastructure - civil works	
Infrastructure - building works	
Infrastructure - services	
Protection & control systems	
Land / easement purchase	
Metering cost	
Outages	
Spares	
Nominal risk allowance	
Project direct costs	
Management contingency	
Project direct costs plus contingency	
Overheads	
Finance charges	
Operating expenditure	
WDV (written down value) of assets to be retired	
Total	