Service constraints at Bayswater Zone Substation

Regulatory Investment Test for Distribution

Draft Project Assessment Report

Published: 12 April 2022

ISSUE/AMENDMENT STATUS

Issue	Date	Description	Author	Approved
1	12/04/2022	First Issue	Murtaza Latif	Gaurav Sharma

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TABLE OF CONTENTS

1 Executive Summary

AusNet Services is a regulated Victorian Distribution Network Service Provider (DNSP) that supplies electrical distribution services to more than 780,785customers. 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).

Our planning approach includes the application of a probabilistic planning methodology, which means that some load cannot be supplied under rare but possible conditions, such as during extreme demand conditions or with a network element out of service. Where relevant, we also prepare, publish, and consult on a regulatory investment test for distribution (RIT-D), which further helps ensure all credible options to address an identified need are considered, and the best option is selected.

This Draft Project Assessment Report (DPAR) is the second stage of the RIT-D consultation process to address the existing and emerging service level constraints in the Bayswater Zone Substation (BWR) supply area. The DPAR follows our earlier publication of a notice of determination in accordance with clause 5.17.4(d) of the National Electricity Rules (the Rules), which explained that there are no credible non-network options that are capable of addressing the identified need at BWR.

This DPAR complies with the requirements of Clause 5.17.4(j) of the Rules, as detailed in section 7 of this document, and the AER's RIT-D application guidelines. The RIT-D analysis concludes that Option 5 is the preferred option, which is the replacement of all existing deteriorated outdoor 22kV bulk oil circuit breakers in C4 and C5 condition with three new indoor switchboards and associated secondary equipment with the new control building.

1.1 Identified need

BWR commenced operation as a 66/22kV transformation station in the late 1960s with three power transformers and two 66kV lines, one from Ringwood Terminal Station (RWTS) and the other from Boronia Zone Substation (BRA). The third 66kV line was constructed in 2015 and it is a three legged line from RWTS to Bayswater and Croydon.

The station has an outdoor 22kV switchyard with twin 22kV feeders. There are seventeen 22kV bulk-oil circuit breakers at the station which were installed in the 1960s and 1970s. The station configuration includes three 66kV buses and three 22kV buses. The physical and electrical condition of some assets have deteriorated and are now presenting an increasing failure risk. Approximately 65% of assets at BWR are in poor to very poor condition, C4 and C5 respectively.[1]

The emerging service constraints at BWR are:

a) Health and safety risks presented by a possible explosive failure of the bushings on a number of the assets;

b) Plant collateral damage risks presented by a possible explosive failure of a number of the assets;

[1] AusNet Services, Distribution Annual Planning Report 2022 – 2026, December 2021, page 57.

c) Environmental risks associated with insulating oil spill or fire; and

d) Reactive asset replacement risks presented by the increasing likelihood of asset failure due to the deteriorating condition of the assets.

Our assessment is that works are required to address the asset-related risks in accordance with our obligations under clause 5.2 of the Electricity Distribution Code, which requires us to meet reasonable customer expectations of reliability of supply.[2]

1.2 Options considered and preferred option

The options considered in this DPAR, which include both credible and non-credible options, are:

1. 'Do nothing' or Business as Usual
2. Retire one transformer
3. Retire one transformer and reduce residual risk through network support
4. Use network support to defer retirement and replacement
5. Replace all 22kV switchgear
6. Replace one transformer and 22kV switchgear
7. Replace two transformers and 22kV switchgear.

Our analysis concludes that only Options 5, 6 and 7 are credible options, and the preferred option is Option 5.

1.3 Consultation

In accordance with Clause 5.17.4(k) of the NER, we request submissions on the matters set out in this DPAR. Notification of this request for submissions will also be provided to Registered Participants, AEMO, non-network providers, interested parties and persons on our demand side engagement register as required by the NER.

Submissions should be sent to ritdconsultations@ausnetservices.com.au by 31 May 2022 and telephone enquiries can be directed to Murtaza Latif on (03) 9695 6000.

Submissions will be published on AusNet Services' website. If you do not wish to have your submission published, please clearly stipulate this at the time of lodging your submission.

2 For further details of the regulatory obligation that underpin the identified needs at BWR, please refer to section 4 of the notice of determination published on 21 April 2021.

2 Background

2.1 Existing network

BWR is located in the eastern suburbs of metropolitan Melbourne approximately 29km east of Melbourne and is the main source of supply for the suburbs of Bayswater, Croydon South, Kilsyth South, Wantirna and Heathmont. BWR supplies approximately 17,700 AusNet Services' customers. The load at BWR includes mostly residential and commercial urban load with some industrial loads.

BWR has a typical Melbourne climate with summer average maximum temperatures of 26°C, winter average minimum temperatures of 6°C with extreme temperatures reaching 46°C in summer and -3°C in winter. The average rainfall is 658mm in this area.

BWR is supplied at 66kV via three 66kV circuits that originate from Ringwood Terminal Station (RWTS), Boronia Zone Substation (BRA) and a three legged line from RWTS to Bayswater & Croydon.

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

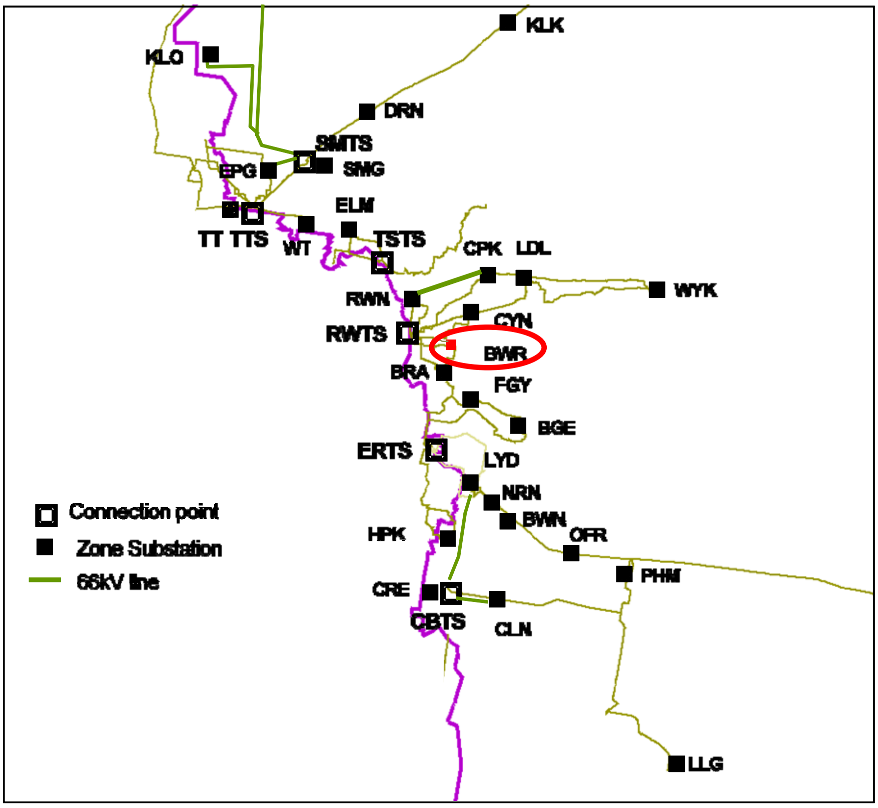

Figure 1: BWR location within AusNet Services distribution network

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

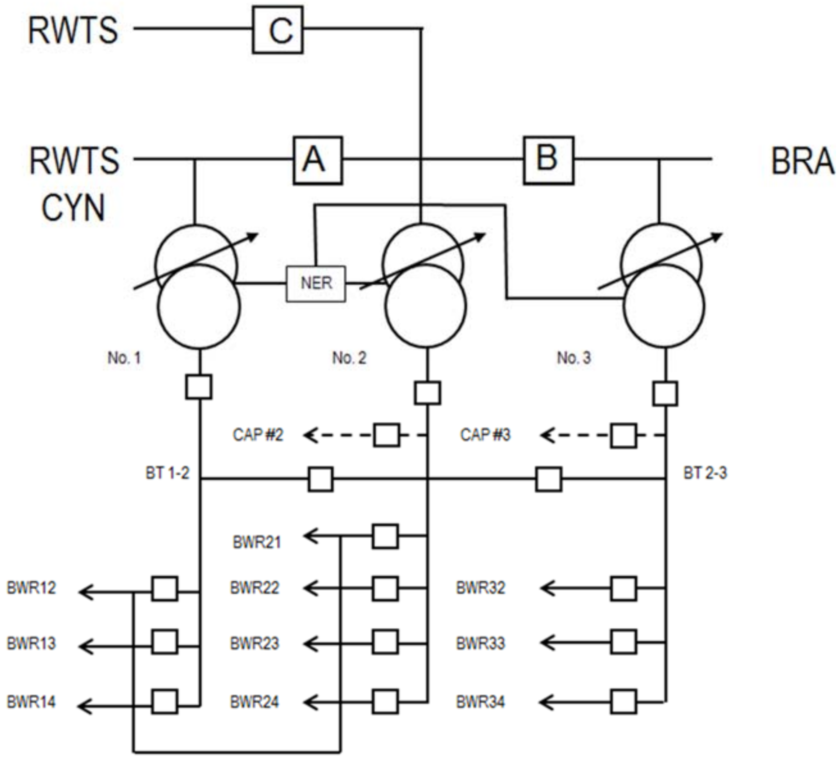

Figure 2: BWR Single Line Diagram

2.2 Customer Composition

BWR has ten 22kV feeders of which supply into the AusNet Services supply area.

Table 1 provides details of the 22kV supply feeders.

Table 1: BWR feeder information

Feeder	Feeder Length (km)	Feeder description	Number of Customers	Customer Type
BWR12	6.5	Summer peaking, urban feeder	789	25% residential 36% commercial 39% industrial 0% farming
BWR13	40.0	Summer peaking, short rural feeder	4,480	92% residential 5% commercial 3% industrial 0% farming
BWR14	1.2	Summer peaking, urban feeder	1	100% commercial
BWR21	1.2	Summer peaking, urban feeder	1	100% commercial
BWR22	10.3	Summer peaking, urban feeder	1,069	45% residential 24% commercial 31% industrial 0% farming

BWR23	19.7	Summer peaking, urban feeder	3,680	92% residential 5% commercial 3% industrial 0% farming
BWR24	8.8	Summer peaking, urban feeder	780	51% residential 33% commercial 16% industrial 0% farming
BWR32	2.9	Summer peaking, urban feeder	2,920	89% residential 8% commercial 3% industrial 0% farming
BWR33	1.2	Summer peaking urban feeder	96	3% residential 54% commercial 43% industrial 0% farming
BWR34	1.7	Summer peaking urban feeder	3,170	86% residential 13% commercial 1% industrial 0% farming

The 22kV feeders interconnect with 22kV feeders from Boronia Zone Substation (BRA), Ringwood Terminal Station (RWTS) and Croydon Zone Substation, providing a load transfer capability of 24.6MVA.

2.3 Zone Substation Equipment

2.3.1 Primary Equipment

BWR includes an air-insulated 66kV switchyard with three 66kV buses separated by bus-tie circuit breakers connected to three incoming 66kV lines from RWTS and BRA.

There are three 22kV air insulated busbars connected to one another with a bus-tie circuit breaker and connected to the three 66/22kV transformers via three transformer circuit breakers. Ten 22kV feeders and one 6MVAr and one 12MVAr capacitor banks are connected to these 22kV busbars.

The 22kV switchyard currently has sixteen 22kV bulk oil circuit breakers which have been assessed as being in C4 and C5 condition. The BWR32 22kV feeders circuit breaker is rated at C3.

Transformation comprises three 20/27MVA 66/22kV transformers located in the No.1, No.2 and No.3 positions, with two manufactured by Wilson rated at C4 and the other manufactured by English Electric rated at C3 and installed at BWR in the late 1960s.

2.3.2 Secondary Equipment

The three incoming 66kV lines and buses are protected by current differential and remote trip send and directional overcurrent protection using modern SEL 411L and GE F650 relays.

The No.1, No.2 and No.3 66/22kV transformer differential protection is provided by new transformer differential protection ABB D21SE2 relays.

The 22kV bus protection consists of high impedance bus protection and bus distance protection using GEC - CDG14 and GE - 30 relays.

The 22kV feeder circuit breakers have master earth fault and back up earth fault protection using older Email - Group, SR 760 and ABB - Group relays.

The 22kV capacitor bank protection has overcurrent, earth fault and voltage balance schemes using a GE - 650 relay.

The station has duplicated 24V AC systems and battery chargers that supply a 125V DC system for the protection relays and trip coils.

2.4 Asset Condition

A summary of asset conditions is provided in the table below.

Table 2: BWR Asset Condition Summary

Asset Type	Number of Assets				
	C1	C2	C3	C4	C5
66kV Circuit Breakers	3				
66kV Current Transformers					3
66kV Voltage Transformers	3				2
66/22kV Power Transformers			1	2	
22kV Circuit Breakers			2	9	7
22kV Current Transformers	1				1
22kV Voltage Transformers		3			

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

2.5 Capacity

2.5.1 Zone Substation Supply Capacity

BWR is a summer peaking station and the peak electrical demand reached 48.2MVA in the summer of 2020/21. The demand at BWR is forecast to increase slowly at a growth rate of less than 0.5% per annum. The figure below shows the forecast maximum demand and supply capacities (cyclic ratings) for BWR.

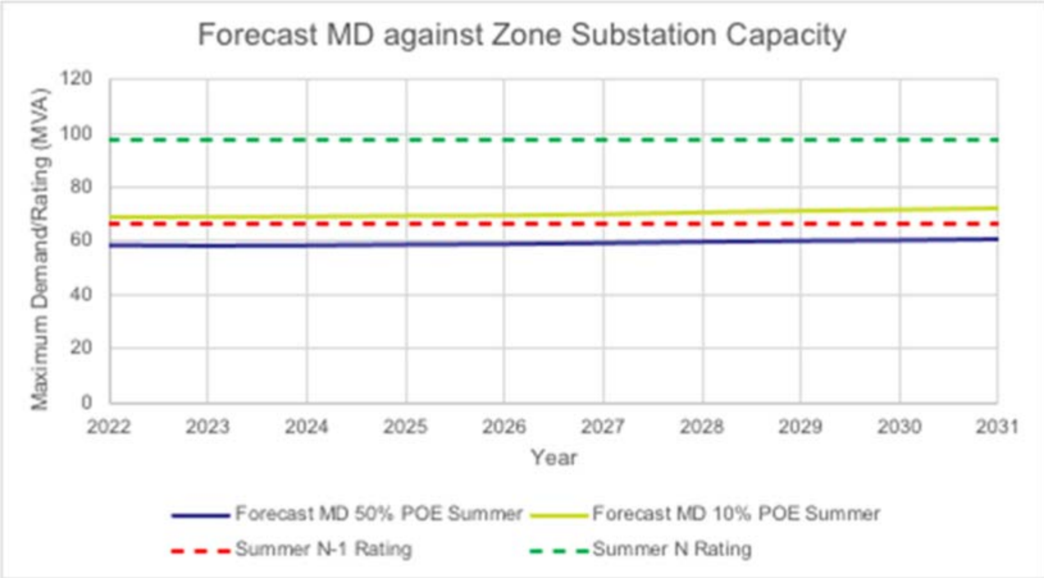

Figure 3: BWR forecast maximum demand against zone substation capacity

2.5.2 Load Duration Curves

The zone substation load duration curves that feed into the risk-cost assessment model are derived from historical actual demands. 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 BWR is presented in Figure 4 and the 10% POE unitised load duration for BWR is presented in Figure 5.

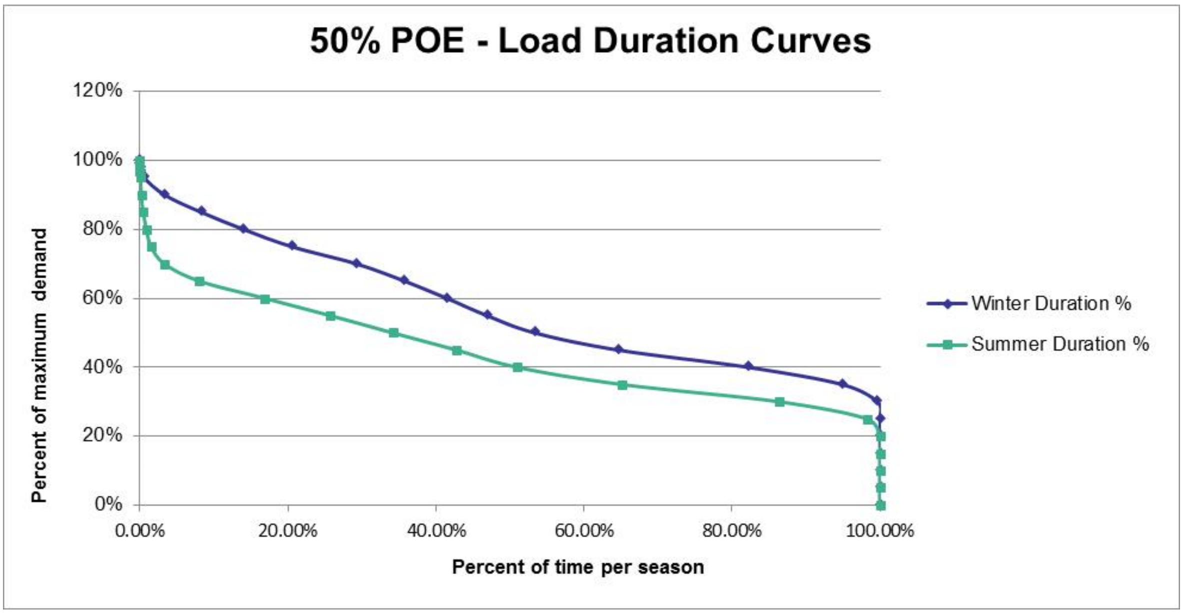

Figure 4: BWR 50% Load Duration Curves

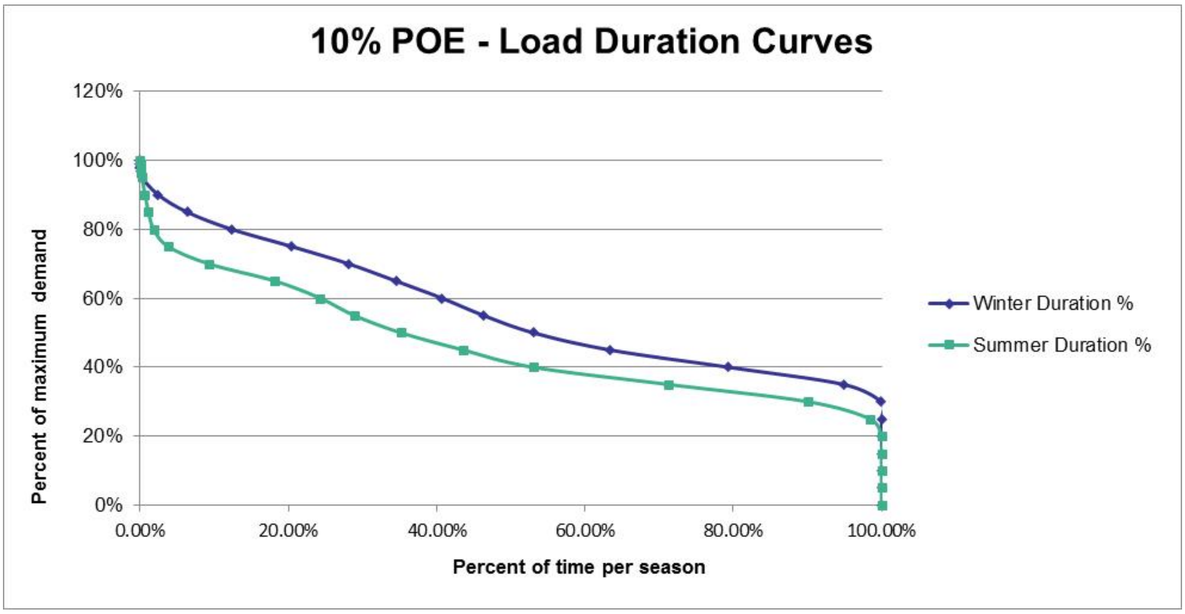

Figure 5: BWR 10% POE Load Duration Curves

2.5.3 Feeder Circuit Supply Capacity

There is currently no requirement for additional feeders at BWR due to the low load growth in the area.

2.5.4 Load Transfer Capability

The Distribution Annual Planning Report provides the load transfer capability (in MW) of the feeder interconnections between BWR and its neighbouring zone substations. The load transfer capability of the feeder interconnections between BWR and its neighbouring zone substations is 24 MVA.[3]

[3] AusNet Services, Distribution Annual Planning Report 2022 – 2026, December 2021, page 57.

3 Identified need

BWR commenced operation as a 66/22kV transformation station in the late 1960s with three power transformers and two 66kV lines, one from Ringwood Terminal Station (RWTS) and the other from Boronia Zone Substation (BRA). The third 66kV line was constructed in 2015 and it is a three legged line from RWTS to Bayswater and Croydon.

The station has an outdoor 22kV switchyard with twin 22kV feeders. There are seventeen 22kV bulk-oil circuit breakers at the station which were installed in the 1960s and 1970s. The station configuration includes three 66kV buses and three 22kV buses. The physical and electrical condition of some assets have deteriorated and are now presenting an increasing failure risk. Approximately 65% of assets at BWR are in poor to very poor condition, C4 and C5 respectively.[4]

The emerging service constraints at BWR are:

a) Health and safety risks presented by a possible explosive failure of the bushings on a number of the assets;
b) Plant collateral damage risks presented by a possible explosive failure of a number of the assets;
c) Environmental risks associated with insulating oil spill or fire; and
d) Reactive asset replacement risks presented by the increasing likelihood of asset failure due to the deteriorating condition of the assets.

The condition of the assets at BWR 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. In light of our Asset Health Report for BWR, our assessment is that works are required to address the asset-related risks in accordance with our obligations under clause 5.2 of the Electricity Distribution Code, which requires us to meet reasonable customer expectations of reliability of supply.[5]

Our planning report for BWR also highlighted the security of supply risks that arise from the station configuration and asset failure. Our updated load forecasts indicate that supply risks do not arise, other than as a result of station configuration. The load at risk as a result of this station configuration issue is an additional factor that will need to be considered in assessing the credible options.

4 AusNet Services, Distribution Annual Planning Report 2022 – 2026, December 2021, page 57.

5 For further details of the regulatory obligation that underpin the identified needs at BWR, please refer to section 4 of the notice of determination published on 21 April 2021.

4 Screening for non-network options

The purpose of the RIT-D is to identify the credible option for addressing an identified need that maximises the net market benefit. Clause 5.17.4(c) of the Rules states that a RIT–D proponent need not prepare a non-network options report if the proponent determines, on reasonable grounds, that there are no credible non-network options that are able to address the identified need, either partly or wholly. In accordance with this requirement, AusNet Services has determined that there are no non-network options that are capable of addressing the identified need.

Our reasoning for concluding that there are no credible non-network options are set out in our notice of determination under clause 5.17.4(d) of the Rules, which we published on 21 April 2021. In summary, in that notice we determined that:

- The nature of the risks are asset-related and cannot be mitigated by a non-network option.
- In addition to the asset related risks noted above, BWR is exposed to a security of supply issue arising from the existing station configuration. While this issue will need to be considered in addressing the preferred network solution, the potential exposure relates to the loss of the entire zone substation which cannot be addressed by a non-network solution.

In accordance with the Rules requirements, we also noted that these reasons are not dependent on any particular assumptions or methodologies. As the identified need must be satisfied because it reflects a compliance obligation, this DPAR must identify a network option that satisfies the RIT-D.

5 Options considered

This section outlines the potential options that have been considered to address the identified need, and summarises the key works and costs associated with implementing these options. The options discussed in this section, which include both credible and non-credible options, are:

1. Do nothing' or Business as Usual
2. Retire one transformer
3. Retire one transformer and reduce residual risk through network support
4. Use network support to defer retirement and replacement
5. Replace all 22kV switchgear
6. Replace one transformer and 22kV switchgear
7. Replace two transformers and 22kV switchgear.

The costs presented in this section are expressed in real 2022 dollars.

5.1 Option 1: Business as Usual

This (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 Business as Usual (counterfactual) option establishes the base level of risk (and associated costs), and provides a basis for comparing potential options to address the identified need.

5.2 Option 2: Retire one transformer

This option 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.

Our analysis shows that this option would increase the expected unserved energy and would produce a negative net present value (NPV) compared to the 'Business as Usual' option. Furthermore, the retirement of one transformer would not address the asset-related risks described in the identified need. On that basis, this option is not credible and is not considered further.

5.3 Option 3: Retire one transformer and reduce residual risk through network support

This option supplements Option 2 by examining whether the addition of network support would provide a cost effective means of eliminating residual risk and therefore produce a higher net market benefit.

Our analysis suggests that network support could reduce the cost of unserved energy that would arise under Option 2, but it would continue to produce an inferior outcome compared to the 'Business as Usual' option. In addition, it would also fail to address the asset-related risks that are described in the identified need.

For these reasons, this option is not credible and is not considered further.

5.4 Option 4: Network support to defer retirement and replacement

This option extends Option 3 to consider whether sufficient network support could be provided to avoid entirely the proposed retirement and replacement of the network assets, i.e. a network support only solution.

For the reasons set out in relation to Options 2 and 3, this option is not credible as it would fail to address the asset-related risks that are described in the identified need. For further information, please refer to our notice of determination, which explained that there are no credible non-network options that are capable of addressing the identified need at BWR.

5.5 Option 5: Replace 22kV switchgear

This option replaces all existing deteriorated outdoor 22kV bulk oil circuit breakers in C4 and C5 condition with three new indoor switchboards and associated secondary equipment with the new control building. This option does not address the risks associated with the 66/22kV power transformers.

The estimated capital cost for this option is $18.97 million in real 2022 dollars.

5.6 Option 6: Replace one transformer and 22kV switchgear

In addition to replacing all 22kV circuit breakers as per Option 5, this option also replaces No.2 66/22kV power transformer. Under this option, No.1 66/22kV power transformer will be replaced seven years after the completion of stage 1, and therefore this option does not immediately address the risks associated with this power transformer.

The estimated capital cost of this option is $23.39 million in real 2022 dollars.

5.7 Option 7: Replace two transformers and 22kV switchgear

This option extends Option 6 by also replacing the No.1 66/22kV power transformer.

The estimated capital cost of this option is $26.81 million in real 2022 dollars.

6 Economic assessment of the credible options

6.1 Market benefits and assessment approach

The regulatory investment test for distribution requires the RIT-D proponent to consider whether each credible option provides the classes of market benefits described in clause 5.17.1(c)(4) of the Rules. To address this requirement, the table below discusses our approach to each of the market benefits listed in clause 5.17.1(c)(4) in assessing the credible options to address the identified need at BWR.

Table 3: Analysis of Market Benefits

Class of Market Benefit	Analysis
(i) changes in voluntary load curtailment;	The options are not expected to lead to changes in voluntary load curtailment.
(ii) changes in involuntary load shedding and customer interruptions caused by network outages, using a reasonable forecast of the value of electricity to customers;	The options are expected to have an impact on involuntary load shedding, although the identified need relates to asset condition. The cost benefit analysis will therefore consider the impact of each option on load shedding. AusNet Services applies probabilistic planning techniques to assess the expected cost of unserved energy for each option. This market benefit is quantified in section 6.4.
(iii) changes in costs for parties, other than the RIT-D proponent, due to differences in: *(A) the timing of new plant;* *(B) capital costs; and* *(C) the operating and maintenance costs;*	There is no impact on other parties.
(iv) differences in the timing of expenditure;	This project will not result in changes in the timing of other expenditure.
(v) changes in load transfer capacity and the capacity of Embedded Generators to take up load;	This project will not impact on the capacity of Embedded Generators to take up load.
(vi) any additional option value (where this value has not already been included in the other classes of market benefits) gained or foregone from implementing the credible option with respect to the likely future investment needs of the National Electricity Market;	This project will not impact the option value in respect to likely future investment needs of the NEM.
(vii) changes in electrical energy losses; and	This project will not result in changes to electrical energy losses.
(viii) any other class of market benefit determined to be relevant by the AER.	We do not consider any other class of market benefit as relevant to the selection of the preferred option.

6.2 Methodology

The purpose of this section is to provide a high level explanation of our methodology for identifying the preferred option. As a general principle, it is important that the methodology takes account of the identified need and the factors that are likely to influence the choice of the preferred option. As such, the methodology is not a ‘one size fits all’ approach, but one that is tailored for the particular circumstances under consideration.

The identified need for this project can be described in terms of two types of risk:

- supply risk, where an asset failure may lead to a loss of supply to customers; and
- non-supply risk, which captures the potential consequences of an asset failure, which may include safety and environmental costs, in addition to damage to adjacent assets or property.

In relation to supply risk, we adopt a probabilistic planning methodology which considers the likelihood and severity of critical network conditions and outages. The expected annual cost to customers associated with supply risk is calculated by multiplying the expected unserved energy (the expected energy not supplied based on the probability of the supply constraint occurring in a year) by the value of customer reliability (VCR).

In relation to non-supply risks, our approach monetises this risk by multiplying the following parameter estimates:

- the probability of asset failure;
- the cost of consequence of the asset failure;
- the likelihood of the consequence given the failure has occurred; and
- the number of assets to which the analysis relates.

The purpose of the cost benefit analysis that underpins the RIT-D assessment is to determine whether there is a cost effective option to mitigate the supply and non-supply risks (the aggregate 'risk-cost'). In order to be cost effective, the reduction in the aggregate risk-cost that an option is expected to provide must exceed the cost of implementing that option. The preferred option provides greatest expected net benefit, expressed in present value terms.

In the absence of remedial action, Figure 6 shows how the aggregate risk-cost will typically increase as the risk of asset failure and energy at risk increase over time. The optimal timing of the preferred option occurs when the annualised capital cost of that option (or the operating cost for a non-network option) is equal to the aggregate risk-cost.

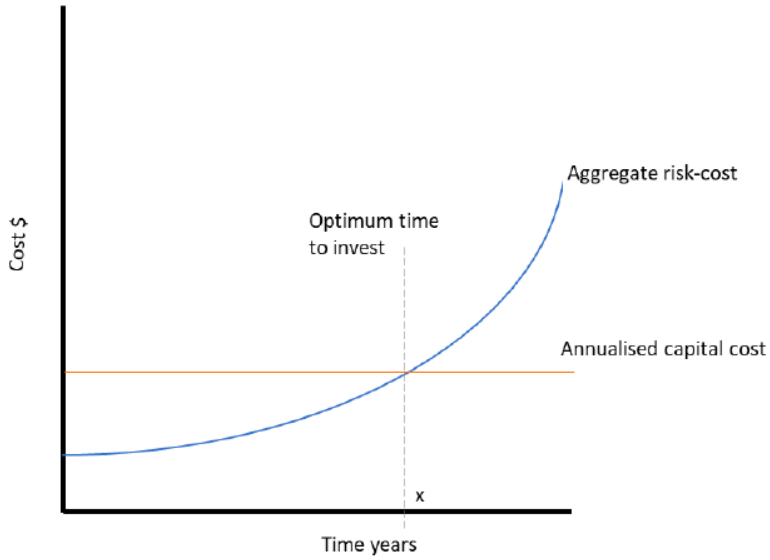

Figure 6: Increasing risk-cost over time and optimal project timing[6]

[6] This figure is reproduced from the AER's Industry practice application note, Asset replacement planning, January 2019, figure 8. This figure assumes that the option eliminates the aggregate risk-cost in full, which may not be the case.

In effect, the preferred option delivers the lowest total cost to customers, which is the sum of the cost of implementing that option and any residual risk-cost. The identification of the preferred option is complicated by the fact that the future is uncertain and that various input parameters are 'best estimates' rather than known values. As a consequence, the RIT-D analysis must be conducted in the face of uncertainty.

To address uncertainty in our assessment of the credible options, we use sensitivity analysis and scenario analysis as part of our cost benefit assessment. As recommended by the AER's application guidelines, we use sensitivity analysis to assist in determining an appropriate set of reasonable scenarios.[7] The relationship between sensitivity analysis and scenarios is best explained by the AER's practice note:[8]

> *Scenarios should be constructed to express a reasonable set of internally consistent possible future states of the world. Each scenario enables consideration of the prudent and efficient investment option (or set of options) that deliver the service levels required in that scenario at the most efficient long run service cost consistent with the National Electricity Objective (NEO).*
>
> *Sensitivity analysis enables understanding of which input values (variables) are the most determinant in selecting the preferred option (or set of options). By understanding the sensitivity of the options model to the input values a greater focus can be placed on refining and evidencing the key input values. Generally the more sensitive the model output is to a key input value, the more value there is in refining and evidencing the associated assumptions and choice of value.*
>
> *Scenario and sensitivity analyses should be used to demonstrate that the proposed solution is robust for a reasonable range of futures and for a reasonable range of positive and negative variations in key input assumptions. NSPs should explain the rationale for the selection of the key input assumptions and the variations applied to the analysis.*

In applying sensitivities and scenarios to our cost benefit assessment, we have regard to the particular circumstances to ensure that the approach is appropriate. Where our analysis shows that an option is clearly preferred, we will not undertake further testing. This approach is consistent with clause 5.17.1(c)(2) of the Rules, which states that the RIT–D must not require a level of analysis that is disproportionate to the scale and likely impact of each credible option considered.

In preparing the RIT-D, we have also had regard to AEMO's 2021 Inputs, Assumptions and Scenarios Report and its draft 2022 Integrated System Plan (ISP). We note that the scenarios adopted by AEMO are focused particularly on the matters that are relevant to major transmission investments, rather than distribution investments of the type considered in this report. Accordingly, we have adopted an approach that is appropriate to the particular circumstances described in this report relating to the identified need and the credible options.

6.3 Key variables and assumptions

Table 4 below lists the key variables and assumptions applied in the economic assessment, which are essential inputs to our methodology described above. The table also sets out the upper and lower bounds of the range of forecasts adopted for each of these variables. As explained above, the lower bound and upper bound estimates are used to undertake sensitivity testing and scenario analysis. The detailed results of this modelling are provided in the next section.

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7 AER, Application guidelines, Regulatory investment test for distribution, December 2018, page 42.

8 AER, Asset replacement planning, January 2019, page 36.

Table 4: Key variables and assumptions

Variable / assumption	Lower bound	Central estimate	Upper bound
Demand forecasts	5% reduction in central estimate of annual growth rate	Average annual growth rate of 0.5%	5% increase in central estimate of annual growth rate
Cost of involuntary supply interruption	25% reduction in central estimate	Value of Customer Reliability (VCR) of $47,888 per MWh[9]	25% increase in central estimate
Safety cost	Central Estimate	Value of statistical life of $4.5 million[10]	Central estimate
Safety cost Disproportionate Factor	Central estimate	Factor of 3	Central estimate
Option cost	15% reduction in central estimate	In-house cost estimates using detailed and high-level project scopes	15% increase in central estimate
Real discount rate per annum[11]	2%	5.5%	7.5%
Probability of asset failure	25% reduction in central estimate	Historical asset performance data, plus forecasts based on condition monitoring and CBRM modelling	25% increase in central estimate

Source: AusNet Services, BWR_V6.0_Economic_Model-Master_Template

6.4 Net present value analysis

The economic analysis allows comparison of the economic cost and benefits of each option to rank the options and to determine the optimal timing of the preferred option. It quantifies the capital costs and the cost of the residual risk for each option, to determine a total cost for each option. The net economic benefit for each credible option is the total cost associated with that option minus the costs of the 'Business as Usual' option.

As each of the credible options involves the replacement of existing assets, we have assumed that the operating cost for each option is unchanged from the 'Business as Usual' option. For the purpose of this RIT-D, we consider this approach to be a reasonable working assumption. The capital cost for each option has been described in section 5 of this DPAR.

We present our analysis as follows:

- Section 6.4.1 presents the NPV analysis using central estimates; and

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9 Calculated using the latest VCR estimates for each sector.

10 Best Practice Regulation Guidance Note Value of statistical life, December 2014, escalated.

11 The discount rates are consistent with AEMO's 2021 Inputs, Assumptions and Scenarios Report.

- Section 6.4.2 presents the sensitivity testing and scenarios analysis.

6.4.1 Net present value analysis

Table 5 presents the annualised net economic benefit of each credible option for each year and highlights the option with the highest net economic benefit, assuming the central estimates for the key variables presented in the previous section. For each option, we have selected the optimal timing or indicated for some options that the solution will not deliver a net benefit over the study period. The analysis shows that Option 5 delivers the highest net benefit in each year.

It should be noted that a residual risk-cost and benefit also applies for each option, which captures the costs and benefits beyond 2031. We have not shown the residual costs and benefits for each option in the table below, but it is considered in our PV analysis which is reported in Table 6.

Table 5: Annualised net economic benefit ($M)

	2023	2024	2025	2026	2027	2028	2029	2030	2031
Option 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Option 2	Not credible for the reasons set out in section 5.2								
Option 3	Not credible for the reasons set out in section 5.3								
Option 4	Not credible for the reasons set out in section 5.4								
Option 5	0.301	0.412	0.528	0.649	0.776	0.908	1.042	1.180	1.323
Option 6	0.111	0.227	0.348	0.474	0.606	0.744	0.884	1.027	1.176
Option 7	0.000	0.101	0.227	0.358	0.495	0.639	0.784	0.933	1.088

Source: AusNet Services, BWR_V6.0_Economic_Model-Master_Template

While the above table is useful in understanding how the options compare with each other in the early years following implementation, the analysis required by the RIT-D must consider the relative performance of the credible options over the life of the asset. In order to identify the preferred option, therefore, it is necessary to show the present value of the net economic benefit for each credible option. The table shows that the preferred option is Option 5, as it has the highest net economic benefit.

Table 6: Present value (PV) of the net economic benefit ($M)

	PV of risk reduction Benefit	PV of Option costs	PV of net economic benefit
Option 1	0.0	0.0	0.0
Option 2	Not credible for the reasons set out in section 5.2		
Option 3	Not credible for the reasons set out in section 5.3		
Option 4	Not credible for the reasons set out in section 5.4		
Option 5	35.40	18.30	17.10
Option 6	37.15	22.56	14.59
Option 7	37.36	24.32	13.04

Source: AusNet Services, BWR_V6.0_Economic_Model-Master_Template

6.4.2 Sensitivity testing and scenario analysis

In addition to the above analysis, we also conducted sensitivity testing to examine how our assessment would be affected if certain parameters were varied. In particular, we considered variations in the risk of asset failure; demand; the cost of each option; and the weighted average cost of capital[12]. The results of this analysis is presented below, which shows that Option 5 is preferred under each of the sensitivities.

Table 7: Sensitivity testing ($M)

	High asset failure	Low asset failure	High demand	Low demand	High option cost	Low option cost	High discount rate	Low discount rate
Option 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Option 2	Not credible for the reasons set out in section 5.2							
Option 3	Not credible for the reasons set out in section 5.3							
Option 4	Not credible for the reasons set out in section 5.4							
Option 5	36.97	2.54	18.42	15.79	14.36	19.85	8.45	31.16
Option 6	35.43	0.45	15.96	13.26	11.30	17.97	5.98	29.31
Option 7	34.83	N/A[13]	14.41	11.75	9.53	16.90	4.57	28.41

Source: AusNet Services, BWR_V6.0_Economic_Model-Master_Template

To test our results further, we have adopted four scenarios, as set out below.

Table 8: Definition of reasonable scenarios

Scenario	Probability of failure	Option Cost	Forecast Demand	VCR	Discount rate
Central Case	Central estimate	Central estimate	Central estimate	Central estimate	Central estimate
Low demand	Central estimate	Central estimate	Lower bound	Central estimate	Central estimate
Weak economic growth	Central estimate	Lower bound	Lower bound	Central estimate	Lower bound
High demand	Central estimate	Upper bound	Upper bound	Central estimate	Upper bound

Table 9 provides a brief description of each scenario.

12 The discount rate used for the purpose of calculating the present value is a pre-tax real rate, with the lower bound consistent with the regulated cost of capital in the AER's decision for our distribution network (which is a nominal, vanilla WACC).

13 This option is not economic during the assessment period under the low asset failure sensitivity.

Table 9: Guide to scenarios

Scenario	Description
Central Case	This scenario adopts the central estimate for each variable in the economic assessment. It represents the most likely outcome.
Low demand	This scenario represents low demand driven by an increase in distributed energy resources. We have retained the other parameters at their central estimates, noting that the scenario is not driven by weak economic growth.
Weak economic growth	This scenario reflects weak economic growth, possibly as a result of the continuing impact of COVID-19. It has lower costs of delivering the option, lower demand and a lower discount rate
High demand	This scenario represents an economic rebound and continuing supply side issues. It is characterised by higher costs of delivering the option, higher demand and an upper bound discount rate.

Table 10: Net economic benefit for each scenario ($M)

	Central case	Low demand	Weak economic growth	High demand
Option 1	0.0	0.0	0.0	0.0
Option 2	Not a credible option			
Option 3	Not a credible option			
Option 4	Not a credible option			
Option 5	17.10	15.79	32.07	6.94
Option 6	14.59	13.26	30.84	4.31
Option 7	13.04	11.75	30.43	2.79

Source: AusNet Services, BWR_V6.0_Economic_Model-Master_Template

On the basis of this scenario analysis, Option 5 is the preferred option as it maximises net economic benefits for each of the scenarios.

6.5 Preferred option

The results of the sensitivity testing confirm our finding that Option 5 is the preferred option, which is the replacement of all existing deteriorated outdoor 22kV bulk oil circuit breakers in C4 and C5 condition with three new indoor switchboards and associated secondary equipment with the new control building. This option is expected to maximise the present value of the net economic benefit to all those who produce, consume and transport electricity in the NEM.

It should be noted that Option 5 is also the lowest cost credible option, as the other credible options require additional work to that described for Option 5. As such, any variation in the costs of delivering Option 5 following more detailed project scoping will not affect the ranking of the credible options or the selection of Option 5 as the preferred option in accordance with the RIT-D.

While Table 5 indicates that the preferred option delivers benefits from 2023, to manage the deliverability and our capital expenditure throughout the 2021-25 EDPR, AusNet Services plans to commence the proposed works in 2023 for completion in January 2026.

6.6 Capital and operating costs of the preferred option

The direct capital expenditure for the preferred option is $15.3 million, excluding management reserve and capitalised overheads, as shown in the table below.

Table 11: Summary of capital expenditure requirements, $'000 nominal

	FY22	FY23	FY24	FY25	Total
Direct capital expenditure	1,056.8	10,476.4	3,813.3	-	**15,346.4**

Source: AusNet Services, DD-0009395 BWR ZSS Rebuild Business Case

Note: Excludes overheads, management reserve, written down value of assets retired/sold.

The operating expenditure associated with this option will relate to the on-going inspection and maintenance of the assets. Our assessment is that a reasonable estimate of the annual operating expenditure is approximately 1.2% of the direct capital cost of the asset, which equates to approximately $180k per annum.

In relation to the timetable for completing these works, we expect to publish the Final Project Assessment Report in August 2022, allowing the construction to commence in Q2 2023 with commission readiness scheduled for 31 January 2026.

7 Satisfaction of the RIT-D

In accordance with clause 5.17.4(j)(11)(iv) of the Rules, we certify the proposed option satisfies the regulatory investment test for distribution. The table below shows how each of these requirements have been met by the relevant section of this report.

Table 12: Compliance with regulatory requirements

Requirement		Section
5.17.4(j) The draft project assessment report must include the following:		
(1)	a description of the identified need for the investment;	Section 3.
(2)	the assumptions used in identifying the identified need (including, in the case of proposed reliability corrective action, reasons that the RIT-D proponent considers reliability corrective action is necessary);	Section 2 provides the background information that underpins the identified need. No assumptions apply in relation to the identified need.
(3)	if applicable, a summary of, and commentary on, the submissions on the non-network options report;	Not Applicable.
(4)	a description of each credible option assessed;	Section 5.
(5)	where a Distribution Network Service Provider has quantified market benefits in accordance with clause 5.17.1(d), a quantification of each applicable market benefit for each credible option;	Section 6.4.1, Table 6.
(6)	a quantification of each applicable cost for each credible option, including a breakdown of operating and capital expenditure;	Section 5. As explained in section 6.4, the operating cost for each option is unchanged from the 'BAU' option.
(7)	a detailed description of the methodologies used in quantifying each class of cost and market benefit;	Section 6.2.
(8)	where relevant, the reasons why the RIT-D proponent has determined that a class or classes of market benefits or costs do not apply to a credible option;	Section 6.1.
(9)	the results of a net present value analysis of each credible option and accompanying explanatory statements regarding the results;	Section 6.4.
(10)	the identification of the proposed preferred option;	Sections 1.2 and 6.5
(11)	for the proposed preferred option, the RIT-D proponent must provide:	
(i)	details of the technical characteristics;	Appendix.
(ii)	the estimated construction timetable and commissioning date (where relevant);	Section 6.6.
(iii)	the indicative capital and operating cost (where relevant);	Section 6.6.

Requirement			Section
	(iv)	a statement and accompanying detailed analysis that the proposed preferred option satisfies the regulatory investment test for distribution; and	Section 7, including this table.
	(v)	if the proposed preferred option is for reliability corrective action and that option has a proponent, the name of the proponent;	Not applicable.
	(12)	contact details for a suitably qualified staff member of the RIT-D proponent to whom queries on the draft report may be directed.	Section 1.3.
5.17.4(k)		The RIT-D proponent must publish a request for submissions on the matters set out in the draft project assessment report, including the proposed preferred option, from: (1) Registered Participants, AEMO, non-network providers and interested parties; and (2) if the RIT-D proponent is a Distribution Network Service Provider, persons on its demand side engagement register.	Section 1.3.
5.17.4(l)		If the proposed preferred option has the potential to, or is likely to, have an adverse impact on the quality of service experienced by consumers of electricity, including: (1) anticipated changes in voluntary load curtailment by consumers of electricity; or (2) anticipated changes in involuntary load shedding and customer interruptions caused by network outages, then the RIT-D proponent must consult directly with those affected customers in accordance with a process reasonably determined by the RIT-D proponent.	Not applicable.
5.17.4(m)		The consultation period on the draft project assessment report must not be less than six weeks from the publication of the report.	Section 1.3.

Appendix A Preferred Option Details

Scope of work

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

Replacement of primary assets

- 66kV Switchyard
  - Replacement of 66kV VTs.
  - Decommission and remove the existing 66kV VT.
  - Replace RWTS-CYN line 66kV VT.
  - Decommission and remove the existing RWTS-CYN line 66kV VT.
  - Note that DD-0006495 is replacing the BRA line 66kV VT.
- Transformers
  - Retain 22kV Surge arresters on transformers and replace 66kV surge arresters.
  - Retire existing No1 25kVA station service transformer. It should be noted that the No1 SST is assumed to be the SST that is connected to the No1 22kV bus.
  - Retire existing No3 25kVA station service transformer. It should be noted that the No2 SST is assumed to be the SST connected to the No3 22kV bus.
  - Establish two new standard 315kVA (22/0.415kV) station service transformers.
- Install the following cables between:
  - No1 22kV Switchboard and No1 Transformer.
  - No2 22kV Switchboard and No2 Transformer.
  - No3 22kV Switchboard and No3 Transformer.
  - No1 22kV Switchboard and No2 22kV Switchboard.
  - No2 22kV Switchboard and No3 22kV Switchboard.
  - No3 22kV Switchboard and No1 22kV Switchboard.
  - No2 22kV Switchboard and No2 22kV Capacitor Bank.
  - No3 22kV Switchboard and No3 22kV Capacitor Bank.
  - No1 22kV Switchboard and No1 S/S Transformer.
  - No3 22kV Switchboard and No2 S/S Transformer.
- Possible temporary 22kV cable may be required. This will likely involve one 22kV cable between the existing 22kV AIS switchgear and the new 22kV switch room.
- 22kV Switchyard
  - Establish three new standard urban types 22kV modular switch rooms complete with a control room, which includes 22kV Bus VTs; 22kV Feeder CBs; 22kV Bus Tie CBs; 22kV Capacitor Bank CBs; Retire existing No.2 22kV 6MVar capacitor bank; and establish one new No.2 22kV 12MVar capacitor bank.
- Other works will include: earth grid and testing; civil and structural works; site establishment; footings and structures; earthworks/grading; storm water and drainage; and demolition.

Secondary works

Secondary works within BWR will include, but are not limited to, the design, procurement, installation/modification, testing and commissioning of the following:

- Existing control room, including works relating to new panels, modifications and decommissioning.
- New Modular 22KV switchroom, including three urban type 22kV switchrooms with switchboard cubicles.
- SCADA, including decommissioning the existing MD1000 RTU cubicles (Cubicle 34 & 22B) and establishing a new Cooper RTU.

In addition to the above works, costs will be incurred in relation to line works and communications.