Regulatory Investment Test for Distribution (RIT-D)

Addressing Reliability Requirements in the Rosewood Network Area

Final Project Assessment Report

3 May 2022

energex
Part of Energy Queensland

EXECUTIVE SUMMARY

About Energex

Energex Limited (Energex) is a subsidiary of Energy Queensland Limited and manages the electricity distribution network in the growing region of South East Queensland which includes the major urban areas of Brisbane, Gold Coast, Sunshine Coast, Logan, Ipswich, Redlands and Moreton Bay. Our electricity distribution area runs from the NSW border north to Gympie and west to the base of the Great Dividing Range.

Our electricity network consists of approximately 54,200 kilometres of powerlines and 680,000 power poles, along with associated infrastructure such as major substations and power transformers.

Today, we provide distribution services to more than 1.4 million domestic and business connections, delivering electricity to a population base of around 3.4 million people.

Identified Need

Rosewood Zone Substation (SSRWD) is supplied from Abermain Bulk Supply Substation (SST136) via a 33kV ring network, which also supplies Karrabin Zone Substation (SSKBN), Marburg Zone Substation (SSMBG) and Amberley Zone Substation (SSABY). SSRWD provides electricity supply to approximately 2,331 predominately domestic customers in the Rosewood, Lower Mount Walker, Ebenezer, Mount Forbes, Mount Walker, Mount Albert, Rosevale, Moorang and Mount Mort areas.

SSRWD has two 33/11kV transformers. It also consists of 33kV and 11kV outdoor switchgear and a control room.

The purpose of the project is to remove a significant risk to safety and customer reliability from the ongoing operation of the problematic 33kV duro-roll goose neck and 11kV braided vertical drop isolators. It is not possible to replace them in-situ because parts of the 11kV bus does not meet the required clearance to the boundary fence and the fence cannot be moved since it is on the property boundary. Under this project expulsive drop out fuses will also be removed and 33kV and 11kV outdoor switchgear will be replaced with indoor switchgear.

Approach

The National Electricity Rules (NER) require that, subject to certain exclusion criteria, network business investments for meeting service standards for a distribution business are subject to a Regulatory Investment Test for Distribution (RIT-D). Energex has determined that network investment is essential in this case for it to continue to provide electricity to the consumers in the Rosewood supply area in a reliable, safe and cost-effective manner. Accordingly, this investment is subject to a RIT-D.

Energex published a Notice of No Non-Network Options for the above-described network constraint on 6th May 2022.

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One feasible option has been investigated:

- **Option 1:** Replace problematic plant items and replace the 33kV and 11kV outdoor switchgear with indoor switchgear

This Final Project Assessment Report (FPAR), where Energex provides both technical and economic information about possible solutions, has been prepared in accordance with the requirements of clause 5.17.4(o) of the NER.

Energex's preferred solution to address the identified need is Option 1 – Remove problematic plant items and replace the 33kV and 11kV outdoor switchgear with indoor switchgear

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1. INTRODUCTION

This Final Project Assessment Report has been prepared by Energex in accordance with the requirements of clause 5.17.4(o) of the NER.

This report represents the final stage of the consultation process in relation to the application of the RIT-D on potential credible options to address the identified need for the Rosewood network area.

In preparing this RIT-D, Energex is required to consider reasonable future scenarios. With respect to major customer loads and generation, Energex has, in good faith, included as much detail as possible while maintaining necessary customer confidentiality. Potential large future connections that Energex is aware of are in different stages of progress and are subject to change (including outcomes where none or all proceed). These and other customer activity can occur over the consultation period and may change the timing and/or scope of any proposed solutions.

1.1. Response to the DPAR

Energex published a Notice of No Non-Network Options for the identified need in the Rosewood network area on the 6th May 2022.

1.2. Structure of the Report

This report:

- Provides background information on the network capability limitations of the distribution network supplying the Rosewood area.
- Identifies the need which Energex is seeking to address, together with the assumptions used in identifying and quantifying that need.
- Describes the credible options that are considered in this RIT-D assessment.
- Quantifies costs and classes of material market benefits for each of the credible options.
- Describes the methods used in quantifying each class of market benefit.
- Provides details of classes of market benefits that are not considered material to this RIT-D assessment and provides explanations as to why these classes of market benefits are not considered material.
- Provides the results of Net Present Value (NPV) analysis of each credible option and accompanying explanatory statements regarding the results.
- Identifies the proposed preferred option, including detailed characteristics, estimated commissioning date, indicative costs, and noting that it satisfies the RIT-D.
- Provides contact details for queries on this RIT-D.

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1.3. Dispute Resolution Process

In accordance with the provisions set out in clause 5.17.5(a) of the NER, Registered Participants or Interested Parties may, within 30 days after the publication of this report, dispute the conclusions made by Energex in this report with the Australian Energy Regulator. Accordingly, Registered Participants and Interested Parties who wish to dispute the conclusions outlined in this report based on a manifest error in the calculations or application of the RIT-D must do so within 30 days of the publication date of this report. Any parties raising a dispute are also required to notify Energex. Dispute notifications should be sent to demandmanagement@energex.com.au

If no formal dispute is raised, Energex will proceed with the preferred option to remove problematic plant items and replace the 33kV and 11kV outdoor switchgear with indoor switchgear at Rosewood 33/11kV Substation.

1.4. Contact Details

For further information and inquiries please contact:

E: demandmanagement@energex.com.au
P: 13 74 66

2. BACKGROUND

2.1. Geographic Region

SSRWD provides electricity supply to predominately domestic customers in the Rosewood, Lower Mount Walker, Ebenezer, Mount Forbes, Mount Walker, Mount Albert, Rosevale, Moorang and Mount Mort areas. The substation and associated 110kV feeders and 33kV feeders are shown in Figure 1.

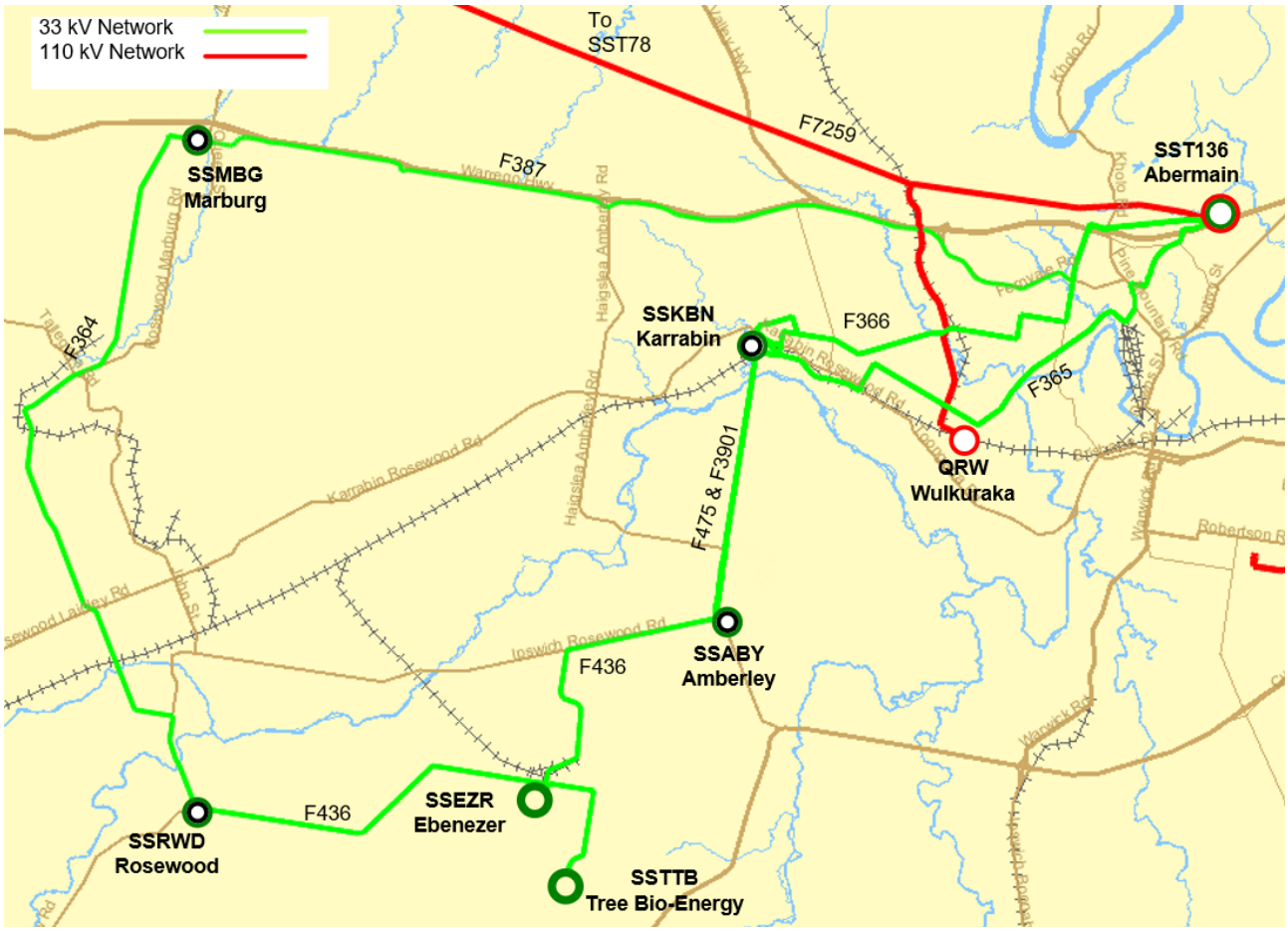

Figure 1: SSRWD, 110kV and33kV Feeders, Existing Network Arrangement (Geographic View)

2.2. Existing Supply System

SSRWD is supplied from SST136 via a 33kV ring network, which also supplies SSKBN, SSMBG and SSABY. SSRWD is supplied from 33kV feeders 364 (SSRWD-SSMBG) and 436 (SSRWD-SSEZR-SSABY). SSRWD has an outdoor 33kV and 11kV switchgear and a control room and 2 x 5MVA 33/11kV transformers (TR1 & TR3). The 11kV bus has three (3) active feeders which supplies a total of 2,331 residential, industrial, commercial, and rural customers, with a peak of 6.93MVA in 2020/21.

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A schematic view of the existing sub-transmission network arrangement and general arrangement is shown in Figure 2, Figure 3 and Figure 4 below.

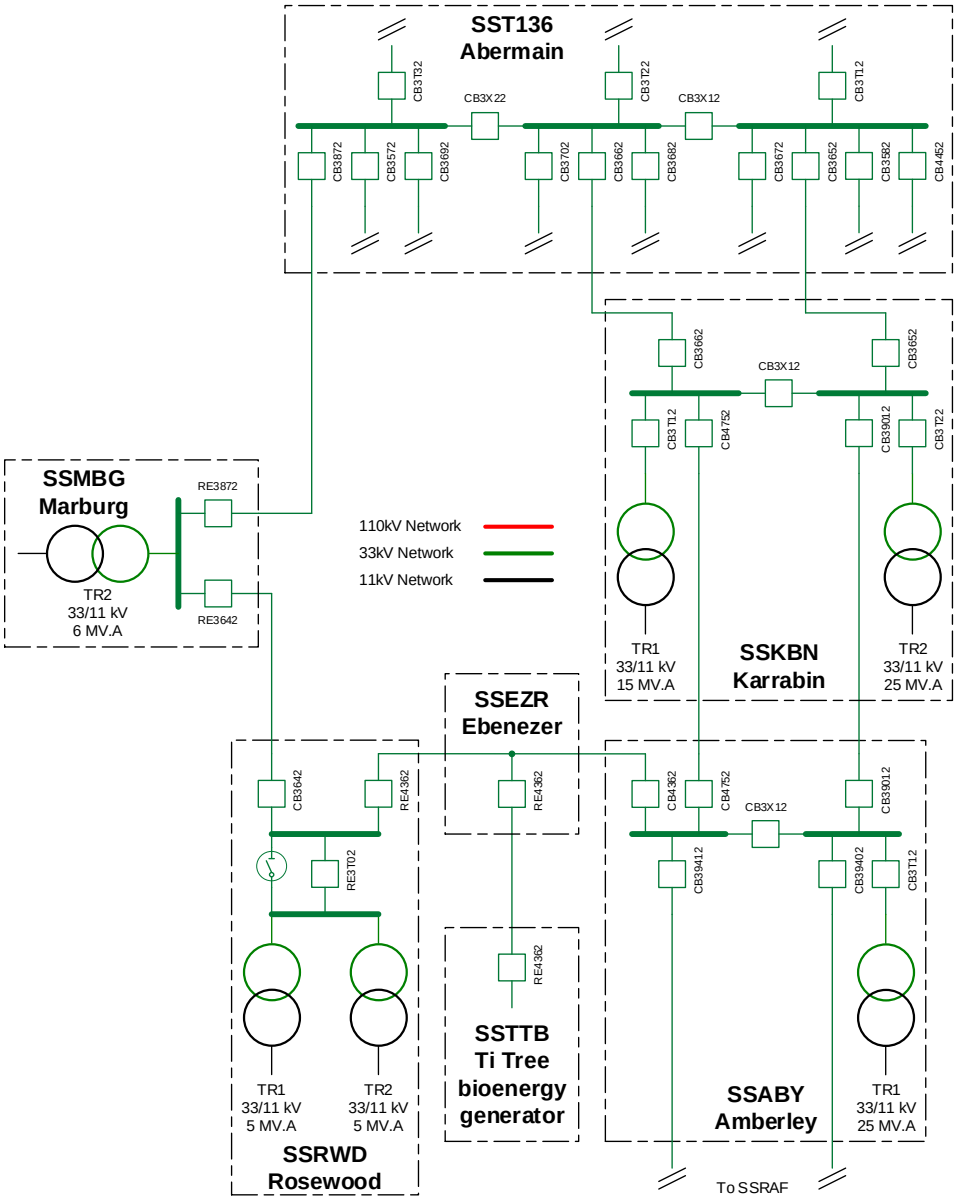

Figure 2: Existing area network arrangement (schematic view)

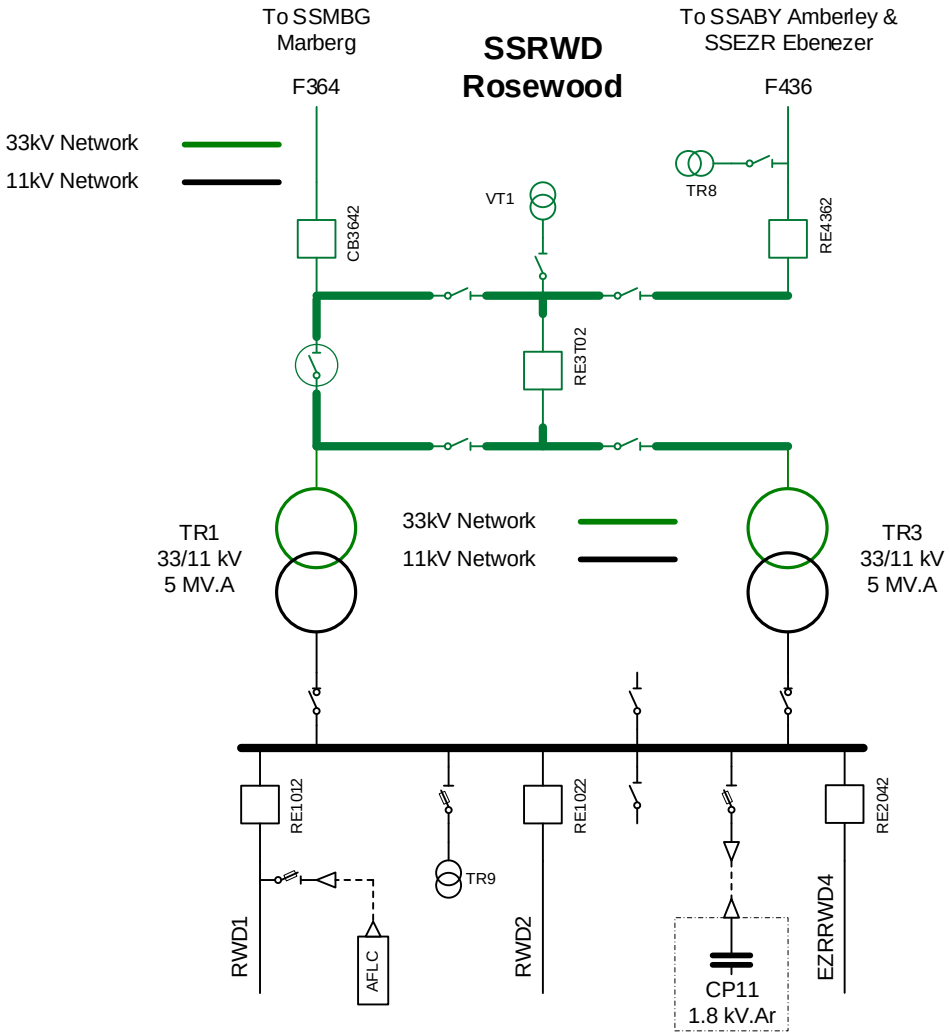

Figure 3: Existing network arrangement (schematic view)

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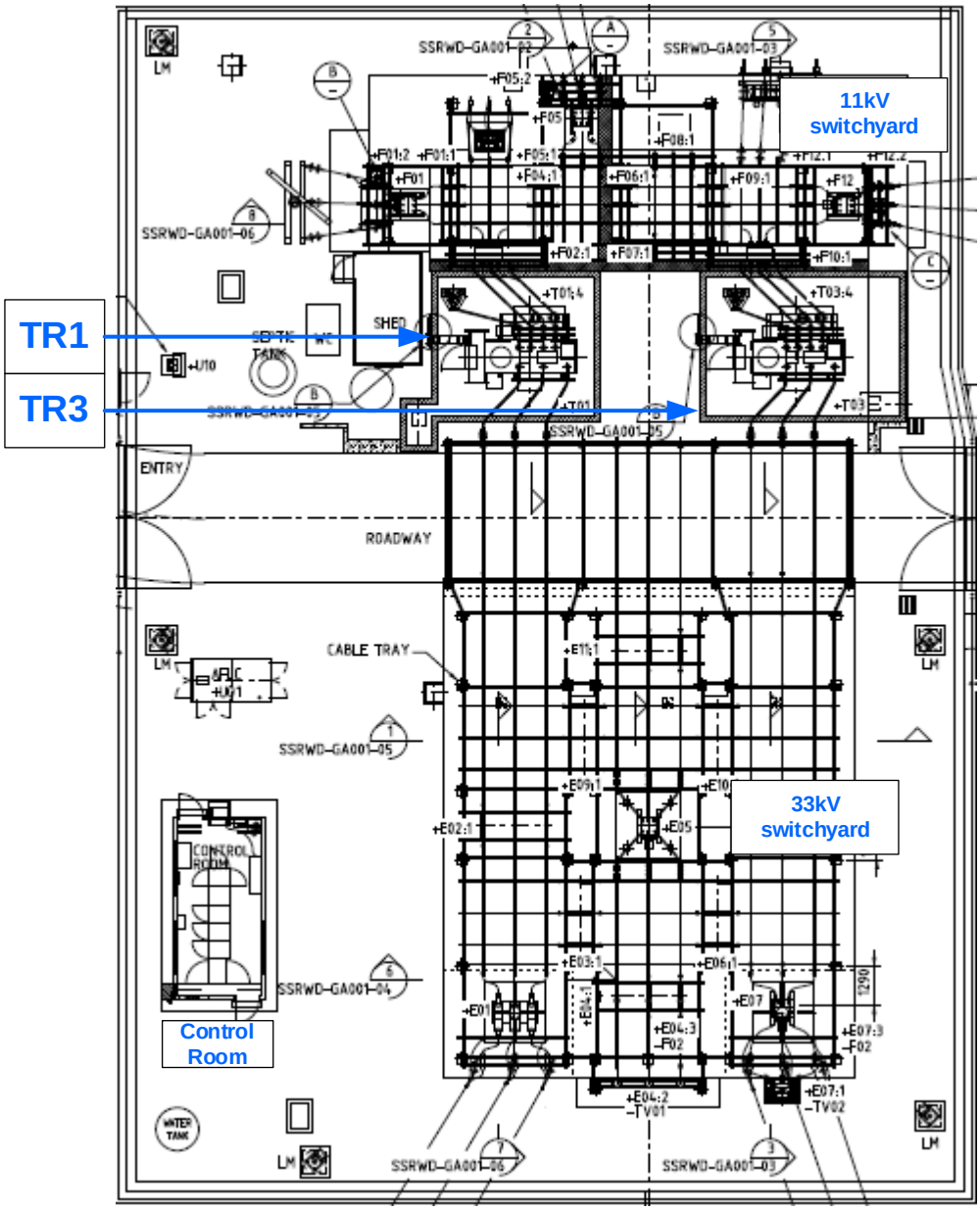

Figure 4: Rosewood Substation (general arrangement)

2.3. Load Profiles / Forecasts

The load at SSRWD comprises a mix of residential and commercial/industrial customers. The load is summer peaking, and the annual peak loads are predominantly driven by residential customers.

2.3.1. Full Annual Load Profile

The full annual load profile for Rosewood 33/11kV zone substation for 2020/21 financial year is shown in Figure 5. The peak occurs through the summer period; however it does not exceed the N-1 capacity of 9.1MVA.

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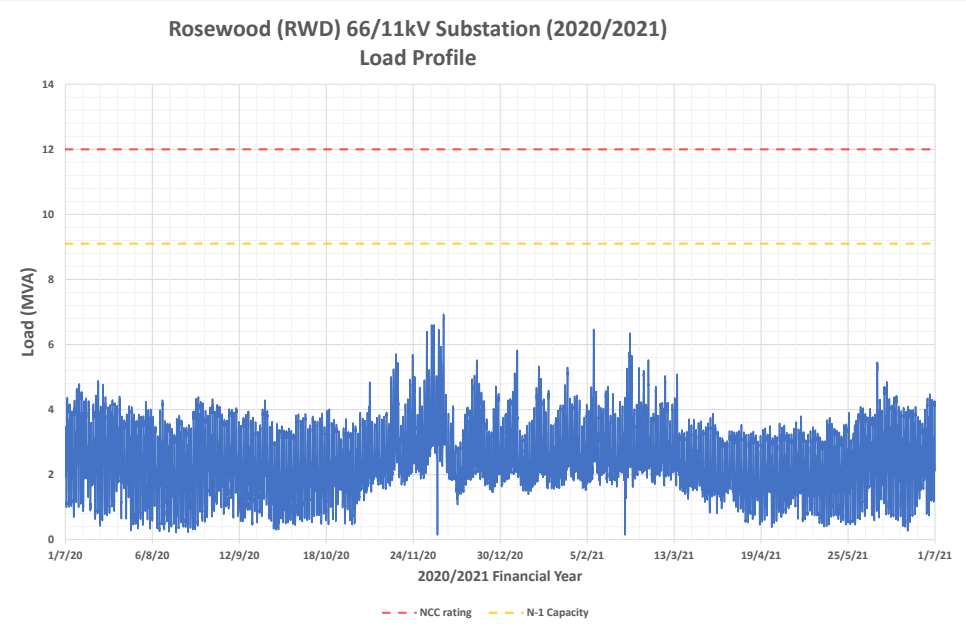

Figure 5: SSRWD actual annual load profile

2.3.2. Load Duration Curve

The load duration curve for SSRWD load for 2020/21 is shown in **Error! Reference source not found.Error! Reference source not found.**. The load does not exceed the N-1 capacity of 9.1MVA.

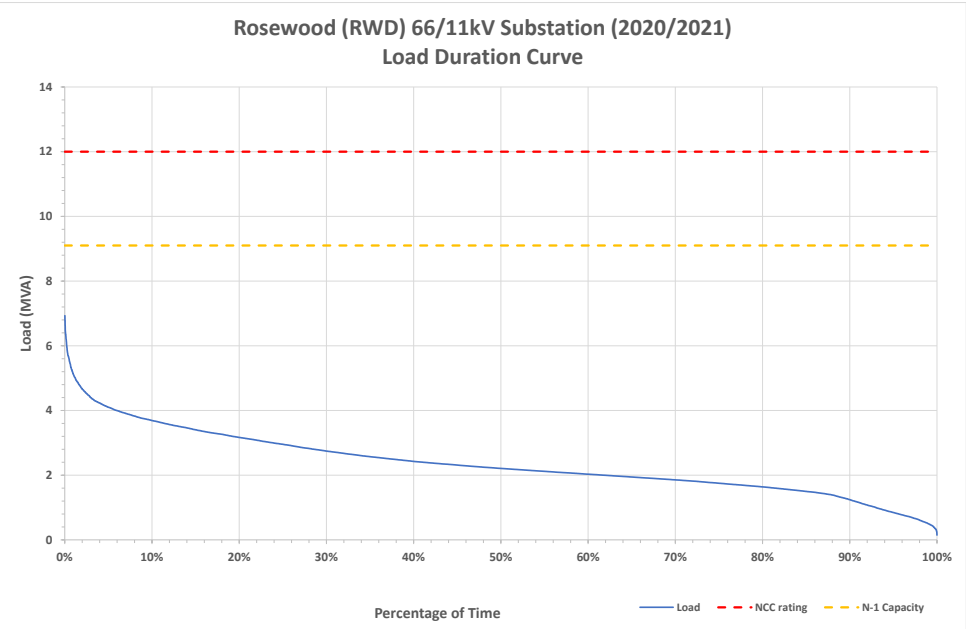

Figure 6: Substation load duration curve for SSRWD

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2.3.3. Average Peak Weekday Load Profile (Summer)

The daily load profile for the average and peak weekday during summer is illustrated below in Figure 7**Error! Reference source not found.**. The summer peak loads for SSRWD are historically experienced in the late afternoon and evening.

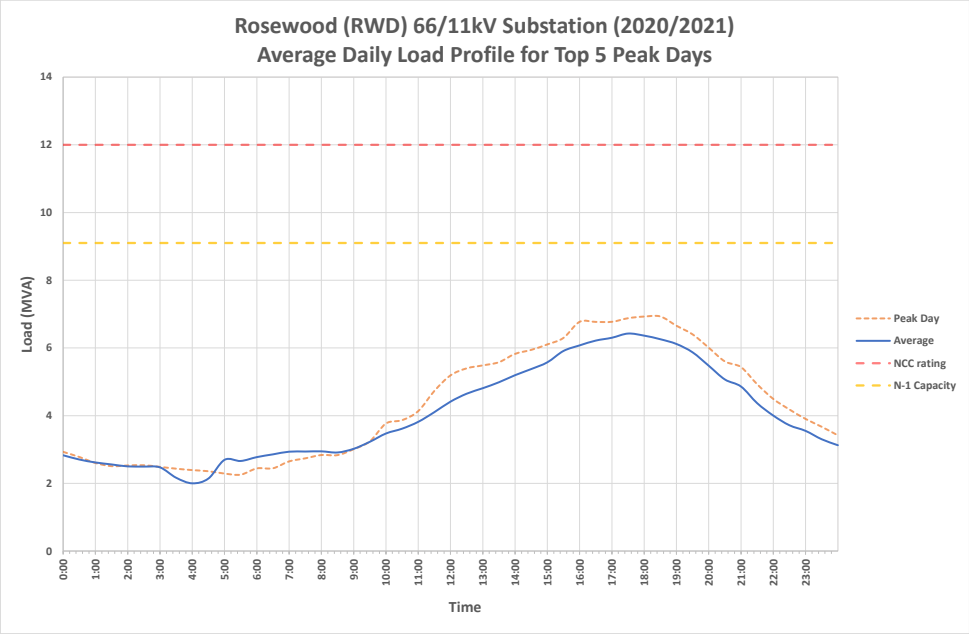

Figure 7: Average Daily and Maximum Load Profiles (Summer)

2.3.4. Base Case Load Forecast

The 10 PoE and 50 PoE load forecasts for the base case load growth scenario are illustrated in Figure 8. The historical peak load for the past six years has also been included in the graph. It can be seen that the 50% POE forecast load growth in the base case scenario does not exceed the N-1 rating of 9.1MVA and the 10% POE forecast load growth in the base case scenario does not exceed the NCC rating of 12MVA. It can also be noted that the peak load is forecast to increase over the next 10 years under the base case scenario.

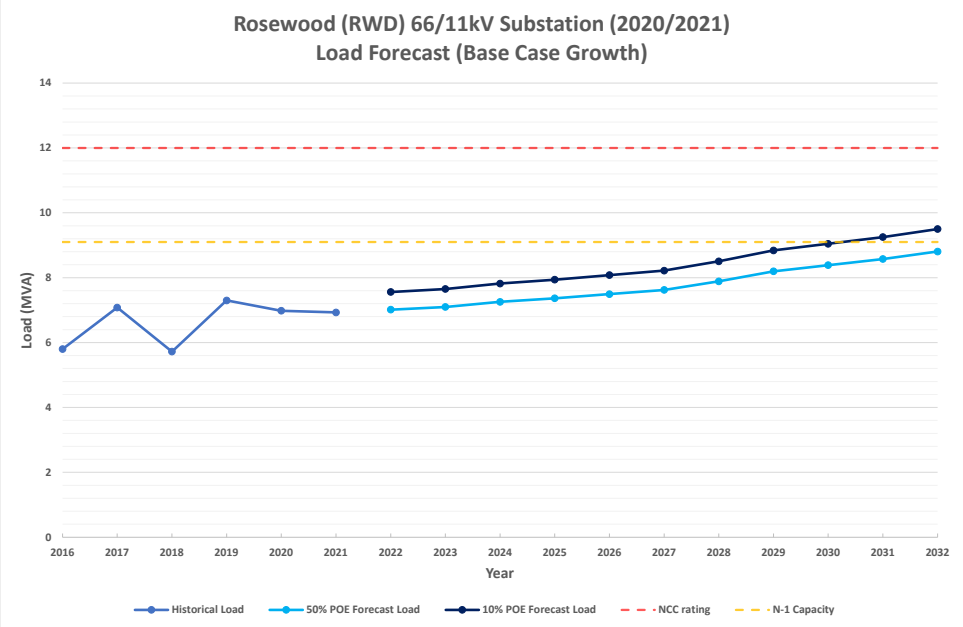

Figure 8: Network Base case load forecast

2.3.5. High Growth Load Forecast

The 10 PoE and 50 PoE load forecasts for the high load growth scenario are illustrated in Figure 9. With the high growth scenario, the peak load is forecast to increase over the next 10 years.

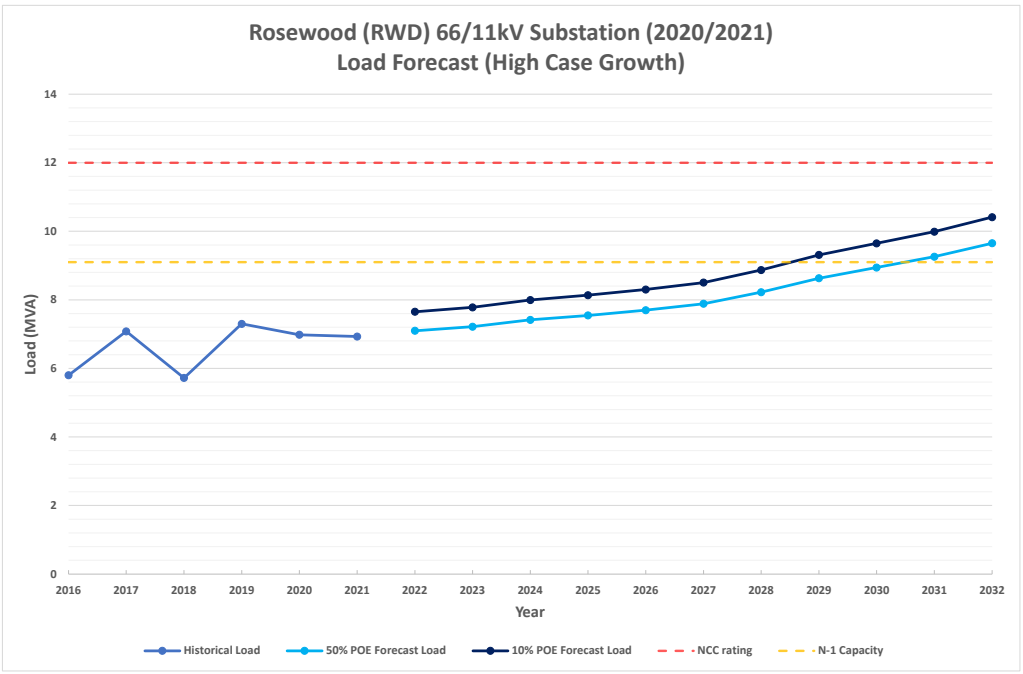

Figure 9: Network High Growth Load Forecast

2.3.6. Low Growth Load Forecast

The 10 PoE and 50 PoE load forecasts for the low load growth scenario are illustrated in Figure 10. With the low growth scenario, the peak load is forecast to remain relatively steady over the next 10 years.

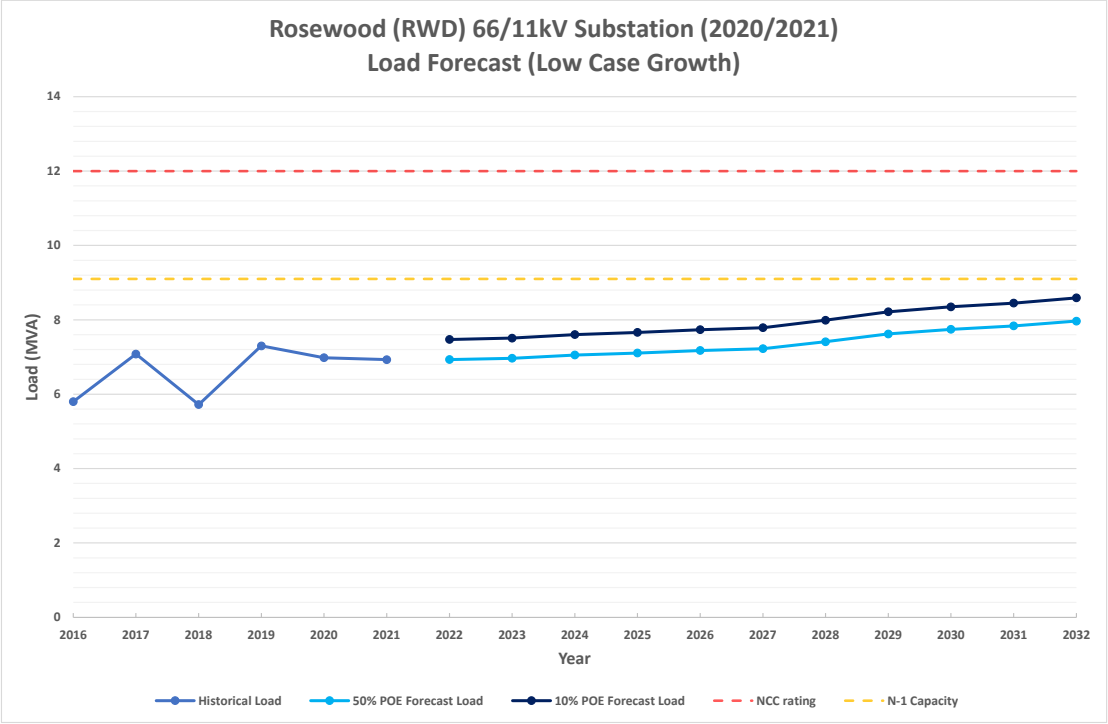

Figure 10: Network Low Growth Load Forecast

3. IDENTIFIED NEED

3.1. Description of the Identified Need

3.1.1. Poor Condition Assets

A recent condition assessment and substation works have highlighted a number of critical assets are at the end of their serviceable life, are in poor condition or are targeted for removal. The condition of these assets presents considerable safety and customer reliability risk. These assets include:

- Two (2) 33kV Surge Arrestors
- Five (5) 33kV Isolators
- Seven (7) 11kV Isolators
- Two (2) Expulsive drop out fuses
- Four (4) Controller for Reclosers
- One (1) Protection Relay
- One (1) 33kV VT Marshalling Box
- One (1) recloser lead
- One (1) 33kV insulator

The deterioration of these primary and secondary system assets poses safety risks to staff working within the switchyard. It also poses a safety risk to the general public, through the increased likelihood of protection relay mal-operation. Without remediation, Energex views that the safety risk to the public and its staff to not be reduced to So Far As Is Reasonably Practicable.

Additionally, the problematic isolators and the poor condition of the assets significantly increases the likelihood of outages, resulting in a reduction in the level of reliability experienced by the customers supplied from Rosewood Substation.

A recent condition assessment has highlighted that a number of critical assets are problematic or at end of life and are in poor condition. The condition of these assets presents a considerable safety, environmental and reliability risk.

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3.1.2. Reliability

Currently the aged assets present a risk to the reliability of supply at Rosewood. Figure 11 shows that the value of customer reliability by replacing the assets is $100,000 after the first seven years. The scenarios that have been considered are:

- 11kV isolator/recloser failure - a failure of any of these items of plant results in loss of 11kV bus and all load at SSRWD; however, it was assumed that 2.3MVA load could be supplied by transfers within 3 hours, with full restoration within 4 hours.
- 33kV isolator/ recloser failure – a failure of any of these items of plant would result in a loss of 33kV bus and all load at SSRWD; however, it was assumed that 2.3MVA load could be supplied by transfers within 3 hours, with full restoration within 4 hours.
- 33kV or 11kV pipework outdoor bus – a failure of any of these items of plant would result in an outage to all load; however, it was assumed that 2.3MVA load could be supplied by transfers within 3 hours, with full restoration within 6 hours.

3.2. Quantification of the Identified Need

3.2.1. Poor Condition Assets

A recent condition assessment has highlighted that a number of critical assets are at end of life and are in poor condition. The condition of these assets presents a considerable safety, environmental and reliability risk.

Condition data indicates a number of problematic and end of life plant items:

- 33kV Duro-roll goose neck and 11kV braided vertical drop isolators. Field experience has revealed common issues with these units:
    - Fixed fingers tend to loosen causing high resistance and heating leading to contact annealing and loss of tension resulting in failure
    - Force of vertical operation causes hairline cracks in insulators resulting in a breakdown of the porcelain
    - Corrosion of braids.
- Porcelain surge arresters are to be replaced with polymetric equivalents
- Expulsive drop out fuses are to be replaced to remove the hazard of expelled material.
- Controllers for reclosers will reach retirement age by 2026.
- The Alstom KCEG142 relay for 33kV feeder 364 has already reached its retirement age in 2021.

The deterioration of these primary and secondary system assets poses safety risks to staff working within the switchyard. It also poses a safety risk to the general public, through the increased likelihood of protection relay mal-operation and failure of the isolators. Additionally, the problematic isolators and the poor condition of these assets significantly increases the likelihood of outages,

resulting in a reduction in the level of reliability experienced by the customers supplied from Rosewood Substation.

Where Energex identifies an imminent asset safety risk, immediate temporary measures are put in place to ensure safety of staff and public until permanent remediation can be performed.

3.2.2. Risk Quantification Benefit Summary

Risk quantification analysis has been completed for option 1 which includes the VCR and cost of emergency replacement (ERC). Figure 11 shows the benefits of Option 1 in comparison to the counter-factual, which in this case is continuing the use of the existing isolators. The benefit of this option is greater than $150,000 by 2028 and increases to $500,000 by 2057.

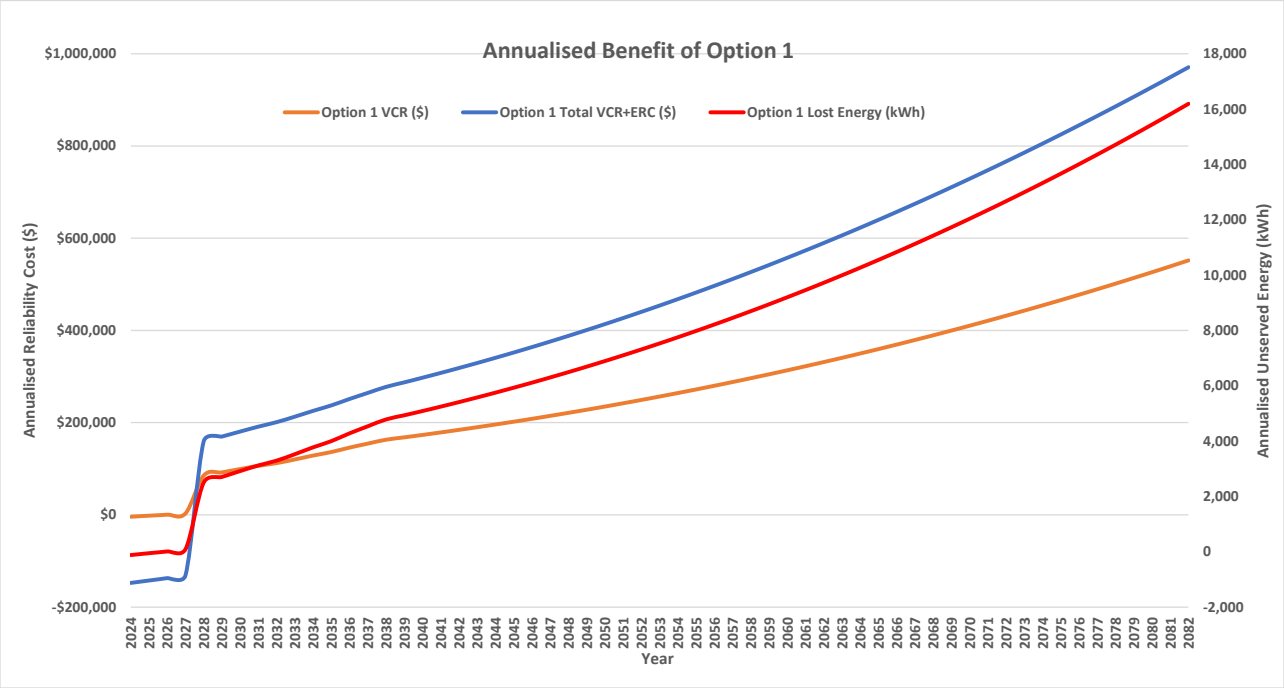

Figure 11: Annualised Benefits of Option 1 compared with Counter-factual

3.3. Assumptions in Relation to Identified Need

Below is a summary of key assumptions that have been made when the identified need has been analysed and quantified.

It is recognised that the below assumptions may prove to have various levels of correctness, and they merely represent a ‘best endeavours’ approach to predict the future identified need.

3.3.1. Forecast Maximum Demand

It has been assumed that forecast peak demand at Rosewood Substation will be consistent with the base case forecast outlined in Section 2.3.4.

Factors that have been taken into account when the load forecast has been developed include the following:

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- load history;
- known future developments (new major customers, network augmentation, etc.);
- temperature corrected start values (historical peak demands); and
- forecast growth rates for organic growth.

3.3.2. Future Load Profile

Characteristic average day load profiles shown in Section **Error! Reference source not found.** are unlikely to change significantly from year to year and the shape of the load profile is assumed to remain virtually the same with increasing maximum demand.

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4. CREDIBLE OPTIONS ASSESSED

4.1. Assessment of Network Solutions

Energex has identified one (1) credible network option that will address the identified need. The option of replacement of the problematic and end of life assets in-situ was considered but rejected, because of the following:

- Parts of the 11kV bus do not meet the required clearance to the boundary fence and the fence cannot be moved since it is on the property boundary.
- The galvanised steel "pipework" structure is not expected to last the life of the problematic isolators once they are replaced, as the pipework structure is already 70 years old.
- Clearance between the 11kV feeder bays is inadequate, thus, to replace the isolators most of the bus would have to be out of service. Therefore, replacement in-situ would require significant load transfers and generation.
- Back-up reach for some 11kV feeders is below requirements and duplicate relays cannot be installed due to the lack of current transformers.

4.1.1. Option 1: Remove problematic plant items and replace the 33kV and 11kV outdoor switchgear with indoor switchgear

This option involves the following works:

- Construct a building to suit 33kV switchgear, 11kV switchgear, control panels, protection panels, telecommunications panels, standard ancillaries, space for a future AFLC coupling cell and space for future control/protection/telecommunications panels.
- Install indoor 33kV and 11kV switchgear as shown in the proposed network arrangement schematic in Figure 12 below. Install bus, transformer and feeder protection panel. Install sensitive earth fault protection. Install a 110V dc battery bank, 110V battery charger, dc panels, ac panels, telecommunications panel, security panel and standard ancillaries.
- Install an outdoor three-way ring main unit and connect to the indoor 11kV switchgear.
- Install a padmount 11kV station service transformer with ring main unit and low voltage switch-fuse board. Connect to the indoor 11kV switchgear and new ac main board. Install a low voltage generator connection board and connect to the new ac board.

A schematic diagram of the proposed network arrangement for Option 1 is shown in Figure 12.

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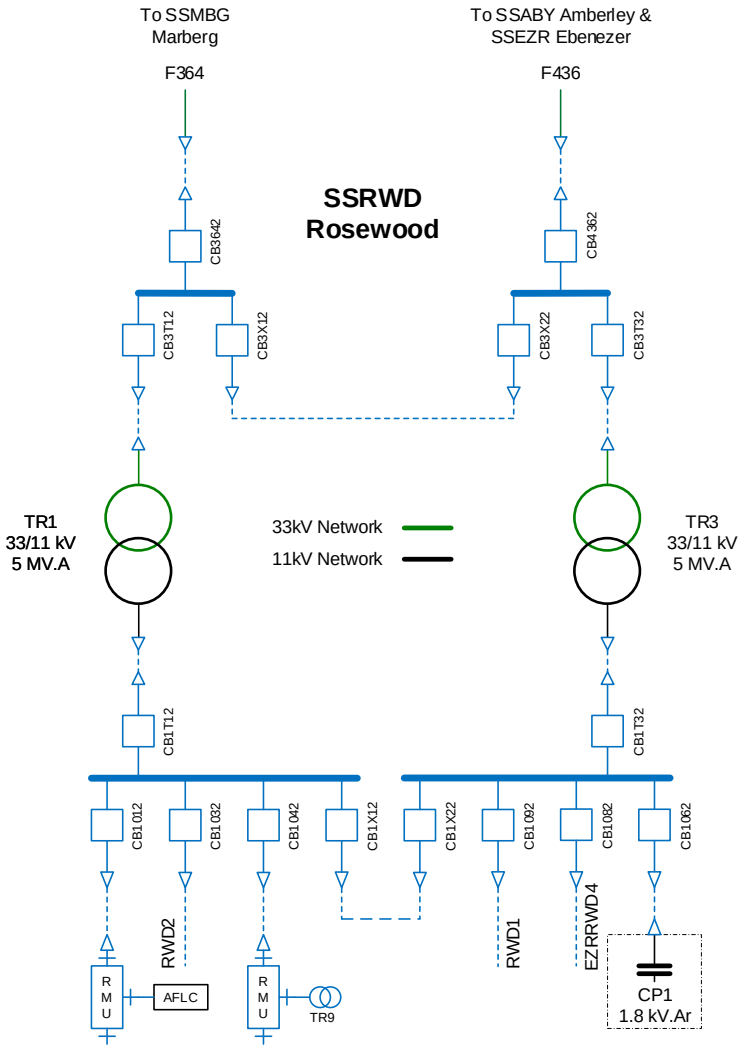

Figure 12: Option 1 proposed network arrangement (schematic view)

4.2. Assessment of Non-Network Solutions

A Notice of no non-network options was published as Energex did not identify any credible non-network solutions.

4.2.1. Demand Management (Demand Reduction)

A non-network investigation Energex normally undertakes is to assess the potential of Demand and Energy Management (DEM). However, for this project to be deferred, the 11kV load would need to be reduced to be zero (0) MVA, therefore demand reduction is not applicable.

4.2.2. Non-Network Solution Summary

Energex has not identified any viable non-network solutions internally that will provide a complete or a hybrid (combined network and non-network) solution to provide the magnitude of network support required in the Rosewood area to address the identified need.

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4.3. Preferred Network Option

Energex's preferred internal network option is Option 1: Replace problematic plant items and replace the 33kV and 11kV outdoor switchgear with indoor switchgear.

Upon completion of these works, the asset safety and reliability risks at SSRWD Substation will be addressed. The preferred option will provide the greatest reliability benefit for customers, whilst also reducing expenditure on obsolete, non-compliant and high maintenance assets, while ensuring more efficient use of design and construction resources.

The estimated capital cost of this option inclusive of interest, risk, contingencies and overheads is $10.3 million. Annual operating and maintenance costs are anticipated to be the same as the existing network as a result of this option. The estimated project delivery timeframe has design commencing in September 2022 and construction completed by October 2024.

5. MARKET BENEFIT ASSESSMENT METHODOLOGY

The purpose of the RIT-D is to identify the option that maximises the present value of net market benefits to all those who produce, consume and transport electricity in the National Electricity Market (NEM).

In order to measure the increase in net market benefit, Energex has analysed the classes of market benefits required to be considered by the RIT-D.

5.1. Classes of Market Benefits Considered and Quantified

Value of Customer Reliability, or involuntary load shedding and avoidance of future emergency replacement of assets have been considered and quantified in this analysis. All Market benefits considered have been listed in section **Error! Reference source not found.** for completeness.

5.1.1. Changes in Involuntary Load Shedding

Involuntary load shedding is where a customer's load is interrupted from the network without their agreement or prior warning. As discussed in Section **Error! Reference source not found.** a number of scenarios exist where an in-service failure of a circuit breaker results in a network outage.

5.2. Classes of Market Benefits not Expected to be Material

The following classes of market benefits are not considered to be material for this RIT-D, and have not been included in this RIT-D assessment:

- Changes in voluntary load curtailment
- Changes in costs to other parties
- Changes in timing of expenditure
- Changes in load transfer capability
- Changes in network losses
- Option value

5.2.1. Changes in Voluntary Load Curtailment

Because none of the credible options include any voluntary load curtailment, and because there are no customers on voluntary load curtailment agreements in the Rosewood area at present, any market benefits associated with changes in voluntary load curtailment have not been considered.

5.2.2. Changes in Costs to Other Parties

Energex does not anticipate that any of the credible options included in this RIT-D assessment will affect costs incurred by other parties.

5.2.3. Changes in Timing of Expenditure

None of the credible options included in this RIT-D assessment is expected to affect the timing of other distribution investments for unrelated identified needs.

5.2.4. Changes in Load Transfer Capability

None of the credible options included in this RIT-D assessment are expected to have an impact on the load transfer capability between the zone substations in the Rosewood area.

5.2.5. Changes in Network Losses

Energex does not anticipate that any of the credible options included in the RIT-D assessment will lead to any significant change in network losses.

5.2.6. Option Value

The AER's view is that option value is likely to arise where there is uncertainty regarding future outcomes, the information that is available in the future is likely to change, and the credible options considered by the RIT-D proponent are sufficiently flexible to respond to that change[1].

Energex does not consider that the identified need for the options included in this RIT-D would be affected by uncertain factors about which there may be more clarity in future.

6. DETAILED ECONOMIC ASSESSMENT

6.1. Methodology

The RIT-D requires Energex to identify the credible option that maximises the present value of net economic benefit to all who produce, consume and transport electricity in the NEM.

Accordingly, a base case Net Present Value (NPV) comparison of the alternative development options has been undertaken.

6.2. Key Variables and Assumptions

The economic assessment contains anticipated costs of providing, operating and maintaining the options as well as expected costs of compliance and administration associated with each option.

The present value comparison summary includes all costs directly associated with constructing and providing the option. This includes the cost of land and easements currently owned or to be acquired for network augmentation.

[1] AER "Regulatory Investment Test for Distribution Application Guidelines", Section A6.
Available at: http://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/regulatory-investment-test-for-distribution-rit-d-and-application-guidelines

Interest on borrowings is not included as a cost in the comparison of options as it represents a cost of project financing, and as such is accounted for in present value calculations through the discounting of the project cash flows at the regulated weighted average cost of capital. The interest on borrowings is included in the Total Project Cost for which approval is being sought as it represents a legitimate cost of network augmentation.

6.3. Net Present Value (NPV) Results

An overview of the initial capital cost and the base case NPV results are provided in Table 1.

Option	Option Name	Rank	Initial Capital Cost	Net Economic Benefit ($ real)	PV of Capex ($ real)	PV of Opex ($ real)	PV of Benefits ($ real)
1	Replace problematic plant items and replace the 33kV and 11kV outdoor switchgear with indoor switchgear	1	$10,300,000	$245,000	-$9,531,000	$0	$9,776,000

Table 1: Base case NPV ranking table

Note: There is no material benefit in OPEX between the current network and Option 1, meaning the PV of OPEX is $0.

7. CONCLUSION

The FPAR represents the final stage of the consultation process in relation to the application of the RIT-D.

Energex intends to take steps to progress the proposed preferred option to ensure any statutory non-compliance is addressed and undertake appropriately justified network reliability improvements, as necessary.

7.1. Preferred Option

Energex's preferred internal network option is Option 1: Replace problematic plant items and replace the 33kV and 11kV outdoor switchgear with indoor switchgear

Upon completion of this work, the asset safety and reliability risks at SSRWD Substation will be addressed. The preferred option will provide the greatest reliability benefit for customers, whilst also reducing expenditure on obsolete, non-compliant and high maintenance assets, while ensuring more efficient use of design and construction resources.

The estimated capital cost of this option inclusive of interest, risk, contingencies and overheads is $10.3 million. Annual operating and maintenance costs are anticipated to be the same as the existing network as a result of this option. The estimated project delivery timeframe has design commencing in September 2022 and construction completed by October 2024.

7.2. Satisfaction of RIT-D

The proposed preferred option satisfies the RIT-D.

This statement is made on the basis of the detailed analysis set out in this report. The proposed preferred option is the credible option that has the highest net economic benefit under the most likely reasonable scenarios.

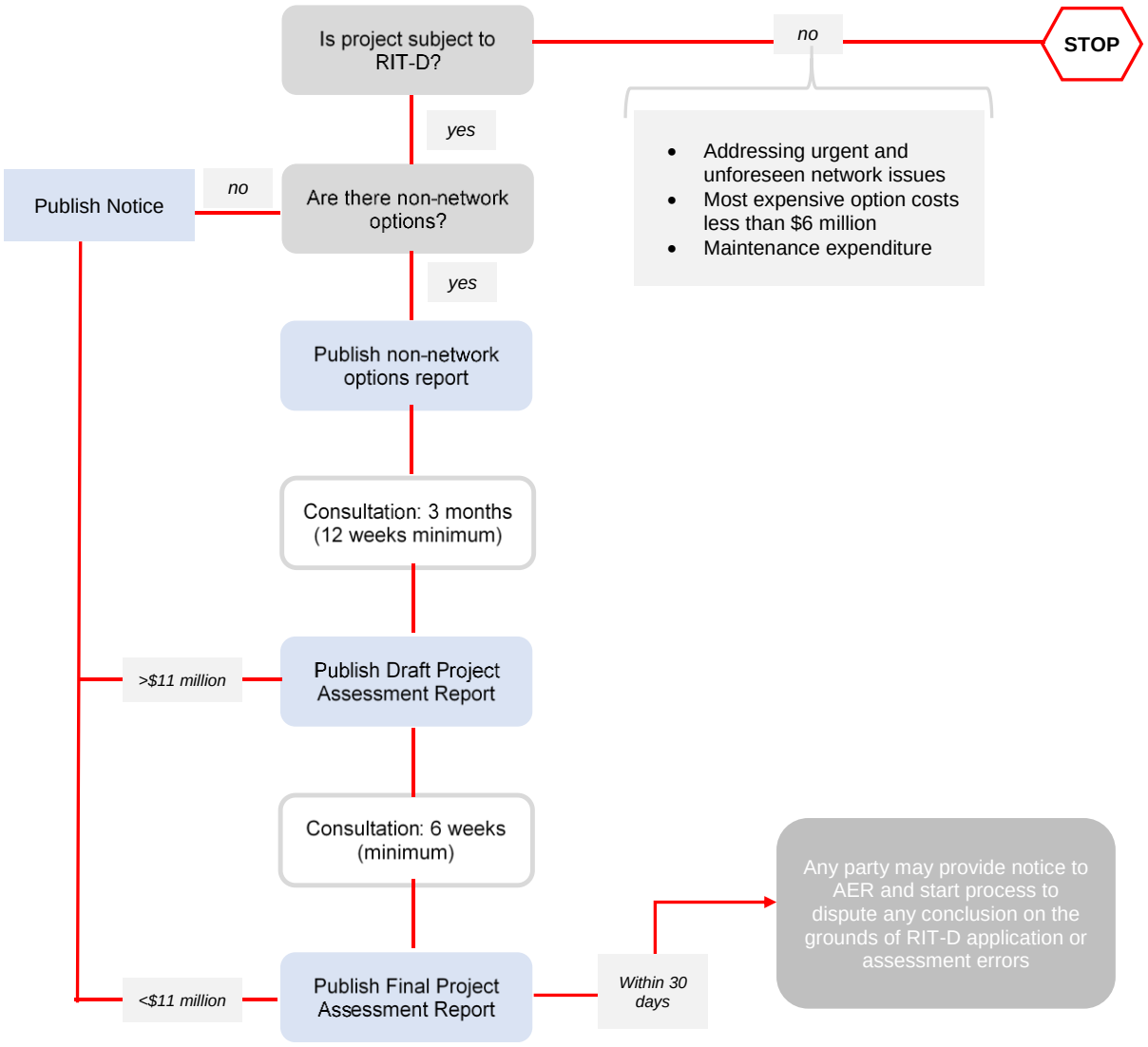
8. COMPLIANCE STATEMENT

This Final Project Assessment Report complies with the requirements of NER section 5.17.4(j) as demonstrated below:

Requirement	Report Section
(1) a description of the identified need for investment;	3
(2) the assumptions used in identifying the identified need (including, in the case of proposed reliability corrective action, why the RIT-D proponent considers reliability corrective action is necessary;	3.3
(3) if applicable, a summary of, and commentary on, the submissions received on the DPAR;	4
(4) a description of each credible option assessed	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 of each credible option	6
(6) a quantification of each applicable cost for each credible option, including a breakdown of operating and capital expenditure	5
(7) a detailed description of the methodologies used in quantifying each class of costs or market benefit	6
(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	6.2
(9) the results of a NPV analysis of each credible option and accompanying explanatory statements regarding the results	7
(10) the identification of the proposed preferred option	8
(11) for the proposed preferred option, the RIT-D proponent must provide: (i) details of the technical characteristics; (ii) the estimated construction timetable and commissioning date (where relevant); (ii) the indicative capital and operating costs (where relevant); (iv) a statement and accompanying analysis that the proposed preferred option satisfied the RIT-D; and (v) if the proposed preferred option is for reliability corrective action and that option has a proponent, the name of the proponent	5.1 & 8

(12) contact details for a suitably qualified staff member of the RIT-D proponent to whom queries on the final report may be directed.	1.4

APPENDIX A – THE RIT-D PROCESS



Source: AEMC, *Rule determination: National Electricity Amendment (Replacement expenditure planning arrangements) Rule 2017*, July 2017, p. 64.