Regulatory Investment Test for Distribution (RIT-D)

Addressing Reliability Requirements in the Mount Sibley Network Area

Notice of Screening for Options

21 February 2024

Ergon Energy Network

Part of Energy Queensland

EXECUTIVE SUMMARY

1.1. About Ergon Energy

Ergon Energy Corporation Limited (Ergon Energy) is part of Energy Queensland and manages an electricity distribution network which supplies electricity to more than 765,000 customers. Our vast operating area covers over one million square kilometres (around 97% of the state of Queensland) from the expanding coastal and rural population centres to the remote communities of outback Queensland and the Torres Strait.

Our electricity network consists of approximately 160,000 kilometres of powerlines and one million power poles, along with associated infrastructure such as major substations and power transformers.

We also own and operate 33 stand-alone power stations that provide supply to isolated communities across Queensland which are not connected to the main electricity grid.

1.2. Identified Need

Mount Sibley 33/11kV (MOSI) zone substation is located approximately 25km south of Toowoomba. The substation takes supply from South Toowoomba 110/33kV Bulk Supply Substation (SOTO).

Mt Sibley substation supplies the townships of Nobby, Greenmount and the surrounding area. Outside of Nobby and Greenmount, the supply area is primarily rural, with the customers including numerous farms. Mt Sibley Substation provides electricity supply to approximately 1,209 customers, of which 80% are residential and 20% are commercial, agricultural and industrial. Mount Sibley Substation is presently supplied via an incoming 33kV feeder from South Toowoomba Substation, and there is an outgoing 33kV feeder from Mount Sibley Substation which provides supply to Clifton 33/11kV Substation.

A preliminary evaluation of Mount Sibley Substation completed in 2022, identified primary and secondary plant and equipment recommended for retirement as assessed by Condition Based Risk Management (CBRM) analysis.

This assessment identified that two 33/11kV power transformers, one 11kV voltage transformer, eleven 33kV and 11kV isolators and three ACR controllers are at the end of their serviceable life. Additionally, a civil assessment of the structures on site also identified that the substation security fence is not compliant with AS2067 and AS1725; the transformer bunding is inadequate and does not satisfy the requirements outlined in AS1940 and AS2067.

The deterioration of these primary and secondary system assets poses safety risks to staff working within the switchyard; and a reliability risk to the customers supplied from Mount Sibley Substation.

1.3. 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). Ergon Energy has determined that network investment is essential in this case for it to continue to provide electricity to the consumers in the Mount Sibley supply area in a reliable, safe and cost-effective manner. Accordingly, this investment is subject to a RIT-D. An internal assessment has been conducted and it has been determined that there is no stand-alone power system (SAPS) or non-network option that is potentially credible, or that forms a significant part of a potential credible option that will meet the identified need or form a significant part of the solution. This Notice has hence been prepared by Ergon Energy in accordance with the requirements of clause 5.17.4(d) of the NER.

CONTENTS

1. BACKGROUND

1.4. Geographic Region

Mt Sibley 33/11kV substation supplies the townships of Nobby, Greenmount and the surrounding area. Outside of the townships of Nobby and Greenmount, the supply area is primarily rural, with the customers including numerous farms. Mt Sibley Substation provides electricity supply to approximately 1,206 customers, of which 80% are residential and 20% are commercial, agricultural and industrial.

The geographical location of Ergon Energy's sub-transmission network and substations in the area is shown in Figure 1.

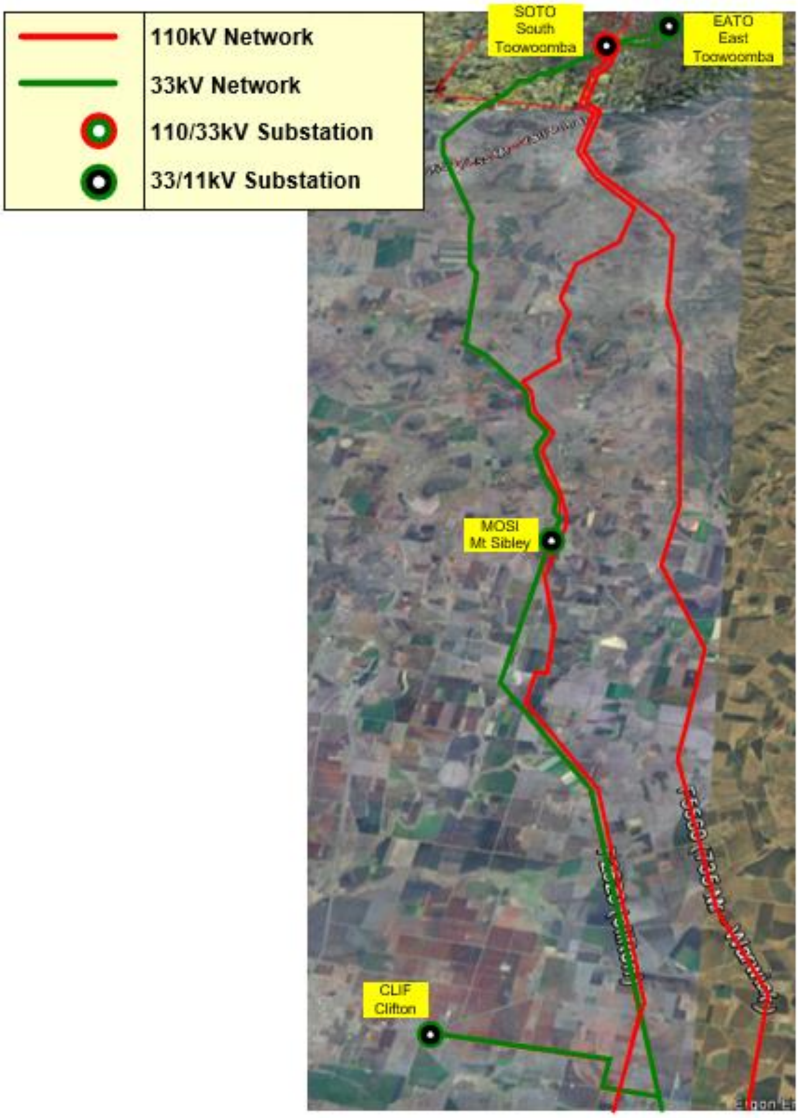


Figure 1: Existing network arrangement (geographic view)

1.5. Existing Supply System

Mount Sibley 33/11kV (MOSI) zone substation is located approximately 25km south of Toowoomba. The substation takes supply from South Toowoomba 110/33kV Bulk Supply Substation (SOTO). Mount Sibley Substation is currently supplied via an incoming 33kV feeder from South Toowoomba Substation, and there is an outgoing 33kV feeder from Mount Sibley Substation which provide supply to Clifton 33/11kV Substation.

Mount Sibley Substation was established in 1968 according to applicable design and construction standards during that time. It has an outdoor 33kV and 11kV switchyard with steel structures, one 5MVA 33/11kV and one 3MVA power transformers, and a small protection and control building. Over time, the substation was expanded with additional 11kV bays and some of the primary plants have been replaced in situ.

The 33kV bus does not contain a bus tie circuit breaker; however, there are two sets of manually operated 33kV bus isolators. The two transformer bays do not contain HV or LV circuit breakers; however, there are VTs on the 11kV side of each transformer. This arrangement impacts adversely on customer reliability.

The 33kV and 11kV bus are manually switched. The 33kV and 11kV bus contains four 33kV isolators and nine 11kV bus isolators. The 11kV bus is operated normally open, one 33/11kV transformer supplies two 11kV feeders and other transformer supplies one 11kV feeder.

Mount Sibley substation supplies three 11kV distribution feeders which contain five existing 11kV feeder ties to 11kV feeders supplied from South Toowoomba 33/11kV substation (SOTO), Kearneys Spring 33/11kV substation (KESP), Broxburn 33/11kV substation (BROX) and Clifton 33/11kV substation (CLIF). Each outgoing 11kV feeder is protected by an automatic circuit recloser (ACR).

Station services are supplied from a 25kVA 11/0.415kV local transformer, supplied off the 11kV bus.

A schematic view of the existing sub-transmission network arrangement is shown in Figure 2 and the geographic view of Mount Sibley Substation is illustrated in

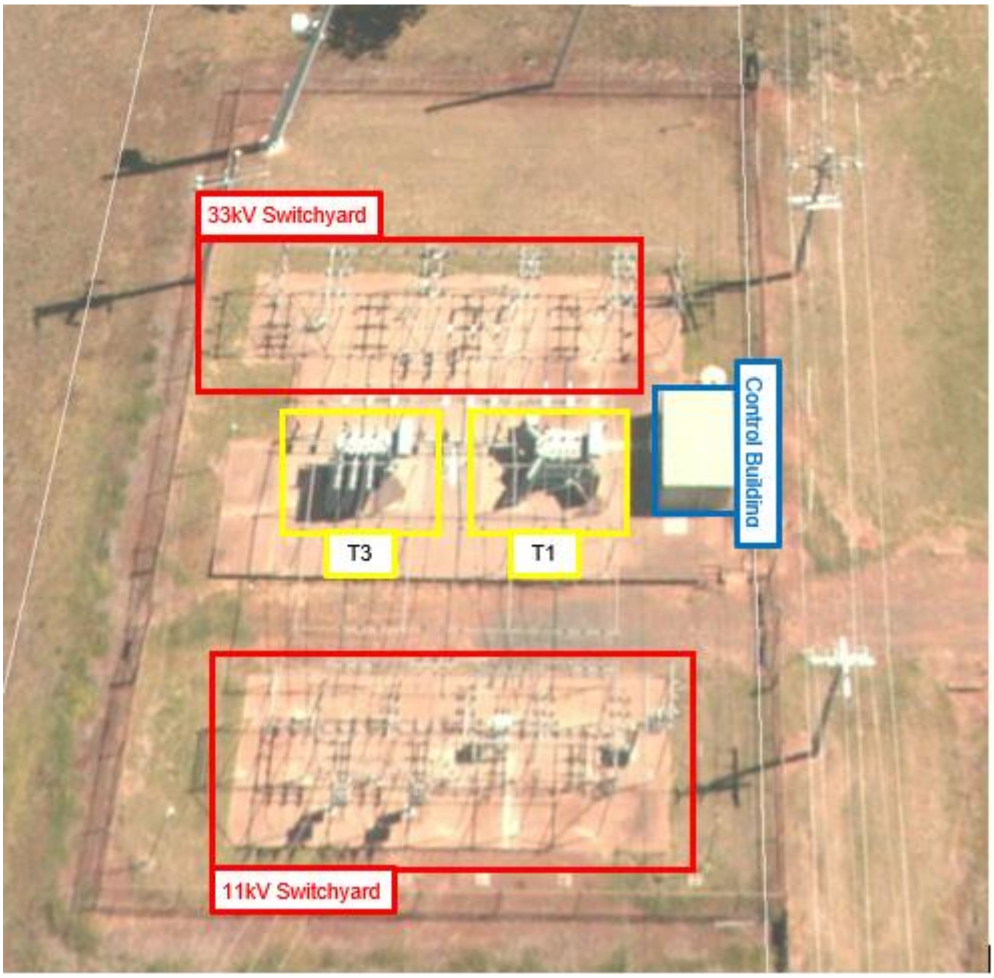


Figure 3.

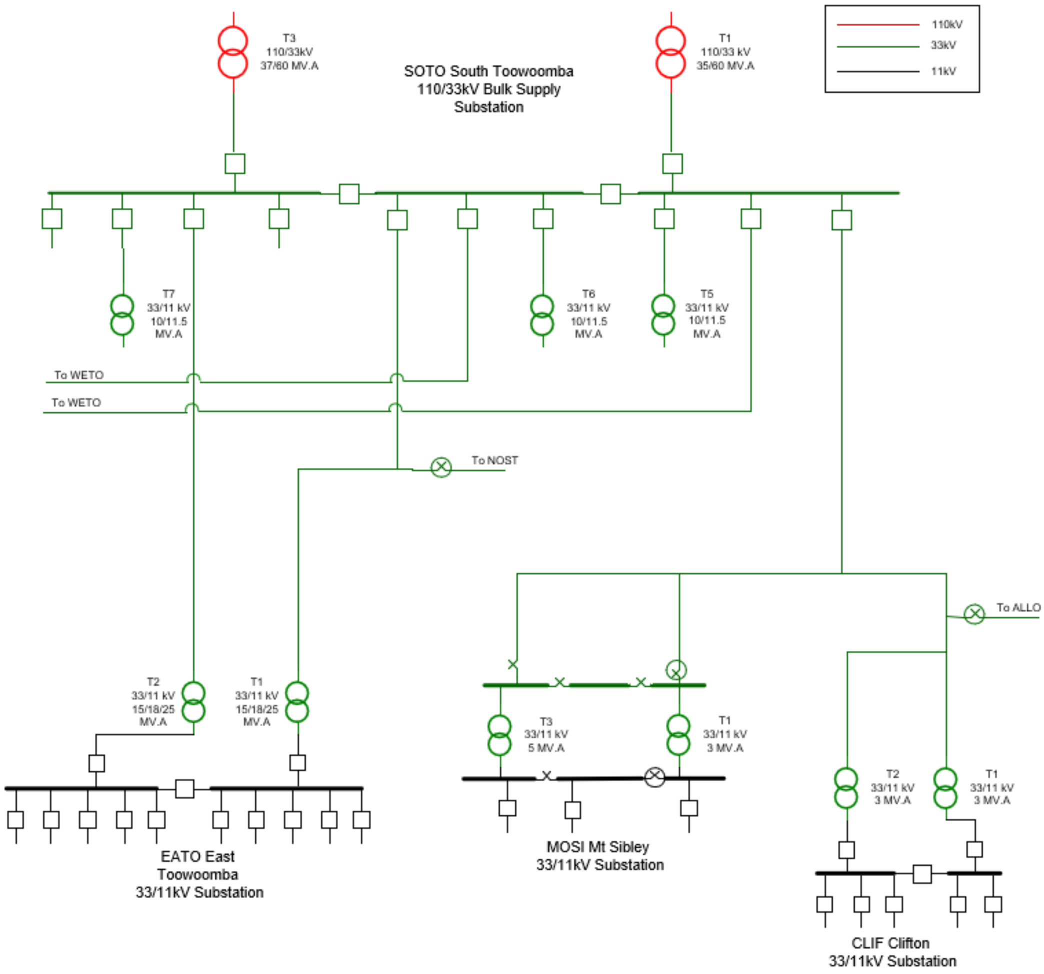


Figure 2: Existing network arrangement (schematic view)

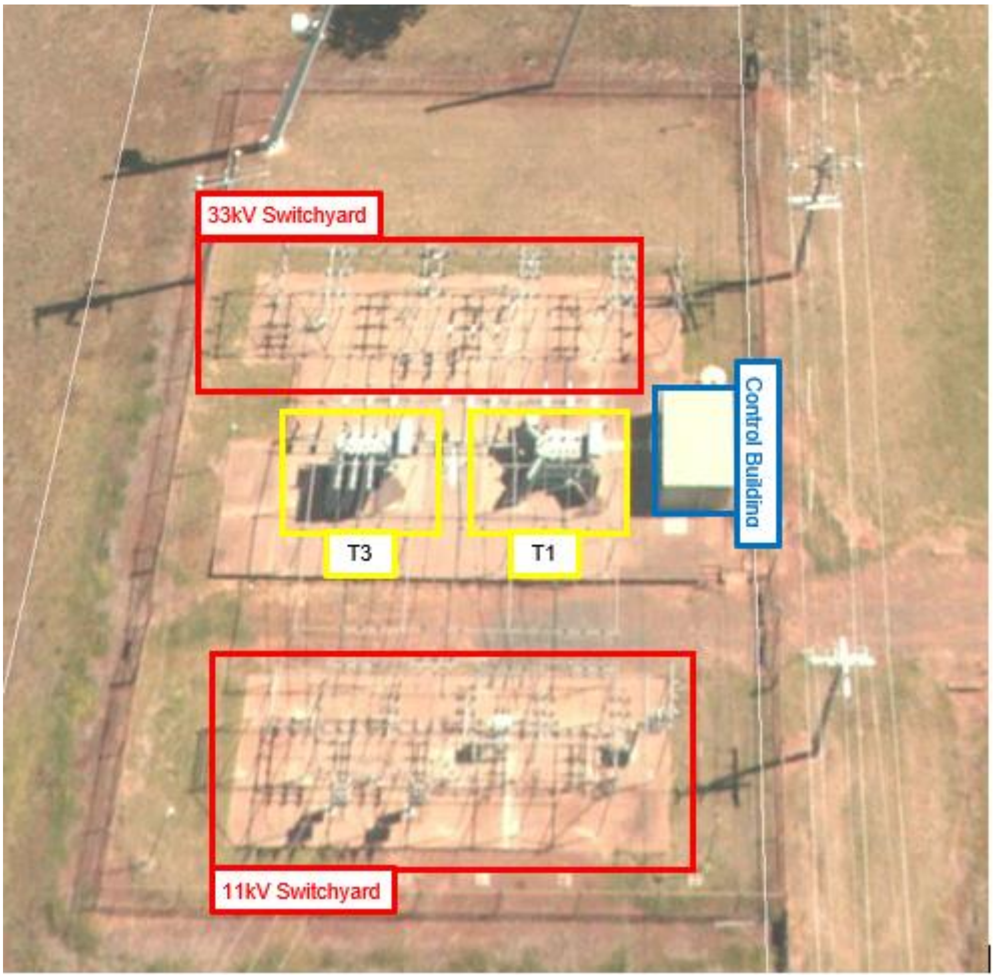


Figure 3: Mount Sibley Substation (geographic view)

1.6. Load Profiles / Forecasts

The load at Mount Sibley Substation comprises a mix of residential and commercial/industrial customers. For the 2022/23 FY, the load has change from previous summer peaking to a winter peak signifying a move away from being predominantly driven by pumping and irrigation.

1.6.1. Full Annual Load Profile

The full annual load profile for Mount Sibley Substation over the 2022/23 financial year is shown in Figure 4. It is noted that the peak load occurs during winter, however substantial load is experienced during the summer season.

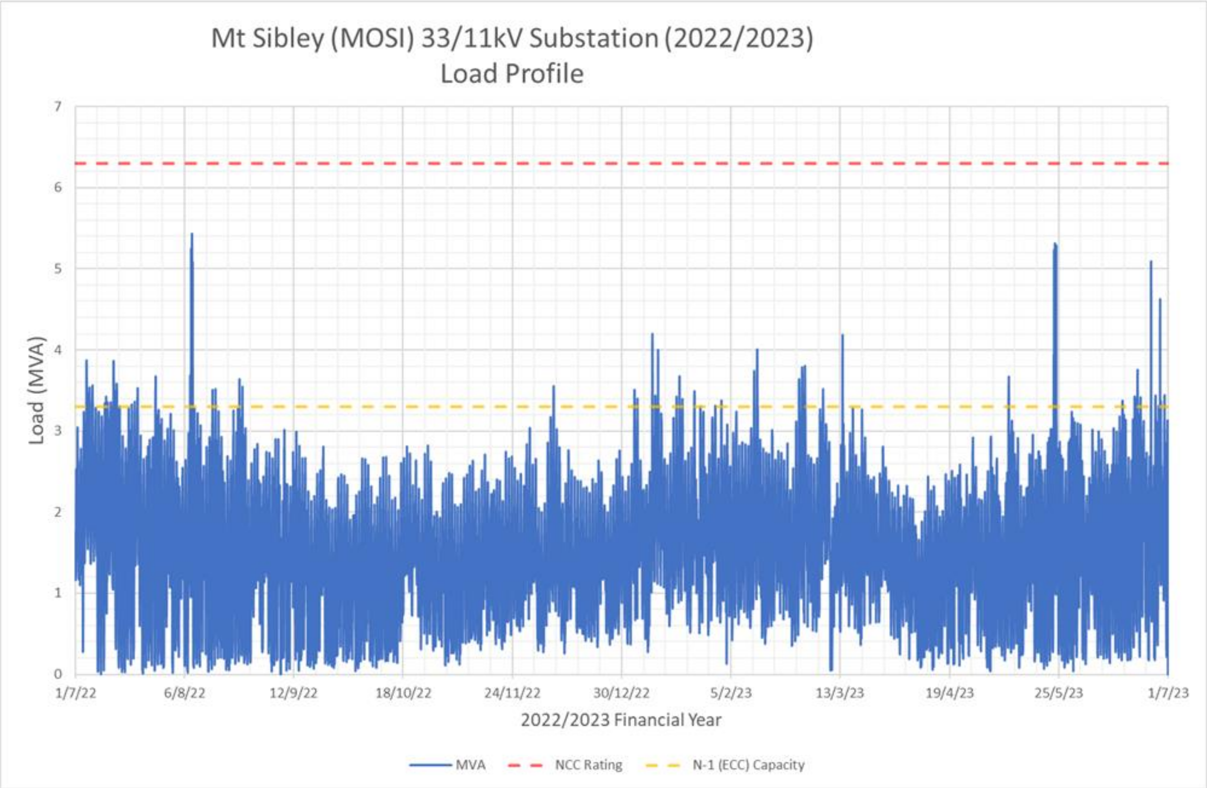


Figure 4: Substation actual annual load profile

1.6.2. Load Duration Curve

The load duration curve for Mount Sibley Substation over the 2022/23 financial year is shown in Figure 5.

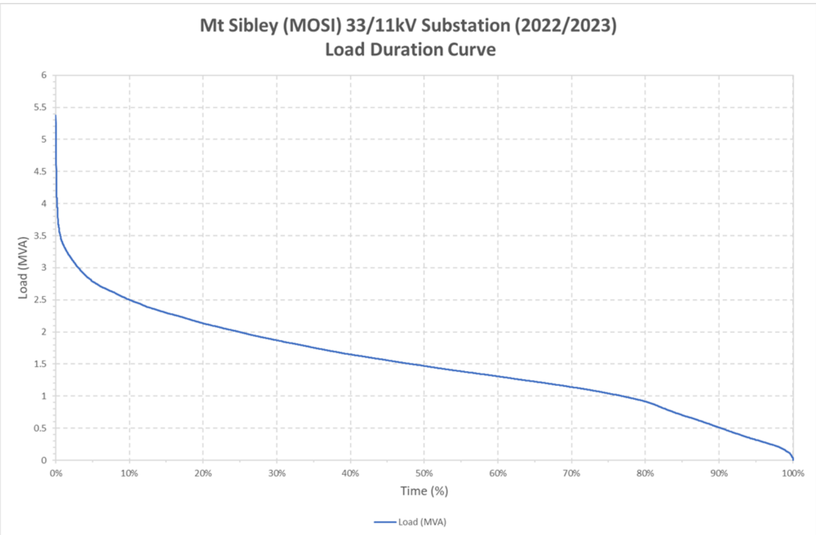


Figure 5: Substation load duration curve

1.6.3. Average Peak Weekday Load Profile

The daily load profile for an average peak weekday is illustrated below in Figure 6. It is noted that historically, Mount Sibley Substation would experience summer peak loads in the late afternoon and evening. However, this behaviour recently changed in 2022/23. Based on averages, supply is relatively even-handedly distributed during the early morning and afternoon hours with demand dropping off during normally peak mid-day hours. Peak demand has also changed to early morning hours due to agricultural demand such as irrigation.

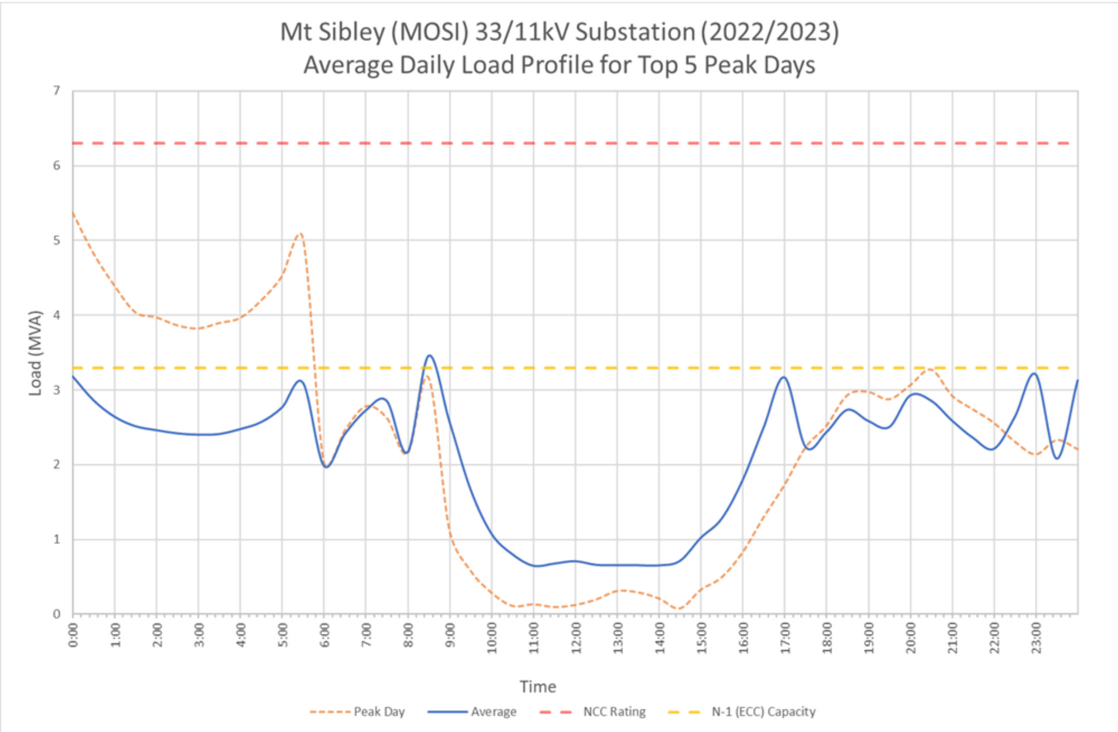


Figure 6: Substation average peak weekday load profile

1.6.4. Base Case Load Forecast

The 10 PoE and 50 PoE load forecasts for the base case load growth scenario are illustrated in Figure 7. The historical peak load for the past six years has also been included in the graph.

Peak loads of between 4 to 5.5MVA were experienced in previous years prior to the recent peak of 5.4MVA. It is also noted that the peak load is forecast to stabilise over the next decade under the base case scenario as shown in Figure 7.

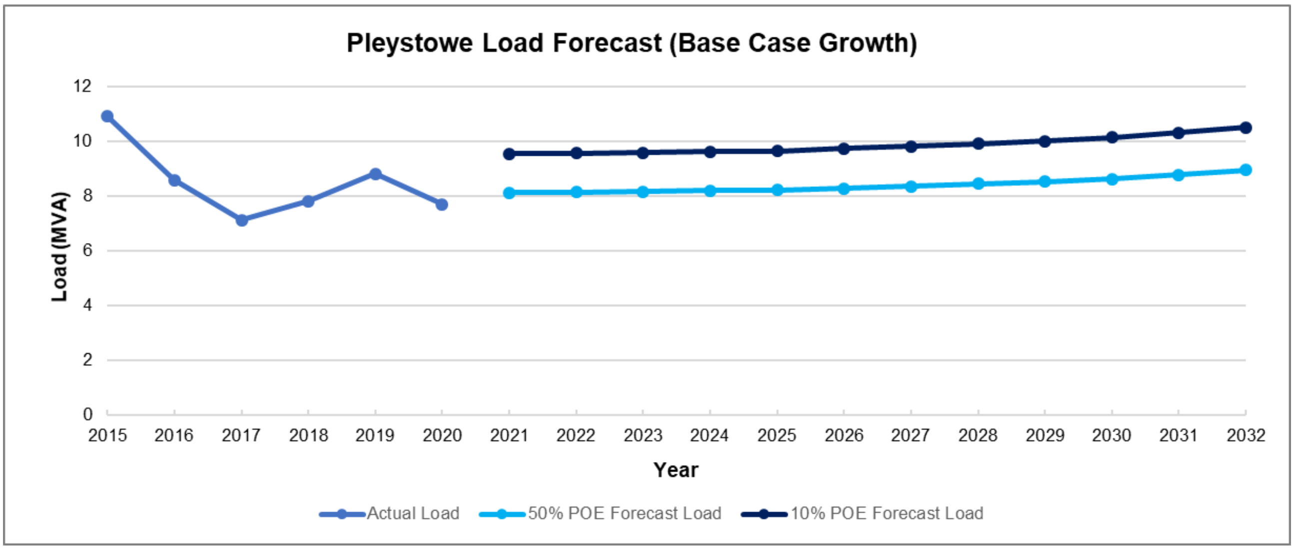


Figure 7: Substation Base Case Load Forecast

1.6.5. High Growth Load Forecast

The 10 PoE and 50 PoE load forecasts for the high load growth scenario are illustrated in Figure 8. With the high growth scenario, the peak load is forecast to increase over the next decade.

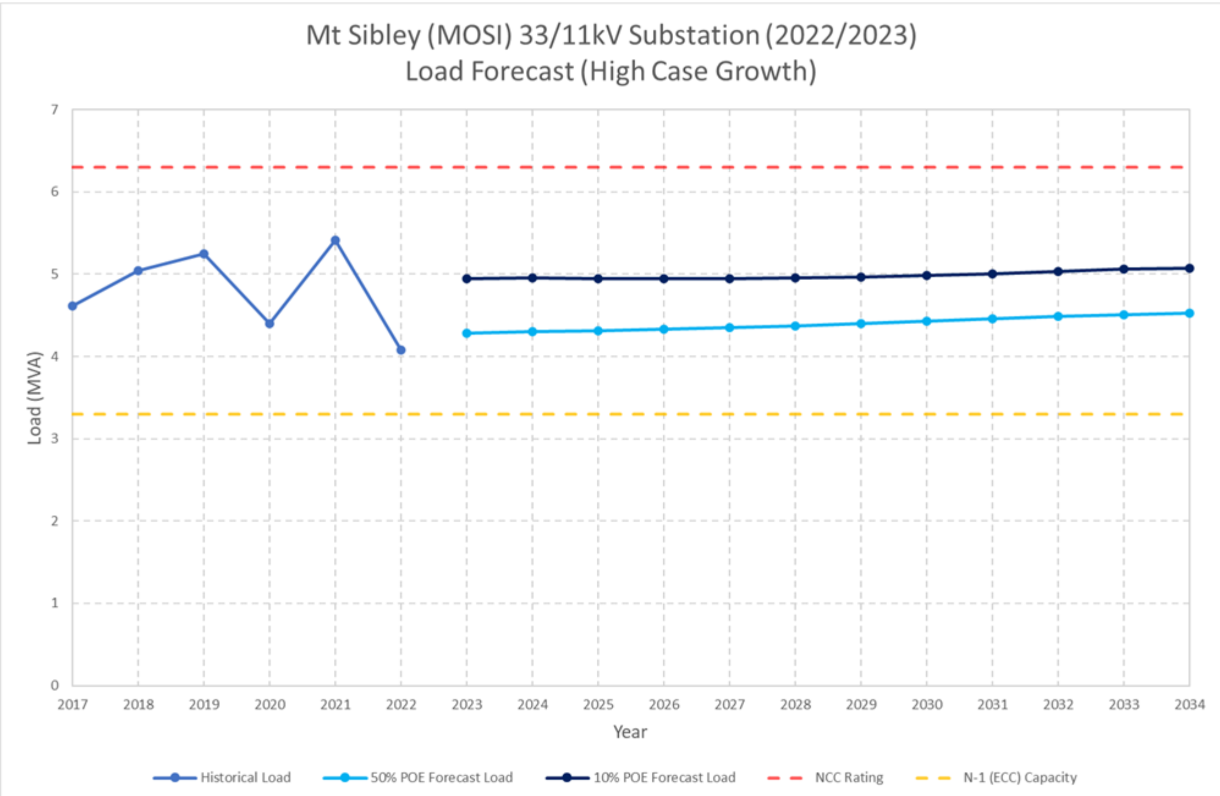


Figure 8: Substation High Growth Load Forecast

1.6.6. Low Growth Load Forecast

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

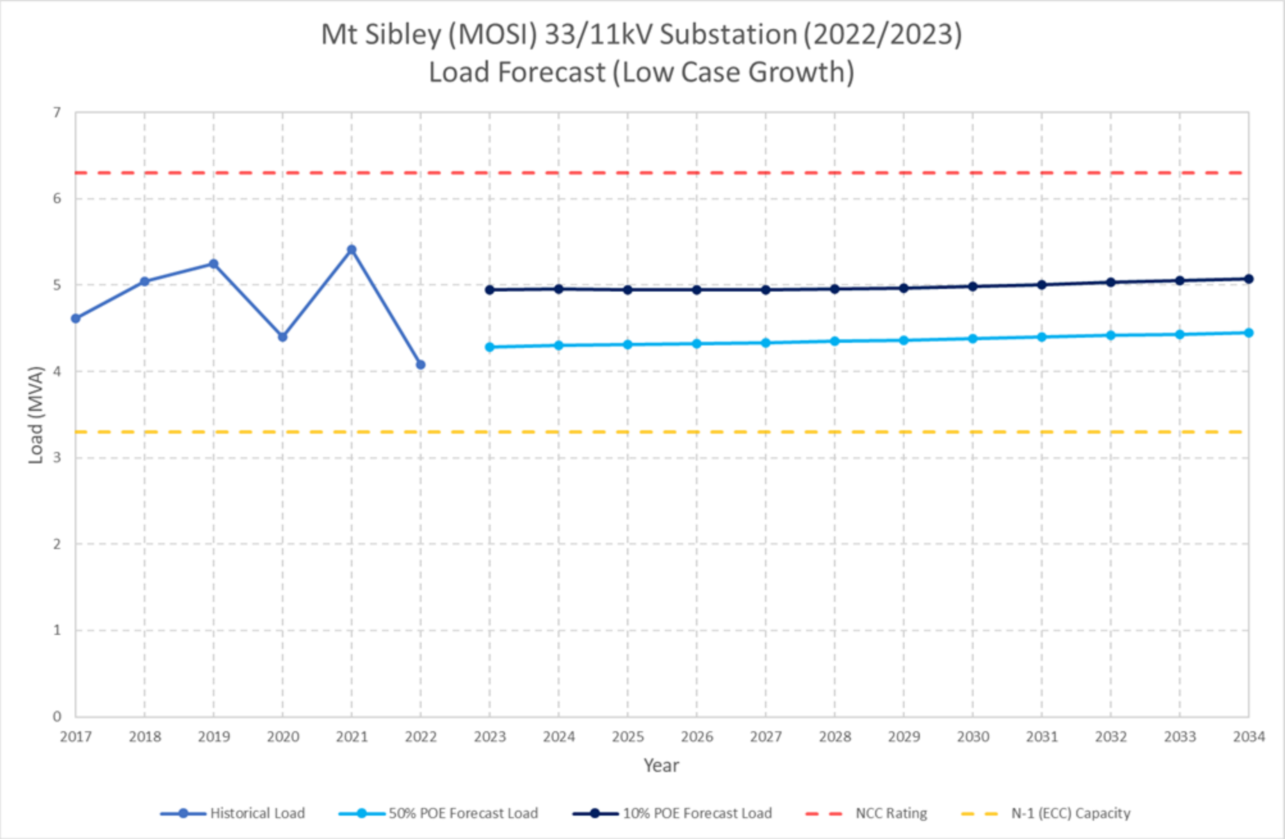


Figure 9: Substation Low Growth Load Forecast

2. IDENTIFIED NEED

2.1. Description of the Identified Need

2.1.1. Aged and Poor Condition Assets

A recent condition assessment has highlighted that several 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 that the two 33/11kV power transformers, the 11kV ACR controllers and most of the 33kV and 11kV isolators at Mount Sibley Substation are reaching end of life. Additionally, a civil assessment of the structures on site also identified that the substation security fence is not compliant with AS2067 and AS1725, and the transformer bunding is inadequate and does not satisfy the requirements outlined in AS1940 and AS2067.

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, though the increased likelihood of protection mal-operation and catastrophic failure of the power transformers. There is also a considerable risk of environmental harm due to loss of oil from the power transformers, which would require clean up and rectification. Additionally, 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 Mount Sibley Substation.

Where Ergon Energy 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.

2.1.2. Reliability

There are presently no HV or LV transformer circuit breakers and no bus tie circuit breakers on the 33kV and 11kV buses at Mount Sibley Substation. Under the existing sub-transmission network configuration any fault within Mount Sibley Substation would result in an outage to all the customers supplied. Such an event would affect almost 1,209 customers and results in a combined peak load at risk of approximately 4.19MVA.

This network arrangement has also contributed to higher-than-average SAIDI and SAIFI for the short rural distribution feeders than is generally expected.

SAIDI or System Average Interruption Duration Index, means the sum of the durations of all the sustained interruptions (in minutes), divided by the customer base. Momentary interruptions (of three minutes or less) are excluded from the calculation of unplanned SAIDI.

SAIFI or System Average Interruption Frequency Index, means the total number of sustained interruptions, divided by the customer base. Momentary interruptions (of three minutes or less) are excluded from the calculation of unplanned SAIFI.

The three-year average network performance for the 11kV distribution feeders supplied from Mount Sibley is shown in Table 1.

Feeder	Category	Customer number	Feeder 3 year average SAIDI	Category SAIDI target	Feeder 3 year average SAIFI	Category SAIFI target
Greenmount	Short Rural	592	1,174.95	424.00	6.027	1.980
Hirstglen	Short Rural	94	1,633.29	424.00	7.186	3.950
Nobby	Long Rural	523	1,199.11	964.00	6.935	7.400

Table 1: Feeder reliability category and performance (existing network)

Feeder reliability classifications are defined below:

- green feeders have a three-year average ≤ target
- yellow feeders have a three-year average > target < 150% target
- amber feeders have a three-year average > 150% target < 200% target
- red feeders have a three-year average > 200% target.

2.1.3. Safety Net Non-Compliance

A fundamental requirement of Ergon Energy's DA D01/99 is to comply with Safety Net targets that seek to effectively mitigate the risk of low probability – high consequence network outages to avoid unexpected customer hardship and / or significant community or economic disruption. Please refer to APPENDIX B for the service standards applied to Ergon Energy's sub-transmission network.

Mount Sibley substation complies with Safety Net requirements based on credible contingencies benchmarked against 50% PoE load in the present configuration with consideration of the following scenarios as listed in Table 2.

Scenario	Failure	Consequence	Actions	SN Minimum Timeline	Typical Timeline	Safety Net Compliance
1	Transformer 33/11 kV	Partial loss of supply to 11 kV supply area (split 11 kv bus); supply capacity limited to 3.0 MVA	1. Open ABS to isolate faulty transformer and close 11 kV bus-tie AB8917 2. The following load shift is not possible during extreme winter/ summer conditions and are subject to further analysis. Transfer part of Greenmount fdr (Watts Siding fdr) to Cambooya fdr (child fdr of Eiser St fdr – SOTO, approx. 300kVA load shift available): Close AB14603 Open CB4162	48 hrs	6 hrs	YES
			3. If necessary, deploy HV injection unit to pick up remaining unsupplied load	48 hrs	8 hrs	YES
			Full supply restored:	48 hrs	8 hrs	YES
2	33 kV pole failure on Clifton Fdr	Total loss of supply to MOSI and CLIF substations	1. Transfer as much MOISI and CLIF load as possible to 33 kV Allora Fdr (from T058) without exceeding the feeder rating (SD 6.6 MVA).	48 hrs	12 hrs	YES
			2. Repair feeder and restore supply.	48 hrs	12 hrs	YES
			Full supply restored:	48 hrs	12 hrs	YES

Table 2: Safety Net - Contingency Analysis

3. INTERNAL OPTIONS CONSIDERED

3.1. Non-Network Options Identified

Ergon Energy 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 Mount Sibley area to address the identified need.

3.2. Network Options Identified

Ergon Energy has identified three credible network options that will address the identified need.

3.2.1. Option A: Replace both 5 MVA and 3 MVA 33/11kV transformers with a 5/8 MVA 33/11 kV transformer; replace both 33kV and 11kV buses with 33kV and 11kV RMUs respectively and install a Mobile Substation Connection

This option proposes to replace existing 33/11kV transformers with a single 5/8 MVA 33/11kV unit and associated installation works including new transformer bunding; installation of 33 and 11kV RMUs; protection system as well as mobile generation connection.

A schematic diagram of the proposed network arrangement for Option A is shown in Figure 10.

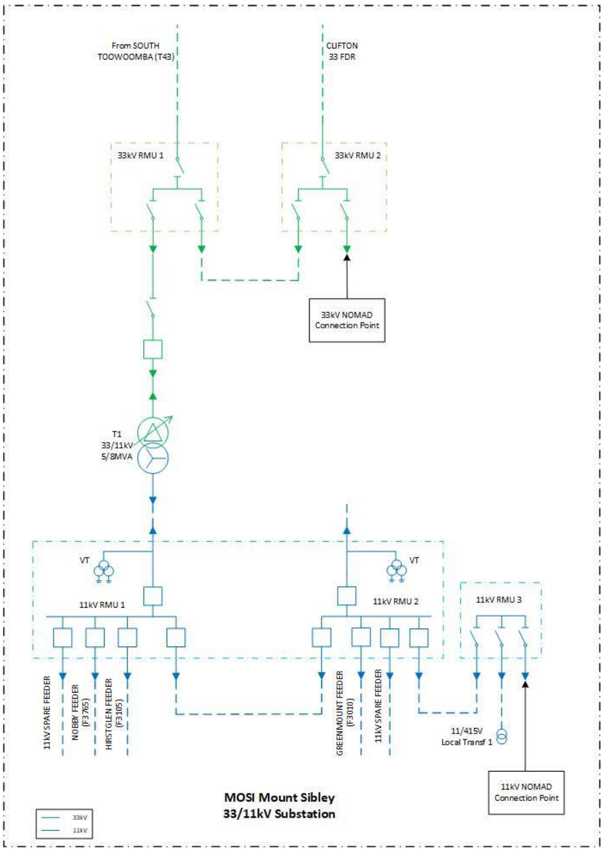


Figure 10: Option A proposed network arrangement (schematic view)

3.2.2. Option B: Replace 5 MVA, 33/11 transformer and 3 MVA 33/11kV transformer with a 5/8 MVA 33/11 kV transformer and install a 33kV bus, replace 11kV bus with 11kV Rural RMU and Install Mobile Substation Connection

This option involves recovering the two existing transformers and installing a new 5/8MVA 33/11kV transformer with compliant bunding and dedicated recloser; in addition, installing 33kV reclosers on the line; replacing the 11kV bus with RMUs; install secondary systems and mobile generation connection.

A schematic diagram with the proposed network arrangement for Option B is shown in Figure 11.

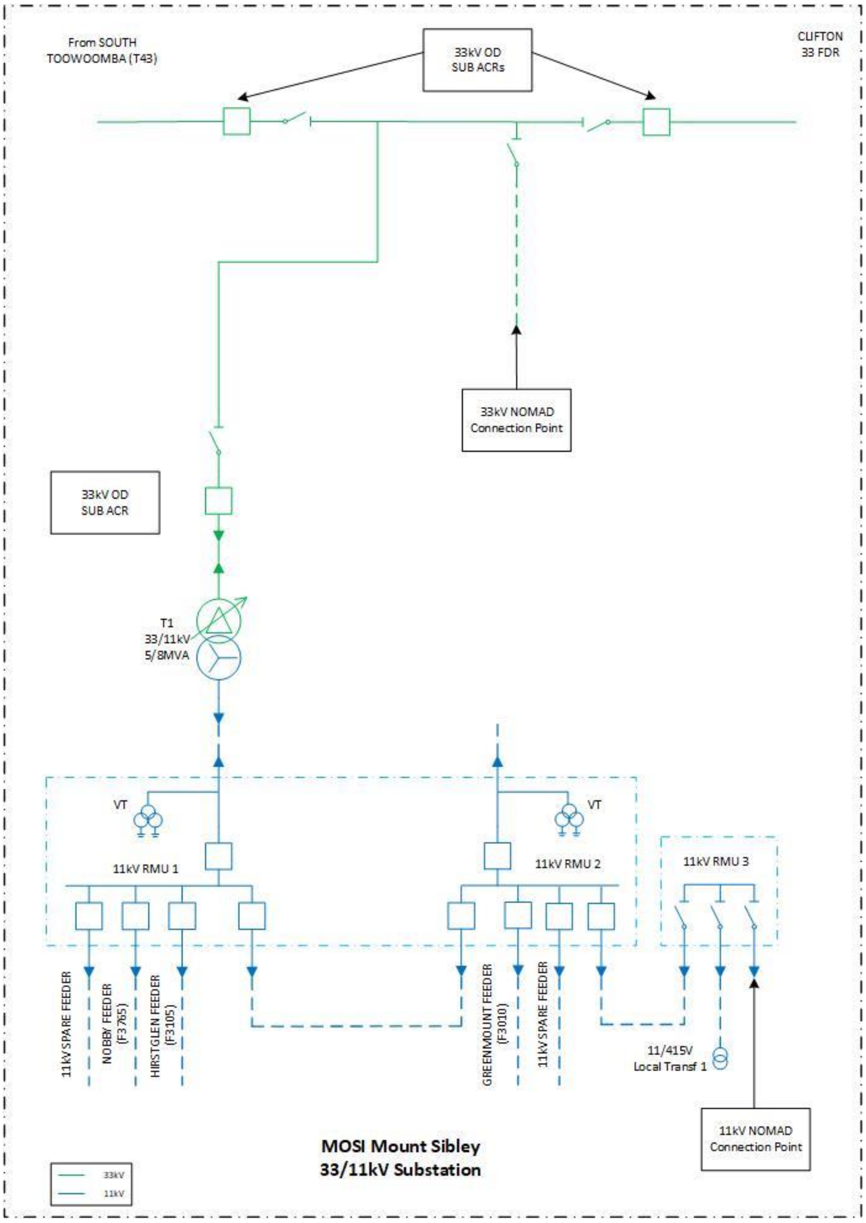


Figure 11: Option B proposed network arrangement (schematic view)

3.3. Preferred Network Option

Ergon Energy's preferred internal network option is Option A - replace both 5 MVA and 3 MVA 33/11kV transformers with a 5/8 MVA 33/11 kV transformer; replace both 33kV and 11kV buses with 33kV and 11kV RMUs respectively and install a Mobile Substation Connection.

Upon completion of these works, the asset safety and reliability risks at Mount Sibley Substation will be addressed. The preferred option will provide the greatest reliability benefit for customers, whilst also reducing expenditure on obsolete and non-compliant 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 $6 million. Annual operating and maintenance costs are anticipated to be 0.5% of the capital cost. The estimated project delivery timeframe has design commencing in December 2028 and construction completed by December 2035.

4. ASSSESSMENT OF SAPS AND NON-NETWORK SOLUTIONS

Ergon Energy has considered SAPS and demand management solutions to determine their feasibility to meet the identified need. Each of these are considered below.

Ergon Energy's Demand & Energy Management (DEM) team has assessed the potential non-network alternative (NNA) options required to defer the network option and determine if there is a viable demand management (DM) option to replace or reduce the need for the network options proposed.

Credible options must be technically and commercially viable and must be able to be implemented in sufficient time to satisfy the identified risk to the public and/or the network due to the identified constraints.

4.1. Consideration of SAPS Options

Ergon Energy considers there is no SAPS option that could form a potential credible option on a standalone basis, or that could form a significant part of the credible option. In particular, the Load Request for DM review/consultation for Mt Sibley 33/11kV Substation requirements, per the forecast in the Mount Sibley region could not be supported by a network that is not part of the interconnected national electricity system.

4.2. Demand Management (Demand Reduction)

Ergon Energy's Demand & Energy Management (DEM) team has assessed the potential non-network alternative (NNA) options required to defer the network option and determine if there is a viable demand management (DM) option to replace or reduce the need for the network options proposed.

Credible options must be technically and commercially viable and must be able to be implemented in sufficient time to satisfy the identified risk to the public and/or the network due to the identified constraints.

The DEM team has completed a review of the Mount Sibley customer base and considered a number of demand management technologies. Asset safety and performance risks are the key project drivers (i.e. the need) at Mount Sibley. It has been determined that most demand management options will not be viable propositions and have been explored in the following sections.

4.2.1. Network Load Control

The residential customers and irrigation load appear to drive the daily peak demand which generally occurs between 10:00pm and 6:00am.

There are ~1,237 customers on tariff T31 and T33 hot water load control (LC). An estimated demand reduction value of 342kVA[1] is available.

Mount Sibley Substation LC signals are controlled from South Toowoomba Bulk Supply Substation (SOTO). The Tariff 33 and 31 hot water LC channels are dynamic (that is, it responds to exceedance settings not on a timetable) and the current control strategy only calls LC when the load at South Toowoomba Bulk Supply Substation exceeds 60MW. This strategy does not directly address demand peaks experienced at Mount Sibley. Tariff 33 air-conditioning channels are under manual control of the operational control centre and are used as required. Therefore, network load control would not sufficiently address the identified need.

4.3. Demand Response

Four methods utilising demand response technology for deferring network investment are: Call Off Load (COL), Customer Embedded Generation (CEG), Large Scale Customer Generation (LSG) and customer solar power systems.

4.3.1. Customer Call Off Load (COL)

COL is an effective technique for deferring network investment where the need is for a short time period. However, in this instance, the need is required on a long-term permanent basis. There are a small number of large customers in the catchment area but the $/kVA funding available for demand reduction is low therefore customer call off load has been assessed as not a viable proposition as it will not address the identified need, nor benefit the community.

4.3.2. Customer Embedded Generation (CEG)

CEG is an effective technique for deferring network investment where the need is for a short time period. The primary driver for investment in this instance is asset safety and performance. A short-term deferral of network investment by using CEG is not a technically or financially feasible option (due to the number of contracts required to be negotiated and managed).

This option has been assessed as technically not viable as it will not address the identified network requirement.

4.3.3. Large-Scale Customer Generation (LSG)

LSG sites such as renewable energy generation, solar or wind farms of multiple MW's capacity constitute an opportunity to support substation investment by reducing demand on, and potentially providing reactive power support for substation assets.

This option could potentially address the identified need, however, has been assessed as technically not viable as there is no known existing or proposed LSG demand response available.

[1] Hot water diversified demand saving estimated at 0.6kVA per system

4.3.4. Customer Solar Power Systems

Approximately 491 customers have solar photo voltaic (PV) systems for a connected inverter capacity of ~3,342kVA.

The daily peak demand was previously driven by residential customer demand with the peak generally occurred between 6:00pm and 8:00pm. However, this recent 2022/23 financial year has seen a change in customer behaviour with significant early morning peak between midnight and dawn, most likely driven by agricultural irrigation. As such customer solar generation does not coincide with the peak load period.

Business customers with large solar arrays are deemed to present a significant opportunity for targeted load control or load curtailment if coupled with a Battery Energy Storage System (BESS). Contracting such customers is attractive as they represent a larger load across fewer customers and therefore are cheaper and easier to engage and contract.

However, only a small percentage of customers in this supply area have solar PV systems and possibly none have a BESS. PV systems with BESS present a future portfolio opportunity for potential demand response but currently this supply area has a very limited solar/BESS. Solar customers without a BESS will not meet the technical needs of the demand reduction as their solar contribution may not be available when the network un-met need is required.

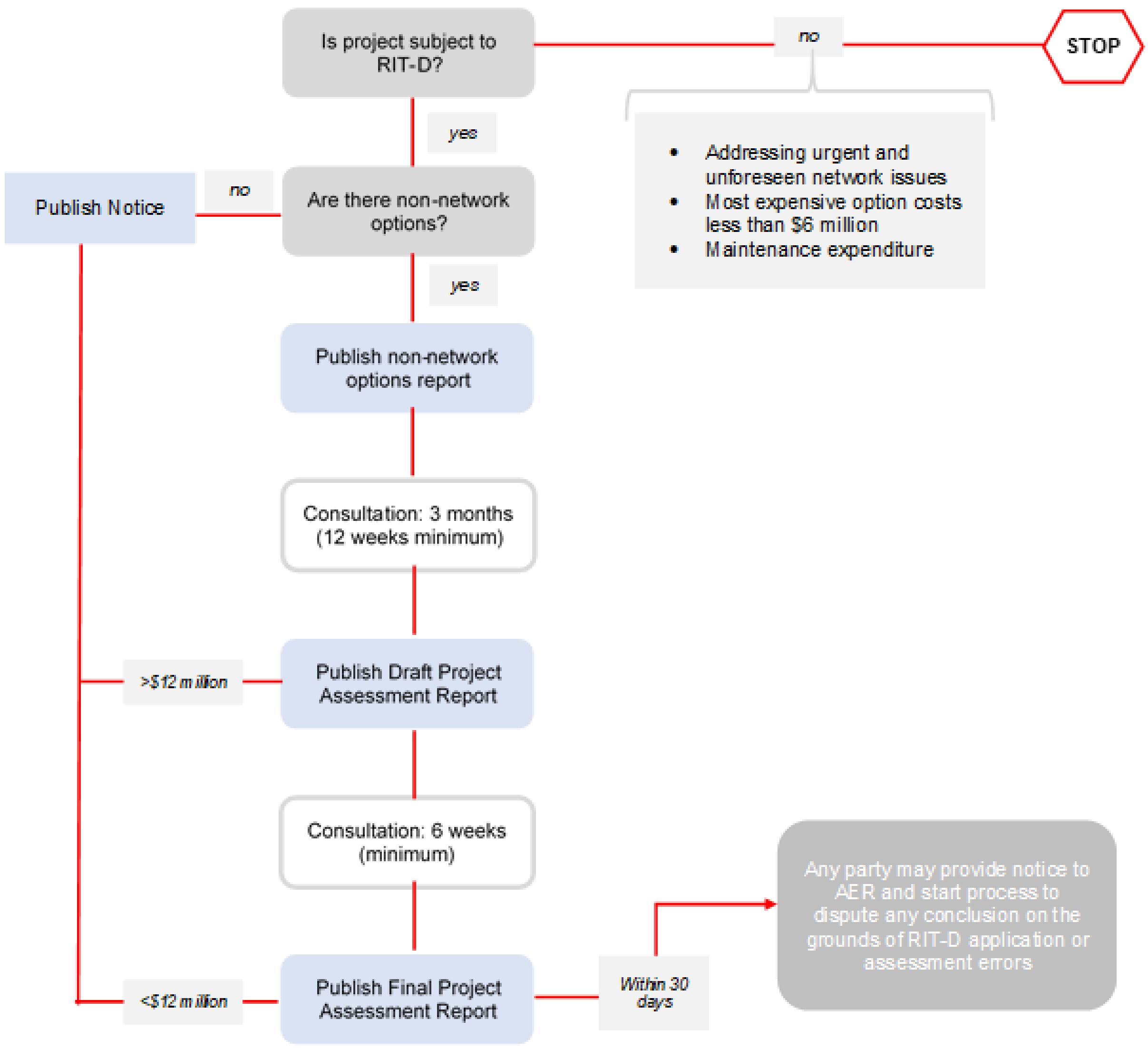
5. CONCLUSION AND NEXT STEPS

The internal investigations undertaken on the feasibility of the SAPS and non-network solutions revealed that it is unlikely to find a complete non-network solution or a hybrid (combined network and non-network) solution to provide the magnitude of network support required in the Mount Sibley area to address the identified need.

The preferred network option is Option A - replace both 5 MVA and 3 MVA 33/11kV transformers with a 5/8 MVA 33/11 kV transformer; replace both 33kV and 11kV buses with 33kV and 11kV RMUs respectively and install a Mobile Substation Connection.

This Notice of Screening for options is therefore published in accordance with rule 5.17.4(d) of the National Electricity Rules. As the next step in the RIT-D process, Ergon Energy will now proceed to publish a Final Project Assessment Report.

APPENDIX A THE RIT-D PROCESS



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

APPENDIX B SERVICE SAFETY NET TARGETS (EXTRACT)

The below table is an extract if the Service Safety Net Targets:

Category	Safety Net - Load not supplied and maximum restoration times following a credible contingency	
	Regional Centre	Rural / Remote
(1)	Less than 20 MVA after 1 hour	Less than 20 MVA after 1 hour
(2)	Less than 15 MVA after 6 hours	Less than 15 MVA after 8 hours
(3)	Less than 5 MVA after 12 hours	Less than 5 MVA after 18 hours
(4)	Fully restored within 24 hours	Fully restored within 48 hours

Source: Department of Energy and Public Works, *Electricity Act 1994 - Queensland Government - Distribution Authority No. D01/99 issued to Ergon Energy Corporation Limited – Schedule 4 Service Safety Net Targets*.