Regulatory Investment Test for Distribution (RIT-D)

Addressing Reliability Requirements in the Sarina Network Area

Notice of Screening for Options

12 December 2023

ERGON ENERGY NETWORK

Part of Energy Queensland

EXECUTIVE SUMMARY

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.

Identified Need

Sarina 66/11kV substation (SARI) supplies over 4,000 customers and 67GWh of energy annually. SARI substation is a critical asset for supply of energy for domestic and commercial business located into the Sarina area. Without the substation over 85% of the load in the area will be unsupplied given there is only 2MVA of load transfers available to adjacent substations. With load forecast to increase on the surrounding substations it is anticipated that this load transfer capability will also decrease year on year.

Assets vital to the operation of the substation are nearing end of life, increasing the risk of asset failure. Continued operation of the assets at SARI results in increased exposure to safety and reliability consequences due to the likelihood of asset failure

Assets which are nearing end of life, and with an increasing risk of asset failure include:

- 11kV indoor switchboard and 7 x CBs (estimated retirement year 2026)
- 4 x 33kV outdoor CBs that are aged and prone to explosive failure (estimated retirement year 2025)
- 4 x 33kV porcelain type surge arrestor sets
- outdoor 33kV galvanised steel tube bus and structures that are significantly corroded.
- 34 x protection relays (estimated retirement year 2014-20)

The purpose of this project is to remove the elevated safety and reliability risks at SARI by replacing assets identified as having an increased likelihood of failure.

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 Sarina 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.

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1. BACKGROUND

1.1. Geographic Region

Sarina 66/11kV substation (SARI) is located on the QLD east coast 30km South of Mackay. SARI currently supplies 4,327 customers and delivers 67GWh of energy annually, with these figures expected to increase within the next 10 years. SARI supplies predominantly domestic customers (40%); however, it also supplies commercial (29%), industrial (22%) and agricultural (9%) load, including a sugar mill at Sarina. Carmilla 33kV Feeder, which emanates from SARI 33kV bus supplies 1,127 customers including a prawn farm near Ilbilbie.

A geographic view of the supply area is shown in Figure 1.

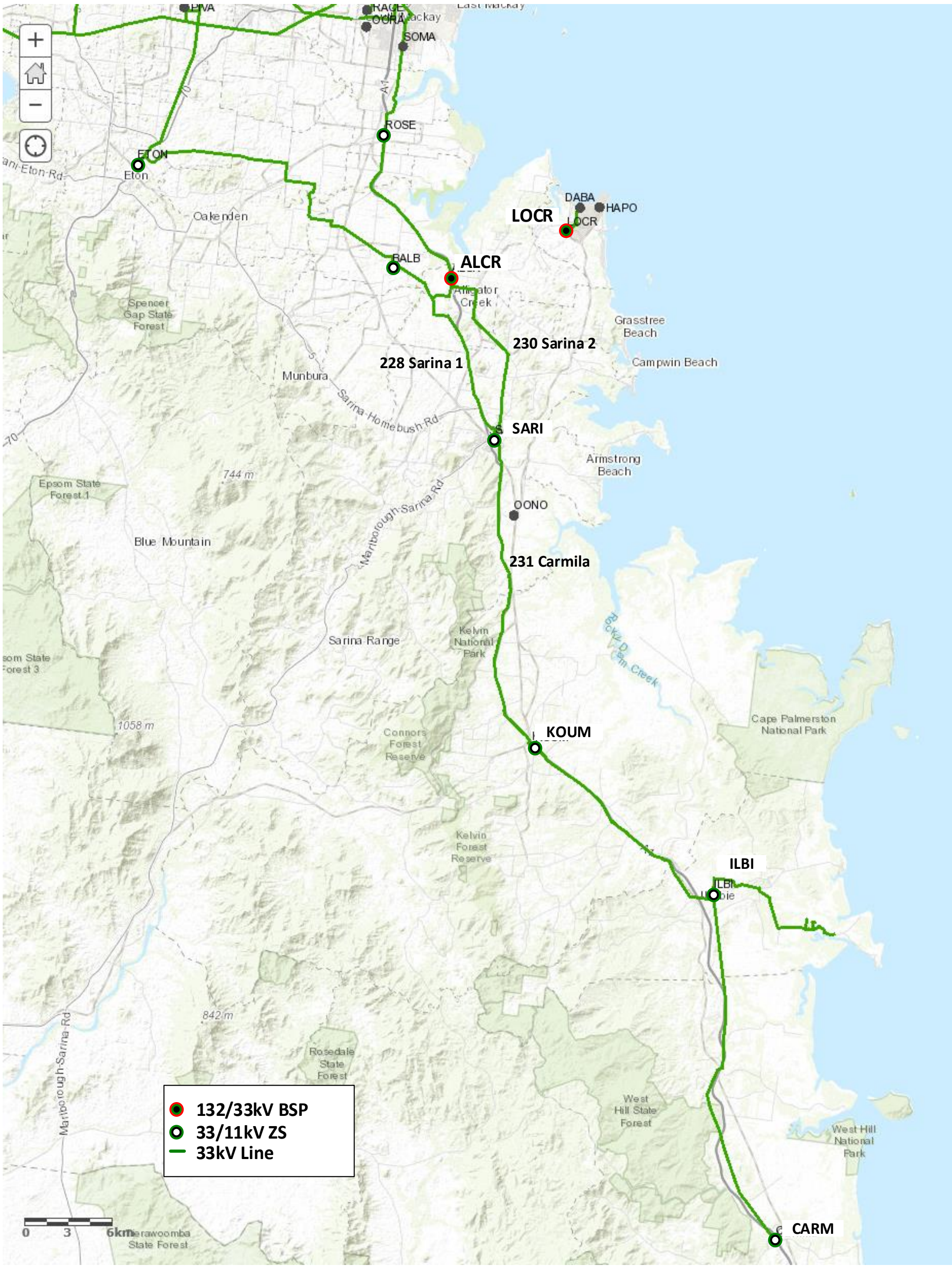


Figure 1: Existing network arrangement (geographic view)

1.2. Existing Supply System

Sarina 33/11kV zone substation (SARI) is normally supplied via two 33kV feeders from Alligator Creek 132/33kV bulk supply substation (ALCR) run in parallel. There is an outgoing 33kV feeder to Carmilla 33/11kV zone substation (CARM) with intermediate connections to Ilbilbie 33/11kV zone substation (ILBI), Koumala 33/11kV zone substation (KOUM), and a Prawn Farm 33kV distribution area.

The SARI distribution network consists of six 11kV feeders which supply the Sarina area. The 11kV feeders have tie points to feeders from neighbouring substations at Balbara (BALB), Rosella (ROSE) and Louis Creek (LOCR) with limited 11kV transfer capability of 2MVA, expected to decrease somewhat over time with distributed load growth.

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

Figure 3.

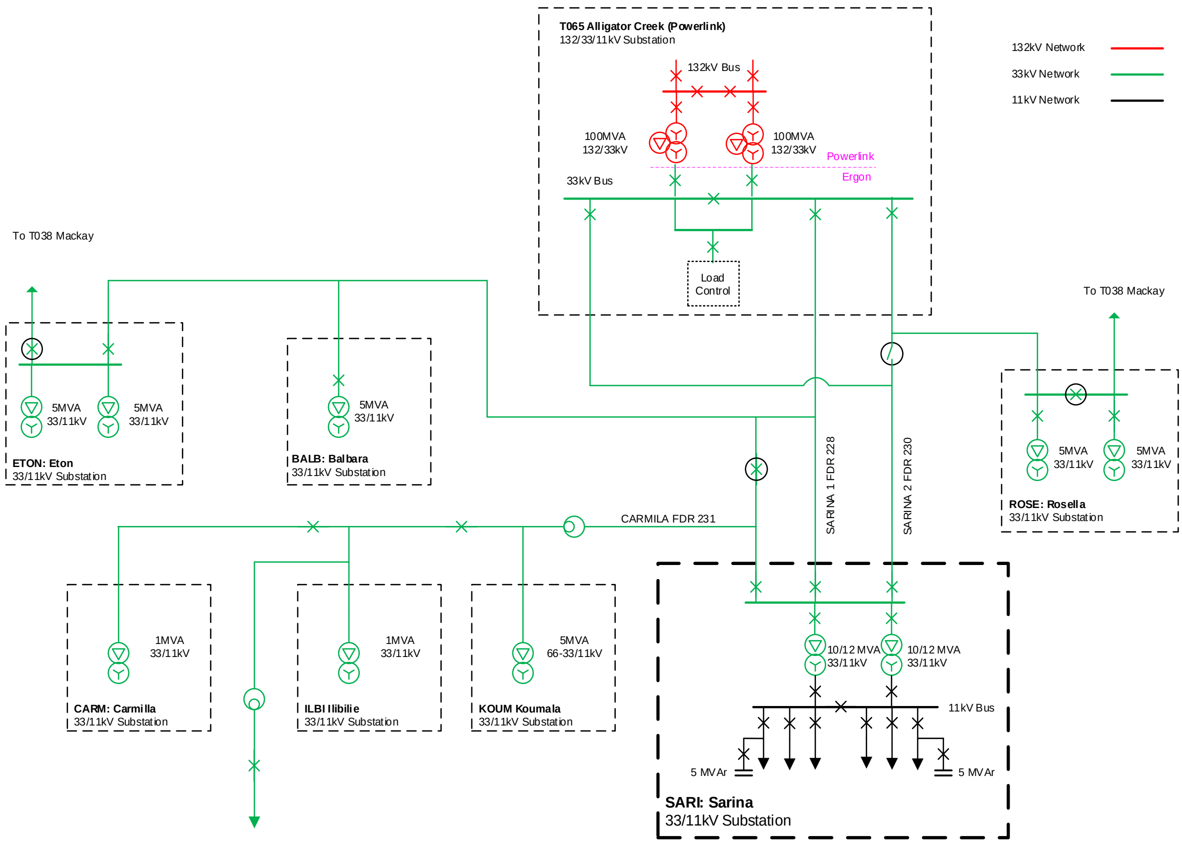


Figure 2: Existing network arrangement (schematic view)

Figure 3: Sarina Substation (geographic view)

1.3. Load Profiles / Forecasts

The load at Sarina Substation comprises a mix of residential and commercial/industrial customers. The annual load peak for the substation occurs during Summer, with reverse power flow in late winter and through spring.

1.3.1. Full Annual Load Profile

The full annual load profile for Sarina Substation over the 2022/23 financial year is shown in Figure 4. It can be noted that the peak load occurs during summer.

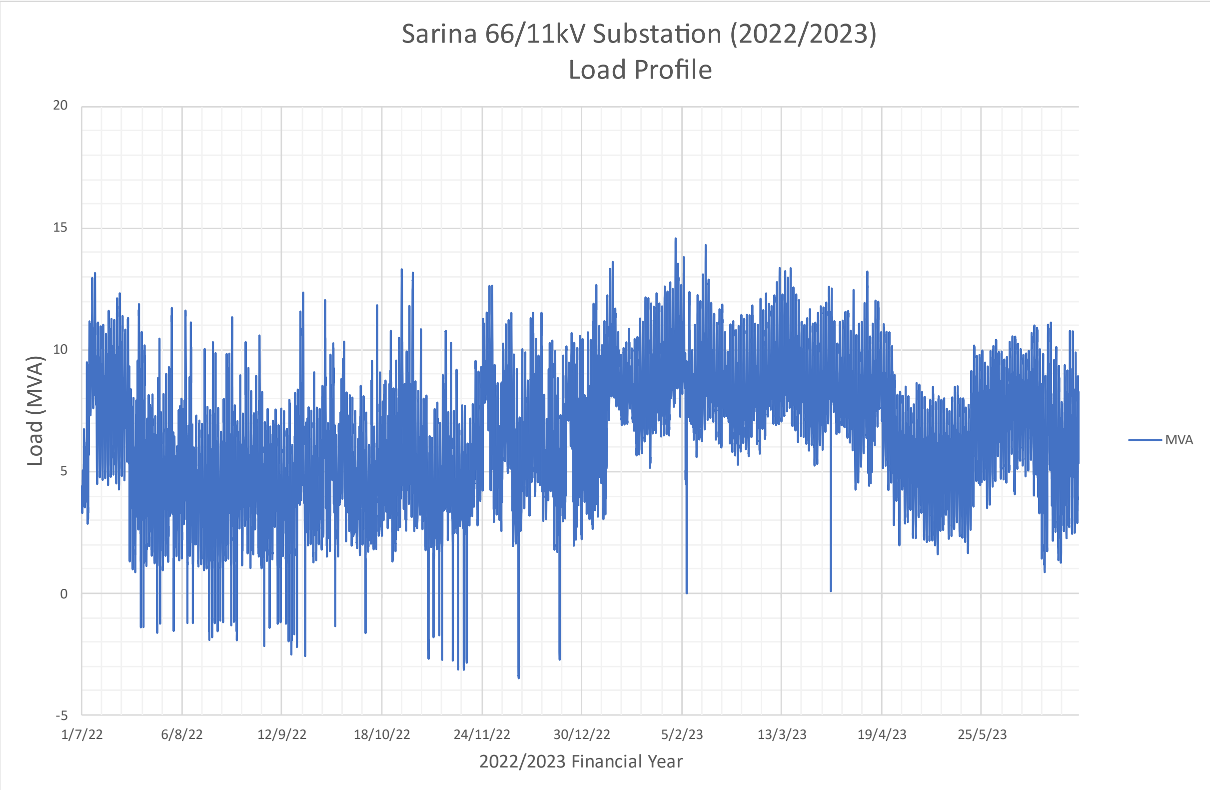


Figure 4: Substation actual annual load profile

1.3.2. Load Duration Curve

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

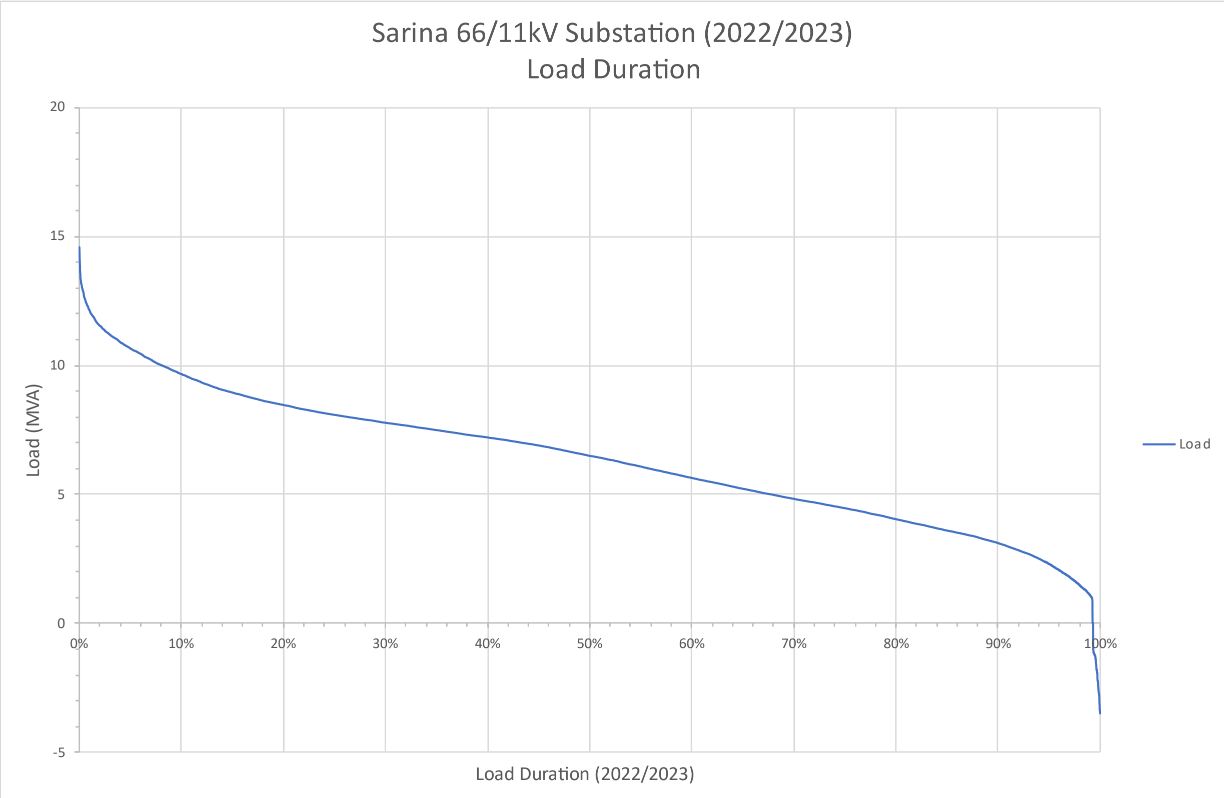


Figure 5: Substation load duration curve

1.3.3. Average Peak Weekday Load Profile (Summer)

The daily load profile for an average peak weekday during summer is illustrated below in Figure 6. It can be noted that the summer peak loads at Sarina Substation are historically experienced in the late afternoon and evening.

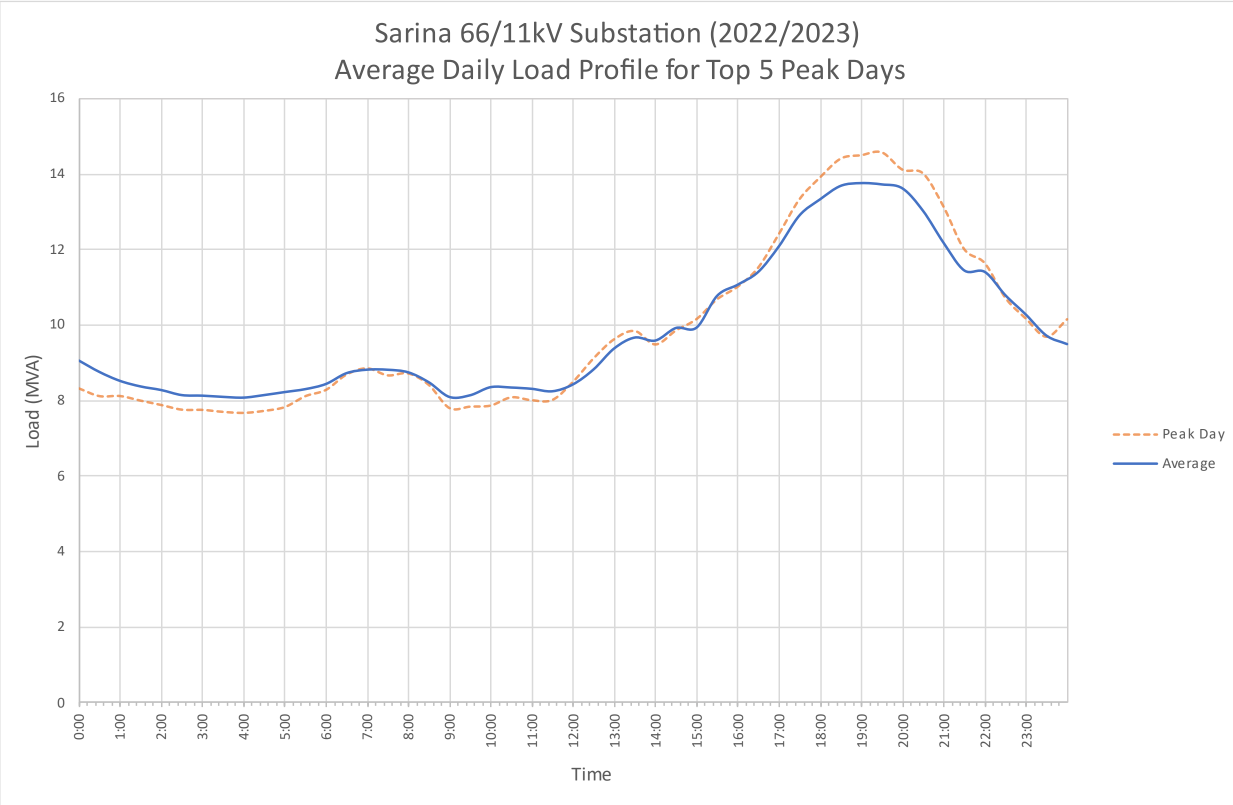


Figure 6: Substation average peak weekday load profile (summer)

1.3.4. Base Case Load Forecast

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

The peak load dropped in 2020, most likely due to COVID-19 pandemic, however the peak load has returned to pre-2020 values in the past 3 years and expected to have steady growth over the next decade.

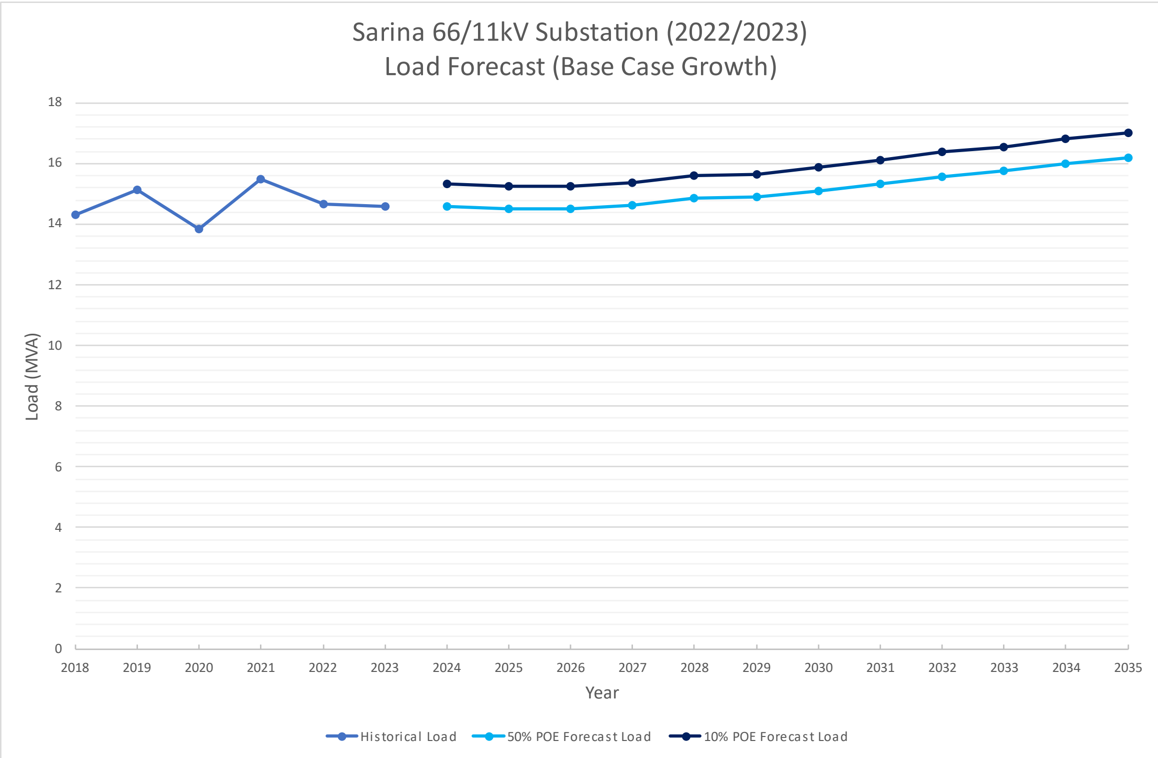


Figure 7: Substation base case load forecast

1.3.5. 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 10 years.

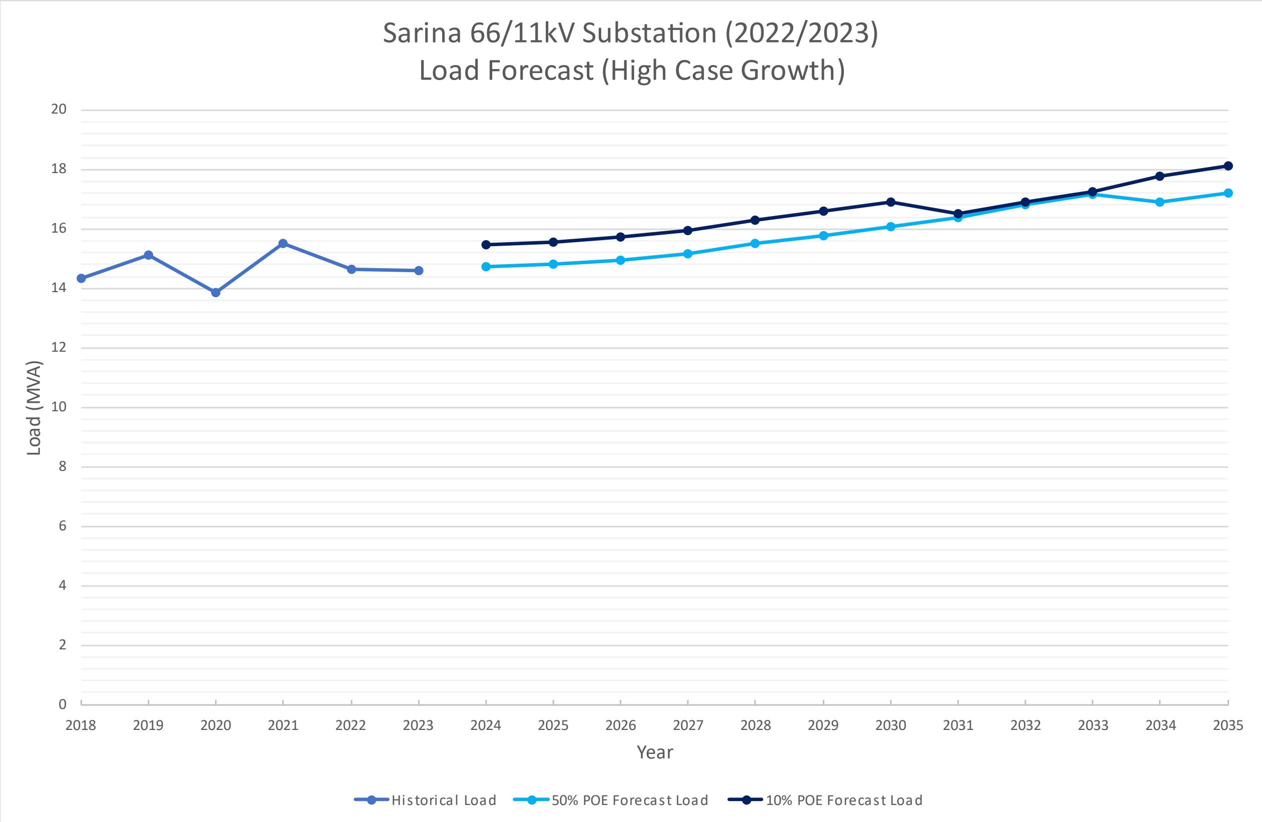


Figure 8: Substation high growth load forecast

1.3.6. 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 remain relatively steady over the next 10 years.

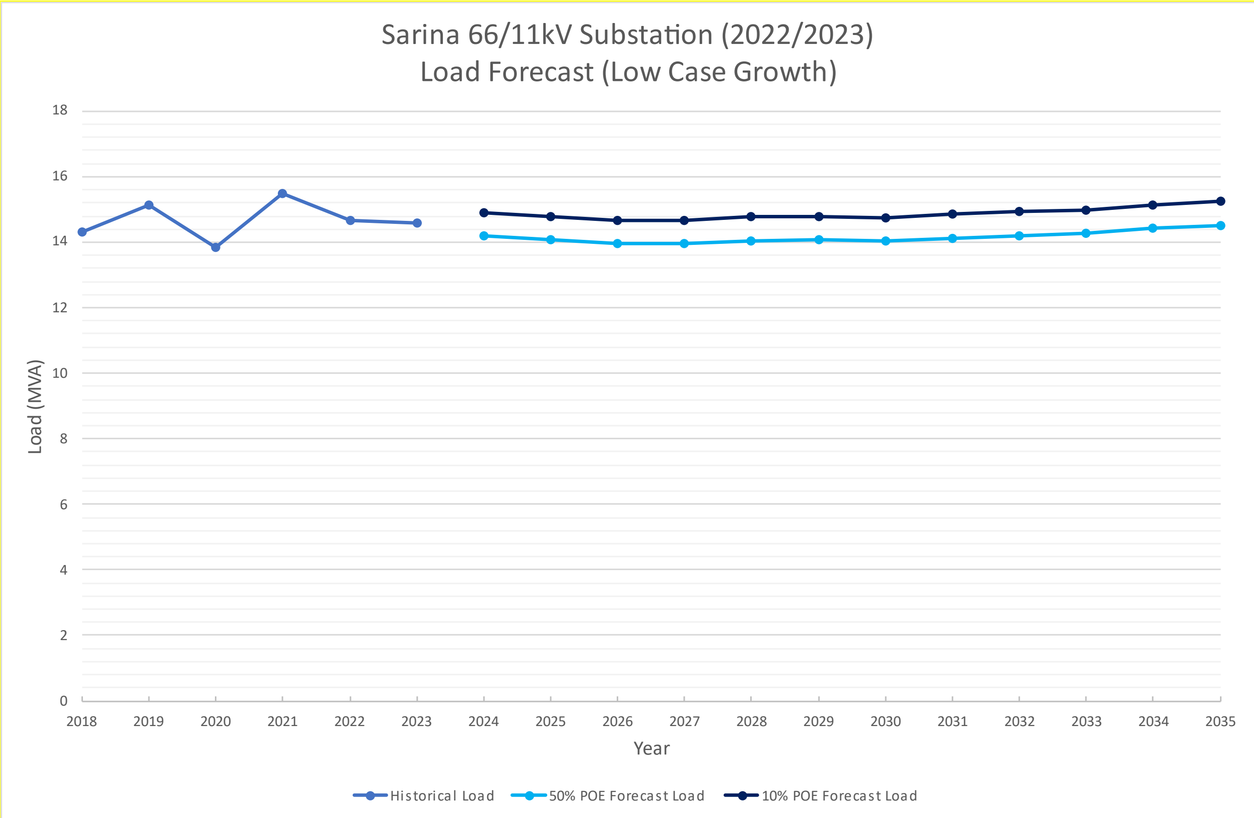


Figure 9: Substation low growth load forecast

2. IDENTIFIED NEED

2.1. Description of the Identified Need

SARI substation is a critical asset for supply of energy for domestic and commercial business located into the Sarina area. Without the substation over 85% of the load in the area will be unsupplied given there is only 2MVA of load transfers available to adjacent substations. With load forecast to increase on the surrounding substations it is anticipated that this load transfer capability will also decrease year on year.

SARI has a number of assets which are nearing end of life, increasing the risk of asset failure. These are further described in Section 2.1.1 The ongoing operation of these assets results in increased exposure to safety and reliability consequences, due to the increased likelihood of asset failure. The purpose of this project is to remove the elevated safety and reliability risks at SARI by replacing assets identified as having an increased likelihood of failure.

2.1.1. Aged and Poor Condition Assets

A Substation Condition Assessment Report was completed for SARI in 2021 which identified a significant number of assets recommended for replacement between 2020 and 2026. These assets, as well as others identified to be replaced in the Asset Limitation Model are summarised below:

- 11kV indoor switchboard and 7 x CBs (estimated retirement year 2026)
- 4 x 33kV outdoor CBs that are aged and prone to explosive failure (estimated retirement year 2025)
- 4 x 33kV porcelain type surge arrestor sets
- outdoor 33kV galvanised steel tube bus and structures that are significantly corroded.
- 34 x protection relays (estimated retirement year 2014-20)

The condition of these assets presents a safety, environmental and reliability risk.

The deterioration of these primary and secondary system assets poses safety risks to staff working within the switchyard. It also poses a safety risk the general public, through the increased likelihood of protection relay mal-operation and catastrophic failure of the power transformers. 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 Sarina Substation. This is especially the case with the condition of the 33kV bus structure and likelihood of failure. Failure of the structure would cause an outage to the entire substation, with rectification times likely to well exceed Safety Net thresholds.

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

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 Sarina is shown in Table 1.

While the aged substation equipment is not the only reason for the poor performance in the area, it is a contributing factor.

Feeder	Category	Customer number	Feeder 3 year average SAIDI	Category SAIDI target	Feeder 3 year average SAIFI	Category SAIFI target
Sarina Beach	Short Rural	1,416	**589.97**	424	**5.466**	3.95
Central	Short Rural	658	**397.52**	424	**3.558**	3.95
Southern	Short Rural	915	**886.41**	424	**5.685**	3.95
Northern	Short Rural	595	**925.40**	424	**6.706**	3.95
Western	Long Rural	881	**949.02**	964	**6.513**	7.40

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.

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 Sarina area to address the identified need.

3.2. Network Options Identified

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

3.2.1. Option A: SARI Asset Replacement

This option involves removing the asset limitations through completion of the following work:

- Establishing a new switchgear and control building on the vacant land adjacent to the substation.
- Replacing the existing 11kV switchboard and protection and control systems into the new building.
- Replacing the existing 33kV outdoor switchgear and galvanised steel bus with 33kV indoor switchboard* in the new building.
- Replacing the existing 11kV and 33kV overhead and underground exit cables to the new switchgear building.
- Replacing the existing 11kV transformer and capacitor bank cables to the new switchgear building.
- Installing new 33kV transformer cables to the new switchgear building.
- Upgrading existing transformer bunds and oil containment systems to meet current environmental standards.
- Upgrading existing substation security fencing and systems to meet current security standards.

*For practicality, an additional 33kV bus tie CB is included for compliance with safety net in future years when 11kV load at SARI grows beyond 20MVA. It is not possible to add this breaker later.

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

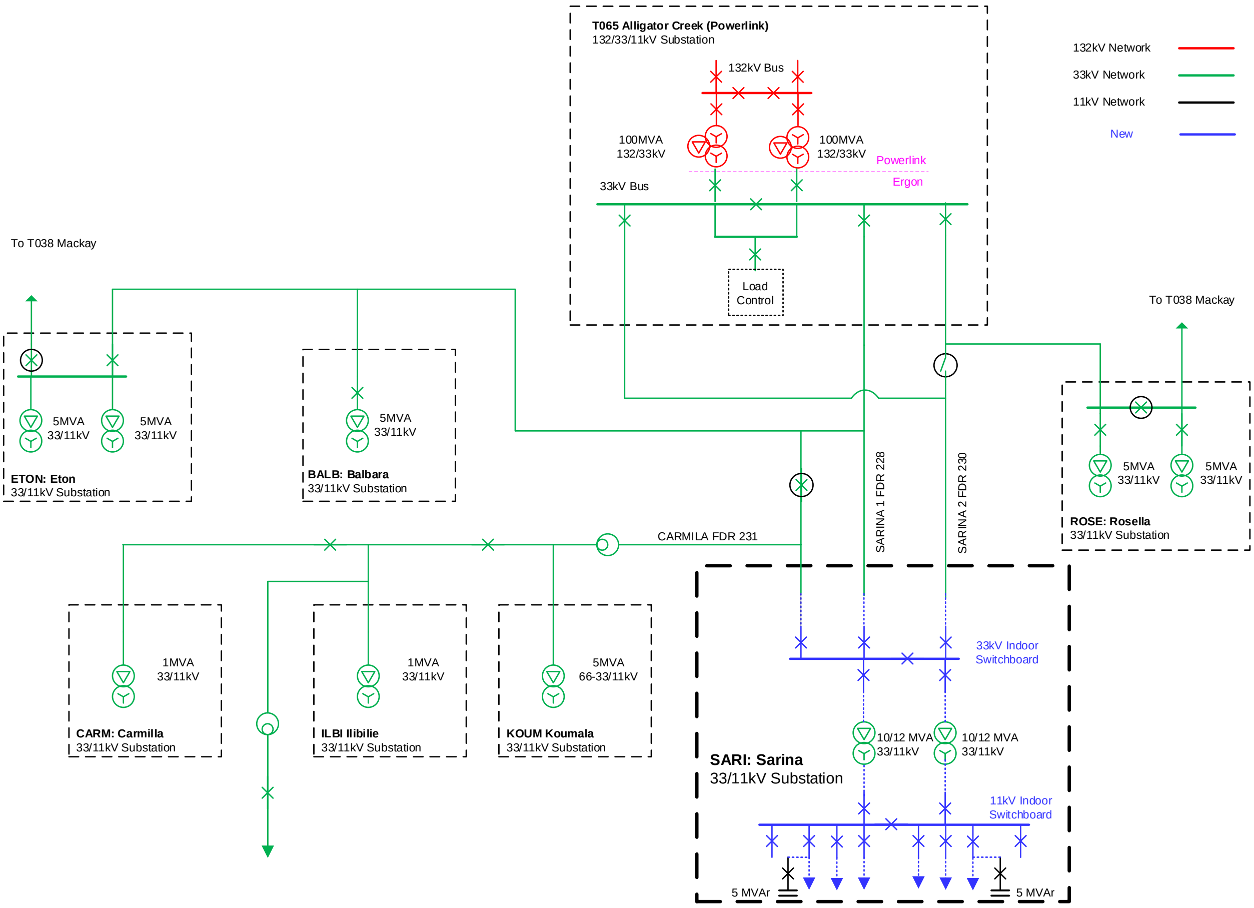


Figure 10: Option A proposed network arrangement (schematic view)

3.3. Preferred Network Option

Ergon Energy's preferred internal network option is Option A, to replace end of life assets at SARI.

Upon completion of these works, the asset safety and reliability risks at Sarina Substation will be addressed. The preferred option will provide the greatest reliability benefit for customers.

The estimated direct capital cost of this option is $8.553 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 mid-2024 and construction completed by November 2027.

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.

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 requirements, per the forecast in the Sarina region could not be supported by a network that is not part of the interconnected national electricity system. Based on the required energy supply and SAP installation cost to date the minimal cost for a SAP solution would be greater than $1.5b.

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 Sarina 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 Sarina. 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 appear to drive the daily peak demand which generally occurs between 5:00pm and 9:00pm.

There are 977 and 1, 681 customers on tariff T31 and T33 hot water load control (LC) respectively. An estimated demand reduction value of 1.5MVA[1] is available.

Sarina Substation LC signals are controlled from T065 Alligator Creek Bulk Supply Substation (ALCR). 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 Alligator Creek Bulk Supply Substation exceeds 50MW. This strategy does not directly address demand peaks experienced at Sarina. Tariff 33 air-conditioning channels are under

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

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.

4.3.4. Customer Solar Power Systems

A total of 4,057 customers have solar photo voltaic (PV) systems for a connected inverter capacity of 7,528kVA.

The daily peak demand is driven by residential customer demand and the peak generally occurs between 5:00pm and 9:00pm. 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 a fewer customers and therefore are cheaper and easier to engage and contract.

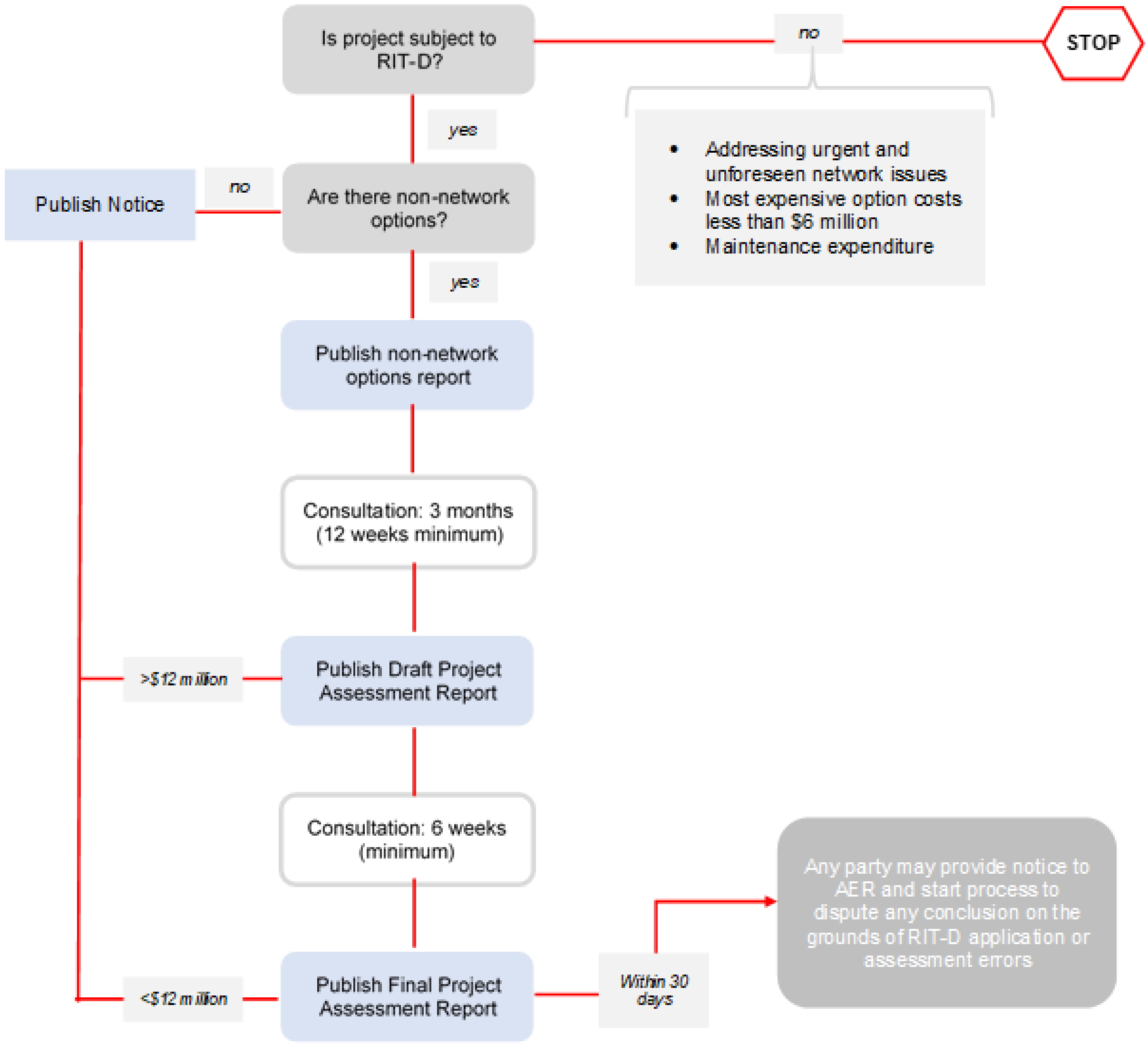
However, only a small percentage of large business customers in this supply area with only 653kVA installed solar PV systems and two BESS units. PV systems with BESS present a future portfolio opportunity for potential demand response but currently this supply area has a very limited solar/BESS. Solar 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 Sarina area to address the identified need.

The preferred network option is Option A – Sarina Asset Replacement. 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.