Regulatory Investment Test for Distribution

Part of Energy Queensland

Addressing Reliability Requirements in the Rockhampton South Network Area

Notice of No Non-Network Options

26 February 2021

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.

IDENTIFED NEED

Rockhampton South 66/11kV Substation is located in the southern part of the central business district (CBD) of Rockhampton. Rockhampton South substation supplies a large portion of Rockhampton CBD and the surrounding areas to the south of Rockhampton, including a total of 2,201 customers, of which 60% are residential and 40% are commercial, agricultural and industrial.

Rockhampton South Substation was established in 1968, and in accordance with applicable design and construction standards during that time. It has an outdoor 66kV switchyard with steel structures, two 15/20MVA 66/11kV power transformers, an indoor 11kV switchboard supplying seven outgoing 11kV feeders, and a protection and control room.

A substation condition assessment of Rockhampton South Substation was completed in 2019 and has identified that significant primary plant and majority of secondary plant and equipment are recommended for retirement based on Condition Based Risk Management (CBRM) analysis.

The assessment identified that one power transformer, two 66kV circuit breakers, the indoor 11kV switchboard, and all secondary systems including protection relays, SCADA systems and voltage regulation control relays are at the end of their serviceable life.

Other limitations include that three of the 66kV current transformers are not compatible with new protection schemes and have reached end of life; the 11kV switchboard fault rating is lower than the ultimate maximum fault level (currently managed with a normally-open 11kV bus tie breaker); the 415Va.c. station services supply is not duplicated and is supplied via an aged and obsolete isolation transformer; the DC backup battery supply to the protection system is not duplicated; the substation security fence and transformer bunding does not meet current day standards; the transformer sound proofing enclosures present access and egress issues; and structural issues exist with roof on one of the transformer enclosures.

The state of these primary and secondary system assets poses safety risk to staff working within the switchyard, reliability risk to the customers supplied from Rockhampton South Substation, and environmental risk associated with inadequate transformer bunding.

APPROACH

The NER requires 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 Rockhampton South 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 not a 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.

1 Background

1.1. Geographic Region

Rockhampton South 66/11kV Substation (ROSO) is located on the southern part of Rockhampton Central Business District (CBD) on the southern side of the Fitzroy river. Rockhampton South Substation supplies the southern half of the CBD precinct, as well as Depot Hill, and Port Curtis areas with a total of 2,201 customers, of which 1,310 are residential and 880 are commercial and industrial. Commercial and Industrial customers include a commercial mall district, newly developed riverside precinct, courthouse and police headquarters, government premises, council chambers, a range of commercial premises typical of a regional centre, and larger customers including Paul's milk processing facility, Aurizon depot and headquarters, and Hastings Deering mining equipment manufacturer. Most of the residential customers supplied from Rockhampton South Substation are in Depot Hill and Port Curtis areas. Rockhampton South Substation also provides transfer capability and security of supply to customers normally supplied from neighbouring Rockhampton substations Rockhampton-Glenmore (ROGL) and Canning Street (CAST), and Gracemere area substation Malchi (MALC). Geographic views of the network area is provided in Figure 1

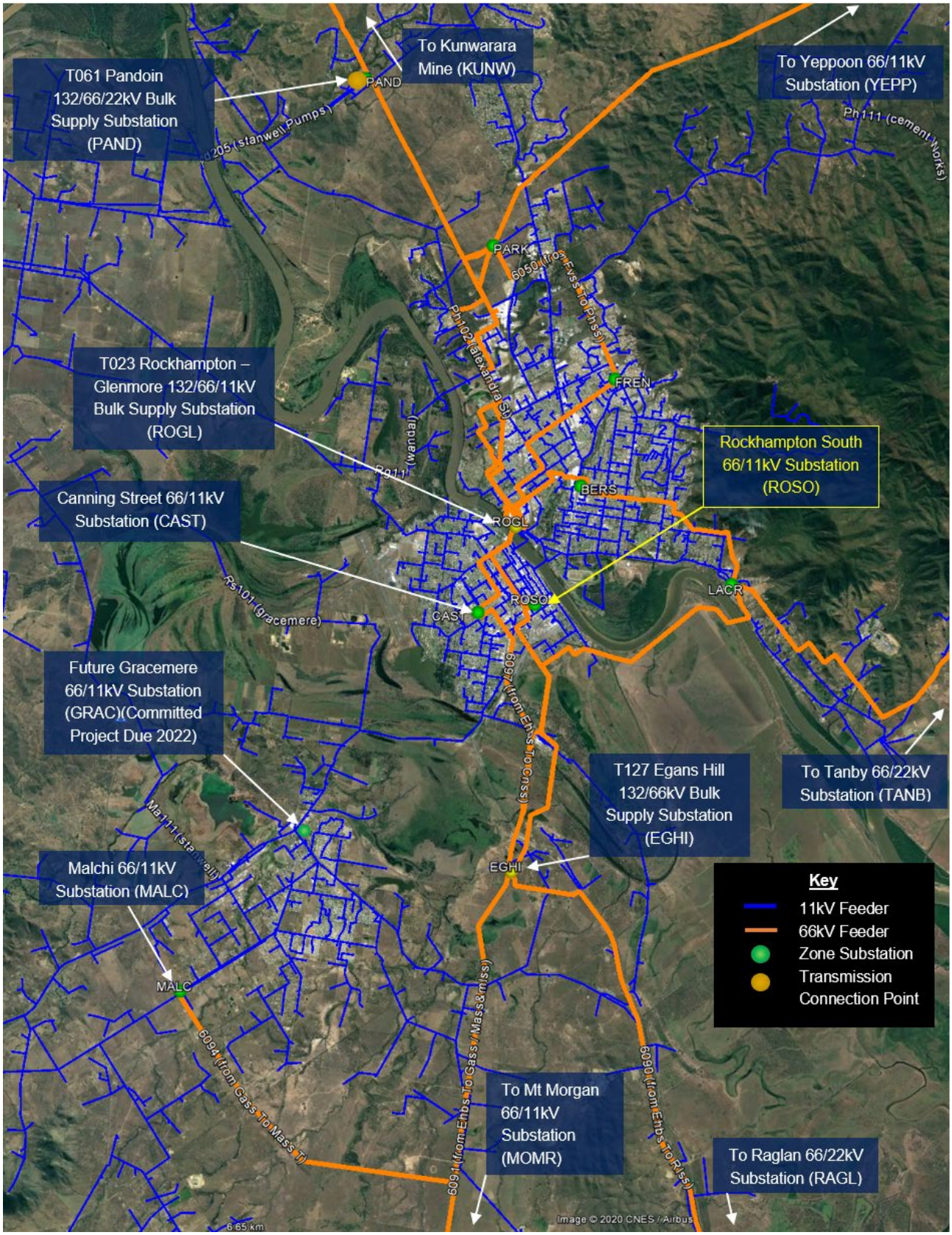


Figure 1: Existing network arrangement (geographic view)

1.2. Existing Supply System

The substation 66kV bus is part of the Rockhampton 66kV sub-transmission meshed network which takes supply from three 132/66kV Transmission Connection Points: T023 Rockhampton-Glenmore (ROGL) in the centre of Rockhampton, T127 Egans Hill (EGHI) to the south, and T061 Pandoin to the north. Rockhampton South Substation is presently supplied via two 66kV feeders which together form the strongest of three links between ROGL and EGHI bulk supply points.

The substation is equipped with two 66/11kV 15/20MVA transformers (one limited to 15.5MVA), an outdoor 66kV bus in “H” arrangement with four (4) circuit breakers and no bus tie breaker, and an indoor 11kV switchboard with two (2) bus sections, seven (7) outgoing feeders, two (2) capacitor bank breakers, two (2) transformer breakers and a normally open bus tie breaker.

Rockhampton South Substation supplies seven 11kV distribution feeders which contain a total of twelve 11kV feeder ties to 11kV feeders supplied from Rockhampton Glenmore 66/11kV substation (ROGL), Canning Street 66/11kV substation (CAST), and currently Malchi, soon to be Gracemere 66/11kV substation (MALC/GRAC).

A schematic view of the existing sub-transmission network arrangement is shown in Figure 2 and the geographic view of Rockhampton South Substation is illustrated in Figure 3

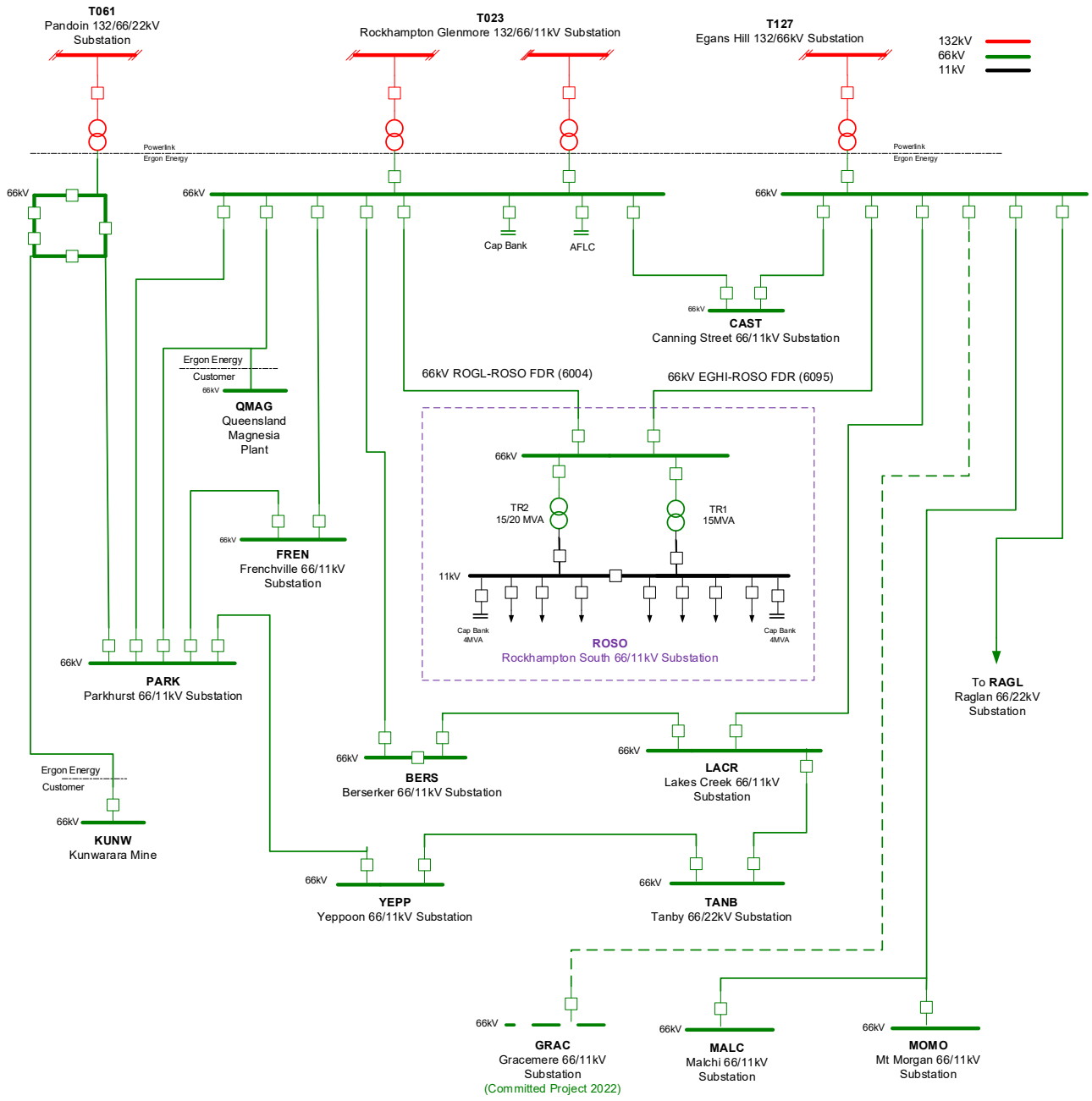


Figure 2: Existing network arrangement (schematic view)

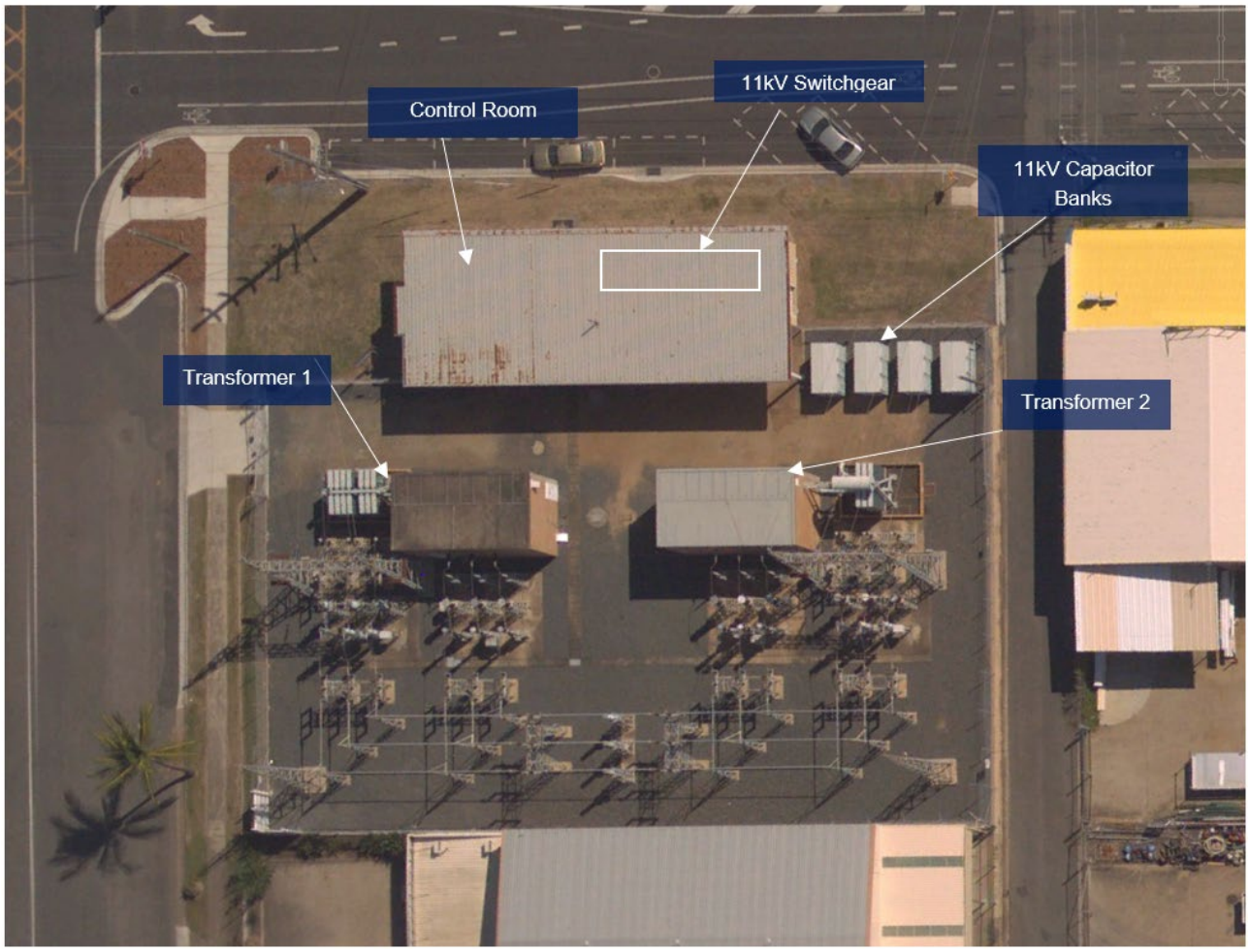


Figure 3: Rockhampton South Substation (geographic view)

1.3. Load profiles & forecasts

The load at Rockhampton South Substation (ROSO) comprises a mix of residential, commercial and industrial customers. The load is summer peaking, and the annual peak loads are predominantly driven by commercial and residential loads.

1.3.1. Full annual load profile

The full annual load profile for Rockhampton South Substation over the 2019/20 financial year is shown in Figure 4.

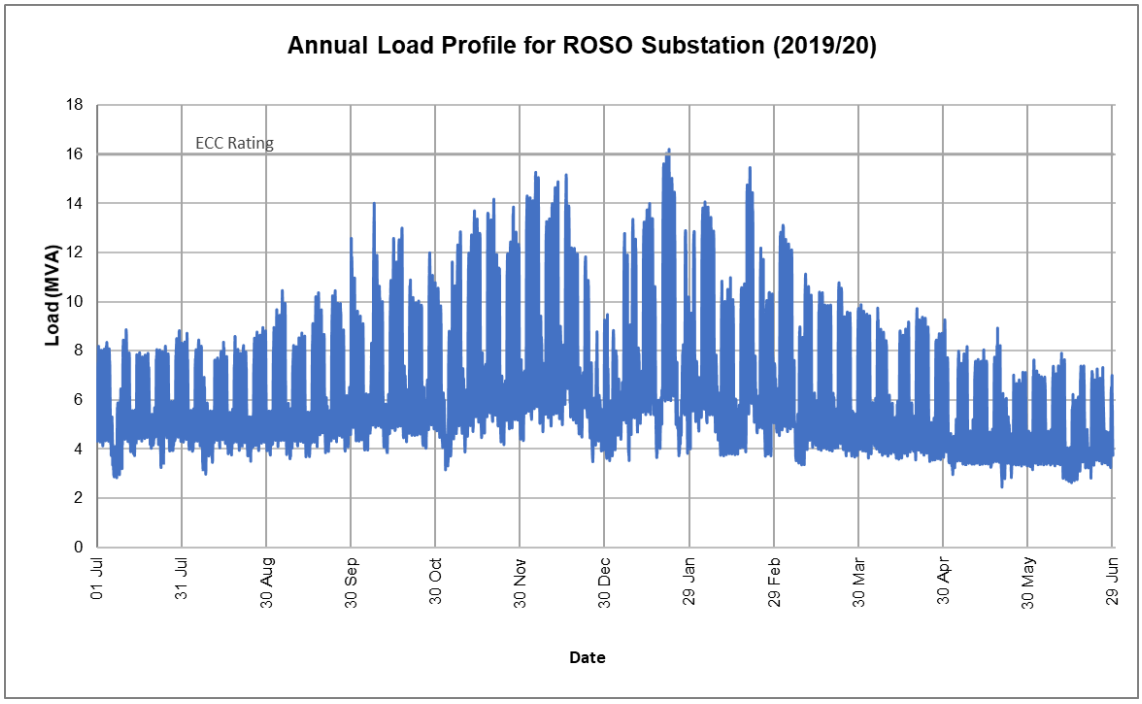


Figure 4: Substation actual annual load profile

1.3.2. Load duration curve

The load duration curve for Rockhampton South Substation over the 2019/20 financial year is shown in Figure 5.

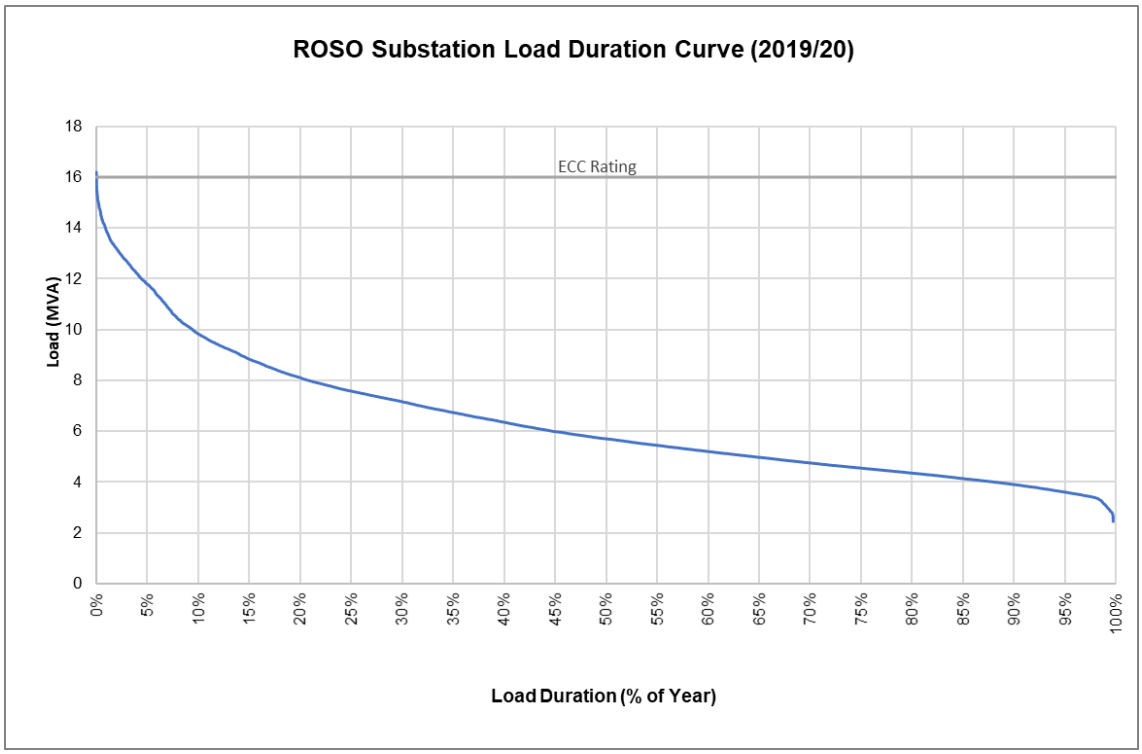


Figure 5: Substation load duration curve

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 Rockhampton South Substation are historically experienced midday through to late afternoon and evening.

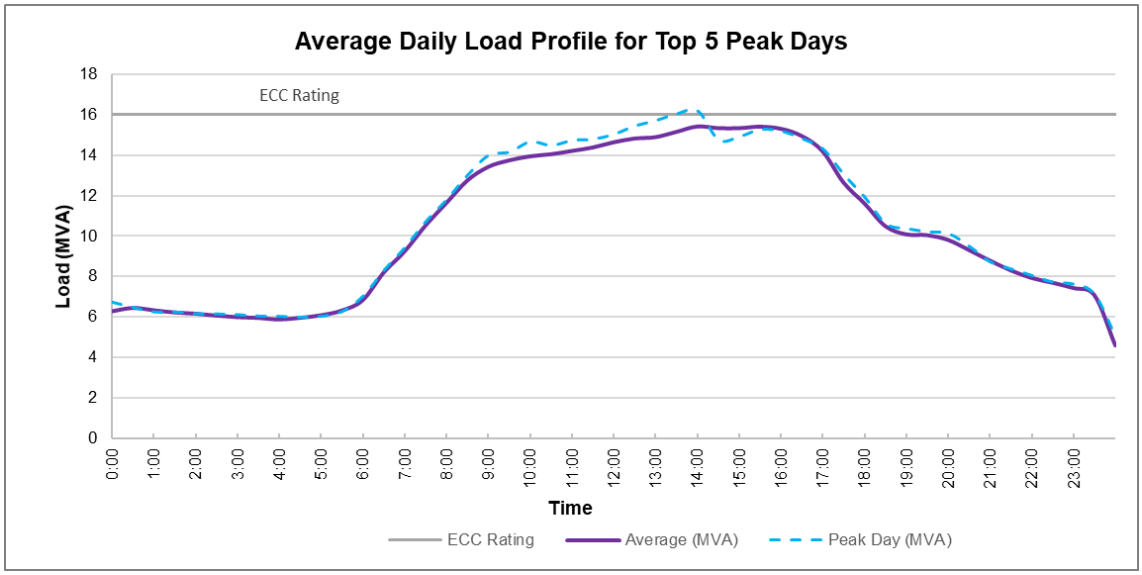


Figure 6: Substation average peak weekday load profile (summer)

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 reduction in peak load in 2017 was due to load being shifted off Rockhampton South Substation to Rockhampton-Glenmore (ROGL) Substation to alleviate 11kV exit cable constraints at Rockhampton South Substation. This 2-3 MVA of load will be shifted back to Rockhampton South Substation when its exit cables are replaced.

Excluding the above factor, with the base case growth scenario, the peak load is forecast to remain relatively steady over the next 10 years.

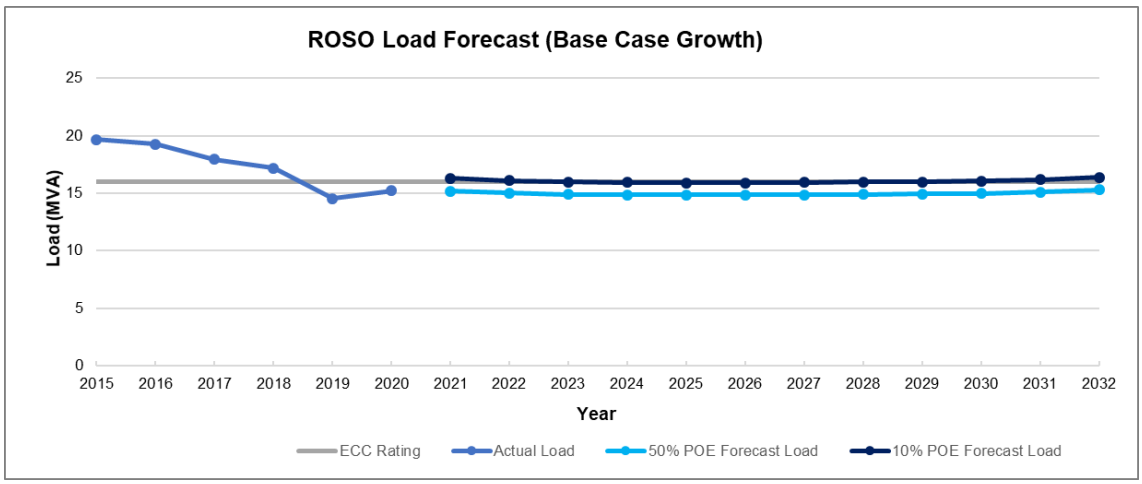


Figure 7: Substation base case load forecast

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 slightly over the next 10 years.

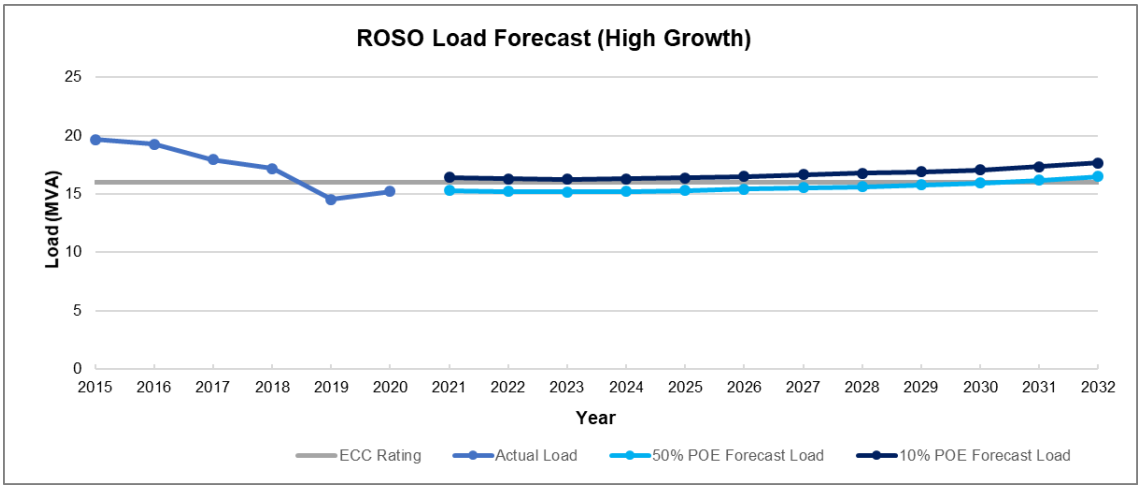


Figure 8: Substation high growth load forecast

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 reduce marginally over the next 10 years.

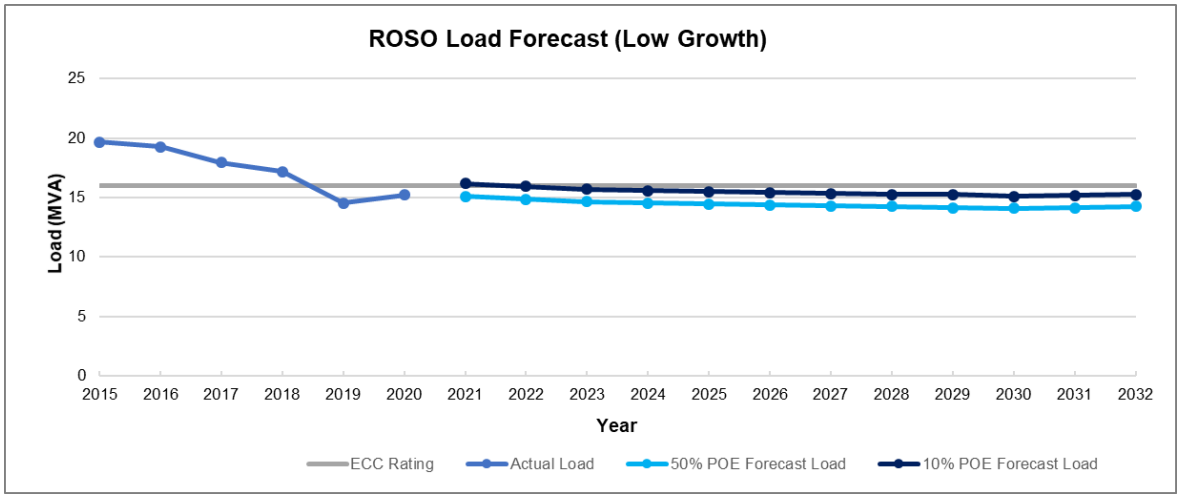


Figure 9: Substation low growth load forecast

2 Identified Need

2.1. Description of the Identified Need

2.1.1. Aged and Poor Condition Assets

Rockhampton South Substation was established in 1968 according to applicable design and construction standards during that time. It has an outdoor 66kV switchyard with steel structures, two 15/20MVA 66/11kV power transformers, an indoor 11kV switchboard supplying seven outgoing 11kV feeders, and a protection and control room.

A substation condition assessment of Rockhampton South Substation was completed in 2019 and has identified that significant primary plant and majority of secondary plant and equipment are recommended for retirement based on Condition Based Risk Management (CBRM) analysis.

The assessment identified that one power transformer, two 66kV circuit breakers, the indoor 11kV switchboard, and all secondary systems including protection relays, SCADA systems and voltage regulation control relays are at the end of their serviceable life.

Other limitations include that three of the 66kV current transformers are not compatible with new protection schemes and have reached end of life; the 11kV switchboard fault rating is lower than the ultimate maximum fault level (currently managed with a normally-open 11kV bus tie breaker); the 415Va.c. station services supply is not duplicated and is supplied via an aged and obsolete isolation transformer; the DC backup battery supply to the protection system is not duplicated; the substation security fence and transformer bunding does not meet current day standards; the transformer sound proofing enclosures present access and egress issues; and structural issues exist with roof on one of the transformer enclosures. The state of these primary and secondary system assets poses safety risk to staff working within the switchyard, reliability risk to the customers supplied from Rockhampton South Substation, and environmental risk associated with inadequate transformer bunding.

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 Rockhampton South 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 1: In-situ Replacement of Aged Plant

This option involves replacing one of the existing transformers and upgrading bunding, replacing two 66kV circuit breakers and three 66kV current transformers, replacing the 11kV switchboard,

replacing secondary systems, AC and DC supply, and upgrading the substation physical security in order to address the identified need.

A schematic diagram of the proposed network arrangement for Option 1 is shown in Figure 10.

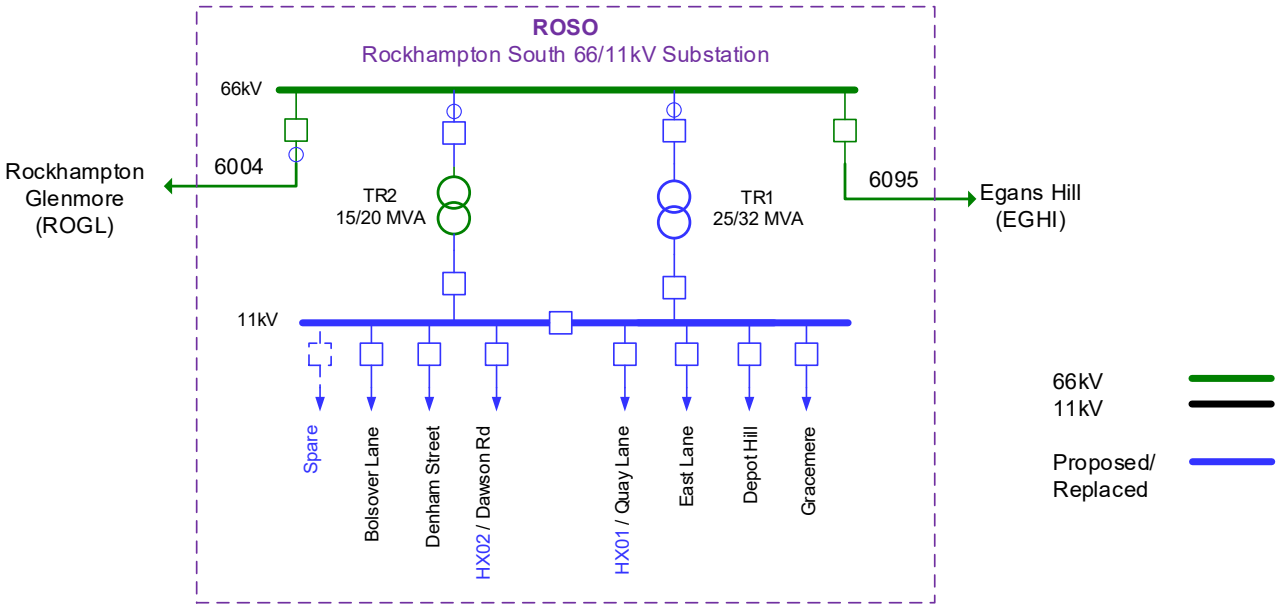


Figure 10: Option 1 proposed network arrangement (schematic view)

3.2.2. Option 2: Rebuild Existing Substation

This option involves replacing the 66kV yard with more compact GIS switchgear in order to make space for new modular 11kV switchroom and secondary systems control room, replacing one of the existing transformers and upgrading bunding, upgrading AC supply, and upgrading the substation physical security in order to address the identified need.

A schematic diagram with the proposed network arrangement for Option 2 is shown in Figure 11.

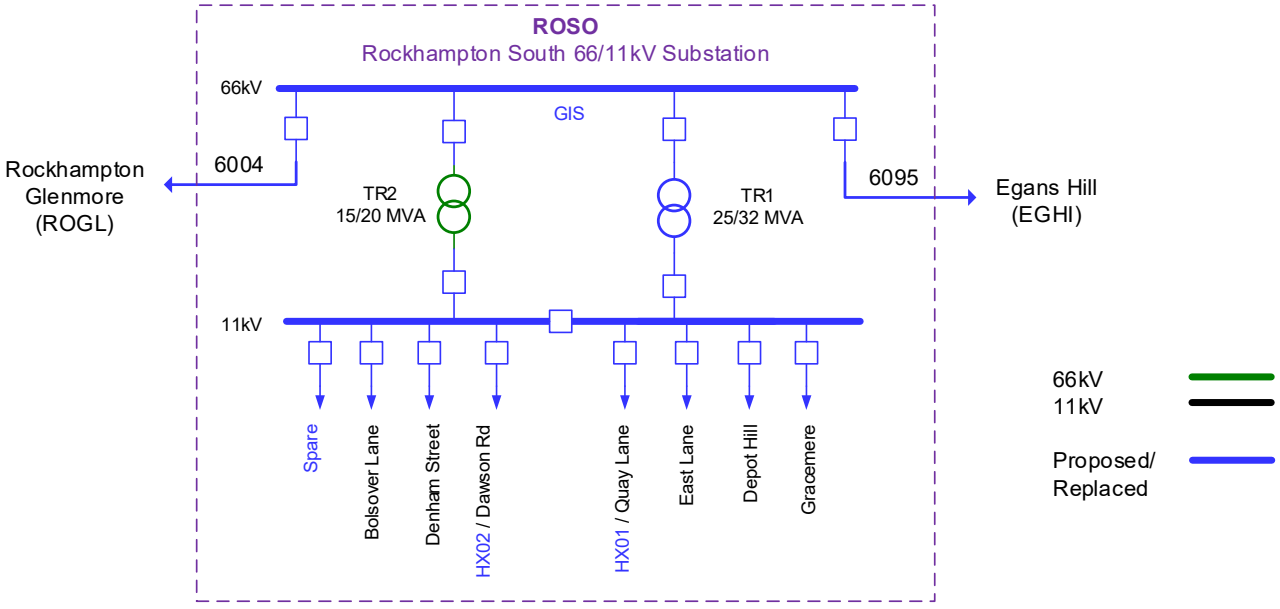


Figure 11: Option 2 proposed network arrangement (schematic view)

3.2.3. Option 3: Full Substation Replacement

This option involves rebuilding the substation with a new substation to current design standards on a new allotment, with the advantage of greenfield works in a single construction stage and with simplified project dependencies.

A schematic diagram with the proposed network arrangement for Option 3 is shown in Figure 11.

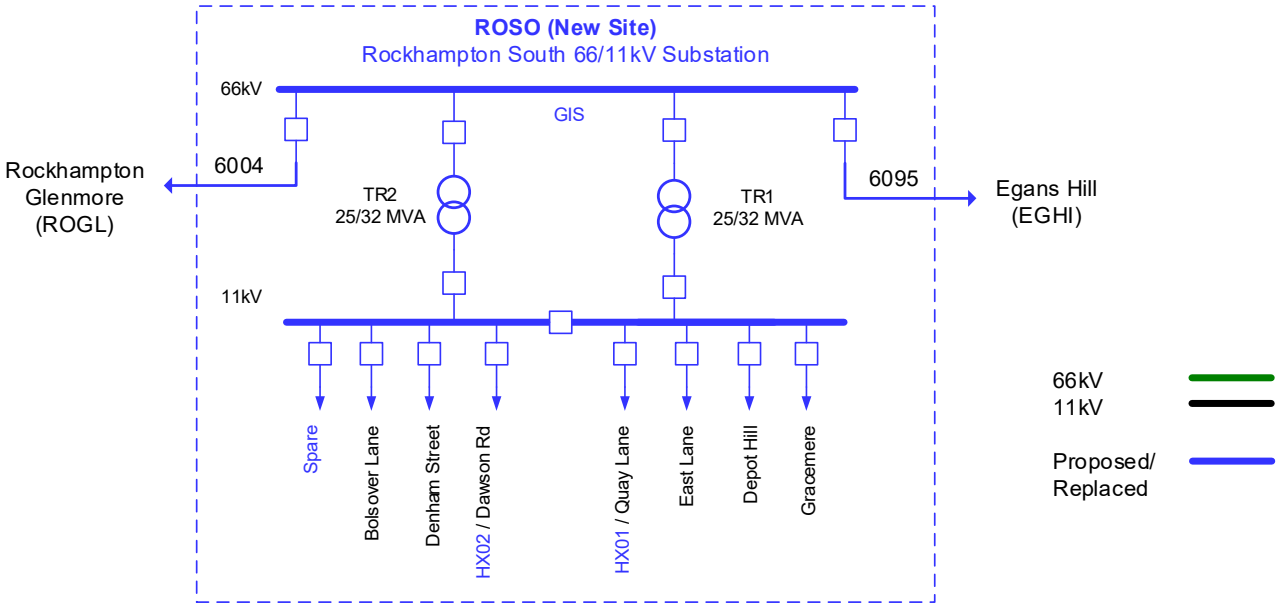


Figure 12: Option 3 proposed network arrangement (schematic view)

3.3. Preferred Network Option

Ergon Energy's preferred internal network option is Option 1, to replace one of the existing transformers, replace two 66kV circuit breakers and three 66kV current transformers, replace the 11kV switchboard, secondary systems, AC and DC supply, and upgrade the physical security at the existing Rockhampton South Substation.

Upon completion of these works, the asset safety, environmental and reliability risks at Rockhampton South Substation will be addressed.

The estimated capital cost of this option inclusive of interest, risk, contingencies and overheads is $11.59 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 late-2023 and construction completed by December 2025.

4 Assessment of Non-Network Solutions

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. Demand Management (Demand Reduction)

The DEM team has completed a review of the Rockhampton South Substation 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 Rockhampton South Substation. It has been determined that most demand management options will not be viable propositions.

4.1.1. Network Load Control

The residential and commercial customers appear to drive the daily peak demand which generally occurs between 12:00pm and 6:00pm. There are 826 customers on tariff T31 and T33 hot water load control (LC). An estimated demand reduction value of 496kVA[1] is available.

Rockhampton South Substation supply area LC signals are controlled from T023 Rockhampton Glenmore Bulk Supply Substation (ROGL). 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 due to Rockhampton South Substation loading when the load on Denham St 11kV feeder exceeds 3.71MW or load on Depot Hill 11kV feeder exceeds 3.54MW. Tariff 33 air-conditioning channels are under manual control of the operational control centre and are used as required.

4.2. 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.

4.2.1. 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.

4.2.2. 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).

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

This option has been assessed as technically not viable as it would not be of sufficient magnitude to address the identified network requirement to replace the aged assets at Rockhampton South Substation.

4.2.3. 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 has been assessed as technically not viable as there is no known existing or proposed LSG demand response options available that could connect at 11kV in the Rockhampton South Substation catchment area and provide enough power to reduce the number of assets at the substation.

4.2.4. Customer Solar Power Systems

A total of 271 customers have solar PV systems for a connected inverter capacity of 3,693kVA.

The daily peak demand is driven by a mixture of residential and commercial customer demand and the peak generally occurs between 12:00pm and 6:00pm. Customer solar generation does tend to coincide with the peak load period. Forecast uptake of residential and commercial PV systems has been included in the forecast substation loads for base, high and low growth scenarios.

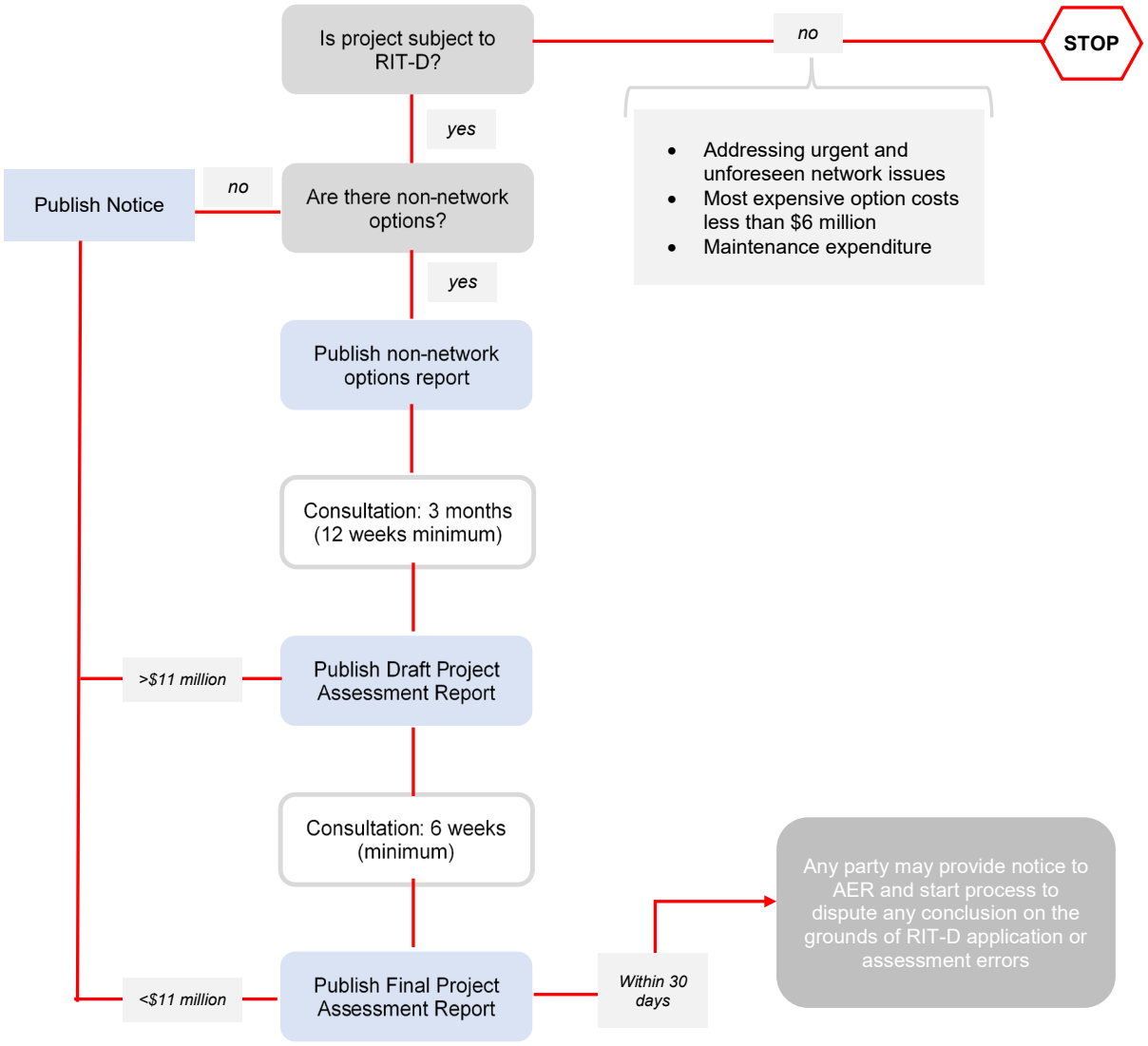
Uptake of solar PV systems would not be of sufficient magnitude to address the identified network requirement to replace the aged assets at Rockhampton South Substation.

5 Conclusion and Next Steps

The internal investigations undertaken on the feasibility of the 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 Rockhampton South supply area to address the identified need.

The preferred network option is Option 1 - to replace in-situ the plant and equipment in poor condition to address the identified need. This Notice of No Non-Network 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 Draft Project Assessment Report.

Appendix – The RIT-D Process



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