Regulatory Investment Test for Distribution (RIT-D)

Mount Garnet Asset Replacement

Notice of No Non-Network Options

21 June 2023

Part of Energy Queensland

Mount Garnet Asset Replacement
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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

Mount Garnet 66/22kV Zone Substation (MOGA) is located north-west of the Atherton Tablelands and is supplied by one incoming 66kV feeder (3MTG) from Atherton Zone Substation (ATHE). 3MTG also supplies a large customer Substation via a tee-off. MOGA provides electricity supply, via two 4MVA 66/22kV transformers to approximately 511 customers, of which 72% are residential and 28% are commercial and industrial (based on customer numbers) with a peak load of 2.0MVA

No capacity limitations have been identified at MOGA within the planning horizon.

A substation condition assessment of MOGA substation was completed and has identified some primary and secondary plant and equipment that are recommended for retirement based on Condition Based Risk Management (CBRM) analysis.

The following have been deemed to reach their retirement age:

- 66/22kV 4MVA Transformers TR1 and TR2 by 2026
- 9 x22kV Isolators by 2023
- 2 x 22kV Protection Relays by 2026

Based on a Condition Based Risk Management (CBRM) analysis, the following have been deemed to be problematic:

- 4 x 66kV Duoroll Isolators
- 2 x 66kV Fault Throw Switches
- Porcelain Surge Arresters

The deterioration of these primary and secondary system assets poses safety risks to staff working within the switchyard, and reliability risk to the customers supplied from Mount Garnet substation.

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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 Garnet 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.

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1. BACKGROUND

1.1. Geographic Region

Mount Garnet 66/22kV Zone Substation (MOGA) is located north-west of the Atherton Tablelands and is supplied by one incoming 66kV feeder (3MTG) from Atherton Zone Substation (ATHE).3MTGalso supplies a large customer substation via a tee-off. MOGA provides electricity supply, via two 66/22kV 4MVA transformers, to approximately 533 customers, of which 72% are residential and 28% are commercial and industrial, with a peak load of 2.0MVA in 2022; however, in 2021 the substation load peak was 2.4MVA.

The geographic view of the network area under study is provided in **Figure 1**

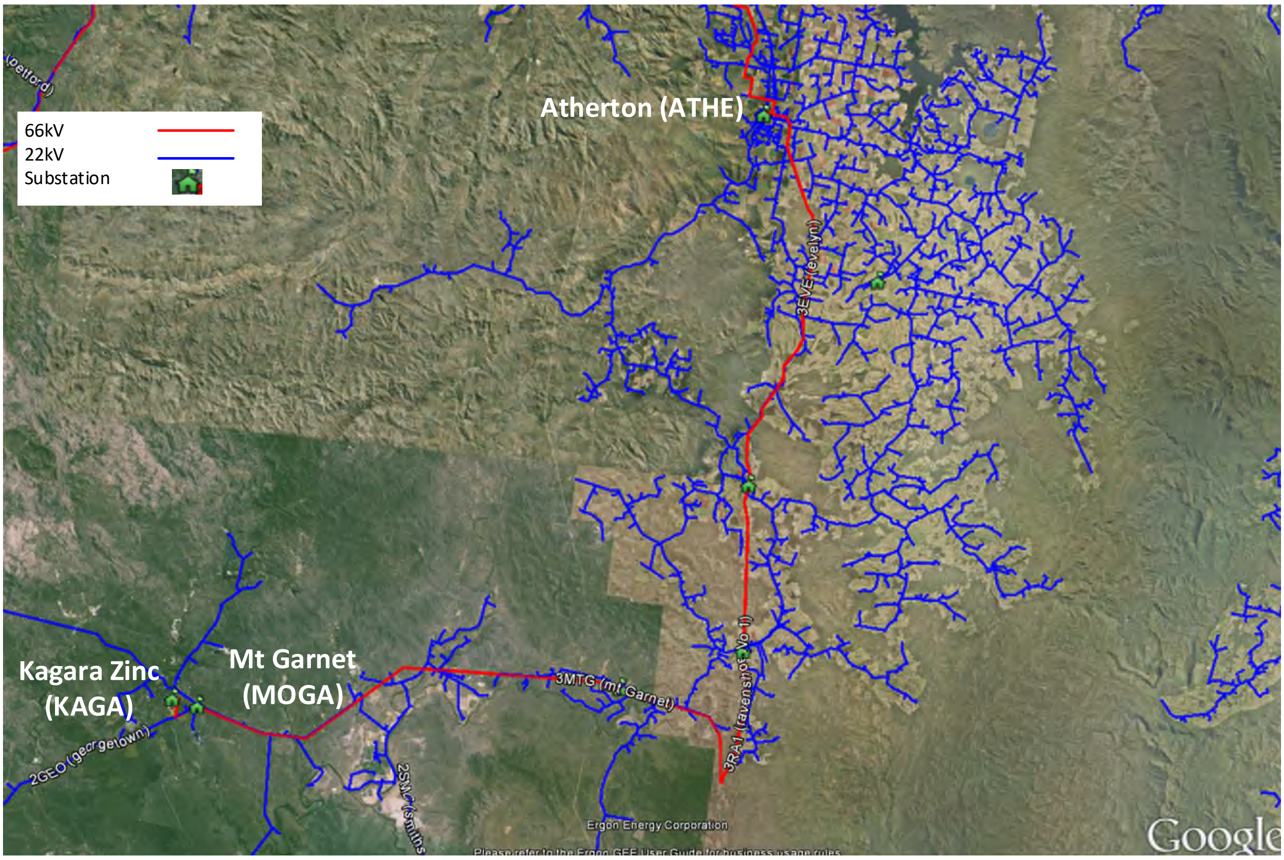


Figure 1: Existing network arrangement (geographic view)

1.2. Existing Supply System

Mount Garnet Zone Substation (MOGA) is supplied by one incoming 66kV feeder (3MTG) from Atherton Zone Substation (ATHE).

A schematic view of the existing sub-transmission network arrangement is shown in. **Figure 2**. Figure 3 shows the geographic view and Figure 4 shows the existing schematic of Mount Garnet substation.

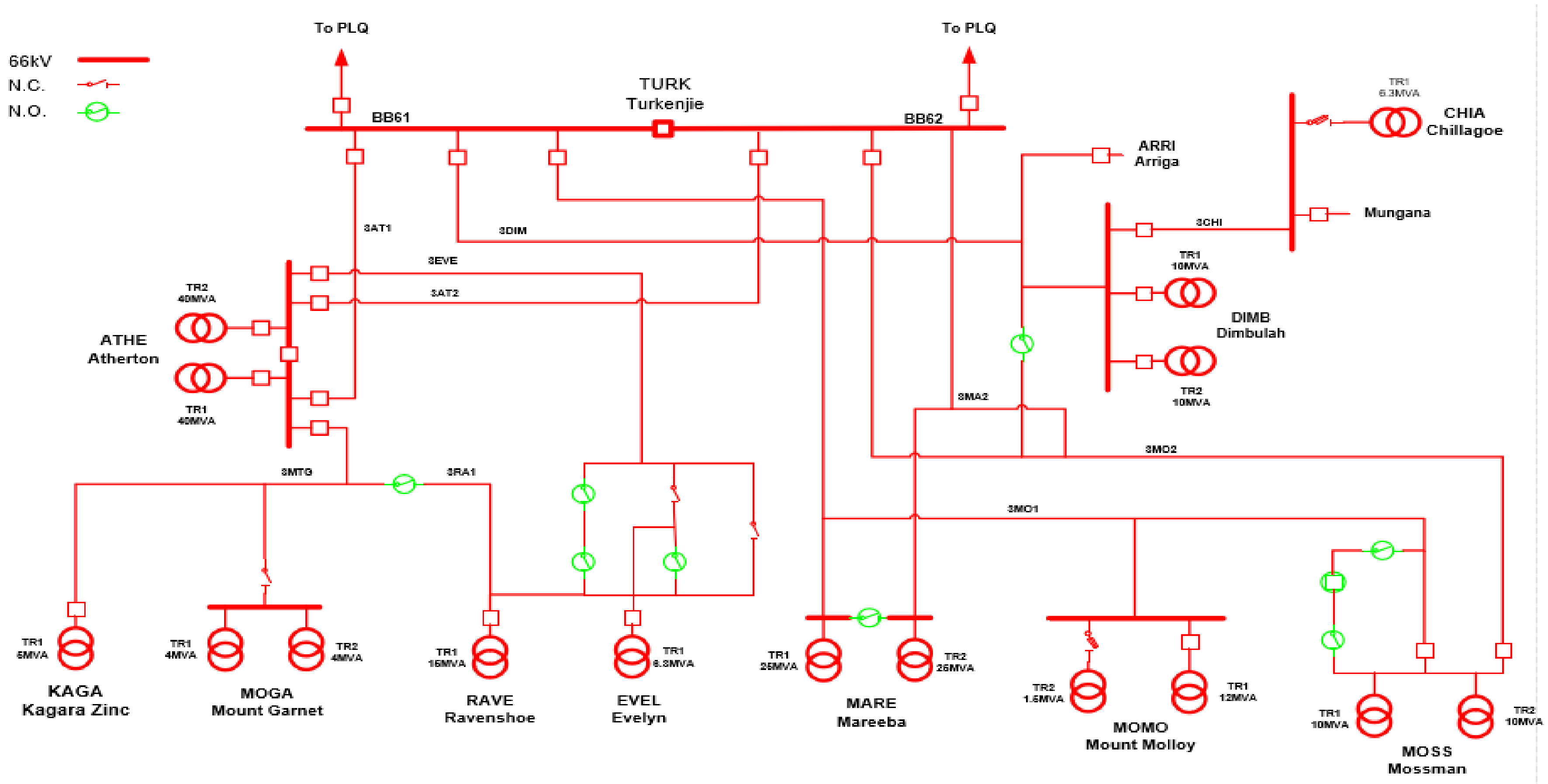


Figure 2: Existing network arrangement (schematic view)

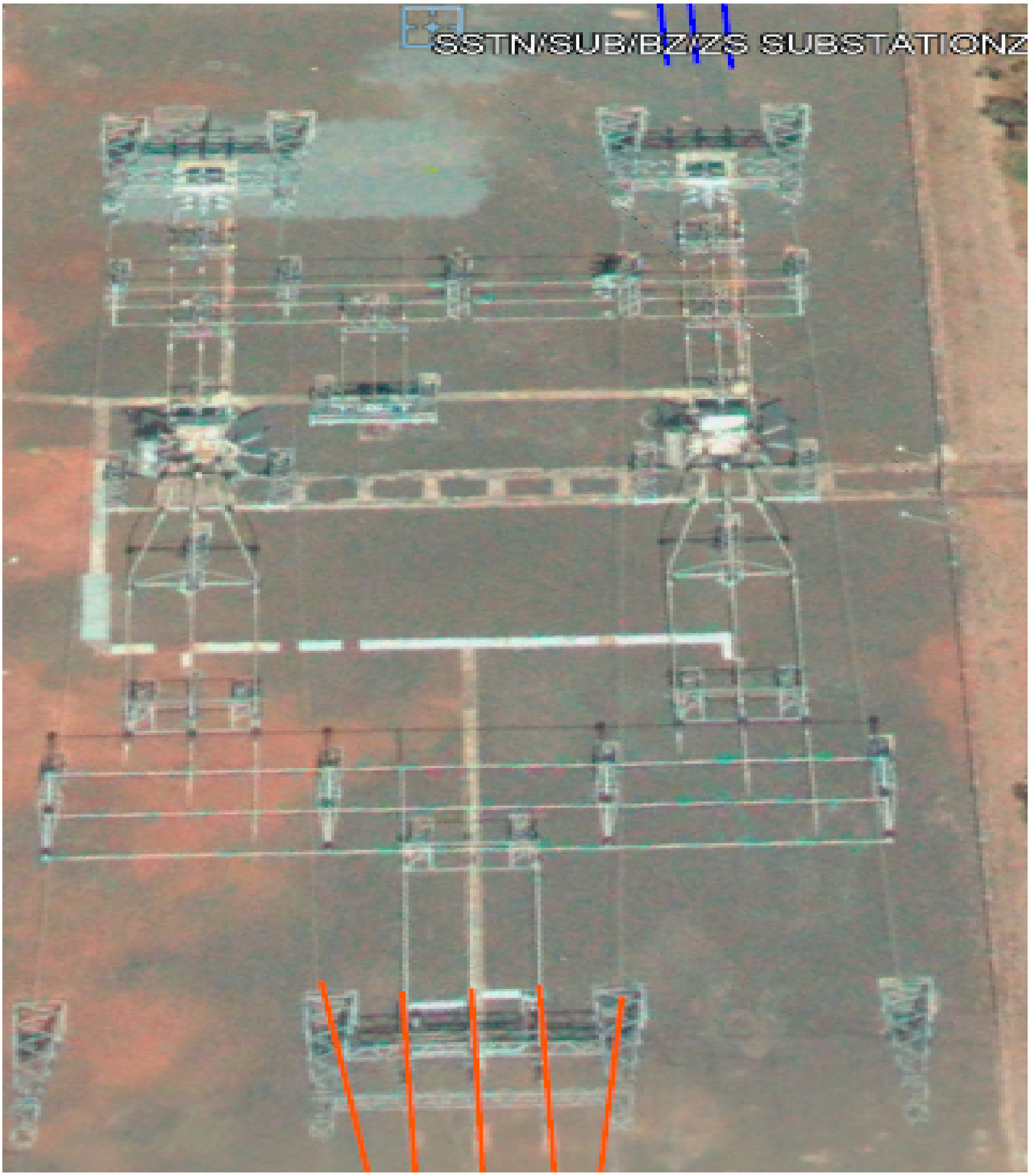


Figure 3 Geographic view of MOGA

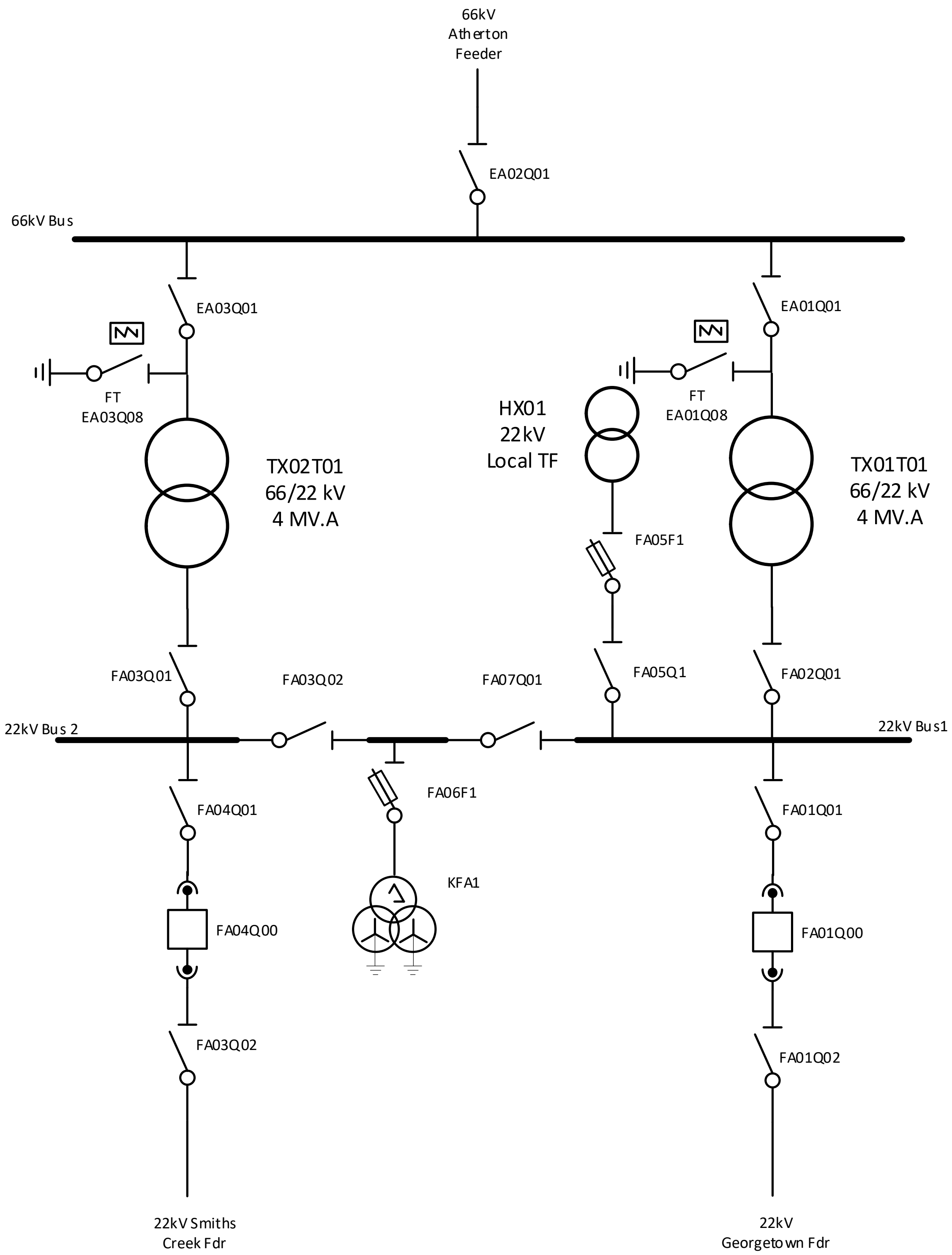


Figure 4 Existing MOGA substation (schematic view)

1.3. Load Profile / Forecast

The load at Mount Garnet substation comprises a mix of residential and commercial/industrial customers of which 72% are residential and 28% are commercial and industrial,
The load is summer peaking, and the annual peak load is 2.4 MVA.

1.3.1. Full Annual Load Profile

The full annual load profile for Mount Garnet substation over the 2021/22 financial year is shown in **Figure 5**.

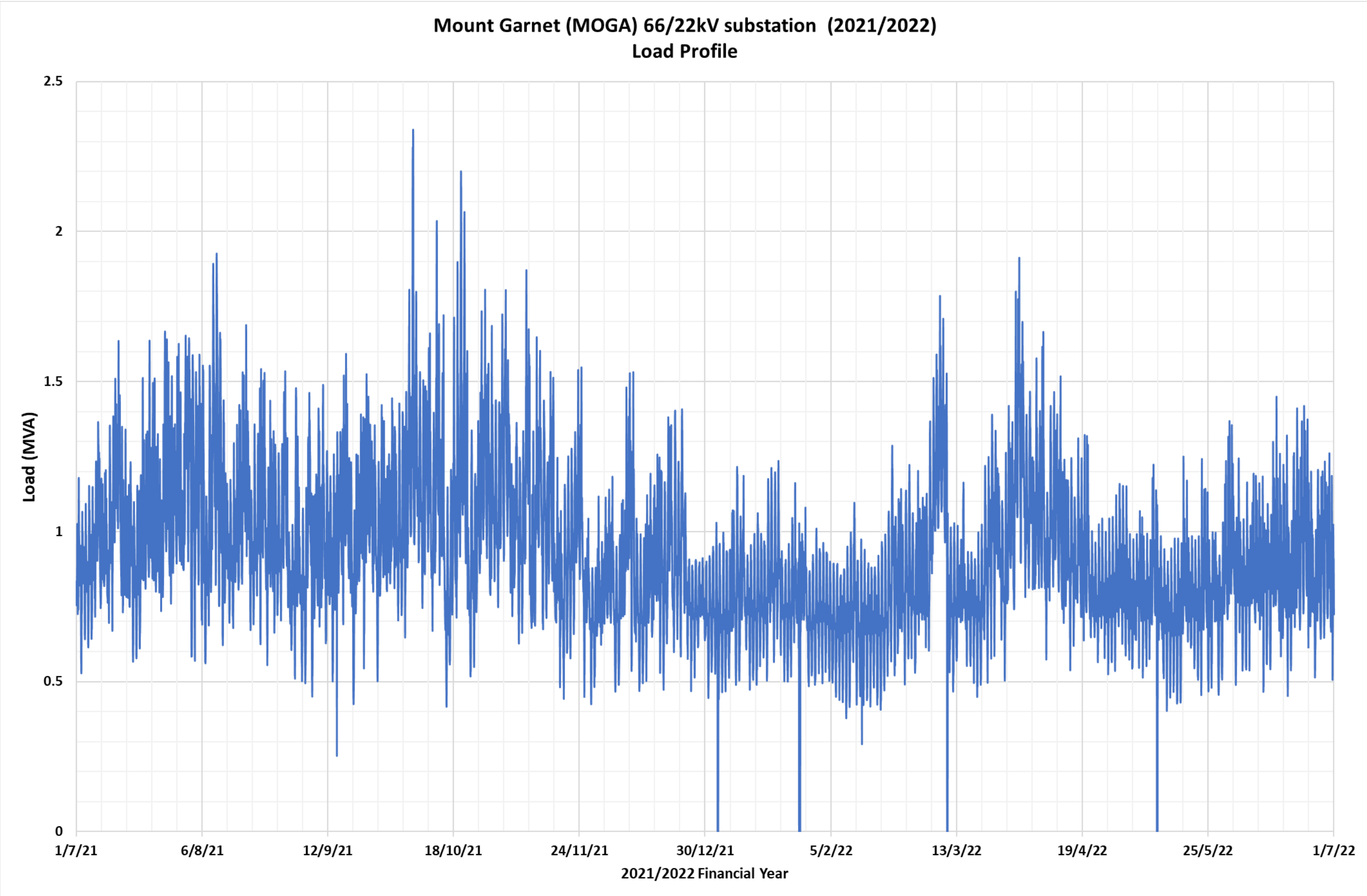


Figure 5: Substation actual annual load profile

1.3.2. Load Duration Curve

The load duration curve for Mount Garnet substation over the 2021/22 financial year is shown in **Figure 6**.

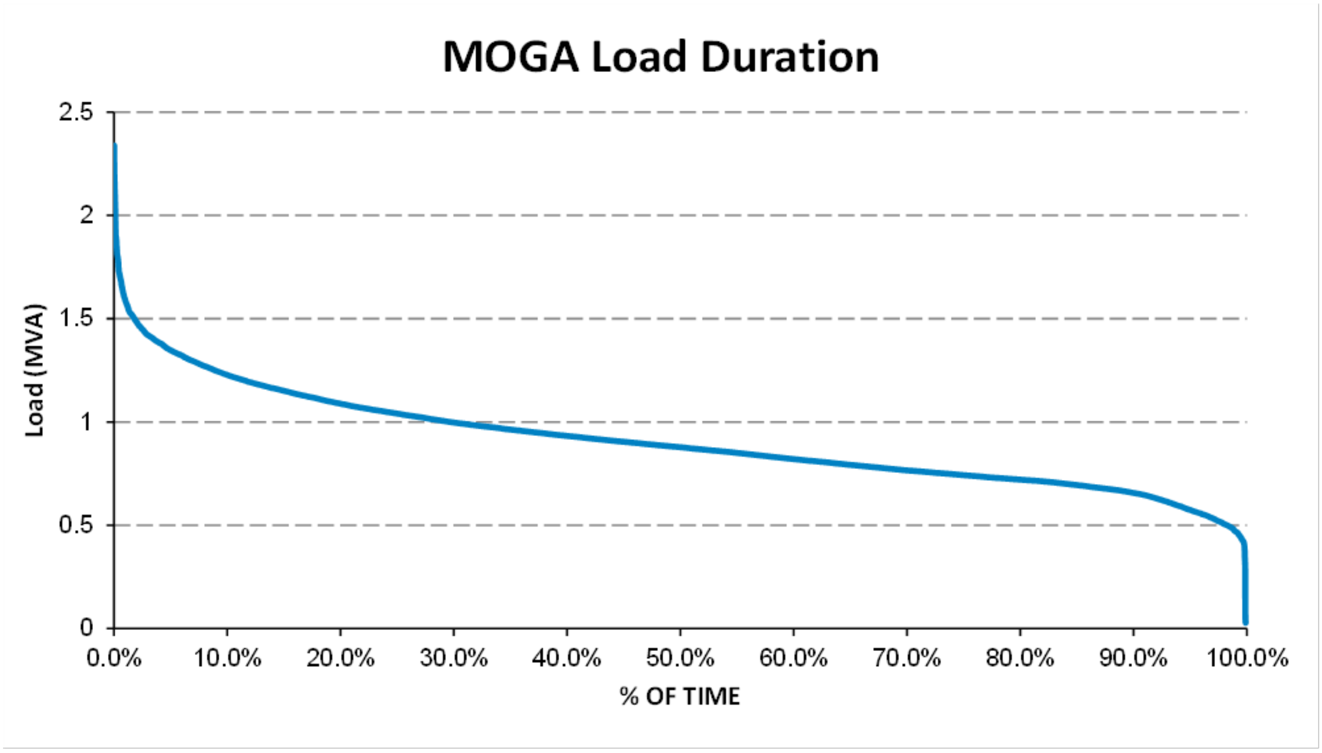


Figure 6: Substation load duration curve

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 7 It can be noted that the summer peak loads at MOGA substation are historically experienced in the late afternoon and evening.

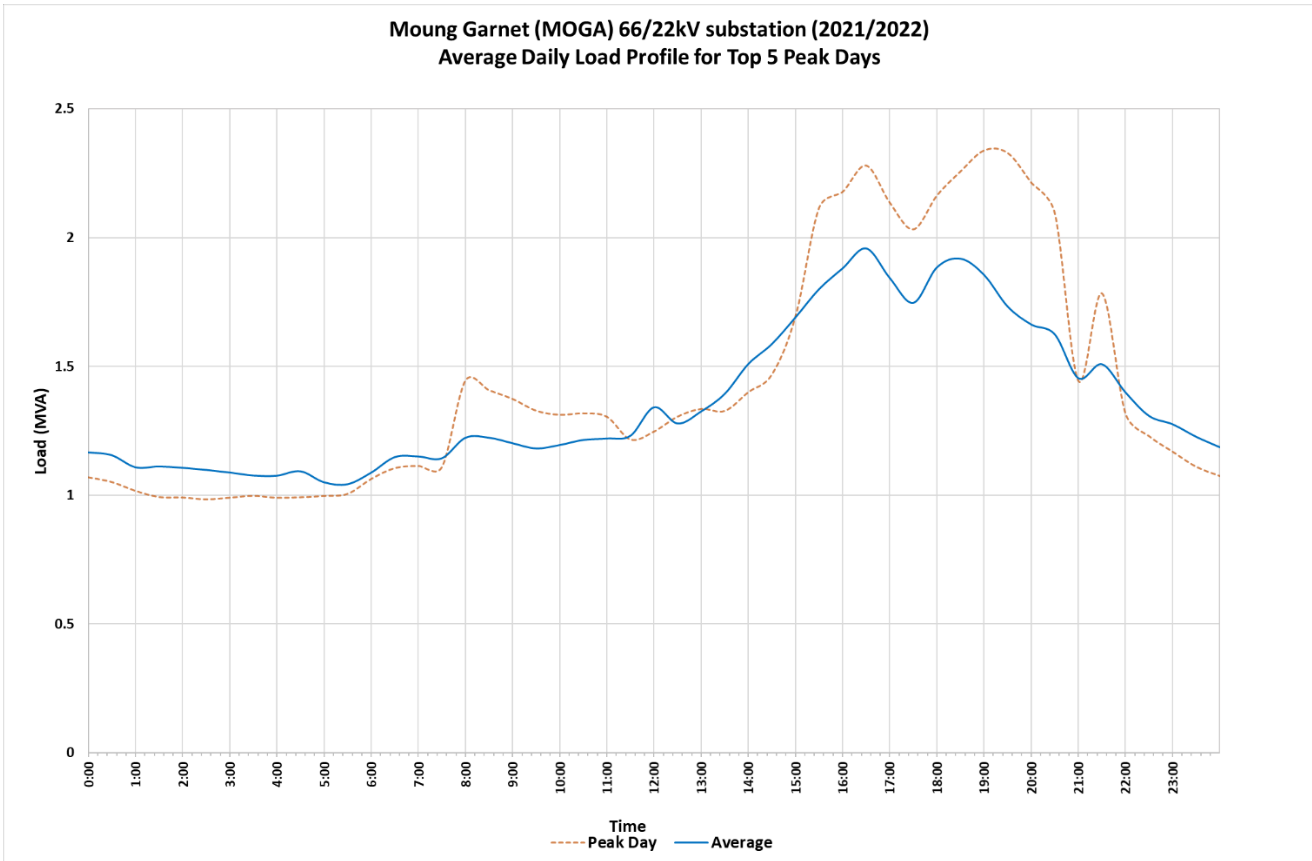


Figure 7 Average Daily Load Profile for Top 5 Peak days

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 8. The historical peak load for the past six years has also been included in the graph. It can be noted that the historical annual peak loads have fluctuated over the past five years. It can also be noted that the peak load is forecast to increase slightly over the next 10 years under the base case scenario.

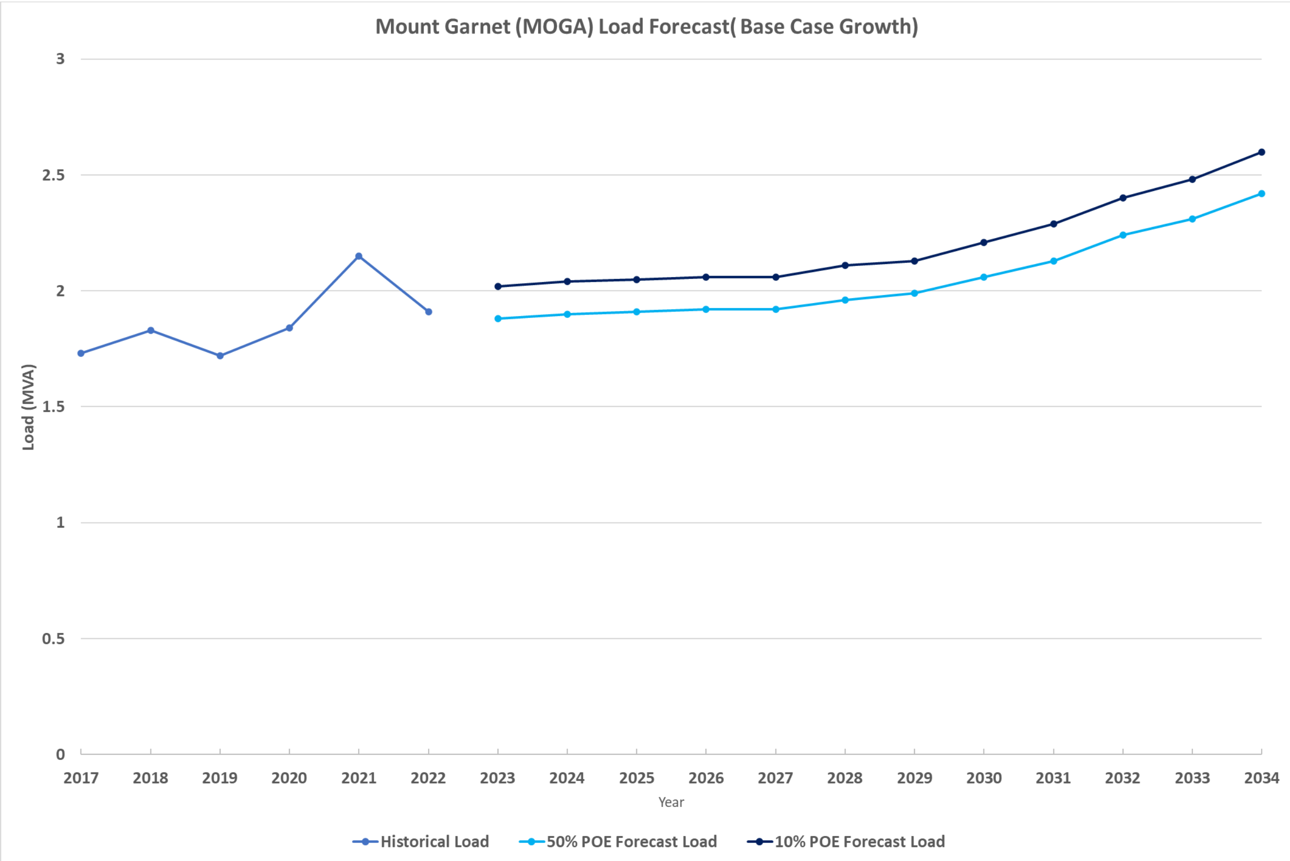


Figure 8 Substation base case load forecast

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 9. With the high growth scenario, the peak load is forecast to increase over the next 10 years.

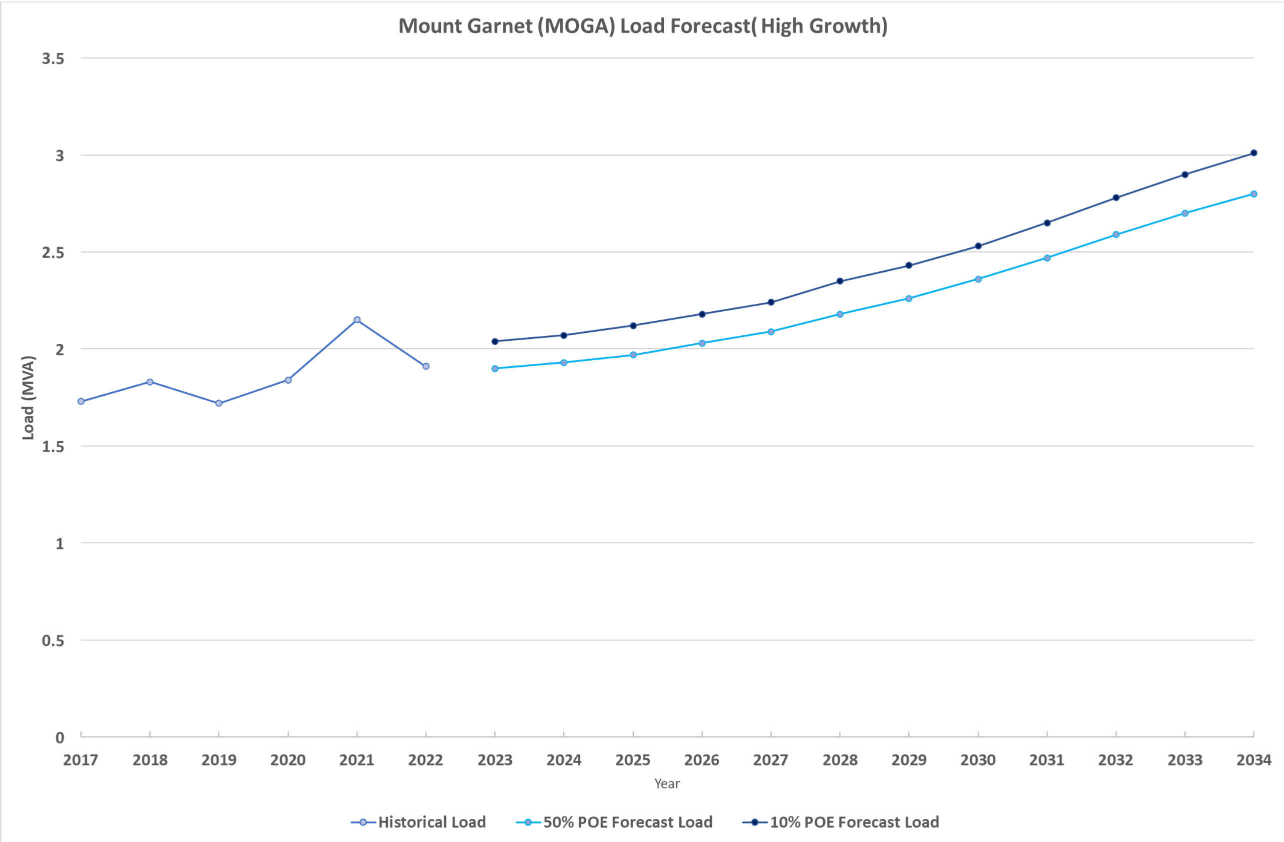


Figure 9 Substation high growth load forecast

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 10. With the low growth scenario, the peak load is forecast to remain relatively steady over the next 10 years.

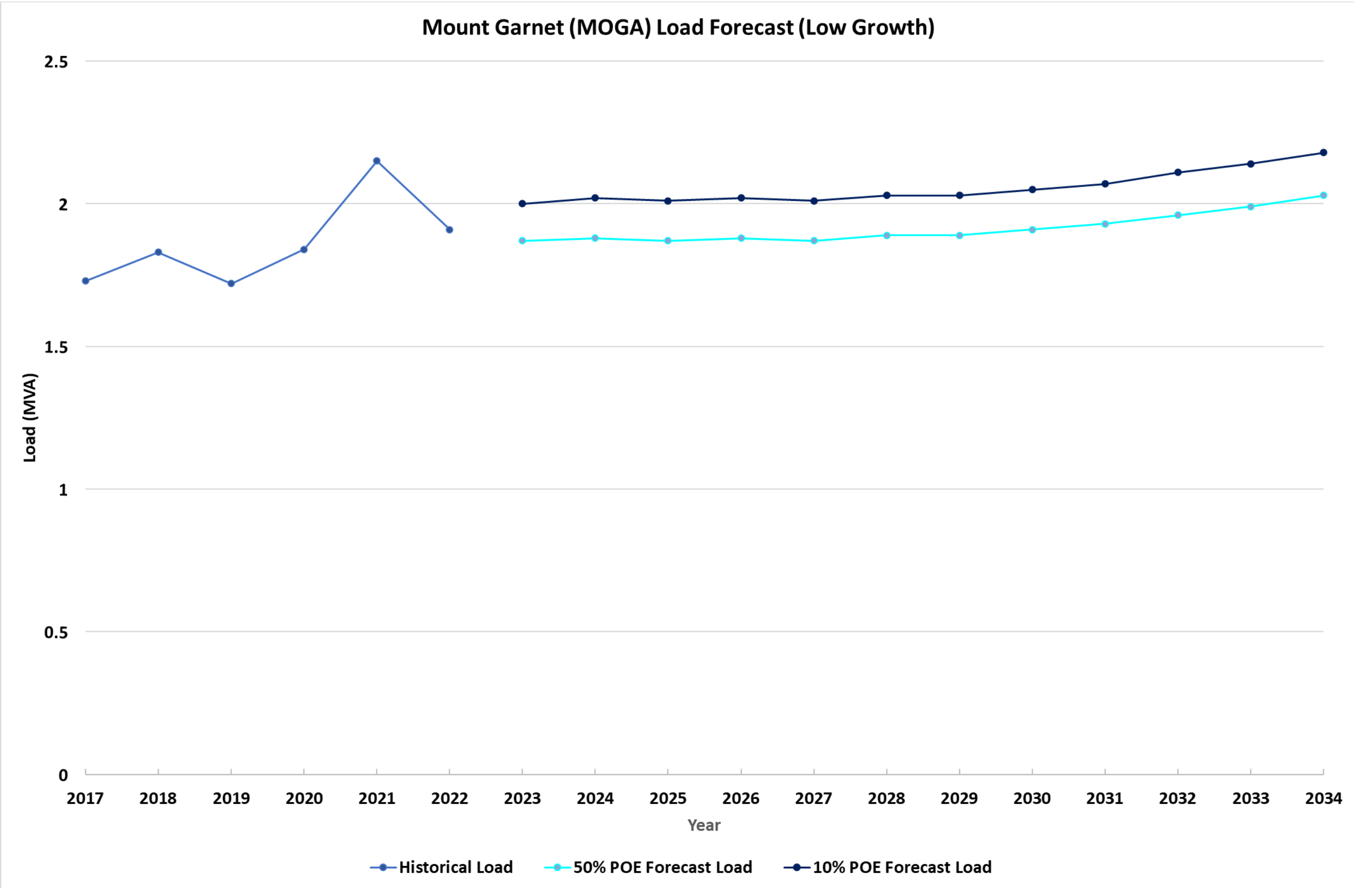


Figure 10 Substation low growth load forecast

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 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.

Based on a Condition Based Risk Management (CBRM) analysis, the following have been deemed to reach their retirement age:

- 66/22kV 4MVA Transformers TR1 and TR2 by 2026
- 9 x22kV Isolators by 2023
- 2 x 22kV Protection Relays by 2026

and

Based on a Condition Based Risk Management (CBRM) analysis, the following have been deemed to be problematic:

- 4 x 66kV Duoroll Isolators
- 2 x 66kV Fault Throw Switches
- Porcelain Surge Arresters

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 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 Garnet 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

Kagara Zinc (KAGA) substation supplies the mine site that is currently owned by a customer. This site is fed from ATHE via a tee-off point to MOGA on 66kV 3MTG feeder.

There is a network limitation on the supply with the mine site approved for a maximum of 3.15MVA. An increase to 6.5MVA was request however only 4.7MVA was considered.

With the present protection scheme, for a fault at the customer substation or anywhere between the tee-off point to the customer substation, the 66kV breaker, EA06Q00, at ATHE will trip thus taking both MOGA and the large customer off-line as illustrated in Figure 11

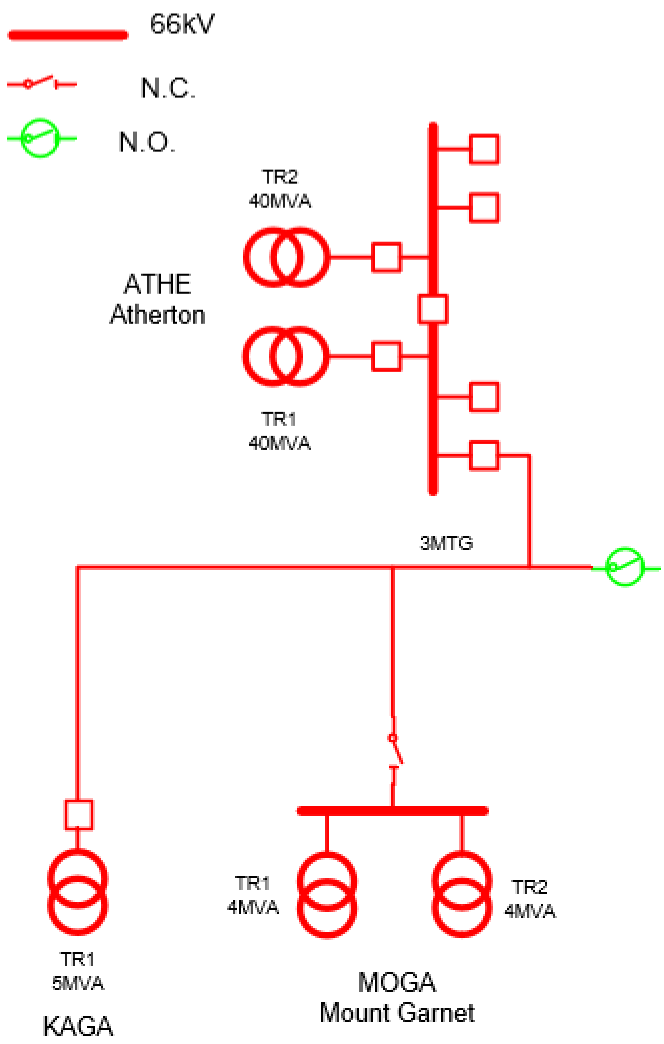


Figure 11 3MTG Tee Off Point

This affects around 500 customers through MOGA and KAGA bulk load customer and results in a combined peak load at risk of approximately 8MVA.This network arrangement has also contributed to higher-than-average SAIDI and SAIFI for the distribution feeders than is generally expected for a short rural network.

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 22kV distribution feeders supplied from MOGA substation 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
George Town	Short Rural	67	2309	424	14.7	7.4
Smith Creek	Short Rural	442	22202	964	12.8	7.4

Table 1 Existing 22kV feeder reliability category and performance

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

There are no Safety Net non-compliance issues identified.

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 Garnet area to address the identified need.

3.2. Network Options Identified

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

3.2.1. Option 1: Replace 1 x transformer, install NOMAD connection points, and remove KAGA fault disruption

This option involves replacing one 4MVA 66/22kV transformer with a brand new 6.3MVA 66/22kV transformer. A 66kV fuse and 36kV recloser will also be installed to provide transformer protection. The other 4MVA 66/22kV transformer will be removed and replaced with NOMAD mobile substation connection points. A new access road will be established to cater for the NOMAD mobile substation. A 100m long feeder will be installed at the 66kV 3MTG tee point between MOGA and customer substation to cut the feeder in and out of MOGA as well as the installation of 66kV circuit breaker. The schematic diagram of the proposed network arrangement for Option 1 is shown in Figure 12.

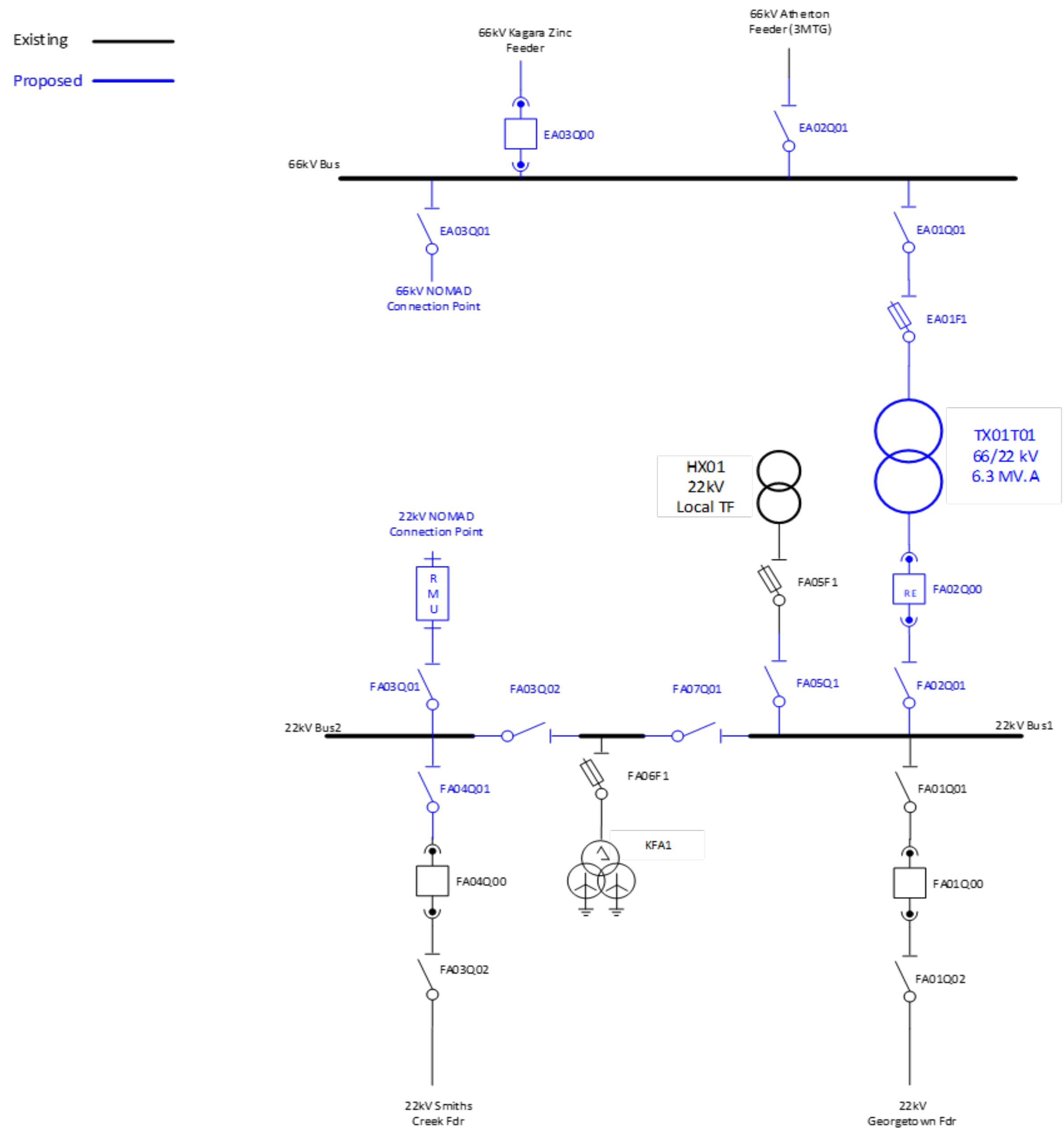


Figure 12 Proposed network arrangement-Option 1

3.2.2. Option 2: Replace 1 x transformer and install NOMAD connection points

This option involves replacing 1 x 4MVA 66/22kV transformer with a brand new 6.3MVA 66/22kV transformer. A 66kV fuse and 36kV recloser will be installed to provide transformer protection. The other 4MVA 66/22kV transformer will be removed and replaced with NOMAD mobile substation connection points. A new access road will be established to cater for the NOMAD mobile.

substation. A schematic diagram with the proposed network arrangement for Option 2 is shown in Figure 13

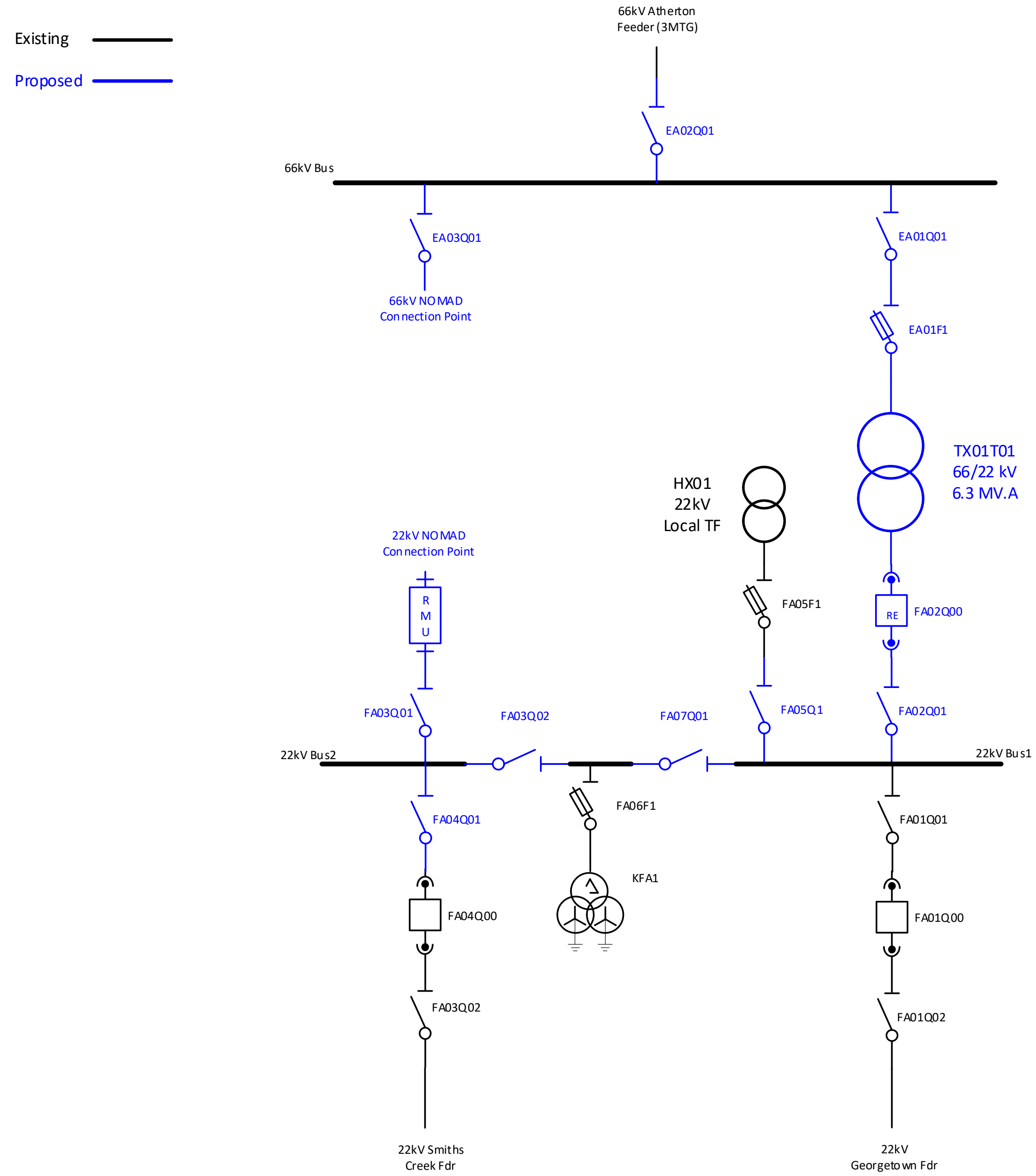


Figure 13 Proposed network arrangement - Option 2

3.2.3. Option 3: Replace 2 x transformers and remove KAGA fault disruption

This option involves replacing 2 x 4MVA 66/22kV transformers with two brand new 6.3MVA 66/22kV transformers. Two 66kV fuses and 36kV reclosers will be installed to provide protection for both transformers. A 100m feeder will be installed at the 66kV 3MTG T point between MOGA and KAGA to cut the feeder in and out of MOGA as well as a 66kV circuit breaker. Refer Figure 14.

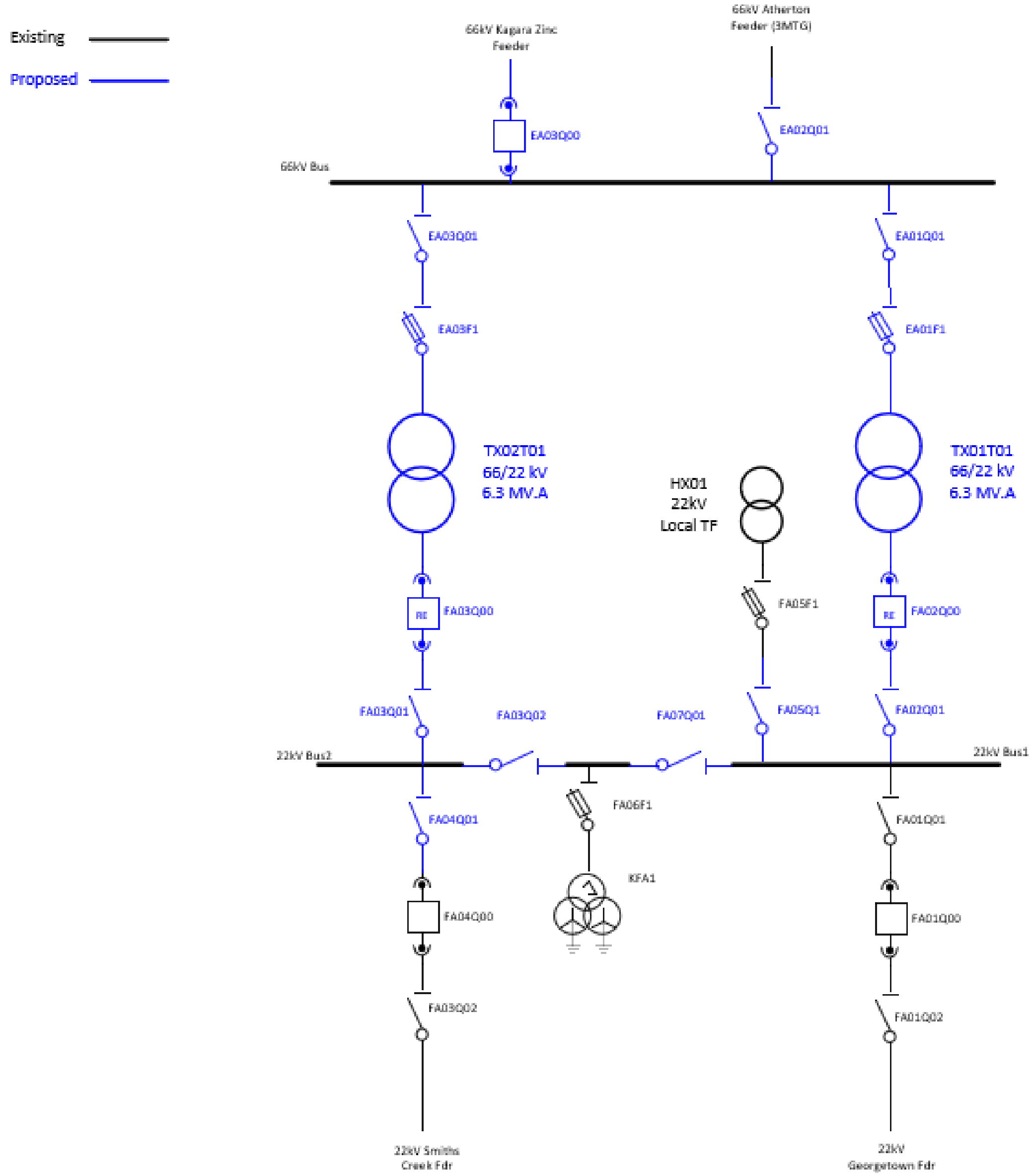


Figure 14 Proposed network arrangement - Option 3

3.2.4 Option 4: Replace 1 x transformer, run 1 x transformer to failure and remove KAGA fault disruption

This option involves replacing 1 x 4MVA 66/22kV transformer with a brand new 6.3MVA 66/22kV transformer. A 66kV fuse and 36kV recloser will be installed to provide transformer protection. The other 4MVA 66/22kV transformer will run to failure. A 100m feeder will be installed at the 66kV 3MTG T point between MOGA and KAGA to cut the feeder in and out of MOGA as well as a 66kV circuit breaker. The Figure 15 provides schematic diagram for Option 4.

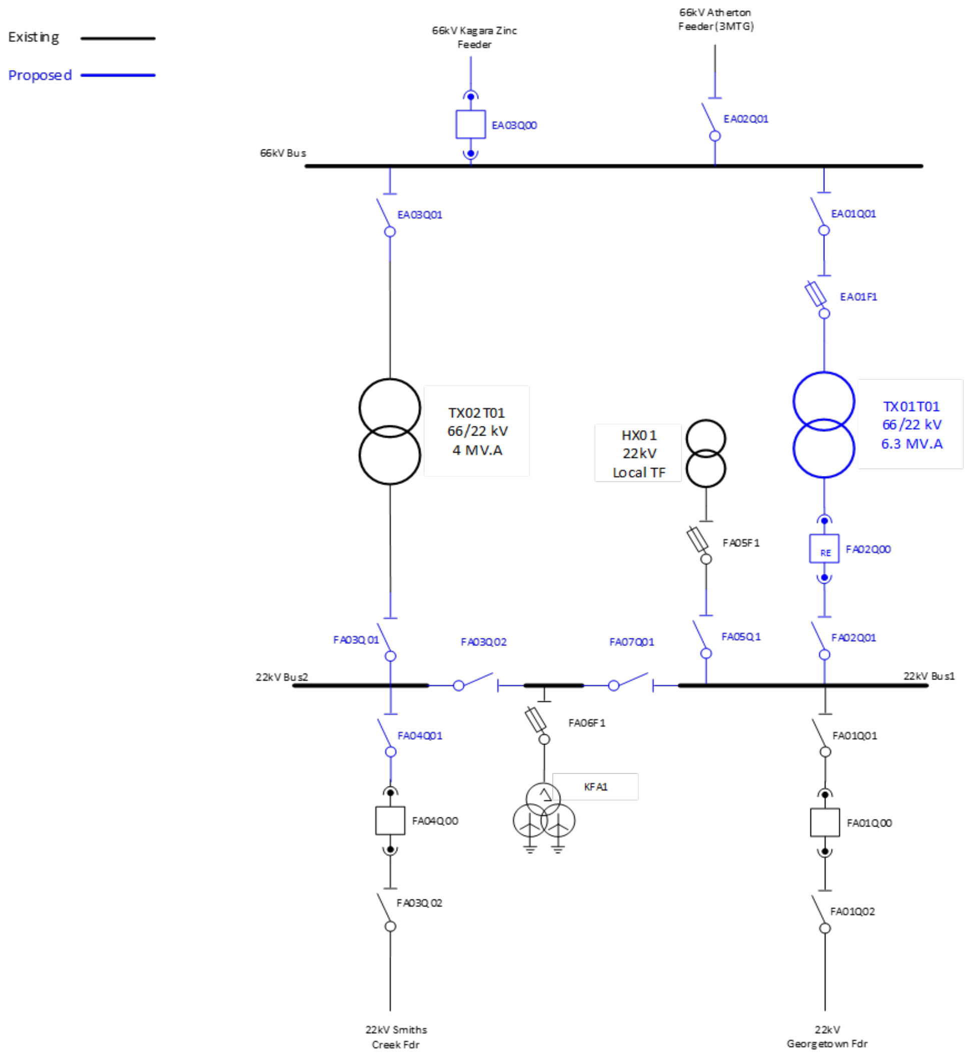


Figure 15 Proposed network arrangement - Option 4

3.3. Preferred Network Option

Ergon Energy's preferred internal network option is option 3, to replace 2 x 4MVA 66/22kV transformers with two brand new 6.3MVA 66/22kV transformers. Two 66kV fuses and 36kV reclosers will be installed to provide protection for both transformers. A 100m feeder will be installed at the 66kV 3MTG T point between MOGA and KAGA to cut the feeder in and out of MOGA as well as a 66kV circuit breaker.

Upon completion of these works, the asset safety and reliability risks at Mount Garnet 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 $6.959 million. Annual operating and maintenance costs are anticipated to be 1.5% of the capital cost. The estimated project construction completed by June 2026.

4. ASSSESSMENT 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 Mount Garnet 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 Garnet. It has been determined that most demand management options will not be viable propositions and have been explored in the following sections.

4.1.1. Network Load Control

The residential customers and some commercial loads appear to drive the daily peak demand which generally occurs between 6:00pm and 9:00pm.

There are 204 customers on tariff T31 and T33 hot water load control (LC). An estimated demand reduction value of 122.4 KVA[1] is available.

Mount Garnet substation LC signals are controlled from Atherton Bulk Supply Substation (ATHE) 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 Atherton Bulk Supply Substation exceeds 24MW. This strategy does not directly address demand peak experienced at Mount Garnet. 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.

4.2. 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.

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

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).

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

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 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.

4.2.4. Customer Solar Power Systems

A total of 94 customers have solar photo voltaic (PV) systems for a connected inverter capacity of 676 kVA.

The daily peak demand is driven by residential customer demand and the peak generally occurs between 6:00pm 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 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.

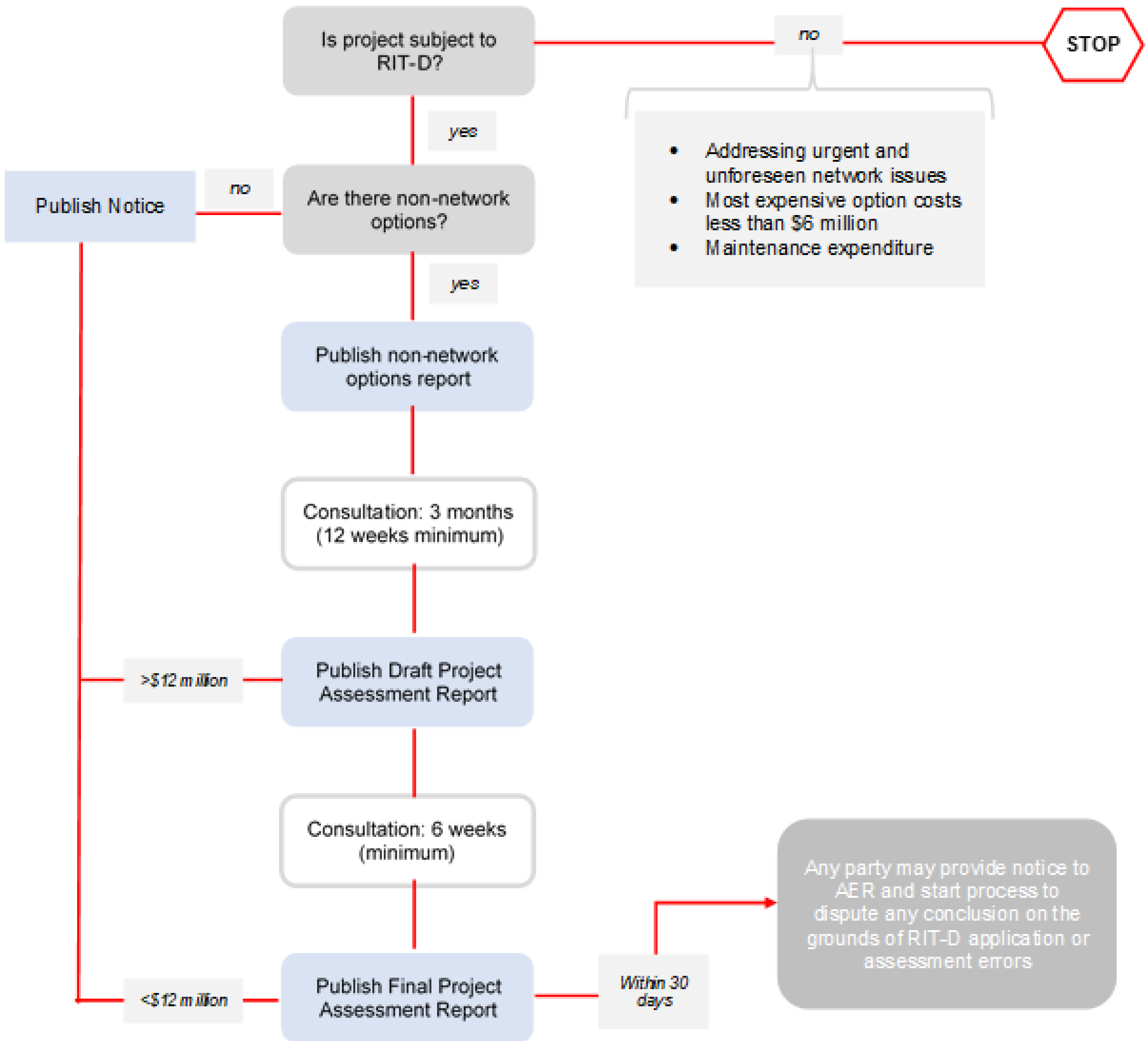
5. CONCLUSION AND NEXT STEPS

The internal investigations undertaken on the feasibility of the 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 Garnet area to address the identified need.

The preferred network option is option 3, to replace 2 x 4MVA 66/22kV transformers with two brand new 6.3MVA 66/22kV transformers. Two 66kV fuses and 36kV reclosers will be installed to provide protection for both transformers. A 100m feeder will be installed at the 66kV 3MTG T point between MOGA and KAGA to cut the feeder in and out of MOGA as well as a 66kV circuit breaker.

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 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.