Regulatory Investment Test for Distribution

Addressing Reliability Requirements in the Pleystowe Network Area

Notice of No Non-Network Options

9 October 2020

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

Pleystowe 33/11kV Substation (PLEY) is located on the southern bank of the Pioneer River approximately 13km west of Mackay and 2.5km north-west of Walkerston. The substation is part of the Mackay 33kV sub-transmission network and takes supply from T038 Mackay 132/33kV Bulk Supply Substation (MACK).

Pleystowe substation supplies the township of Walkerston and the surrounding area. Outside of Walkerston, the supply area is primarily rural, with the customers including numerous sugar cane farms and the Pleystowe Sugar Mill (which ceased milling operation in 2008). Pleystowe Substation provides electricity supply to approximately 2,400 customers, of which 85% are residential and 15% are commercial, agricultural and industrial. Pleystowe Substation is presently supplied via two incoming 33kV feeders from T038 Mackay Substation, and there are two outgoing 33kV feeders from Pleystowe Substation which provide supply to Farleigh 33/11kV Substation (FARL) and the Pleystowe Mill.

Pleystowe Substation was established in 1964 according to applicable design and construction standards during that time. It has an outdoor 33kV and 11kV switchyard with steel structures, three 5MVA 33/11kV power transformers, and a small protection and control building. Over time, the substation was expanded with additional 11kV bays and some of the primary plant have been replaced in situ.

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

The assessment identified that the three 33/11kV power transformers, the three 33kV ACR controllers and 17 of the protection relays 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, 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 significant safety risks to staff working within the switchyard, and reliability risk to the customers supplied from Pleystowe Substation.

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 Pleystowe 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

Pleystowe substation supplies the township of Walkerston and the surrounding area. Outside of Walkerston, the supply area is primarily rural, with the customers including numerous sugar cane farms and the Pleystowe Sugar Mill (which ceased milling operation in 2008). Pleystowe Substation provides electricity supply to approximately 2,400 customers, of which 85% are residential and 15% 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.

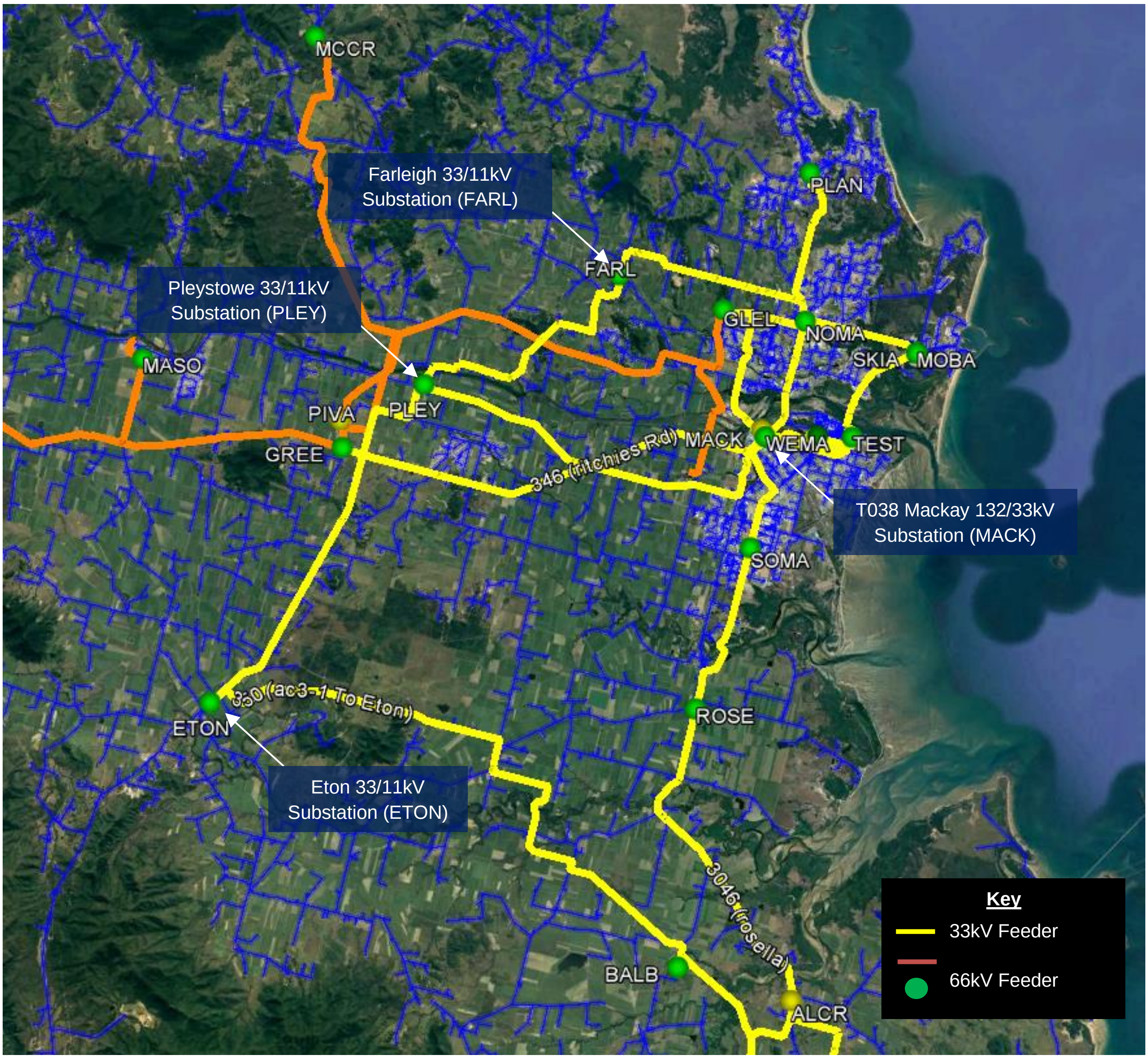

Figure 1: Existing network arrangement (geographic view)

1.2. Existing Supply System

Pleystowe 33/11kV Substation (PLEY) is located on the southern bank of the Pioneer River approximately 13km west of Mackay and 2.5km north-west of Walkerston. The substation is part of the Mackay 33kV sub-transmission network and takes supply from T038 Mackay 132/33kV Bulk Supply Substation (MACK). Pleystowe Substation is presently supplied via two incoming 33kV feeders from T038 Mackay Substation, and there are two outgoing 33kV feeders from Pleystowe Substation which provide supply to Farleigh 33/11kV Substation (FARL) and the Pleystowe Mill.

Pleystowe Substation was established in 1964 according to applicable design and construction standards during that time. It has an outdoor 33kV and 11kV switchyard with steel structures, three 5MVA 33/11kV power transformers, and a small protection and control building. Over time, the substation was expanded with additional 11kV bays and some of the primary plant have been replaced in situ.

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

The 11kV main bus and the 11kV transfer bus are both manually switched. Each bus contains three 11kV bus isolators. The bus isolators on the main bus are normally closed and the bus isolators on the transfer bus are normally open.

Pleystowe substation supplies four 11kV distribution feeders which contain seven existing 11kV feeder ties to 11kV feeders supplied from Farleigh 33/11kV substation (FARL), West Mackay 33/11kV substation (WEMA), Rosella 33/11kV substation (ROSE), Eton 33/11kV substation (ETON), Marian South 66/11kV substation (MASO) and McKinley Creek 66/11 kV substation (MCCR). Each outgoing 11kV feeder is protected by an automatic circuit recloser (ACR).

There are two station services transformers at Pleystowe substation; local transformer 1 is a 25kVA 11/0.415kV transformer supplied off the 11kV bus, and local transformer 2 is a 20kVA 33/0.415kV transformer supplied off the 33kV bus.

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

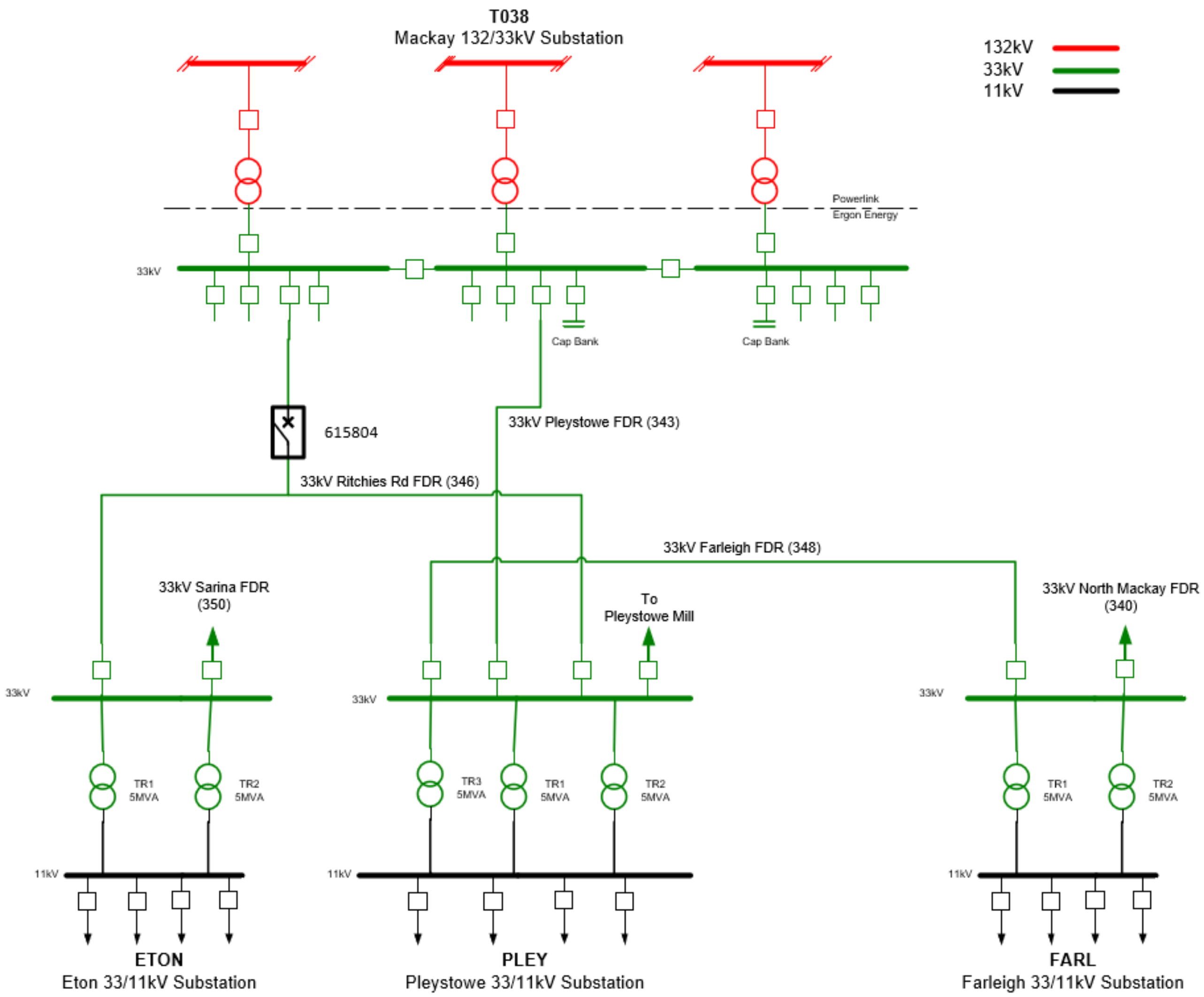

Figure 2: Existing network arrangement (schematic view)

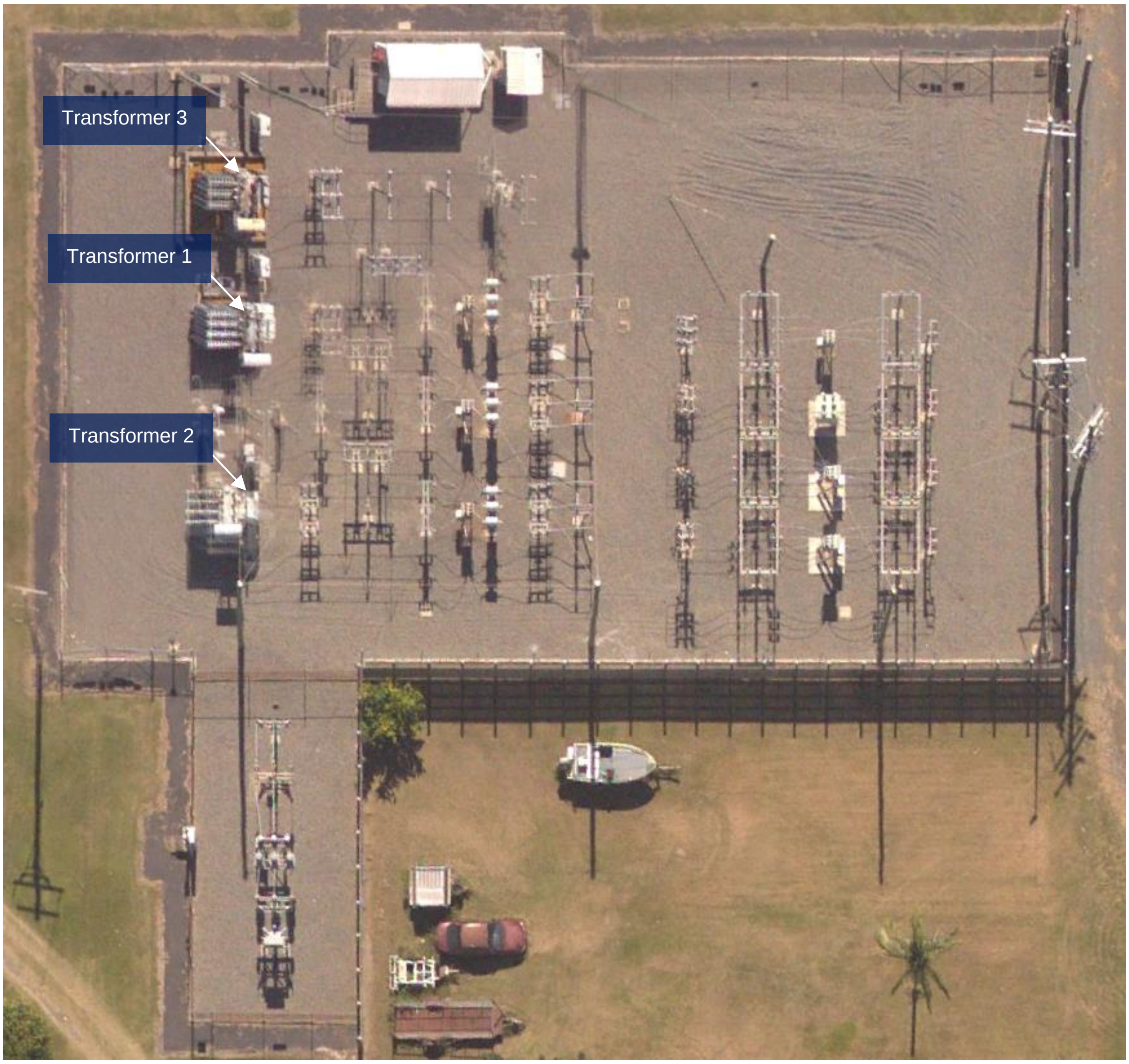

Figure 3: Pleystowe Substation (geographic view)

1.3. Load Profiles / Forecasts

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

1.3.1. Full Annual Load Profile

The full annual load profile for Pleystowe Substation over the 2019/20 financial year is shown in Figure 4. It can be noted that the peak load occurs during summer.

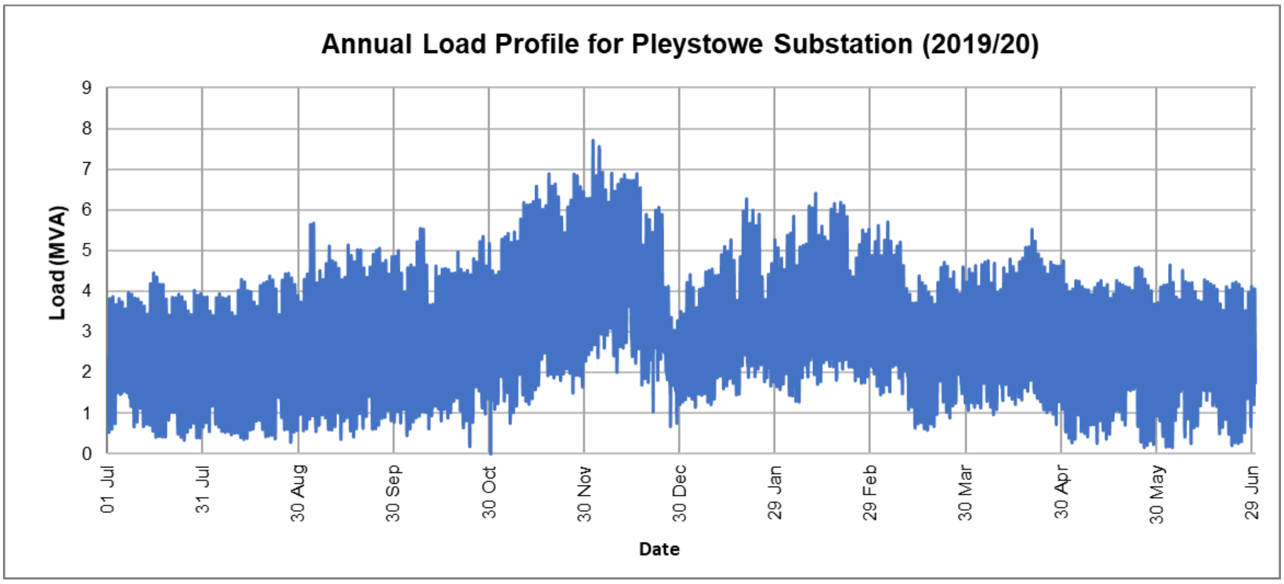

Figure 4: Substation actual annual load profile

1.3.2. Load Duration Curve

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

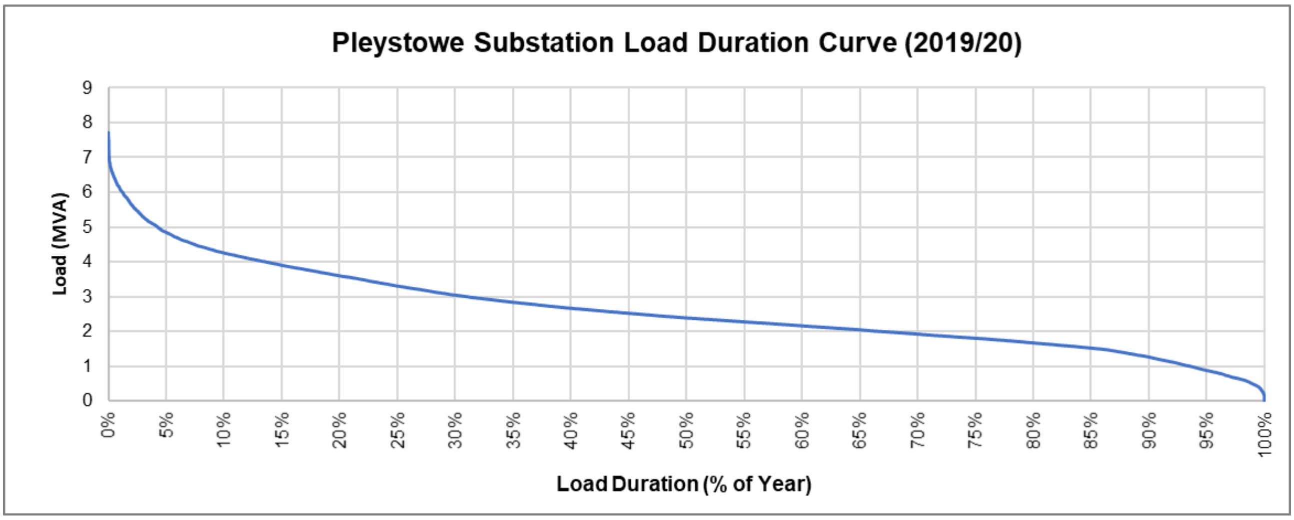

Figure 5: Substation load duration curve

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 Pleystowe Substation are historically experienced in the late afternoon and evening.

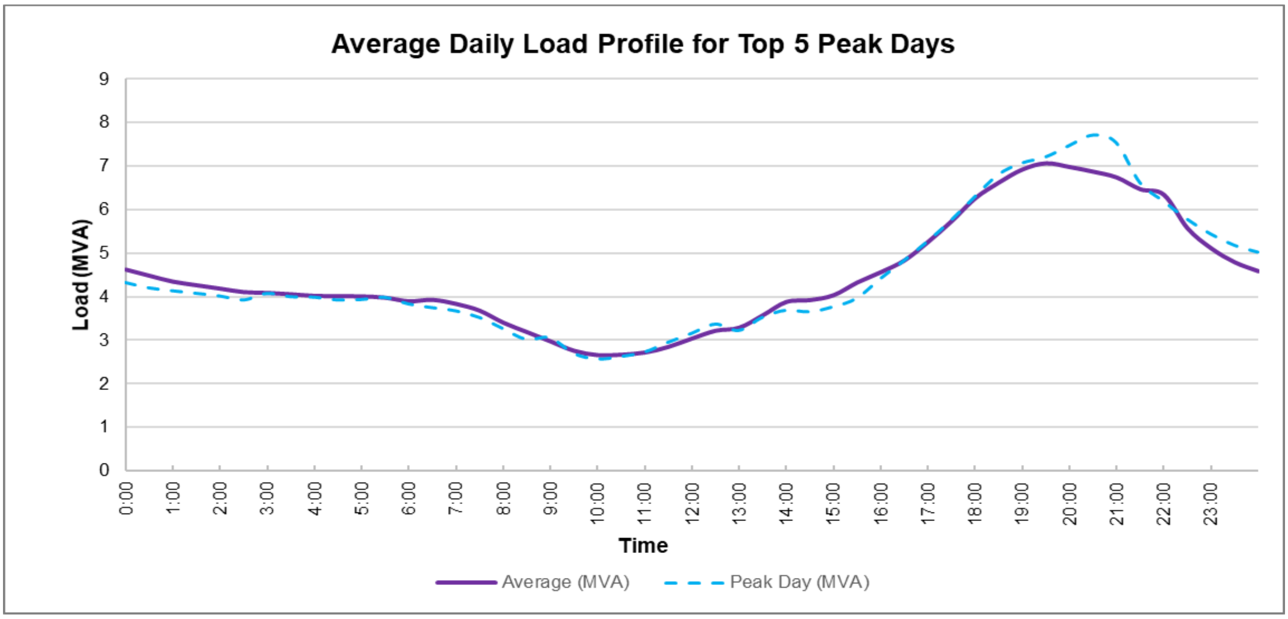

Figure 6: Substation average peak weekday load profile (summer)

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. Note that the reduction in peak load in 2016 was due to the commissioning of the Marian South Substation.

It can be noted that the historical annual peak loads have fluctuated over the past five years, primarily due to seasonal variation in pumping and irrigation load due to the quantity and timing of rainfall in the area. It can also be noted that the peak load is forecast to increase slightly over the next 10 years under the base case scenario.

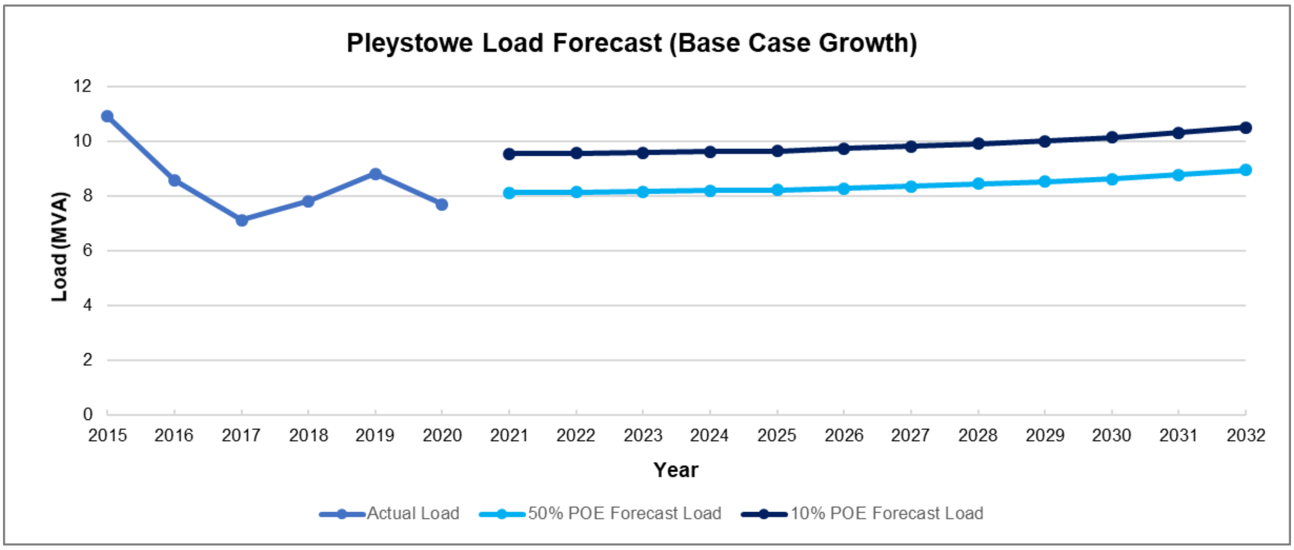

Figure 7: Substation base case load forecast

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.

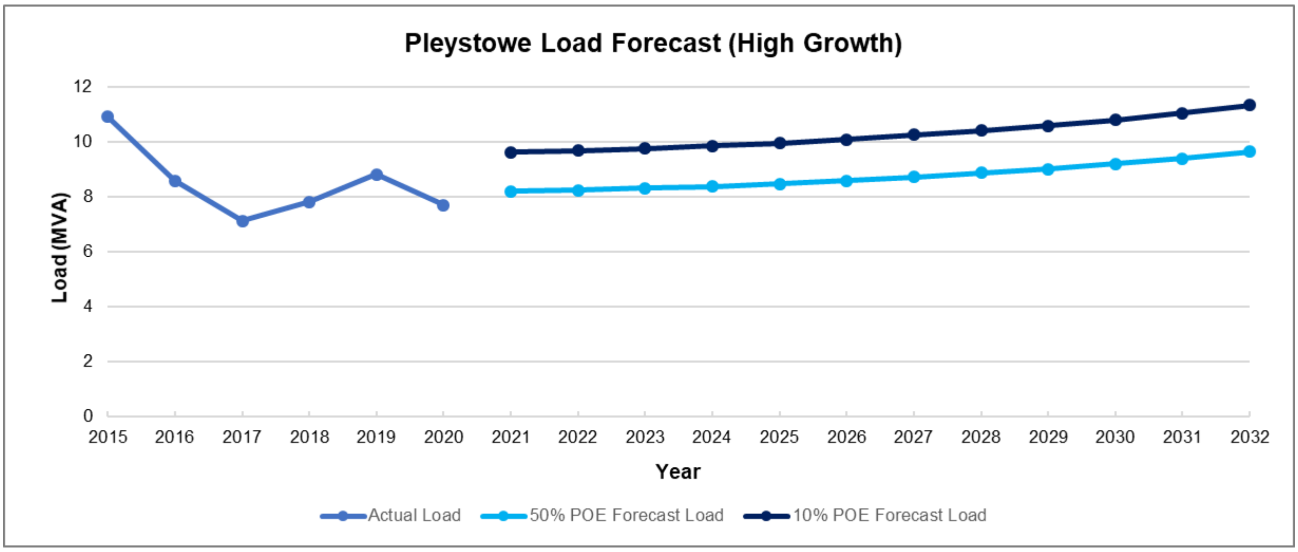

Figure 8: Substation high growth load forecast

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.

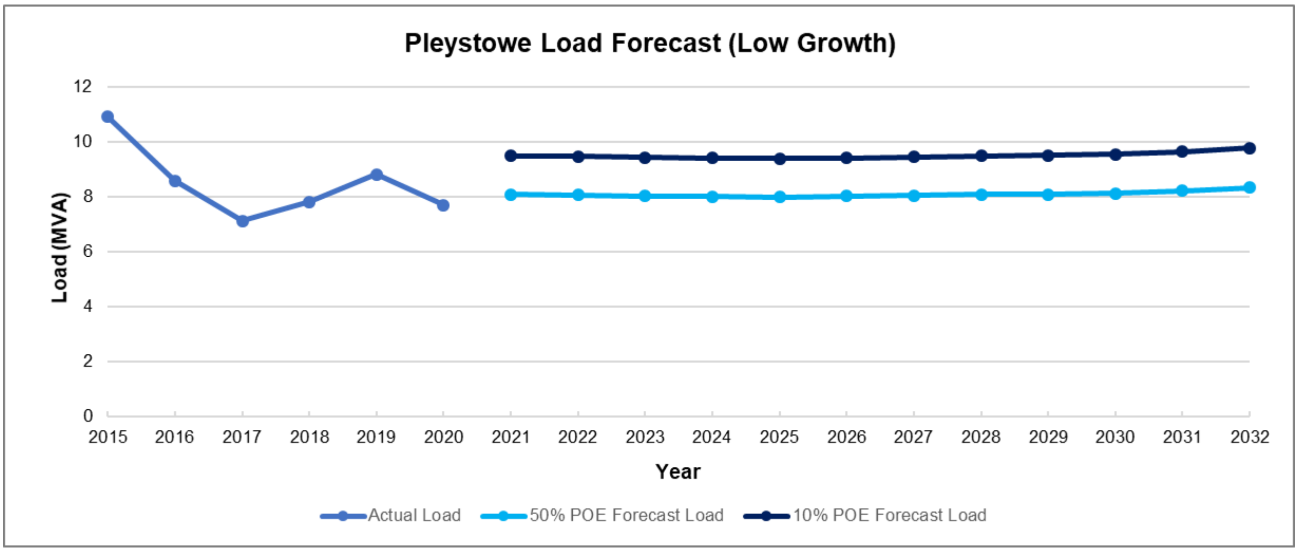

Figure 9: Substation low growth load forecast

2 Identified Need

2.1. Description of the Identified Need

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 significant safety, environmental and reliability risk.

Condition data indicates that the three 33/11kV power transformers, the 33kV ACR controllers and most of the protection relays at Pleystowe 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 significant safety risks to staff working within the switchyard. It also poses a safety risk the general public, though the increased likelihood of protection relay mal-operation and catastrophic failure of the power transformers. There is also a significant 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 Pleystowe Substation.

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 Pleystowe Substation. Under the existing sub-transmission network configuration any fault within Pleystowe Substation will result in an outage to all the customers supplied from Pleystowe and Farleigh Substations. This affects almost 4,000 customers and results in a combined peak load at risk of approximately 12MVA.

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 11kV distribution feeders supplied from Pleystowe and Farleigh Substations 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
Eastern	Short Rural	779	468	424	3.47	3.95
Western	Short Rural	299	516	424	3.79	3.95
Nebia	Short Rural	271	890	424	5.02	3.95
Walkerston	Short Rural	1051	228	424	2.82	3.95
Farleigh	Short Rural	699	386	424	5.01	424
Wundaru	Short Rural	752	1009	424	7.12	424

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 Pleystowe area to address the identified need.

3.2. Network Options Identified

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

3.2.1. Option A: Install Two New 10MVA Transformers

This option involves recovering the three existing transformers and installing two new 10MVA 33/11kV transformers with compliant bunding, upgrading the substation physical security and addressing secondary systems limitations in order to address the identified need.

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

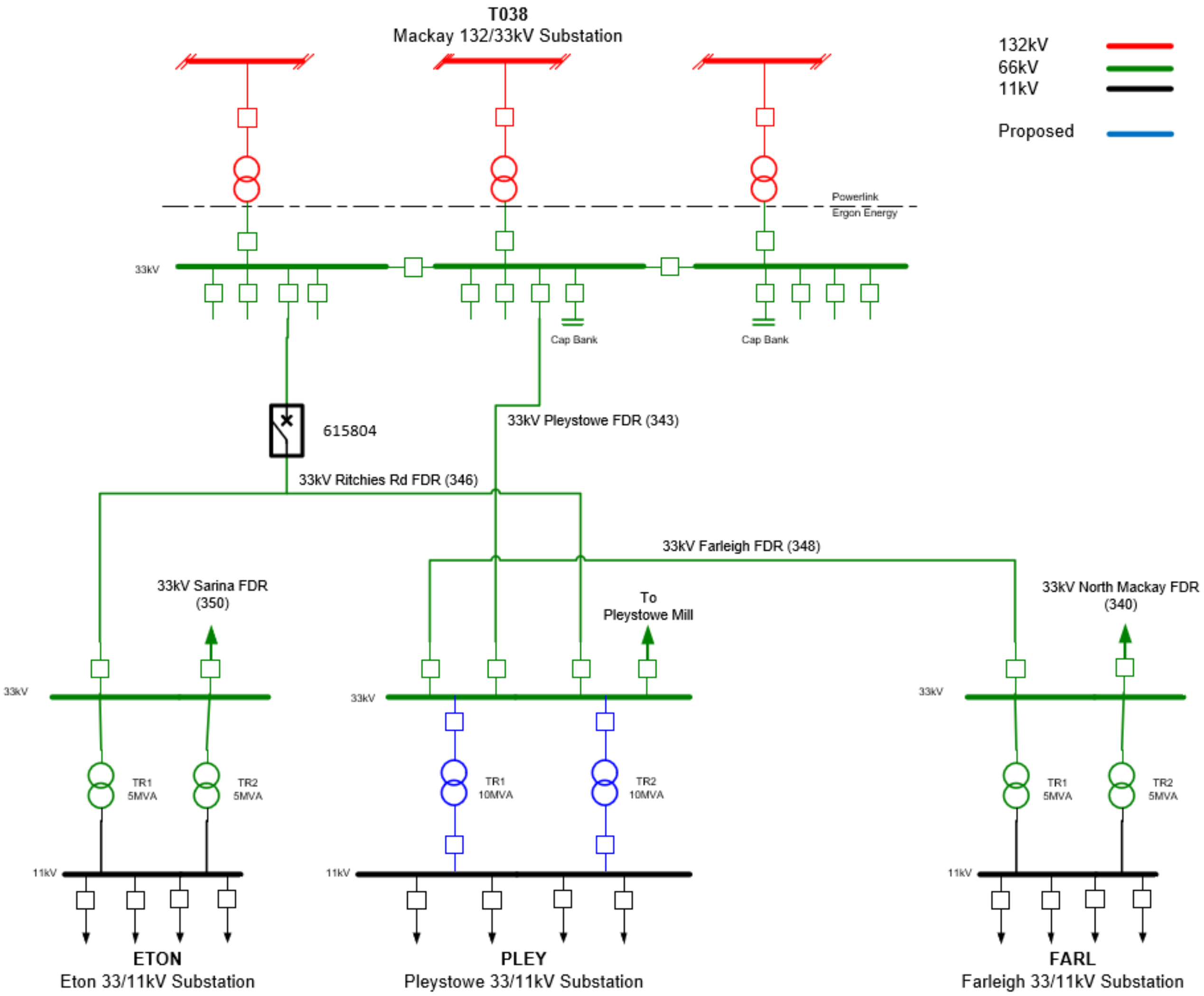

Figure 10: Option A proposed network arrangement (schematic view)

3.2.2. Option B: Install Two New 10MVA Transformers & 33kV Switchboard

This option involves recovering the three existing transformers and installing two new 10MVA 33/11kV transformers with compliant bunding, installing a fully switched 33kV bus, upgrading the substation physical security and addressing secondary systems limitations in order to address the identified need.

In order to improve reliability on the 33kV sub-transmission network and provide long term benefits, a fully switched 33kV switchboard has been proposed under this option. This would provide transformer HV circuit breakers and a bus tie circuit breaker.

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

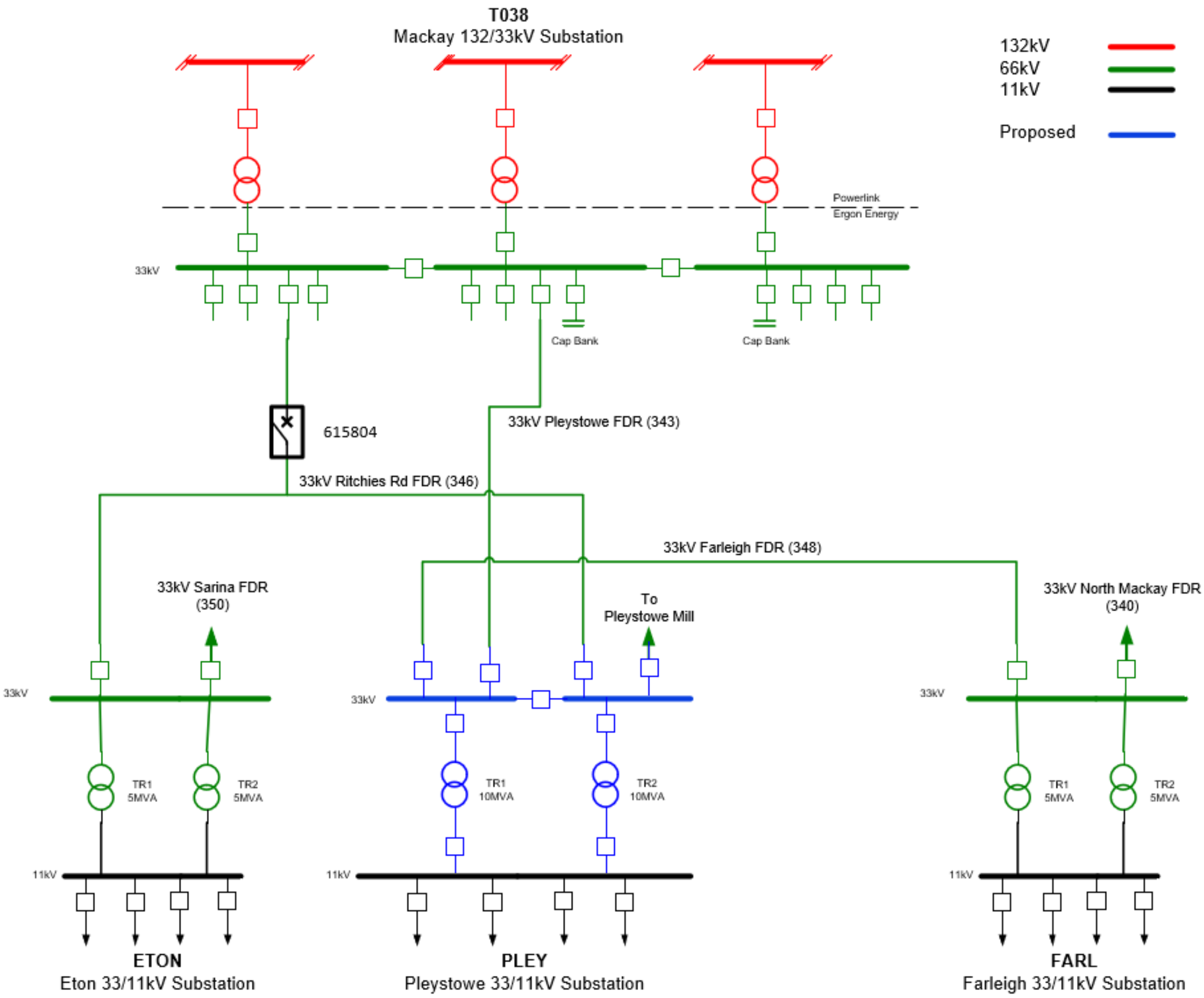

Figure 11: Option B proposed network arrangement (schematic view)

3.3. Preferred Network Option

Ergon Energy's preferred internal network option is Option B, to install two new 10MVA 33/11kV transformers, recover the three existing transformers, upgrade secondary systems and install a new 33kV switchboard in a new control building at Pleystowe Substation.

Upon completion of these works, the asset safety and reliability risks at Pleystowe 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 $9.74 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-2021 and construction completed by February 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 Pleystowe 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 Pleystowe. 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 irrigation load appear to drive the daily peak demand which generally occurs between 6:00pm and 10:00pm.

There are 1446 customers on tariff T31 and T33 hot water load control (LC). An estimated demand reduction value of 868kVA[1] is available.

Pleystowe Substation LC signals are controlled from T038 Mackay Bulk Supply Substation (MACK). 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 Mackay Bulk Supply Substation exceeds 105MW. This strategy does not directly address demand peaks experienced at Pleystowe. 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.

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.

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

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 701 customers have solar photo voltaic (PV) systems for a connected inverter capacity of 3,475kVA.

The daily peak demand is driven by residential customer demand and the peak generally occurs between 6:00pm and 10:00pm. 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.

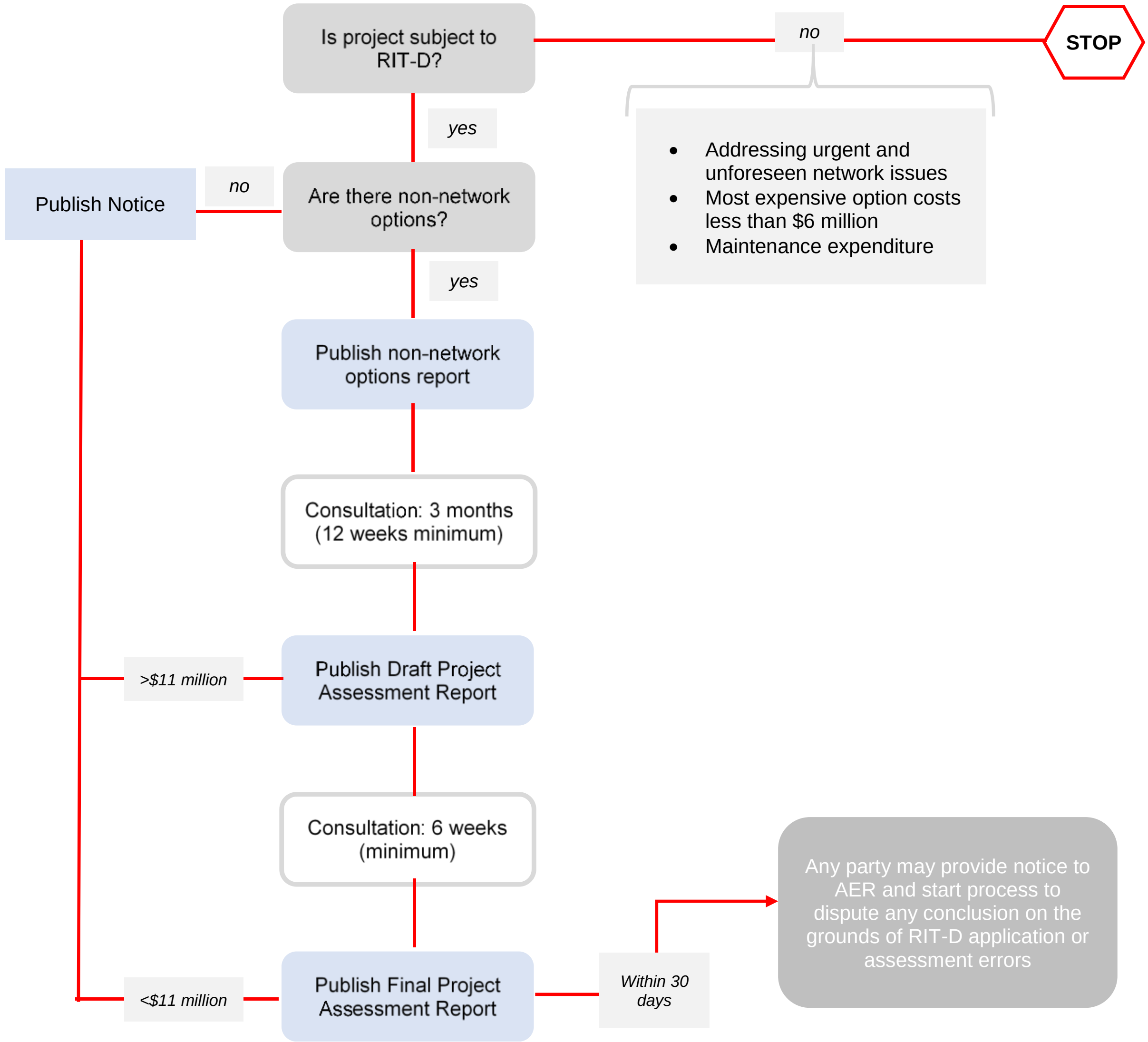
However, only a small percentage of customers in this supply area have solar PV systems and possibly none have a BESS. PV systems with BESS present a future portfolio opportunity for potential demand response but currently this supply area has a very limited solar/BESS. Solar customers without a BESS 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 Pleystowe area to address the identified need.

The preferred network option is Option B - to replace the assets in poor condition. 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 – The RIT-D Process



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