Regulatory Investment Test for Distribution (RIT-D)

Addressing Reliability Requirements in the Pampas Network Area

Notice of Screening for Options

2 November 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

Pampas substation (PAMP) consists of two 33/11kV 5MVA transformers as well as 33kV and 11kV outdoor bus. The support structures for part of the outdoor 33kV bus and complete 11kV bus is pipework which is now more than 50 years old. The existing substation 11kV bus configuration prevents further expansion, and the 33/11kV transformers have been deemed to reach their retirement age in 2027, after almost 60 years in operation.

Millmerran 33/11kV Substation is located downstream of Pampas Substation via 33kV feeder F3530 and was previously connected via a 33kV voltage regulator R1 located at Pampas substation. Due to an internal regulator fault in April 2022, Regulator R1 at Pampas is to be replaced with a pole mounted regulator in a return to service project. The regulator had originally been flagged as an identified need for replacement, however, has been removed from this scope given works will be completed before construction on this project begins. Millmerran 33/11kV Substation supplies approximately 1300 customers of which 76% are residential and 24% are commercial, agricultural, and industrial.

The 33/11kV transformers TR1 and TR3 at Pampas Substation were manufactured by AEI Engineering in 1965. Both transformers are fitted with AEI tap changers, which are considered to have good reliability. However there has been numerous oil leaks reported on the transformers which have been repaired over time. A Condition Based Risk Management (CBRM) analysis has been undertaken with the following assets deemed to reach retirement age:

- 33/11kV 5MVA transformer T1 by 2027;
- 33/11kV 5MVA transformer T2 by 2027;
- 11kV isolators are all beyond estimated retirement age.

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 Pampas 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 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

Pampas 33/11kV Substation (PAMP) is located approximately 60km southwest of Toowoomba. The substation is part of the Toowoomba and Southwest region 33kV sub-transmission network and takes supply from Yarranlea 110/33kV Bulk Supply Substation (YARA) via a 33kV feeder F3867.

Pampas substation supplies Pampas and the surrounding Condamine Plains, Yandilla, and Brookstead localities via four 11kV feeders. Pampas Substation provides electricity supply to approximately 630 primarily rural premise, of which 56% are residential and 44% 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.

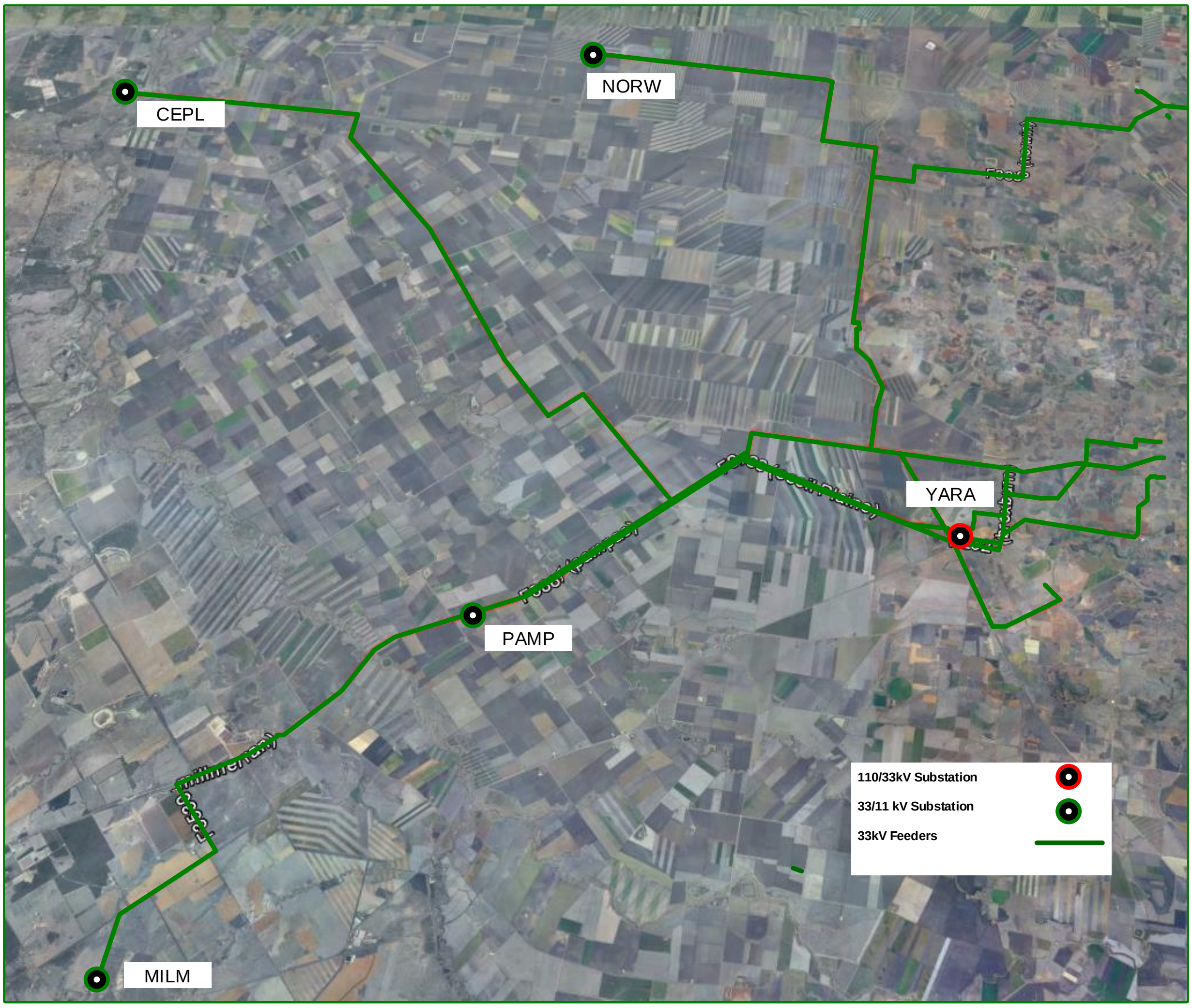


Figure 1: Existing network arrangement (geographic view)

1.2. Existing Supply System

Pampas 33/11kV Substation (PAMP) is located approximately 60km southwest of Toowoomba. The substation is part of the Toowoomba and Southwest region 33kV sub-transmission network and takes supply from Yarranlea 110/33kV Bulk Supply Substation (YARA) via 33kV feeder F3867. Pampas substation supplies Pampas and the surrounding Condamine Plains, Yandilla, and Brookstead localities via four 11kV distribution feeders (Anchorfield F2075, St. Ronans F4230, Yandilla F4715, Lemon Tree F3385) each protected by an automatic circuit recloser (ACR).

Pampas substation consists of an outdoor 33kV and 11kV switchyard with steel structures, two 5MVA ONAN 33/11kV power transformers, a NOMAD connection bay, and a small protection and control building. There is one local station services transformer which is a 25kVA 11/0.415kV transformer with year of manufacturer 2012 supplied from the 11kV bus and supported by a structure below the 11kV pipe support bus structure.

There are five existing 11kV feeder ties between the four Pampas substation 11kV feeders. Three 11kV ties between F4715 and F3385, one between F4715 and F4230, and one between F4230 and F2075.

The four Pampas substation 11kV feeders also contain seven existing 11kV distribution feeder ties to Millmerran Town Feeder, Brookstead feeder, Clifton West feeder, Evanslea feeder, Haslemere feeder, and two ties to Mywybilla feeder. There is also one 12.7kV SWER tie at the end of the Yandilla 11kV feeder to Thanes Ck SWER. Pampas substations Yandilla feeder also includes a Pegasus Connection point near Kirby Rd, Leyburn.

Millmerran 33/11kV Substation is located downstream of Pampas Substation via 33kV feeder F3530 with ties into Pampas Substation and was previously connected via a 33kV voltage regulator R1 located at Pampas substation. Due to an internal regulator fault April 2022 Regulator R1 at Pampas is to be replaced with a pole mounted regulator in return to service project with a pole mounted inline regulator proposed external to Pampas substation. Millmerran 33/11kV Substation supplies approximately 1300 customers of which 76% are residential and 24% are commercial, agricultural, and industrial.

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

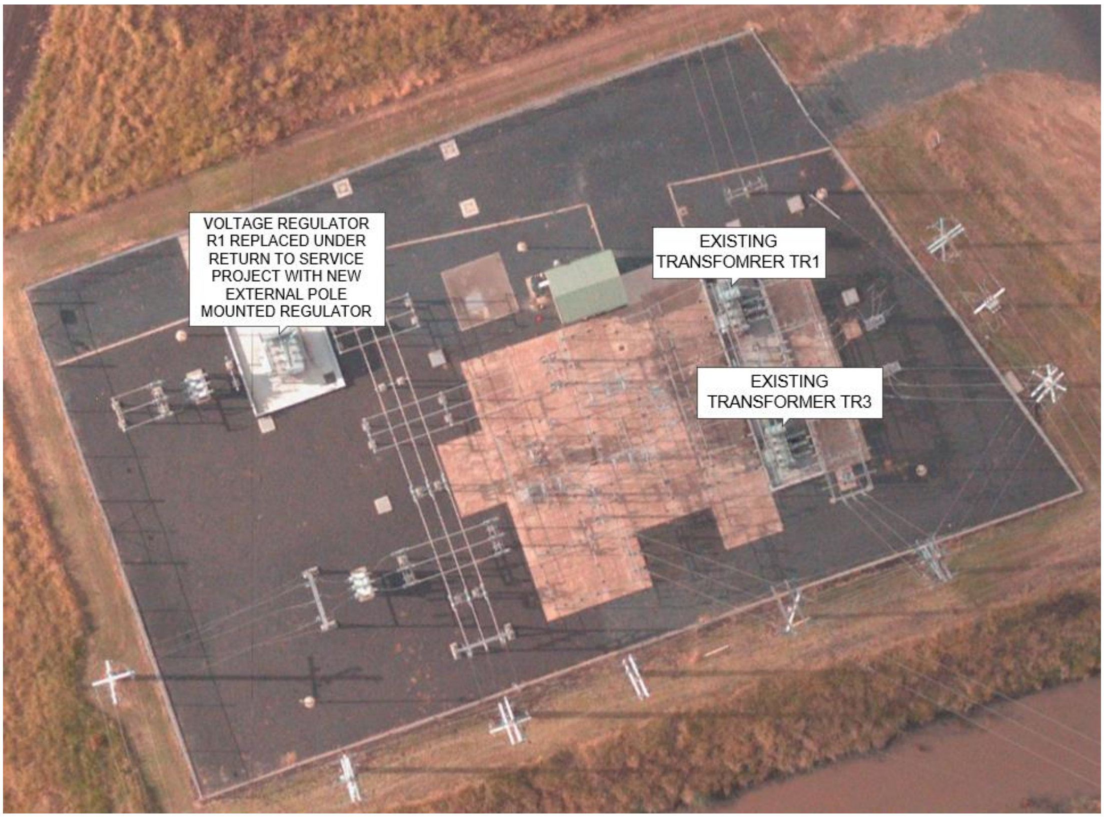

VOLTAGE REGULATOR R1 REPLACED UNDER RETURN TO SERVICE PROJECT WITH NEW EXTERNAL POLE MOUNTED REGULATOR
EXISTING TRANSFOMRER TR1
EXISTING TRANSFORMER TR3

Figure 3.

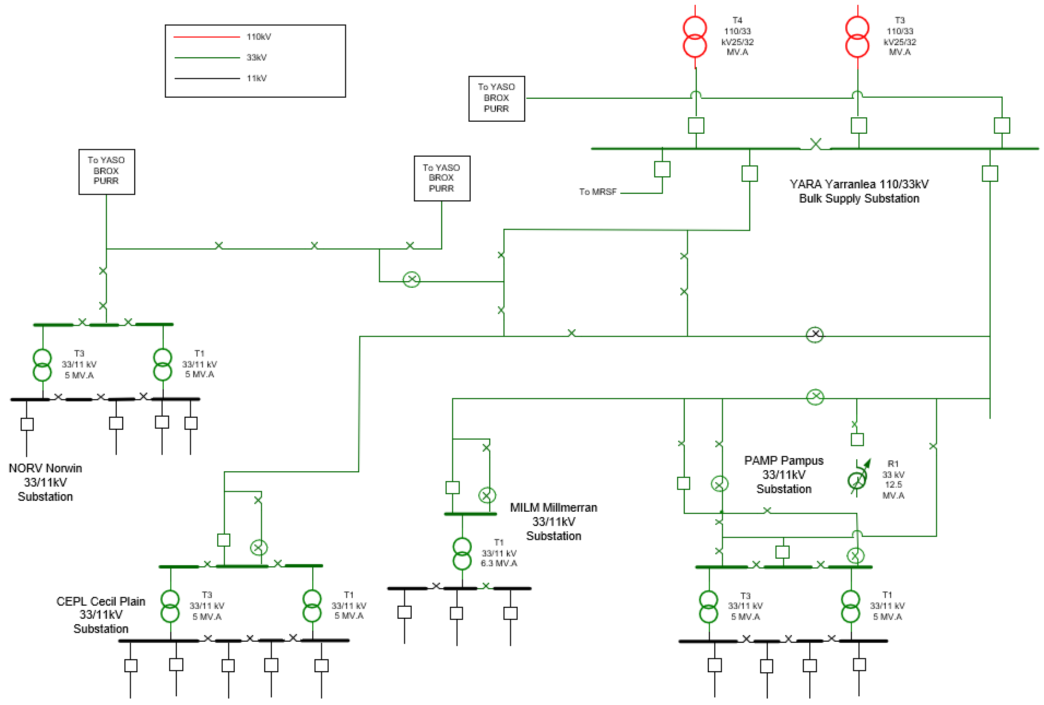


Figure 2: Existing network arrangement (schematic view)

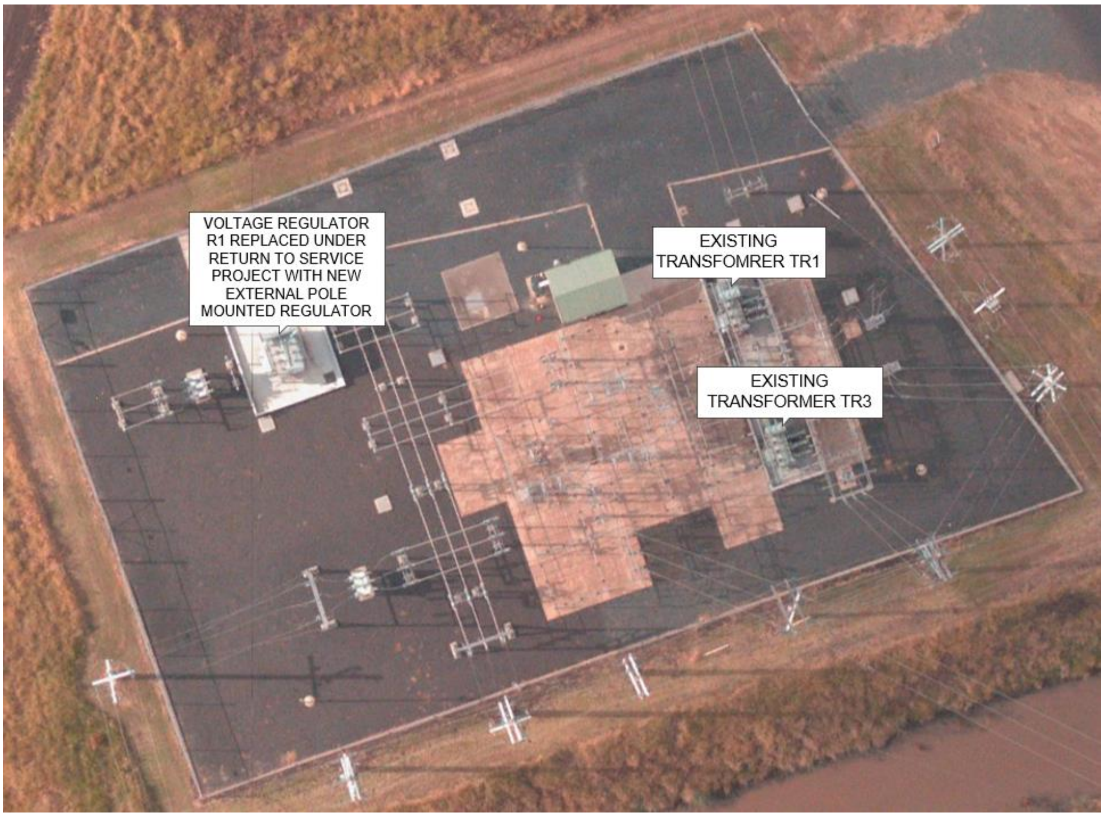


Figure 3: Pampas Substation (geographic view)

1.3. Load Profiles / Forecasts

The load at Pampas Substation comprises a mix of residential and agricultural/commercial 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 Pampas Substation over the 2022/23 financial year is shown in Figure 4. It can be noted that the peak load occurs during summer.

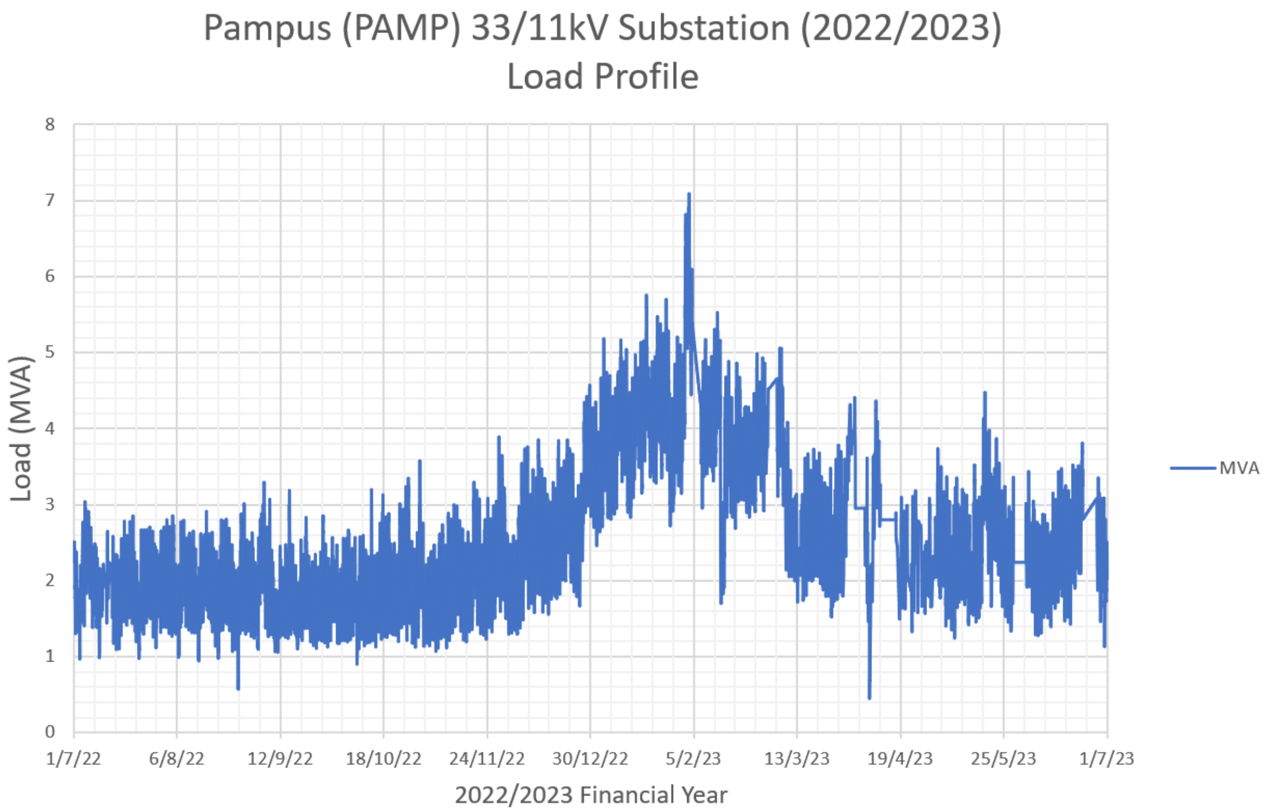


Figure 4: Substation actual annual load profile

1.3.2. Load Duration Curve

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

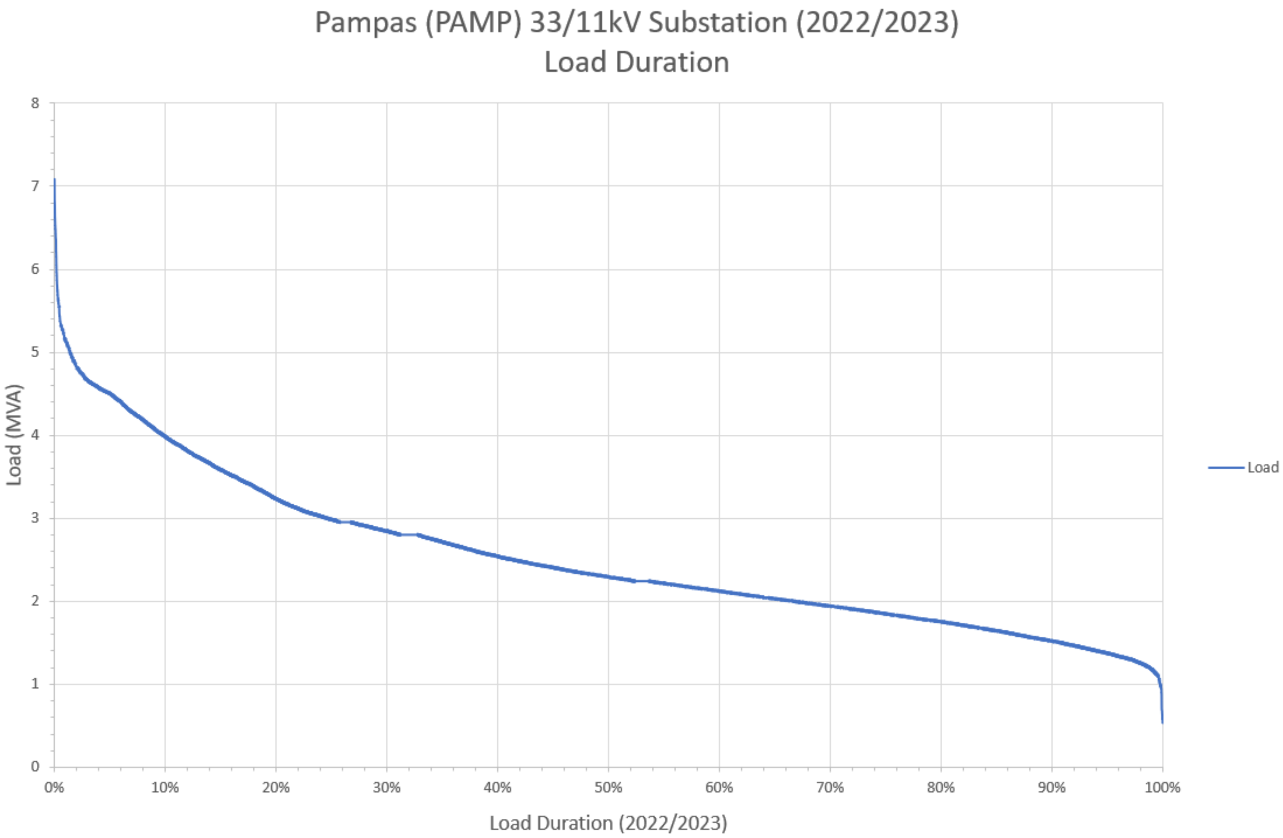


Figure 5: Substation load duration curve

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 during the 2022/23 period at Pampas Substation are mornings.

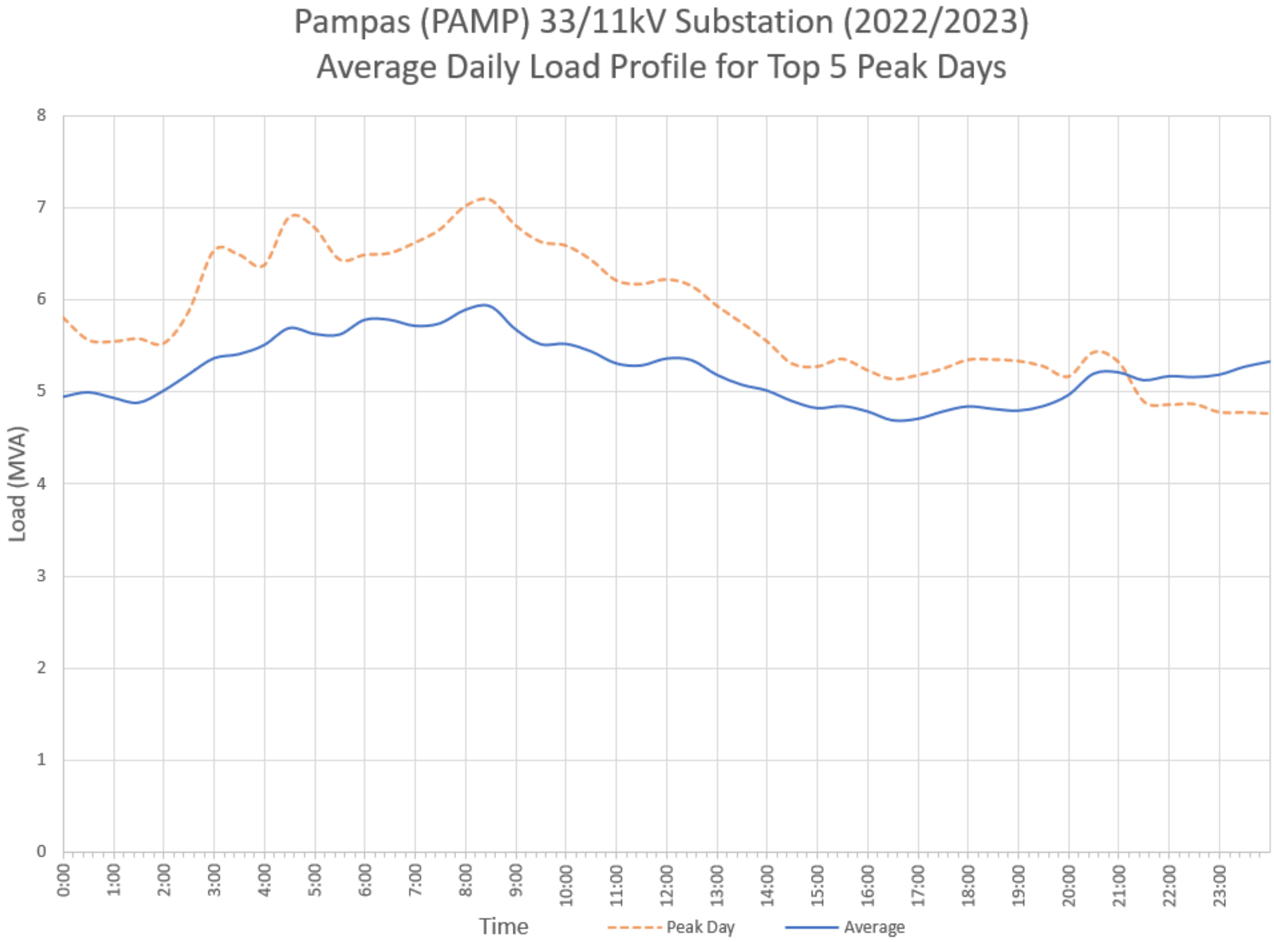


Figure 6: Substation average peak weekday load profile (summer)

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.

It can be noted that the historical annual peak loads have fluctuated over the past five years, possibly 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.

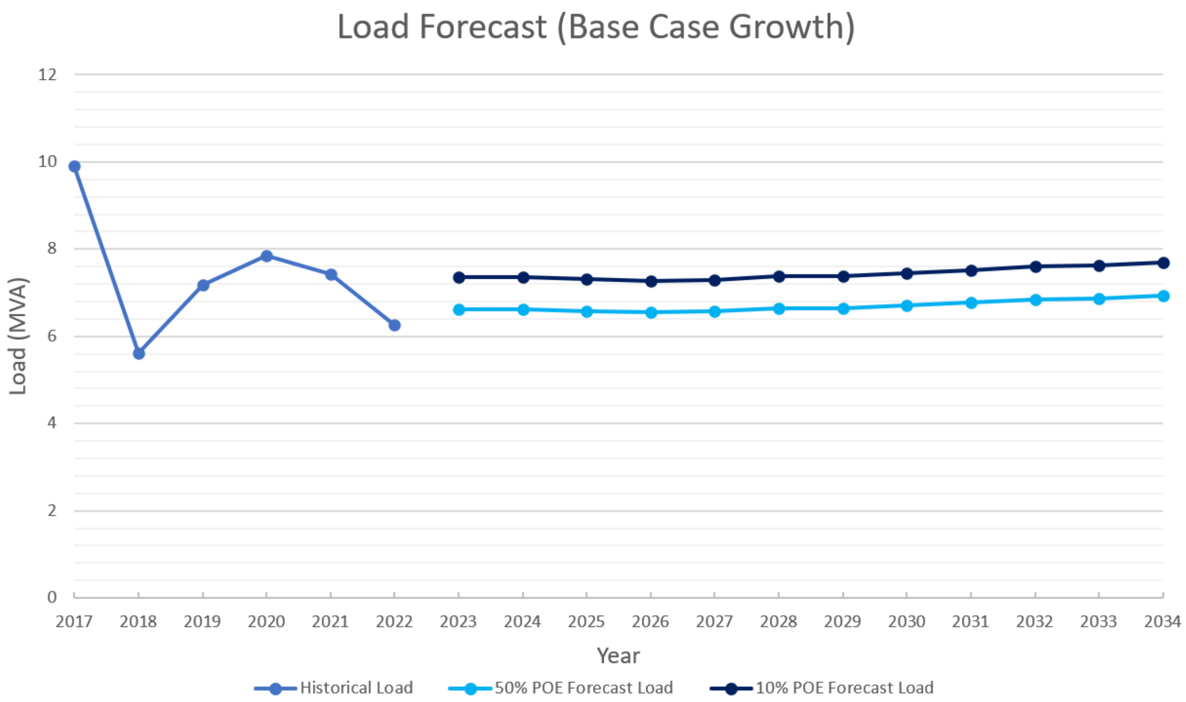


Figure 7: Substation base case load forecast

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.

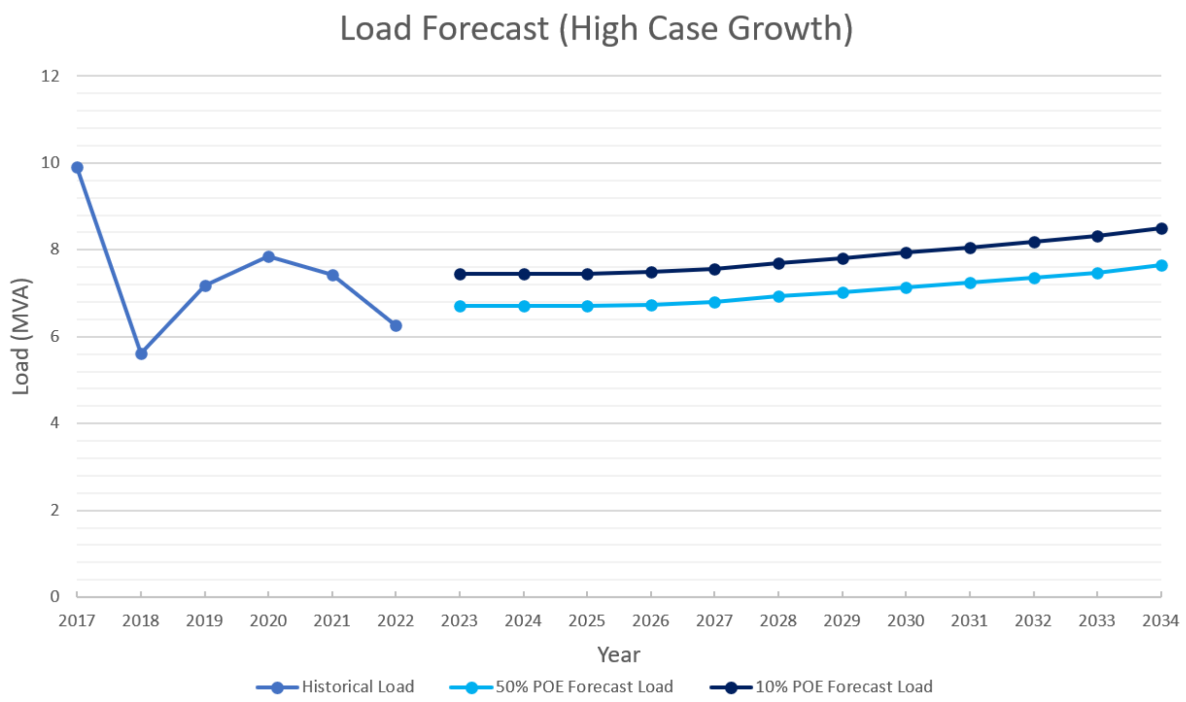


Figure 8: Substation high growth load forecast

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.

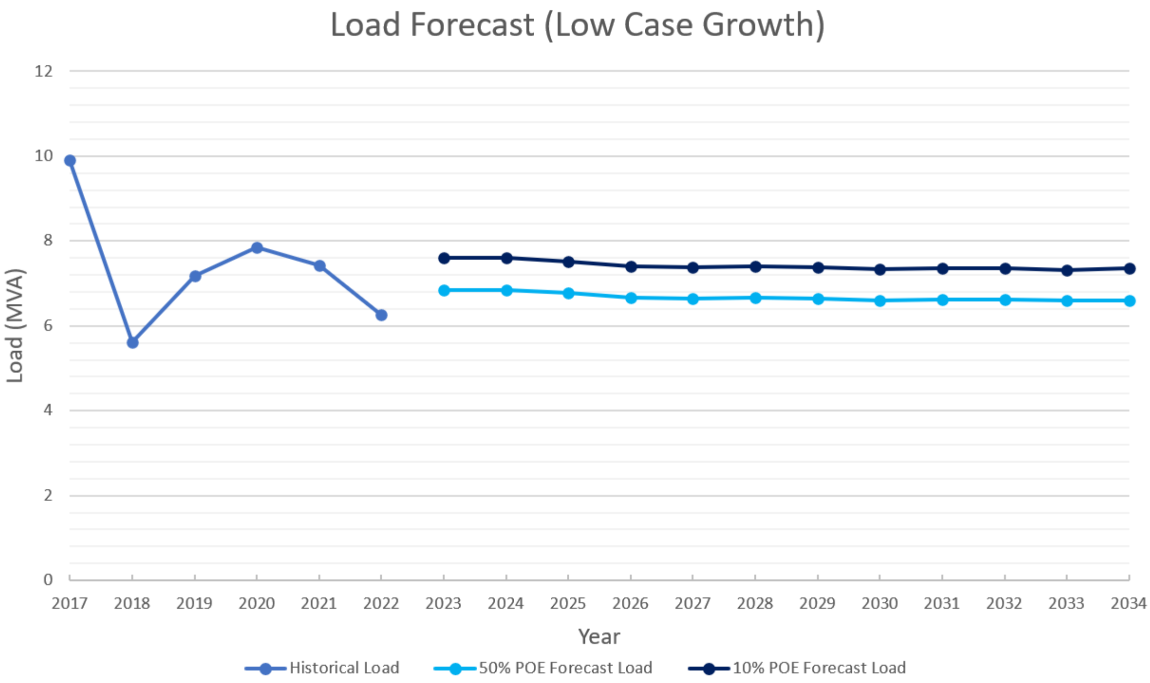


Figure 9: Substation low growth load forecast

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 several critical assets are at end of life and are in poor condition. The condition of these assets presents a considerable safety, environmental and reliability risk.

Based on Condition Based Risk Management (CBRM) analysis of the current condition and age on the expected life of the two existing 33/11kV power transformers they are deemed to reach retirement age by 2027, and the 11kV isolators are beyond noted retirement age. There have been numerous oil leaks reported on the transformers and repair has been completed over time. Additionally, the existing pipe work bus structure for part of the outdoor 33kV bus and the complete 11kV bus are more than 50years old, with the 11kV bus configuration preventing further expansion.

The deterioration of these primary assets pose safety risks to staff working within the switchyard. It also poses a safety risk to the public, though the increased likelihood of 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.

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

Under the existing sub-transmission network configuration any fault within Pampas Substation will result in an outage to all the customers supplied from Pampas and Millmerran Substations. This affects almost 1,900 customers and results in a combined peak load at risk of approximately 10MVA.

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 feeders supplied from Pampas and Millmerran Substations are shown in Table 1.

Feeder	Category	Customer number	Feeder 3 year average SAIDI	Category SAIDI target	Feeder 3 year average SAIFI	Category SAIFI target
Lemontree	Short Rural	55	1102	424	4.66	3.95
Yandilla	Long Rural	385	902	964	4.16	7.40
St Ronans	Short Rural	52	1565	424	5.50	3.95
Anchorfield	Short Rural	142	1466	424	7.38	3.95
Bringalily	Long Rural	373	1549	964	6.99	7.40
Rocky Creek	Short Rural	91	777	424	4.49	3.95
Millmerran Town	Short Rural	798	796	424	4.85	3.95

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

Feeder reliability classifications are defined below:

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

2.1.3. Safety Net Non-Compliance

The two existing 5MVA 33/11kV transformer arrangement, and the proposed preferred option of two new 5/8MVA 33/11kV transformers at Pampas Substation does not currently have any Safety Net breaches. All credible Non-Network options for Pampas must be capable of meeting the Rural Area safety net requirements. Below is the Ergon Energy Safety Net table – Interpretation Outage Times by Unsupplied Load.

Sub-transmission network type		
Regional Centre	Unsupplied Load	Allowed Outage Duration
	> 20 MVA	≤ 60 minutes
	> 15MVA ≤ 20MVA	≤ 6 hours
	> 5MVA ≤ 15MVA	≤ 12 hours
	≤ 5MVA	≤ 24 hours
	0MVA	> 24 hours (full restoration)
Rural Area	Unsupplied Load	Allowed Outage Duration
	> 20 MVA	≤ 60 minutes
	> 15MVA ≤ 20MVA	≤ 8 hours
	> 5MVA ≤ 15MVA	≤ 18 hours
	≤ 5MVA	≤ 48 hours
	0MVA	> 48 hours (full restoration)

Figure 10: Ergon Energy Safety Net Table

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 Pampas area to address the identified need.

3.2. Network Options Identified

Ergon Energy has identified two (2) credible network options that will address the identified need.

3.2.1. Option A: Replace 5 MVA, 33/11kV Transformers with 5/8 MVA 33/11 kV units and Replace 11kV bus with 11kV RMUs.

To address the limitation at Pampas zone substation it is proposed to replace existing 33/11kV transformers with 5/8 MVA 33/11kV units. This option also includes replacement of all pipe work bus support structures. Works include:

- Extend electric perimeter fence and earth grid to suit new installations or utilise existing substation yard if suites.
- Construct foundations for new 33/11kV transformers, 33kV circuit breakers, 33kV disconnectors, 11kV RMUs and station service transformer
- Install control building to house protection and control panels.
- Modify/Construct oil contamination tank if required and connect transformer bunding.
- Investigate the existing earth grid and improve as required.
- Recover and scrap 33/11kV transformer T1 and T2.
- Install 5/8 MVA, 33/11kV new transformers to replace T1 and T2.
- Install 33kV circuit breakers for new transformers T1 and T2.
- Install new 33kV bay for Cecil Plain 33kV feeder.
- Install 33kV disconnectors on 33kV bus as required.
- Recover and scrap 11kV bus, bus supports and reclosers.
- Install 2 X 12kV outdoor VVVVV type RMU’s or equivalent to replace 11kV feeder reclosers and 11kV bus.
- Install protection panels for new transformers, 33kV and 11kV feeders.

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

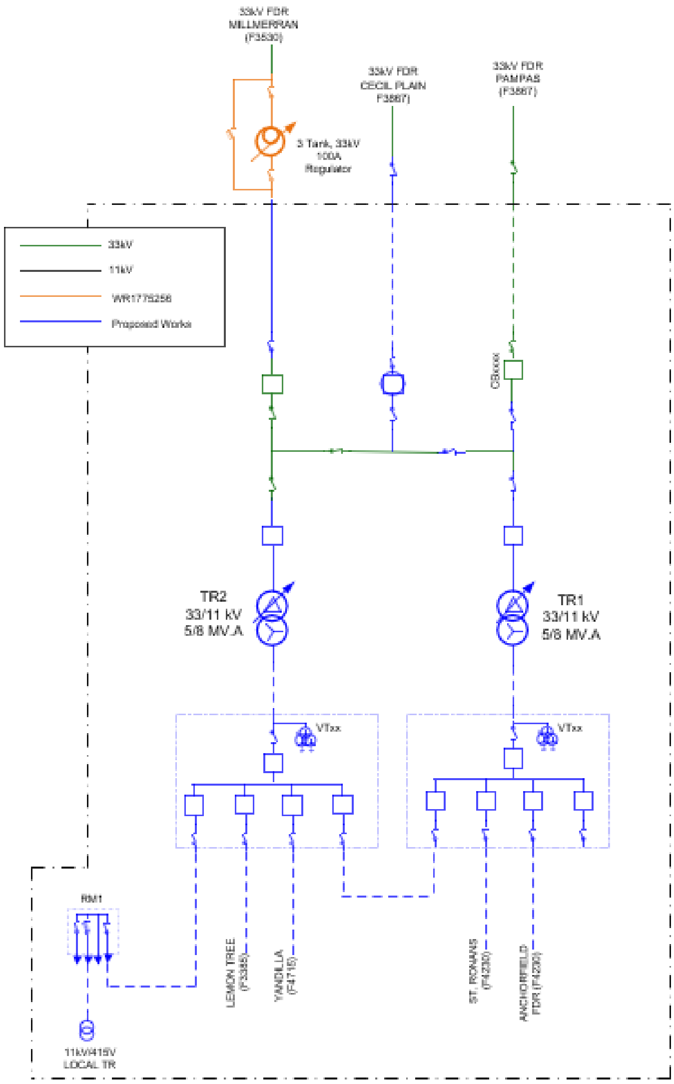


Figure 10: Option A proposed network arrangement (schematic view)

3.2.2. Option B: Install a new 5/8 MVA, 33/11kV transformer, install a new 33kV Regulator and Existing Transformers Run to Failure

This option proposes to install a new 5/8 MVA, 33/11kV transformer, install a new 33kV regulator and leave existing transformers to run to fail. Scope includes:

- Extend electric perimeter fence and earth grid to suit new installations.
- Install control building to house protection and control panels.
- Modify/Construct oil contamination tank if required and connect transformer bunding.
- Investigate the existing earth grid and improve as required.
- Construct foundations for new 33/11kV transformer, 33kV and 11kV transformer circuit breakers and 33kV regulator.

- Install 15 MVA, 33/33kV voltage regulator.
- Install a new 5/8 MVA, 33/11kV new transformer.
- Install 33kV and 11kV circuit breakers and a 33kV isolator for new transformer.
- Install 33kV and 11kV cables for new transformer.
- Install 33kV disconnector on 33kV bus for 33kV incoming feeder.
- Install protection panels for new transformers and 33kV feeders.
- Recover and scrap 11kV VTs 1VT and 3 VT. Replace 1VT and 3VT with standard units.
- Recover and scrap 33kV disconnector AB17376 and IS92902359 and replace AB17376 with a standard 33kV disconnectors.
- Recover and scrap 11kV disconnectors AB10445, AB3593, AB3594, AB3595, AB3596, AB7170, AB7171 and AB7172 with standard 11kV disconnectors.

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

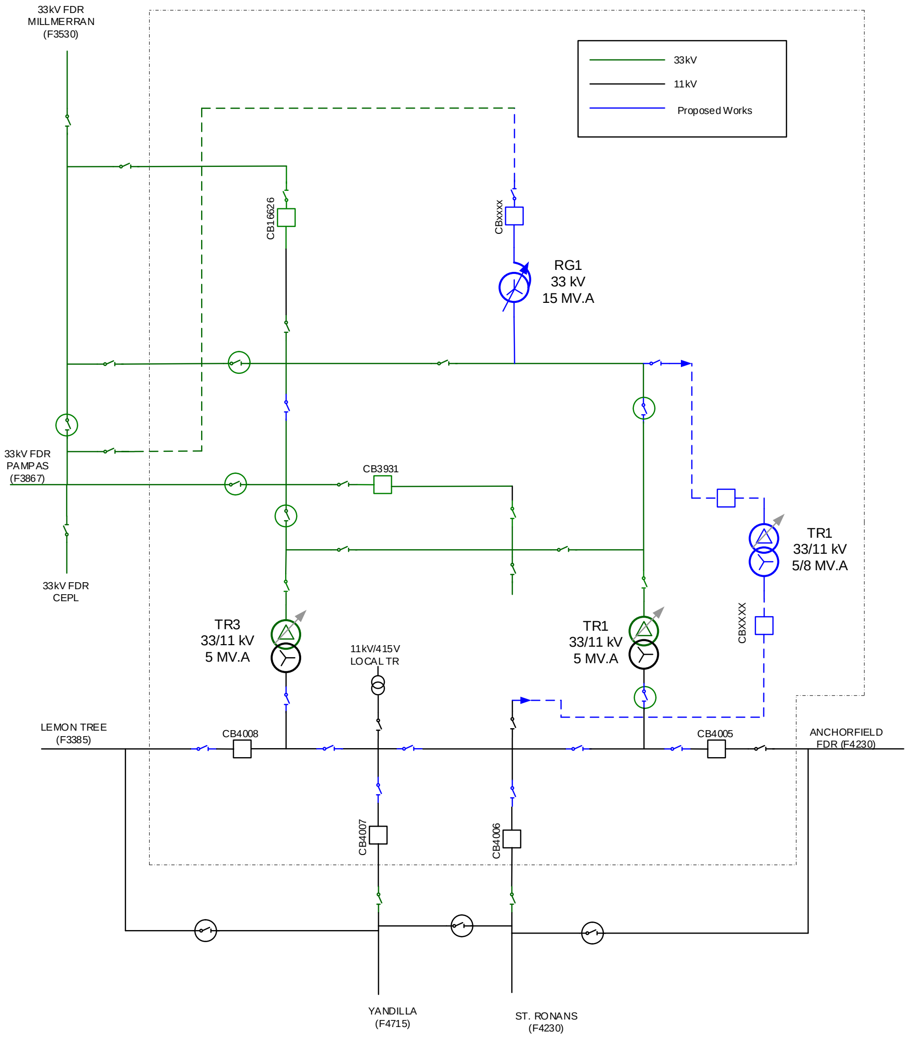


Figure 11: Option B proposed network arrangement (schematic view)

3.3. Preferred Network Option

Ergon Energy's preferred internal network option is Option A, to install two new 5/8MVA 33/11kV transformers including required civil works, recover the two existing transformers, replace existing 11kV pipe work bus and reclosers with two new 12kV outdoor RMU's, and construct new 33kV bay for Cecil Plains 33kV feeder connection at Pampas Substation.

Upon completion of these works, the asset safety and reliability risks at Pampas 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 $10.385 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 2024 and construction completed 2027.

4. ASSSESSMENT OF SAPS AND NON-NETWORK SOLUTIONS

Ergon Energy has considered Standalone Power Systems (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 Pampas region could not be supported by a network that is not part of the interconnected national electricity system.

4.2. Demand Management (Demand Reduction)

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

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

The DEM team has completed a review of the Pampas 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 Pampas. It has been determined that most demand management options will not be viable propositions and have been explored in the following sections.

4.2.1. Network Load Control

The residential customers and irrigation load appear to drive the daily peak demand which generally occurs in the morning around 7am to 9am or the afternoon around 5pm to 7pm.

There are 263 customers on load control (LC) tariffs. An estimated demand reduction value of 157.8kVA[1] is available.

Pampas Substation LC signals are controlled from T010 Yarranlea 110/33kV Bulk Supply Substation (YARA). 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 Yarranlea Substation exceeds 23.5MW. This strategy does not directly address demand peaks experienced at Pampas. Therefore, network load control would not sufficiently address the identified need.

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

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 177 customers have solar photo voltaic (PV) systems for a connected inverter capacity of 2,193kVA at Pampas Substation. A total of 380 customers have solar photo voltaic (PV) systems for a connected inverter capacity of 2,779kVA at Millmerran Substation.

The daily peak demand is driven by residential, industry and irrigation demand and the peak generally occurs in the morning around 7am to 9am or the afternoon around 5pm to 7pm. 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.

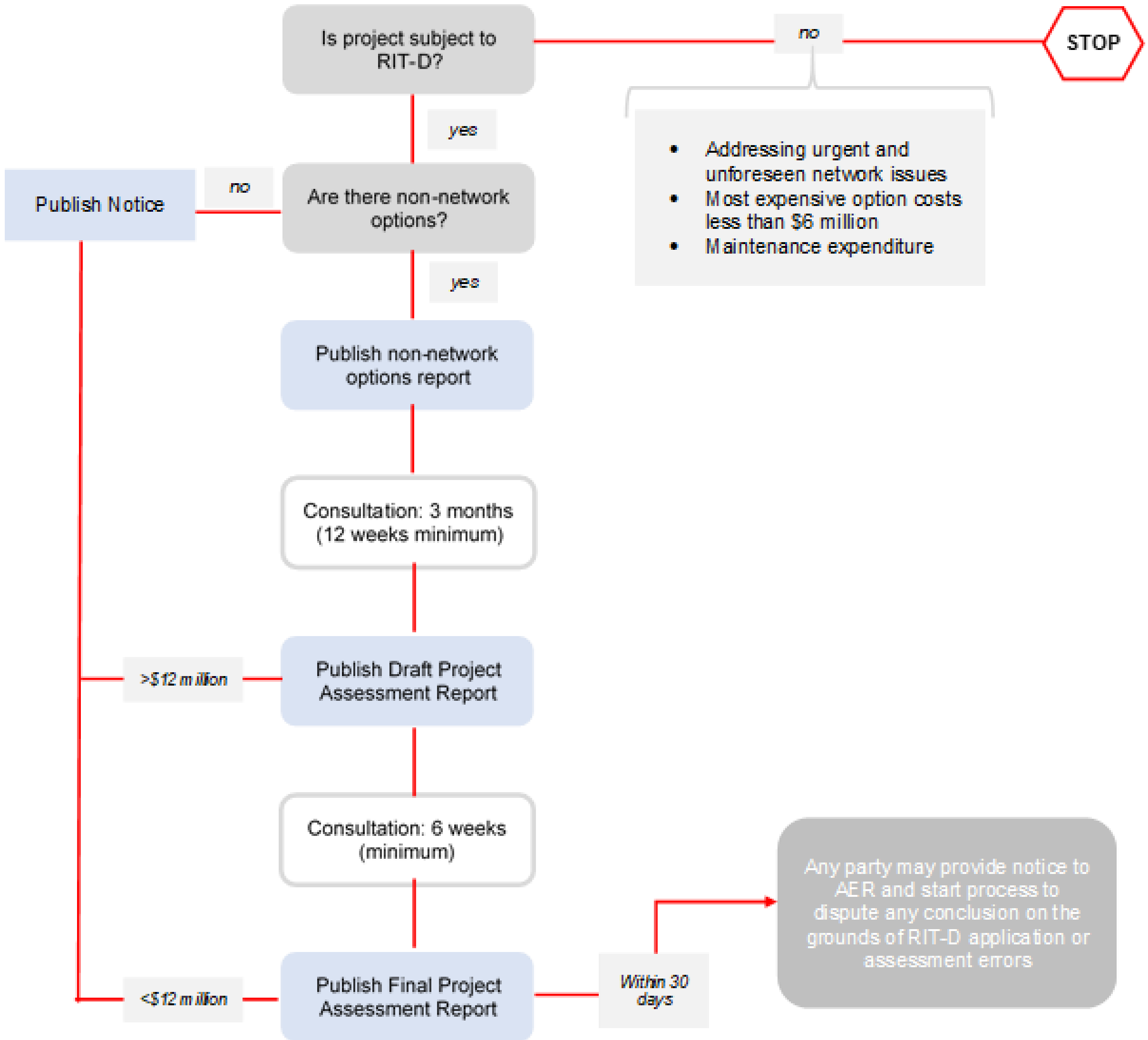
However, only a small percentage of customers in this supply area have solar PV systems and possibly none have a BESS. PV systems with BESS present a future portfolio opportunity for potential demand response but currently this supply area has a very limited solar/BESS. Solar customers without a BESS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

The preferred network option is Option A - to replace the assets in poor condition. This notice 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.