



Final Project Assessment Report

ublication Date: 31 October 2019

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1.Executive Summary

Ergon Energy Corporation Limited (Ergon Energy) has determined that there is no non-network solution that can become a potential credible option, or that forms a significant part of a potential credible option to address the identified need in the North Toowoomba electricity supply areas covered by Meringandan, Highfields and Cawdor substations. Accordingly, Ergon Energy has published a Notice of No Non-Network Options under clause 5.17.4(d) of the National Electricity Rules NER on 29/10/2019.

This Final Project Assessment Report (FPAR) has been prepared by Ergon Energy in accordance with the requirements of clause 5.17.4(p) of the NER as the final step of this RIT-D process.

This report includes information relating to the following matters:

- A description of the identified need Ergon Energy is investing in;
- The assumptions used in identifying the need;
- A description of each credible option assessed by Ergon Energy and their;
 - applicable cost, including breakdown of operating and capital expenditure;
- a detailed description of the methodologies used in quantifying each class of cost
- results of a net present value analysis of each credible option and supporting explanatory statements;
- identification of Ergon Energy's proposed preferred option, including:
 - o details of the technical characteristics;
 - \circ $\;$ the estimated construction timetable and commissioning date;
 - o indicative capital and operating cost;
 - a statement of accompanying detailed analysis that the proposed preferred option satisfies the RIT-D.

Under its Distribution Authority (DA) Ergon Energy is responsible for electricity supply to the North Toowoomba area in Southern Queensland. The DA requires that Ergon Energy must:

- comply with the Guaranteed Service Levels regime notified by the Queensland Regulator which includes reliability of supply to customers;
- plan and develop its supply network in accordance with good electricity industry practice, having regard to the value that end users of electricity place on the quality and reliability of electricity services;
- use all reasonable endeavours to ensure that it does not exceed in a financial year the Minimum Service Standards (System Average Interruption Duration Index (SAIDI) and System Average Interruption Frequency Index (SAIFI) limits) applicable to its feeder types; and
- ensure, to the extent reasonably practicable, that it achieves its Safety Net targets.

Meringandan (MERN) 33/11kV substation is one of a number of substations located in the North of Toowoomba that supplies electricity to the residential developments in the area. MERN supplies approximately 3500 predominantly residential customers and recorded a peak load of 11.7MVA in the summer of 2017. Other substations in this area are Cawdor Skid (CAWD) 33/11kV and Highfields (HIGH) 33/11kV substations. The Northern suburbs of Toowoomba are highlighted in

the Toowoomba Regional Council (TRC) Planning Scheme as a key growth area over the next 15 years. It is predicted that an additional 7000 residents will be living in the Highfields area by 2031, almost double the current population. This growth is resulting in increased loading on MERN, CAWD and HIGH substations.

Furthermore, MERN and HIGH substations were built in the 1960s. A number of assets are in very poor condition, approaching or are at end of service life. The continued operation of these aging assets is expensive and uneconomical, and poses a significant challenge in maintaining a reliable supply to the distribution area.

The first objective of the proposed investment is to maintain a safe and sustainable energy supply to customers by managing the lifecycle of aged plant at MERN and HIGH substations.

The second objective is to ensure that there is sufficient capacity in the network to meet existing and future customer demand and to avoid customer load shedding during peak demand.

The third objective is to provide a secure and reliable energy supply to customers by ensuring that the network meets Ergon Energy's statutory network security and reliability performance standards.

Ergon Energy is confident that no non-network option exists that is technically or economically viable to; 1) remove the need for replacing the aged assets at MERN and HIGH substations within the required timeframe, 2) meet the increasing demand at CAWD, HIGH and MERN substations and 3) meet Ergon Energy's statutory network security and reliability performance standards to ensure the safe, reliable and efficient supply of electricity to the customers. Consequently, a Non-Network Options Report has not been prepared in accordance with rule 5.17.4(c) of the NER and a notice was published on 29/10/2019.

2.Next Steps

This Final Project Assessment Report represents the final stage of the RIT-D process to address the identified need in the North Toowoomba supply areas of Meringandan, Highfields and Cawdor. Ergon Energy intends to commence with the preferred network option which is to develop Kleinton (KLEI) substation.

2.1. Publication of the FPAR

This Final Project Assessment Report (FPAR) has been prepared by Ergon Energy in accordance with the requirements of clause 5.17.4(p) of the NER as the final step of this RIT-D process. Ergon Energy published a Notice of No Non-Network Options under clause 5.17.4(d) of the NER on 29/10/2019.

This report includes information relating to the following matters:

- A description of the identified need Ergon Energy is investing in;
- The assumptions used in identifying the need;
- A description of each credible option assessed by Ergon Energy and their;
 - o applicable cost, including breakdown of operating and capital expenditure;
- a detailed description of the methodologies used in quantifying each class of cost
- results of a net present value analysis of each credible option and supporting explanatory statements;
- identification of Ergon Energy's proposed preferred option, including:
 - o details of the technical characteristics;
 - the estimated construction timetable and commissioning date;
 - o indicative capital and operating cost;
 - a statement of accompanying detailed analysis that the proposed preferred option satisfies the RIT-D.

2.2. Dispute Resolution Process

In accordance with the provisions set out in clause 5.17.5(a) of the NER, Registered Participants or Interested Parties may, within 30 days after the publication of this report, dispute the conclusions made by Ergon Energy in this report with the Australian Energy Regulator. Accordingly, Registered Participants and Interested Parties who wish to dispute the analysis, conclusions, or recommendations outlined in this report must do so within 30 days of the publication date of this report. Any parties raising such a dispute are also required to notify Ergon Energy by using Ergon Energy's "Regulatory Investment Test for Distribution (RIT-D) Partner Portal". The portal is available at:

https://www.ergon.com.au/network/network-management/network-infrastructure/regulatory-testconsultations

If no formal dispute is raised, Ergon Energy will proceed with the preferred network option to develop Kleinton substation.

2.3. Contact Details

Inquiries about this RIT-D may be sent to:

E: demandmanagement@ergon.com.au

P: 13 74 66

3. Addressing reliability and capacity requirements

Highfields, a northern suburb of Toowoomba, and its surrounding suburbs are highlighted in the Toowoomba Regional Council (TRC) Planning Scheme for growth over the next 15 years. It is predicted that an additional 7000 residents will be living in the Highfields area by 2031. The existing population is 8131 (2016 census). Supporting this forecast is the number of approved large subdivisions in various stages of implementation in the area, such as Habitat Mt Kynoch (1000 lots), The Avenues (500+ lots) and Highfields North Estate (450 lots). The concentration of building activity in the MERN, CAWD and HIGH substation supply areas represents significant load growth over the next 5 to 10 years. To provide the infrastructure for these new residents, Toowoomba Regional Council has purchased 20 hectares of land in Highfields and created the Central Highfields Master Plan to develop the land with a mix of retail/commercial, residential, mixed use areas and civic spaces. Other drivers for growth in the area are the \$1.6B Toowoomba Second Range Crossing (TSRC) and the newly-constructed Brisbane West Wellcamp airport.

The primary driver of this project is the reliability and safety concerns due to the aging equipment at MERN and HIGH substations. In 2021 condition-based replacement is required for two 33kV circuit breakers, one 33kV voltage transformer, one 11/0.415kV 10kVA service transformer, two 33kV isolators and four 11kV isolators at MERN substation. To manage the reliability and safety concerns at HIGH substation, aged substation assets including 33/11kV 5MVA transformer T3 and one 33kV isolator are recommended to be replaced in 2024.

Due to the risk posed to reliability and safety from the asset condition in two of the area's zone substations, combined with the forecast load growth in the area over the next 15 years, it is essential to consider all the risks and impact to the security of supply in the area for the three zone substations in the North Toowoomba area.

3.1.Investment Objectives

Objective 1: Increase the reliability and maintain safety standards for customer supply by managing the lifecycle (year of manufacture, use, end of life) of primary plant at MERN and HIGH substations. Refer to Table 4 and Table 5 for the primary plant that is at its end of life as determined by the CBRM methodology.

Objective 2: Ensure that there is sufficient capacity available in the future to enable customers to connect new loads and to avoid customer load shedding during peak demand. Loads at MERN are forecast to exceed the safety net security of supply criteria in 2028 and loads at CAWD are already in breach of these criteria. Without addressing these constraints proactively, Ergon Energy will be unable to meet the responsibilities under its DA.

Objective 3: Provide a secure and reliable energy supply to customers by ensuring that the network meets Ergon Energy's statutory network security and reliability performance standards.

4.Substation load forecast, asset lifecycle management, and peak load profiles

4.1.Existing network

Figure 1 below illustrates the existing 33 kV network, interconnected substations, and power transformer capacity in the study area. Figure 2 is the geographical representation of the same area showing the close proximity of MERN substation to CAWD and HIGH substations.

As shown in Figure 2 and Figure 3, MERN substation is normally supplied by the 33kV Shirley Road feeder from Torrington T116 Bulk Supply Point substation, which is approximately 20km south of Meringandan. The alternate 33kV supply to MERN is via the Meringandan 33 kV feeder and the "pump loop" originating from Postmans Ridge 110/33/11 kV Bulk Supply Point substation (PORI).

CAWD is protected by a remote-controlled 33kV circuit breaker (CB) with a 'T' connection onto the 33kV Shirley Road feeder and has no alternate supply if there is a fault on the 20km long Shirley Road Feeder.

HIGH is also protected by a remote-controlled 33kV CB with a 'T' connection onto the Meringandan/Highfields 33 kV feeder and has no alternate supply if there is a fault on the 22km feeder.







Figure 2 - Geographic of the 33 kV supply network

Figure 3 - Geographic of 11 kV supply areas for MERN, CAWD and HIGH and the 33 kV network



4.2. Substation forecast and Safety Net

4.2.1. Meringandan substation

MERN substation supplies approximately 3500 predominantly residential customers in the Meringandan, Cabarlah and Highfields areas, including approximately 258 industrial customers and other retail/office complexes. Meringandan 11kV supply area is identified in green in Figure 3. MERN substation had a maximum demand of 11.7MVA on 12 February 2017. In case of a transformer contingency, 3.2MVA of load can be at risk. After temperature correction was considered, this load was considered higher than a Probability of Exceedance (10POE) 10 load forecast day. Figure 4 details the load forecast for MERN substation taken from the 2018 Strategic Planning Report – Toowoomba North. The Strategic Planning Report utilises the forecast from the Substation Investment Forecast Tool (SIFT) as it takes into consideration multiple local determinants and the long term forecast. The strategic planning forecast modelling methodology uses SIFT historic load growth, predicted population growth rates, incrementally "infills" for available land parcels in the zoning data, multivariate load densities for the commercial properties, and the impact of disruptive technologies such as batteries, solar, and electric vehicles. Each green line in Figure 4 represents a multivariate load forecast over the next twenty years for MERN substation.

Figure 4 - MERN substation load forecast



Table 1 - MERN substation load forecast and Safety Net

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
MERN Safety Net (MVA)	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2
MERN forecast (MVA)	11.7	11.8	12.0	12.1	12.3	12.4	12.6	12.7	12.9	13.0	13.2	13.5

The Safety Net limit for MERN substation is determined as 13.2MVA based on a 9.2MVA substation N-1 rating with 2MVA of temporary generation and 2MVA load transfer capacity. The load forecast against Safety Net limits, provided in Table 1 above, predicts that the Safety Net security of supply criteria will be breached in 2028.

4.2.2. Cawdor substation

CAWD substation currently supplies 2377 residential customers and 156 commercial/industrial customers. CAWD substation recorded the maximum demand on 12 February 2017 at 5.87MVA. 1.9MVA of load was assessed as the load at risk according to the Security of Supply Safety Net criteria. Figure 5 shows the load forecast for CAWD substation taken from the 2018 Strategic Planning Report – Toowoomba North. Table 2 shows the CAWD load forecast and its NCC rating.



Figure 5 - CAWD substation load forecast (including 1.6 MVA load transfer from NOST) and constraints

Table 2 - CAWD Substation load Torecast and NOO constraint												
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
CAWD NCC (MVA)	12	12	12	12	12	12	12	12	12	12	12	12
CAWD forecast (MVA)	3.87	3.90	3.93	5.6 ¹	5.9	6.0	6.1	6.3	6.5	6.7	6.9	7.1

CAWD is a single 33/11kV 10MVA SKID substation with a Safety Net limit of 4MVA (based on 2MVA temporary generation and 2MVA load transfer capacity). In 2017 and 2018, Cawdor substation load exceeded the Security of Supply Safety Net Criteria with maximum demands above 4MVA. In approximately 2021, 1.6MVA of load is planned to be transferred to CAWD substation which will result in the maximum demand of CAWD substation increasing to 5.6MVA which will further increase the Safety Net risk. If the SKID failed at peak load times, it is unlikely that full load could be restored within 24 hours to meet Safety Net.

¹ Includes a 1.6MVA load transfer from NOST in 2021

4.2.3. Highfields Substation

HIGH substation is equipped with one 33/11kV 5MVA transformer T3 and one 33/0.415kV 750kVA transformer T1. The HIGH substation site was established in 1957 with a single 33/0.415kV transformer T1 to supply the adjacent Toowoomba Regional Council pump station. T3 was added to the site in 2004 and supplies a single 11kV distribution feeder to the Highfields commercial centre and local residential areas. HIGH substation currently supplies 623 residential customers and 63 commercial/industrial customers. Maximum demand on the substation was recorded on 12/02/2017 of 2.52MVA. Maximum demand in 2018 was recorded at 1.98MVA on 14/02/2018. Figure 6 is the load forecast for HIGH substation taken from the 2018 Strategic Planning Report – Toowoomba North. Due to the low loading on HIGH substation, the interplay between the network support by residential battery systems and load impact from electric vehicles is evident in the strategic modelling and highlighted by the shaded yellow area in Table 3. The mean strategic forecast growth for HIGH substation was around 0.9% over the long term.



Figure 6 - HIGH substation forecast and constraint

Table 3 - HIGH substation load forecast and NCC constraint

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
HIGH NCC (MVA)	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75
HIGH forecast (MVA)	2.0	2.03	2.06	2.10	2.13	2.16	2.20	2.23	2.25	2.28	2.30	2.31

HIGH is a single 33/11kV 5 MVA substation with a Safety Net limit of 4MVA (based on 2MVA temporary generation and 2MVA load transfer capacity). HIGH substation forecast load over the next 10 years is predicted to be below the Security of Supply Safety Net Criteria.

4.3. Substation assets lifecycle management

4.3.1. Meringandan substation

MERN substation has a number of primary assets that have been identified (Table 4) to be retired in the next five years. Figure 7 highlights the assets in the substation single line diagram. Their retirement is based on a combination of Condition Based Risk Management (CBRM) modelling, age, known problematic operational and maintenance issues and the need to manage safety and network risk associated with unplanned failure. Figure 7 provides a visual of the extent of assets that require replacement up to 2025. CBRM is a structured process that combines asset information, engineering knowledge and practical experience to define the current and future condition, performance and risk for network assets. The process has been progressively applied for those asset classes where sufficient information is available to produce a health index and probability of failure for an individual asset.

Bay Description	Asset Type	Asset IDs (refer to SLD in appendices B&C)	Asset retirement year as modelled
33kV Bus	Voltage Transformer	SW MERN VT # ph VT93230587 1967 33kV ENDURANCE ELECTRIC > ### (R5020)	2021
33kV T1 Bay	Circuit Breaker	SW MERN CB3921 - CB92893989 1951 33kV - REYROLLE > ORT3/X3/QM (1SORT3-4)	2021
33kV T3 Bay	Circuit Breaker	SW MERN CB3922 - CB92893179 1952 33kV - REYROLLE > ORT3/X2/QM (HSORT3-26)	2021
33kV T1 Bay Bypass	Isolator	SW MERN AB7734 - IS92557229 1984 33kV ##A ### > ### (###)	2021
33kV T3 Bay Bypass	Isolator	SW MERN AB7735 - IS92231587 1984 33kV ##A ### > ### (###)	2021
11kV Bus	Local Transformer	FN MERN LOCAL TRANSF 1 - TD92326793 1959 11/0.415 kV 10kVA Crompton Parkinson (21065)	2020
11kV bus Meringandan fdr	Isolator	SW MERN AB7742 - IS92694943 1980's 11kV ##A ### > ### (###)	2021
11kV bus Rogers Drive fdr	Isolator	SW MERN AB17595- IS93650820 1971 11kV ##A ### > ### (###)	2021
11kV bus O'Brien's Rd fdr	Isolator	SW MERN AB7744 - IS92691642 1971 11kV ##A ### > ### (###)	2021
Cabarlah Fdr	Nulec controller	SW MERN - PR93209638 1998 - SCHNEIDER > NULEC CAPM4 - FB52 - 11kV Feeder (OC, EF, SEF, AR)	2023

Table 4 - Meringandan substation CBRM asset list (up to 2025)

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Bay Description	Asset Type	Asset IDs (refer to SLD in appendices B&C)	Asset retirement year as modelled
Meringandan Fdr	Nulec controller	SW MERN - PR93206989 2000 - SCHNEIDER > NULEC CAPM5 - FB53 - 11kV Feeder (OC, EF, SEF, AR)	2025
O'Briens Rd Fdr	Nulec controller	SW MERN - PR93209595 2000 - SCHNEIDER > NULEC CAPM4 - FB54 - 11kV Feeder (OC, EF, SEF, AR)	2025

Figure 7: MERN substation single line diagram highlighting assets listed in CBRM



4.3.2. Cawdor substation

There is no asset condition issue at CAWD substation.

4.3.3. Highfields substation

HIGH substation has a number of primary assets identified (Table 5) to be retired in the next five years. Their retirement is based on a combination of Condition Based Risk Management (CBRM) modelling, age, known problematic operational and maintenance issues and the need to manage safety and network risk associated with unplanned failure. In addition to the 33/11kV 5MVA power transformer and 33kV isolator, it has been identified that there are significant clearance, bunding and space issues at the substation site. Toowoomba Regional Council has expressed dissatisfaction with the close proximity of the site to the surrounding residential houses. This is supported by the aerial photo provided in Figure 8. Figure 8 also shows the aged transformers T1 and T3 as well as some of the bus work.

Table 5 - HIGH REPEX asset list (2024)

HIGH REPEX Assets (2024)
SW HIGH T3 - TR93603610 1967 33/11 kV 5MVA AEI (46072)
SW HIGH AB2993 - IS91791427 yyyy 33kV ##A ### > ### (###)

Figure 8 - HIGH substation aerial overview and T1 & T3



4.4. Restoration Timeframes and Safety Net

4.4.1. Safety Net requirements

A fundamental requirement of Ergon Energy's Distribution Authority D01/99 is to comply with Safety Net targets that seek to effectively mitigate the risk of low probability – high consequence network outages to avoid unexpected customer hardship and / or significant community or economic disruption. To address the low probability high impact risk for N-1 contingencies, the Safety Net Security Criteria is applied to restore supply within certain allowable timeframes. The safety net criteria are classified into Regional Centre and Rural Area, each with a different timeline as follows:

Table 6 - Safety Net security criteria

Safety Net – Load not supplied and maximum restoration times following a credible contingency Following an N-1 Event, load not supplied must be:							
Regional Centre	Rural Areas						
Less than 20MVA (8000 customers) after 1 hour;	Less than 20MVA (8000 customers) after 1 hour;						
Less than 15MVA (6000 customers) after 6 hours;	Less than 15MVA (6000 customers) after 8 hours;						
Less than 5MVA (2000 customers) after 12 hours; and	Less than 5MVA (2000 customers) after 18 hours; and						
Fully restored within 24 hours.	Fully restored within 48 hours.						

Note that each of the zone substations MERN, HIGH and CAWD are classified Regional Centres for Safety Net purposes.

4.4.2. Safety Net contingency plan of MERN substation

Error! Reference source not found. Table 7 shows the Safety net contingency plan for MERN substation.

Safety Net Contingency Plan

Note: This plan was developed to ensure Safety Net <u>compliance</u> for a credible event occurring on the day of (forecast) maximum demand for a <u>normal</u> (POE50) year. It does not necessarily represent the "best" contingency (i.e. the plan that results in the smallest number of lost customer minutes/ unsupplied load). Most events will occur when demand is less than the forecast MD. In these cases, some actions such as shedding large customers, deploying Nomads/Pegasus units, etc. will not be necessary to achieve SN *compliance* and it will be up to the co-ordinator to decide on what is best. Where the event occurs on a day where demand is higher than the forecast MD, SN compliance may not be possible – in which case, best endeavours is all that is required.

Scenario	Failure	Consequence	Actions	SN Minimum Timeline	Typical Timeline	Safety Net Compliance
1	Transformer 33/11kV	Part loss of supply to 11 kV supply area (assuming 11 kV bus tie is open)	 Open 11 kV Tx ABS to isolate faulty transformer and close 11 kV bus tie AB7740 to restore supply to 11 kV network. Transfer 11 kV load to adjacent 11 kV feeders (from CAWD and HIGH ZS) 	24 hrs	6 hrs	Yes
			Full supply restored	24 hrs	6 hrs	Yes
2	33kV Pole failure on Shirley Rd Feeder	Total loss of supply to MERN and CAWD substations; (>12MVA unsupplied load)	 Transfer MERN to Pump Loop feeder. Transfer CAWD 11 kV load to MERN 11 kV feeders. Repair / restore 11 kV supply. 	12 hrs 24 hrs 24 hrs	3 hrs 8 hrs 24 hrs	Yes Yes Yes
			Full supply restored:	24 hr	24 hrs	Yes

 Table 7 - Meringandan substation contingency plan

5.Technical requirements of the solution

A suitable solution needs to meet the investment objectives detailed in Section 3.1. It is expected that any proposed solution is in accordance with good electricity industry practices, such that a reliable, safe and secure solution is delivered.

5.1.End of Life Plant

A suitable solution would need to maintain a safe and sustainable energy supply to customers by managing the lifecycle of aged plant at MERN and HIGH substations.

5.2. Network Capacity

A suitable solution would need to provide enough network capacity to meet existing and future network loads.

5.3.Service Standards

A suitable solution would need to meet Ergon Energy's service standards as described below.

Minimum Service Standards

Under its DA licence conditions, Ergon Energy is responsible for electricity supply to the Toowoomba - Highfields area. The DA requires that Ergon Energy must:

- Comply with the Guaranteed Service Levels regime notified by the Queensland Regulator which includes reliability of supply to customers;
- Plan and develop its supply network in accordance with good electricity industry practice, having regard to the value that end users of electricity place on the quality and reliability of electricity services;
- Use all reasonable endeavours to ensure that it does not exceed in a financial year the Minimum Service Standards (System Average Interruption Duration Index and System Average Interruption Frequency Index limits) applicable to its feeder types; and
- Ensure, to the extent reasonably practicable, that it achieves its Safety Net targets (refer to Section 4.4).

6. Preferred Internal Option Identified – develop a 2 x 33/11kV 20MVA Kleinton (KLEI) substation in three stages

Ergon Energy purchased a block of land adjacent to the existing MERN substation, in 2012-13 for future expansion of the substation. This vacant block is located on the eastern side of the MERN substation. To address the reliability, safety, standards compliance and capacity constraints, it is proposed to construct a 33/11kV 2 x 20MVA substation in stages on this vacant block. The new substation will be named Kleinton (KLEI) substation. Figure 9 shows the proposed site for the KLEI substation. It is proposed to initially install a single 33/11kV 20MVA transformer with a prefabricated building suitable for 33kV and 11kV switchgear at the proposed KLEI substation in 2021. This will be Stage 1 of the development. After Stage 1 of KLEI substation is built, 1.6MVA of load from CAWD will be transferred and then in 2024 2.2MVA of load from HIGH substation will be transferred to KLEI. HIGH substation will be decommissioned after 2024. This will be Stage 2 of the development.

In 2034, a second 33/11kV 20MVA transformer and a second prefabricated switchroom building will be added to comply with the Safety Net security standard. This will be Stage 3 of the development. The remaining load on MERN substation will then be transferred over to the KLEI substation and the existing MERN substation can be decommissioned.

Initially, the proposed site for KLEI substation was right adjacent to MERN substation. Site investigations have revealed that the soil condition at the existing MERN substation has a rocky surface. From civil works perspective it would be very costly to expand the existing MERN substation to accommodate new infrastructure. The proposed site indicated in Figure 9 below has better soil type for construction of the new substation.



Figure 9 - Location of the proposed Kleinton substation

6.1.Load Forecast and Safety Net

Figure 10 shows the load forecast of the combined MERN and KLEI substations. The load forecast shows the loads to be transferred from CAWD and HIGH in 2021, 2024 and then finally in 2034. Table 8 lists the sum total of the forecast of KLEI and MERN substations with Safety Net.



Figure 10 – Preferred Internal Option – MERN / KLEI load forecast (including CAWD HIGH load transfer) and Safety Net

Table 8 Preferred Internal Option- MERN & KLEI Substation Load Forecast with Safety Net (1st 20MVA TX in 2021, 2nd 20MVA TX in 2034, MERN decommissioned in 2034)

	2018	2019	2020	2021 (1 st 20MVA Tx installed)	2022	2023	2024	2025	2026
MERN & KLTN SN (MVA)	13.2	13.2	13.2	<mark>22.4</mark>	22.4	22.4	22.4	22.4	22.4
Total load of MERN forecast including HIGH and CAWD load transfer (MVA)	11.7	11.8	12.0	15.3	15.6	18.0	18.4	18.7	19.0
	2027	2028	2029	2030	2031	2032	2033	2034 (2 nd 20MVA Tx installed)	2035
MERN & KLTN SN (MVA)	22.4	22.4	22.4	22.4	22.4	22.4	22.4	<mark>29</mark>	29
Total load of MERN forecast including HIGH and CAWD load transfer (MVA)	19.4	19.8	20.3	20.7	21.1	21.5	22.0	22.4	22.8

	2036	2037	2038	2039	2040	2041	2042
MERN & KLTN SN (MVA)	29	29	29	29	29	29	29
Total load of MERN forecast including HIGH and CAWD load transfer (MVA)	23.6	24.1	24.5	24.7	24.9	25.1	25.3
	2044	2045	2046	2047	2048	2049	2050
MERN & KLTN SN (MVA)	29	29	29	29	29	29	29
Total load of MERN forecast including HIGH and CAWD load transfer (MVA)	25.7	26.0	26.2	26.4	26.6	26.8	27.1

6.2.Scope

This option is implemented in three stages. In 2021 a 33/11kV 20MVA transformer and one prefabricated building with 33 kV and 11 kV switchboards are installed at KLEI substation (Stage 1). In 2024 HIGH load is transferred to KLEI substation and HIGH substation is decommissioned (Stage 2). In 2034 a second 33/11kV 20MVA transformer and a second prefabricated building will be installed at KLEI substation (Stage 3). MERN will be decommissioned after KLEI Stage 3 is completed.

The scopes are as follows –

Stage 1 - 2021 (refer to Figure 11)

Kleinton substation

 Establish 1 x 20MVA 33/11kV transformer and 33kV and 11kV indoor switchgear in a modular building

Meringandan substation

- Decommission and recover aging 33kV circuit breakers, VT
- Replace aging 11kV assets
- Relocate some 11kV load from MERN to the new KLEI substation
- Install the 11kV inter-connection between MERN and KLEI

Cawdor substation

 Transfer load from CAWD substation to KLEI & MERN substations via the 11kV distribution network to keep CAWD substation Safety Net compliant.

Stage 2 - 2024

Highfields substation

• Decommission HIGH substation

Stage 3 - 2034

Kleinton substation (refer to Figure 12)

- Install a 2nd 33/11kV 20MVA power transformer and a second modular building (B2)
- Relocate remaining 11kV Meringandan feeders to KLEI substation.

Meringandan substation

Decommission MERN substation

This option provides a substation solution for the future load growth. It provides two 33kV spare feeders and four 11kV spare feeders.

6.2.1. Substation and Network Configuration

Figure 11 shows the Single Line Diagram of MERN/KLEI substations in 2021 and Figure 12 shows the Single Line Diagram of KLEI substation in 2034 (ultimate arrangement).

Figure 11 Preferred Internal Option- MERN & KLEI Substation Single Line Diagram (2021)





Figure 12 Preferred Internal Option- KLEI Substation Single Line Diagram in 2034 (ultimate)

6.3.Cost of the Preferred Internal Option and financial comparison with other network options

The estimated total Stage 1 capital cost of this Preferred Internal Option is \$9.5M. Four network options were costed. Option A being the lowest cost option is ranked 1 and is the network option proposed to be implemented.

Note that the figures in the NPV table below are a summary of the combined Stage 1, 2 and 3 discounted present values evaluated over a 20 year period. These direct costs do not include any risk, contingencies or overheads.

Option A	Build a 33/11kV 20MVA KLTN substation with modular building of 33kV & 11kV switchgear at site adjacent to MERN site in 2021; decommission HIGH in 2024; install a 2 nd 33/11kV 20MVA substation at KLTN in 2034, decommission MERN outdoors substation
Option B	Build KLTN substation with 2 x $33/1$ kV 20MVA transformers in 2021, decommission MERN substation.
Option C	Install a 2 nd 33/11kV 10MVA SKID at CAWD in 2021; decommission HIGH in 2024; install a 33/11kV 10MVA SKID at MERN in 2034
Option D	Install a 33/11kV 10MVA SKID at MERN in 2021; build 2 x 33/11kV 20MVA KLTN substation in 2034, decommission MERN in 2034

Table 9 – List of Options Utilised in the Financial Analysis

Table 10 – Net Present Value Summary of Options

\$ Millions	Option A	Option B	Option C	Option D
Сарех	(8.35)	(14.66)	(13.33)	(13.03)
Opex	(3.40)	(4.67)	(3.00)	(3.12)
Direct Benefits	0.00	.00 0.00 0.0		0.00
Commercial NPV	(11.75)	(19.33)	(16.33)	(16.14)
Ranking	1	4	3	2
Indirect Benefits	0.15	0.15	0.28	0.15
Commercial + Risk	(11.60)	(19.18)	(16.05)	(15.99)
Rankina	1	4	3	2

7.Assessment of non-network solutions

7.1. Required load supply profile

MERN substation

In 2017 MERN substation recorded peak demand at 11.7MVA (12/02/2017 19:00). Figure 13 shows the daily load profile of the substation on 12/02/2017 and its predicted peak daily profiles based on the forecast from 2019 to 2050. The red line represents the safety net limit which is 13.2MVA. MERN substation load is predicted to breach the safety net security criteria in 2028.





CAWD substation

In 2018 CAWD substation recorded its peak demand at 9653kVA (04/09/2017 19:00). Figure 14 shows the predicted peak daily load profiles based on the forecast from 2021 to 2050. The red line represents the safety net limit for CAWD substation which is 4MVA. The load at CAWD substation is already breaching the safety net limit.



Figure 14 - Peak daily load profile of CAWD substation (2021 - 2050)

MERN and HIGH substations

If the load of HIGH substation is transferred to MERN substation in 2024, the peak daily load of MERN will increase accordingly. Figure 15 shows the peak daily load profile of MERN substation including the HIGH load from 2017 to 2050. The red line represents the safety net of 13.2MVA.



Figure 15 - Peak daily load profile of MERN substation including HIGH load transfer (2017 - 2050)

As the above figures show, any non-network option must meet the load characteristics of the substations to comply with the safety net security standard. A feasible non-network option must be financially and technically viable to solve the network constraints. It must also be able to be implemented in sufficient time to satisfy the identified risk to the public and to the network due to load growth and the reliability and safety-driven aged asset replacement schedule.

7.2. Demand management value

Ergon Energy's Intelligent Grid Systems Customer Interactions (IGSCI) Team has assessed the potential demand management options required to defer the network option and determined that there is not a viable demand management (DM) option to replace or reduce the need for the network options proposed. IGSCI has reviewed the customer base and considered a number of DM technologies based on the key drivers of this investment: reliability (safety net), load growth, risk to personnel and community safety, and concerns around proximity of aged assets to residential homes.

7.2.1. Demand Management (Demand Reduction)

Energy efficiency and other demand reduction measures such as power factor correction, high efficiency lighting etc. have been assessed as not technically or economically viable as:

• restoration times for the number of unmet load hours can be achieved more cost effectively through temporary load transfers.

- it is not considered as a sufficient measure to address the risk posed by the constant loading of the aged oil-type 33 kV circuit breakers and other aged assets.
- it won't address community concerns of proximity of substation assets to residential homes.

Demand reduction activities may have an effect on customer demand growth over time and marginally positively impact issues that relate to load growth.

7.2.2. Demand response

Demand response through customer embedded generation, load call-off and load curtailment contracts have been assessed as technically or economically not viable as:

- with Safety net concerns temporary losses of supply from failure of a 33kV oil-type circuit breaker (OCB) can be temporarily restored by load transfers to other 11kV feeders more cost effectively than by DM measures.
- it does not address the risk posed by the constant loading of the aged OCB 33kV circuit breakers and other aged assets.
- it will not address community concerns of proximity of substation assets to residential homes
- it will not address growth for more than short periods but could marginally assist with block load growth issues
- there is a lack of suitable customers with sufficient loads for viable contracts.

7.2.3. Customer solar power systems

Business customers with large solar arrays are deemed to present a significant future opportunity for targeted load control or load curtailment if coupled with a Battery Energy Storage System (BESS). Contracting such customers can be attractive as they represent a larger load across a fewer customers and therefore are cheaper and easier to engage and contract.

The Meringandan supply area is predominantly comprised of residential customers. MERN and CAWD substations have 29% and 38% respectively of customers that have solar PV systems and as yet BESS ownership is low or non- existent. PV systems with BESS present a future portfolio opportunity for potential demand response but currently this supply area has a very limited BESS penetration. 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.

In terms of the unsupplied load at Meringandan, this form of load curtailment opportunity is not technically feasible.

8.Conclusion

Based on the DM options considered above, it is deemed that sufficient DM measures cannot be feasibly implemented to technically and economically defer the network investment required at MERN and KLEI substations. Consequently, a Non-Network Options Report has not been prepared in accordance with rule 5.17.4(c) of the National Electricity Rules.