Regulatory Investment Test for Distribution

Part of Energy Queensland

Draft Project Assessment Report

Reliability of Electricity Supply and Network Asset Risk Management in the Wide Bay Burnett Area

Publication Date: 19 **February 2020**

Executive Summary

ABOUT ERGON ENERGY

Ergon Energy Corporation Limited (Ergon Energy) is part of the Energy Queensland Group and manages an electricity distribution network which supplies electricity to more than 740,000 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

Ergon Energy Corporation Limited (Ergon Energy) is responsible (under its Distribution Authority (DA)) for electricity supply to the Wide Bay - Burnett area in Queensland.

The existing 66kV M028 feeder forms part of the 66kV subtransmission network supplying the 66/11kV zone substations Degilbo (DEGI), Gayndah (GAYN), Mundubbera Town (MUTO) and Eidsvold (EIDS) as well as the Mount Rawdon gold mine (MORW). Feeder M028 is 92km long, 66 years old and has reached its end of life based on the condition of the 7/.104 HDBC conductor and wooden poles. Due to the poor condition of the poles and the conductor, and the fact that there is no overhead earth wire for lightning protection, the feeder has extremely poor reliability. Feeder M028 has four times the subtransmission feeder average number of outages and has become a safety risk to power workers and the public. The Isis – Gayndah 66kV ring which is normally run closed, is voltage constrained during present peak loading, and is limited by the thermal rating of the M028 feeder during the contingency loss of the other half of the ring (M049 feeder).

- The first objective of the proposed investment is to maintain a safe and sustainable energy supply to customers by reducing the significant safety and environmental risks associated with the aged M028 feeder to as low as reasonably practicable (ALARP).
- The second objective is to ensure that there is sufficient capacity in the network to meet existing customer demand and also to enable customers to connect new loads in the future.
- 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.

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 Upper Burnett supply area in a reliable, safe and cost-effective manner. Accordingly, this investment is subject to a RIT-D.

Ergon Energy published a Non-Network Options Report for the above described network constraint on 16/10/2019. One submission was received by the closing date of 16/01/2020.

Four potentially feasible options have been investigated:

- Option 1: Replace the aged M028 feeder with a new 66kV single circuit wood pole feeder, strung with Iodine conductor and optical ground wire (OPGW), originating from the 132/66kV Isis Bulk Supply Point and connecting Degilbo and Gayndah zone substations by December 2023.
- Option 2: Replace the aged M028 feeder with a new 66kV single circuit concrete pole feeder, strung with Iodine conductor and optical ground wire (OPGW), originating from the 132/66kV Isis Bulk Supply Point and connecting Degilbo and Gayndah zone substations by December 2023.
- Option 3: Replace the aged M028 feeder with a new 66kV single circuit concrete pole feeder, strung with Neon conductor and optical ground wire (OPGW), originating from the 132/66kV Isis Bulk Supply Point and connecting Degilbo and Gayndah zone substations by December 2023.
- Option 4: Replace the aged M028 feeder with a new 66kV single circuit wood pole feeder, strung with Iodine conductor and optical ground wire (OPGW), originating from the 132/66kV Isis Bulk Supply Point and connecting Degilbo and Gayndah zone substations by December 2023. Install a 10MW / 20MWh BESS connecting to the 11kV bus at Gayndah zone substation.

This is a Draft Project Assessment Report (DPAR), where Ergon Energy provides both technical and economic information about possible solutions has been prepared in accordance with the requirements of clause 5.17.4(i). **Ergon Energy's preferred solution to address the identified need is Option 3 – replace M028 with a new 66kV single circuit concrete pole line strung with Neon conductor and OPGW.**

The DPAR seeks information from interested parties about possible alternate solutions to address the need for investment.

Submissions in writing (electronic preferably) are due by 4pm on 2nd April 2020 and should be lodged to Ergon Energy's Demand Management Inbox:

demandmanagement@ergon.com.au

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1 Introduction

This DPAR has been prepared by Ergon Energy in accordance with the requirements of clause 5.17.4(i) of the NER.

This report represents the second stage of the consultation process in relation to the application of the RIT-D on potential credible options to address the identified need to continue to provide electricity to the consumers in the Upper Burnett supply area in a reliable, safe and cost-effective manner.

In preparing this RIT-D, Ergon Energy is required to consider reasonable future scenarios. With respect to major customer loads and generation, Ergon Energy has, in good faith, included as much detail as possible while maintaining necessary customer confidentiality. Potential large future connections that Ergon Energy is aware of are in different stages of progress and are subject to change (including outcomes where none or all proceed). These and other customer activity can occur over the consultation period and may change the timing and/or scope of any proposed solutions.

1.1. Structure of the report

This report:

- Provides background information on the network capability limitations of the subtransmission network supplying DEGI, GAYN, MUTO, EIDS and MORW.
- Identifies the need which Ergon Energy is seeking to address, together with the assumptions used in identifying and quantifying that need.
- Summarises and provides commentary on the submission(s) received on the Non-Network Options Report.
- Describes the credible options that are considered in this RIT-D assessment.
- Quantifies costs and classes of material market benefits for each of the credible options.
- Describes the methods used in quantifying each class of market benefit.
- Provides details of classes of market benefits that are not considered material to this RIT-D assessment and provides explanations to why these classes of market benefits are not considered material.
- Provides the results of Net Present Value (NPV) analysis of each credible option and accompanying explanatory statements regarding the results.
- Identifies the proposed preferred option, including detailed technical characteristics, estimated commissioning date, indicative costs, and noting that it satisfies the RIT-D.
- Provides contact details for queries on this RIT-D.

1.2. Contact Details

Submissions in writing (electronic preferably) are due by 4pm on 2nd April 2020 and should be lodged to Ergon Energy's Demand Management Inbox:

demandmanagement@ergon.com.au

2 Background

2.1. Geographic Region

The Upper Burnett River catchment area encompasses the towns of Eidsvold, Mundubbera and Gayndah and is considered some of the most ideal agricultural areas for grazing and cropping in Queensland with the area being supported by the perennial Burnett River. Eidsvold is the self-proclaimed beef capital of the Burnett. Gayndah/Mundubbera, is situated in the centre of the biggest citrus growing area in Queensland and is considered the orange capital of the state and holds a biennial orange festival. The baseload requirements for these towns is primarily for irrigation purposes. This trend is expected to continue with more pressure on agricultural producers to move to more intense farming practices for higher yields per hectare.

The largest employer in the area is the Mt Rawdon Mine, an open pit gold mine owned by Evolution Mining. The facility operates 24hr per day and has historically produced between 95,000 - 100,000 ounces of gold per year since full production commenced in 2001. In 2018 the mine reached a milestone of achieving fifty tonnes of total gold output since operations started[1].

2.2. Existing Supply System

The 66kV subtransmission supply for this area initiates from T131 Isis Bulk Supply Point (BSP), which was upgraded from a switching station to a BSP in 1987. The original 66kV subtransmission line ran from Isis substation 8km to the north to the township of Childers, then south-west 92km to Gayndah supplying the Degilbo substation on route. A geographical layout of the 66kV subtransmission network for the area can be seen in Figure 1.

The Childers to Gayndah feeder designated M028 was constructed in 1954 with natural untreated bush poles and strung with 7/0.104 Hard Drawn Bare Copper (HDBC) at 50°C for a 15.1MVA summer day rating. In 1986 after the initial requests from the Mt Rawdon Mine, a second feeder (M049) was constructed with pesticide treated wood poles and strung with 7/4.75 AAAC 1120 (Iodine) at 75°C for a 45.6MVA summer day rating. Neither feeder has an aerial earth wire along the full length of the feeder and is therefore susceptible to damage and outages caused by lightning strikes. This second feeder runs 93km from Isis BSP to Gayndah with a tee off at 65km for a supply to Mt Rawdon Gold Mine, a further 29km to the north of the tee. Feeders M028 and M049 are operated as a closed ring at Gayndah substation. Figure 2 shows a representative geographic diagram of the area.

Furthermore, a small hydro-generation facility exists at Degilbo and is operated irregularly for peak energy market events. The reservoir has insufficient water to run this generator continuously or be relied on for local outage events.

[1] Source: https://evolutionmining.com.au/mt-rawdon/

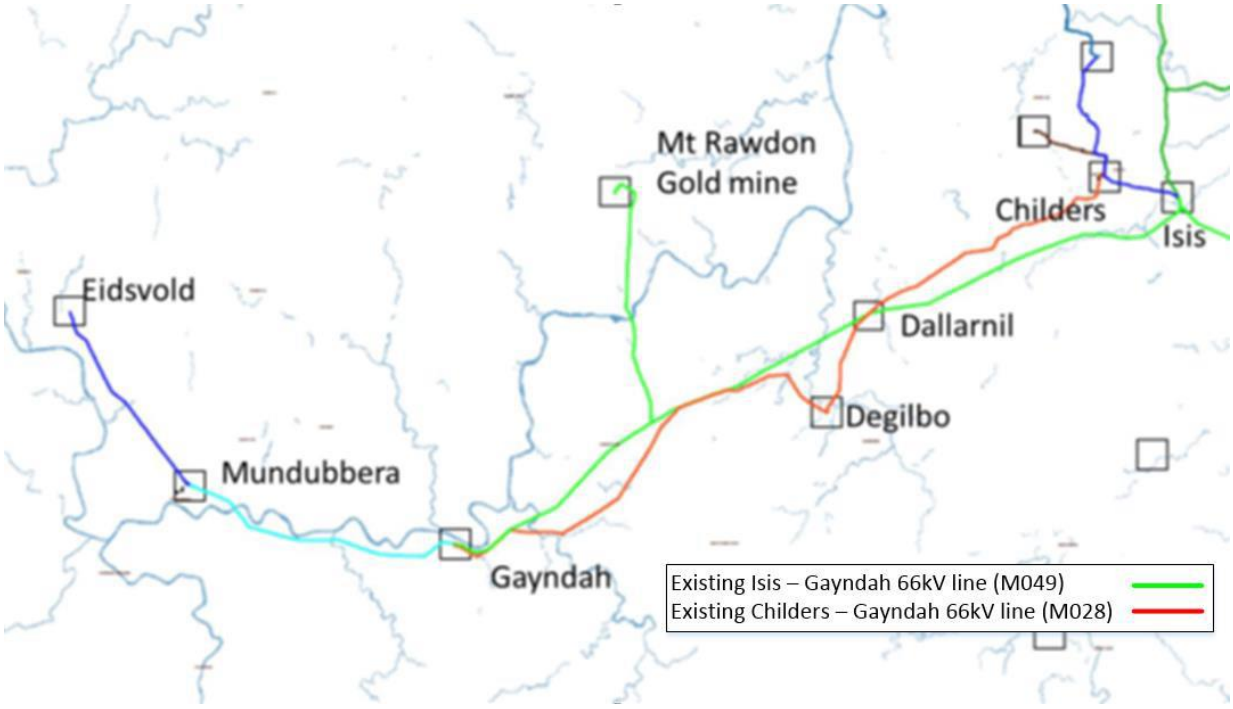

Figure 1 - Upper Burnett River Subtransmission Network Geographical Diagram

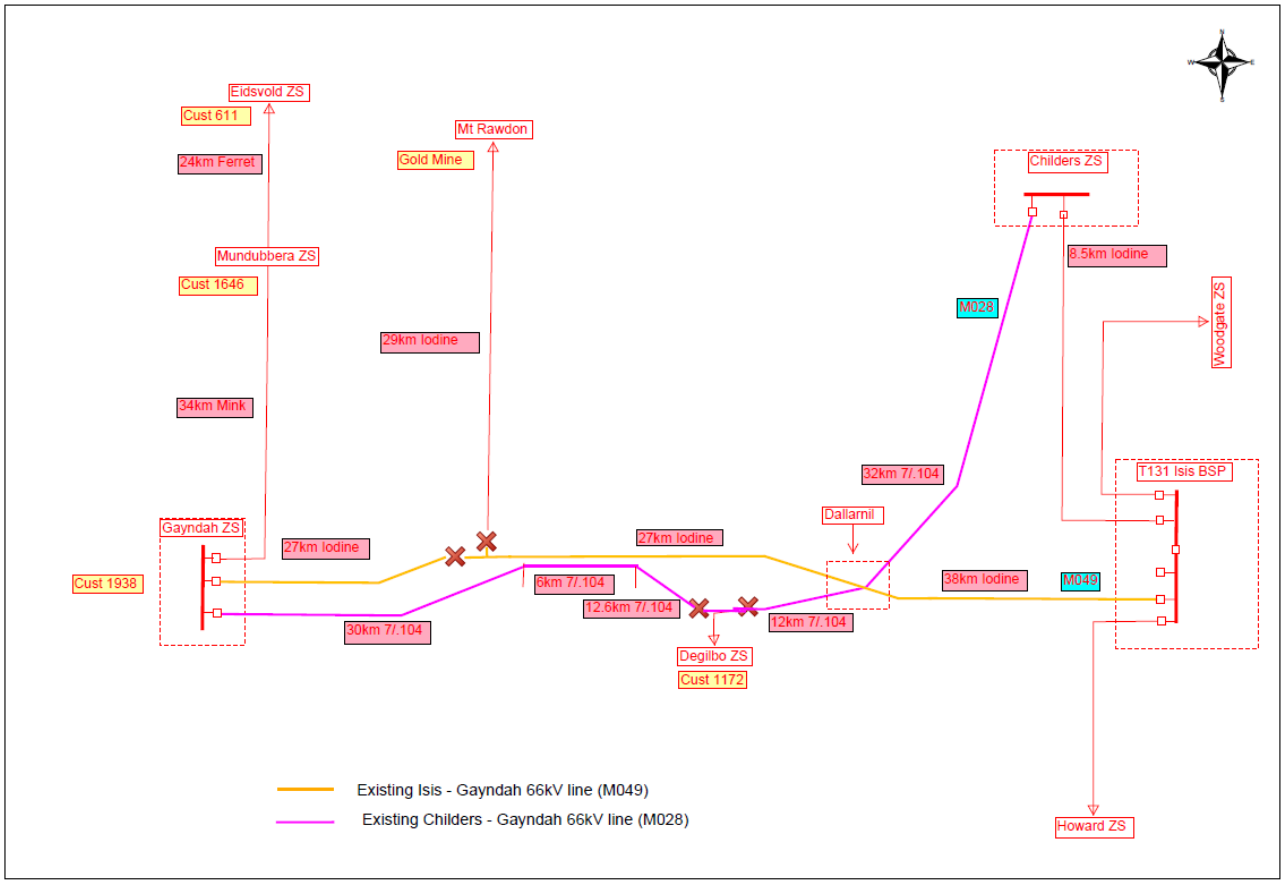

Figure 2 - 66kV Subtransmission Network Representative Geographic Diagram

3 Identified Need

3.1. Description of the Identified Need

The existing 66kV M028 feeder forms part of the 66kV subtransmission network supplying the 66/11kV zone substations DEGI, GAYN, MUTO and EIDS as well as MORW. Feeder M028 is 92km long, 66 years old and has reached its end of life based on the condition of the 7/0.104 HDBC conductor and wooden poles. Due to the poor condition of the poles and the conductor, and the fact that there is no overhead earth wire for lightning protection, the feeder has extremely poor reliability. Feeder M028 has four times the subtransmission feeder average number of outages and has become a safety risk to power workers and the public. The Isis – Gayndah 66kV ring which is normally run closed, is voltage constrained during present peak loading and is limited by the thermal rating of the M028 feeder during the contingency loss of the other half of the ring (M049 feeder).

3.1.1. End of Life Aged Asset Risks

There is a need to maintain a safe and sustainable energy supply to customers by reducing the significant safety and environmental risks associated with the end of life, aged M028 feeder to as low as reasonably practicable (ALARP).

3.1.2. Network Capacity

There is a need to ensure that there is sufficient capacity and power transfer capability within the network to meet existing customer demand and also to enable customers to connect new loads in the future.

3.1.3. Network Security and Reliability

There is a need to provide a secure and reliable energy supply to customers by ensuring that the network meets Ergon Energy's statutory network security (Safety Net) and reliability performance standards.

3.2. Quantification of the Identified Need

3.2.1. End of Life Aged Assets (M028)

The M049 Isis – Gayndah feeder which was constructed in 1987 with pesticide treated wood poles and strung with 7/4.75 AAAC 1120 (Iodine) conductor at 75°C with no aerial earth wire, is showing degradation typical of a 31-year-old feeder. M049 feeder is inspected every 4 years under the pole inspection program and has a standard number of pole replacements, pole nailing, cross arm replacements, insulator and support replacements for an asset of this age. The conductor is not in need of replacement.

M028 Childers to Gayndah feeder constructed in 1954 (pre-treated poles period) and strung with 7/0.104 Hard Drawn Bare Copper (HDBC) conductor at 50°C with no aerial earth wire, is showing standard degradation for a feeder of 66 years old.

Both feeders do not have aerial earth wires over the length of the feeders, which makes these assets susceptible to lightning strikes and coinciding damage. Lightning damage happens at any time

between inspection cycles and makes the feeder susceptible to unassisted pole failure which creates dangerous situations for the public and crews and can create significant damage and long outages for the customers during repairs. M028 still has 37% of the original untreated wood poles.

Since 2010, Ergon Energy performed approximately 110 termite treatments on poles on the M028 feeder. To further manage the associated safety risk of termite pole failures on this feeder, Ergon Energy is proposing to proactively treat any remaining untreated poles.

The aged copper conductor on M028 is in poor condition, suffering damage over the 66 years from natural aging, lightning strikes, fault currents and 'work hardening' at suspension clamps. Laboratory analysis of conductor samples has confirmed that the line does not always meet minimum load break requirements. The line has reached the end of its useful life.

3.2.2. Network Risk Assessment

Appendix B Network Risk Assessment *Table 7* summarises the network (business) risks associated with the aged M028 line that Ergon Energy would be exposed to if the project was not undertaken. The Inherent Risks are not deemed to be ALARP. The preferred solution will reduce Ergon Energy's risk exposure by reducing all risks to ALARP.

3.2.3. Network Capacity and Voltage Constraints

Load flow modelling of 66kV system voltages was completed using peak loading of the existing system and for different system configurations and capacitor bank arrangements. The modelling was completed with the peak demand of 33.8MVA. The substation forecast numbers are indicating low growth for the Upper Burnett region, while the historical loads suggest there is still load recovery to occur from severe floods in 2010 and 2013. In summary, if loads increase above historic levels, then the existing network will experience more severe voltage limitations at a number of substations during maximum demand days.

According to NER s5.1a.4, at all times supply voltage must remain between 90% and 110% of the normal voltage, while the target voltages are within 95% and 105%. The following conclusions can be drawn from these assessments:

- With the existing system intact (both feeders M028 and M049 in service) and all cap banks switched in, the network is voltage constrained during peak load periods with 66kV voltages at GAYN reaching 0.89Vpu and MORW gold mine reaching 0.88Vpu.
- With feeder M028 out of service, all cap banks need to be switched in to support system voltages, MORW gold mine reaches 0.85Vpu, GAYN reaches 0.84Vpu, MUTO reaches 0.89Vpu and EIDS reaches 0.88Vpu.
- With feeder M049 out of service, MORW gold mine cannot be supplied due to insufficient system voltages. Even with MORW switched off, a further 5MW of load needs to be shed from GAYN/MUTO/EIDS/DEGI in order to maintain adequate voltage levels.
- With most transformers at the zone substations at maximum boost tap, and unable to further support voltages, it is clear that the network is voltage constrained both in system normal and contingency scenarios. Future large customer connections may not be possible or may only be possible with restrictions e.g. limiting operation to off-peak times or utilising peak lopping generators.

3.2.4. Reliability

M028 Childers to Degilbo to Gayndah feeder is having on average six unplanned outages per year, which has accumulated 1.8 Million customer minutes in the previous four years. As this section of subtransmission network is a ring, most customers can be restored, but the 1172 customers supplied from DEGI experience power interruptions for every outage until the feeder is repaired. If the fault is beyond DEGI, DEGI can be reenergised via manual switching. Over the last four years, Degilbo customers have experienced on average six and half hours of supply outages per year. The reliability for M028 is around 6.4 faults/100km/year that is more than four times Ergon Energy's average outage rate of 1.4 faults per 100km per year typical for subtransmission wood pole feeders.

M049 Isis – Mt Rawdon – Gayndah feeder, even though it is half the age at 31 years old, is averaging 4 outages per year and has accumulated over 2.3 Million customer minutes over the same 4 year period. This equates on average to over two hours per year in supply outages. The biggest impact from an outage of M049 feeder is the interruption of supply to Mt Rawdon Gold Mine which has a 24hr operation. Mt Rawdon Gold Mine is the biggest employer in the area and is considered for reliability purposes the same as a single residential dwelling, or one customer. The reliability for M049 is around 4 faults/100km, which is 250% worse than Ergon Energy's average outage rate for subtransmission wood pole feeders.

The fact that neither M028 or M049 feeder have aerial earth wires, combined with the fragility of the poles and wires, makes these feeders susceptible to lightning strikes and storms. Unplanned outage data shows a high correlation with the spring/summer storm season.

For reliability comparison, a concrete pole feeder with an aerial earth wire, has an average 0.25 faults per 100km, this is 24 times and 16 times better reliability than experienced by the customers on feeders M028 and M049 respectively.

Value of Customer Reliability (VCR) modelling shows the outage cost to customers (excluding Mt Rawdon Gold Mine) for both feeders (M028 and M049) was estimated at $1.3M per annum FY18/19 (excluding further asset degradation). With a further VCR impact for Mt Rawdon Gold Mine of up to $10.6M per annum. This cost is significant to customer supply and operations.

Detail about how the VCR is applied in investment analysis is included in Ergon Energy's Distribution Annual Planning Report[2] (DAPR) under section 6.4 on Network Planning Criteria.

3.2.5. Safety Net

Appendix C – Ergon Energy's Minimum Service Standards and Safety Net Targets Table 8 describes the applicable service standard for network security – Safety Net. It is noted that each of the zone substations supplied from M028 and M049 are classified Rural Area for Safety Net purposes, therefore requiring full supply to all customers to be completed within 48 hours.
It should also be noted that since MORW is connected to the sub-transmission network, its load does not count towards Safety Net load-at-risk calculations[3]. Mt Rawdon's load does however apply in calculating reliability measures such as VCR (see below).

[2] The Ergon Energy DAPR is available at https://www.ergon.com.au/network/network-management/future-investment/distribution-annual-planning-report
[3] In accordance with the Ergon Energy document "Safety Net Application Guideline".

Each of the individual substations (DEGI, GAYN, MUTO and EIDS) are deemed to be Safety Net compliant.

When M028 Childers to Gayndah feeder, M049 Isis to Gayndah feeder and connected substations are considered under Safety Net as a system, the network is only **JUST** Safety Net compliant. As would be expected, for the 93km and 92km, respectively, M028 and M049 transverse through hilly and forested terrain that makes access for repairs challenging and restoration times could approach 18 - 20 hours.

If M049 incurred a low probability outage during peak load days, rotational load shedding of 5MW on GAYN/MUTO/EIDS substations would be required until the repairs are complete. Since the load shedding required is 5MW to maintain network integrity, these events will meet safety net. If the load increases into the future, even by 1MW, then M028 and M049 as a system will no longer meet the Safety Net Security Criteria.

In summary, with existing loading, the system is right on the verge of being Safety Net compliant and that any further growth will lead to Safety Net non-compliance.

3.3. Assumptions in Relation to Identified Need

3.3.1. System Capability

Subtransmission Line Ratings

Feeder M028 Childers to Gayndah 7/0.104 HDBC has a Summer Day Rating (SDR) 15.1MVA. If feeder M049 is out of service, M028 only has the thermal capability at peak times to supply Degilbo, Gayndah, Mundubbera and Eidsvold. M028 does not have the thermal capacity to also supply Mt Rawdon gold mine.

The M049 Isis to Gayndah feeder is strung with 7/4.75 AAAC 1120 (Iodine) conductor at 75°C and has a summer day rating of 45.6MVA. If M028 is out of service, M049 has the thermal capability at peak times to supply all the connected substations including Mt Rawdon gold mine. See Table 1 below for network design and thermal details.

Table 1 - Line Thermal Ratings for the Relevant 66kV Feeders.

Feeder	Line Section	Line Length (km)	Conductor	Design Temp. (°C)	Summer Day (09:00-17:00) A (MVA)	Summer Evening (17:00-22:00) A (MVA)	Summer Night/ Morning (22:00-09:00) A (MVA)
M049	ISIS – MORW Tee	1.5	19/3.75 AAAC Neon	75	548 (62.9)	579 (66.2)	521 (59.6)
M049	ISIS – MORW Tee	63.2	19/4.75 AAAC Iodine	75	399 (45.6)	415 (47.4)	371 (42.3)
M047	MORW Tee – MORW	30.3	19/4.75 AAAC Iodine	50	193 (22.1)	275 (31.4)	267 (30.5)

M049	MORW Tee – GAYN	26.7	19/4.75 AAAC Iodine	75	399 (45.6)	415 (47.4)	370 (42.3)
M027	ISIS – CHIL	8.5	19/4.75 AAAC Iodine	75	399 (45.6)	415 (47.4)	370 (42.3)
M028	CHIL – DEGI Tee	43.5	7/.104 HDBC	50	132 (15.1)	167 (19.1)	159 (18.2)
M028	DEGI Tee – GAYN	48.3	7/.104 HDBC	50	132 (15.1	167 (19.1)	159 (18.2)

3.4. Load Profiles

Daily Maximum Demands for M049 and M028 66kV feeders from 2015 to 2018 is shown in Figure 3, illustrating a system peak of 30.8MVA which occurred at 19:30 on the 12/02/2017, aligning with other substation peaks across Ergon's network. The load split was 10.5MVA on M028 and 20.5MVA on M049. The peak day (12/02/2017) load profiles for the connected substations are shown in Figure 3.

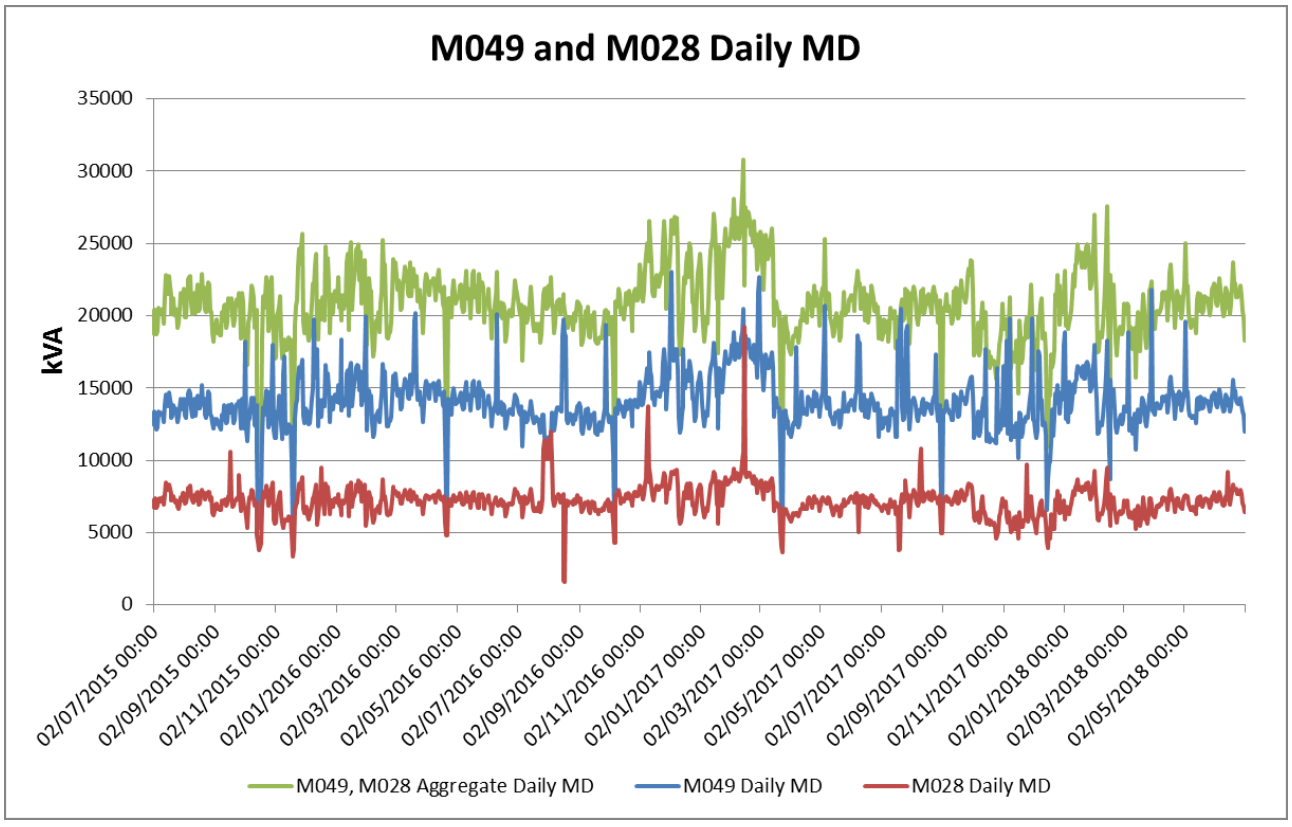

Figure 3 - Daily Maximum Demands for M049 and M028 66kV feeders from 2015 to 2018

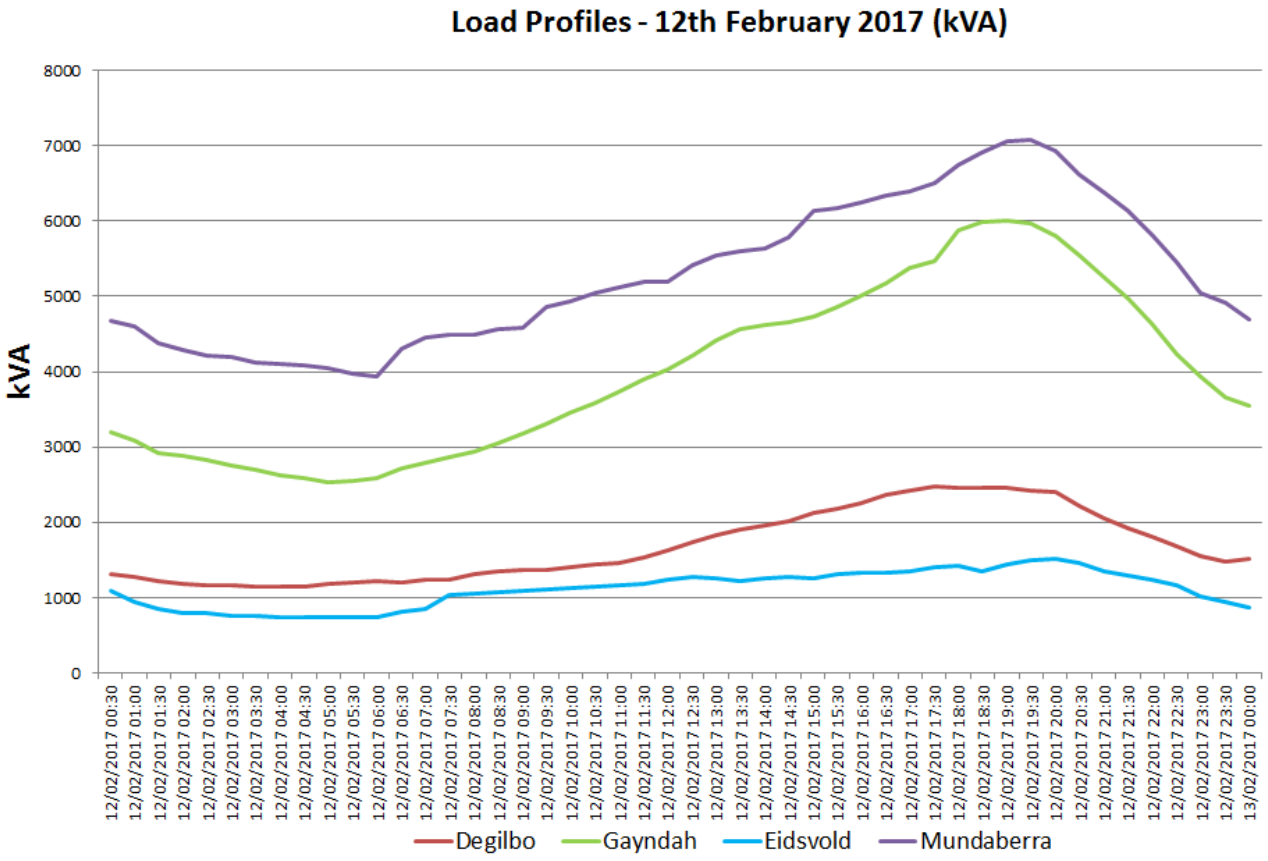

Figure 4 - Substation Load Profiles for Maximum Demand Day 12 February 2017

3.5. Forecast Maximum Demand

Figure 5 and Figure 6 below display the 50POE and 10POE historical yearly maximum demands and zone substation forecasts. The impacts of severe flooding of the Burnett River in 2010 and 2013 (and subsequent closing down of several farms and orchards) can be seen in the drop in historic loads at Mundubbera.

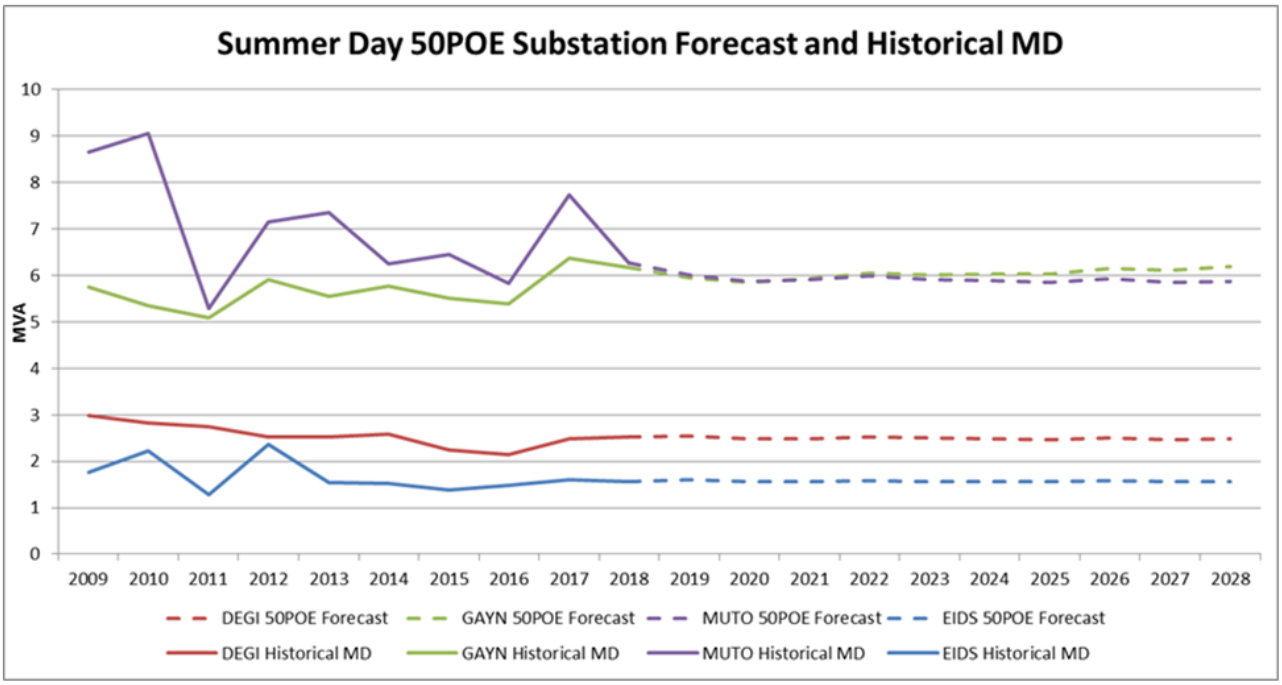

Figure 5 - Summer day 50POE zone substation forecast

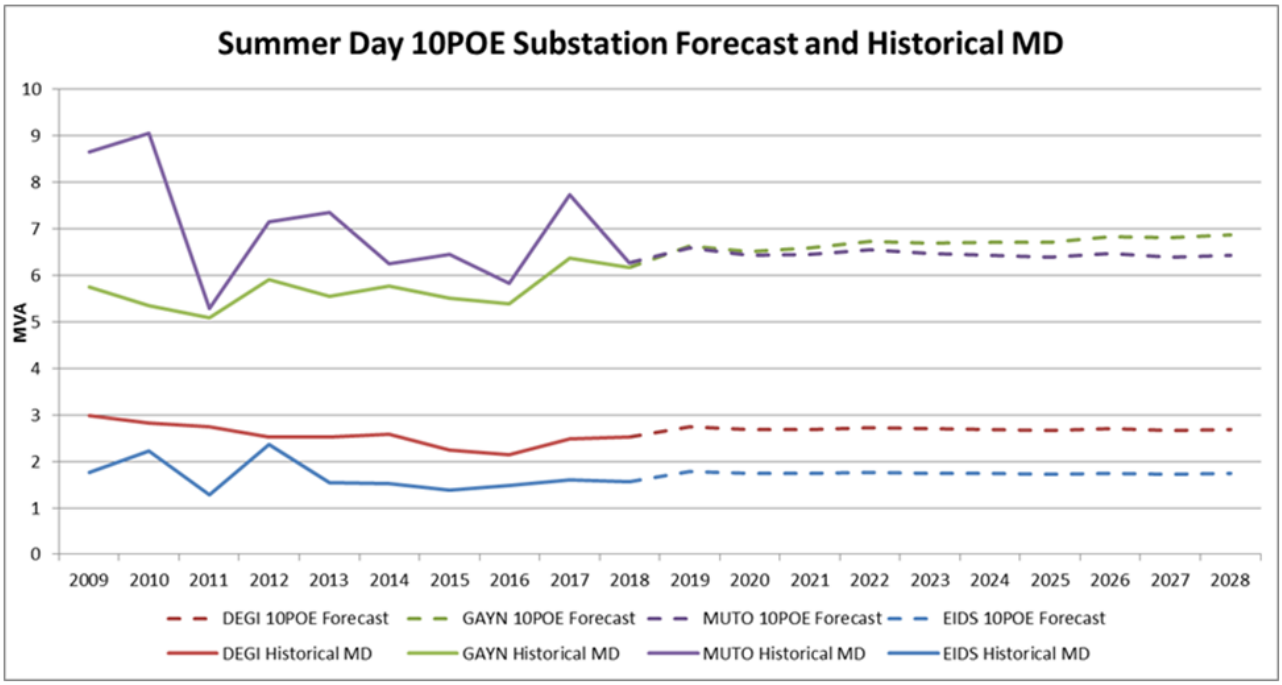

Figure 6 - Summer day 10 POE zone substation forecast

Future growth in the area is probable with several Department of State Development, Manufacturing, Infrastructure and Planning (DSDMIP) initiatives proposed for the region being monitored by Ergon Energy's Major Customer group. The ability to supply potential new loads has been considered when assessing options for M028 and the Upper Burnett network.

4 Non-Network Options

Two internal non-network options have been considered. These solutions have been sized to meet a peak load of 35MW and average load of 26.25MW (see Table 2).

Table 2 – Non-Network Options Considered

Asset Solution	Overview	Considerations
Hybrid Generation Solution	• 25MW AC Solar PV • 14MW Battery Energy System Solution • 45MW Diesel Genset (10 x 4.5MW)	• Very high capital cost $96.7M • High non-fuel annual OPEX cost $4.3M • No reduction in safety or environmental risks • Effectively placement within the network to best minimise reliability impacts – unlikely to totally remove reliability risk.
Diesel Generation Solution	• 45MW Diesel Genset (10 x 4.5MW)	• Moderate capital cost $49.5M • Very high OPEX fuel cost $58.7M • No reduction in safety or environmental risks • Effectively placement within the network to best minimise reliability impacts – unlikely to totally remove reliability risk.

4.1. Assessment of Non-Network Solutions

The two non-network options have not been analysed further due to the very high up-front cost of the hybrid solution ($96.7M) and excessive operational cost ($58.7M) of the diesel solution.

4.2. Feasible vs Non-Feasible Options

4.2.1. Potentially Feasible Options

The primary investment drivers for this project are safety and reliability, addressing both asset safety and performance risks arising from the poor condition of feeder M028. A successful non-network solution may be able to reduce the scope of the internally identified option; however, the non-network alternatives will not be able to impact the project timing due to the risks posed by aging equipment. Solutions that cost-effectively address the network risk, capacity, security and reliability objectives given in Section 3.1 are likely to represent reasonable options.

An example of a potentially feasible option is:

- Radial ISIS-GAYN configuration: Decommission feeder M028 and building a new section of 66kV line from M049 to Degilbo. It is expected that significant levels (>10MW) of demand management and/or generation would also need to be implemented for peak load lopping and Safety Net compliance.

4.2.2. Options that are unlikely to be feasible

Without attempting to limit a potential proponent's ability to innovate when considering opportunities, some technologies/approaches are unlikely to represent a technically or financially feasible solution. Unproven, experimental or undemonstrated technologies are unlikely to be feasible.

Options will also be deemed unfeasible if they:

- Do not satisfy all of the objectives stated in Section 3.1.
- Require a completion date beyond December 2023.

Do not meet or are unable to demonstrate they can meet the Service Standards of Ergon Energy.

4.2.3. Timing of Feasible Options

The consequence of not addressing the ageing assets of feeder M028 is significant. As a result of this it is expected that for an option to be considered feasible it will be required to be completed, commissioned, accepted by Ergon Energy, and fully operational by December 2023.

5 Technical Characteristics of Non-Network Options

A suitable solution needs to meet the investment needs identified 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 Aged Asset Risks

A suitable solution would need to reduce the significant safety and environmental risks associated with the end of life, aged M028 feeder to as low as reasonably practicable (ALARP).

5.2. Network Capacity

A suitable solution would need to provide sufficient network capacity and power transfer capability to meet existing and future network loads.

5.3. Network Security and Reliability

A suitable solution would need to ensure that the network meets Ergon Energy's statutory network security (Safety Net) and reliability performance standards.

6 Network Options Considered

Table 3 summarises the technical characteristics of the network options considered, including total indicative costs. Note that each of these options has a planned construction completion date of December 2023.

Table 3 – Network Options Considered

Asset Solution (Up-Front CAPEX*)	Circuit / Pole	Conductor	Route	Considerations
Option 1 – Rebuild M028 Timber, Iodine **($63.4M)**	Single Circuit Timber	Iodine at 75°C (7/4.75 AAAC 1120) with aerial earth wire 45 MVA capacity	Isis Bulk Supply Point to Gayndah Zone Substation (99km)	• Limited availability of >15m wooden poles with 20kN loading. • Timber poles require replacement after 50 years. • Operate in parallel with M049. • No improvement for Mt Rawdon Gold Mine reliability, due to unacceptable voltages when connecting to a new Iodine feeder.
Option 2 – Rebuild M028 Concrete, Iodine **($73.1M)**	Single Circuit Concrete	Iodine at 75°C (7/4.75 AAAC 1120) with aerial earth wire 45 MVA capacity	Isis Bulk Supply Point to Gayndah Zone Substation (99km)	• Concrete pole life is 60 years. • Operate in parallel with M049. • No improvement for Mt Rawdon Gold Mine reliability, due to unacceptable voltages when connecting to a new Iodine feeder.
Option 3 – Rebuild M028 Concrete, Neon (Preferred Network Option) **($74.2M)**	Single Circuit Concrete	Neon at 75°C (19/3.75 AAAC 1120) with aerial earth wire 62MVA capacity	Isis Bulk Supply Point to Gayndah Zone Substation (99km)	• Concrete pole life is 60 years. • Operate in parallel with M049. • Enables possible retirement of M049 at end of life (load dependant). • Reliability improvement for Mt Rawdon Gold Mine reliability costs.

* Direct costs including overheads

7 Summary of Submissions Received in Response to Non-Network Options Report

7.1. Submissions Received which are Potentially Credible Options:

7.1.1. Option 4 - Rebuild M028 as a timber pole, iodine conductor overhead line from Isis to Gayndah and install a 10MW / 20MWh BESS at Gayndah

This solution submitted (hereby called ‘Option 4’ in this report) includes a similar scope of works to Option 1 and with the added inclusion of a 10MW / 20MWh BESS (Battery Energy Storage System) system connected to the 11kV bus at GAYN.

The submission provider is proposing to design, build and operate the BESS within the Gayndah area. The BESS would be developed to provide local network support, frequency control ancillary services and energy arbitrage, providing network benefits.

Local network support will be provided in two ways. The first will be through the provision of reactive power support to help regulate voltage levels around the Gayndah area and the second will be to provide demand management (additional real power support) in the event of peak loads exceeding equipment ratings.

7.1.2. Option 4 Costs

The cost of using the BESS to provide demand support would be $500k per annum for 15 years indexed at CPI (see summary of option costs in Appendix D – Summary of Project Costs Table 9). The submission states that after 15 years another demand management contract could be agreed and it is expected that this would be less than the initial demand management contract due to the declining cost of battery cells, the increasing volatility of electricity wholesale pricing and a large amount of the infrastructure still within design life and hence not in need of replacement. The amount of reduced contracted costs is not quantified in the submission and so for the purposes of NPV options comparison, this report assumes that contracted costs falling after 15 years are discounted to 90% (to account for this decrease in costs).

The received submission assumed that the cost of Network Use of System (NUoS) charges of the BESS (estimated to be approximately $750k per annum) would be met by Ergon Energy. However, as communicated to the submission provider during the NNOR consultation period, the BESS connection and any proposed network support arrangement will be treated separately. That is, charges will be applied as per Ergon Energy standard connection practices. ***Therefore, NUoS costs (and any other network costs associated with the BESS connection) lie with the connection proponent and don't form part of the Option 4 costs for the purposes of the NPV options comparison in this report.***

8 Market Benefit Assessment Methodology

8.1. Classes of Market Benefits Considered and Quantified

The purpose of the RIT-D is to identify the option that maximises the present value of net market benefits to all those who produce, consume and transport electricity in the National Electricity Market (NEM).

In order to measure the increase in net market benefit, Ergon Energy has analysed the classes of market benefits required to be considered by the RIT-D.

The following classes of market benefits are considered material, and have been included in this RIT-D assessment:

- Changes in network losses
- Changes in involuntary load shedding

8.1.1. Changes in network losses

Market benefits associated with the expected change in network losses for each option have been quantified by power system modelling. Annual MWh network losses were calculated by completing load-flow modelling in 30-minute steps over an entire year (using metered load data over the period 1/7/2016 – 1/7/2017, 17520 load-flows in total). These MWh figures were then multiplied by

the value of those losses, as determined by the volume weighted average spot price of electricity for QLD 2015-19 ($78.87/MWh)[4]. The arbitraging and load profile flattening capability of the BESS is ignored.

8.1.2. Changes in involuntary load shedding

The credible options assessed provide varying levels of customer reliability. Under normal system conditions, each option is capable of meeting existing and forecast demand. However, the expected availability of each subtransmission feeder varies across the options due to differences in construction type (e.g. wood pole vs concrete pole), asset condition and average repair/restoration times. The load at risk also varies depending on the operating configuration of each option (e.g. radial vs parallel feeders) and system demand.

Changes in involuntary load shedding market benefits were quantified by VCR calculations. VCR is defined based on the cost of interruption to the customer; it is an economic value applied to customers' annual unserved energy.

8.2. Classes of Market Benefits not Expected to be Material

The following classes of market benefits are not considered to be material for this RIT-D assessment:

- Changes in voluntary load curtailment
- Changes in load transfer capability
- Changes in costs to other parties
- Changes in timing of expenditure
- Option value

8.2.1. Changes in voluntary load curtailment

None of the credible options include any voluntary load curtailment and there are no customers on voluntary load curtailment agreements in the distribution areas of interest at present. Therefore, any market benefits associated with changes in voluntary load curtailment have not been considered.

8.2.2. Changes in load transfer capability

Each credible option included in this RIT-D assessment provide varying levels of power transfer capability. However, under normal system conditions and based on the forecast system demand, each will provide sufficient capacity to meet current and future loads. It is assumed that the proportion of time that the system would be in an abnormal system state is too small for differences in option capabilities to materially affect the selection of the preferred option. Therefore, there is no need to quantify these market benefits.

[4] Source: https://www.aer.gov.au/wholesale-markets/wholesale-statistics/annual-volume-weighted-average-spot-prices-regions

8.2.3. Changes in costs to other parties

Ergon Energy does not anticipate that any of the credible options included in this RIT-D assessment will materially affect costs incurred by other parties.

8.2.4. Changes in timing of expenditure

None of the credible options included in this RIT-D assessment is expected to affect the timing of other distribution investments for unrelated identified needs.

8.2.5. Option value

The AER's view is that option value is likely to arise where there is uncertainty regarding future outcomes, the information that is available in the future is likely to change, and the credible options considered by the RIT-D proponent are sufficiently flexible to respond to that change[5].

Each option is assumed to be installed and commissioned by December 2023 which is effectively an irreversible investment. In this context each option will have the same option value and so it is not required to be quantified.

9 Detailed Economic Assessment

9.1. Methodology

The capital and operational costs for each credible option considered in this RIT-D assessment are summarised in Appendix D – Summary of Project Costs Table 9. The NPV of each option has been determined by considering costs and benefits over the program lifetime from FY2020/21 to FY2059/60.

Key Variables and Assumptions:

- The scope of work was costed based on Asset Replacement; including costs and resources required for the installation of new infrastructure and removal of the existing assets, and include overheads. These activities are well known and established.
- The NPV of each option has been determined by considering costs and benefits over the program lifetime from FY2019/20 to FY2059/60 including a sensitivity analysis of the discount rate.

9.2. Scenarios adopted for Sensitivity Testing

9.2.1. Discount Rate

NER clause 5.17.1(c)(9)(iii) requires that the RIT–D specify the method for determining the discount rate or rates to apply. Paragraphs 16–17 of the RIT–D state:

[5] AER "Regulatory Investment Test for Distribution Application Guidelines", Section 3.9.3. Available at: https://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/rit-t-and-rit-d-application-guidelines-2018

16. The present value calculations must use a commercial discount rate appropriate for the analysis of a private enterprise investment in the electricity sector. The discount rate used must be consistent with the cash flows that the RIT–D proponent is discounting.

17. The lower boundary should be the regulated cost of capital.

The discount rate is an important parameter in the NPV analysis and so the sensitivity of the analysis to changes in the discount rate is explored by using probability weighted scenarios, as shown in Table 4. The lower bound was chosen to be the regulated cost of capital as per the NER direction above.

Table 4 – NPV Discount Rate Scenarios

Scenario	Probability	NPV Discount Rate
Regulated cost of capital	0.7	2.62%
Medium cost of capital	0.2	4.00%
High cost of capital	0.1	5.50%

9.3. NPV Results

NPVs of the five credible options are presented in Table 5 below. This comparison demonstrates that Option 3 has the greatest NPV.

Table 5 – NPV comparison of options

Option	NPV ($M)	Up-Front CAPEX ($M)	Option CAPEX (PV $M)	Option OPEX (PV $M)	Ave. Market Benefit p.a. ($M)
Option 1 – Rebuild M028 Timber, Iodine	155.6	63.4	95.4	2.8	12.1
Option 2 – Rebuild M028 Concrete, Iodine	157.2	73.1	104.8	1.4	12.6
Option 3 – Rebuild M028 Concrete, Neon (Preferred Network Option)	334.1	74.2	75.9	1.4	20.0
Option 4 – Rebuild M028 as a timber pole, iodine conductor overhead line from Isis to Gayndah and install a BESS at Gayndah	165.8	63.4	95.4	6.0	12.1

9.4. Option Risk Reduction

An identified need of the RIT-D project is to reduce all network risks due to aged assets to ALARP (see Section 3.1.1). Appendix E – Summary of Option Network Risk Reduction Table 10 summarises the extent to which each option meets the ALARP requirement.

9.5. Selection of Preferred Option

The previous section has presented the results of the NPV analysis conducted for this RIT-D assessment. The NER requires the Draft Project Assessment Report to include the preferred option under the RIT-D. This should be the option which is expected to maximise the present value of the net economic benefits to all those who produce, consume and transport electricity in the NEM.

The total NPV of Option 3, inclusive of operating costs and market benefits, was estimated at approximately $334.1M. This was substantially larger than the estimated value of each of the other options assessed (Option 1 $155.6M, Option 2 $157.2M and Option 4 $165.8M). The larger value of Option 3 when compared to the other options is attributed to:

- Increased customer reliability benefits due to the replacement of M028 with a highly reliable concrete pole line (compared to options that replace with a timber pole line).
- The use of lower impedance Neon conductor increases the power transfer capacity of the replaced M028 feeder and alleviates the need to replace M049 when it reaches end of life in 2040, whereas other options that replaced M028 using Iodine conductor required M049 to be replaced at that time.

Sensitivity of the NPV results was explored by reducing the reliability improvement parameters of the M028 replacement line (hence reducing customer reliability benefits). It was found that reducing the expected amount of reliability improvement in this way (and even removing all customer reliability benefits from the analysis) had no impact on the ordering of the options by NPV. This shows that Option 3 maximises the present value of net economic benefits under all reasonable scenarios considered within this RIT-D. The preferred option is therefore:

- Option 3 – replace M028 with a new 66kV single circuit concrete pole line strung with Neon conductor and OPGW.

9.6. Satisfaction of RIT-D

Option 3 is the preferred RIT-D option since it maximises the present value of net economic benefits as well as addressing each of the identified needs in Section 3.1.

10 Submission and Next Steps

10.1. Submissions from Solution Providers

Ergon Energy invites written submissions on this report from registered participants and interested parties.

Ergon Energy will not be legally bound in any way or otherwise obligated to any person who may receive this RIT-D report or to any person who may submit a proposal. At no time will Ergon Energy be liable for any costs incurred by a proponent in the assessment of this RIT-D report, any site visits, obtainment of further information from Ergon Energy or the preparation by a proponent of a proposal to address the identified need specified in this RIT-D report.

The RIT-D process is aimed at identifying a technically feasible non-network alternative to the internal option that has greater net economic benefits. However, the selection of the solution provider to implement the preferred option will be done in accordance with Ergon Energy's standards for procurement.

Submissions in writing are due by 4pm on 2nd April 2020 and should be lodged to Ergon Energy's Demand Management Inbox:

demandmanagement@ergon.com.au

10.2. Next Steps

Following Ergon Energy's consideration of submissions received in response to this report, the preferred option, and a summary of and commentary on any submissions received will be included as part of the Final Project Assessment Report (FPAR). The FPAR represents the final stage of the consultation process in relation to the application of the RIT-D.

Ergon Energy intends to publish the FPAR no later than 16th April 2020. Ergon Energy will use its reasonable endeavours to publish the FPAR by the above date. This may however not be achievable due to changing power system conditions or other circumstances beyond the control of Ergon Energy.

At the conclusion of the consultation process, Ergon Energy intends to take steps to progress the recommended solution(s) to ensure any statutory non-compliance is addressed and undertake appropriately justified network reliability improvement(s), as necessary.

Table 6 – Timetable for this RIT-D

Step 1	Release date of the Non-Network Options Report inviting non-network options from interested participants.	16/10/2019
Step 2	Consultation period concluded.	16/01/2020
Step 3	Release date of Draft Project Assessment Report (DPAR) (this report).	19/02/2020
Step 4	Consultations in response to the DPAR.	**Minimum of 6 weeks**
Step 5	Deadline for Submission of proposals for non-network alternatives.	4pm 02/04/2020
Step 6	Planned release date of the Final Project Assessment Report (FPAR).	16/04/2020
Ergon Energy reserves the right to revise this timetable at any time. The revised timetable will be made available on the Ergon Energy RIT-D website.		

Ergon Energy will take all reasonable efforts to maintain the consultation schedule listed above. Due to various circumstances the schedule may change, however, up-to-date information will be available on Ergon Energy's "Regulatory Test Consultations" website:

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

During the consultation period, Ergon Energy will review, compare and analyse all internal and external solutions. Detailed economic options analysis and comparisons of expected market benefits will be undertaken during this time. At the end of the consultation and review process Ergon Energy will publish a final report which will detail the most feasible option and proceed to implement that option.

11 Compliance Statement

This Draft Project Assessment Report complies with the requirements of NER section 5.17.4(j) as demonstrated below:

Requirement	Report Section
(1) a description of the identified need for investment;	3
(2) the assumptions used in identifying the identified need (including, in the case of proposed reliability corrective action, why the RIT-D proponent considers reliability corrective action is necessary);	3.3
(3) if applicable, a summary of, and commentary on, the submissions received on the NNOR;	7
(4) a description of each credible option assessed	4, 6 & 7
(5) where a *Distribution Network Service Provider* has quantified market benefits in accordance with clause 5.17.1(d), a quantification of each applicable market benefit of each credible option	8
(6) a quantification of each applicable cost for each credible option, including a breakdown of operating and capital expenditure	6 & 7
(7) a detailed description of the methodologies used in quantifying each class of costs or market benefit	8
(8) where relevant, the reasons why the RIT-D proponent has determined that a class or classes of market benefits or costs do not apply to a credible option	8.2
(9) the results of an NPV analysis of each credible option and accompanying explanatory statements regarding the results	9
(10) the identification of the proposed preferred option	9.5
(11) for the proposed preferred option, the RIT-D proponent must provide: (i) details of the technical characteristics; (ii) the estimated construction timetable and commissioning date (where relevant); (ii) the indicative capital and operating costs (where relevant); (iv) a statement and accompanying analysis that the proposed preferred option satisfied the RIT-D; and (v) if the proposed preferred option is for reliability corrective action and that option has a proponent, the name of the proponent	9.5 & 9.6
(12) contact details for a suitably qualified staff member of the RIT-D proponent to whom queries on the draft report may be directed.	1.2

Appendix A – The RIT-D Process

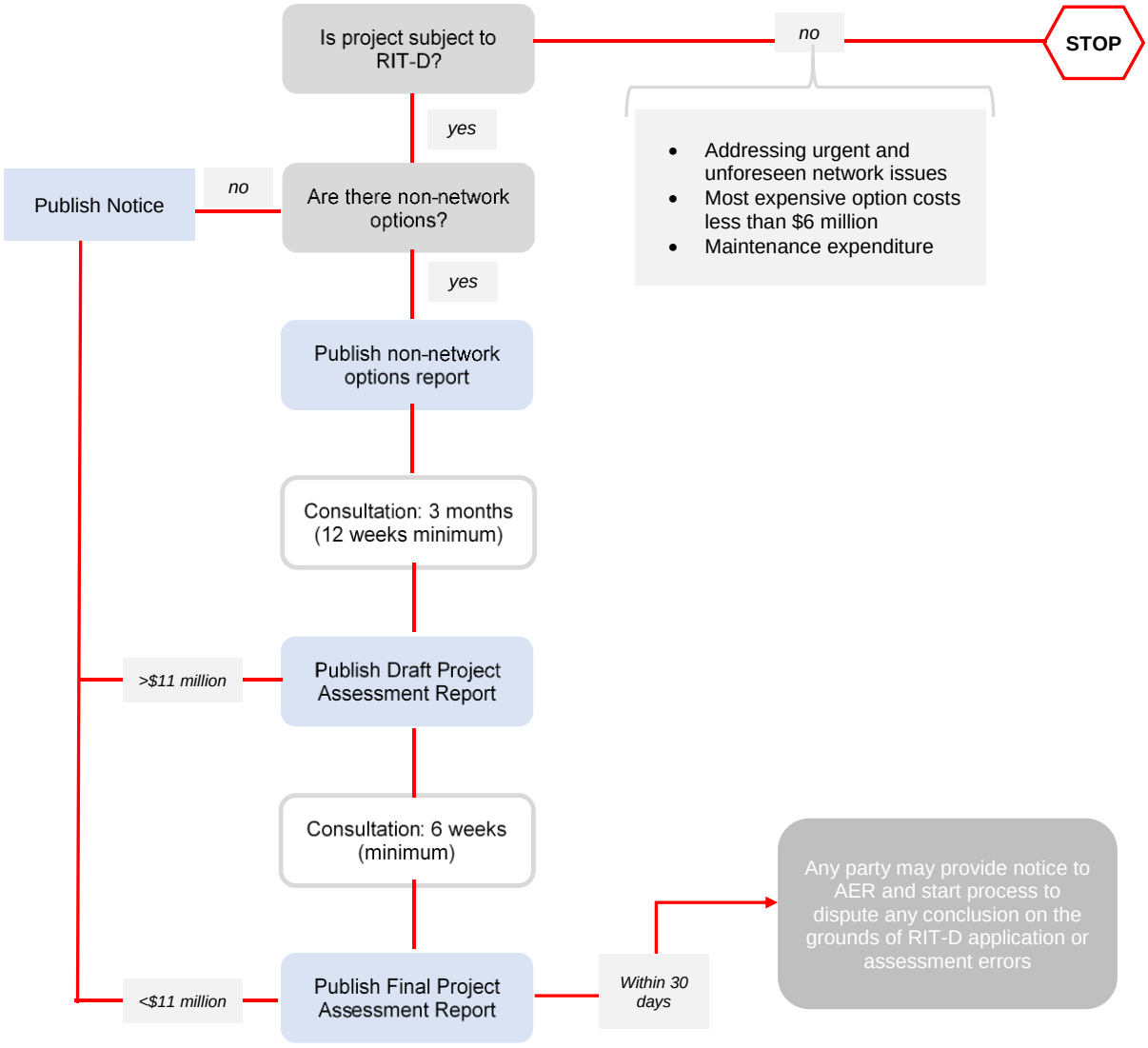

Figure 4 – The RIT-D process

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

Appendix B – Network Risk Assessment

Table 7 - Summary of M028 network risks

Risk Scenario	Risk Type	Consequence (C)	Likelihood (L)	Risk Score	Risk Year
Public Safety Impact - Conductor/pole failure in a public access area results in single fatality.	Safety	5 *(Single fatality / incurable fatal illness)*	3 *(Moderate Exposure)*	**15** ***(Moderate)***	2019
Worker Safety Impact – Failure of an aged copper conductor during re-tensioning results in loss of control of conductor striking a worker causing single serious injury.	Safety	3 *(Single serious injury / illness)*	5 *(Very High Exposure)*	**15** ***(Moderate)***	2019
Bushfire Impact – An energised conductor fails and falls to ground starting bushfire resulting in medium-term disruption to eco-system. Area surrounding M028 Feeder classified as bush fire prone with 'high' to 'very high' bushfire potential.	Environment	4 *(Medium term disruption to eco-system)*	3 *(Unlikely)*	**12** ***(Moderate)***	2019
Asset Impact – Interruption to a single large-scale business (Mt Rawdon Gold Mine) for >12 hours leads to shut down process and involves rolling load shedding at DEGI, GAYN, MUTO and EIDS while the line is repaired.	Customer	3 *(Disruption to single large-scale business)*	4 *(Likely)*	**12** ***(Moderate)***	2019
Asset Impact – Limitations on maintenance works program leads to potential load shedding at DEGI, GAYN, MUTO and EIDS due to ban on live line works resulting in interruptions >12 hours	Customer	3 *(Interruption >12 hours)*	4 *(Likely)*	**12** ***(Moderate)***	2019
Compliance Impact – Failure to meet EQL policies or external standard AS C41 -1968**.**	Business	3 *(Compliance breach with Energex / Ergon policies or external standards)*	5 *(Very likely)*	**15** ***(Moderate)***	2019
Customer & Political Sensitivity- Continued inability to maintain this feeder in accordance with EQL standards leads to ongoing interruption and adverse regional media attention.	Customer	**3** *(Adverse regional media attention)*	3 *(Unlikely)*	**9** ***(Low)***	2019

Appendix C – Ergon Energy's Minimum Service Standards and Safety Net Targets

Applied Service Standards

The applicable service standard for this planning proposal is Safety Net which is "a strategy to avoid unexpected customer hardship and/or significant community or economic disruption by mitigating the effects of credible contingencies largely on the sub-transmission network, which have a low probability of occurring and result in high consequence network outages and loss of supply to many customers. Safety Net provides a 'base-case' security level to cater for Low-Probability High Impact events". It is included in Ergon Energy's Distribution Authority and is therefore a mandatory business requirement.

Safety Net Security Criteria

To address the low probability high impact risk for feeder outage contingencies, the Safety Net Security Criteria is applied to restore supply within the allowable timeframe. The safety net criteria are classified into Regional Centre and Rural Area, each with a different timeline as shown in Table 8.

Table 8 – Safety Net Criteria

Safety Net – Load not supplied and maximum restoration times following a credible contingency	
Regional Centre	**Rural Areas**
Less than 20MVA (5000 customers) after 1 hour	Less than 20MVA (7700 customers) after 1 hour
Less than 15MVA (3600 customers) after 6 hours	Less than 15MVA (5800 customers) after 8 hours
Less than 5MVA (1200 customers) after 12 hours	Less than 5MVA (2000 customers) after 18 hours
Fully restored within 24 hours.	Fully restored within 48 hours.

Appendix D – Summary of Project Costs

Table 9 - Summary of Option Costs (PV terms)

Initial CAPEX	Year 2023 Option Scope	Year 2023 CAPEX ($M)*	Year 2040 Option Scope	Year 2040 CAPEX ($M)*	Option Network Support OPEX
Option 1 Rebuild M028 Timber pole, Iodine	Rebuild M028 Timber, Iodine	63.4	Replace M049	62.6	Nil
Option 2 Rebuild M028 Concrete pole, Iodine	Rebuild M028 Concrete, Iodine	73.1	Replace M049	62.6	Nil
Option 3 Rebuild M028 Concrete pole, Neon (Preferred Network Option)	Rebuild M028 Concrete pole, Neon	74.2	Recover M049	7.4	Nil
Option 4 Rebuild M028 as a timber pole, iodine conductor overhead line from Isis to Gayndah and install a BESS at Gayndah	Rebuild M028 as a timber pole, iodine conductor overhead line from Isis to Gayndah and install a BESS at Gayndah	63.4	Replace M049	62.6	$0.5M per annum in year 1-15 and then $0.45M[6] in subsequent years

* Direct costs including overheads

[6] $0.45M represents a reduction in the annual Network Support costs (10% reduction assumed) after a battery cell refresh after 15 years of operation. This is due to expected lower future cost of battery cells and the fact that much of the BESS plant will still be within its design life and won't need to be replaced.

Appendix E – Summary of Option Network Risk Reduction

Table 10 – Qualitative summary of option network risk reduction

Risk No.	Risk Scenario	Option 1 Explanation (*Option ranking**)	Option 2 Explanation (*Option ranking**)	Option 3 Explanation (*Option ranking**)	Option 4 Explanation (*Option ranking**)
1	**Public Safety Impact** - Conductor/pole failure in a public access area results in single fatality.	M028 replacement in 2023 reduces safety risks on this line however M049 risks remain. ***(2)***	M028 replacement in 2023 reduces safety risks on this line however M049 risks remain. ***(2)***	M028 replacement in 2023 reduces safety risks on this line. M049 risks removed when line recovered in 2040. ***(1)***	M028 replacement in 2023 reduces safety risks on this line however M049 risks remain. ***(2)***
2	**Worker Safety Impact –** Failure of an aged copper conductor during re-tensioning results in loss of control of conductor striking a worker causing single serious injury.	Risk removed when M028 replaced in 2023. ***(1)***	Risk removed when M028 replaced in 2023. ***(1)***.	Risk removed when M028 replaced in 2023. ***(1)***	Risk removed when M028 replaced in 2023. ***(1)***
3	**Bushfire Impact –** An energised conductor fails and falls to ground starting bushfire resulting in medium-term disruption to eco-system. Area surrounding M028 Feeder classified as bush fire prone with 'high' to 'very high' bushfire potential.	M028 replacement in 2023 reduces bushfire risks on this line however M049 risks remain. ***(2)***	M028 replacement in 2023 reduces bushfire risks on this line however M049 risks remain. ***(2)***	M028 replacement in 2023 reduces bushfire risks on this line. M049 risks removed when line recovered in 2040. ***(1)***	M028 replacement in 2023 reduces bushfire risks on this line however M049 risks remain. ***(2)***
4	**Asset Impact –** Interruption to a single large-scale business (Mt Rawdon Gold Mine) for >12 hours leads to shut down process and involves rolling load shedding at DEGI, GAYN, MUTO and EIDS while the line is repaired.	M028 replacement in 2023 with a higher capacity wood pole feeder removes requirement for rolling load shedding at zone substations (for contingency loss of M049). Mt Rawdon load remains at risk during system peak load periods. ***(3)***	M028 replacement in 2023 with a higher capacity concrete pole feeder removes requirement for rolling load shedding at zone substations (for contingency loss of M049). Mt Rawdon load remains at risk during system peak load periods. ***(2)***	M028 replacement in 2023 with a higher capacity concrete pole feeder removes requirement for rolling load shedding at zone substations (for contingency loss of M049). Mt Rawdon load can be supplied at all levels of system demand. ***(1)***	M028 replacement in 2023 with a higher capacity wood pole feeder and BESS removes requirement for rolling load shedding at zone substations (for contingency loss of M049). Mt Rawdon load can be supplied at all levels of system demand. ***(1)***

5	**Asset Impact –** Limitations on maintenance works program leads to potential load shedding at DEGI, GAYN, MUTO and EIDS due to ban on live line works resulting in interruptions >12 hours	M028 replacement in 2023 removes ban on live line work and subsequent risks. ***(1)***	M028 replacement in 2023 removes ban on live line work and subsequent risks. ***(1)***	M028 replacement in 2023 removes ban on live line work and subsequent risks. ***(1)***	M028 replacement in 2023 removes ban on live line work and subsequent risks. ***(1)***
6	**Compliance Impact –** Failure to meet EQL policies or external standard AS C41 -1968**.**	M028 replacement in 2023 removes risk of non-compliance to EQL policies and AS C41 – 1968. ***(1)***	M028 replacement in 2023 removes risk of non-compliance to EQL policies and AS C41 – 1968. ***(1)***	M028 replacement in 2023 removes risk of non-compliance to EQL policies and AS C41 – 1968. ***(1)***	M028 replacement in 2023 removes risk of non-compliance to EQL policies and AS C41 – 1968. ***(1)***
7	**Customer & Political Sensitivity-** Continued inability to maintain this feeder in accordance with EQL standards leads to ongoing interruption and adverse regional media attention.	M028 replacement in 2023 removes risk of non-compliance to EQL and external standards. ***(1)***	M028 replacement in 2023 removes risk of non-compliance to EQL and external standards. ***(1)***	M028 replacement in 2023 removes risk of non-compliance to EQL and external standards. ***(1)***	M028 replacement in 2023 removes risk of non-compliance to EQL and external standards. ***(1)***

* Options are ranked in order of levels of residual risk with lower ranked options having a lower level of residual risk.

Appendix F – Glossary of Terms

Table 11 – Glossary of terms

Abbreviation	Description
10POE	Peak load forecast which has a 10% probability of being exceeded in any year
50POE	Peak load forecast which has a 50% probability of being exceeded in any year
ALARP	As low as reasonably practicable
DEGI	Degilbo substation 33/11kV
EIDS	Eidsvold substation 33/11kV
GAYN	Gayndah substation 33/11kV
HDBC	Hard Drawn Bare Copper
MORW	Mt Rawdon gold mine
MUTO	Mundubbera Town substation 33/11kV
RIT-D	Regulatory Investment Test for Distribution