Regulatory Investment Test for Distribution

Non Network Options Report

Addressing Reliability Requirements in the Cloncurry Network Area

ERGON ENERGY NETWORK
Part of Energy Queensland

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Consultation Period Starts: **14 February 2020**

Consultation Period Closes: **15 May 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.

IDENTIFED NEED

Cloncurry is located approximately 110km east of Mt Isa and is supplied from Cloncurry 66/11kV Substation (CLON) and North Cloncurry 66/11kV Substation (NOCL) that supply 1,512 customers. Cloncurry 66/11kV Substation (CLON) and North Cloncurry 66/11kV Substation (NOCL) are normally supplied from Chumvale 220/66kV Substation (CHUM) via a single circuit 66kV sub-transmission feeder. Chumvale Substation is supplied by a single circuit 220kV sub-transmission feeder from the Mica Creek 'C' Substation (MICC) at Mt Isa. There is also a single circuit 66kV sub-transmission feeder from Mount Isa's Duchess Road 132/11/66kV Substation (DURO) to a normally open isolation point (designated DR-CC-1), which is located outside Chumvale Substation. This 66kV feeder supplies two small pole-mounted 66/11kV substations between Mount Isa and Cloncurry, and is also used to supply Cloncurry in the event of an extended outage on the 220kV network.

Approximately 184 spans on the Duchess Road to Cloncurry 66kV feeder (DR-CC-1) have been identified as having insufficient ground clearance to meet minimum statutory requirements at the 50°C designed operating temperature. As such, the thermal rating of the DR-CC-1 66kV feeder is no longer adequate to supply Cloncurry under peak load conditions and Ergon Energy would not comply with the Safety Net requirements based on credible contingencies benchmarked against 50% POE load in the present configuration.

For the failure of the 220/66kV transformer at Chumvale Substation, resulting in the loss of supply to Cloncurry and North Cloncurry Substations, full restoration of supply would be greater than 48 hours due to the distance of this area from the required mobile generation assets and the complex logistics involved in the deployment of these generation assets. As such, supply restoration is not Safety Net compliant for this scenario.

Condition data also indicates that the 66kV voltage transformers and 11/66kV step-up transformer (T4) at Duchess Road Substation which supplies the DR-CC-1 66kV feeder are reaching end of life; and there are three sets of ABB Duoroll isolators on the 66kV bus at Duchess Road Substation which are inoperable and recommended for retirement.

Ergon Energy proposes to meet the identified need by uprating the DR-CC-1 66kV feeder through interpoling the spans with insufficient ground clearance, and replacing the 66/11kV step-up transformer and undertaking 66kV asset refurbishment at Duchess Road Substation.

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 supply to the consumers in the Cloncurry supply areas in a reliable, safe and cost-effective manner. Accordingly, this investment is subject to a RIT-D. This Non-Network Options Report has been prepared by Ergon Energy in accordance with the requirements of clause 5.17.4(e) of the NER and seeks information from interested parties about possible alternate solutions to address the need for investment.

Submissions in writing are due on the **15 May 2020** by 4:00 PM and must be lodged to demandmanagement@ergon.com.au

For further information and inquiries please contact:

E: demandmanagement@ergon.com.au
P: 13 74 66

1 Introduction

This Non-Network Options Report has been prepared by Ergon Energy in accordance with the requirements of clause 5.17.4(e) of the NER.

This report represents the first stage of the consultation process in relation to the application of the RIT-D on potential credible options to address the identified need for the Cloncurry network area.

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 distribution network supplying the Cloncurry area.
- Identifies the need which Ergon Energy is seeking to address, together with the assumptions used in identifying and quantifying that need.
- Describes the credible options that Ergon Energy currently considers may address the identified need, including for each:
  - Its technical definitions;
  - The estimated commissioning date; and
  - The total indicative cost (including capital and operating costs).
- Sets out the technical characteristics that a non-network option would be required to deliver in order to address the identified need.
- Is an invitation to registered participants and interested parties to make submissions on credible options to address the identified need.

1.2. General Terms and Conditions

1. By issuing this Non-Network Options Report (NNOR), Ergon Energy is under no obligation whatsoever to review, discuss, select or enter into any agreement with any proponent who may submit a proposal.
2. Proponents will be responsible for all costs associated with the preparation and assessment of providing a proposal in response to this NNOR including but not limited to any site visits and responding to further information requests made by Ergon Energy in order to assist Ergon Energy in its assessment of the proposal.
3. When evaluating a proposal, Ergon Energy will be dictated by the NER and RIT-D Guidelines (available on the AER website). Further, Ergon Energy will follow the process as described in Ergon Energy's Demand Side Engagement Strategy (DSES) a copy of which can be found at the following link.
4. Ergon Energy may combine all or parts of separate proposals for the purposes of evaluation where this may lead to a more efficient outcome than the separate proposal or option. Proponents should indicate in their proposal whether they wish to have their

proposals or options considered in isolation or in combination with other proponents proposals.

5. Ergon Energy will publicly announce the outcome of the evaluation process. This announcement will be published on Ergon Energy's website and unless otherwise agreed in writing at the commencement of the assessment process all details of proposals including cost information will be treated as public information.

1.3. Contact Details

Submissions in writing are due by 4pm on **15 May 2020** and should be lodged to demandmanagement@ergon.com.au.

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2 Background

2.1. Geographic Region

The town of Cloncurry is the administrative centre of the Shire of Cloncurry in north-west Queensland. Cloncurry is located 110km east of Mt Isa and 770km west of Townsville. The region has a population of approximately 3,000 people, and the primary industries include cattle grazing, transport services, copper mining and gold mining.

The geographical location of Ergon Energy's sub-transmission network and substations in the Cloncurry area is illustrated in the Google Earth image below.

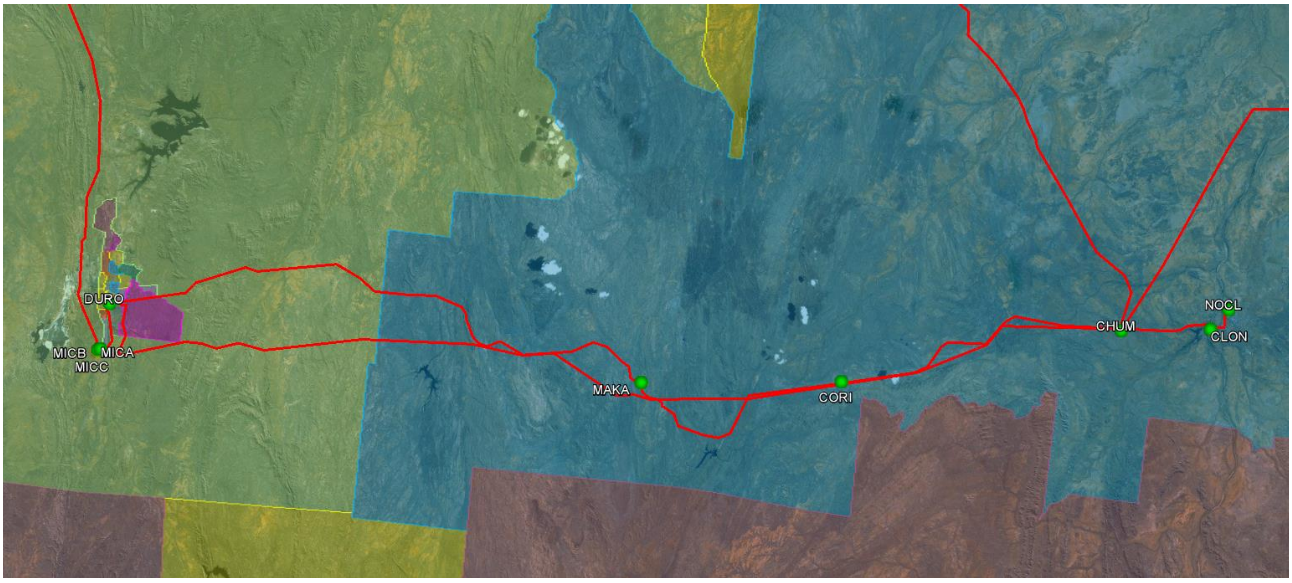

Figure 1: Cloncurry District Sub-transmission Network (Geographical Overview)

2.2. Existing Supply System

The Cloncurry supply system is part of the Northern Region of Ergon Energy's network. Chumvale 220/66kV Substation (CHUM) supplies electricity to 1,512 customers in the Cloncurry township and surrounding areas via the Cloncurry (CLON) and North Cloncurry (NOCL) 66/11kV Substations.

Cloncurry (CLON) Substation presently supplies 697 customers and has two 66/11kV transformers. Transformer 1 has an ONAF cooling system with a normal cyclic rating of 3.35MVA and long term emergency cyclic rating of 3.44MVA. Transformer 2 has an ONAN cooling system with a normal cyclic and long term emergency cyclic rating of 4.25MVA. Cloncurry Substation supplies three 11kV distribution feeders which contain five existing 11kV feeder ties to 11kV feeders supplied from North Cloncurry 66/11kV Substation (NOCL).

North Cloncurry (NOCL) Substation presently supplies 815 customers and has two 66/11kV transformers. Transformer 1 has an ONAF cooling system with a normal cyclic rating of 6.83MVA and long term emergency cyclic rating of 7.85MVA. Transformer 2 has an ONAN cooling system with a normal cyclic rating of 5.39MVA and long term emergency cyclic rating of 6.22MVA. North Cloncurry Substation also supplies three 11kV distribution feeders.

When the supply system is in its normal configuration Cloncurry and North Cloncurry Substations are supplied from Chumvale Substation via a single 12.4km 66kV circuit feeder (CH-CC-1). Chumvale Substation is supplied by a single 99.4km 220kV feeder (MICC-CHUM) from the Mica Creek 'C' Yard Substation (MICC) at Mt Isa. Chumvale Substation also has two outgoing 220kV feeders which supply the Ernest Henry and Dugald River mines located north of Cloncurry.

A 109.7km single circuit 66kV feeder (DR-CC-1) also exists between Mount Isa's Duchess Road 132/11/66kV Substation (DURO) and Cloncurry Substation, but has a normally open isolation point outside Chumvale Substation. In the normal system configuration, this 66kV feeder also supplies Mary Kathleen 66/11kV Substation (MAKA) and Corella River 66/11kV Substation (CORI) which are two small pole-mounted 66/11kV substations located between Mount Isa and Cloncurry.

The existing sub-transmission network arrangement is shown schematically in the figure below.

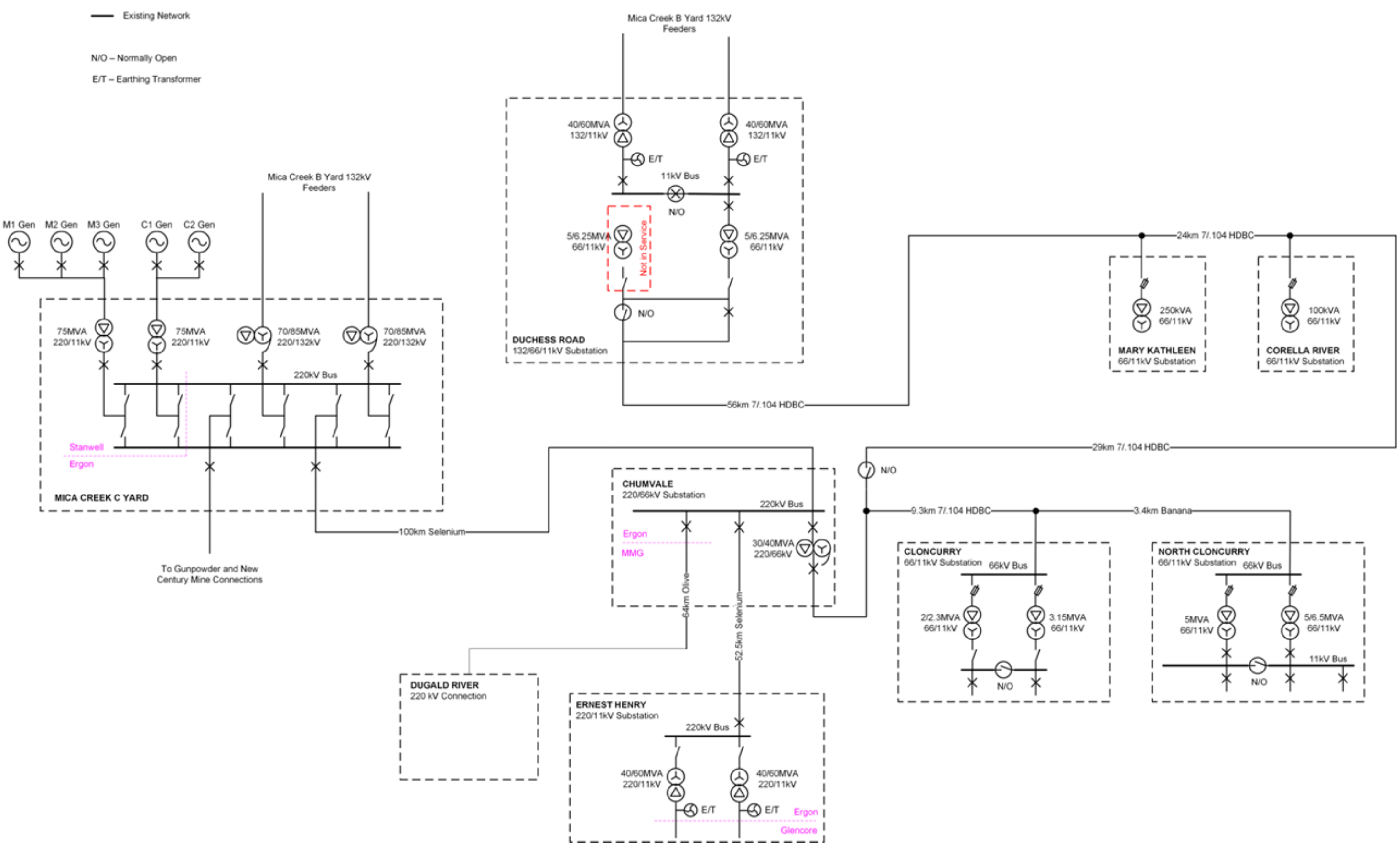

Figure 2: Existing Sub-transmission Network

Ergon Energy's electricity network supplying the townships of Mount Isa and Cloncurry and surrounding rural areas (the Mount Isa – Cloncurry network), is not connected to the national grid and is not subject to full regulation under the National Electricity Law (NEL) and National Electricity Rules (NER). The Mount Isa – Cloncurry network is regulated by the AER in terms of revenue and prices, as such, these customers have access to regulated network prices. However, the network assets that are owned by Ergon Energy are unregulated and therefore not subject to the technical requirements of the NER. Notwithstanding, given the intent of the RIT-D process is to ensure expenditure on the shared network is prudent and efficient, Ergon Energy has deemed it appropriate to apply the RIT-D to any network that has direct control services charges applying to it.

2.3. Load Profiles / Forecasts

The load at Cloncurry comprises a mix of residential, commercial and industrial customers. The load is summer peaking, and annual peak loads are predominantly driven by air-conditioning.

2.3.1. Full Annual Load Profile

The full annual load profile for Chumvale 220/66kV Substation (combined load of Cloncurry and North Cloncurry Substations) over the 2018/19 financial year is illustrated in the figure below. It can be noted that the peak load occurs during summer.

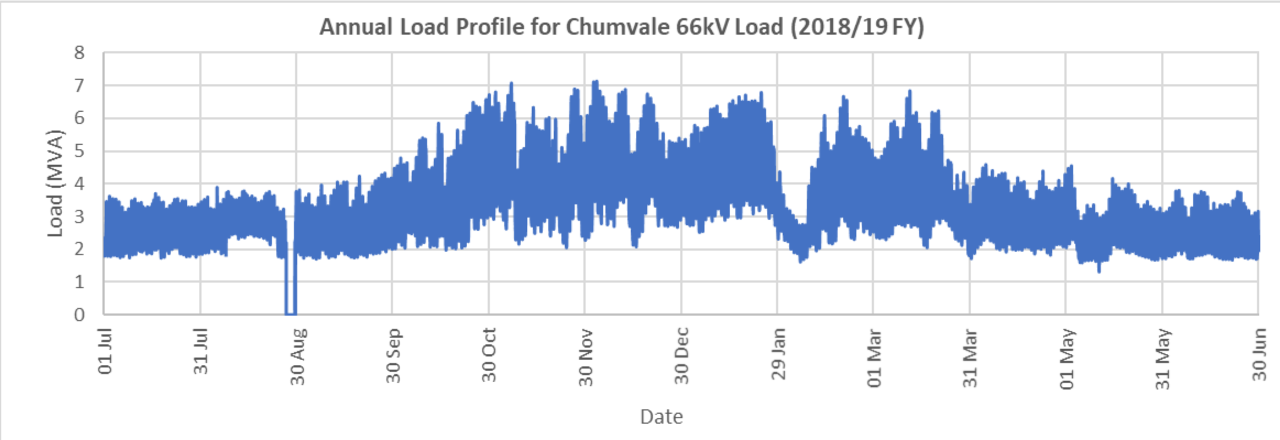

Figure 3: Full Annual Load Profile

2.3.2. Load Duration Curve

The load duration curve for Chumvale 220/66kV Substation (combined load of Cloncurry and North Cloncurry Substations) over the 2018/19 financial year is illustrated in the figure below.

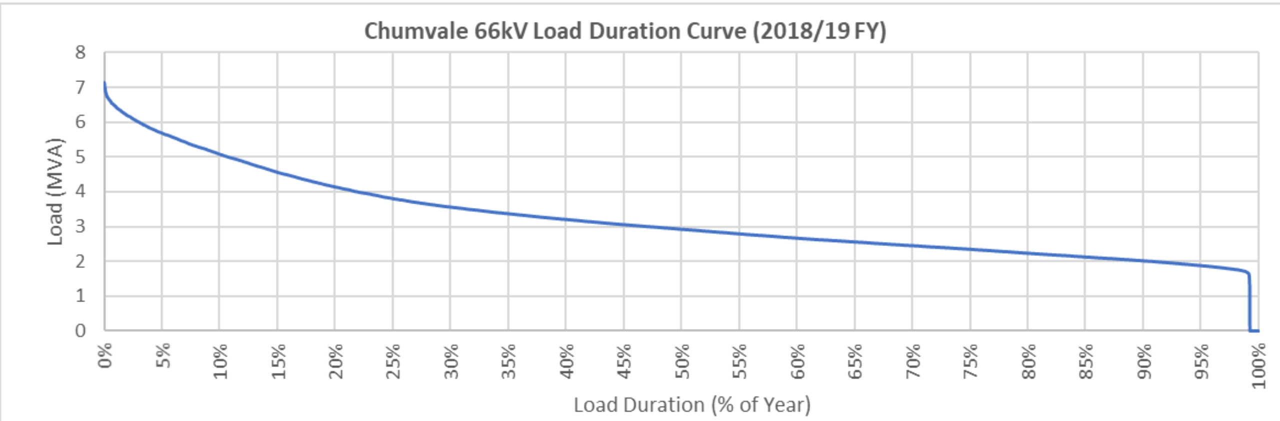

Figure 4: Load Duration Curve

2.3.3. Average Peak Weekday Load Profile (Summer)

The daily load profile for an average peak weekday during summer is illustrated in the figure below. It can be noted that the summer peak loads at Cloncurry are historically experienced in the late afternoon and evening.

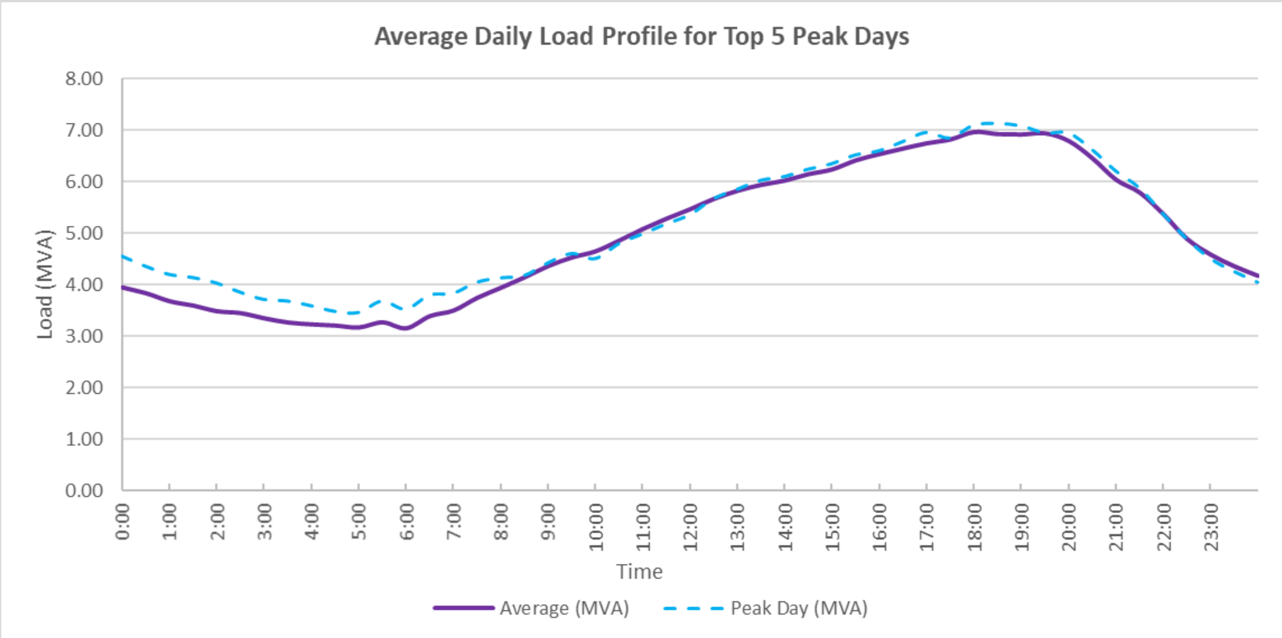

Figure 5: Average Peak Weekday Load Profile (Summer)

2.3.4. Base Case Load Forecast

The combined 10% POE and 50% POE load forecast for the base case load growth scenario out until 2031 is illustrated in the graph below. The historical peak load for the past five years has also been included in the graph.

It can be noted that the historical annual peak loads have fluctuated between 7MVA and 8MVA over the past five years, and the peak load is forecast to remain steady and begin to reduce slightly over the next 10 years.

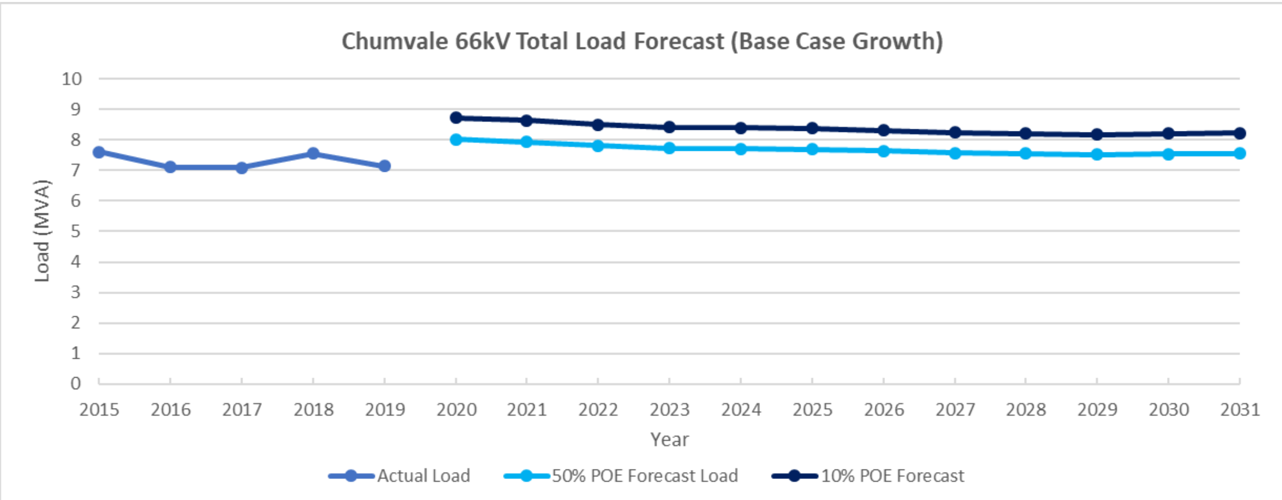

Figure 6: Base Case Load Forecast

2.3.5. High Growth Load Forecast

The combined 10% POE and 50% POE load forecast for the high load growth scenario out until 2031 is illustrated in the graph below. With the high growth scenario, the peak load is forecast to remain steady and begin to increase slightly over the next 10 years.

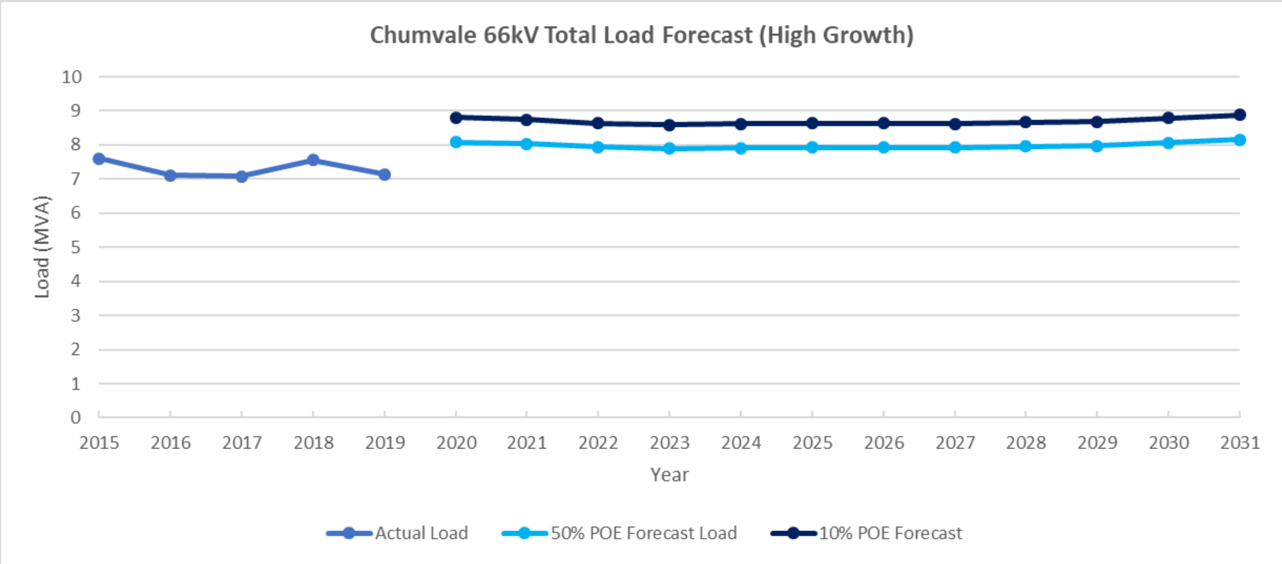

Figure 7: High Growth Load Forecast

2.3.6. Low Growth Load Forecast

The combined 10% POE and 50% POE load forecast for the low load growth scenario out until 2031 is illustrated in the graph below. It can be noted, that the peak load is not forecast to drop below 7MVA over the next 10 years, even under the low growth forecast scenario.

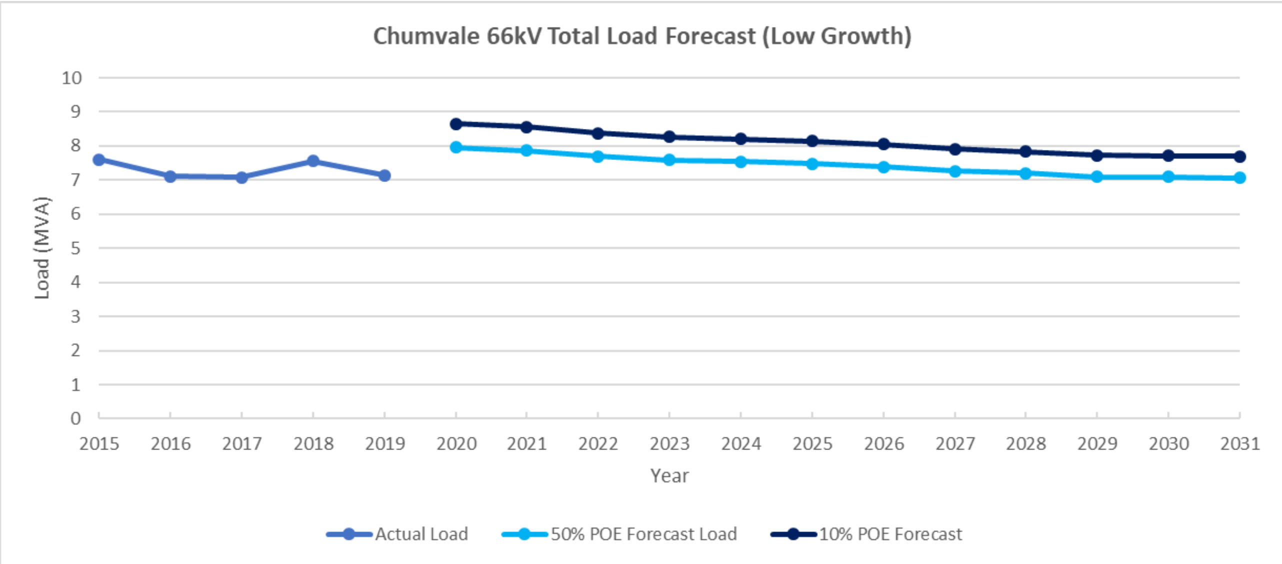

Figure 8: Low Growth Load Forecast

3 Identified Need

3.1. Description of the Identified Need

3.1.1. Reliability

The existing sub-transmission network configuration has all the customers supplied from Cloncurry and North Cloncurry Substations reliant upon the single circuit 220kV feeder from Mica Creek C to Chumvale and the single circuit 66kV feeder from Chumvale to Cloncurry. Currently a fault on either of these feeders or the 220/66kV transformer at Chumvale Substation will result in an outage for all Cloncurry and North Cloncurry customers. This combines for a peak load at risk of approximately 7.5MVA.

This network arrangement has resulted in higher than average SAIDI and SAIFI.

3.1.2. Safety Net Non-compliance

A number of spans on the DR-CC-1 66kV feeder between Duchess Road Substation and Cloncurry Substation no longer meet minimum statutory clearance heights at the 50°C designed operating temperature. The summer day thermal rating of the DR-CC-1 66kV feeder with consideration for the clearance issues is not adequate to supply Cloncurry under peak load conditions.

Under a credible contingency event (such as for an outage of the 220/66kV transformer at Chumvale Substation) benchmarked against 50% POE load, Ergon Energy will not be able to meet Safety Net restoration times as the DR-CC-1 feeder does not have sufficient capacity to supply the total load of North Cloncurry Substation and Cloncurry Substation.

3.1.3. Aged and Poor Condition Assets

A recent condition assessment has highlighted that a number of assets are at end of life and in poor condition. The condition of these assets presents a significant safety, environmental and reliability risk.

Condition data indicates that the 66kV voltage transformers and 11/66kV step-up transformer (T4) at Duchess Road Substation which supplies the DR-CC-1 66kV feeder are reaching end of life. Additionally, there are three sets of ABB Duoroll isolators on the 66kV bus at Duchess Road Substation which are inoperable and recommended for retirement.

3.2. Quantification of the Identified Need

3.2.1. Reliability Impacts

The average number of momentary and sustained outage on the Mica Creek to Chumvale 220kV feeder, Duchess Road to Cloncurry 66kV feeder and the Chumvale to Cloncurry 66kV feeder over the past five years are illustrated in the table below.

Table 1: Reliability Statistics for Sub-transmission Network

Unplanned Outage Data – Average Annual Outage Frequency		
Impacted Feeder	Average No. Momentary outages/year	Average No. Sustained outages/year
CH-CC-1 (12.4km EPT Steel Tower/Concrete Pole – 55% of feeder has OHEW)	3.2	1.2
DR-CC-1 (110km Predominantly EPT Steel Tower – No/Minimal Shielding)	13	2.8
MICR-CHUM-1 (99.4km Steel Tower + OHEW)	3	0.6

The performance of the CH-CC-1 (12.4km) and DR-CC-1 (110km) 66kV feeders with no OHEW is worse than the typical outage rate of 8 outages per 100km/year for this construction type. The performance of the MICR-CHUM-1 220kV feeder with OHEW is also worse than the typical outage rate of 1.30 to 2.50 outages per 100km/year for its construction type.

The North West region of Queensland normally has higher ceraunic levels than most of Queensland and a majority of the outages on these feeders are associated with storm activity.

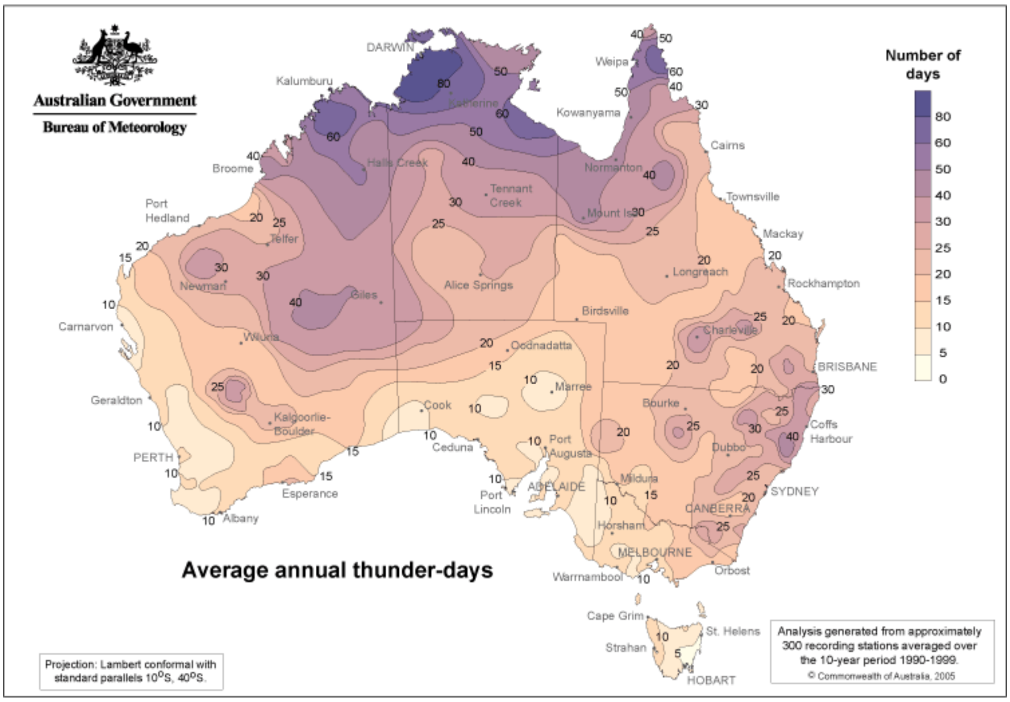

Figure 9: BOM Average Annual Thunder Days Map[1]

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[1] http://www.bom.gov.au/jsp/ncc/climate_averages/thunder-lightning/index.jsp

The reliability statistics of the 11kV distribution feeders supplied from Cloncurry and North Cloncurry Substations are listed in the table below.

Table 2: Reliability Statistics for Distribution Feeders

Sub.	Feeder	Cat	2013/14		2014/15		2015/16		2016/17		2017/18	
			SAIDI	SAIFI	SAIDI	SAIFI	SAIDI	SAIFI	SAIDI	SAIFI	SAIDI	SAIFI
CLON	CLON No.1	LR	276	1.98	257	3.10	309	5.48	799	5.28	694	4.41
	CLON No.2	UR	525	3.77	45	2.07	1016	9.12	383	2.16	80	0.32
	CLON No.3	SR	142	2.00	824	5.00	151	3.00	1725	4.00	412	3.00
NOCL	NOCL No.2	LR	566	3.64	2560	7.02	1641	6.29	1260	2.77	2558	5.02
	NOCL No.3	SR	82	1.25	532	6.72	438	4.37	526	3.60	405	6.29
	NOCL No.4	UR	914	9.51	81	2.39	646	5.99	228	1.75	79	0.29

SAIDI or System Average Interruption Duration Index, means the sum of the durations of all the sustained interruptions (in minutes), divided by the customer base. Momentary interruptions (of three minutes or less) are excluded from the calculation of unplanned SAIDI.

SAIFI or System Average Interruption Frequency Index, means the total number of sustained interruptions, divided by the customer base. Momentary interruptions (of three minutes or less) are excluded from the calculation of unplanned SAIFI.

3.2.2. Safety Net Non-compliance

Cloncurry and North Cloncurry Substations are categorised as *Rural Areas* under Ergon Energy's Distribution Authority No. D01/99.

As a number of spans on the DR-CC-1 66kV feeder no longer meet minimum statutory clearance heights under maximum loading conditions; under a credible contingency event for the loss of the 220/66kV transformer at Chumvale, Ergon Energy will not be able to meet Safety Net standards as the DR-CC-1 line cannot supply the North Cloncurry and Cloncurry load.

Under this scenario it is not possible to transfer load to adjacent substations and full repair or replacement of a failed 220/66kV transformer could take up to 6 months.

Relying on mobile generation for support at short notice is infeasible due to the distance of this area from the required mobile generation assets and the complex logistics involved in the deployment of these assets to Cloncurry.

Based on Ergon Energy's Safety Net contingency management plan for Chumvale, the assessed time to deploy 1.5MVA of LV generation[2] from Mt Isa, Cloncurry and the western depots (including stand-up, loading, transport and phase in) is 21 hours. This is not within the 18 hour period required under the Safety Net criteria and is reflected in the figure below.

Full restoration is required within 48 hours, however the assessed time to deploy sufficient HV and LV temporary generation resources to facilitate full restoration is 60 hours[3]. The Safety Net non-compliance is demonstrated in Figure 10.

[2] Hire generation is dependent upon what is available in Cloncurry and Mt Isa at the time of the outage
[3] Assuming that HV generation units are not tied up in long rural deployments or planned work

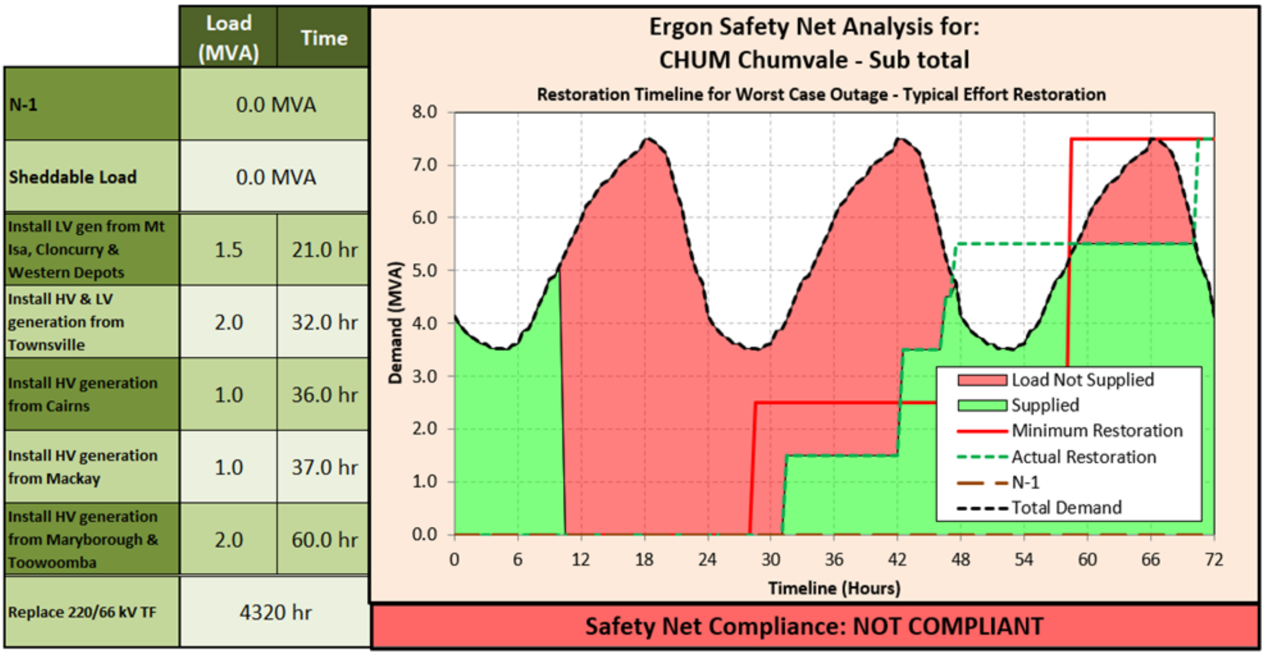


Figure 10: Safety Net Analysis for Chumvale (Loss of 220/66kV Transformer)

3.2.3. Network limitations

Substation Limitations

Condition based assessments of the substations in the Cloncurry supply area have identified the following limitations.

Table 3: Substation Limitations

Substation	Limitations
Chumvale (CHUM)	• Recently underwent a significant yard extension, with the connection of the Dugald River Mine 220kV private line in 2017. This included the installation of a "stub" for a future 220kV bay to allow capacity expansion. • Currently supplies both Cloncurry and North Cloncurry zone substations.
Cloncurry (CLON)	• The long-term strategic plan is to retire this zone substation so it is anticipated that the existing configuration will be maintained until the end of life. • When retired, all network connections will be transferred to North Cloncurry.
North Cloncurry (NOCL)	• Future capacity increases will be required to facilitate the transfer of connections from CLON when that substation is retired. This is likely to align with end-of-life replacement of the existing transformers.
Duchess Road (DURO)	• Supplies NOCL & CLON via a 66kV feeder in a contingency scenario only. • Supplies Mary Kathleen (MAKA) & Corella River (CORI) in normal operating conditions. • Condition data indicates that the 66kV voltage transformers and 11/66kV step-up transformer (T4) which supplies the DR-CC-1 66kV feeder are reaching end of life. • Additionally, there are three sets of ABB vertical Duoroll isolators on the 66kV bus which are inoperable and recommended for retirement. • Investigations have identified the Buchholz protection device on TF4 causes the transformer to trip when there is a feeder fault. Further analysis is necessary to understand the root cause of this issue and identify appropriate remediation. • Previous testing of TF3 in 2013 determined problems with both insulation resistance and winding resistance. Insulation resistance has been remediated but it is not believed at the time of writing that the winding resistance has been remediated to meet Maintenance Acceptance Criteria (MAC) testing.

Sub-transmission Feeder Limitations

The table below shows the summer thermal ratings for the sub-transmission feeders that supply the Duchess Road and Cloncurry substations from the Mica Creek switchyards. The limitations are based on standard Ergon Energy sub-transmission feeder ratings.

Table 4: Design Ratings for Sub-transmission Feeders

Operational Number	Feeder Name	Limiting Conductor	SD	SE	SNM
			Rating (A)	Rating (A)	Rating (A)
CH-CC-1	CHUMVALE-CLONCURRY 66kV	7/.104 HDBC	83	136	141
DR-CC-1	DUCHESS RD-CLONCURRY 66kV	7/.104 HDBC	83	136	141
MICB-DURO 1	MICA CK B-DUCHESS RD NO.01 132 kV	Grape	384	491	462
MICB-DURO 2	MICA CK B-DUCHESS RD NO.02 132 kV	19/.111 HDBC	279	345	336
MICC-CHUM	MICC-CHUM 220KV FDR 7018 220 kV	Selenium	855	930	872

The limiting feeder rating on the DR-CC-1 66kV feeder provides a SD equivalent limit of approximately 9.5MVA. It should be noted that the transfer capacity of the DR-CC-1 feeder would also be limited by the rating of DURO T4 and the associated 11 kV transformer cable. The DURO T4 has a limited tapping range, resulting in voltage limitations for demand above 6.25MVA. The 11kV cables on this transformer are also limited to a rating of 7.5MVA.

Ground Clearance Limitations

The majority of the DR-CC-1 66kV feeder does not have an overhead earth wire (OHEW). The construction is a mix of steel lattice towers and concrete poles. An investigation was completed in March 2017 from ROAMES (Remote Observation Automated Modelling Economic Simulation) data to ascertain what condition this line was in, compared with the original design parameters. The study has confirmed that a high percentage of spans on this feeder do not meet their original design parameters and as such require detailed assessment. A total of 564 spans were analysed with 195 of these spans showing as being in violation of the 6.1m clearance requirement at the 50°C original design temperature. Three of these spans were identified as high risk and remediation works have already been completed on these spans. Eight of these spans were identified as a medium risk and were planned to be rectified by November 2019. The remaining 184 spans have been classified as a lower risk due to locality and the ground clearance.

A ground survey was conducted on a 12km section of this feeder to confirm the accuracy of the ROAMES data and the results were generally within 100-200mm between the two datasets.

Based on preliminary advice the conductor on this feeder is considered to generally be in a reasonable condition with no visible signs of corrosion. Over the years some sections of conductor (approximately 4km) have been annealed by bush fires and these have been replaced.

3.3. Assumptions in Relation to Identified Need

Below is a summary of key assumptions that have been made when the identified need has been analysed and quantified.

It is recognised that the below assumptions may prove to have various levels of correctness, and they merely represent a 'best endeavours' approach to predict the future identified need.

3.3.1. Forecast Maximum Demand

It has been assumed that forecast peak demand at Cloncurry and North Cloncurry Substations will be consistent with the base case forecast outlined in Section 2.3.4.

Factors that have been taken into account when the load forecast has been developed include the following:

- load history
- known future developments (new major customers, network augmentation, etc.)
- temperature corrected start values (historical peak demands)
- forecast growth rates for organic growth

3.3.2. Load Profile

Characteristic peak day load profiles shown in Section 2.3.3 are unlikely to change significantly from year to year and the shape of the load profile is assumed to remain virtually the same with increasing maximum demand.

3.3.3. System Capability – Line Ratings

The thermal ratings of the sub-transmission lines that supply the Cloncurry area have been calculated based on the main parameters listed in the table below.

Table 5: Line Rating Parameters

Parameter	Summer Day (9am – 5pm)	Summer Evening (5pm – 10pm)
Ambient Temperature	41°C	37°C
Wind Velocity	1.5 m/s	0.8 m/s
Wind Angle to Conductor Axis	45°	45°
Direct Solar Radiation	910 W/m^2	200 W/m^2
Diffuse Solar Radiation	210 W/m^2	20 W/m^2

3.4. Risk Assessment

If the identified limitations are not addressed, the risks outlined report are considered to be an unacceptable level of risk, specifically:

- Unacceptable public safety risks due to inadequate clearance to ground on a large number (195) of line sections. Such a risk scenario could result in a single fatality;
- Inability to supply Mary Kathleen and Corella River in system abnormal network operation due to constraints at Duchess Road Substation; and
- Inability to meet Safety Net service target timeframes in the Cloncurry District during a contingency where the 220kV network or the 220/66kV transformer at Chumvale Substation is unavailable.

The network (business) risks associated with the existing supply system in the Cloncurry area that the organisation would be exposed to if no action is taken are summarised in the table below. The inherent risks are **not** deemed to be As Low As is Reasonably Practicable (ALARP).

Risk Scenario	Risk Type	Consequence (C)	Likelihood (L)	Risk Score	Risk Year
Failure of CHUM 220/66kV TF supplying CLON and NOCL and existing alternate supply from DURO is unavailable, resulting in sustained customer outages >12 hours.	Customer	3 *(interruption to 5,000 customers, >12 hours, three times in a week)*	3 *(Unlikely)*	**9** ***(Low)***	2020
Failure of CHUM 220/66kV TF supplying NOCL and CLON, requiring generation to meet shortfall in supply due to lack of capacity from DURO line, resulting in additional business costs of >$1million	Business	4 *(equates to business cost of >$1million or equivalent)*	3 *(Unlikely)*	**12** ***(Moderate)***	2020
Failure of CHUM 220/66kV TF supplying CLON and NOCL and existing alternate supply from DURO unavailable, resulting in a notifiable Service Safety Net Targets breach and an improvement notice issued by the regulator	Legislated	4 *(Improvement notice issued by the regulator)*	3 *(Unlikely)*	**12** ***(Moderate)***	2020
Inadvertent contact with 66kV OH line due to non-compliant clearance to ground, resulting in a single fatality	Safety	5 *(single fatality/ incurable fatal illness)*	2 *(Very Unlikely)*	**10** ***(Low)***	2020

4 Assessment Methodology and Assumptions

4.1. Planning Criteria

Ergon Energy's Distribution Authority includes legislated Safety Net targets. The Safety Net targets provide a 'base-case' or minimum security criteria for the network to be planned to, and provide protection against low probability, high impact events. The Distribution Authority requires Ergon Energy to ensure "to the extent reasonably practical" compliance with the Safety Net criteria.

The purpose of the Safety Net planning criteria is 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. Additional investment beyond the Safety Net requirements would be driven based on an economic, reliability based Value of Customer Reliability (VCR) methodology. This approach is consistent with the recommendations from the National Reliability Framework.

There are two sets of Safety Net targets applicable to Ergon Energy: "Regional Centre" and "Rural Areas", each having different timelines as shown below in Table 6. The Cloncurry and North Cloncurry Substation supply areas are classed as 'Rural / Remote' areas.

Table 6: Ergon Energy Safety Net Targets

Area	Targets (for restoration of supply following an N-1 Event)
Regional Centre	Following an N-1 event, load not supplied must be: ○ Less than 20MVA (8000 customers) after 1 hour; ○ Less than 15MVA (6000 customers) after 6 hours; ○ Less than 5MVA (2000 customers) after 12 hours; and ○ Fully restored within 24 hours.
Rural Areas	Following an N-1 event, load not supplied must be: ○ Less than 20MVA (8000 customers) after 1 hour; ○ Less than 15MVA (6000 customers) after 8 hours; ○ Less than 5MVA (2000 customers) after 18 hours; and ○ Fully restored within 48 hours.
Note: All modelling and analysis will be benchmarked against 50% POE loads and based on credible contingencies. 'Regional Centre' relates to larger centres with predominantly urban feeders. 'Rural Areas' relates to areas that are not Regional Centres.	

4.2. Reliability Standards

Ergon Energy is expected to employ all reasonable measures to ensure it does not exceed minimum service standards (MSS) for reliability, assessed by feeder types as:

- System Average Interruption Duration Index (SAIDI), and;
- System Average Interruption Frequency Index (SAIFI).

The legislated SAIDI and SAIFI limits from Ergon Energy's Distribution Authority are detailed in Table 7.

Table 7: SAIDI (minutes per customer) and SAIFI (interruptions per customer) limits

Feeder Category	SAIDI MSS Limits	SAIFI MSS Limits
Urban	149	1.98
Short Rural	424	3.95
Long Rural	964	7.40

MSS performance information is publicly reported annually in the Distribution Annual Planning Report (DAPR).

4.3. Value of Customer Reliability

Value of Customer Reliability (VCR) is an economic value applied to customers' unserved energy for any particular year. VCR values represent customers' willingness across the National Electricity Market (NEM) to pay for reliable electricity supply. The VCR is used for estimating market benefits that relate to reliability, such as changes in involuntary and voluntary load curtailment.

Any reduction in unserved energy a solution that addresses the identified need described in Section 3 will bring will be treated as a benefit based on the corresponding reduction in customer financial consequence.

The Value of Customer Reliability calculated for this analysis is $49/kWh. This estimate is based on the customer mix shown in Table 8 and the VCR values for different customer types shown in Table 9 as published by the AER in the following factsheet.

AER - Values of Customer Reliability

Table 8: Customer Breakdown

Substation	Residential	Industrial	Residential (kWh)	Industrial (kWh)	VCR ($/kWh)
Cloncurry	529	168	5,479,127	9,396,449	$50.03
North Cloncurry	604	211	5,944,398	7,914,492	$47.76
Total	**1,133**	**379**	**11,423,525**	**17,310,941**	**$48.93**

Table 9: AER VCR Values for Different Customer Types

Sector	$/kWh (2019)
Residential (Climate Zone 3 & 4)	$26.42
Commercial*	$44.52
Industrial*	$63.79
Agriculture*	$37.87

*Business using <10MVA peak demand

$$VCR = \frac{(Domestic\ Customers\ Energy\ \times\ VCR\ value) + (Industrial\ Customers\ Energy\ \times\ VCR\ value)}{Total\ Energy}$$

$$VCR\ = \frac{(11{,}423{,}525 \times \$26.42) + (17{,}310{,}941 \times \$63.79)}{11{,}423{,}525 + 17{,}310{,}941}$$

$$VCR = \$48.93 \approx \$49/kWh$$

5 Internal Options Considered

5.1. Non-Network Options Identified

Ergon Energy has not identified any viable non-network solutions internally that will address the identified need.

5.2. Network Options Identified

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

Option A: Uprate the DR-CC-1 66kV Feeder & Replace 66kV Assets at DURO

- Uprate the DR-CC-1 66kV feeder to 9.5MVA by interpoling (inserting intermediate poles) within the necessary spans of the feeder (approximately 184 spans);
- Condition based replacement of the existing 66/11kV step-up transformer (T4) and 66kV bay VT set at Duchess Road Substation;
- Condition based replacement of the 66kV Duoroll isolators at DURO; and
- Condition based replacement of the segmented insulators on the 66kV bus at DURO.

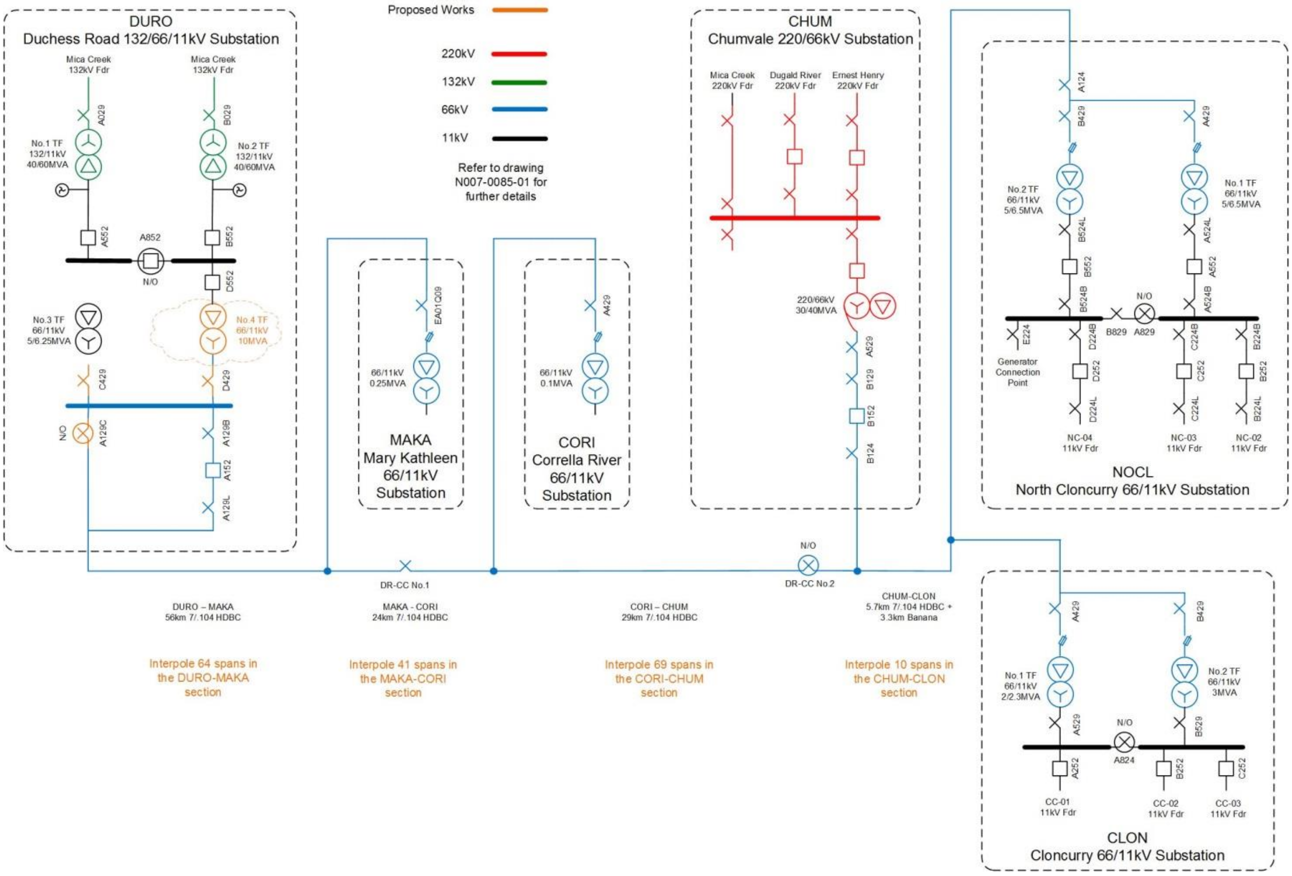


Figure 11: Option A Single Line Diagram

Option B: Install a Second 220/66kV Transformer at CHUM

- Extend the CHUM yard and install a new 220/66kV transformer bay;
- Install a new 220kV feeder bay at MICC and connect to the existing MICC-CHUM feeder;
- Interpole along the necessary sections of the existing CH-CC-1 66kV feeder (28 spans);
- Decommission 53km of the DR-CC-1 66kV feeder between MAKA and CHUM;
- Redeploy the remaining section of DR-CC-1 between DURO and MAKA at 11kV;
- Decommission the 66/11kV transformer at MAKA and install 11kV voltage regulators; and
- Decommission all remaining 66kV assets at DURO (including 66/11kV transformers, 66kV bus, 66kV VTs and 66kV isolators).

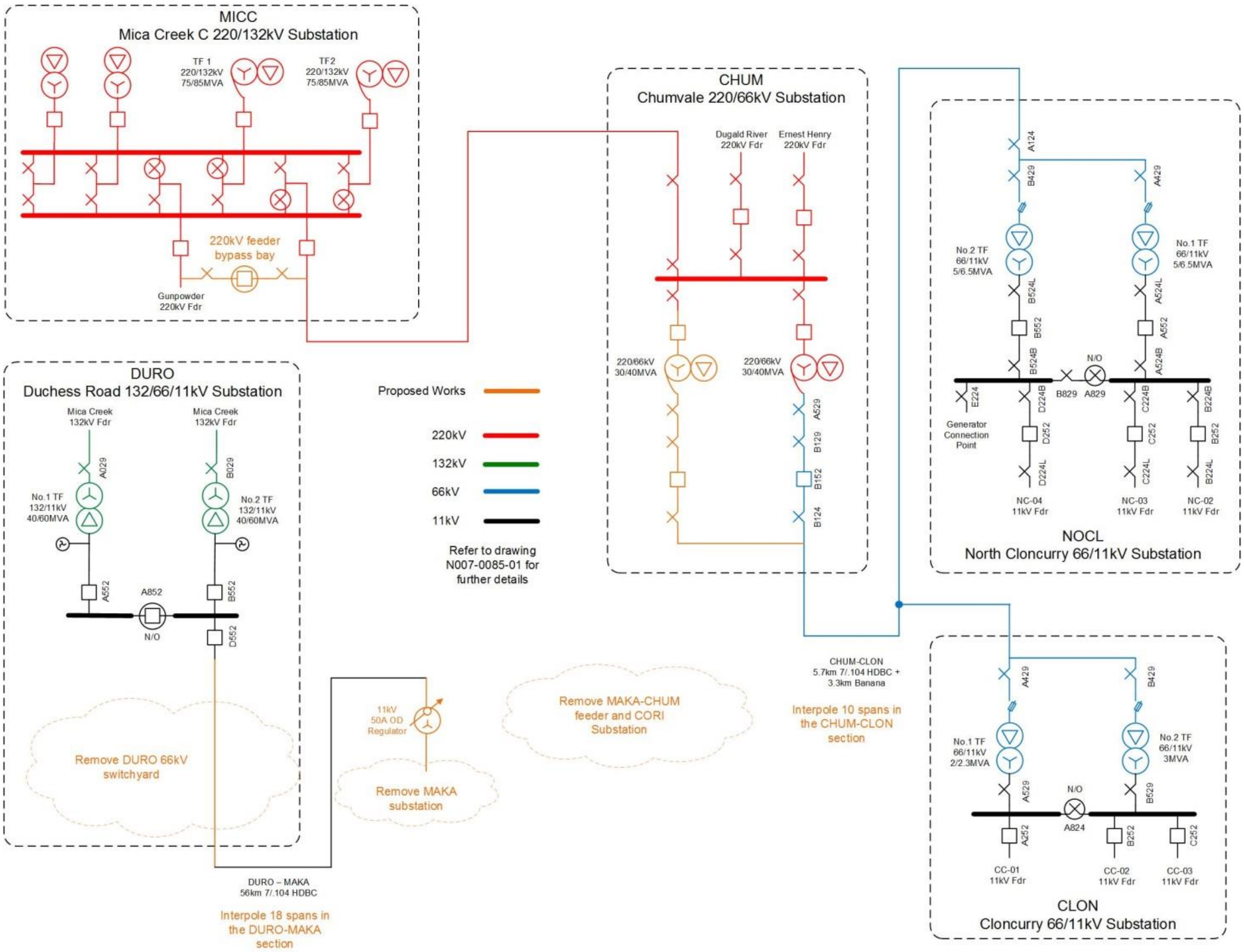


Figure 12: Option B Single Line Diagram

Option C: Install 2.5MVA of Permanent Standby Generation Assets at Cloncurry

- Install a new 11kV bay at NOCL to support the connection of generation assets;
- Install 2.5MVA of permanent standby generation assets at Cloncurry (additional temporary generation would be deployed if required);
- Interpole along the necessary sections of the existing CH-CC-1 66kV feeder (28 spans);
- Decommission 53km of the DR-CC-1 66kV feeder between MAKA and CHUM;
- Redeploy the remaining section of DR-CC-1 between DURO and MAKA at 11kV;
- Decommission the 66/11kV transformer at MAKA and install 11kV voltage regulators; and
- Decommission all remaining 66kV assets at DURO.

5.3. Preferred Network Option

Ergon Energy's preferred internal network option at this stage is to uprate the DR-CC-1 66kV feeder to 9.5MVA by interpoling spans, replace the existing 66/11kV step-up transformer and refurbish the 66kV bus at Duchess Road Substation.

Upon completion of these works, Cloncurry would be Safety Net compliant. This option will minimise capital expenditure to cover reliability and Safety Net requirements, whilst also reducing expenditure on obsolete assets.

The estimated capital cost of this option inclusive of interest, risk, contingencies and overheads is $7.88m. Annual operating and maintenance costs are anticipated to be 0.5% of the capital cost. The estimated project delivery timeframe has design commencing in late 2020 and construction completed by June 2023.

6 Technical Characteristics of Non-Network Options

This section describes the technical characteristics of the identified need that a non-network option would be required to comply with.

6.1. Size

To meet Ergon Energy's ongoing operational needs it is expected that any alternate solution must provide stand-alone supply to the distribution network that supports a load up to the values listed in the table below.

Table 10: Demand Reduction Required

Year	Demand Reduction Required
2020	8.0 MVA
2021	8.0 MVA
2022	7.8 MVA
2023	7.7 MVA
2024	7.7 MVA
2025	7.7 MVA
2026	7.6 MVA
2027	7.6 MVA
2028	7.5 MVA
2029	7.5 MVA
2030	7.5 MVA
2031	7.6 MVA

6.2. Location

The location where network support and load restoration capability will be measured / referenced is on the 66kV bus at Cloncurry Substation; however alternative options may be located downstream on the 66kV or 11kV network, so long as they can be operationally utilised when required.

6.3. Timing

6.3.1. Implementation timeframe

In order to ensure compliance with Ergon Energy's planning criteria and the National Electricity Rules, a non-network solution will need to be implemented by June 2023.

6.3.2. Time of year

Following a fault on the 220/66kV transformer at Chumvale Substation, the network support may be called upon for a duration of up to six months. Specific timing will be agreed with providers as part of the contract negotiations.

Ergon Energy envisages that there may be in the order of one event per year where project proponents must supply the demand management reductions required.

6.3.3. Duration

Load restoration capability (for Service Safety Net Targets) may be required at any time of the year. Network support may be required for 24 hours per day for a duration of up to six months, although the required magnitude will be significantly lower during seasons with low to moderate daily peak loads (e.g. late autumn, winter and early spring).

6.4. Compliance with Regulations and Standards

As a distribution network service provider (DNSP), Ergon Energy must comply with regulations and standards, including the Queensland Electricity Act and Regulation, Distribution Authority, National Electricity Rules and applicable Australian Standards.

These obligations must be taken in consideration when choosing a suitable solution to address the identified need at Cloncurry as discussed in this RIT-D report.

6.5. Longevity

Proposed non-network options will typically be required to provide solutions to the identified need for a period of at least 10 years. However, alternative solutions that can defer additional network investment for a smaller number of years may also be considered.

6.6. Potential Deferred Augmentation Charge

The annual deferred augmentation charge associated with the identified need is approximately $200k per year.

7 Non Network Options

7.1. Assessment of Non-Network Solutions

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

7.1.1. Demand Management (Demand Reduction)

The DEM team has completed a review of the Cloncurry customer base and considered a number of demand management technologies. Reliability of supply and Safety Net compliance are the key project drivers (i.e. the need) at Cloncurry. It has been determined that most demand management options will not be viable propositions.

Network Load Control

The residential customers appear to drive the daily peak demand which generally occurs between 5:00pm and 8:00pm.

There are 405 customers on tariff T31 and T33 hot water load control (LC). An estimated demand reduction value of 243kVA[4] is available.

Cloncurry and North Cloncurry Substation LC signals are controlled from Duchess Road Substation. The Tariff 33 and 31 hot water LC channels are dynamic (that is, it responds to exceedance settings not on a timetable) and the current control strategy only calls LC when the load at Duchess Road exceeds 36.5MW. This strategy does not directly address peaks experienced at Cloncurry. Tariff 33 air-conditioning channels are under manual control of the operational control centre and are used as required.

7.1.2. Demand Response

Four methods utilising demand response technology for deferring network investment are: call off load (COL), customer embedded generation (CEG), large scale customer generation (LSG) and customer solar power systems.

Customer Call off Load (COL)

COL is an effective technique for deferring network investment where the need is for a short time period. This is however not the case this instance. There are a small number of Large Customers in the catchment area but the businesses are not suited to call off. This option is therefore assessed as technically not viable as it does not address the risk of possible failures to major sections of the HV network.

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

Customer Embedded Generation (CEG)

CEG is an effective technique for deferring network investment where the need is for a short time period. The primary driver for investment in this instance is the requirement for a contingency for Safety Net. A short-term deferral of network investment by using CEG may not be a technical or financially feasible option (due to the number of contracts required to be negotiated and managed).

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

Large-Scale Customer Generation (LSG)

LSG sites such as renewable energy generation, solar or wind farms of multiple MW's capacity constitute an opportunity to support ZS investment by reducing demand on, and potentially providing reactive power support for substation assets.

This option could potentially reduce future demand, however has been assessed as technically not viable as there is no known existing or proposed LSG demand response available.

Customer Solar Power Systems

A total of 146 customers have solar PV systems for a connected inverter capacity of 1074kVA.

The daily peak demand is driven by residential customer demand and the peak generally occurs between 5:00pm and 8:00pm. As such customer solar generation does not coincide with the peak load period.

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

Only a small percentage of customers in this supply area have solar PV systems and possibly none have a BESS. PV systems with BESS present a future portfolio opportunity for potential demand response but currently this supply area has a very limited solar/BESS. Solar customers without a BESS will not meet the technical needs of the demand reduction as their solar contribution may not be available when the network un-met need is required.

7.2. Feasible vs Non-Feasible Options

7.2.1. Potentially Feasible Options

The identified need presented in this RIT-D is driven by the capability and reliability of the existing sub-transmission network that supplies Cloncurry. As such, solutions that cost-effectively provide increased contingency load restoration capability are likely to represent reasonable options.

A non-exhaustive list of potentially feasible options includes:

- New embedded dispatchable network generation
- Existing customer generation
- Embedded energy storage systems.

7.2.2. 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.

A non-exhaustive list of options that are unlikely to be feasible includes:

- Renewable generation not coupled with energy storage and/or dispatchable generation
- Unproven, experimental or undemonstrated technologies.

7.2.3. Timing of Feasible Options

In order to ensure compliance with Ergon Energy's planning criteria and the National Electricity Rules, a non-network solution will need to be implemented by June 2023.

8 Submission and Next Steps

8.1. Submissions from Solution Providers

Ergon Energy invites written submissions to address the identified need in this report from registered participants and interested parties. With reference to Section 6, all submissions should include sufficient technical and financial information to enable Ergon Energy to undertake comparative analysis of the proposed solution against other options. The proposals shall include, but are not limited to, at least the following:

- Full costs of completed works.
- Whole of life costs including losses.
- Project execution strategy including design, testing and commissioning plans.
- Engineering network system studies and study reports.
- Verified and approved engineering designs.
- Manufacture and supply of all plant, equipment and materials.
- Delivery to site, receiving and off-loading of all plant, equipment and materials.
- Assembly and installation on site.

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 4:00 PM on the **15 May 2020** and should be lodged to demandmanagement@ergon.com.au

8.2. Next Steps

Ergon Energy intends to carry out the following process to assess what action should be taken to address the identified need in the Cloncurry supply area:

Table 11: Timetable for this RIT-D

Step 1	Publish Non Network Options Report (this report) inviting non-network options from interested participants	Date Released: **14 February 2020**
Step 2	Consultation period	**Minimum of 3 months (12 weeks)**
Step 3	Deadline for Submission of proposals for non-network alternatives	**15 May 2020**
Step 4	Release of Draft Project Assessment Report (DPAR)	Anticipated to be released by: **12 June 2020**
Step 5	Consultations in response to the DPAR	**Minimum of 6 weeks**
Step 6	Publish the Final Project Assessment Report (FPAR)	Anticipated to be released by: **14 August 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 the Partner Portal.

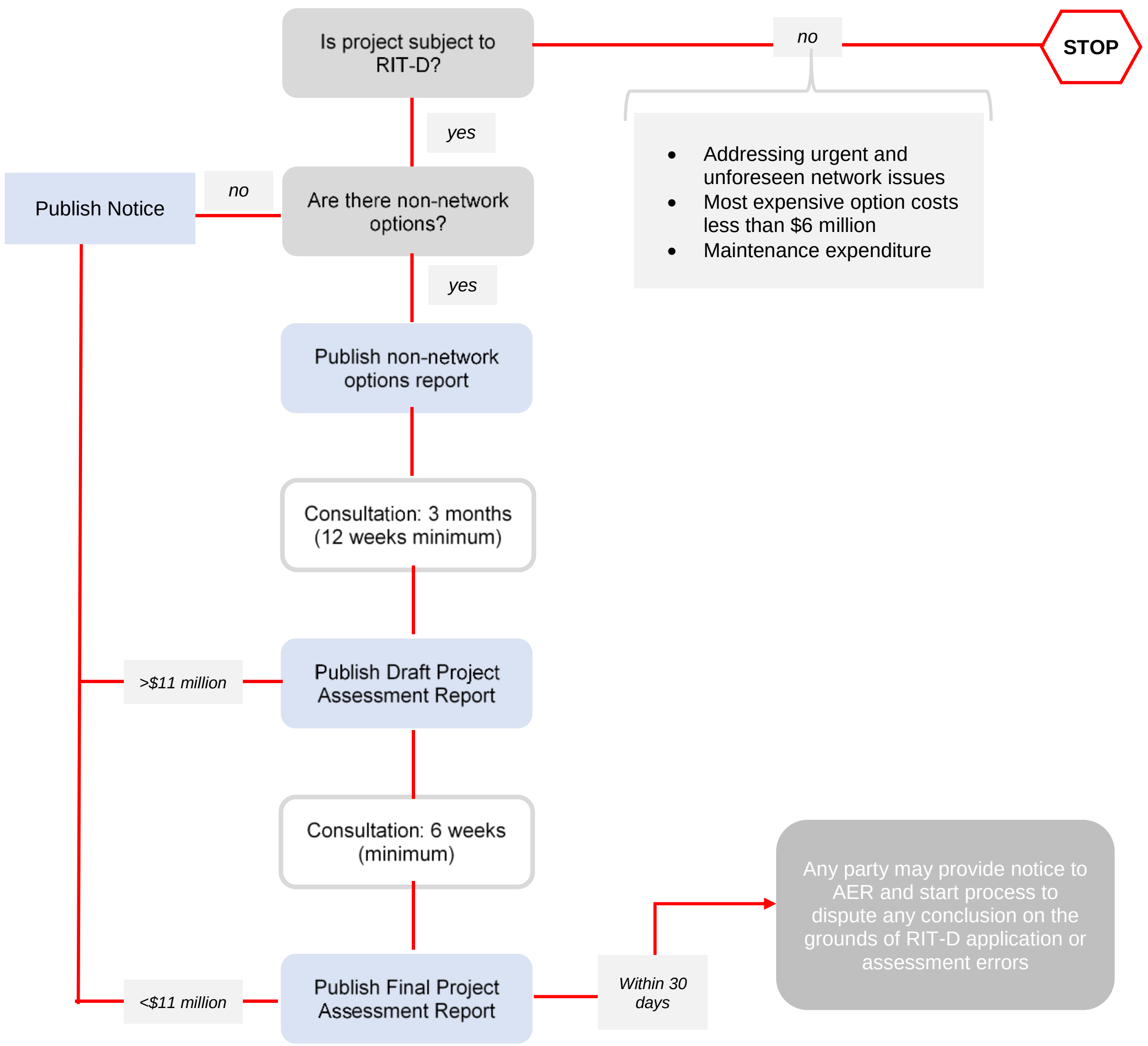
During the consultation period, Ergon Energy will review, compare and analyse all internal and external solutions. Detailed economic options analysis and comparisons of expected market benefits will be undertaken during this time. At the end of the consultation and review process Ergon Energy will publish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

9 Compliance Statement

This Non-Network Options Report complies with the requirements of NER section 5.17.4(e) as demonstrated below:

Requirement	Report Section
(1) a description of the identified need;	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 available, the relevant annual deferred *augmentation* charge associated with the identified need;	6.6
(4) the technical characteristics of the identified need that a non-network option would be required to deliver, such as: (i) the size of *load* reduction or additional *supply*; (ii) location; (iii) contribution to *power system security* or *reliability*; (iv) contribution to *power system* fault levels as determined under clause 4.6.1; and (v) the operating profile;	2 & 3.3
(5) a summary of potential credible options to address the identified need, as identified by the RIT-D proponent, including network options and non-network options;	5 & 7
(6) for each potential credible option, the RIT-D proponent must provide information, to the extent practicable, on: (i) a technical definition or characteristics of the option; (ii) the estimated construction timetable and commissioning date (where relevant); and (iii) the total indicative cost (including capital and operating costs); and	5 & 6
(7) information to assist non-network providers wishing to present alternative potential credible options including details of how to submit a non-network proposal for consideration by the RIT-D proponent.	8

Appendix A – The RIT-D Process



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

Appendix B – Glossary of Terms

B1 – Acronyms and Abbreviations

The following acronyms and abbreviations are used within this report:

Acronym	Definition
ALARP	As Low As is Reasonably Practicable
BESS	Battery Energy Storage System
CB	Circuit Breaker
CEG	Customer Embedded Generation
COL	Call Off Load
CT	Current Transformer
DA	Distribution Authority
DM	Demand Management
DNSP	Distribution Network Service Provider
EG	Embedded Generator / Generating Unit
HV	High Voltage
IES	Inverter Energy Systems
LC	Load Control
LSG	Large Scale Generation
LV	Low Voltage
MEGU	Micro-embedded Generating Unit
MSS	Minimum Service Standards
NER	National Electricity Rules
NNA	Non-Network Alternative
OH	Overhead
ONAF	Oil Natural Air Forced
ONAN	Oil Natural Air Natural
POE	Probability of Exceedance
p.u.	Per Unit
PV	Photovoltaic
RIT-D	Regulatory Investment Test for Distribution
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
UG	Underground
VCR	Value of Customer Reliability
VT	Voltage Transformer
ZS	Zone Substation

B2 – Definitions

For the purposes of this report, the following definitions apply:

Term	Description
10% POE	Peak load forecast which has a 10% probability of being exceeded in any year
50% POE	Peak load forecast which has a 50% probability of being exceeded in any year
Long Rural	A feeder which is not a CBD or urban feeder and has a total route length greater than 200km
Short Rural	A feeder which is not a CBD or urban feeder and has a total route length less than 200km
Urban	A feeder which is not a CBD feeder, which a maximum demand per total feeder route length greater than 0.3MVA/km