Regulatory Investment Test for Distribution

Part of Energy Queensland

Addressing Reliability Requirements in the Chinchilla Network Area

Notice of No Non-Network Options

30 October 2020

Executive Summary

ABOUT ERGON ENERGY

Ergon Energy Corporation Limited (Ergon Energy) is part of Energy Queensland and manages an electricity distribution network which supplies electricity to more than 765,000 customers. Our vast operating area covers over one million square kilometres – around 97% of the state of Queensland – from the expanding coastal and rural population centres to the remote communities of outback Queensland and the Torres Strait.

Our electricity network consists of approximately 160,000 kilometres of powerlines and one million power poles, along with associated infrastructure such as major substations and power transformers.

We also own and operate 33 stand-alone power stations that provide supply to isolated communities across Queensland which are not connected to the main electricity grid.

IDENTIFED NEED

Chinchilla 132/110/33kV Substation (CHIN) is located in the township of Chinchilla in south-west Queensland. The substation is a joint site with Powerlink Queensland, with Powerlink Queensland owning the 132kV switchyard.

Chinchilla substation supplies the 33kV sub-transmission network in Chinchilla and the surrounding area. Chinchilla Substation provides electricity supply to approximately 6,500 customers, of which 82% are residential and 18% are commercial, agricultural and industrial. Chinchilla Substation is presently supplied via two incoming 132kV feeders from H018 Tarong Substation, and there are two outgoing 132kV feeders from Chinchilla Substation which provide supply to T194 Columboola Substation.

The 33kV bus at Chinchilla Substation is supplied by two transformer bays. The primary supply is from a single 132/33/11kV 63MVA transformer, and the back-up supply is provided by a 132/110kV 30MVA transformer that supplies a 110/33kV 20MVA transformer and a 33kV 20MVA voltage regulator.

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

The assessment identified that the 132/110kV transformer is in poor condition with high levels of acetylene and acidity, and the 110/33kV transformer, 33kV CTs, 110kV CTs and 30 of the protection relays are at the end of their serviceable life. The deterioration of these primary and secondary system assets poses significant safety risks to staff working within the switchyard, and reliability risk to the customers supplied from Chinchilla Substation.

APPROACH

The NER requires that, subject to certain exclusion criteria, network business investments for meeting service standards for a distribution business are subject to a Regulatory Investment Test for Distribution (RIT-D). Ergon Energy has determined that network investment is essential in this case for it to continue to provide electricity to the consumers in the Chinchilla supply area in a reliable, safe and cost-effective manner. Accordingly, this investment is subject to a RIT-D. An internal assessment has been conducted and it has been determined that there is not a non-network option that is potentially credible, or that forms a significant part of a potential credible option that will meet the identified need or form a significant part of the solution. This Notice has hence been prepared by Ergon Energy in accordance with the requirements of clause 5.17.4(d) of the NER.

1 Background

1.1. Geographic Region

Chinchilla 132/110/33kV Substation (CHIN) is located in the township of Chinchilla in south-west Queensland. The substation supplies the 33kV sub-transmission network in Chinchilla and the surrounding area. Outside of Chinchilla, the supply area is primarily rural. Chinchilla Substation provides electricity supply to approximately 6,500 customers, of which 82% are residential and 18% are commercial, agricultural and industrial.

The geographical location of Ergon Energy's sub-transmission network and substations in the area is shown in Figure 1.

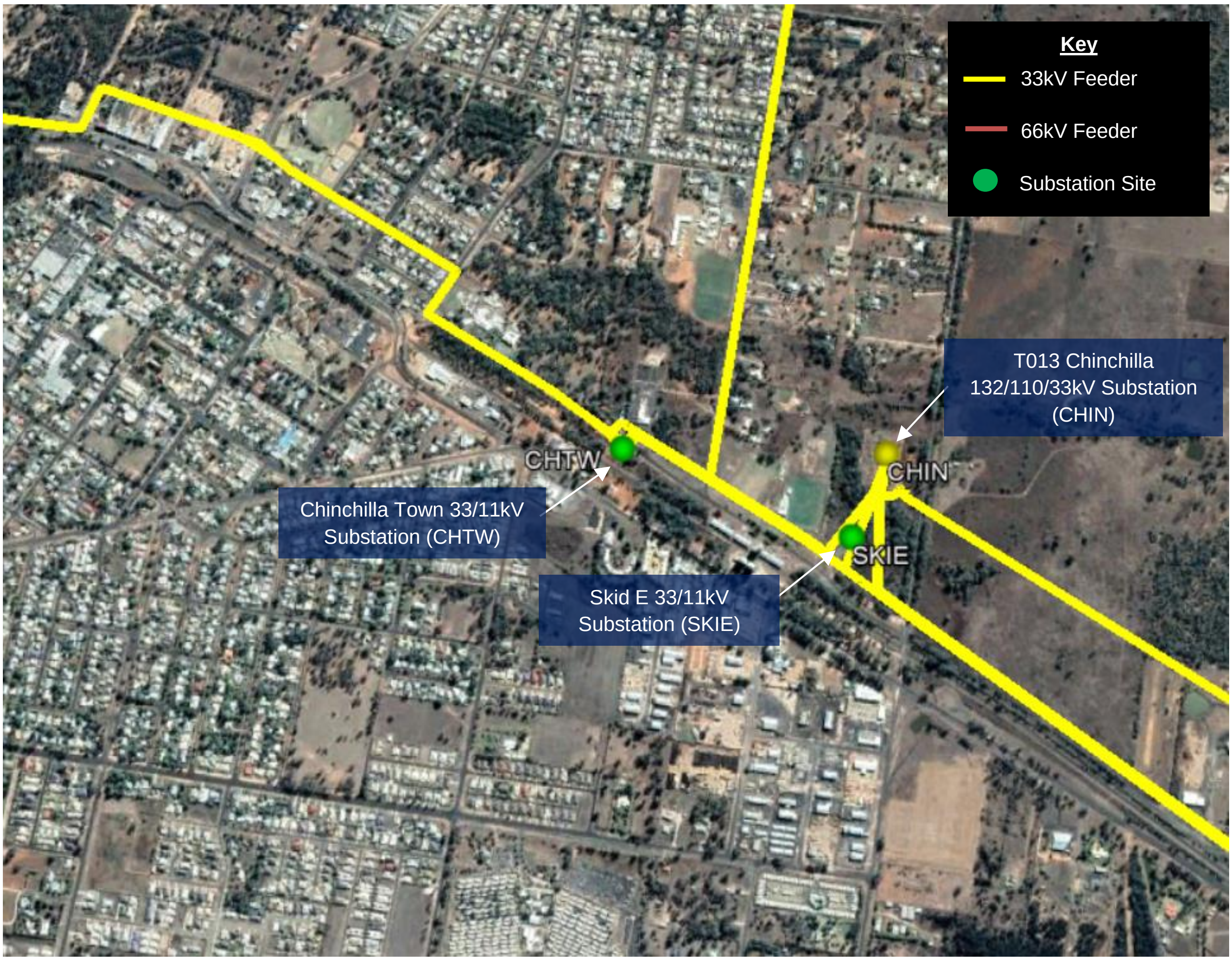


Figure 1: Existing network arrangement (geographic view)

1.2. Existing Supply System

Chinchilla Substation is a joint site with Powerlink Queensland, with Powerlink Queensland owning the 132kV switchyard. The substation is presently supplied via two incoming 132kV feeders from

H018 Tarong Substation, and there are two outgoing 132kV feeders from Chinchilla Substation which provide supply to T194 Columboola Substation.

Chinchilla Substation was established in 1956 according to applicable design and construction standards during that time. The 33kV bus at Chinchilla Substation is supplied by two transformer bays. Under system normal conditions, the 33kV bus is supplied by a single 132/33/11kV 63MVA transformer.

Back-up supply is provided by a 132/110kV 30MVA transformer that supplies a 110/33kV 20MVA transformer and a 33kV 20MVA voltage regulator. These assets are kept energised but unloaded and are operated as a hot spare in the case of the loss of the 132/33kV transformer.

The 33kV bus does not contain a bus tie circuit breaker; however, there are two sets of manually operated 33kV bus isolators. This arrangement impacts adversely on customer reliability.

Chinchilla substation supplies four 33kV feeders; the Chinchilla Town feeder, Kogan feeder, Brigalow feeder and Fairymeadow feeder. The Chinchilla Town 33kV feeder supplies the Chinchilla Town 33/11kV Substation (CHTW) and the Chinchilla Skid E 33/11kV Substation (SKIE). The Chinchilla Town Substation has two outgoing 11kV feeders which supply the township and there is also one additional 11kV feeder that is supplied from the Chinchilla Skid Substation.

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

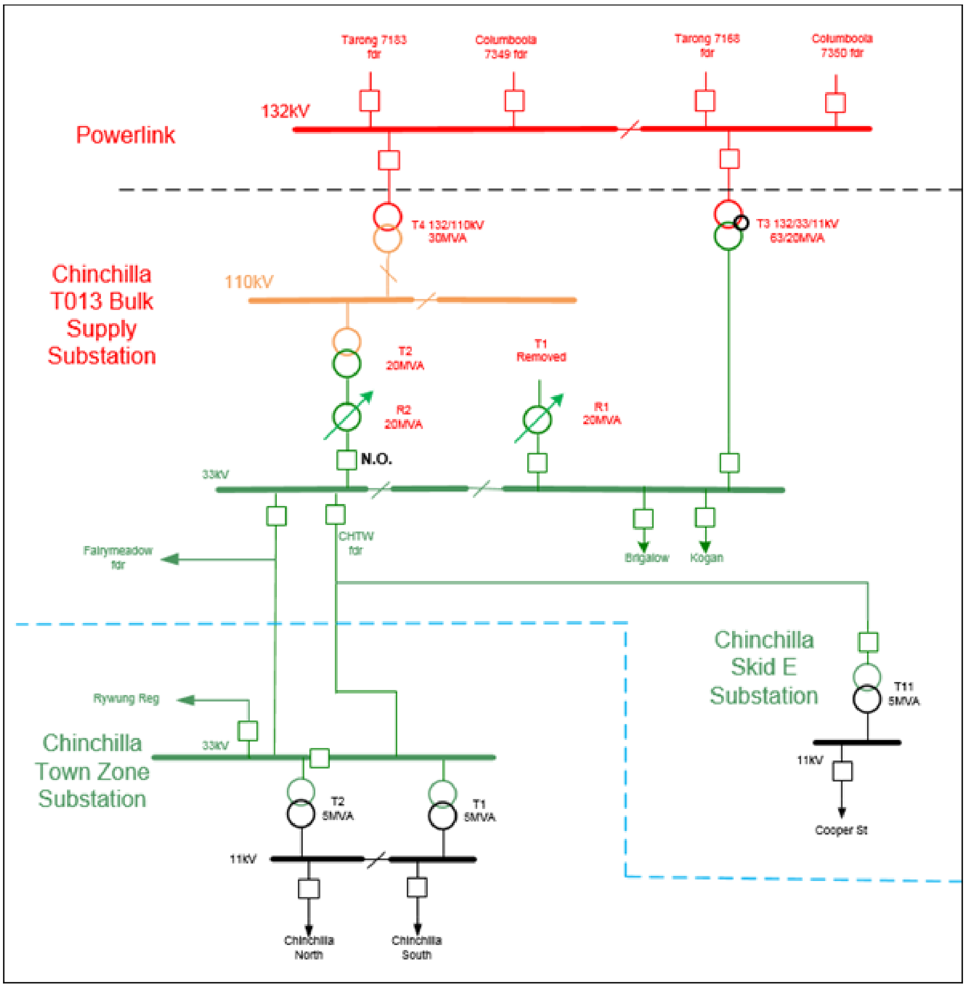


Figure 2: Existing network arrangement (schematic view)

Figure 3: Chinchilla Substation (geographic view)

1.3. Load Profiles / Forecasts

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

1.3.1. Full Annual Load Profile

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

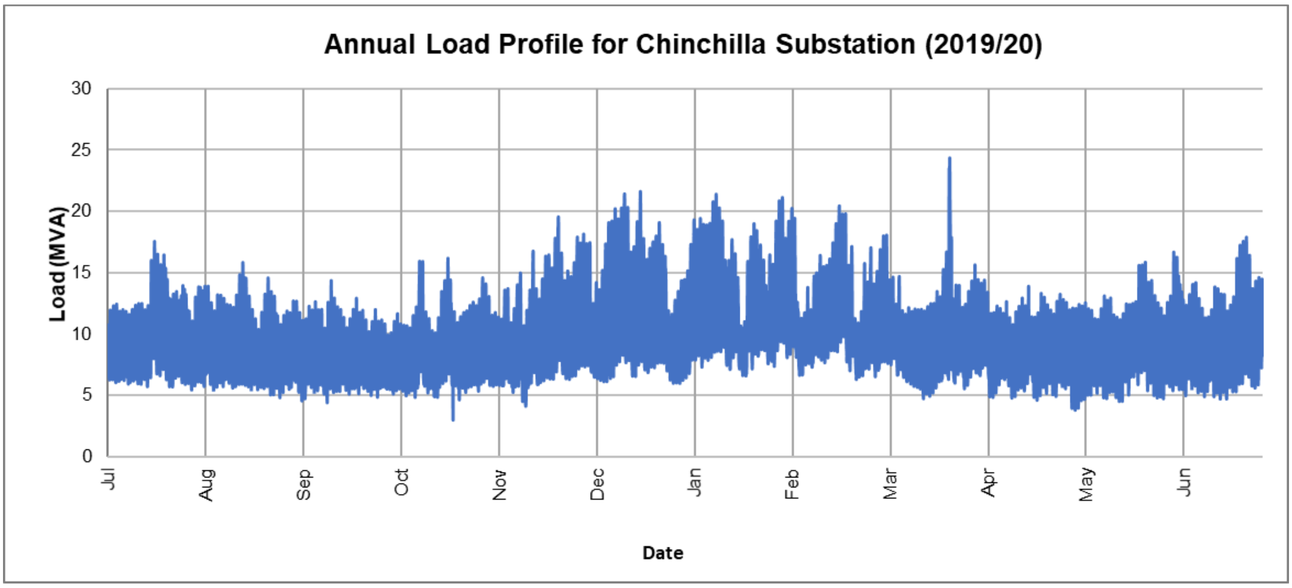


Figure 4: Substation actual annual load profile

1.3.2. Load Duration Curve

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

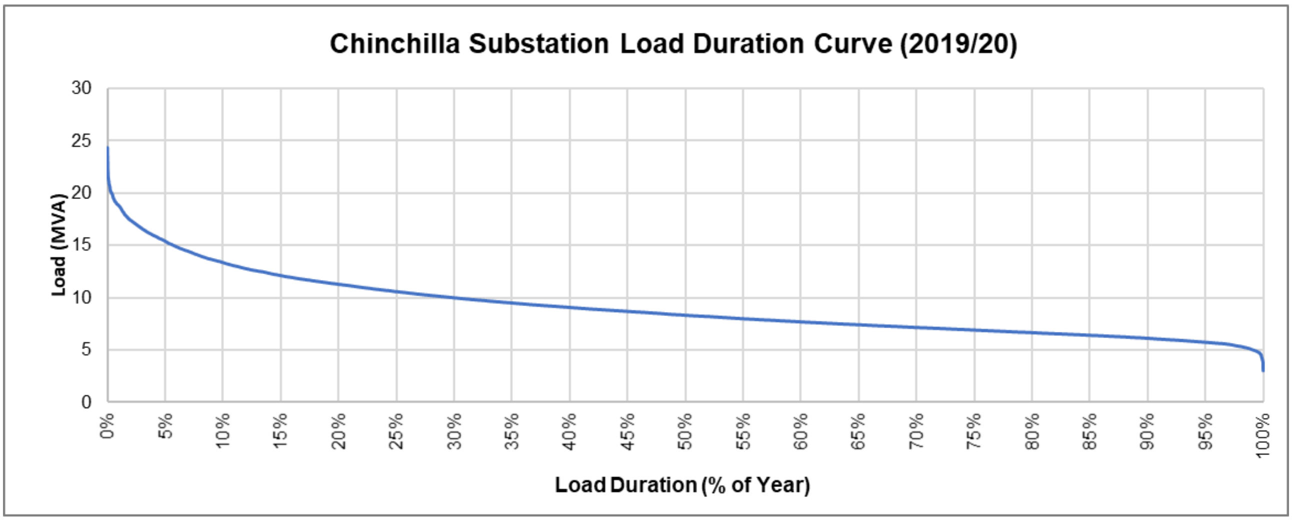


Figure 5: Substation load duration curve

1.3.3. Average Peak Weekday Load Profile (Summer)

The daily load profile for an average peak weekday during summer is illustrated below in Figure 6. It can be noted that the summer peak loads at Chinchilla Substation are historically experienced in the late afternoon and evening.

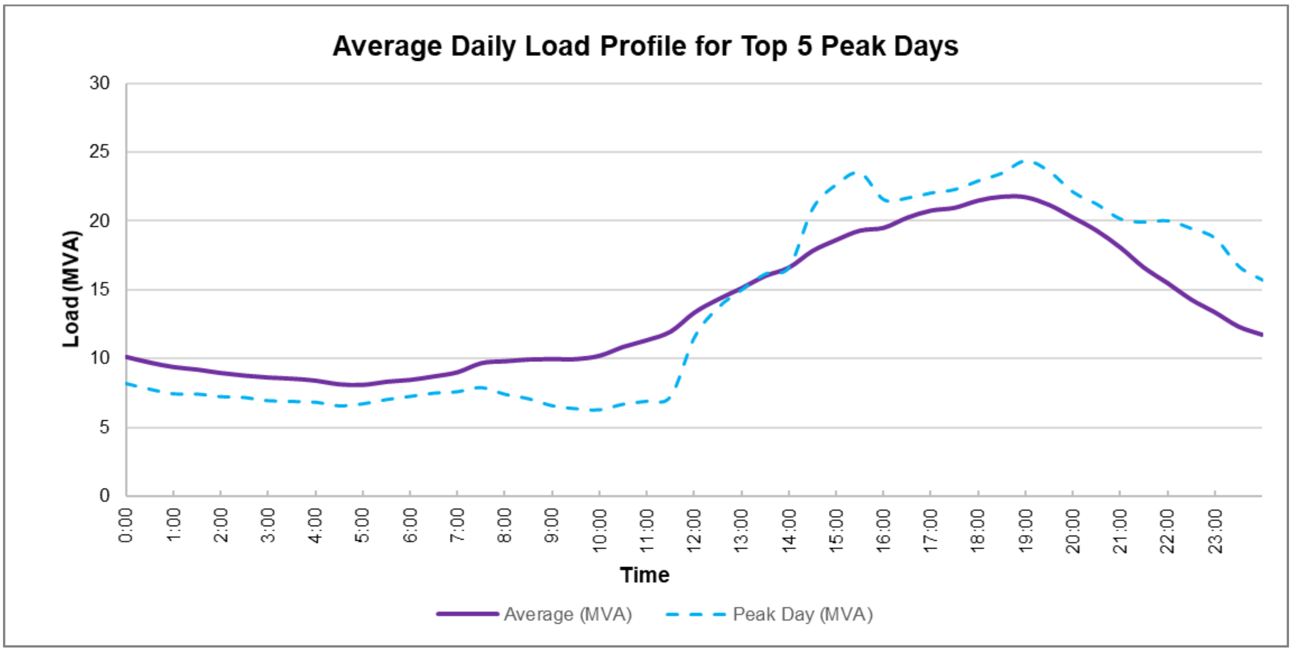


Figure 6: Substation average peak weekday load profile (summer)

1.3.4. Base Case Load Forecast

The 10 PoE and 50 PoE load forecasts for the base case load growth scenario are illustrated in Figure 7. The historical peak load for the past six years has also been included in the graph.

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

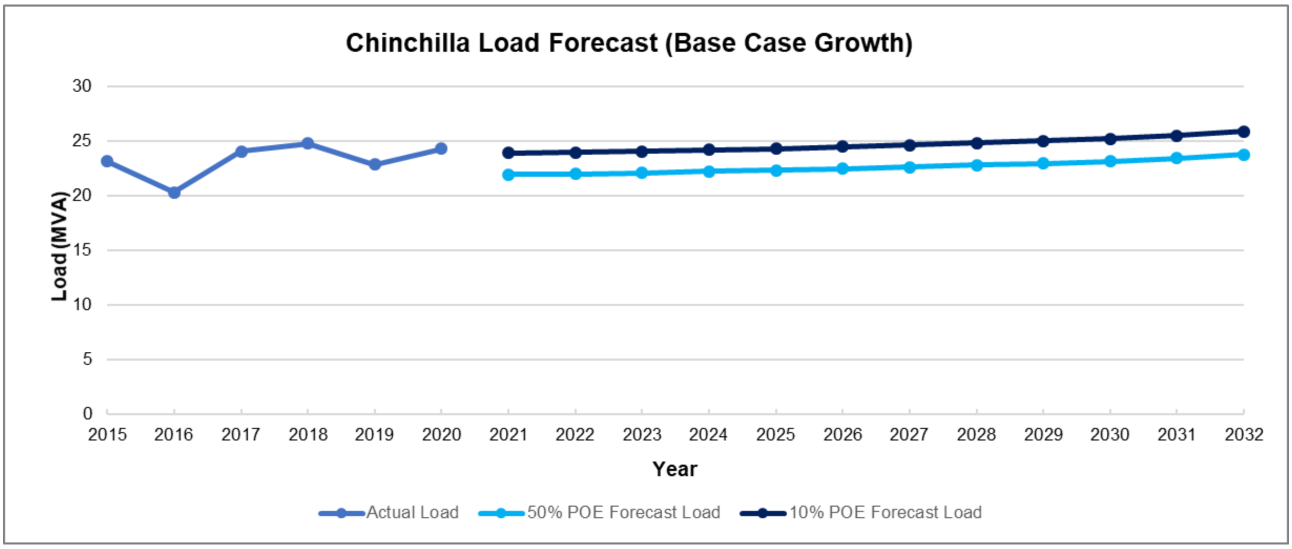


Figure 7: Substation base case load forecast

1.3.5. High Growth Load Forecast

The 10 PoE and 50 PoE load forecasts for the high load growth scenario are illustrated in Figure 8. With the high growth scenario, the peak load is forecast to increase over the next 10 years.

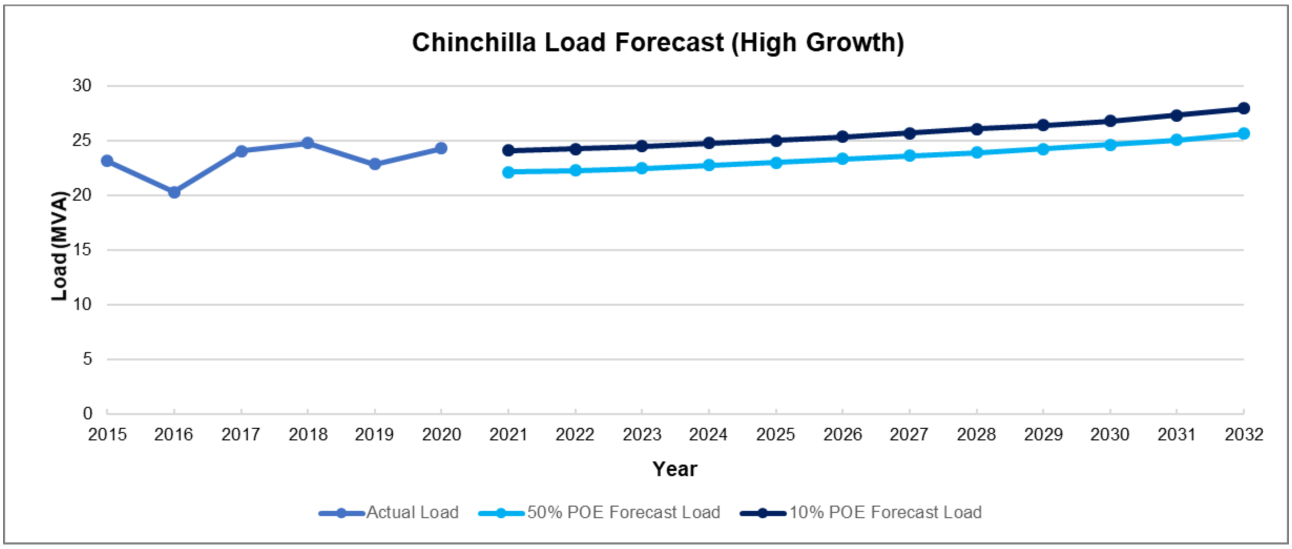


Figure 8: Substation high growth load forecast

1.3.6. Low Growth Load Forecast

The 10 PoE and 50 PoE load forecasts for the low load growth scenario are illustrated in Figure 9. With the low growth scenario, the peak load is forecast to remain steady over the next 10 years.

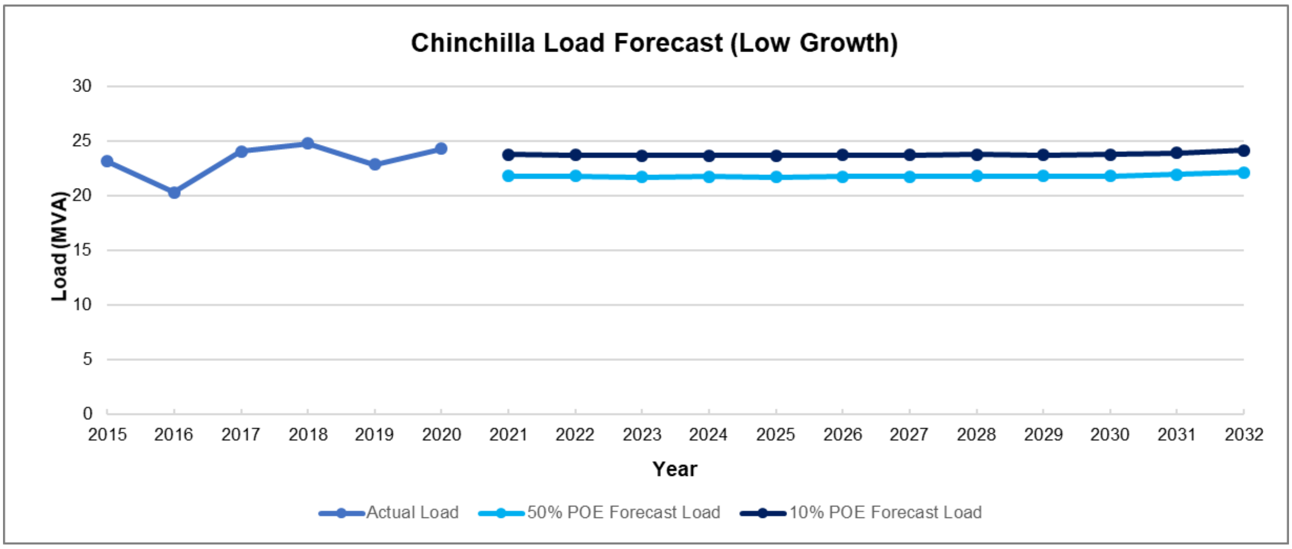


Figure 9: Substation low growth load forecast

2 Identified Need

2.1. Description of the Identified Need

2.1.1. Aged and Poor Condition Assets

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

Condition data indicates that the 132/110kV transformer is in poor condition with high levels of acetylene and acidity, and the 110/33kV transformer, 33kV voltage regulators, five 33kV AEI CTs, three 110kV CTs, seven 33kV VTs, 110kV VTs and 30 of the protection relays are also at the end of their serviceable life.

The deterioration of these primary and secondary system assets poses significant safety risks to staff working within the switchyard. It also poses a safety risk the general public, though the increased likelihood of protection relay mal-operation and catastrophic failure of the power transformers. There is also a significant risk of environmental harm due to loss of oil from the power transformers, which would require clean up and rectification. Additionally, the poor condition of these assets significantly increases the likelihood of outages, resulting in a reduction in the level of reliability experienced by the customers supplied from Chinchilla Substation.

2.1.2. Reliability

There is presently no bus tie circuit breaker on the 33kV bus at Chinchilla Substation. Under the existing sub-transmission network configuration most faults that occur within Chinchilla Substation will result in an outage to all the customers supplied from Chinchilla. This affects almost 6,500 customers and results in a combined peak load at risk of approximately 24MVA.

This network arrangement has also contributed to higher than average SAIDI and SAIFI for the distribution feeders than is generally expected for a short rural network.

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

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

The three year average network performance for the distribution feeders supplied from Chinchilla, Chinchilla Town and Chinchilla Skid E substations is shown in Table 1.

Feeder	Category	Feeder 3 year average SAIDI	Category SAIDI target	Feeder 3 year average SAIFI	Category SAIFI target
Chinchilla North	Short Rural	200	424	2.65	3.95
Chinchilla South	Short Rural	288	424	4.42	3.95
Cooper Street	Short Rural	204	424	3.58	3.95
Kogan	Short Rural	1111	424	5.37	3.95
Brigalow	Long Rural	707	964	5.64	7.40
Fairymeadow	Short Rural	794	424	5.16	3.95

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

Feeder reliability classifications are defined below:

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

2.1.3. Safety Net Non-compliance

Chinchilla Substation is categorised as a *Rural Area* under Ergon Energy's Distribution Authority No. D01/99.

Under a credible contingency event involving a 33kV bus fault at Chinchilla Substation benchmarked against 50% POE load, Ergon Energy will not be able to meet Safety Net restoration times as the assessed time required to isolate the faulted section of the bus and perform manual switching to restore supply to the remaining section of bus is more than one hour.

This is not within the one hour period required under the Safety Net criteria and is reflected in the figure below.

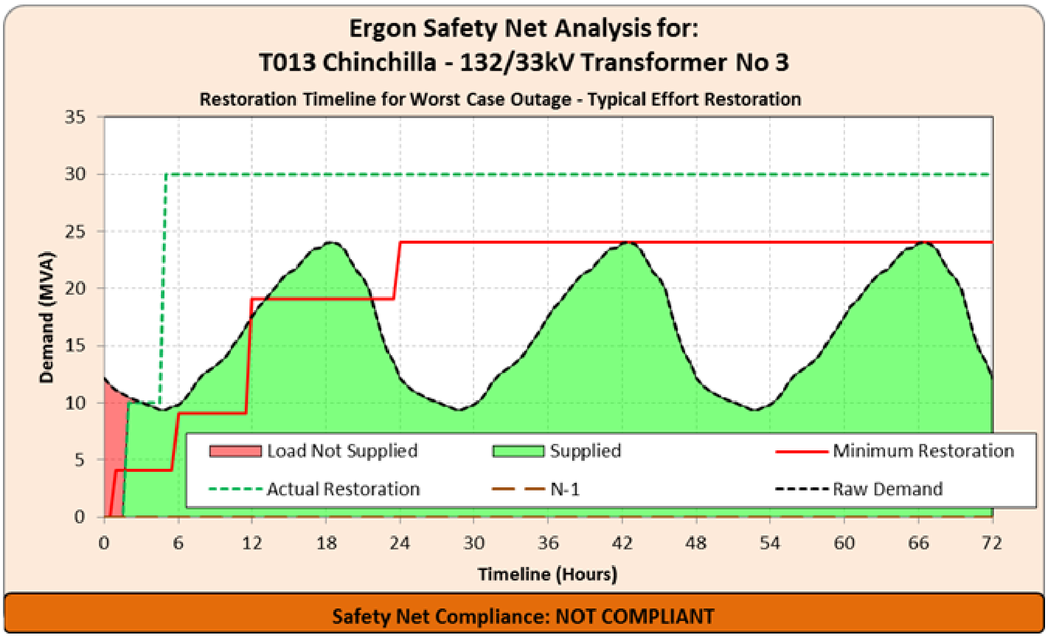


Figure 10: Safety Net analysis for Chinchilla (loss of a 33kV bus section)

3 Internal Options Considered

3.1. Non-Network Options Identified

Ergon Energy has not identified any viable non-network solutions internally that will provide a complete or a hybrid (combined network and non-network) solution to provide the magnitude of network support required in the Chinchilla area to address the identified need.

3.2. Network Options Identified

Ergon Energy's preferred internal network option is to remove all 110kV assets and replace them with a 132/33kV transformer at Chinchilla Substation.

This option involves recovering the existing 110kV assets including the transformers, regulators, circuit breakers, bus and isolators, and installing one new 63MVA 132/33kV transformer with compliant bunding. The project will also involve the installation of a 33kV bus tie circuit breaker, secondary systems upgrades and the condition-based replacement of 33kV VTs and CTs in order to address the identified need.

A schematic diagram of the proposed network arrangement for the preferred option is shown in Figure 11.

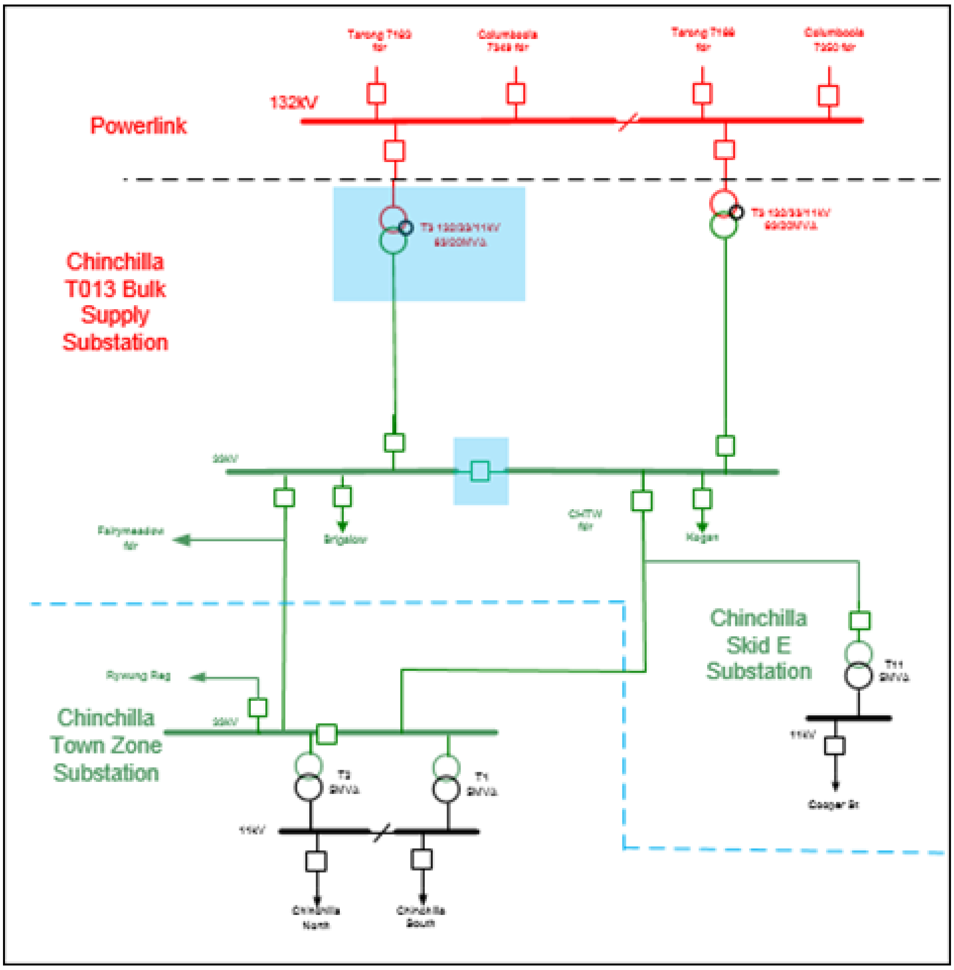


Figure 11: Proposed network arrangement (schematic view)

Upon completion of these works, the asset safety and reliability risks at Chinchilla Substation will be addressed. The preferred option will provide the greatest reliability benefit for customers, whilst also reducing expenditure on obsolete and non-compliant assets while ensuring more efficient use of design and construction resources.

The estimated capital cost of this option inclusive of interest, risk, contingencies and overheads is $7.89 million. Annual operating and maintenance costs are anticipated to be 0.5% of the capital cost. The estimated project delivery timeframe has design commencing in mid-2022 and construction completed by May 2026.

4 Assessment of Non-Network Solutions

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

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

4.1. Demand Management (Demand Reduction)

The DEM team has completed a review of the Chinchilla customer base and considered a number of demand management technologies. Asset safety and performance risks are the key project drivers (i.e. the need) at Chinchilla. It has been determined that most demand management options will not be viable propositions and have been explored in the following sections.

4.1.1. Network Load Control

The residential load appears to drive the daily peak demand which generally occurs between 3:00pm and 9:00pm.

Chinchilla Substation LC signals are controlled from Chinchilla 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 calls LC when the load at Chinchilla Substation exceeds 20.8MW. Tariff 33 air-conditioning channels are under manual control of the operational control centre and are used as required.

There are 2,118 customers on tariff T31 and T33 hot water load control (LC). An estimated demand reduction value of 1,270kVA[1] is available.

Therefore, network load control would not sufficiently address the identified need.

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

4.2. Demand Response

Four methods utilising demand response technology for deferring network investment are: Call Off Load (COL), Customer Embedded Generation (CEG), Large Scale Customer Generation (LSG) and customer solar power systems.

4.2.1. Customer Call off Load (COL)

COL is an effective technique for deferring network investment where the need is for a short time period. However, in this instance, the need is required on a long-term permanent basis. There are a small number of large customers in the catchment area but the $/kVA funding available for demand reduction is low therefore customer call off load has been assessed as not a viable proposition as it will not address the identified need, nor benefit the community.

4.2.2. Customer Embedded Generation (CEG)

CEG is an effective technique for deferring network investment where the need is for a short time period. The primary driver for investment in this instance is the condition of existing assets and associated asset safety and performance. A short-term deferral of network investment by using CEG will not address the primary driver and hence is not a technically or financially feasible option.

4.2.3. Large-Scale Customer Generation (LSG)

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

The only existing LSG site supplied from Chinchilla Substation is the Baking Board Solar Farm Chinchilla 14.7MW solar photovoltaic power station which is connected to the Fairymeadow 33kV feeder.

LSG does not address the identified need and has been assessed as technically not viable. The peak demand period occurs between 3:00pm and 9:00pm which does not coincide with the solar photovoltaic generation profile of the existing solar farm, and there is no other known existing or proposed LSG demand response available in the Chinchilla supply area. LSG also does not address poor condition asset replacement requirements, and associated safety and reliability issues which are a primary driver for this project.

4.2.4. Customer Solar Power Systems

A total of 887 customers have solar photo voltaic (PV) systems for a connected inverter capacity of 3,820kVA.

The daily peak demand is driven by residential customer demand and the peak generally occurs between 3:00pm and 9:00pm. As such customer solar generation does not coincide with the majority of the peak load period.

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

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

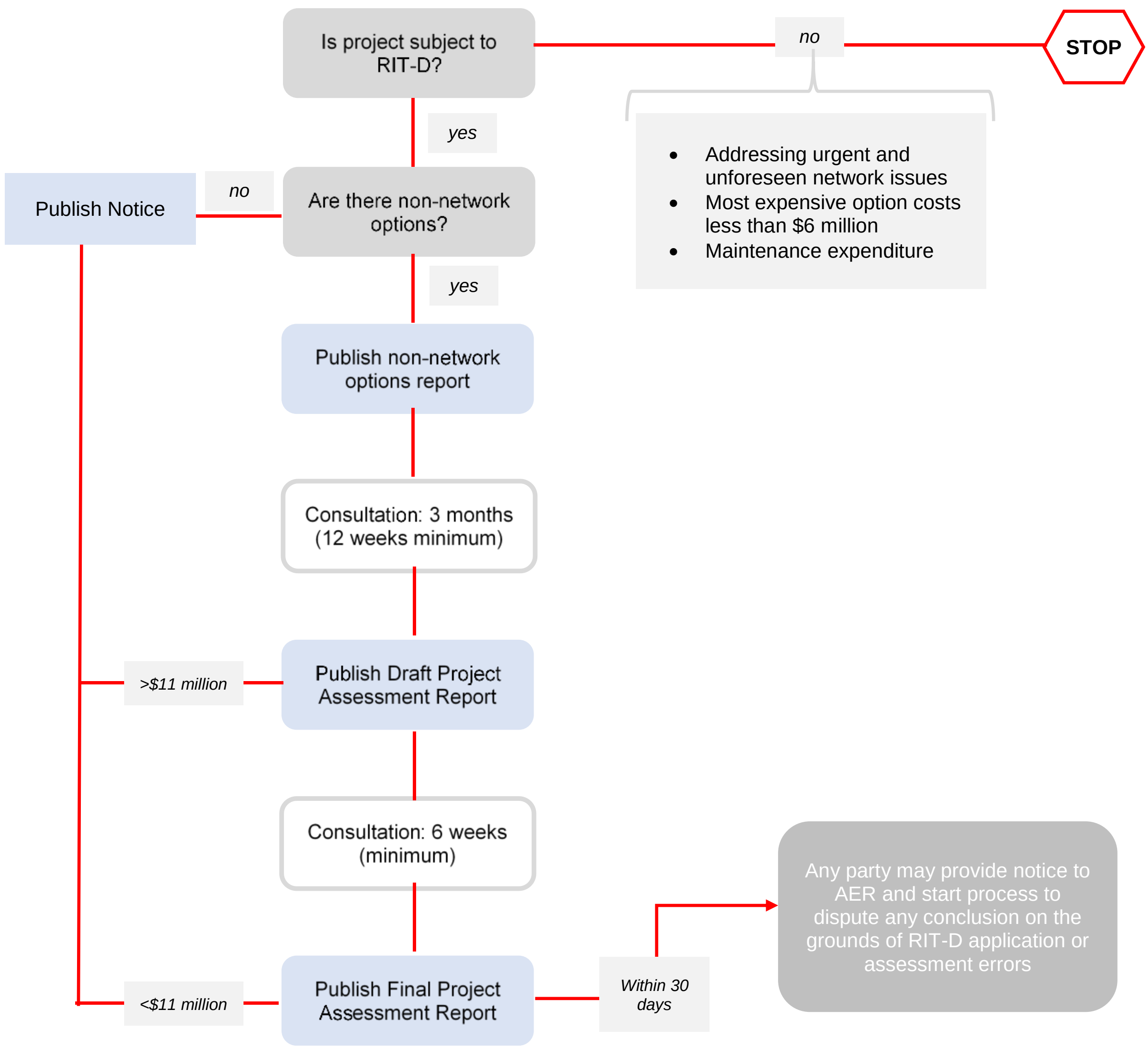
Customer Solar Power Systems also do not address poor condition asset replacement requirements, and associated safety and reliability issues which are a primary driver for this project.

5 Conclusion and Next Steps

The internal investigations undertaken on the feasibility of the non-network solutions revealed that it is unlikely to find a complete non-network solution or a hybrid (combined network and non-network) solution to provide the magnitude of network support required in the Chinchilla area to address the identified need.

The preferred network option is to replace the assets in poor condition. This Notice of No Non-Network Options is therefore published in accordance with rule 5.17.4(d) of the National Electricity Rules. As the next step in the RIT-D process, Ergon Energy will now proceed to publish a Final Project Assessment Report.

Appendix – The RIT-D Process



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