Ergon Energy Corporation Limited

Final Report

Emerging Distribution Network Limitations in the Central Toowoomba Area

16 May 2013

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1. EXECUTIVE SUMMARY

This final report provides both economic and technical information on the proposed upgrade to the distribution network in the Central Toowoomba area in southern Queensland. This report is prepared in accordance with clause 5.6.2(h) of the National Electricity Rules (NER).

Ergon Energy Corporation Limited (Ergon Energy) is responsible (under its Distribution Authority) for electricity supply to the Central Toowoomba area in southern Queensland. We have identified emerging limitations in the electricity distribution network supplying the central Toowoomba area. The loads on Ergon Energy's aged and poor condition Central Toowoomba zone substation has progressively increased such that augmentation is required if reliable supply is to be maintained.

The Toowoomba inner city area is presently supplied by seven 11kV feeders from the Central Toowoomba 33/11kV zone substation and comprises approximately 2100 commercial and residential customers.

The 2011/12 peak load at Central Toowoomba substation was 25.4MVA and the N-1 capacity of the substation is 25.4MVA for the transformers and 27.3MVA for the subtransmission supply feeders. The demand on Central Toowoomba substation is forecast to increase at over 2%pa over the next 10 yrs. As well as this the Central Toowoomba substation has been identified as requiring rebuilding due to its age and poor condition.

In order to ensure that supply to customers in the central Toowoomba area complies with Ergon Energy's security of supply criteria, corrective action will be required to be completed prior to the summer of 2014/15.

Ergon Energy published a Request for Information relating to this emerging network constraint on 20 December 2012. No submissions were received by the closing date of 14 February 2013.

Ergon Energy published a Consultation and Draft Recommendation on 4 April 2013 relating to this emerging network constraint. No submissions were received by the closing date of 2 May 2013.

Two feasible solutions to the emerging network constraint have been identified:

Option 1	Rebuild the Central Toowoomba sub at 110/11kV
Option 2	Rebuild the Central Toowoomba sub at 33/11kV

Ergon Energy's recommended action is Option 1. The estimated cost of this option is $41,000,000, and it is planned to be completed by December 2014.

Information relating to the consultation about this project is provided on our web site:
http://www.ergon.com.au/community--and--our-network/network-management-and-projects/regulatorytest-consultations

For further information, please email: regulatory.tests@ergon.com.au

2. INTRODUCTION

2.1. Background

Ergon Energy is responsible for electricity supply to the Toowoomba area (under its Distribution Authority) and has identified emerging limitations in the electricity distribution network supplying central Toowoomba. Augmentation to the electricity distribution network supplying this area is required if reliable supply is to be restored.

When a distribution network service provider (DNSP) proposes to establish a new small distribution network asset[1] to address such limitations it is required to conduct an economic cost effectiveness analysis of possible options to address the limitations in accordance with the Australian Energy Regulator's (AER) Regulatory Test (version 3, November 2007).

A DNSP does not need to consult on an option which would be a new small distribution network asset. Accordingly, Ergon Energy has not previously consulted on this project.

This project has been considered under the reliability limb of the Regulatory Test as the service standards linked to the technical requirements of Schedule 5.1 of the NER and Ergon Energy's licence conditions are unable to be met, as detailed in Section 4 of this report.

This project was included in the Ergon Energy Network Management Plan 2012/13 to 2016/17.

2.2. Purpose of this "Final Report"

The purpose of this Final Report is to:

- Provide information about the existing distribution network in the central Toowoomba area.
- Provide information about emerging distribution network limitations and the expected time by which action must be taken to maintain the reliability of the distribution system.
- Provide information about options identified and considered.
- Explain the process (including approach and assumptions), and the AER's Regulatory Test used to evaluate alternative solutions, including distribution options.
- Report the solution Ergon Energy has decided on.

[1] As defined in the NER.

3. EXISTING SUPPLY SYSTEM TO THE CENTRAL TOOWOOMBA AREA

3.1. Geographic Region

The geographic region covered by this Final Report is broadly described as the central Toowoomba area as shown on the map below. Also shown are the existing zone substations located around the central Toowoomba area.

Note: the Yellow lines are the 33kV subtransmission feeders

3.2. Existing Supply System

The Central Toowoomba 3 x 12.5MVA 33/11kV zone substation presently supplies about 2100 commercial and residential customers in the inner city of Toowoomba. The Central Toowoomba substation represents a large collection of aged and poor condition plant (25 items of high voltage plant are 45 years of age or older with some items over 50 years old). As well as this it doesn't meet present standards in regard to Safety Clearances, Protection, Fault Ratings and transformer capacity. Due to the many aged and poor condition plant items and the multiple modes of risk exposure it has been determined that the Central Toowoomba substation represents significant safety and reliability risk exposure. Because of these factors it has been determined to rebuild the Central Toowoomba substation.

Central Toowoomba substation is normally supplied via two 33kV subtransmission feeders from the South Toowoomba bulk supply substation. The load levels on Central Toowoomba sub are expected to be such that within several years these feeders will no longer provide N-1 supply capacity into Central Toowoomba sub. Also Central Toowoomba sub does not provide N-1 zone transformer capacity to the 11kV network supplying Toowoomba's inner city.

Ergon Energy's planning criteria requires that for Central Toowoomba substation there should be no interruption of supply to customers for a transformer or subtransmission feeder contingency event. Therefore additional subtransmission feeder capacity and additional zone transformer capacity is required at Central Toowoomba substation to comply with this criterion.

- Due to its poor condition and age Central Toowoomba substation needs significant rebuilding or total replacement. Rebuilding of Central Toowoomba substation would involve significant works, due to the large number of less than acceptable condition plant items, being carried out in proximity to energised poor condition HV plant with inadequate exclusion zones in areas where touch potentials likely exceed the maximum safe levels. Given the issues and risks associated with Central Toowoomba substation it seems very unlikely that it would be acceptable or feasible to carry out significant plant replacement or substation rebuilding at the existing substation. Therefore it is proposed that a new Central Toowoomba substation be established and the existing substation removed.
- The adjacent zone substations to Central Toowoomba zone substation (North St, West Toowoomba & East Toowoomba substations) are also heavily loaded and do not have the spare capacity to provide adequate permanent load relief to Central Toowoomba substation.

4. EMERGING NETWORK LIMITATIONS

4.1. Applied Service Standards

The service standards that are applicable to a consideration of supply constraints affecting this area of study are summarised below:

- As per the Ergon Energy Security of Supply Standard, for a zone substation classified as Significant Commercial & Industrial exceeding 5MVA of load a base security level of N-1 (A) must be met for transformer and subtransmission feeder capacity. This permits a short outage of less than 1 minute.

4.2. Limitations of the Existing Network

ME04 Central Toowoomba substation has a summer peaking load. In the 2010/11 summer the recorded peak load at the Central Toowoomba substation was 28MVA. The 2011/12 peak load was reduced due to the effect of the Toowoomba flood in January 2011 and was recorded at 25.4MVA. The forecast demand growth rate is about 2% pa. Table 1 below shows the annual Central Toowoomba substation recorded and forecast peak loads.

Table 1: ME04 Central Toowoomba Annual Maximum Demands (MVA)

Zone Substation	Maximum Annual Demand Actual (MVA)			Maximum Annual Demand Forecast (MVA)								Compound Growth Factor
	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	18/19	20/21	24/25	%/pa
Central Twmba	**29.4**	**28.0**	**25.4**	**27.2**	**24.6**	**27.9**	**27.0**	**27.8**	**28.6**	**30.6**	**33.1**	2.0%

Notes: i) the 2011/12 recorded MD is reduced due to the effects of the Toowoomba flood in January 2011.
ii) the above forecast includes a 2MVA load transfer to the rebuilt North St zone sub in 2013/14 and a proposed 4MVA major shopping centre development in 2014/15.

Transformer Capacity

Central Toowoomba substation contains 3 x 12.5MVA 33/11kV transformers which were manufactured in 1980. These transformers are deemed to be in Average condition with estimated remaining lives of 14-19 yrs. These transformers provide an N-1 transformer capacity of 25.4MVA. Based on the forecast demands of Table 1 the Central Toowoomba sub load has already exceeded its N-1 TF capacity and hence breaches the Security of Supply criteria. The level of exceedance will continue to increase into the future.

33kV Feeder Capacity

ME04 Central Toowoomba substation is supplied by the Victoria St and the Dent St 33kV feeders out of the T43 South Toowoomba bulk supply substation. These feeders provide an N-1 33kV feeder capacity of 27.3MVA.

Based on the forecast demands of Table 1 the Central Toowoomba sub load has already exceeded its N-1 33kV feeder capacity, and hence breaches the Security of Supply criteria. The exceedance is forecast to continue into the future.

4.3. Timeframes for Taking Corrective Action

In order to ensure that security of supply to customers in the Toowoomba inner city area complies with Ergon Energy's planning and security criteria, corrective action should be completed by summer 2014/15.

4.4. Known Future Network and Generation Development

(i.e. projects that have been approved and are firm to proceed)

Ergon Energy is not aware of any other network augmentations or generation developments in the Toowoomba area that could relieve the emerging network limitations described in section 4.0 above.

5. OPTIONS CONSIDERED

5.1. Non-Distribution Options Identified

In order to satisfy the Regulatory Test, Ergon Energy sought to identify demand side options or demand side/network combinations that address the network limitations at a lower total present value than the proposed network solution.

To be considered an alternative demand side option, the proposed solution was required to:

- Have the capacity to defer the proposed network solution by reducing demand below the identified constraint limits;
- Cost less than the savings gained by deferring or removing the proposed network solution; and
- Meet all applied service standard requirements.

This analysis did not identify feasible demand side alternative options.

5.2. Distribution Options Identified

Ergon Energy carried out studies to determine the most appropriate distribution network solutions. It was considered that a “do nothing” approach was unacceptable. Two feasible corrective solutions were identified, details of which are contained in the following Section 6.

6. FEASIBLE SOLUTIONS

This section provides an overview of the feasible solutions identified, with full details of the financial analysis contained in Section 7.

6.1. Option 1 – Establish a New 110/11kV Zone Substation in central Toowoomba

Option 1 – Toowoomba Central 110/11kV Zone Substation		
Date Req'd	*Augmentation*	*Capital Cost*
2014	Install a new 2 x 40MVA 110/11kV Zone sub in central Toowoomba, including distribution works	$22.5m
	Establish a 110kV bus and seven 110kV CB bays (4 x fdr, 2 x TF, 1 x bus section) at South Toowoomba 110/33kV sub to supply two new 110kV feeders to Toowoomba Central sub.	$8.9m
	Establish two new 110kV feeders from South Toowoomba sub to Toowoomba Central sub (approx 3.4km)	$9.2m
2016	Replace No1 110/33kV TF at South Toowoomba sub with a 100MVA unit	$5.1m
2025	Replace No3 110/33kV TF at South Toowoomba sub with a 100MVA unit. Augment 33kV busbars at South Toowoomba sub	$7.6m
2036	Establish a 2nd inner city sub	$40m

This option involves the establishment of a new 110/11kV 2 x 40MVA zone substation in central Toowoomba by December 2014, and removal of the existing poor condition Central Toowoomba 33/11kV sub. This proposed new sub will be supplied by installing two new 110kV feeders from South Toowoomba bulk supply substation. Ten distribution feeders will be established by augmenting and restructuring the surrounding 11kV network. The 2014 works defined above are the subject of this regulatory test process. The 2016, 2025 and 2036 works are included to allow a long term comparative cost between options to be established.

6.2. Option 2 – Establish a New 33/11kV Zone Substation in central Toowoomba

Option 2 – Central Toowoomba 33/11kV Zone Substation		
Date Req'd	*Augmentation*	*Capital Cost*
2014	Install a new 2 x 32MVA 33/11kV Zone sub in central Toowoomba, including distribution works	$24.2m
	Establish a 3rd 33kV feeder from South Toowoomba 110/33kV sub to Central Toowoomba sub.	$9.1m
	At South Toowoomba sub: - Install 33kV feeder bay - Replace No1 & 3 110/33kV TFs with 100MVA units. - Augment 33kV busbars	$13.3m
2030	Establish a 2nd inner city sub	$40m

This option involves the establishment of a new 33/11kV 2 x 32MVA zone substation in central Toowoomba by December 2014, and removal of the existing poor condition Central Toowoomba 33/11kV sub. This proposed new sub will be supplied by the existing two 33kV feeders plus a new 3rd 33kV feeder from South Toowoomba sub. Ten distribution feeders will be established by augmenting and restructuring the surrounding 11kV network. The 2014 works defined above are the subject of this regulatory test process. The 2030 works are included to allow a long term comparative cost between options to be established.

7. FINANCIAL ANALYSIS & RESULTS

7.1. Format and Inputs to Analysis

7.1.1 Regulatory Test Requirements

The requirements for the comparison of options to address an identified network limitation are contained in the Regulatory Test (version 3, Nov 2007) prescribed by the Australian Energy Regulator (AER).

The Regulatory Test requires that, for reliability augmentations, the recommended option be the one that **"minimises the costs of meeting those requirements, compared with alternative option/s in a majority of reasonable scenarios"**. To satisfy the Regulatory Test, the proposed augmentation must achieve the lowest cost in the majority of (but not necessarily all) credible scenarios.

The Regulatory Test contains guidelines for the methodology to be used to identify the lowest cost option. Information to be considered includes construction, operating and maintenance costs and the costs of complying with existing and anticipated laws and regulations. The Regulatory Test specifically excludes indirect costs and costs that cannot be measured in terms of financial transactions in the electricity market.

7.1.2 Inputs to Analysis

A solution to address the future supply requirements for the central Toowoomba area as outlined in this document is required to satisfy reliability requirements linked to Schedule 5.1 of the NER and the requirements of the Queensland *Electricity Act 1994*.

According to the AER's Regulatory Test, this means that the costs of all options must be compared, and the least cost solution is considered to satisfy the Regulatory Test. The results of this evaluation, carried out using a discounted cash flow model to determine the present value costs of the various options, are shown in section 7.2.2.

The cost to implement the network augmentations outlined in section 6 have been estimated by Ergon Energy. Sensitivity studies have been carried out using variations in capital cost estimates of plus or minus 20%. The operating and maintenance costs have been derived as a fixed proportion of capital cost. As a result, a variation in capital costs would be equivalent to separately varying the operating and maintenance cost.

The financial analysis considers all foreseeable cost impacts of the proposed network augmentations to market participants as defined by the regulatory process. Estimated savings in the cost of network losses have been excluded from the analysis because they were not found to differ significantly between the two feasible options over the study period.

7.2. Financial Analysis

The economic analysis undertaken considered the present value of cost of alternative options over the 22 year period from 2014 to 2036.

7.2.1 Present Value Analysis

Financial analysis was carried out to calculate and compare the Present Value (PV) of the costs of each option under the range of assumed scenarios.

A 22 year analysis period was selected as an appropriate period for financial analysis. A discount rate of 10% was selected as a relevant commercial discount rate.

The Base Case (Scenario A) was developed to represent the most likely market scenario.

Market scenarios B - G were formulated to test the robustness of the analysis to variations in load forecast, capital costs and the discount rate. As required by the Regulatory Test, the lower boundary of the sensitivity testing was the regulated cost of capital.

Under the Regulatory Test, it is the ranking of options which is important, rather than the actual present value results. This is because the Regulatory Test requires the recommended option to have the lowest present value cost compared with alternative projects.

The following table is a summary of the economic analysis. It shows the present value cost of each alternative and identifies the best ranked option, for the range of scenarios considered.

The summary shows that **Option 1 (Toowoomba Central 110/11kV substation) has the lowest present value under all but one of the scenarios**.

7.2.2 Summary of Economic Analysis

		Option 1 **110/11kV sub**	**Option 2** **33/11kV**
Scenario A	PV ($M)	$69.79	$73.64
Base Case	Rank	1st	2nd
Scenario B	PV ($M)	$61.33	$59.21
Low Load Growth	Rank	2nd	1st
Scenario C	PV ($M)	$67.73	$77.26
High Load Growth	Rank	1st	2nd
Scenario D	PV ($M)	$64.31	$68.18
Discount Rate = 12%	Rank	1st	2nd
Scenario E	PV ($M)	$75.27	$78.93
Discount Rate = 8.5%	Rank	1st	2nd
Scenario F	PV ($M)	$83.74	$88.37
Increased Capital Costs	Rank	1st	2nd
Scenario G	PV ($M)	$55.84	$58.91
Decreased Capital Costs	Rank	1st	2nd

7.3. Discussion of Results

The following conclusions have been drawn from the analysis presented in this report:

- There is no acceptable 'do nothing' option. If the emerging network constraints are not addressed by summer 2014/15, Ergon Energy will not be able to meet its security criteria in the event of a transformer or 33kV feeder failure at Central Toowoomba substation, potentially resulting in loss of supply to network users.

- Economic analysis carried out in accordance with the Regulatory Test has identified that proposed augmentation described in Option 1 Establish Toowoomba Central 110/11kV Substation, is the least cost solution over the 22 yr period of analysis in all but one of the scenarios considered.

- Sensitivity testing showed that the analysis is robust to variations in capital costs and the selected discount rate.

- As Option 1 is the lowest cost option in the majority of scenarios, it is considered to satisfy the AER's Regulatory Test.

8. FINAL REPORT & DECISION

Based on the conclusions drawn from the analysis in sections 6 and 7 above, it is recommended that Ergon Energy proceeds with Option 1 to:-

- **Establish a new 110/11kV 2 x 40MVA zone substation in central Toowoomba by December 2014.**

Technical details relevant to the proposed new large distribution assets are contained in section 6.1.

Ergon Energy now intends to take immediate steps to implement the solution decided on to ensure system reliability is maintained.