Regulatory Test – Final recommendation report

Proposed deferral of a new 66/22kV substation at Malanda
5 February 2014

Ergon Energy Corporation Limited

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EXECUTIVE SUMMARY

Ergon Energy Corporation Limited (Ergon Energy) is responsible (under its Distribution Authority) for electricity supply to the Atherton Tablelands area in Far North Queensland. We have identified emerging limitations in the electricity distribution network supplying the southern Atherton Tablelands area. The loads on Ergon Energy's 22kV network in the southern Atherton Tablelands area have progressively increased such that action is required if reliable supply is to be maintained.

The southern Atherton Tablelands area is presently supplied by three 22kV feeders from the Atherton 66/22kV substation. This substation is supplied via a dual circuit 66kV line from Powerlink Queensland's T55 Turkinje substation.

In the past for an outage of one of the three 22kV feeders the remaining two 22kV feeders could be switched to restore full customer supply. However due to ongoing customer load growth the aggregate customer load has exceeded the capacity that any two 22kV feeders can provide, and consequently a 22kV feeder outage results in a sustained interruption of supply to affected customers until line repairs can be completed.

To maintain acceptable reliability of supply for the southern Atherton Tablelands area Ergon Energy needs an additional minimum of 4.9MVA firm capacity at 22kV to be provided to this area. This size has been matched to expected load requirements within Ergon Energy's typical 10 year planning horizon.

Initial corrective action is required as soon as possible. However the earliest that a network solution can be delivered is by the summer of 2015/16. A decision about the selected option is required by February 2014 if any option involving significant construction is to be completed by November 2015.

Ergon Energy published a Request for Information relating to this emerging network constraint on 25 July 2012. Two external submissions and one internal submission were received by the closing date of 19 September 2012.

Ergon Energy published a Consultation and Draft Recommendation on 11 December 2013. One submission to the Consultation and Draft Recommendation was received by the closing date of 15 January 2014.

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

Option 1	Establish a new 66/22kV substation with one 10MVA transformer near Malanda by November 2015.
Option 2	Implement customer embedded generation to defer the establishment of Malanda 66/22kV Substation until November 2019.
Option 3	Develop one new 22kV feeder to Malanda and defer the establishment of Malanda 66/22kV substation until November 2020.

In accordance with the requirements of the National Electricity Rules (NER), this is now a Final Report where Ergon Energy provides both economic and technical information about possible solutions, and the solution decided on, being Option 2, to implement customer embedded generation to defer the establishment of Malanda 66/22kV Substation until November 2019.

1. INTRODUCTION

Ergon Energy has identified emerging limitations in the electricity distribution network supplying the southern Atherton Tablelands area.

When a distribution network service provider proposes to establish a new large distribution network asset to address such limitations, it is required under the National Electricity Rules (NER) clause 5.6.2(f) to consult with affected Registered Participants, AEMO and Interested Parties on possible options to address the limitations. These options may include but are not limited to demand side options, generation options, and market network service provider options.

Under clause 5.6.2(g) of the NER the consultation must include an economic cost effectiveness analysis of possible options to identify options that satisfy the Australian Energy Regulator's (AER) Regulatory Test, while meeting the technical requirements of Schedule 5.1 of the NER.

This Final Report is based on:

- the assessment that a reliable power supply is not able to be maintained in the southern Atherton Tablelands area.
- the Request for Information consultation undertaken by Ergon Energy to identify potential solutions to address the emerging distribution network limitations; and
- an analysis of feasible options in accordance with the AER's Regulatory Test.

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 2010/11 to 2014/15.

Information relating to the consultation about this project is provided on our web site:

https://www.ergon.com.au/community--and--our-network/network-management/regulatory-test-consultations

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

2. BACKGROUND & REASONS AUGMENTATION IS REQUIRED

2.1. Background

If technical limits of the distribution system will be exceeded and the rectification options are likely to exceed $10M, Ergon Energy is required under the NER[1] to notify Registered Participants,[2] AEMO and Interested Parties[3] within the time required for corrective action and meet the following regulatory requirements:

- Consult with Registered Participants, AEMO and Interested Parties regarding possible solutions that may include local generation, demand side management and market network service provider options[4].
- Demonstrate proper consideration of various scenarios, including reasonable forecasts of electricity demand, efficient operating costs, avoidable costs, costs of ancillary services and the ability of alternative options to satisfy emerging network limitations under these scenarios.
- Ensure the recommended solution meets reliability requirements while minimising the present value of costs when compared to alternative solutions[5].

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

2.2. Purpose of this "Final Report"

The purpose of this Final Report is to:

- Provide information about the existing distribution network in the southern Atherton Tablelands 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.

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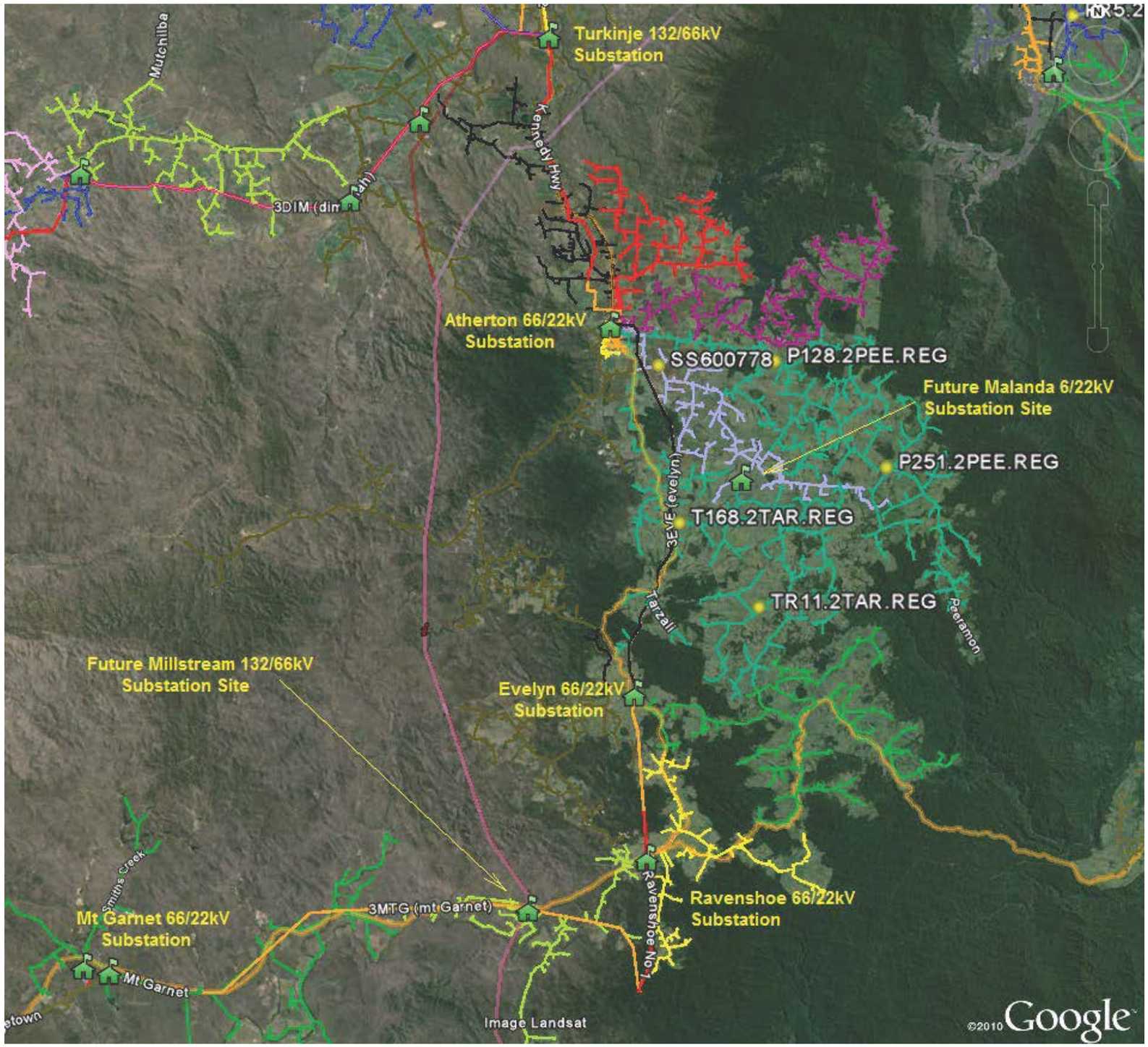
[1] Clause 5.6.2(f)
[2] As defined in the NER
[3] As defined in the NER
[4] NER clause 5.6.2(f)
[5] In accordance with the AER's Regulatory Test Version 3, November 2007

3. EXISTING SUPPLY SYSTEM TO THE SOUTHERN ATHERTON TABLELANDS AREA

3.1. Geographic Region

The geographic region covered by this Final Recommendation report is broadly described as the southern Atherton Tablelands area as shown on the map below. Substation locations are identified, voltage regulators in the 22kV Malanda, Peeramon and Tazali feeders as yellow dots, and power-lines are shown in different colours.



3.2. Existing Supply System

Electricity supply to Malanda Town and the surrounding rural area is provided by three 22kV feeders from the Atherton 66/22kV Substation. These feeders are named the 22kV Malanda feeder, the 22kV Peeramon feeder, and the 22kV Tarzali feeder.

These feeders have an aggregate length of approximately 525km and supply 3,935 customers. The total undiversified load on the three feeders is approximately 10MVA. The extremity of the three feeder network (ie. Malanda and the rural area to the south) comprises nearly 2,100 customers and 5.8MVA of load.

In the past for an outage of one of the three 22kV feeders the remaining two 22kV feeders could be switched to restore full customer supply. However due to ongoing customer load growth the aggregate customer load has exceeded the capacity that any two 22kV feeders can provide, and consequently a 22kV feeder outage results in a sustained interruption of supply to affected customers until line repairs can be completed.

The 22kV Malanda feeder supplies 1,079 customers in Malanda Town. The 22kV Peeramon feeder supplies 1,566 customers and has a feeder length of 223km. The 22kV Tarzali feeder supplies 1,290 customers and has a feeder length of 212km. Acceptable supply voltages are only maintained at the extremities of these 22kV feeders due to sets of voltage regulators installed at appropriate locations in the feeders. However in the event of a feeder outage, if additional load is transferred onto any neighbouring feeder unacceptable supply voltages can result.

The Malanda Dairy Centre (Dairy Farmers) processing plant is a major industrial customer in Malanda and draws a maximum demand of approximately 2MW (@ 0.89 power factor) via a 22kV connection point. Due to the size of the Malanda Dairy Centre load, and the feeder distance from Atherton substation, a temporary voltage swell of 10% can occur on the 22kV Malanda feeder if the Malanda Dairy Centre load is tripped and lost. A voltage step of this size does not comply with National Electricity Code requirements.

Ergon Energy's planning criteria require that for a distribution feeder outage full customer supply must be restored within 4 hours for urban loads. Generally this objective is achieved by transferring unserved load to neighbouring distribution feeders. Ergon Energy has only three 22kV feeders supplying the Malanda area so the criterion for this case is rationalised to become '3 into 2' load transfer during feeder outages. With the existing distribution feeder load levels in the Malanda area full customer supply cannot be restored within 4 hours following a distribution feeder outage.

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 Supply Security Standard, for a distribution feeder supplying urban load any interruption to supply should be restored within four hours through remote or manual switching or through use of embedded or mobile generation.
- As per the Ergon Energy Supply Security Standard, for a distribution feeder supplying rural load any interruption to supply should be restored within six hours through remote or manual switching or through use of embedded or mobile generation.

4.2. Limitations of the Existing Network

A load history and forecast for the 22kV Malanda, Peeramon and Tazali feeders (which supply Malanda town and the surrounding rural area) is shown in Table 1 below.

TABLE 1 – 22kV Feeder Load History & Forecast (MVA)

Year	**09/10**	**10/11**	**11/12**	***12/13***	***13/14***	***14/15***	***15/16***	***16/17***	***17/18***		***20/21***
22kV Malanda Feeder Load (MVA)	4.3	3.9	4.4	*Forecast* *4.5*	*Forecast* *4.6*	*Forecast* *4.8*	*Forecast* *4.9*	*Forecast* *5.0*	*Forecast* *5.2*		*Forecast* *5.6*
22kV Peeramon Feeder Load (MVA)	3.3	3.1	3.4	*Forecast* *3.5*	*Forecast* *3.6*	*Forecast* *3.7*	*Forecast* *3.8*	*Forecast* *3.9*	*Forecast* *4.0*		*Forecast* *4.3*
22kV Tarzali Feeder Load (MVA)	3.2	2.7	2.8	*Forecast* *2.9*	*Forecast* *3.0*	*Forecast* *3.1*	*Forecast* *3.1*	*Forecast* *3.2*	*Forecast* *3.3*		*Forecast* *3.6*

It has been determined that the capability to restore full customer supply using a '3 into 2' load transfer following a single feeder outage would be provided by a 2MVA aggregate load reduction from the present load levels.

Based on this determination Ergon Energy needs an additional minimum of 4.9MVA firm capacity at 22kV to be provided to this area to meet the security of supply criteria for the southern Atherton Tablelands area. This size has been matched to expected load requirements within Ergon Energy's typical 10 year planning horizon

4.3. Timeframes for Taking Corrective Action

In order to ensure that security of supply to customers in the southern Atherton Tablelands area complies with Ergon Energy's planning and security criteria, corrective action should be completed as soon as possible. However the earliest achievable completion date for the first stage of major network augmentation programme is November 2015.

A decision about the selected option is required by February 2014 if any option involving significant construction is to be completed by November 2015.

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 southern Atherton Tablelands area that could relieve the emerging network limitations described in section 5.0 above.

5. OPTIONS CONSIDERED

5.1. Consultation Summary

During its planning process, Ergon Energy identified that action would be required to address an anticipated distribution network limitation related to supply to the southern Atherton Tablelands area.

On 25 July 2012 Ergon Energy released a Request for Information providing details on the emerging network limitations in the southern Atherton Tablelands area. That paper sought information from Registered Participants, AEMO and Interested Parties regarding potential solutions to address the anticipated limitations.

Ergon Energy received two submissions by 19 September 2012, being the closing date for submissions to the Request for Information paper. Liaison with the proponents of the two submissions did not result in any competitive solutions.

On 11 December 2013, Ergon Energy released a Consultation and Draft Recommendation Report. Ergon Energy received one submission by 15 January 2014, being the closing date for submissions. Liaison with the proponent of the submission did not result in a competitive solution.

5.2. Non-Network 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 that 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 identified one feasible demand side alternative option, details of which are contained in the following Section 6.

5.3. Distribution Options Identified

In addition to the consultation process to identify possible non-network solutions, 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 66/22kV Substation with one 10MVA transformer near Malanda by November 2015

Option 1 – Establish Malanda 66/22kV Substation & Develop new 22kV Feeders		
Year Req'd	*Augmentation*	*Cost*
2015	Review and upgrade the protection schemes in the 66kV Atherton-Mt Garnet feeder bay at Atherton substation.	$250,000
	Build 6km of dual circuit 66kV line to Malanda substation site, cut in and out of the existing 66kV Atherton-Mt Garnet feeder.	$4,921,000
	Establish Malanda 66/22kV substation with one 10MVA transformer.	$10,032,000
	Develop three new 22kV feeders out of Malanda substation.	$2,100,000

This option involves delivery of the following work by November 2015:-

- Establish a new 66/22kV substation on the existing Malanda Substation site, complete with one 10MVA transformer, a new control building and one section of a new 22kV switchboard. A new 66kV switchyard will provide two 66kV feeder bays, one transformer bay and one bus tie bay without a circuit breaker or CTs.
- Build approximately 6km of dual circuit 66kV line which will connect the Malanda Substation in and out from the existing 66kV Atherton-Mt Garnet feeder.
- Review and upgrade the protection equipment and schemes in the existing 66kV Mt Garnet feeder bay at Atherton 66/22kV substation to account for the new supply to Malanda Substation.
- Develop three new 22kV feeders from the Malanda Substation to supply the existing loads in and around Malanda.

Benefits of this option include:

- This option will restore acceptable voltage levels, voltage regulation and quality of supply to customers in the Malanda area.
- This option will eliminate the present 22kV feeder constraints and significantly improve reliability of customer supply.
- This option will significantly reduce network losses (80% reduction).
- This option promotes the long term strategic plan for the southern Atherton Tablelands network.

Disadvantages of this option include:

- This option has a higher Net Present Value cost than Option 2.

6.2. Option 2 – Implement Customer Embedded Generation to defer the Establishment of Malanda 66/22kV Substation until November 2019

Option 2 – Assist Customer Embedded Generation to defer the Establishment of Malanda Substation		
Year Req'd	*Augmentation*	*Cost*
2015	Implement customer embedded generation to achieve 2MVA peak load reduction during feeder contingencies.	$245,000
2016	Maintain customer embedded generation to achieve 2MVA peak load reduction during feeder contingencies.	$130,000
2017	Maintain customer embedded generation to achieve 2MVA peak load reduction during feeder contingencies.	$130,000
2018	Maintain customer embedded generation to achieve 2MVA peak load reduction during feeder contingencies.	$130,000
2019	Maintain customer embedded generation to achieve 2MVA peak load reduction during feeder contingencies.	$130,000
2019	Review and upgrade the protection schemes in the 66kV Atherton-Mt Garnet feeder bay at Atherton substation.	$250,000
	Build 6km of dual circuit 66kV line to Malanda substation site, cut in and out of the existing 66kV Atherton-Mt Garnet feeder.	$4,921,000
	Establish Malanda 66/22kV substation with one 20MVA transformer.	$10,032,000
	Develop three new 22kV feeders out of Malanda substation.	$2,100,000

This option involves delivery of the following work:-

- In 2015 implement customer embedded generation (Malanda Dairy Centre) to achieve 2MVA peak load reduction.

In 2019:-

- Establish a new 66/22kV substation on the existing Malanda Substation site, complete with one 10MVA transformer, a new control building and one section of a new 22kV switchboard. A new 66kV switchyard will provide two 66kV feeder bays, one transformer bay and one bus tie bay without a circuit breaker or CTs.
- Build approximately 6km of dual circuit 66kV line which will connect the Malanda Substation in and out from the existing 66kV Atherton-Mt Garnet feeder.
- Review and upgrade the protection equipment and schemes in the existing 66kV Mt Garnet feeder bay at Atherton 66/22kV substation to account for the new supply to Malanda Substation.
- Develop three new 22kV feeders from the Malanda Substation to supply the existing loads in and around Malanda.

Benefits of this option include:

- This option will improve delivery of acceptable voltage levels, voltage regulation and quality of supply to customers in the Malanda area.
- This option will ameliorate the present 22kV feeder constraints.
- This option has a lower Net Present Value cost than Options 1 and 3.

Disadvantages of this option are:

- This option will not immediately reduce network losses.
- This option does not immediately promote the long term strategic plan for the southern Atherton Tablelands network.

6.3. Option 3 – Develop one new 22kV Feeder to Malanda and defer the Establishment of Malanda 66/22kV Substation until November 2020

Option 3 – Develop one new 22kV Feeder to Malanda to defer the Establishment of Malanda Substation		
Year Req'd	*Augmentation*	*Cost*
2015	Atherton Substation – Install one new 22kV feeder bay.	$305,000
	Develop one new 22kV feeder from Atherton Substation to Malanda.	$8,254,000
2020	Review and upgrade the protection schemes in the 66kV Atherton-Mt Garnet feeder bay at Atherton substation.	$250,000
	Build 6km of dual circuit 66kV line to Malanda substation site, cut in and out of the existing 66kV Atherton-Mt Garnet feeder.	$4,921,000
	Establish Malanda 66/22kV substation with one 20MVA transformer.	$10,032,000
	Develop three new 22kV feeders out of Malanda substation.	$2,100,000

This option involves delivery of the following work:-

In 2015:-

- Install one new 22kV feeder bay at Atherton 66/22kV substation to terminate a new feeder.
- Develop a new 22kV feeder from Atherton Substation to Malanda and redistribute the customer loads in Malanda and surrounds to four feeders instead of the existing three.

In 2020:-

- Establish a new 66/22kV substation on the existing Malanda Substation site, complete with one 10MVA transformer, a new control building and one section of a new 22kV switchboard. A new 66kV switchyard will provide two 666kV feeder bays, one transformer bay and one bus tie bay without a circuit breaker or CTs.
- Build approximately 6km of dual circuit 66kV line which will connect the Malanda Substation in and out from the existing 66kV Atherton-Mt Garnet feeder.
- Review and upgrade the protection equipment and schemes in the existing 66kV Mt Garnet feeder bay at Atherton 66/22kV substation to account for the new supply to Malanda Substation.
- Develop three new 22kV feeders from the Malanda Substation to supply the existing loads in and around Malanda.

Benefits of this option include:

- This option will restore acceptable voltage levels, voltage regulation and quality of supply to customers in the Malanda area.
- This option will eliminate the present 22kV feeder constraints and improve reliability of customer supply.
- This option will reduce network losses.

Disadvantages of this option are:

- This option has a higher Net Present Value cost than Options 1 and 2.
- This option does not immediately promote the long term strategic plan for the southern Atherton Tablelands network.

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, November 2007) prescribed by the 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 southern Atherton Tablelands 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 7.2.27.2.2.

The cost to implement the network augmentations outlined in section 6 has 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.

7.2. Financial Analysis

The economic analysis undertaken considered the present value of cost of alternative options over the 15 year period from 2013 to 2028.

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 15 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 2 (Implement Customer Embedded Generation to defer the Establishment of Malanda 66/22kV Substation) has the lowest present value under all scenarios**.

7.2.2 Summary of Economic Analysis

		Option 1	Option 2	Option 3
Scenario A	PV ($M)	$15.38	$10.15	$16.37
Base Case	Rank	2	1	3
Scenario B	PV ($M)	$13.41	$9.76	$14.63
Low Load Growth	Rank	2	1	3
Scenario C	PV ($M)	$16.45	$11.58	$18.01
High Load Growth	Rank	2	1	3
Scenario D	PV ($M)	$14.60	$8.92	$14.63
Discount Rate = 12%	Rank	2	1	3
Scenario E	PV ($M)	$16.23	$11.22	$17.87
Discount Rate = 8.5%	Rank	2	1	3
Scenario F	PV ($M)	$18.46	$12.18	$19.65
Increased Capital Costs	Rank	2	1	3
Scenario G	PV ($M)	$12.31	$8.12	$13.10
Decreased Capital Costs	Rank	2	1	3

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 2015, Ergon Energy will not be able to maintain acceptable reliability of supply in the southern Atherton Tablelands area.

- Economic analysis carried out in accordance with the Regulatory Test has identified that proposed augmentation described in Option 2 (Implement Customer Embedded Generation to defer the Establishment of Malanda 66/22kV Substation), is the least cost solution over the 15 year period of analysis in all scenarios considered.

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

- As Option 2 is the lowest cost option in all scenarios, it is considered to satisfy the AER's Regulatory Test.

8. FINAL DECISION & RECOMMENDATION

Based on the conclusions drawn from the analysis in sections 6 and 7 above, it is recommended that Ergon Energy proceeds with Option 2 to:-

- **Implement Customer Embedded Generation by November 2014 to defer the Establishment of Malanda 66/22kV Substation until 2019**

Technical details relevant to the proposed solution are contained in section 6.2.

Ergon Energy will commence actions to progress the solution decided on to ensure system reliability is maintained.