FINAL REPORT:

Proposed New Large Network Asset –

Inland Central Queensland

(includes supply to the Bowen Basin coal mining area near Moura, Blackwater, Emerald, Dysart and Moranbah)

Powerlink Queensland
9 April 2003

1.0 EXECUTIVE SUMMARY

Powerlink Queensland has identified emerging limitations in the electricity transmission network supplying inland Central Queensland. This area includes major mining developments in the Bowen Basin and the towns of Biloela, Moura, Blackwater, Emerald, Dysart and Moranbah.

Inland central Queensland is primarily supplied by a 275kV circuit between Broadsound and Lilyvale (50km north-east of Emerald), supported by a 132kV network. Technical studies have identified that, from late 2004, an outage of the 275kV transmission line will result in overloads of the supporting 132kV network and loss of supply to customers. Action is required to overcome this limitation before late 2004 to allow Powerlink to meet its obligations under the Electricity Act and technical standards in the National Electricity Code.

There are two feasible options for network reinforcement –

Option 1: construct a second 275kV single circuit line between Broadsound and Lilyvale, and

Option 2: upgrade the 132kV network to prevent overloads during a 275kV contingency. This would involve construction of a new 132kV line between Callide and Baralaba, and the installation of a second 275/132kV transformer at Calvale.

Powerlink carried out consultation with interested parties to identify and determine feasible non-network alternatives to address the emerging network limitations. A response was received from three parties seeking to develop coal seam methane generation projects (~6-25MW in size). No other alternatives were put forward during the consultation process.

The proposed coal seam methane generation facilities are not committed, with commercial negotiations still to be finalised. Due to the uncertainty associated with these proposals, they are not considered feasible solutions to address the reliability limitations that are expected to arise in inland central Queensland by late 2004. It is also unlikely that sufficient capacity could be installed prior to the end of 2004 to overcome the emerging network limitations. The potential for future local generation to reduce the demand on the transmission grid has, however, been considered in the market development scenarios used in the evaluation in this report.

The market development scenarios also take into account the potential for substantial increases in the forecast load in the inland central Queensland area. Since Powerlink issued its initial 'Request for Information' consultation document, Ergon Energy has revised the demand forecast for the area upwards based on recent progress towards the development of new mine proposals.

In total, six market development scenarios with varying load growth forecasts and embedded generation assumptions were developed. Financial analysis was carried out to compare the Net Present Value (NPV) of the costs to market participants of the options identified in accordance with the ACCC Regulatory Test. Sensitivity to the six market development scenarios, and to assumptions about capital cost, cost of network losses and discount rate was assessed.

The ACCC Regulatory Test requires that for reliability requirements (as is the case for the inland Central Queensland area limitations), the recommended option be the option with the lowest net present value cost under the majority of market development scenarios considered. The economic analysis identified that Option 1 is the least-cost solution over the fifteen-year period of analysis. Sensitivity analysis showed the results of the financial analysis to be robust under a range of assumptions.

Consequently, a draft recommendation to implement Option 1 to address the identified network limitations in the inland Central Queensland area was published as an 'Application Notice' in February 2003. The proposed new large network asset is:

- a single circuit 275kV transmission line between Broadsound and Lilyvale and associated substation works. The asset, estimated to cost $23.1M, is required to be commissioned by October 2004.

No submissions were received in response to the draft recommendation. Powerlink has therefore adopted the draft recommendation without change as its final recommendation. Immediate steps will be taken to implement this recommendation.

2.0 INTRODUCTION

This report contains a final recommendation to address emerging transmission network limitations in inland Central Queensland. This area includes major mining developments in the Bowen Basin and the towns of Biloela, Moura, Blackwater, Emerald, Dysart and Moranbah.

The recommendation is based on:

- The assessment that a reliable power supply will not be able to be maintained in the inland Central Queensland area during single network contingencies from late 2004 onwards;

- the consultation undertaken by Powerlink to identify potential solutions to address these emerging network limitations;

- analysis of feasible options in accordance with the ACCC Regulatory Test;

- and publication of an 'Application Notice' containing a draft recommendation to allow comment by interested parties.

The recommended option maximises the net economic benefits to participants in the National Electricity Market. These economic benefits arise from maintaining a reliable power supply during single network contingencies at the least cost to the market and therefore to end-use customers.

3.0 REASONS AUGMENTATION IS REQUIRED

Powerlink has identified emerging limitations in the electricity network supplying inland central Queensland. This area is defined as being west of Powerlink's 275kV transmission grid, south of Collinsville and north of Biloela. It includes major mining developments in the Bowen Basin and the towns of Biloela, Moura, Blackwater, Emerald, Dysart and Moranbah.

Inland central Queensland is primarily supplied by a single 275kV transmission circuit between Broadsound and Lilyvale (50km north-east of Emerald). This is supported by a 132kV transmission network. Power can also be injected into the network in this area from a combined cycle 55MW gas turbine power station at Barcaldine.

Powerlink's planning studies have identified that, from the summer of 2004/05 onwards, emergency thermal ratings will be exceeded in the 132kV network to the south of Lilyvale during an outage of the 275kV circuit between Broadsound and Lilyvale. Analysis to support this conclusion, including load forecasts and relevant assumptions, was published in the previous consultation document "Request for Information – Emerging Network Limitations in Inland Central Queensland."[1]

Consistent with the National Electricity Code and its transmission licence requirements, Powerlink plans future network augmentations so that the reliability and power quality standards of Schedule 5.1 of the Code can be met during the worst single credible fault or contingency (N-1 conditions) unless otherwise agreed with affected participants. This is based on satisfying Powerlink's obligation "to ensure as far as technically and economically practicable that the transmission grid is operated with enough capacity (and if necessary, augmented or extended to provide enough capacity) to provide network services to persons authorised to connect to the grid or take electricity from the grid" (Electricity Act 1994, S34.2).

If no corrective action is taken, interruptions to customer supply will need to occur throughout inland central Queensland from late 2004 onwards to prevent equipment being overloaded beyond its emergency thermal ratings during a 275kV network contingency. This is not consistent with Powerlink's planning obligations, except where agreed with relevant Code participants[2]. Powerlink therefore considers action to address the emerging network limitations in inland central Queensland to be a 'reliability augmentation', as defined in the National Electricity Code[3].

The late 2004 timing conclusion was based on forecast demand growth of approximately 3.5% p.a. over the next two years. As noted in the October 2002 consultation document, this forecast did not include several new mine proposals under investigation. Ergon Energy subsequently revised the demand forecast for the inland central Queensland area upwards by 27MW based on a view that at least one uncommitted mine proposal appeared likely to be commissioned in 2004. This view has now been confirmed, with the announcement on 6 March 2003 that MIM will proceed with the development of the Rolleston open cut thermal coal mine. The large-scale mining operation, located near Blackwater, is scheduled to begin in the second half of calendar 2004, with production to ramp up over three years.

Powerlink evaluated the sensitivity of the need for augmentation to a potential 'step increase' in demand using market development scenarios (refer section 6.0). Interested parties are advised

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[1] Published 14th October 2002 - refer Powerlink's website www.powerlink.com.au

[2] Ergon Energy has agreed to implement a load management system if Barcaldine Power Station is not operating (refer previous consultation document) as an interim measure pending completion of suitable augmentation works. This agreement has been taken into account in determining the consequences of a single network contingency on the ability to maintain a reliable supply to customers.

[3] A transmission network augmentation that is necessitated solely by inability to meet the minimum network performance requirements set out in schedule 5.1 or in relevant legislation, regulations or any statutory instrument of a participating jurisdiction.

that additional demand does not change the conclusion that supply will not be able to be maintained during single 275kV network contingencies from summer 2004/05 onwards. If, however, no action is taken, the level of overloading and therefore loss of supply during network contingencies would be significantly increased.

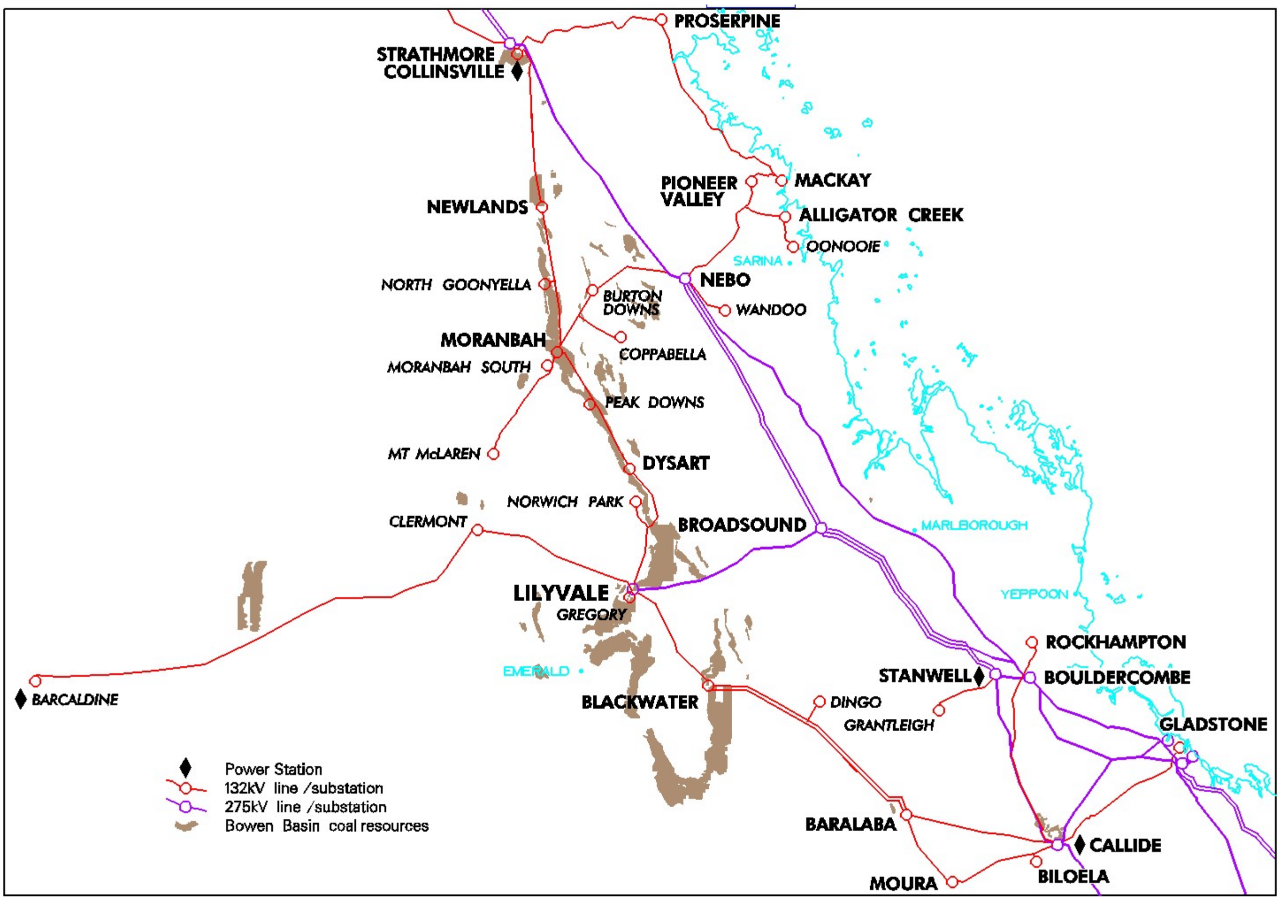

Figure 1 - Existing Supply System – Inland Central Queensland

4.0 RESPONSES TO THE 'APPLICATION NOTICE'

Powerlink issued an 'Application Notice' in accordance with Code requirements in February 2003. This Application Notice contained a draft recommendation to address the emerging network limitations. It was recommended that:

- Powerlink construct a single circuit 275kV transmission line between Broadsound and Lilyvale and associated substation works. The asset, estimated to cost $23.1M, is required to be commissioned by October 2004.

No submissions were received in response to this draft recommendation.

5.0 OPTIONS CONSIDERED

5.1 Consultation Summary

Powerlink identified in its 2001 and 2002 Annual Planning Reports[4] an expectation that action would be required in the relatively short-term to address an anticipated major network limitation related to supply to the inland Central Queensland area.

In October 2002, Powerlink issued a consultation document providing more detailed information on the emerging network limitations in inland central Queensland. This paper was the first step in meeting regulatory requirements related to proposed network augmentations. It sought information from Code Participants and interested parties regarding potential solutions to address the anticipated network limitations. Powerlink held briefings with Queensland Rail, the Queensland Mining Council and local generators in the area (Enertrade and CS Energy) prior to issuing the document to ensure their input was taken into account.

Powerlink received no submissions from interested parties by the closing date for submissions to the 'Request for Information' paper. However, three parties subsequently contacted Powerlink regarding potential coal seam methane generation projects in the area.

5.2 Non-Transmission Options Identified

5.2.1. Existing Generation

It is Powerlink's assessment that the existing generators in the area have minimal impact on the emerging network limitations[5]. Generation at Barcaldine power station has already been considered in the assessment of the capability of the transmission network. No additional information was provided by existing generators during the consultation process.

5.2.2. Demand Side Management

Powerlink's demand and energy forecasts consider all existing demand side management initiatives. No information about other initiatives was put forward during the consultation process.

5.2.3. Embedded Generation

[4] Published in July 2001 and June 2002 respectively

[5] Refer data and assumptions in previous consultation document.

An allowance for potential cogeneration and renewable energy developments embedded[6] in the distribution network in the relevant area is included in Powerlink's forecasts of energy and demand. Generation above these allowed levels would be required if local generation is to reduce demand on the transmission network and defer the need for other forms of corrective action.

During the consultation process, three parties – Ergon Energy, Envirogen and Energy Developments – contacted Powerlink to advise of proposals to establish coal seam methane generation facilities in the inland central Queensland area.

Project Status: All parties indicated that commercial and connection agreements for the proposed generation facilities have not been finalised. None of the generation proposals can therefore be considered committed.

Timing: The parties indicated that they were targeting the establishment of initial developments by mid to late 2004, with subsequent development anticipated in later years. If reliability of supply to the area is to be maintained, it is essential that the emerging network limitations are addressed by late 2004.

Location and Capacity: Much of the information regarding potential generator location and capacity was provided to Powerlink on a confidential basis. However, it is in the public domain that the development of coal seam methane generation is being considered at German Creek Coal Mine, located a relatively short distance to the north of Powerlink's Lilyvale substation. Other sites are also being considered for development.

Total[7] initial development capacity is proposed to be between 6 and 25MW by mid to late 2004. It was suggested to Powerlink during the consultation process that total coal seam methane generating capacity in the inland central Queensland area of approximately 40MW in the next three to five years would not be unrealistic. Subsequent additional expansion may be possible depending on fuel availability and economics.

The location of proposed generation has a significant impact on its ability to reduce demand on the transmission system during a 275kV network contingency. As stated in the initial consultation document, it is the 132kV network to the south of Lilyvale that is at risk of overloads during a 275kV network contingency. However, generation near Lilyvale will mainly supply local load to the north of Lilyvale during a contingency, with only a small portion of its output acting to support supply to customers to the south of Lilyvale[8]. Preliminary load flow studies by Powerlink indicate that 10MW of generation hypothetically connected directly to the Lilyvale substation[9] would reduce flows on the 132kV network to the south of Lilyvale by approximately 3-4MW during a 275kV network contingency[10].

This suggests that at least 30MW of equivalent generation would initially be required at Lilyvale to offset one year's load growth (approximately 15MW per year) in the inland central Queensland area. This is based on the June 2002 forecast published in the previous consultation document, and does not include any 'step increase' in load due to new mining developments. Significantly greater generation capacity would be required to defer further corrective action if new mining loads of 20-60MW are developed in the next few years. As noted earlier, Ergon Energy has provided Powerlink with a revised forecast that includes an additional 27MW of load in 2004/05.

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[6] An embedded generator connects directly to the low voltage distribution network. Output from such generators therefore reduces the expected energy that the transmission grid is required to deliver. Embedded generators may also reduce the demand the transmission grid is required to deliver, depending on their mode of operation.

[7] The proposals are not mutually exclusive, as there is some competition to develop the same fuel resources.

[8] This occurs due to the configuration and ratings of the individual network elements

[9] The proposals provide for the generators to be located at mine sites – the actual impact of a specific generator can only be determined once connection arrangements and generator specifications are known.

[10] Generation further south would result in a greater reduction in power flows on the relevant 132kV network elements at Calvale and between Calvale and Lilyvale.

Conclusion: As the embedded generation proposals are uncommitted projects and the proposed capacity is limited, they are not considered feasible solutions to address the emerging network limitations in inland central Queensland. If the emerging network limitations are not addressed, the reliability of supply to inland central Queensland will be reduced. It is not considered appropriate to rely on uncommitted proposals, where there is uncertainty as to whether such projects will eventuate. However, the potential impact of future embedded generation on demand to be supplied through the transmission system has been taken into account through the use of market development scenarios (see section 6.0).

5.3 Transmission Options Identified

In addition to the consultation process to identify possible non-transmission solutions, Powerlink carried out studies to determine the most appropriate transmission network solution to address the emerging limitations. Two feasible options were identified. Details are contained in the next section, and in the spreadsheets in Appendix 2.

6.0 FEASIBLE SOLUTIONS

This section provides an overview of the feasible options identified, with full details of the financial analysis contained in the spreadsheets in Appendix 2.

Option 1 – 275kV Augmentation between Broadsound and Lilyvale[11]		
Date Reqd	Augmentation	Capital Cost
Late 2004	Construct single circuit 275kV line from Broadsound to Lilyvale	$23.1M
	Other Foreseeable Augmentations	
Late 2004	Install 2x375MVA transformers at Lilyvale; remove existing transformers & utilise one as spare transformer	$6.1M
Late 2005	Install other ex-Lilyvale transformer at Nebo substation	$4.0M
Late 2011	Construct 132kV single circuit line from Lilyvale to Blackwater	$12.4M

The proposed works in option 1 include the construction of approximately 110km of single circuit 275kV transmission line between Broadsound and Lilyvale. Substation works to connect the new 275kV line would also be required at the existing Broadsound and Lilyvale substations. In option 1, commitments to construction of the network augmentation would be made in mid 2003, for completion by late 2004. The line would be constructed adjacent to the existing 275kV line, except in one short section of the easement. In this section, the design would provide for a wider separation between the existing and new line to meet mining industry requirements for 'crossing' of the easement by mining draglines.

The new line would overcome the identified emerging network limitations. An additional 275kV line provides significant additional capability to supply the inland central Queensland area during a contingency on the existing 275kV circuit.

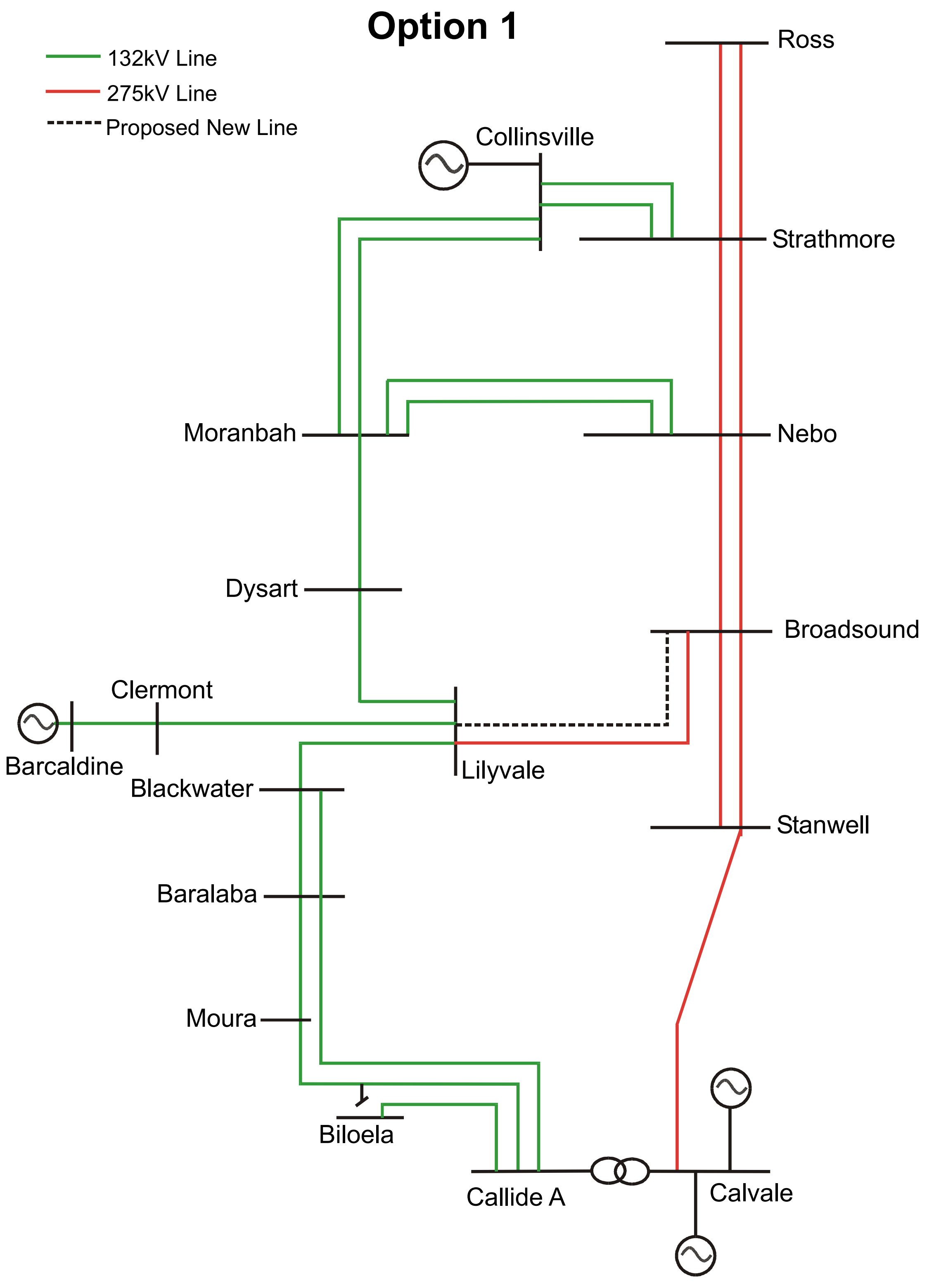
Continuing growth in electricity demand in the inland central Queensland area in accordance with the June 2002 forecasts is anticipated to require augmentation of 132kV capacity between Lilyvale and Blackwater in 2011/12. Without this augmentation, it is anticipated that long-term growth in electricity demand will cause overloads in this part of the inland central Queensland 132kV network. It is also expected that load growth will require additional 275/132kV transformer capacity at Lilyvale beyond 2008/09. Powerlink is proposing to advance this transformer augmentation to coincide with the proposed 275kV line between Broadsound and Lilyvale, by purchasing new 375MVA transformers for Lilyvale and utilising the existing 200MVA Lilyvale transformers to meet system requirements at Nebo and elsewhere[12]. The Lilyvale-Blackwater 132kV augmentation and all expenditure associated with the proposed transformer movement are included as foreseeable works in the economic analysis to ensure feasible options are compared on an equivalent basis in terms of the potential long-term development of the electricity grid[13].

[11] All timings in the table are based on the electricity demand forecasts as published in the initial consultation paper issued by Powerlink in October 2002. The financial analysis evaluates possible variations to the timings for different load growth forecasts using the market development scenarios in section 6.0.

[12] Such requirements are independent of inland central Queensland emerging network limitations. It is expected that Regulatory Test and Code requirements to address future transformer capacity needs will form part of Powerlink's 2003 Annual Planning Report due to be released in June 2003.

[13] Other works that are common to both options have not been included in the financial analysis.

Option 1 is not expected to materially impact other transmission networks within the National Electricity Market.



Option 2 – 132kV Augmentation of Network between Callide and Lilyvale[14]		
Date Reqd	Augmentation	Capital Cost
Late 2004	Install new 275/132kV transformer at Calvale	$4.7M
	Construct single circuit 132kV line from Callide to Baralaba	$13.7M
	Other Foreseeable Augmentations	
Late 2004	Purchase 2 x 250MVA transformers to meet requirements at Nebo + spare	$5.3M
	Install new transformer at Nebo	$4.0M
Late 2008	Upgrade transformer capacity at Lilyvale to 250MVA (installation of fans)	$0.2M
Late 2010	Construct single circuit 275kV line from Broadsound to Lilyvale	$23.1M
Late 2012	Install 3rd 250MVA transformer at Lilyvale	$7.1M
Late 2017	Construct 132kV single circuit line from Lilyvale to Blackwater	$12.4M

Powerlink has identified that the 132kV network to the south of Lilyvale will overload in the event of a contingency on the existing 275kV line between Broadsound and Lilyvale from late 2004 onwards. Therefore, option 2 consists of an approach where this 132kV network is upgraded to avoid such overloads.

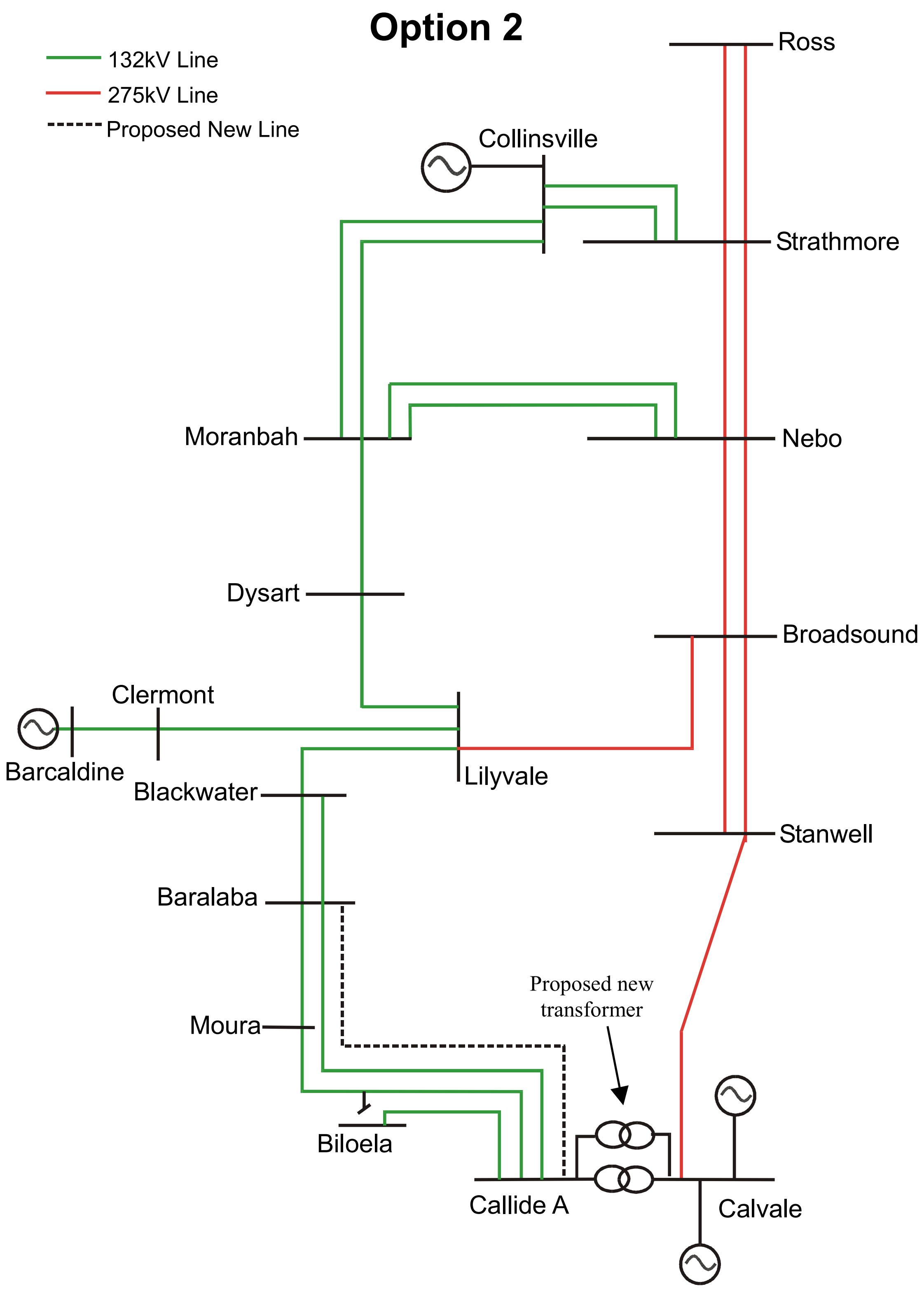
Option 2 works include the installation of a new 275/132kV transformer at Calvale and construction of 79km of new 132kV line between Callide A and Baralaba in late 2004. These works will prevent 132kV network overloads during a 275kV network contingency.

A new Calvale transformer and a new Callide – Baralaba line are capable of addressing the 132kV overloads during a 275kV contingency for approximately six years. At that time, further reinforcement to maintain a reliable power supply to customers in the relevant area will be necessary. Powerlink's assessment, based on continuing electricity demand growth in accordance with current forecasts, is that option 2 will require the construction of a 275kV circuit between Broadsound and Lilyvale in late 2010, and a new 132kV connection between Lilyvale and Blackwater in late 2017. In addition to these works, it is anticipated that augmentation of 275/132kV transformer capacity at Lilyvale substation will be required by 2008/09. In Option 2, Powerlink proposes to upgrade the capacity of the existing transformers from 200MVA to 250MVA through the installation of fans in 2008 and install a 3rd 250MVA transformer at Lilyvale in 2012[16]. As with Option 1, these long-term augmentations are included in the financial analysis as foreseeable augmentations to ensure feasible options are compared on an equivalent basis[15].

Option 2 is not expected to materially impact other transmission networks within the National Electricity Market.

[14] All timings in the above table are based on the electricity demand forecasts as published in the initial consultation paper issued by Powerlink in October 2002. The financial analysis evaluates possible variations to the timings in this 'base case' using the market development scenarios in section 6.0

[15] As noted in Option 1, works common to both options have not been included in the financial analysis.


Option 2
132kV Line
275kV Line
Proposed New Line
Ross
Collinsville
Strathmore
Moranbah
Nebo
Dysart
Broadsound
Clermont
Barcaldine
Blackwater
Lilyvale
Stanwell
Baralaba
Proposed new
transformer
Moura
Biloela
Callide A
Calvale

7.0 MARKET DEVELOPMENT SCENARIOS

7.1 Context for Evaluation of Options

All feasible solutions to the identified network constraints must be viewed in the context of wider developments in the National Electricity Market:

- NEMMCO's Statement of Opportunities (SOO) issued in July 2002 contained information on existing and committed generation developments in Queensland. There is a considerable margin between supply capacity and demand, with several large new generating units commissioned in Queensland in the past 18 months.

- The Queensland Government is proceeding with the implementation of its policy requirement for Queensland energy retailers to source 13% of their energy from gas-fired generation from 1 January 2005. The 13% Gas Scheme is designed to deliver on the government policy objectives of diversifying the State's energy mix towards a greater use of gas and encouraging new gas infrastructure in Queensland, while reducing the growth in greenhouse gas emissions. Coal seam methane is an eligible fuel source under this Scheme.

7.2 Assumed Market Development Scenarios

The ACCC Regulatory Test requires that options to address a network limitation be assessed against a number of plausible market development scenarios. These scenarios need to take account of:

- the existing system
- future network developments.
- variations in load growth
- committed generation and demand side developments
- potential generation and demand side developments

The purpose of utilising this approach is to test the Net Present Value costs of the options being evaluated under a range of plausible scenarios.

7.2.1. Existing Network and Future Transmission Developments:

No market development scenarios have been developed related to new transmission works proposed by Powerlink outside the Inland Central Queensland area. These are independent of the identified network limitations that are the subject of this report, and are considered to be common to all options analysed.

7.2.2. Variations in Load Growth:

Powerlink carries out the majority of its detailed planning using a medium economic growth, typical weather (50% probability of exceedance) forecast for electricity usage. These forecasts include all known information about existing and planned demand side initiatives, and also include independent forecasts of local embedded generation developments. However, the forecasts do not include potential new mining developments which could result in step increases in load in the area of between 20-60MW. They also, by definition, do not consider extreme temperature conditions or higher or lower rates of economic growth.

Market development scenarios have been developed to consider sensitivity to variations in load growth. The scenarios used in the analysis in this report are outlined in 6.2.5.

7.2.3. Existing and Committed Generators:

Analysis of potential solutions in this paper is not considered sensitive to the generation pattern of existing and committed generators. As outlined in the previous 'Request for Information' document, the generation output of existing generators has little impact on the power flows on the 132kV network during a 275kV network contingency[16]. For this reason, market development scenarios have not been developed to test assumptions about different operational patterns of existing and committed generators.

7.2.4. Potential Generation Developments:

Recent additional generation capacity commitments within Queensland mean that a healthy electricity supply-demand balance is anticipated over the medium term. New generation is only likely to be developed where organisations identify commercial opportunities, rather than being developed in response to load requirements.

There are no indications that large-scale generation projects will be developed in inland central Queensland. Large generation developments outside the relevant area (eg – such as proposals for major new generation in north Queensland, the Callide area or at Kogan Creek) will have minimal impact on the Inland Central Queensland area limitations, and are therefore not significant factors in this study. For these reasons, no market development scenarios have been developed to account for potential large generation developments.

As noted in section 4.2, several parties are proposing to establish relatively small scale (6-25MW) embedded generation facilities in inland central Queensland utilising coal seam methane as a fuel source. These proposals are not committed, and there remains uncertainty as to whether they will proceed. However, it is recognised that the Queensland 13% Gas Scheme and Australian Greenhouse Office initiatives may provide incentives for the development of coal seam methane generation projects.

For this reason, several market development scenarios have been developed to reflect the potential establishment of coal seam methane generators in inland central Queensland. For the purposes of these scenarios, it is assumed that these generators are connected at Lilyvale substation. It is also assumed that the full output of the generators is available to reduce demand on the transmission system at the time of local peak demand.

7.2.5. Market Development Scenarios:

Six market development scenarios have been developed to simulate the impact of variations in load growth and assumptions as outlined above:

[16] Barcaldine Power Station has been considered in the assessment of network capability as outlined in the previous consultation document. Powerlink's analysis assumed zero output from Callide A Power Station. CS Energy has advised that it plans to return Callide A Power Station to service in 2005, depending on load developments in the Central Queensland area. Powerlink's previous consultation document (based on June 2002 forecasts) noted that a return to service of Callide A Power Station prior to late 2004 may defer the required timing for corrective action by twelve months.

Scenario A	"Medium" load growth forecast – June 2002[17] No new inland central Queensland generation
Scenario B	"Medium" load growth forecast – June 2002 20MW new inland central Queensland generation in 2004
Scenario C	"Medium" load growth forecast – June 2002 20MW new inland central Queensland generation in 2004 20MW new inland central Queensland generation in 2005 20MW new inland central Queensland generation in 2006
Scenario D	"Medium Plus" load growth forecast – November 2002[18] No new inland central Queensland generation
Scenario E	"Medium Plus" load growth forecast – November 2002 20MW new inland central Queensland generation in 2004 20MW new inland central Queensland generation in 2005 20MW new inland central Queensland generation in 2006
Scenario F	High load growth forecast[19] 20MW new inland central Queensland generation in 2004

[17] Medium economic growth and typical weather as published in the previous consultation document.
[18] Medium economic growth and typical weather forecast as published in the previous consultation document plus a 27MW step increase in load in 2004. This revised forecast has been provided by Ergon Energy to reflect progress towards new mining developments in inland central Queensland. Interested parties are advised that mining developments that could increase load substantially above this revised forecast are being considered, and could occur.
[19] High economic growth and typical weather

8.0 FORMAT AND INPUTS TO ANALYSIS

8.1 Regulatory Test Requirements

The requirements for the comparison of options to address an identified network limitation are contained in the Regulatory Test prescribed by the Australian Competition and Consumer Commission (ACCC).

The Regulatory Test requires that the recommended option be the option that "maximises the net present value of the market benefit having regard to a number of alternative projects, timings and market development scenarios". To satisfy the Test, a proposed augmentation must achieve a greater market benefit in most, *but not necessarily all*, credible scenarios.

The Regulatory Test contains guidelines for the methodology to be used to calculate the net present value (NPV) of the market benefit. For example, where an augmentation is required to satisfy minimum network performance requirements (ie – a reliability augmentation), the methodology published by the ACCC defines "market benefit" as the total net cost to all those who produce, distribute and consume electricity in the National Electricity Market. That is, the option with the lowest net present value cost maximises the market benefit.

Information to be considered includes the 'efficient operating costs of competitively supplying energy to meet forecast demand' and the cost of complying with existing and anticipated laws. However, the Regulatory Test specifically excludes indirect costs, and costs that cannot be measured as a cost in terms of financial transactions in the electricity market.

8.2 Inputs to Analysis

A solution to address emerging network limitations in the Inland Central Queensland area as outlined in this document is required to satisfy reliability requirements linked to Schedule 5.1 of the National Electricity Code and the requirements of the Queensland Electricity Act[20].

According to the ACCC 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 cash flow model to determine the Net Present Value (NPV) of the various options, are shown in section 8.0.

Cost inputs to the NPV analysis are described below.

<u>8.2.1. Cost of Transmission Augmentations:</u>

The cost of the transmission augmentations outlined in the options in section 5.0 have been estimated by Powerlink. Sensitivity studies have been carried out using variations in the capital cost estimates of plus or minus 15% (see section 8.3).

The financial analysis considers all cost impacts of the proposed network augmentations to market participants as defined by regulatory processes. The estimated saving in the cost of network losses for each option has been included based on the assumption of typical load factor and an

[20] Refer section 3.0.

average cost of losses of \$25/MWh[21]. Sensitivity studies have also been carried out on the assumed cost of losses (see section 8.3).

While a solution must be adopted by late 2004 to overcome the identified network limitations, the NPV analysis contains subsequent augmentations required to address long-term supply reliability requirements. The sensitivity of the timing of these subsequent works to load growth and generation development scenarios (and therefore the incidence of the capital expenditure) has been taken into account in the financial analysis.

[21] Network losses are a function of the length and capacity of individual network elements, and the power being transferred through them. Additional network elements reduce the amount of power that must be forced through the existing network, and therefore reduce total losses.

9.0 FINANCIAL ANALYSIS

9.1 Description of Financial Analysis Approach

The economic analysis undertaken considered the net present value (NPV) of net market benefits of alternative options over the fifteen year period from 2003 to 2017. Full details of this analysis are contained in Appendix 2.

9.2 Net Present Value Analysis

Financial analysis was carried out to calculate and compare the Net Present Value (NPV) of the costs to market participants of each option under the range of assumed market development scenarios.

A fifteen 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, and sensitivity analysis was conducted to test this assumption.

Capital and operating costs for items which are common to all options were not included in the analysis. These common costs include the capital and operating costs of other future transmission works, where these costs are independent of the identified network limitations. As such, they have no impact on the relative ranking of options resulting from the analysis. Where the timing of common works is affected by the proposed options, the cost of the other works proposed has been included in the NPV analysis.

Under the Regulatory Test, it is the ranking of the options which is important, rather than the actual net present value results. This is because the Regulatory Test requires the recommended option to have the lowest net present value cost under most but not necessarily all plausible scenarios.

The following table is a summary of the economic analysis contained in Appendix 2. It shows the net present value of each alternative, and identifies the best ranked option, for the range of scenarios considered.

Discount rate 10%	**Option 1** **275kV Augmentation Broadsound to Lilyvale**		**Option 2** **132kV Augmentations south of Lilyvale**	
Scenario A Medium growth	NPV ($M) Rank	$22.79 1	NPV ($M) Rank	$24.18 2
Scenario B Medium growth. 20MW generation	NPV ($M) Rank	$22.79 1	NPV ($M) Rank	$23.13 2
Scenario C Medium growth. 20MW each year for 3 years	NPV ($M) Rank	$22.79 2	NPV ($M) Rank	$21.30 1
Scenario D Medium + growth.	NPV ($M) Rank	$23.93 1	NPV ($M) Rank	$27.38 2
Scenario E Medium + growth. 20MW each year for 3 years	NPV ($M) Rank	$23.93 1	NPV ($M) Rank	$24.07 2
Scenario F High growth. 20MW generation	NPV ($M) Rank	$24.59 1	NPV ($M) Rank	$27.49 2

9.3 Sensitivity Analysis:

In addition to examining the impact of market development scenarios, the sensitivity of the option ranking to other critical parameters was also examined.

The effect of varying these parameters over their credible range was investigated using standard Monte Carlo techniques.[22] The following table shows the parameters that were investigated in the sensitivity analysis, the distribution that was assumed for each parameter and the range of values.

Parameter	Distribution
Capital Cost of Transmission Option	The capital cost of the two options was tested for sensitivity to variations of plus or minus 15% from the expected value. The variation in each cost was modelled as a triangular distribution with the assumption that the costs are statistically independent. This means that the cost of each network component is allowed to vary within plus and minus 15% independently of the over or underspend of the other components.
Cost of losses	The sensitivity to the average cost of losses was tested by allowing this parameter to vary randomly between $20/MWh and $30/MWh using a triangular distribution with a mode of $25/MWh.

The Monte Carlo analysis assigns a value to each of the above parameters according to its distribution and then ranks the options. This simulation is done many times (in this case, 1,000 times) to cover a large number of combinations of parameters. The analysis identifies which option is the best ranked option (the option that has the lowest cost on an NPV basis for the largest number of samples) and gives the frequency for which this option 'wins'.

In addition to the above sensitivities, the sensitivity of the ranking of options to the discount rate assumption was also investigated by repeating the above analysis with a discount rate of 8%, 10% and 12%. The following table shows the 'winning option' and the frequency for which it 'wins' for each scenario and discount rate across the range of parameters assessed.

	Discount Rate		
	8%	10%	12%
Scenario A - Medium growth	1 (100%)	1 (100%)	1 (100%)
Scenario B - Medium growth. 20MW generation	1 (80%)	1 (68%)	1 (56%)
Scenario C - Medium growth. 20MW each year for 3 years	2 (98%)	2 (98%)	2 (99%)
Scenario D - Medium + growth.	1 (100%)	1 (100%)	1 (100%)
Scenario E - Medium + growth. 20MW each year for 3 years	1 (73%)	1 (57%)	2 (56%)
Scenario F - High growth. 20MW generation	1 (100%)	1 (100%)	1 (100%)

As can be seen in this table, Option 1 is the highest ranked option under the majority of scenarios. These sensitivity analysis results are consistent with the base case economic analysis, and the outcome is robust in terms of the variations in parameters assessed.

[22] Using the @Risk add-in for Microsoft Excel.

10.0 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 limitations are not addressed by late 2004, power supply will be unable to be maintained during a single 275kV contingency on the Broadsound to Lilyvale line. This situation is not consistent with reliability standards which Powerlink considers it must meet, as the Queensland transmission network service provider.

- Ergon Energy has provided Powerlink with a revised load forecast since the publication of the initial consultation document in October 2002. This forecast contains an additional 27MW of load in 2004 due to anticipated new mining developments. This anticipated 'step increase' in load will substantially increase the loss of supply during single network contingencies if no corrective action is taken. It also increases the amount of local generation or demand side initiatives required to address emerging network limitations. Ergon's revised forecast was based on a view that one or more new mining developments were likely to proceed in inland central Queensland in the near future. This view has been confirmed, with the announcement on 6 March 2003 that MIM will proceed with the development of the Rolleston open-cut mine near Blackwater by the second half of calendar 2004.

- Powerlink carried out a consultation process in late 2002. Three parties advised that they were considering embedded generation options using coal seam methane in inland central Queensland. The proposed coal seam methane generation facilities are not committed, with commercial arrangements still to be finalised. The proposed capacity for installation by 2004 is relatively small (~6-25MW) and will not be sufficient to address the emerging network limitations. Due to the uncertainty associated with these proposals, they are not considered feasible solutions to address the reliability limitations that are expected to arise in inland central Queensland by late 2004. The potential for embedded generators to reduce the demand on the transmission grid has, however, been considered in the market development scenarios used in the evaluation in this report.

- Two feasible network solutions were assessed. Economic analysis identified that Option 1 is the least-cost solution over a fifteen year period of analysis under the majority of scenarios considered. On this basis, an augmentation comprising a single circuit 275kV line from Broadsound to Lilyvale at a cost of $23.1M would satisfy the regulatory test.

- Sensitivity analysis showed that this conclusion was robust to variation in capital cost and other assumptions. Option 1 is also the highest ranked option under the majority of applicable market development scenarios.

- In addition to maximisation of benefit, the Regulatory Test requires that a transmission network service provider optimise the timing of any proposed network augmentation that is justified under the Regulatory Test. It is evident from the analysis that action is required prior to October 2004 in order to maintain a reliable power supply to customers. Any deferral of timing beyond late 2004 will result in unacceptable system reliability.

- The construction time for a network solution will require works to commence in the second quarter of 2003 to ensure completion by October 2004. Consequently, deferral of a decision to proceed with implementation of the proposed solution is not recommended.

11.0 FINAL RECOMMENDATION

Based on the conclusions drawn from the analysis, and the absence of submissions to the draft recommendation contained in the Application Notice, it is recommended that the draft recommendation be adopted without change. That is, it is recommended that the following 'new large network asset' be constructed to address the emerging transmission network limitations in inland Central Queensland:

- A single circuit 275kV transmission line between Broadsound and Lilyvale and associated substation works at Broadsound and Lilyvale at a cost of $23.1M.

Technical details relevant to this proposed new large network asset are contained in Appendix 1.

The proposed construction timetable provides for award of construction and equipment contracts in Quarter 2, 2003, commencement of on-site construction in October 2003, and commissioning by October 2004. Immediate steps will be taken to implement this recommendation.

APPENDIX 1:

TECHNICAL DETAILS OF PROPOSED NEW LARGE NETWORK ASSET

The proposed new large network asset recommended in this application notice comprises the following works:

- 110km of 275kV single circuit “sulphur” conductor transmission line from Broadsound to Lilyvale, including OPGW and one earthwire.

- Extra strain towers and part of OPGW undergrounded near Lilyvale to permit mining draglines to cross line easement without supply or communications signal interruption

- An additional diameter with two circuit breakers at Broadsound substation

- Extensions to the 275kV section of Lilyvale substation to provide a second busbar, three diameters and a four circuit breaker “mesh” switching arrangement.

New works are highlighted in the following network configuration diagram:

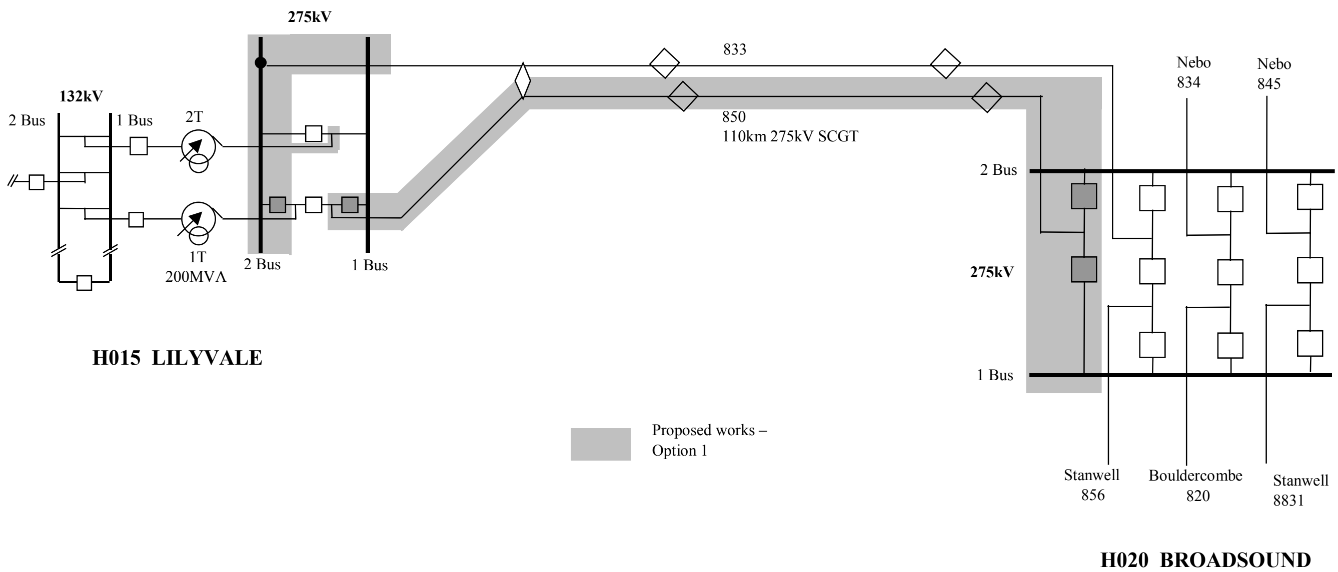


Figure 2 –
Network Configuration Diagram
Broadsound to Lilyvale 275kV Line

APPENDIX 2 - FINANCIAL ANALYSIS

Summary

Discount rate 10%	**Option 1** **275kV Augmentation Broadsound to Lilyvale**		**Option 2** **132kV Augmentations south of Lilyvale**	
Scenario A Medium growth	NPV ($M) Rank	$22.79 1	NPV ($M) Rank	$24.18 2
Scenario B Medium growth. 20MW generation	NPV ($M) Rank	$22.79 1	NPV ($M) Rank	$23.13 2
Scenario C Medium growth. 20MW each year for 3 years	NPV ($M) Rank	$22.79 2	NPV ($M) Rank	$21.30 1
Scenario D Medium + growth.	NPV ($M) Rank	$23.93 1	NPV ($M) Rank	$27.38 2
Scenario E Medium + growth. 20MW each year for 3 years	NPV ($M) Rank	$23.93 1	NPV ($M) Rank	$24.07 2
Scenario F High growth. 20MW generation	NPV ($M) Rank	$24.59 1	NPV ($M) Rank	$27.49 2

Development Options	FY	Capex $M	FY	Capex $M	FY	Capex $M	FY	Capex $M	FY	Capex $M	FY	Capex $M
	Scenario A		Scenario B		Scenario C		Scenario D		Scenario E		Scenario F	
Option 1 - 275kV Reinforcement												
275kV Line Broadsound to Lilyvale	04/05	23.14	04/05	23.14	04/05	23.14	04/05	23.14	04/05	23.14	04/05	23.14
2 x 375MVA transformers Lilyvale	04/05	6.05	04/05	6.05	04/05	6.05	04/05	6.05	04/05	6.05	04/05	6.05
Transformer movement	04/05	0.00	04/05	0.00	04/05	0.00	04/05	0.00	04/05	0.00	04/05	0.00
Nebo transformer works	05/06	4.00	05/06	4.00	05/06	4.00	05/06	4.00	05/06	4.00	05/06	4.00
Lilyvale to Blackwater 132kV Line	11/12	12.43	11/12	12.43	11/12	12.43	09/10	12.43	09/10	12.43	08/09	12.43
Option 2 - 132kV Reinforcement												
Calvale transformer	04/05	4.65	04/05	4.65	04/05	4.65	04/05	4.65	04/05	4.65	04/05	4.65
Callide A to Baralaba 132kV Line	04/05	13.65	04/05	13.65	04/05	13.65	04/05	13.65	04/05	13.65	04/05	13.65
1x250MVA; 1x375MVA transformers	04/05	5.25	04/05	5.25	04/05	5.25	04/05	5.25	04/05	5.25	04/05	5.25
Nebo transformer works	04/05	4.00	04/05	4.00	04/05	4.00	04/05	4.00	04/05	4.00	04/05	4.00
Upgrade Lilyvale transformers (fans)	08/09	0.22	10/11	0.22	13/14	0.22	07/08	0.22	10/11	0.22	07/08	0.22
275kV Line Broadsound to Lilyvale	10/11	23.14	11/12	23.14	13/14	23.14	08/09	23.14	11/12	23.14	08/09	23.14
3rd Lilyvale transformer	12/13	7.13	13/14	7.13	15/16	7.13	10/11	7.13	13/14	7.13	11/12	7.13
Lilyvale to Blackwater 132kV Line	17/18	12.43	17/18	12.43	17/18	12.43	15/16	12.43	15/16	12.43	14/15	12.43

Scenario A		Medium growth														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
Option 1		**275kV Augmentation Broadsound to Lilyvale**														
275kV Line Broadsound to Lilyvale																
=> TUOS		0.000	0.000	2.552	2.517	2.483	2.449	2.415	2.381	2.347	2.313	2.279	2.245	2.211	2.177	2.143
==> NPV of TUOS	$14.04															
2 x 375MVA transformers Lilyvale																
=> TUOS		0.000	0.000	0.667	0.658	0.649	0.640	0.631	0.623	0.614	0.605	0.596	0.587	0.578	0.569	0.560
==> NPV of TUOS	$3.67															
Transformer movement																
=> TUOS		0.000	0.600	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$0.50															
Nebo transformer works																
=> TUOS		0.00	0.00	0.00	0.44	0.44	0.43	0.42	0.42	0.41	0.406	0.400	0.394	0.388	0.382	0.376
==> NPV of TUOS	2.13															
Lilyvale to Blackwater 132kV Line																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.370	1.352	1.334	1.316	1.297	1.279
==> NPV of TUOS	$2.46															
Relative Losses																
* Losses $		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$0.00															
Total for Option 1	**$22.79**															
Option 2		**132kV Augmentations south of Lilyvale**														
Calvale transformer																
Callide A to Baralaba 132kV Line																
=> TUOS		0.000	0.000	2.017	1.991	1.964	1.937	1.910	1.883	1.856	1.829	1.802	1.775	1.748	1.722	1.695
==> NPV of TUOS	$11.10															
1x250MVA; 1x375MVA transformers																
=> TUOS		0.000	0.000	0.579	0.571	0.563	0.556	0.548	0.540	0.533	0.525	0.517	0.509	0.502	0.494	0.486
==> NPV of TUOS	$3.19															
Nebo transformer works																
=> TUOS		0.000	0.000	0.441	0.435	0.429	0.423	0.417	0.412	0.406	0.400	0.394	0.388	0.382	0.376	0.370
==> NPV of TUOS	$2.43															
Upgrade Lilyvale transformers (fans)																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.024	0.024	0.024	0.023	0.023	0.023	0.022	0.022	0.022
==> NPV of TUOS	$0.08															
275kV Line Broadsound to Lilyvale																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.552	2.517	2.483	2.449	2.415	2.381	2.347
==> NPV of TUOS	$5.59															
3rd Lilyvale transformer																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.786	0.776	0.765	0.755	0.744
==> NPV of TUOS	$1.12															
Lilyvale to Blackwater 132kV Line																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$0.00															
Relative Losses																
* Losses $		0.000	0.172	0.287	0.318	0.328	0.345	0.366	-0.094	-0.175	-0.176	-0.194	-0.205	-0.218	-0.231	-0.161
=> NPV of Losses	$0.68															
Total for Option 2	**$24.18**															

Scenario B		Medium growth. 20MW generation														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
Option 1		**275kV Augmentation Broadsound to Lilyvale**														
275kV Line Broadsound to Lilyvale																
=> TUOS		0.000	0.000	2.552	2.517	2.483	2.449	2.415	2.381	2.347	2.313	2.279	2.245	2.211	2.177	2.143
==> NPV of TUOS	$14.04															
2 x 375MVA transformers Lilyvale																
=> TUOS		0.000	0.000	0.667	0.658	0.649	0.640	0.631	0.623	0.614	0.605	0.596	0.587	0.578	0.569	0.560
==> NPV of TUOS	$3.67															
Transformer movement																
=> TUOS		0.000	0.600	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$0.50															
Nebo transformer works																
=> TUOS		0.00	0.00	0.00	0.44	0.44	0.43	0.42	0.42	0.41	0.406	0.400	0.394	0.388	0.382	0.376
==> NPV of TUOS	2.13															
Lilyvale to Blackwater 132kV Line																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.370	1.352	1.334	1.316	1.297	1.279
==> NPV of TUOS	$2.46															
Relative Losses																
* Losses $		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$0.00															
Total for Option 1	**$22.79**															
Option 2		**132kV Augmentations south of Lilyvale**														
Calvale transformer																
Callide A to Baralaba 132kV Line																
=> TUOS		0.000	0.000	2.017	1.991	1.964	1.937	1.910	1.883	1.856	1.829	1.802	1.775	1.748	1.722	1.695
==> NPV of TUOS	$11.10															
1x250MVA; 1x375MVA transformers																
=> TUOS		0.000	0.000	0.579	0.571	0.563	0.556	0.548	0.540	0.533	0.525	0.517	0.509	0.502	0.494	0.486
==> NPV of TUOS	$3.19															
Nebo transformer works																
=> TUOS		0.000	0.000	0.441	0.435	0.429	0.423	0.417	0.412	0.406	0.400	0.394	0.388	0.382	0.376	0.370
==> NPV of TUOS	$2.43															
Upgrade Lilyvale transformers (fans)																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.024	0.024	0.024	0.023	0.023	0.023	0.022
==> NPV of TUOS	$0.05															
275kV Line Broadsound to Lilyvale																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.552	2.517	2.483	2.449	2.415	2.381
==> NPV of TUOS	$4.57															
3rd Lilyvale transformer																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.786	0.776	0.765	0.755
==> NPV of TUOS	$0.86															
Lilyvale to Blackwater 132kV Line																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$0.00															
Relative Losses																
* Losses $		0.000	0.164	0.273	0.302	0.311	0.327	0.347	0.369	-0.014	-0.149	-0.184	-0.195	-0.207	-0.220	-0.153
=> NPV of Losses	$0.93															
Total for Option 2	**$23.13**															

Scenario C		Medium growth. 20MW each year for 3 years														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
Option 1		**275kV Augmentation Broadsound to Lilyvale**														
275kV Line Broadsound to Lilyvale																
=> TUOS		0.000	0.000	2.552	2.517	2.483	2.449	2.415	2.381	2.347	2.313	2.279	2.245	2.211	2.177	2.143
==> NPV of TUOS	$14.04															
2 x 375MVA transformers Lilyvale																
=> TUOS		0.000	0.000	0.667	0.658	0.649	0.640	0.631	0.623	0.614	0.605	0.596	0.587	0.578	0.569	0.560
==> NPV of TUOS	$3.67															
Transformer movement																
=> TUOS		0.000	0.600	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$0.50															
Nebo transformer works																
=> TUOS		0.00	0.00	0.00	0.44	0.44	0.43	0.42	0.42	0.41	0.406	0.400	0.394	0.388	0.382	0.376
==> NPV of TUOS	2.13															
Lilyvale to Blackwater 132kV Line																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.370	1.352	1.334	1.316	1.297	1.279
==> NPV of TUOS	$2.46															
Relative Losses																
* Losses $		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$0.00															
Total for Option 1	**$22.79**															
Option 2		**132kV Augmentations south of Lilyvale**														
Calvale transformer																
Callide A to Baralaba 132kV Line																
=> TUOS		0.000	0.000	2.017	1.991	1.964	1.937	1.910	1.883	1.856	1.829	1.802	1.775	1.748	1.722	1.695
==> NPV of TUOS	$11.10															
1x250MVA; 1x375MVA transformers																
=> TUOS		0.000	0.000	0.579	0.571	0.563	0.556	0.548	0.540	0.533	0.525	0.517	0.509	0.502	0.494	0.486
==> NPV of TUOS	$3.19															
Nebo transformer works																
=> TUOS		0.000	0.000	0.441	0.435	0.429	0.423	0.417	0.412	0.406	0.400	0.394	0.388	0.382	0.376	0.370
==> NPV of TUOS	$2.43															
Upgrade Lilyvale transformers (fans)																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.024	0.024	0.024	0.023
==> NPV of TUOS	$0.03															
275kV Line Broadsound to Lilyvale																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.552	2.517	2.483	2.449
==> NPV of TUOS	$2.78															
3rd Lilyvale transformer																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.786	0.776
==> NPV of TUOS	$0.39															
Lilyvale to Blackwater 132kV Line																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$0.00															
Relative Losses																
* Losses $		0.000	0.164	0.261	0.274	0.278	0.293	0.311	0.330	0.453	0.515	0.023	-0.150	-0.179	-0.196	-0.137
=> NPV of Losses	$1.38															
Total for Option 2	**$21.30**															

Scenario D		Medium + growth.														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		03/04	**04/05**	**05/06**	**06/07**	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**	**17/18**
Option 1		**275kV Augmentation Broadsound to Lilyvale**														
275kV Line Broadsound to Lilyvale																
=> TUOS		0.000	0.000	2.552	2.517	2.483	2.449	2.415	2.381	2.347	2.313	2.279	2.245	2.211	2.177	2.143
==> NPV of TUOS	$14.04															
2 x 375MVA transformers Lilyvale																
=> TUOS		0.000	0.000	0.667	0.658	0.649	0.640	0.631	0.623	0.614	0.605	0.596	0.587	0.578	0.569	0.560
==> NPV of TUOS	$3.67															
Transformer movement																
=> TUOS		0.000	0.600	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$0.50															
Nebo transformer works																
=> TUOS		0.00	0.00	0.00	0.44	0.44	0.43	0.42	0.42	0.41	0.406	0.400	0.394	0.388	0.382	0.376
==> NPV of TUOS	2.13															
Lilyvale to Blackwater 132kV Line																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.370	1.352	1.334	1.316	1.297	1.279	1.261	1.243
==> NPV of TUOS	$3.60															
Relative Losses																
* Losses $		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$0.00															
Total for Option 1	**$23.93**															
Option 2		**132kV Augmentations south of Lilyvale**														
Calvale transformer																
Callide A to Baralaba 132kV Line																
=> TUOS		0.000	0.000	2.017	1.991	1.964	1.937	1.910	1.883	1.856	1.829	1.802	1.775	1.748	1.722	1.695
==> NPV of TUOS	$11.10															
1x250MVA; 1x375MVA transformers																
=> TUOS		0.000	0.000	0.579	0.571	0.563	0.556	0.548	0.540	0.533	0.525	0.517	0.509	0.502	0.494	0.486
==> NPV of TUOS	$3.19															
Nebo transformer works																
=> TUOS		0.000	0.000	0.441	0.435	0.429	0.423	0.417	0.412	0.406	0.400	0.394	0.388	0.382	0.376	0.370
==> NPV of TUOS	$2.43															
Upgrade Lilyvale transformers (fans)																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.024	0.024	0.024	0.023	0.023	0.023	0.022	0.022	0.022	0.021
==> NPV of TUOS	$0.09															
275kV Line Broadsound to Lilyvale																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	2.552	2.517	2.483	2.449	2.415	2.381	2.347	2.313	2.279
==> NPV of TUOS	$7.92															
3rd Lilyvale transformer																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.786	0.776	0.765	0.755	0.744	0.734	0.723
==> NPV of TUOS	$1.72															
Lilyvale to Blackwater 132kV Line																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.370	1.352
==> NPV of TUOS	$0.68															
Relative Losses																
* Losses $		0.000	0.193	0.321	0.355	0.376	-0.090	-0.172	-0.168	-0.183	-0.194	-0.206	-0.219	-0.154	-0.137	-0.146
=> NPV of Losses	$0.25															
Total for Option 2	**$27.38**															

Scenario E		Medium + growth. 20MW each year for 3 years														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
Option 1		**275kV Augmentation Broadsound to Lilyvale**														
275kV Line Broadsound to Lilyvale																
=> TUOS		0.000	0.000	2.552	2.517	2.483	2.449	2.415	2.381	2.347	2.313	2.279	2.245	2.211	2.177	2.143
==> NPV of TUOS	$14.04															
2 x 375MVA transformers Lilyvale																
=> TUOS		0.000	0.000	0.667	0.658	0.649	0.640	0.631	0.623	0.614	0.605	0.596	0.587	0.578	0.569	0.560
==> NPV of TUOS	$3.67															
Transformer movement																
=> TUOS		0.000	0.600	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$0.50															
Nebo transformer works																
=> TUOS		0.00	0.00	0.00	0.44	0.44	0.43	0.42	0.42	0.41	0.406	0.400	0.394	0.388	0.382	0.376
==> NPV of TUOS	2.13															
Lilyvale to Blackwater 132kV Line																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.370	1.352	1.334	1.316	1.297	1.279	1.261	1.243
==> NPV of TUOS	$3.60															
Relative Losses																
* Losses $		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$0.00															
Total for Option 1	**$23.93**															
Option 2		**132kV Augmentations south of Lilyvale**														
Calvale transformer																
Callide A to Baralaba 132kV Line																
=> TUOS		0.000	0.000	2.017	1.991	1.964	1.937	1.910	1.883	1.856	1.829	1.802	1.775	1.748	1.722	1.695
==> NPV of TUOS	$11.10															
1x250MVA; 1x375MVA transformers																
=> TUOS		0.000	0.000	0.579	0.571	0.563	0.556	0.548	0.540	0.533	0.525	0.517	0.509	0.502	0.494	0.486
==> NPV of TUOS	$3.19															
Nebo transformer works																
=> TUOS		0.000	0.000	0.441	0.435	0.429	0.423	0.417	0.412	0.406	0.400	0.394	0.388	0.382	0.376	0.370
==> NPV of TUOS	$2.43															
Upgrade Lilyvale transformers (fans)																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.024	0.024	0.024	0.023	0.023	0.023	0.022
==> NPV of TUOS	$0.05															
275kV Line Broadsound to Lilyvale																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.552	2.517	2.483	2.449	2.415	2.381
==> NPV of TUOS	$4.57															
3rd Lilyvale transformer																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.786	0.776	0.765	0.755
==> NPV of TUOS	$0.86															
Lilyvale to Blackwater 132kV Line																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.370	1.352
==> NPV of TUOS	$0.68															
Relative Losses																
* Losses $		0.000	0.174	0.289	0.319	0.338	0.359	0.461	0.515	0.020	-0.155	-0.172	-0.186	-0.136	-0.124	-0.131
=> NPV of Losses	$1.19															
Total for Option 2	**$24.07**															

Scenario F		High growth. 20MW generation														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
Option 1		**275kV Augmentation Broadsound to Lilyvale**														
275kV Line Broadsound to Lilyvale																
=> TUOS		0.000	0.000	2.552	2.517	2.483	2.449	2.415	2.381	2.347	2.313	2.279	2.245	2.211	2.177	2.143
==> NPV of TUOS	$14.04															
2 x 375MVA transformers Lilyvale																
=> TUOS		0.000	0.000	0.667	0.658	0.649	0.640	0.631	0.623	0.614	0.605	0.596	0.587	0.578	0.569	0.560
==> NPV of TUOS	$3.67															
Transformer movement																
=> TUOS		0.000	0.600	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$0.50															
Nebo transformer works																
=> TUOS		0.00	0.00	0.00	0.44	0.44	0.43	0.42	0.42	0.41	0.406	0.400	0.394	0.388	0.382	0.376
==> NPV of TUOS	2.13															
Lilyvale to Blackwater 132kV Line																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	1.370	1.352	1.334	1.316	1.297	1.279	1.261	1.243	1.224
==> NPV of TUOS	$4.25															
Relative Losses																
* Losses $		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$0.00															
Total for Option 1	**$24.59**															
Option 2		**132kV Augmentations south of Lilyvale**														
Calvale transformer																
Callide A to Baralaba 132kV Line																
=> TUOS		0.000	0.000	2.017	1.991	1.964	1.937	1.910	1.883	1.856	1.829	1.802	1.775	1.748	1.722	1.695
==> NPV of TUOS	$11.10															
1x250MVA; 1x375MVA transformers																
=> TUOS		0.000	0.000	0.579	0.571	0.563	0.556	0.548	0.540	0.533	0.525	0.517	0.509	0.502	0.494	0.486
==> NPV of TUOS	$3.19															
Nebo transformer works																
=> TUOS		0.000	0.000	0.441	0.435	0.429	0.423	0.417	0.412	0.406	0.400	0.394	0.388	0.382	0.376	0.370
==> NPV of TUOS	$2.43															
Upgrade Lilyvale transformers (fans)																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.024	0.024	0.024	0.023	0.023	0.023	0.022	0.022	0.022	0.021
==> NPV of TUOS	$0.09															
275kV Line Broadsound to Lilyvale																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	2.552	2.517	2.483	2.449	2.415	2.381	2.347	2.313	2.279
==> NPV of TUOS	$7.92															
3rd Lilyvale transformer																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.786	0.776	0.765	0.755	0.744	0.734
==> NPV of TUOS	$1.41															
Lilyvale to Blackwater 132kV Line																
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.370	1.352	1.334
==> NPV of TUOS	$1.07															
Relative Losses																
* Losses $		0.000	0.183	0.297	0.321	0.347	-0.009	-0.143	-0.154	-0.172	-0.188	-0.204	-0.145	-0.132	-0.143	-0.155
=> NPV of Losses	$0.28															
Total for Option 2	**$27.49**															