ElectraNet SA
electricity transmission network

FINAL REPORT

Proposed New Large Network Asset

South Eastern South Australia Region

ElectraNet SA
21 November 2003

Disclaimer

While care was taken in preparation of the information in this paper, and it is provided in good faith, ElectraNet SA accepts no responsibility or liability for any loss or damage that may be incurred by any person acting in reliance on this information or assumptions drawn from it. This Final Report has been prepared in accordance with clause 5.6.6 of the NEC for the purpose of consulting with Code participants and interested parties regarding the proposed new large network asset. The document has been prepared with consideration for pertinent information provided by a number of third parties. It contains assumptions regarding, among other things, economic growth and load forecasts that, by their nature, may or may not prove to be correct. All information and underlying assumptions should be independently verified to the extent possible before assessing any alternative investment proposals.

1.0 EXECUTIVE SUMMARY

ElectraNet SA has identified emerging limitations in the 132 kV electricity transmission network supplying the lower south-east region of South Australia. This area includes the towns of Millicent, Snuggery, and Mount Gambier. A significant portion of the electrical load in the region (about 40%) is due to a single tissue and paper manufacturing customer situated adjacent to ElectraNet SA's Snuggery substation and about 10 kilometres from Millicent. The remainder of the load comprises domestic, commercial, light industrial, and rural loads. Land usage in the region is devoted largely to forestry plantation (to support the local timber industry), farming, and progressively, to the establishment of vineyards.

Primary 132 kV supply to the region is provided from South East 275/132 kV substation via the double circuit 275 kV transmission line connecting Tailem Bend, in South Australia to Heywood substation, in Victoria.

Technical studies have identified that the most onerous contingency for this 132 kV network is an outage of the South East-Mount Gambier 132 kV line. When this line is out of service, the 275/132 kV network injection at South East substation can no longer directly supply Mount Gambier and Blanche substations, instead requiring these connection points to be supplied through the Keith-Snuggery 132 kV line. Should this outage occur during a period of high demand, the loading on the Keith-Snuggery 132 kV line will exceed the line's thermal emergency rating, 132 kV voltage levels at Blanche and Mount Gambier will fall to unsustainable levels, and ultimately, voltage collapse will occur.

ElectraNet SA has determined that, without corrective action, the capability of its 132 kV transmission network supplying the south-east region of South Australia will be exceeded during worst case single contingency conditions from the summer of 2003/04 onwards. ElectraNet SA is required to use its best endeavours to overcome this limitation within 12 months and, in any case, within 3 years, to meet the standards of the SA Transmission Code, and must also meet the technical requirements of the National Electricity Code. Although ElectraNet SA presently has a transmission support contract in place with the Snuggery generators for the provision of transmission support to cover such contingencies, the generators are now no longer capable of providing sufficient back-up during this contingency due to the growing loads in the area.

ElectraNet SA has identified two feasible reinforcement options that will address these network limitations:

Option 1: Construct a 132 kV transmission line from South East 275/132 kV substation to Snuggery substation, and subsequently;

Install a 3rd 275/132 kV transformer at South East substation by late 2006, and three 15 Mvar 132kV capacitor banks, one each by late 2008, 2013, and 2018, respectively, at Blanche substation.

Option 2: Construct a 275 kV transmission line from South East substation to Snuggery substation, and establish a new 275/132 kV substation adjacent the existing Snuggery substation, and subsequently;

Install an additional 132 kV capacitor bank at Blanche by late 2018.

ElectraNet SA has carried out consultation with interested parties to identify feasible non-transmission alternatives to address the emerging network limitations. This was done by way of two documents, titled "Request for Information – Emerging Transmission Network Limitations, South Eastern South Australia Region", and "Application Notice – Proposed New Large Network Asset, South Eastern South Australia Region", in accordance with the requirements of Clause 5.6.6 of the National Electricity Code. These two documents were published on ElectraNet SA's website at *www.electranet.com.au/news/* in December 2002 and August 2003, with closing dates for submissions of 31st January 2003 and 18th September 2003, respectively.

Having followed due process stipulated by Code requirements to ensure that feasible non-transmission solutions have been properly considered, ElectraNet SA has subjected the two network reinforcement options that it has identified to the ACCC's Regulatory Test for *reliability augmentations*, as is the case for the emerging limitations in the south-eastern South Australia transmission network. (This test requires that the recommended option be the option with the *"lowest net present value cost under the majority of market development scenarios considered"*.) This Regulatory Test identifies Option 1 as the least-cost solution for all of the scenarios considered, over the fifteen-year analysis timeframe. Furthermore, sensitivity analysis shows this result to be robust under a range of assumptions.

Consequently, a draft recommendation to implement Option 1 to address the identified network limitations in the south-eastern region of South Australia was published as an 'Application Notice' in August 2003. The proposed new large network asset is:

- A single circuit 132 kV transmission line between South East substation and Snuggery substation, and associated substation works. The asset, estimated to cost $15.1M, is required to be commissioned by late 2004.

- In addition to this new line, Option 1 also involves the installation of a third 275/132 kV transformer at South East substation by late 2006, and three additional 15 Mvar 132 kV capacitor banks in the years 2008, 2013, and 2018, respectively, at Blanche substation. While the $15.1M cost to construct the 132 kV line does not include the costs associated with these subsequent projects, the supporting economic analysis for the previously published Application Notice, and for this Final Report, does include these additional costs since the economic analysis is required to span a 15-year period. Necessary consultation for each of the additional projects mentioned will be conducted nearer to their time of implementation.

Two submissions were received in response to the draft recommendation. A brief summary of the submissions follows, with more detailed discussion provided in section 4.0 of this report.

The first submission was from the Electricity Supply Industry Planning Council (ESIPC), which was established by the Government of South Australia to provide expert advice in relation to the performance, future capacity, and reliability of South Australia's power system.

The Planning Council supports the proposal in principle, and further advises that it foresees the lower south east transmission network being augmented at some time in the future, by additional circuits at 132 kV and/or 275 kV following completion of the proposed line, and as such, recommends that it would be prudent transmission network planning that ElectraNet make provision for the future need to construct and route additional transmission lines in the South East, particularly in the vicinity of the South East substation switchyard. The Planning Council also suggests that easement negotiations be such that the proposed corridor width (either initially or as an option to widen) be able to facilitate installation of a future second circuit (overhead construction to 275 kV), initial utilisation of the corridor should be such as to accommodate installing a future parallel circuit, either wholly or in part, over the easement length, and that line design parameters for the proposed line should be determined so as to facilitate construction/installation of a second circuit (to 275 kV), either wholly or in part, on the proposed easement corridor.

Although ElectraNet SA acknowledges and agrees with the recommendations presented by the Planning Council, there is considerable risk that the Regulator will not allow the additional expense involved in adopting the recommendations as a prudent investment in ElectraNet's regulated asset base. Furthermore, adoption of the recommendations would not be consistent with the outcome from the ACCC Regulatory Test for reliability augmentations, which states that the least cost solution is considered to satisfy the Regulatory Test. As a consequence, these recommendations have not been considered further.

The second submission was from Synergen (International Power), the owners of Snuggery Power Station. Synergen proposed that the existing capacity of Snuggery Power Station, together with committed and potential wind-farm developments proposed for the area, would be sufficient to support existing loads and future load growth in the area, and that no substantial modification to the existing transmission infrastructure would be required. However, studies performed by ElectraNet SA as part of its initial analysis of the situation confirmed that such an arrangement would not satisfy the requirements of the SA Transmission Code in relation to the transmission network supplying the south-east region of South Australia. Following a meeting between Synergen and ElectraNet SA, Synergen "acknowledged that ElectraNet's analysis has indicated a different outcome to Synergen's assertions".

Although ElectraNet SA respects their intent, it considers that neither submission can justifiably change the outcome of the draft recommendation, and ElectraNet SA has therefore adopted this 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 the lower south-east region of South Australia.

The recommendation is based on:

- identification of an emerging network limitation in the south-east of South Australia during worst case single network contingencies from late 2003 onwards;
- the consultation undertaken by ElectraNet SA to identify potential non-transmission solutions to address these emerging network limitations,
- an analysis of feasible options in accordance with the ACCC's Regulatory Test;
- the assessment that a major network augmentation is necessary by late 2004 to maintain a reliable supply to customers, and;
- the publication of an 'Application Notice' containing a draft recommendation.

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

The south-east region of South Australia is supplied by a 132 kV network loop that extends some 200 kilometres from Keith, in the north to Mount Gambier in the south (refer Figure 1).

Primary supply to the 132 kV network is provided by 275/132 kV injection at South East substation, about 10 kilometres north of Mount Gambier, with secondary supply provided via the 132 kV network north of Keith. Two 48 MW combined cycle gas-turbine generators located at Penola West, about 40 km north of South East substation, and three 18.5 MW distillate generators at Snuggery, supplement supply to the 132 kV network.

ElectraNet SA's planning studies have identified that, from the summer of 2003/04 onwards, thermal ratings will be exceeded in the Keith-Snuggery 132 kV line during an outage of the South East-Mount Gambier 132 kV line at periods of high demand, and that this would be accompanied by 132 kV voltage levels at Blanche and Mount Gambier falling to unsustainable levels, ultimately leading to voltage collapse. Analysis to support this conclusion, including load forecasts and relevant assumptions, was published in the previous consultation document "Request for Information – Emerging Transmission Network Limitations, South Eastern South Australia Region"[1].

This means that ElectraNet SA will no longer comply with South Australian Transmission Code reliability standards at these connection points.

If no corrective action is taken, interruptions to customer supply would need to occur throughout south-eastern South Australia from late 2003 onwards to prevent equipment being overloaded beyond its emergency thermal ratings during a worst case 132 kV network contingency.

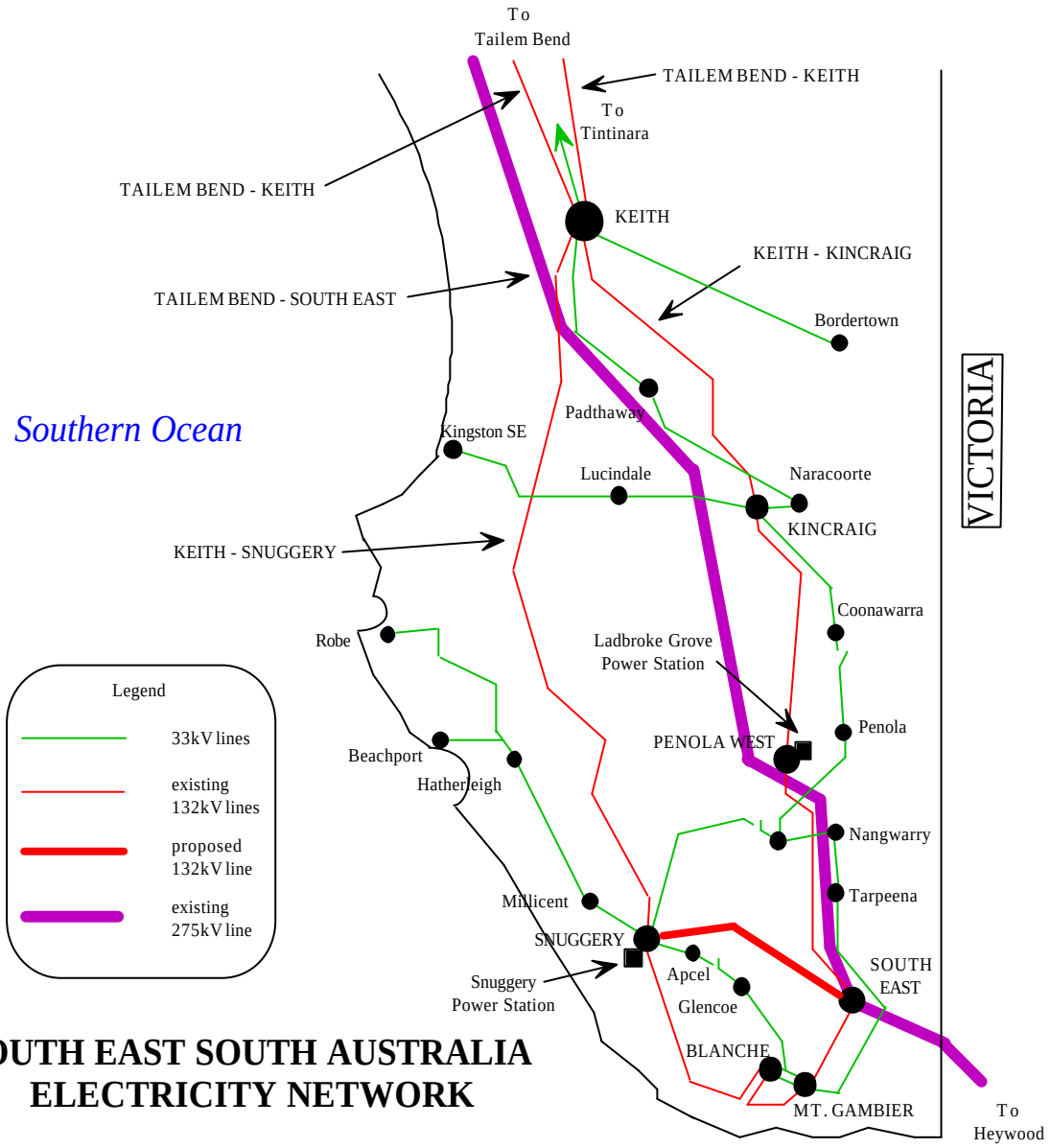
ElectraNet SA considers, therefore, that the new large network asset proposed to address the emerging network limitations in south-eastern South Australia is a 'reliability augmentation', as defined in the National Electricity Code[2].

The late 2003 timing conclusion was based on forecast demand growth at approximately 3.9% per annum in the short term. As noted in the December 2002 and August 2003 consultation documents, the load in the south-east is dominated by a single, large, relatively constant manufacturing load which accounts for about 40% of the total load in the region. This manufacturing load is soon to increase by approximately 25%. By excluding this manufacturing load from the calculation, it can be shown that the underlying load growth in the region is approximately 5.0% per annum. Demand forecasts issued by ETSA Utilities (South Australia's Distribution Network Service Provider, or DNSP) for the connection points supplied by the south-east 132 kV network suggest that load growth will settle to a rate of just over 2.5% per annum in the medium term.

ElectraNet SA evaluated the sensitivity of the need for augmentation to different demand growth rates using 'market development scenarios' (refer section 7.0 of this document). This analysis also supports the need for the proposed large network augmentation.

1 Published 16th December 2002 – refer ElectraNet SA's website *www.electranet.com.au*

2 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.



SOUTH EAST SOUTH AUSTRALIA ELECTRICITY NETWORK

FIGURE 1

4.0 RESPONSES TO THE 'APPLICATION NOTICE'

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

- A single circuit 132 kV transmission line between South East substation and Snuggery substation, and associated substation works. The asset, estimated to cost $15.1M, is required to be commissioned by late 2004.

- In addition to this new line, Option 1 also involves the installation of a third 275/132 kV transformer at South East substation by late 2006 and three additional 15 Mvar 132 kV capacitor banks to be installed in the years 2008, 2013, and 2018, respectively, at Blanche substation.

Two submissions were received in response to this draft recommendation.

4.1 Submission Received

4.1.1 Electricity Supply Industry Planning Council (ESIPC)

The first of the two submissions received was from the ESIPC, which was established by the Government of South Australia to provide expert advice in relation to the performance, future capacity, and reliability of South Australia's power system.

The ESIPC supports the proposal to build a transmission line between South East and Snuggery substations, and offers the following advice on aspects associated with the physical implementation of the proposed South East-Snuggery 132 kV transmission line:

"...all existing trends indicate that overall electricity demand will continue to increase. There are presently no commercially viable alternatives for servicing customer demands that materially alters the present technology of power transport utilising high voltage transmission networks. The Planning Council foresees the lower South East transmission networks being augmented at some time in the future, by additional circuits at 132 kV and/or 275 kV following completion of the proposed line. Consequently the Planning Council believes it would be prudent transmission network planning that ElectraNet SA consider at this stage and, as appropriate, make provision for the future need to construct and route additional transmission lines in the South East, particularly in the vicinity of the South East substation switchyard.

... The proposed line will create a new transport corridor physically (and electrically) between South East and Snuggery switchyards. The Planning Council foresees that this corridor may also be able to meet the physical needs, either wholly or in part, of possible future transmission circuits. The Planning Council therefore advises and recommends that:

a) easement negotiations be such that the proposed corridor width (either initially or as an option to widen) be able to facilitate installation of a future second circuit (overhead construction to 275 kV);

b) initial utilisation of the corridor should be such as to accommodate installing a future prarllel circuit, either wholly or in part, over the easement length;

c) line design parameters for the proposed line should be determined so as to facilitate construction/installation of a second circuit (to 275 kV), either wholly or in part, on the proposed easement corridor."

ElectraNet SA supports the long-term strategic view presented by the ESIPC. ElectraNet agrees that there can be long-term benefits in designing and constructing high capacity 275 kV lines, and has evaluated a 275 kV option in the Application Notice.

From an economic perspective, ElectraNet SA must develop its network in accordance with the existing ACCC regulatory framework. Any development must represent a prudent investment and pass the ACCC Regulatory Test before inclusion in ElectraNet's regulated asset base. This report shows that the option of building a line between South East and Snuggery substations at 275 kV would cost in the order of $6M more than the recommended option, and this is not justifiable under the ACCC Regulatory Test.

Notwithstanding the above comments, ElectraNet SA will endeavour to acquire an easement of sufficient width to accommodate an additional 132 kV circuit and/or an upgrade from 132 kV to 275 kV voltage levels where the opportunity presents itself along the proposed line route. Specific attention will be given to this pursuit in the vicinity of the two terminating substations.

4.1.2 Synergen (International Power)

Generation at Snuggery Substation

Synergen has expressed the view that the existing capacity of Snuggery Power Station, together with committed and potential wind-farm developments, would be sufficient to support existing and future load growth in the South East Region of South Australia using the existing transmission infrastructure. ElectraNet SA does not support these views for the following reasons:

The SA Transmission Code defines the Mount Gambier, Blanche and Snuggery Connection Points as Category 3 loads. This classification requires that ElectraNet SA provide sufficient N-1 line capacity to support the Agreed Maximum Demand (AMD) at each of these Connection Points. Presently, ElectraNet SA can only provide N-1 line capacity of approximately 80 MW for the total combined load of the three Connection Points in the event of the most critical contingency for this system (an outage of the Mt Gambier-South East substation 132 kV line). This level of N-1 capacity includes (relies on) full real-power generation dispatch (3x18.5 MW) from Snuggery Power Station. However, the combined AMD for the Mount Gambier, Blanche and Snuggery Connection Points for the summer of 2003/04, obtained by adding the undiversified peak load forecast supplied by ETSA Utilities for each of the three Connection Points, is in the order of 128 MW. From these two figures it can be seen that the N-1 line capacity shortfall for the approaching summer is approximately 50 MW (80 MW – 128 MW), and this capacity shortfall is expected to grow at approximately 6-8 MW per annum based on load forecasts provided by ETSA Utilities.

Although Lake Bonney Wind-Farm Stage 1 has recently assumed 'committed status', studies involving projected wind-farm power output levels (based on information provided by Babcock Brown Wind Power) indicate that sufficient real power levels to meet the existing or future shortfalls in N-1 line capacity cannot be guaranteed from the wind-farm. Furthermore, with respect to the establishment of additional wind generation, we confirm that Lake Bonney Wind-Farm Stage 1 will use most of the available 132 kV transmission capacity in the South East Region. However, if significant variations to the technical requirements of NEC S5.2 for generators are approved by NEMMCO, it may be possible to connect some additional wind generation in this region without the need for further network capacity reinforcement.

Voltage Regulation at Blanche Substation

ElectraNet SA recognises that Snuggery Power Station currently provides reactive power services to the NEM and confirms that dispatch for this service is a matter for NEMMCo as it assumed responsibility for voltage control on 1 April 2003.

ElectraNet SA and ETSA Utilities have recently completed an 18-month programme to install under-voltage load-shedding controls at Mount Gambier, Blanche and Snuggery substations. These controls will prevent potential System Security violations under N-1 operating conditions and will inherently reduce the need for Snuggery Power Station to run as synchronous condensers under system normal operating conditions. However, ElectraNet SA is of the view that real and reactive support services from Snuggery Power Station will continue to be required under a range of

contingency operating conditions until the South East - Snuggery 132 kV transmission line is established.

Summary

In summary, ElectraNet SA confirms that the existing capacity of Snuggery Power Station, supplemented by wind-farm output from committed wind farm projects, will not satisfy the requirements of the SA Transmission Code in relation to the South East Region of South Australia.

5.0 OPTIONS CONSIDERED

5.1 Consultation Summary

The 2003 Annual Planning Report[3] identified that action would be required in the relatively short term to address an impending network limitation related to supply to the south-east region of South Australia.

In December 2002 ElectraNet SA issued a consultation paper providing more detailed information on the emerging network limitations in the south-eastern region of South Australia. This paper sought information from Code Participants and interested parties regarding potential solutions to address the anticipated network limitations.

ElectraNet SA did not receive any submissions in response to this paper.

5.2 Non-Transmission Options Identified

5.2.1 Existing and New Generation

It is ElectraNet SA's assessment that the existing generators in the area have minimal impact on the emerging network limitations[4]. Increased generation at Snuggery has been considered by ElectraNet SA in the assessment of the capability of the transmission network, but this has been shown to have marginal impact due to the high impedances of adjacent transmission lines and the lack of reactive support at Blanche and/or Mount Gambier substations. No additional information was provided by existing generators during the consultation process.

5.2.2 Demand Side Management

ElectraNet SA obtains electricity demand forecasts over a ten-year horizon from ETSA Utilities. ETSA Utilities confirms that these forecasts take into account demand management programmes in-place or proposed that may reduce the forecast demand at transmission connection points. No information about other initiatives was put forward during the consultation process.

5.2.3 Embedded Generation

As with demand side management programmes, ETSA Utilities electricity demand forecasts take account of embedded[5] generation, either in-place or proposed, that may similarly reduce the forecast demand at transmission connection points. Again, no information about other initiatives was provided during the consultation process.

5.3 Transmission Options Identified

In addition to the consultation process to identify possible non-transmission solutions, ElectraNet SA carried out studies to determine the most appropriate transmission network solution to address the emerging limitations. Two feasible options were identified, details of which are contained in the next section.

3 Published in June 2003.
4 Refer to the data and assumptions provided in the previous consultation document.
5 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.

6.0 FEASIBLE SOLUTIONS

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

Option 1 - 132 kV augmentation between South East substation and Snuggery substation[6]		
Date reqd.	Proposed Augmentation	Capital cost
Late 2004	Construct a single circuit 132 kV transmission line from South East substation to Snuggery substation	$15.1M
	Anticipated Future Augmentation	
...then, in late 2006	*Install a third 275/132 kV transformer at South East substation*	*$7.4M*
*...then, in late 2008**	*Install a 15 Mvar 132 kV capacitor bank at Blanche substation*	*$1.1M*
*...then, in late 2013**	*Install an additional 15 Mvar 132 kV capacitor bank at Blanche substation*	*$1.1M*
*...then, in late 2018**	*Install a third 15 Mvar 132 kV capacitor bank at Blanche substation*	*$1.1M*

** Timing of the capacitor installations will depend on the rate of load growth. Dates shown above reflect the high load growth scenarios. Timings used for medium and low growth rates are detailed in Appendix 2.*

The proposed works for Option 1 include the construction of 43 kilometres of single circuit 132 kV transmission line between South East and Snuggery substations. Substation work will also be required at both of the substations to connect the new 132 kV line. This essentially entails the installation of an additional 132 kV circuit breaker in the existing mesh-bus arrangement at each of the substations. The preferred route for the proposed transmission line has been selected such that the line will traverse access roadways through pine plantations or be co-located with existing roadways for most of its length.

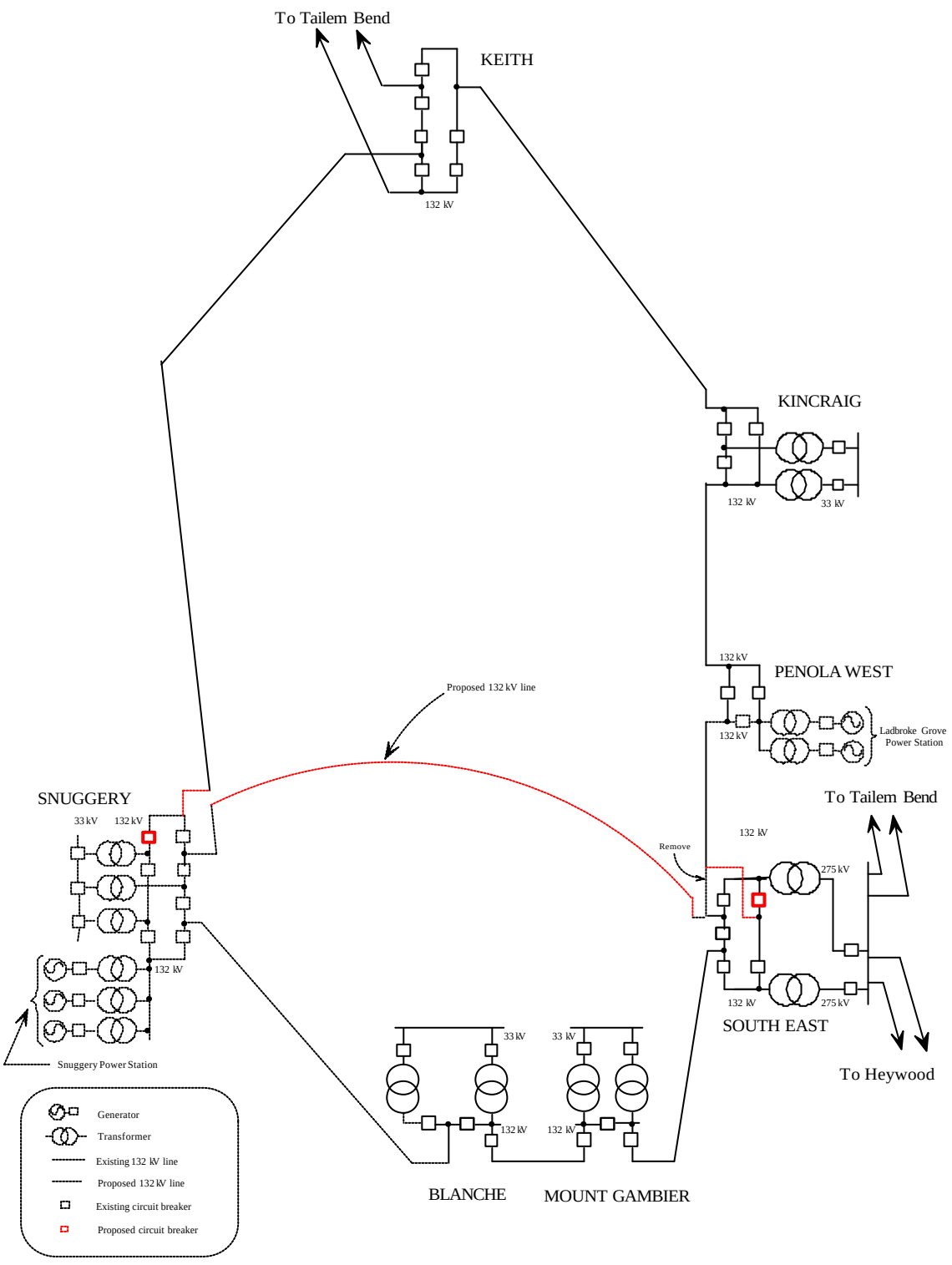
Establishing the new line will effectively eliminate loss of supply at the Snuggery, Blanche and Mount Gambier connection points in the event of a single line contingency on either the South East-Mount Gambier or Mount Gambier-Blanche circuits, therefore overcoming the identified network limitations.

6 The timing of the augmentation is based on the electricity demand forecast as published in the initial consultation paper issued by ElectraNet SA in December 2002. The financial analysis evaluates possible variations to the timings for different load growth forecasts using the market development scenarios in section 7.0.

The financial analysis includes the costs of installing a third transformer at South East substation, and the subsequent installation of three capacitor banks in progressive years, to enable an equitable comparison of the economic benefits with Option 2. These later projects will be the subject of future consultation before they proceed. However, the actual cost of this project excludes these additional costs.

Planning studies show that this option will not materially impact other transmission networks within the National Electricity Market.

Option 1


To Tailem Bend
KEITH
132 kV
KINCRAIG
132 kV
33 kV
132 kV
PENOLA WEST
132 kV
Ladbroke Grove
Power Station
Proposed 132 kV line
SNUGGERY
33 kV
132 kV
132 kV
Snuggery Power Station
Remove
To Tailem Bend
132 kV
275 kV
132 kV
275 kV
SOUTH EAST
To Heywood
33 kV
33 kV
132 kV
132 kV
BLANCHE
MOUNT GAMBIER
Generator
Transformer
Existing 132 kV line
Proposed 132 kV line
Existing circuit breaker
Proposed circuit breaker

Option 2 - 275 kV augmentation between South East substation and Snuggery substation[7]		
Date reqd.	Proposed Augmentation	Capital cost
Late 2004	Construct a single circuit 275 kV transmission line from South East substation to Snuggery substation, and establish a 275/132 kV substation adjacent the existing substation at Snuggery	$30.3M
*...then, in late 2018**	*Install a 15 Mvar 132 kV capacitor bank at Blanche substation*	*$1.1M*

** Timing of the capacitor installation will depend on the rate of load growth. Dates shown above reflect the high load growth scenarios. Timings used for medium and low growth rates are detailed in Appendix 2.*

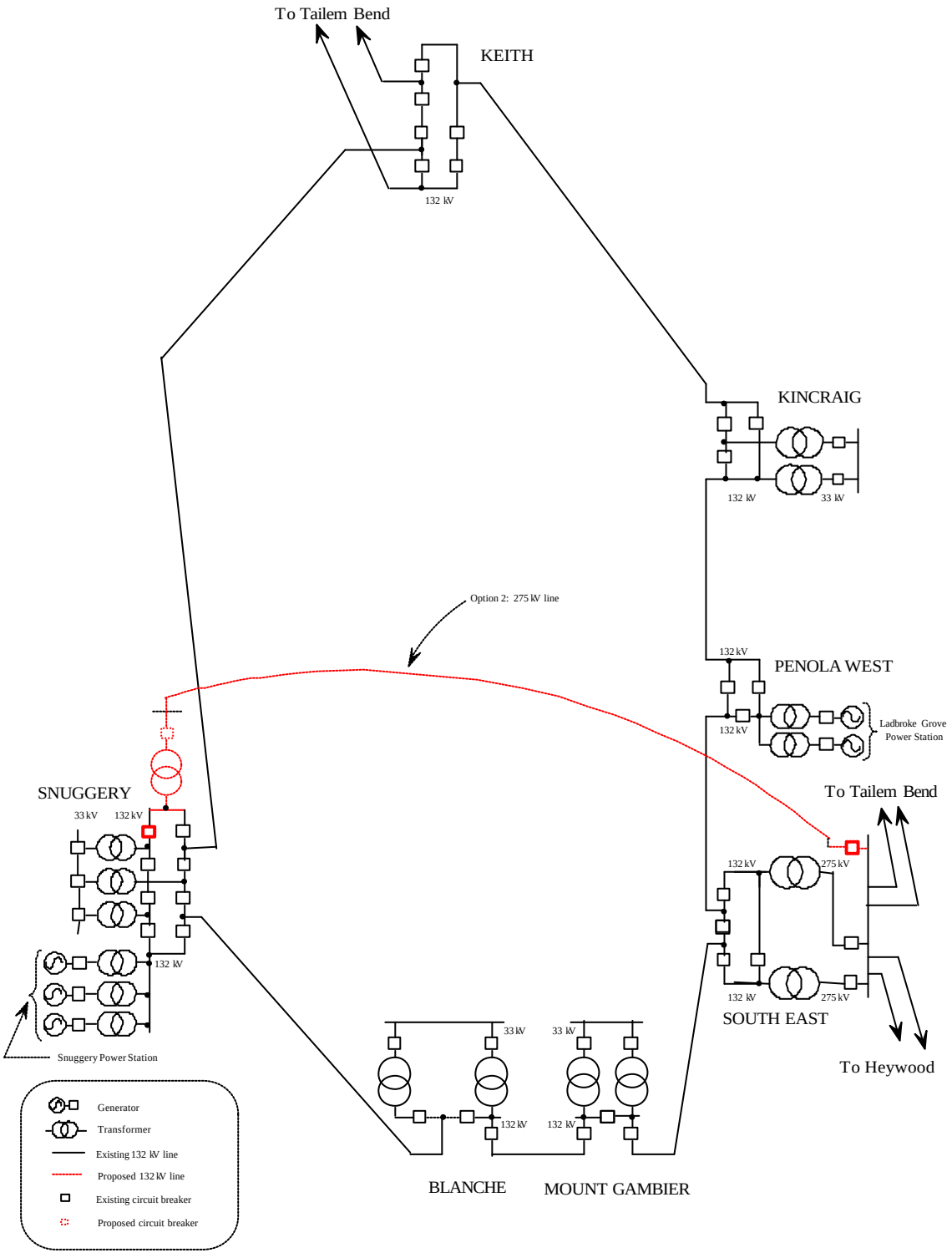
Option 2 proposes that a 275 kV line be constructed between the two substations, and a 275/132 kV substation established adjacent the existing substation at Snuggery. This variation on the proposal contained in Option 1 would provide essentially the same operational benefits as the 132 kV option, but would have an additional benefit of lower transmission losses compared to the 132 kV option because power is being transmitted at a higher voltage.

The cost of installing the capacitor bank has been included to enable an equitable comparison of the economic benefits with Option 1. This later project will however be the subject of future consultation before proceeding.

Planning studies show that this option will not materially impact other transmission networks within the National Electricity Market.

7 The timing of the augmentation is based on the electricity demand forecast as published in the initial consultation paper issued by ElectraNet SA in December 2002. The financial analysis evaluates possible variations to the timings for different load growth forecasts using the market development scenarios in section 7.0.

Option 2


To Tailem Bend
KEITH
132 kV
KINCRAIG
132 kV
33 kV
Option 2: 275 kV line
132 kV
PENOLA WEST
132 kV
Ladbroke Grove
Power Station
SNUGGERY
33 kV
132 kV
To Tailem Bend
132 kV
275 kV
132 kV
275 kV
SOUTH EAST
132 kV
Snuggery Power Station
To Heywood
33 kV
33 kV
132 kV
132 kV
BLANCHE
MOUNT GAMBIER
Generator
Transformer
Existing 132 kV line
Proposed 132 kV line
Existing circuit breaker
Proposed circuit breaker

7.0 MARKET DEVELOPMENT SCENARIOS

7.1 Context for Evaluation of Options

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

- Commonwealth legislation has been in effect since 1 January 2001 to encourage increased generation from renewable resources. ElectraNet SA has considered both committed and likely levels of wind generation to connect to the south-eastern 132 kV transmission network when formulating relevant market development scenarios.

- NEMMCO's Statement of Opportunities (SOO) issued in July 2003 contained information on existing and committed generation developments in South Australia, an extract from which follows:

  "Victoria and South Australia: The analysis of supply and demand in Victoria and South Australia indicates that while reserves for the winter will be adequate until 2011, summer reserves fall below the minimum requirement in the coming summer. The reserve deficit is forecast to be 69 MW in summer 2003/04, and in summer 2008/09, the demand exceeds the supply side capacity."

  The proposed large network augmentation facilitates the dispatch of existing and proposed new generation schemes thereby assisting the market to address summer reserve shortfalls.

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 robustness of the Net Present Value analysis of the options being evaluated under a range of plausible scenarios.

7.2.1 Existing Network and Future Transmission Developments

When formulating the market development scenarios, existing network behaviour and the impact of the two proposed transmission augmentations were taken into account. Other planned transmission augmentations are independent of the identified limitations to supply in the south-east and were therefore not included within the scenarios.

7.2.2 Variations in Load Growth

ElectraNet SA's planning studies rely on annual electricity demand forecasts provided by ETSA Utilities. These forecasts span a ten-year horizon and take into account demand management and embedded generation programmes, in-place or proposed, that may reduce the forecast demand at transmission connection points. ETSA Utilities confirms that the forecasts are representative of electricity usage during hot summer conditions.

The analysis of ElectraNet SA's transmission system in the south-east of the State for the 10-year period from 2003 has been based on the *medium* growth forecast provided by ETSA Utilities, as this represents the most likely load growth scenario. The results of this analysis have then enabled ElectraNet SA to identify and assess what potential limitations may occur in meeting system reliability and security standards in accordance with the National Electricity Code and the South Australian Transmission Code.

However, ETSA Utilities also provides two other load forecasts - high and low - to provide an indication of the effects of possible changes to the level of economic activity within the State. This information and the basis of the forecasts is contained in the 2003 APR.

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 7.2.5.

7.2.3 Existing and Committed Generation

ElectraNet SA has carried out analyses examining the power flows and voltage levels on the 132 kV lines in the south-east transmission system with a variety of assumptions about plausible generation patterns. As outlined in the previous 'Request for Information' document, it has been found that during the most critical contingency for the area on the existing system (loss of the South East-Mount Gambier 132 kV line during a period of high load), the outcome is not sensitive to the level of generation from existing and committed sources. Specifically, while increased generation at Snuggery does reduce loading on the 132 kV network upstream of Snuggery, the relatively high impedance and thermal rating limit of the 132 kV Snuggery-Blanche and Blanche-Mount Gambier lines, and lack of reactive support at Blanche and/or Mount Gambier, makes the identified system shortcomings relatively insensitive to the level of generation at Snuggery. (Generation at Ladbroke Grove does not impact on Mount Gambier and Blanche during this contingency since the South East-Mount Gambier tie is out of service. No scenarios have therefore been developed for existing generation developments.)

7.2.4 Potential Generation Developments

Several wind-farm proposals have been submitted for the south-eastern region of South Australia. The proponents of Lake Bonney Wind Farm have recently committed to the initial stage comprising an 80 MW wind-farm site to the south-west of Snuggery. The most likely means of connection into the existing system for this, and most other proposals tabled to date, will be via the 132 kV network. Connection would be achieved either by establishing radial ties between the wind-farms and the existing 132 kV network, or by constructing a new, purpose-built line along the coast that would provide transmission network access for the wind-farms. Irrespective of the means of connection, the most likely connection point into the existing transmission network, from both a technical and an economic perspective, would be Snuggery substation. Referring again to the discussion provided in section 7.2.3 above, the identified shortcomings in the existing system are relatively insensitive to the level of generation at Snuggery. However, the overall market benefit of any proposed transmission network development option will be influenced by the level of generation provided by wind-farms connecting into Snuggery due to the impact on transmission system losses. With this in mind, alternative market development scenarios have been developed to reflect varying levels of generation attributable to the proposed wind-farms.

The analysis was conducted using assumed average wind-farm generation levels into Snuggery of 80 MW and 160MW. These assumed generation levels are based on information supplied by the sole committed proponent to-date, and make provision for potential generation levels from other wind-farm proponents that have forwarded submissions. A level of dispatch ranging between these two values is expected to be present for at least 90% of any one year.

For completeness and to test the robustness of the proposed large network augmentation, scenarios involving no wind generation were also included. This would cover sustained periods of low wind and lengthy maintenance periods for the wind generators. The inclusion of these scenarios did not impact on the proposed augmentation.

7.2.5 Market Development Scenarios

Nine market development scenarios have been developed to simulate the impact of variations in load growth while incorporating the assumptions outlined above:

Scenario A	Low load growth forecast No wind generation into Snuggery
Scenario D	Low load growth forecast 80 MW wind generation into Snuggery
Scenario G	Low load growth forecast 160 MW wind generation into Snuggery
Scenario B	Medium load growth forecast No wind generation into Snuggery
Scenario E	Medium load growth forecast 80 MW wind generation into Snuggery
Scenario H	Medium load growth forecast 160 MW wind generation into Snuggery
Scenario C	High load growth forecast No wind generation into Snuggery
Scenario F	High load growth forecast 80 MW wind generation into Snuggery
Scenario I	High load growth forecast 160 MW wind generation into Snuggery

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 (i.e. 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 south-east of South Australia 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 Electricity Act[8].

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 NPV of the various options, are shown in section 9.0.

Cost inputs to the NPV analysis are described below.

8.2.1 Cost of Transmission Augmentations

The cost to implement each of the two feasible transmission augmentations outlined in section 5.0 of this document have been estimated by ElectraNet SA. Sensitivity studies have been carried out using variations in the capital cost estimates of plus and minus 15% (see section 9.3).

The financial analysis considers all foreseeable 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 average cost of losses of $30/MW.h. Sensitivity studies have also been carried out on the assumed cost of losses (see section 9.3).

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 capability expenditure) has been taken into account in the financial analysis.

8 Refer section 3.0.

9.0 FINANCIAL ANALYSIS

9.1 Description of Financial Analysis Approach

The economic analysis undertaken considered the NPV of net market benefits of the two options over the fifteen-year period from 2003 to 2018. A full summary of the results of this analysis is contained in Appendix 2.

9.2 Net Present Value Analysis

Financial analysis was carried out to calculate and compare the NPV of the costs to market participants of each of the options under the range of assumed market development scenarios.

A fifteen-year analysis period was selected as an appropriate period for financial analysis. ElectraNet SA has elected to use this period based on the National Electricity Code requirement that TNSPs use a minimum planning horizon of ten years, combined with the Inter-regional Planning Committee (IRPC) recommendation that the planning horizon be extended to beyond ten years to better-reflect the long-term nature of transmission infrastructure investments.

A discount rate of 10% was selected as a relevant commercial discount rate, and sensitivity analysis was conducted to test the robustness of this assumption.

Capital and operating costs for items that 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.

It should also be noted that supporting studies are based on the medium load growth forecast supplied by the DNSP, unless stated otherwise. This level of growth is considered to represent the most likely development scenario, with the high and low load growth options less likely to occur.

Under the Regulatory Test, it is the ranking of the options that 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 two tables summarise the results of the economic analysis provided in Appendix 2. The first table shows the Net Present Cost of implementing each of the two options and the NPV of the two alternatives for levels of wind-generation that are expected to be present under typical system operating conditions. The second table demonstrates the affect of varying levels of wind generation by providing results that are based, firstly, on no wind generation, and secondly, on the establishment of large scale wind generation. For each of the scenarios considered, the best-ranked option is highlighted.

Discount rate 10%		Option 1 132 kV augmentation between South East and Snuggery substations		Option 2 275 kV augmentation between South East and Snuggery substations	
		Net Present Cost ($M)	Rank	Net Present Cost ($M)	Rank
80MW wind generation into Snuggery	Scenario D (low load growth)	$15.78	1	$20.71	2
	Scenario E (medium load growth)	$16.02	1	$20.77	2
	Scenario F (high load growth)	$16.13	1	$20.61	2

Discount rate 10%		Option 1 132 kV augmentation between South East and Snuggery substations		Option 2 275 kV augmentation between South East and Snuggery substations	
		Net Present Cost ($M)	Rank	Net Present Cost ($M)	Rank
No wind generation into Snuggery	Scenario A (low load growth)	$14.29	1	$18.99	2
	Scenario B (medium load growth)	$13.04	1	$17.41	2
	Scenario C (high load growth)	$11.75	1	$15.84	2
160MW wind generation into Snuggery	Scenario G (low load growth)	$14.24	1	$18.98	2
	Scenario H (medium load growth)	$13.27	1	$17.66	2
	Scenario I (high load growth)	$12.80	1	$16.90	2

9.3 Sensitivity Analysis

In addition to examining the impact of market development scenarios, the sensitivity of the option-ranking to three other critical parameters was also examined. The following table shows the parameters that were investigated, the range over which each of the parameters was varied, and the resulting Net Present Value and ranking of each of the two options under the stated conditions. The analysis was conducted using medium load growth and an assumed average wind-farm generation level into Snuggery of 80 MW, as discussed previously.

Parameter incurring variation (all studies at 10%pa discount rate, DNSP forecast loads and $30/MW.h cost of losses, unless stated otherwise)	Net Present Cost ($M)			
	Option 1 South East-Snuggery 132 kV line	Rank	Option 2 South East-Snuggery 275 kV line	Rank
Discount Rate (% pa)				
7.5%	$18.84	1	$24.37	2
10%	$16.02	1	$20.77	2
12.5%	$13.79	1	$17.90	2
Cost of losses				
$25/MW.h	$16.06	1	$20.81	2
$30/MW.h	$16.02	1	$20.77	2
$35/MW.h	$15.99	1	$20.73	2
Capital Cost of project				
15% less than estimated cost	$13.59	1	$17.62	2
estimated cost	$16.02	1	$20.77	2
15% more than estimated cost	$18.46	1	$23.92	2

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

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 contingency on the South East – Snuggery 132 kV transmission line. This situation is not consistent with reliability standards that ElectraNet SA must meet as the South Australian Transmission Network Service Provider.

- ElectraNet SA carried out the consultation process regarding this system limitation in accordance with NEC requirements, publishing the "Emerging Limitations" document in late 2002, and the "Application Notice" in August 2003, with 31st January 2003 and 18th September 2003 as the closing dates for submissions, respectively. Two submissions were received.

- 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 all of the scenarios considered. On this basis, an augmentation comprising a single-circuit 132 kV line from South East to Snuggery substations, at an estimated cost of $15.1M, will satisfy the ACCC Regulatory Test.

- Sensitivity analysis showed that this conclusion was robust when considered against variations in capital cost and other factors outside of the influence of ElectraNet SA. Option 1 is also the highest-ranked option under all of the applicable market development scenarios.

- Study results of dynamic stability analysis involving future generation developments support the establishment of a single-circuit 132 kV line from South East to Snuggery substations in preference to the 275 kV line option.

- 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. The construction time for a network solution will require works to commence as early as practically possible (late 2003 / early 2004) to ensure completion within the required timeframe. 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 with consideration for the submissions received to the draft recommendation contained in the Application Notice, it is recommended that that 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 the south-east region of South Australia:

- a single circuit 132 kV transmission line from South East substation to Snuggery substation and associated substation works at South East and Snuggery substations, at an estimated cost of $15.1M.

The proposed construction timetable provides for award of equipment and construction contracts and the commencement of on-site construction in early 2004, following satisfactory resolution of Development Approvals, and commissioning by November 2004. Immediate steps will be taken to implement this recommendation.

APPENDIX 1

TECHNICAL DETAILS OF PROPOSED NEW LARGE NETWORK ASSET

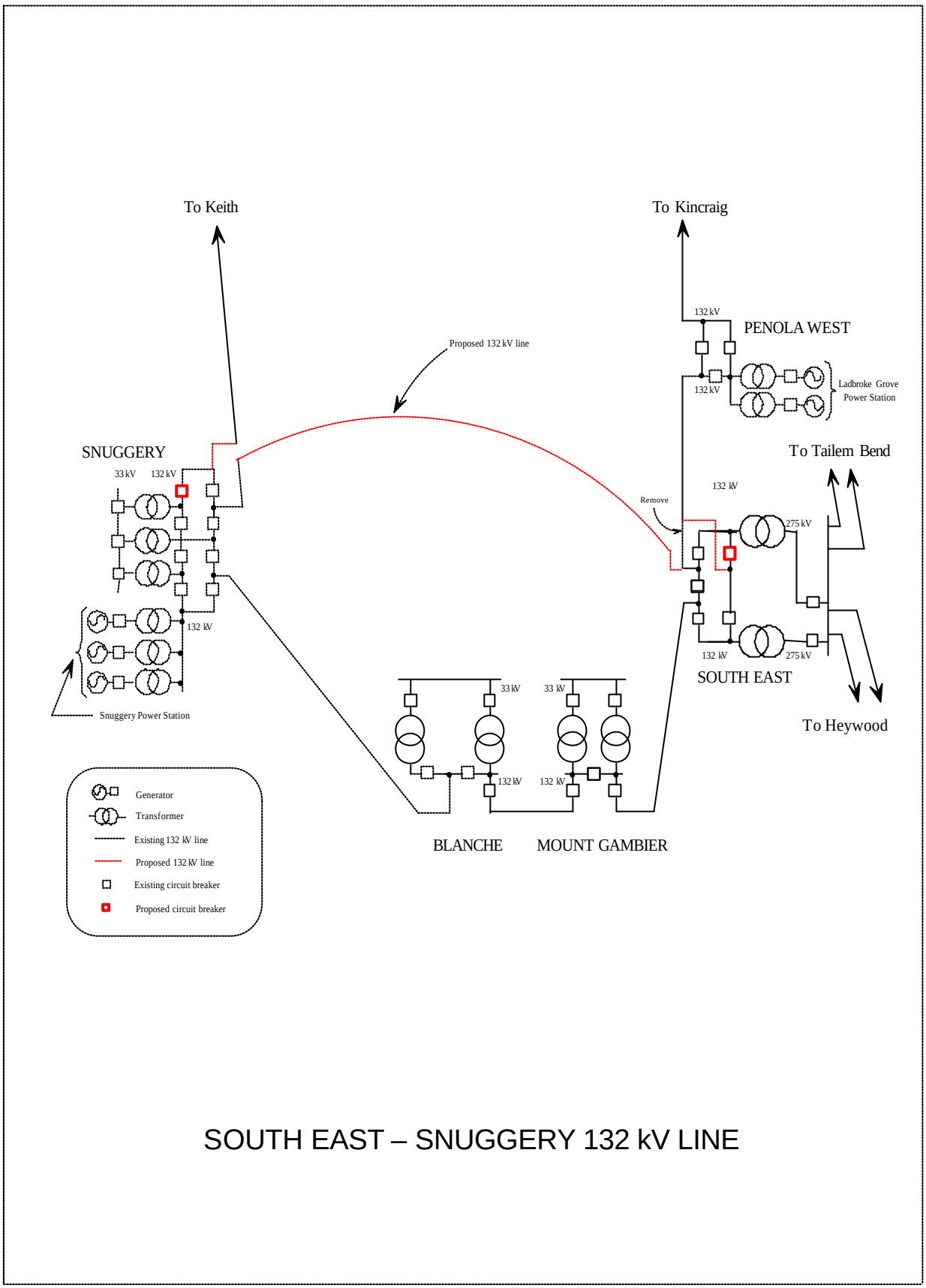
The proposed new large network asset recommended in this Application Notice comprises the following works:

- constructing a 43 kilometre 132 kV transmission line from South East substation to Snuggery substation using Stobie Pole construction, and including 24-fibre OPGW and earth-wire for the entire route;

- establishing a new 132 kV line exit at Snuggery substation, including installation of an additional 132 kV circuit breaker and associated protection and communications;

- establishing a new 132 kV line exit at South East substation, including installation of an additional 132 kV circuit breaker and associated protection and communications, and;

- cutting into the existing Keith-Snuggery 132 kV transmission line, diverting the Keith end into Snuggery substation, and using the Snuggery end as the connection to the new South East-Snuggery 132 kV line.



SOUTH EAST – SNUGGERY 132 kV LINE

APPENDIX 2

Financial Analysis Summary

15 Year Analysis Period

Discount rate 10%	**Scenario A** *Low load Growth, 0MW wind generation*		**Scenario B** *Medium load Growth, 0MW wind generation*		**Scenario C** *High load Growth, 0MW wind generation*		**Scenario D** *Low load Growth, 80MW wind generation*		**Scenario E** *Medium load Growth, 80MW wind generation*		**Scenario F** *High load Growth, 80MW wind generation*		**Scenario G** *Low load Growth, 160MW wind generation*		**Scenario H** *Medium load Growth, 160MW wind generation*		**Scenario I** *High load Growth, 160MW wind generation*	
	NPV ($M)	**Rank**	**NPV ($M)**	**Rank**	**NPV ($M)**	**Rank**	**NPV ($M)**	**Rank**	**NPV ($M)**	**Rank**	**NPV ($M)**	**Rank**	**NPV ($M)**	**Rank**	**NPV ($M)**	**Rank**	**NPV ($M)**	**Rank**
Option 1 132 kV line option	$14.29	1	$13.04	1	$11.75	1	$15.78	1	$16.02	1	$16.13	1	$14.24	1	$13.27	1	$12.80	1
Option 2 - 275 kV line option	$18.99	2	$17.41	2	$15.84	2	$20.71	2	$20.77	2	$20.61	2	$18.98	2	$17.66	2	$16.90	2

Development Options

Development Options	Scenario A *Low load Growth, 0MW wind generation*	Scenario B *Medium load Growth, 0MW wind generation*	Scenario C *High load Growth, 0MW wind generation*	Scenario D *Low load Growth, 80MW wind generation*	Scenario E *Medium load Growth, 80MW wind generation*	Scenario F *High load Growth, 80MW wind generation*	Scenario G *Low load Growth, 160MW wind generation*	Scenario H *Medium load Growth, 160MW wind generation*	Scenario I *High load Growth, 160MW wind generation*
Option 1									
132 kV South East-Snuggery	04/05	04/05	04/05	04/05	04/05	04/05	04/05	04/05	04/05
3rd 275/132 kV transformer	06/07	06/07	06/07	06/07	06/07	06/07	06/07	06/07	06/07
15 Mvar 132 kV capacitor	10/11	09/10	08/09	10/11	09/10	08/09	10/11	09/10	08/09
15 Mvar 132 kV capacitor	17/18	15/16	13/14	17/18	15/16	13/14	17/18	15/16	13/14
15 Mvar 132 kV capacitor	N/A	N/A	18/19	N/A	N/A	18/19	N/A	N/A	18/19
Option 2									
275 kV South East-Snuggery	04/05	04/05	04/05	04/05	04/05	04/05	04/05	04/05	04/05
15 Mvar 132 kV capacitor	N/A	N/A	18/19	N/A	N/A	18/19	N/A	N/A	18/19

Scenario A		*Low load Growth, 0MW wind generation*														
Option 1		**132 kV line option**														
132 kV Snuggery-South East line		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	18/19
=> TUOS		0.984	1.674	1.651	1.628	1.606	1.583	1.560	1.538	1.515	1.492	1.470	1.447	1.424	1.402	1.379
==> NPV of TUOS	$11.34															
3rd 275/132 kV Transformer at South East		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	18/19
=> TUOS		0.000	0.000	0.484	0.823	0.811	0.800	0.789	0.778	0.767	0.756	0.745	0.733	0.722	0.711	0.700
==> NPV of TUOS	$4.32															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112	0.111
==> NPV of TUOS	$0.36															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> 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	0.072	0.122
==> NPV of TUOS	$0.05															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> 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		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	18/19
* Losses $		0.205	0.210	0.216	0.221	0.228	0.233	0.235	0.242	0.249	0.257	0.262	0.270	0.279	0.286	0.291
=> NPV of Losses	$1.79															
Total for Option 1	**$14.29**															
Option 2		**275 kV line option**														
275 kV Snuggery-South East line		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	18/19
=> TUOS		0.984	1.674	1.651	1.628	1.606	1.583	1.560	1.538	1.515	1.492	1.470	1.447	1.424	1.402	1.379
==> NPV of TUOS	$21.01															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> 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		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	18/19
* Losses $		0.230	0.236	0.243	0.249	0.256	0.263	0.266	0.274	0.282	0.291	0.296	0.305	0.314	0.324	0.330
=> NPV of Losses	$2.02															
Total for Option 2	**$18.99**															

Scenario B		***Medium load Growth, 0MW wind generation***														
Option 1		**132 kV line option**														
132 kV Snuggery-South East line		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	18/19
=> TUOS		0.984	1.674	1.651	1.628	1.606	1.583	1.560	1.538	1.515	1.492	1.470	1.447	1.424	1.402	1.379
==> NPV of TUOS	$11.34															
3rd 275/132 kV Transformer at South East		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	18/19
=> TUOS		0.000	0.000	0.484	0.823	0.811	0.800	0.789	0.778	0.767	0.756	0.745	0.733	0.722	0.711	0.700
==> NPV of TUOS	$4.32															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112	0.111	0.109
==> NPV of TUOS	$0.42															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119
==> NPV of TUOS	$0.12															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> 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		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	18/19
* Losses $		0.234	0.241	0.387	0.400	0.411	0.426	0.439	0.451	0.477	0.495	0.522	0.552	0.602	0.643	0.698
=> NPV of Losses	$3.17															
Total for Option 1	**$13.04**															
Option 2		**275 kV line option**														
275 kV Snuggery-South East line		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	18/19
=> TUOS		0.000	3.364	3.319	3.273	3.228	3.182	3.136	3.091	3.045	3.000	2.954	2.909	2.863	2.817	2.772
==> NPV of TUOS	$21.01															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> 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		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	18/19
* Losses $		0.264	0.272	0.438	0.452	0.466	0.482	0.498	0.513	0.542	0.561	0.594	0.629	0.680	0.729	0.792
=> NPV of Losses	$3.59															
Total for Option 2	**$17.41**															

Scenario C		***High load Growth, 0MW wind generation***														
Option 1		**132 kV line option**														
132 kV Snuggery-South East line		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	18/19
=> TUOS		0.984	1.674	1.651	1.628	1.606	1.583	1.560	1.538	1.515	1.492	1.470	1.447	1.424	1.402	1.379
==> NPV of TUOS	$11.34															
3rd 275/132 kV Transformer at South East		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	18/19
=> TUOS		0.000	0.000	0.484	0.823	0.811	0.800	0.789	0.778	0.767	0.756	0.745	0.733	0.722	0.711	0.700
==> NPV of TUOS	$4.32															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112	0.111	0.109	0.107
==> NPV of TUOS	$0.49															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116
==> NPV of TUOS	$0.20															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> 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	0.072
==> NPV of TUOS	$0.02															
Relative Losses		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	18/19
* Losses $		0.244	0.284	0.319	0.364	0.413	0.470	0.539	0.618	0.700	0.812	0.933	1.110	1.333	1.621	2.039
=> NPV of Losses	$4.62															
Total for Option 1	**$11.75**															
Option 2		**275 kV line option**														
275 kV Snuggery-South East line		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	18/19
=> TUOS		0.000	3.364	3.319	3.273	3.228	3.182	3.136	3.091	3.045	3.000	2.954	2.909	2.863	2.817	2.772
==> NPV of TUOS	$21.01															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> 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	0.072
==> NPV of TUOS	$0.02															
Relative Losses		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	18/19
* Losses $		0.278	0.321	0.363	0.410	0.465	0.532	0.608	0.697	0.793	0.909	1.064	1.241	1.485	1.795	2.231
=> NPV of Losses	$5.19															
Total for Option 2	**$15.84**															

Scenario D		***Low load Growth, 80MW wind generation***														
Option 1		**132 kV line option**														
132 kV Snuggery-South East line		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	18/19
=> TUOS		0.984	1.674	1.651	1.628	1.606	1.583	1.560	1.538	1.515	1.492	1.470	1.447	1.424	1.402	1.379
==> NPV of TUOS	$11.34															
3rd 275/132 kV Transformer at South East		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	18/19
=> TUOS		0.000	0.000	0.484	0.823	0.811	0.800	0.789	0.778	0.767	0.756	0.745	0.733	0.722	0.711	0.700
==> NPV of TUOS	$4.32															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112	0.111
==> NPV of TUOS	$0.36															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> 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	0.072	0.122
==> NPV of TUOS	$0.05															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> 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		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	18/19
* Losses $		0.036	0.035	0.037	0.039	0.042	0.044	0.046	0.046	0.043	0.040	0.037	0.035	0.032	0.029	0.031
=> NPV of Losses	$0.29															
Total for Option 1	**$15.78**															
Option 2		**275 kV line option**														
275 kV Snuggery-South East line		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	18/19
=> TUOS		0.000	3.364	3.319	3.273	3.228	3.182	3.136	3.091	3.045	3.000	2.954	2.909	2.863	2.817	2.772
==> NPV of TUOS	$21.01															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> 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		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	18/19
* Losses $		0.035	0.035	0.037	0.039	0.043	0.046	0.046	0.046	0.044	0.041	0.039	0.037	0.035	0.032	0.030
=> NPV of Losses	$0.30															
Total for Option 2	**$20.71**															

Scenario E		***Medium load Growth, 80MW wind generation***														
Option 1		**132 kV line option**														
132 kV Snuggery-South East line		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	18/19
=> TUOS		0.984	1.674	1.651	1.628	1.606	1.583	1.560	1.538	1.515	1.492	1.470	1.447	1.424	1.402	1.379
==> NPV of TUOS	$11.34															
3rd 275/132 kV Transformer at South East		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	18/19
=> TUOS		0.000	0.000	0.484	0.823	0.811	0.800	0.789	0.778	0.767	0.756	0.745	0.733	0.722	0.711	0.700
==> NPV of TUOS	$4.32															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112	0.111	0.109
==> NPV of TUOS	$0.42															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119
==> NPV of TUOS	$0.12															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> 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		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	18/19
* Losses $		0.018	0.018	0.033	0.031	0.028	0.025	0.023	0.021	0.023	0.023	0.022	0.023	0.020	0.021	0.026
=> NPV of Losses	$0.18															
Total for Option 1	**$16.02**															
Option 2		**275 kV line option**														
275 kV Snuggery-South East line		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	18/19
=> TUOS		0.000	3.364	3.319	3.273	3.228	3.182	3.136	3.091	3.045	3.000	2.954	2.909	2.863	2.817	2.772
==> NPV of TUOS	$21.01															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> 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		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	18/19
* Losses $		0.015	0.015	0.041	0.038	0.036	0.034	0.032	0.030	0.031	0.030	0.033	0.034	0.036	0.038	0.047
=> NPV of Losses	$0.23															
Total for Option 2	**$20.77**															

Scenario F		*High load Growth, 80MW wind generation*														
Option 1		**132 kV line option**														
132 kV Snuggery-South East line		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	18/19
=> TUOS		0.984	1.674	1.651	1.628	1.606	1.583	1.560	1.538	1.515	1.492	1.470	1.447	1.424	1.402	1.379
==> NPV of TUOS	$11.34															
3rd 275/132 kV Transformer at South East		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	18/19
=> TUOS		0.000	0.000	0.484	0.823	0.811	0.800	0.789	0.778	0.767	0.756	0.745	0.733	0.722	0.711	0.700
==> NPV of TUOS	$4.32															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112	0.111	0.109	0.107
==> NPV of TUOS	$0.49															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116
==> NPV of TUOS	$0.20															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> 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	0.072
==> NPV of TUOS	$0.02															
Relative Losses		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	18/19
* Losses $		0.044	0.033	0.019	0.017	0.012	-0.001	0.000	-0.006	-0.003	-0.003	0.014	0.043	0.101	0.161	0.253
=> NPV of Losses	$0.25															
Total for Option 1	**$16.13**															
Option 2		**275 kV line option**														
275 kV Snuggery-South East line		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	18/19
=> TUOS		0.000	3.364	3.319	3.273	3.228	3.182	3.136	3.091	3.045	3.000	2.954	2.909	2.863	2.817	2.772
==> NPV of TUOS	$21.01															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> 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	0.072
==> NPV of TUOS	$0.02															
Relative Losses		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	18/19
* Losses $		0.044	0.033	0.024	0.026	0.017	0.014	0.016	0.014	0.027	0.038	0.065	0.111	0.167	0.234	0.323
=> NPV of Losses	$0.41															
Total for Option 2	**$20.61**															

Scenario G		***Low load Growth, 160MW wind generation***														
Option 1		**132 kV line option**														
132 kV Snuggery-South East line		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	18/19
=> TUOS		0.984	1.674	1.651	1.628	1.606	1.583	1.560	1.538	1.515	1.492	1.470	1.447	1.424	1.402	1.379
==> NPV of TUOS	$11.34															
3rd 275/132 kV Transformer at South East		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	18/19
=> TUOS		0.000	0.000	0.484	0.823	0.811	0.800	0.789	0.778	0.767	0.756	0.745	0.733	0.722	0.711	0.700
==> NPV of TUOS	$4.32															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112	0.111
==> NPV of TUOS	$0.36															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> 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	0.072	0.122
==> NPV of TUOS	$0.05															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> 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		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	18/19
* Losses $		0.226	0.228	0.231	0.233	0.235	0.240	0.243	0.245	0.249	0.252	0.255	0.258	0.265	0.268	0.272
=> NPV of Losses	$1.83															
Total for Option 1	**$14.24**															
Option 2		**275 kV line option**														
275 kV Snuggery-South East line		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	18/19
=> TUOS		0.000	3.364	3.319	3.273	3.228	3.182	3.136	3.091	3.045	3.000	2.954	2.909	2.863	2.817	2.772
==> NPV of TUOS	$21.01															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> 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		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	18/19
* Losses $		0.246	0.249	0.253	0.256	0.259	0.263	0.267	0.271	0.276	0.280	0.289	0.293	0.298	0.303	0.308
=> NPV of Losses	$2.03															
Total for Option 2	**$18.98**															

Scenario H		***Medium load Growth, 160MW wind generation***														
Option 1		**132 kV line option**														
132 kV Snuggery-South East line		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	18/19
=> TUOS		0.984	1.674	1.651	1.628	1.606	1.583	1.560	1.538	1.515	1.492	1.470	1.447	1.424	1.402	1.379
==> NPV of TUOS	$11.34															
3rd 275/132 kV Transformer at South East		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	18/19
=> TUOS		0.000	0.000	0.484	0.823	0.811	0.800	0.789	0.778	0.767	0.756	0.745	0.733	0.722	0.711	0.700
==> NPV of TUOS	$4.32															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112	0.111	0.109
==> NPV of TUOS	$0.42															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119
==> NPV of TUOS	$0.12															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> 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		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	18/19
* Losses $		0.274	0.279	0.363	0.371	0.380	0.384	0.394	0.408	0.424	0.435	0.455	0.471	0.509	0.539	0.574
=> NPV of Losses	$2.94															
Total for Option 1	**$13.27**															
Option 2		**275 kV line option**														
275 kV Snuggery-South East line		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	18/19
=> TUOS		0.000	3.364	3.319	3.273	3.228	3.182	3.136	3.091	3.045	3.000	2.954	2.909	2.863	2.817	2.772
==> NPV of TUOS	$21.01															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> 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		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	18/19
* Losses $		0.301	0.307	0.414	0.425	0.435	0.442	0.454	0.464	0.484	0.497	0.528	0.549	0.586	0.621	0.664
=> NPV of Losses	$3.35															
Total for Option 2	**$17.66**															

Scenario I		***High load Growth, 160MW wind generation***														
Option 1		**132 kV line option**														
132 kV Snuggery-South East line		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	18/19
=> TUOS		0.984	1.674	1.651	1.628	1.606	1.583	1.560	1.538	1.515	1.492	1.470	1.447	1.424	1.402	1.379
==> NPV of TUOS	$11.34															
3rd 275/132 kV Transformer at South East		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	18/19
=> TUOS		0.000	0.000	0.484	0.823	0.811	0.800	0.789	0.778	0.767	0.756	0.745	0.733	0.722	0.711	0.700
==> NPV of TUOS	$4.32															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116	0.114	0.112	0.111	0.109	0.107
==> NPV of TUOS	$0.49															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.072	0.122	0.121	0.119	0.117	0.116
==> NPV of TUOS	$0.20															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> 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	0.072
==> NPV of TUOS	$0.02															
Relative Losses		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	18/19
* Losses $		0.247	0.266	0.281	0.309	0.340	0.379	0.417	0.478	0.527	0.606	0.698	0.806	0.936	1.125	1.347
=> NPV of Losses	$3.58															
Total for Option 1	**$12.80**															
Option 2		**275 kV line option**														
275 kV Snuggery-South East line		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	18/19
=> TUOS		0.000	3.364	3.319	3.273	3.228	3.182	3.136	3.091	3.045	3.000	2.954	2.909	2.863	2.817	2.772
==> NPV of TUOS	$21.01															
15 Mvar 132 kV capacitor at Blanche		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	18/19
=> 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	0.072
==> NPV of TUOS	$0.02															
Relative Losses		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	18/19
* Losses $		0.276	0.299	0.326	0.353	0.395	0.438	0.490	0.555	0.625	0.705	0.815	0.929	1.078	1.287	1.535
=> NPV of Losses	$4.12															
Total for Option 2	**$16.90**															