

Final Report

**New Large Network Asset  
supplying the Southern Suburbs and  
supporting the Eastern Suburbs of  
Metropolitan Adelaide and the Eastern Hills  
and Southern Rural Regions of  
South Australia**

ElectraNet Pty Ltd  
(ABN 41 094 482 416)

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## **1.0 EXECUTIVE SUMMARY**

### **1.1 Background**

In its role as the principal Transmission Network Service Provider (TNSP) in the State of South Australia, ElectraNet Pty Ltd (ElectraNet) continually monitors and assesses the performance of its transmission network against the relevant standards and principles contained within the National Electricity Rules (NER), the South Australian Electricity Transmission Code (ETC), and other relevant laws, standards, guidelines, and practices.

ElectraNet has assessed the forecast adequacy of the existing 275 kV electricity transmission system that supplies the Southern Suburbs of metropolitan Adelaide and the Southern Rural electrical loads further to the south (collectively referred to as the 'Southern Suburbs') and has identified emerging network limitations in that system. Furthermore, due to the interconnected nature of the transmission system, the effect of those limitations is not isolated to the supply reliability of the Southern Suburbs, but also directly impacts the supply reliability of other load areas referred to collectively as the 'Eastern Suburbs' (which includes the Adelaide CBD) and 'Eastern Hills' regions.

In combination, the affected load areas represent nearly 50% of South Australia's peak electrical demand. They cover a geographic region that extends to the south of Golden Grove (a suburb about 20 kilometres to the north of Adelaide) and to the west of Murray Bridge and Lake Alexandrina. This area includes the Adelaide CBD, the entire southern metropolitan area, and the semi-urban and rural regions of the Fleurieu Peninsula and Kangaroo Island, including major regional centres at Mount Barker and Victor Harbor. The majority of that load is supplied via a transmission corridor along the Adelaide Hills face extending from Para (near Elizabeth), southwards via Magill, Happy Valley, Cherry Gardens and Morphett Vale East.

ElectraNet, in conjunction with ETSA Utilities (ETSA), the principal Distribution Network Service Provider (DNSP) in South Australia, has undertaken comprehensive studies to assess the implications of the identified projected network limitations. Consideration of the results of those studies and other relevant information that was received through the joint and individual consultation processes undertaken by ElectraNet and ETSA has resulted in the preparation and issue of this Final Report by ElectraNet SA as required under the NER.

### **1.2 Description of Existing System**

The Eastern and Southern Suburbs load regions are supplied by the 'Magill - East Terrace - Northfield' and 'Happy Valley - Morphett Vale East' grouped connection points, respectively, as defined in the ETC.

The Eastern Suburbs load comprises the Adelaide CBD, and the eastern and north-eastern suburbs of Adelaide. The Magill and East Terrace 275/66 kV substations are two of the three main in-feeds that supply the Eastern Suburbs grouped connection point and in combination are responsible for supplying about 50% of the entire Eastern Suburbs load. The two 275 kV lines that supply both substations also contribute to the supply of the Southern Suburbs grouped connection point. Northfield 275/66 kV substation supplies the remainder of the Eastern suburbs load from an electrically separate 275 kV transmission system. The two lines supplying southwards from Para to Magill connect to the 275 kV switchyards at Torrens Island Power Station (TIPS) and Para substation, on the western and northern outskirts of Adelaide, respectively. Both of those 275 kV lines traverse the Adelaide Hills for considerable portions of their length, and both play a significant role in supplying the Eastern Suburbs and Adelaide CBD.

The Happy Valley and Morphett Vale East 275/66 kV substations jointly supply the Southern Suburbs grouped connection point and obtain their 275 kV supply from Magill and Cherry Gardens substations. Magill substation is located about 20 kilometres to the north-east, and Cherry Gardens approximately 8 kilometres to the east, of Happy Valley substation. Magill substation is supplied via two 275 kV lines, one from TIPS and one from Para substation. Cherry Gardens is supplied via one 275 kV circuit from TIPS and two 275 kV circuits from Davenport substation, at Port Augusta, about 300 kilometres to the north of Adelaide. The two Davenport circuits also supply Robertstown substation, located about 110 kilometres north of Adelaide, and whose main role it is to provide supply to the Riverland region in the east of the State. However, due to their length, the two circuits from Davenport via Robertstown provide relatively weak in-feeds into this supply system, whereas the remaining three in-feeds (two from TIPS and one from Para) provide strong 275 kV supply to both the Southern and Eastern Suburbs load regions.

Cherry Gardens substation not only supplies the Southern Suburbs connection point, but also provides a 275/132 kV in-feed into the Eastern Hills load region in conjunction with Para and Tailem Bend 275/132 kV substations. The Eastern Hills region includes major connection points at Mount Barker and Mobilong, near Murray Bridge. Significantly, all Murray River water pumping for Adelaide is supplied from the Eastern Hills 132 kV network.

### 1.3 Projected Network Limitations

Detailed analysis has shown that the transfer capability of the existing transmission system is limited southwards from Para towards Magill. Under high load conditions, an outage of the strong TIPS - Cherry Gardens in-feed to the Happy Valley - Morphett Vale East grouped connection point will result in thermal overloads in the remaining two circuits from Para and TIPS (the two lines that provide supply to Magill, which in turn supplies Happy Valley). To avoid this situation, the electrical power delivered into those areas would need to be limited to less than the peak forecast load levels expected to occur during summer 2006/07 and beyond. However, this would be a violation of the ETC, which states that under all credible single contingency operating conditions the transmission network must be able to continuously supply the peak load of a Category 4 connection point (such as Happy Valley - Morphett Vale East). Because of the interconnected nature of the 275 kV transmission system, those thermal limitations will also adversely impact the transmission network's ability to supply the Category 5 grouped connection point that supplies the Eastern Suburbs (and Adelaide CBD), where more onerous supply reliability requirements apply. That is because East Terrace substation, which is the main transmission supply to the CBD, is supplied from Magill substation via a single 275 kV cable.

In addition to the line overload limitations, a voltage limitation also exists in the Southern Suburbs load area, as identified in the Request for Information / Request for Proposals paper published in April 2004 and the subsequent Application Notice published in March 2005. An outage of either of the Magill - Happy Valley or the TIPS - Cherry Gardens 275 kV lines will result in considerably reduced 275 kV transmission voltages at the Southern Suburbs supply points, and will ultimately lead to voltage collapse across the entire region should the contingency occur at a time of high loads.

### 1.4 Discussion

Any augmentation of the transmission network specifically intended to remedy the projected limitations in the Southern Suburbs network would clearly be classified as a *reliability augmentation* under the NER (since the augmentation is necessitated solely by the network's inability to meet the minimum performance requirements set out in schedule 5.1 of those Rules due to load growth in the region), and as such, must satisfy the Australian Energy Regulator's

Regulatory Test for that type of augmentation. A reliability augmentation option satisfies the Regulatory Test if ...*“the option minimises the present value of costs, compared with a number of alternative options in a majority of reasonable scenarios”*..., where “cost” is defined by the ACCC as *“the total cost of that option (or an alternative option) to all those who produce, distribute or consume electricity in the National Electricity Market”*.

The anticipated total cost of the network augmentation needed to address the projected network limitations will exceed \$10M, and as such, the necessary augmentation will be classified as a “new large network asset” under the NER, and the consultation process associated with that type of development has therefore been followed by ElectraNet.

ElectraNet, in conjunction with ETSA, carried out initial consultation with Market participants and other interested parties to identify feasible non-transmission alternatives to address the projected network limitations in the Southern Suburbs. This was done via the document titled “Projected Transmission and Distribution Network and 275/66kV Connection Point Limitations – Electricity Supply to the Southern Suburbs of Metropolitan Adelaide, South Australia”, published on ElectraNet’s web-site in April 2004, and provided opportunity for Market participants and other interested parties to provide submissions on the document within a period of 30 business days. While a number of potential solution providers made preliminary enquiries during that consultation period, no firm submissions or proposals for practical alternative non-network solutions were received.

ElectraNet then conducted its own independent consultation that focussed specifically on the projected limitations associated with the transmission network by publishing an Application Notice on its website in March 2005. That document outlined the projected limitations, the network solutions that ElectraNet had considered, and a description of ElectraNet’s proposed course of action, and included invitation for submissions from National Electricity Market (NEM) participants and interested parties regarding ElectraNet’s proposed augmentation. One submission was received, that being from the South Australian Electricity Supply Industry Planning Council (ESIPC). The ESIPC submission provided constructive commentary and recommended that ElectraNet broaden the scope of its intended solution to maximise the potential benefits that could be derived from the proposed augmentation. ElectraNet supports in principle the ESIPC recommendation, however, ElectraNet is required to abide by the NER Regulatory Test requirement that it select the solution that ... *“minimises the present value of costs, compared with a number of alternative options in a majority of reasonable scenarios”*. An economic analysis of this ESIPC recommendation found that the additional cost involved could not be justified and would not pass the requirements of the Regulatory Test.

The ESIPC also recommended the up-rating of the Cherry Gardens – Morphett Vale East 275 kV line in lieu of constructing a new circuit between Cherry Gardens and the Magill - Happy Valley 275 kV line. ElectraNet’s evaluation shows that the ESIPC’s proposal would provide additional capacity for the local network in the short term as originally proposed by ElectraNet, which would defer the need for more substantial reinforcement by about five years, depending on load growth. The economic evaluation (refer Appendix 2) demonstrates that the deferment in capital expenditure brought about by implementing the ESIPC recommendation is sufficient to justify the up-rating work. Consequently, ElectraNet has adopted this suggestion.

A preliminary assessment of alternative network solutions that would increase the transmission capacity southwards of Para, that invariably involved the rebuilding of existing 275 kV line routes from Para to Cherry Gardens using multiple circuit construction, was conducted. However, those options were dismissed due to their significantly higher costs, system security issues during construction, and their failure to deliver compensating technical or other benefits.

ElectraNet has undertaken and completed public consultation on the projected network limitations and the proposed new large network asset in accordance with the requirements of

the NER, and where appropriate included and adopted suggestions arising from that process that contributed to the overall value of the project. ElectraNet will now proceed immediately with the implementation of its recommended solution, including the revised line up-rate suggestion provided by ESIPC. The recommended solution involves the establishment of a 275 kV substation at Tungkillo, at the point where the two 275 kV lines heading south-east out of Para to Tailem Bend cross over the two Robertstown - Cherry Gardens 275 kV lines, and necessary works to up-rate the Cherry Gardens – Morphett Vale East 275 kV line to a design temperature of 120°C. The augmentation that ElectraNet will proceed with meets the required technical and service standards in the most cost-effective manner to participants in the NEM, and provides a technically efficient solution that utilises existing transmission assets, requires no new transmission line corridors, and enhances the 275 kV network supplying all affected load areas. It also provides for a strategically diverse path from Para southwards to Cherry Gardens via the eastern side of the Adelaide Hills, through Tungkillo. Sensitivity analysis has shown this result to be robust under a range of plausible economic assumptions that are beyond the control of ElectraNet.

## 1.5 Recommendation

The proposed new large network assets that address the projected network limitations in the transmission network that supplies the Southern and Eastern Suburbs of metropolitan Adelaide (including the Adelaide CBD), and that supports the Eastern Hills load region, have been subjected to the Regulatory Test and consulted in accordance with the requirements of the NER. This Final Report therefore proposes that the following augmentation and associated up-rating work be implemented:

- The establishment of a 275 kV substation at a vacant ElectraNet site at Tungkillo, approximately 40 kilometres east of the Adelaide CBD, at the point where the two Tailem Bend - Para 275 kV lines cross the two Robertstown - Cherry Gardens 275 kV lines;
- The reconfiguration of the four lines at Tungkillo to form:
  - One Robertstown to Para 275 kV circuit;
  - One Tailem Bend to Cherry Gardens 275 kV circuit;
  - One Robertstown to Tungkillo 275 kV circuit;
  - One Tailem Bend to Tungkillo 275 kV circuit;
  - One Tungkillo to Para 275 kV circuit, and;
  - One Tungkillo to Cherry Gardens 275 kV circuit;
- The up-rating of the Cherry Gardens – Morphett Vale East 275 kV line to a design temperature of 120°C, and;
- The upgrading of communication facilities at Mount Beevor Radio Station, and Para, Tailem Bend, Robertstown and Cherry Gardens substations, to provide necessary 275 kV protection and SCADA functionality.

The total cost of these new large network assets and associated system modifications is estimated to be \$30.3 M.

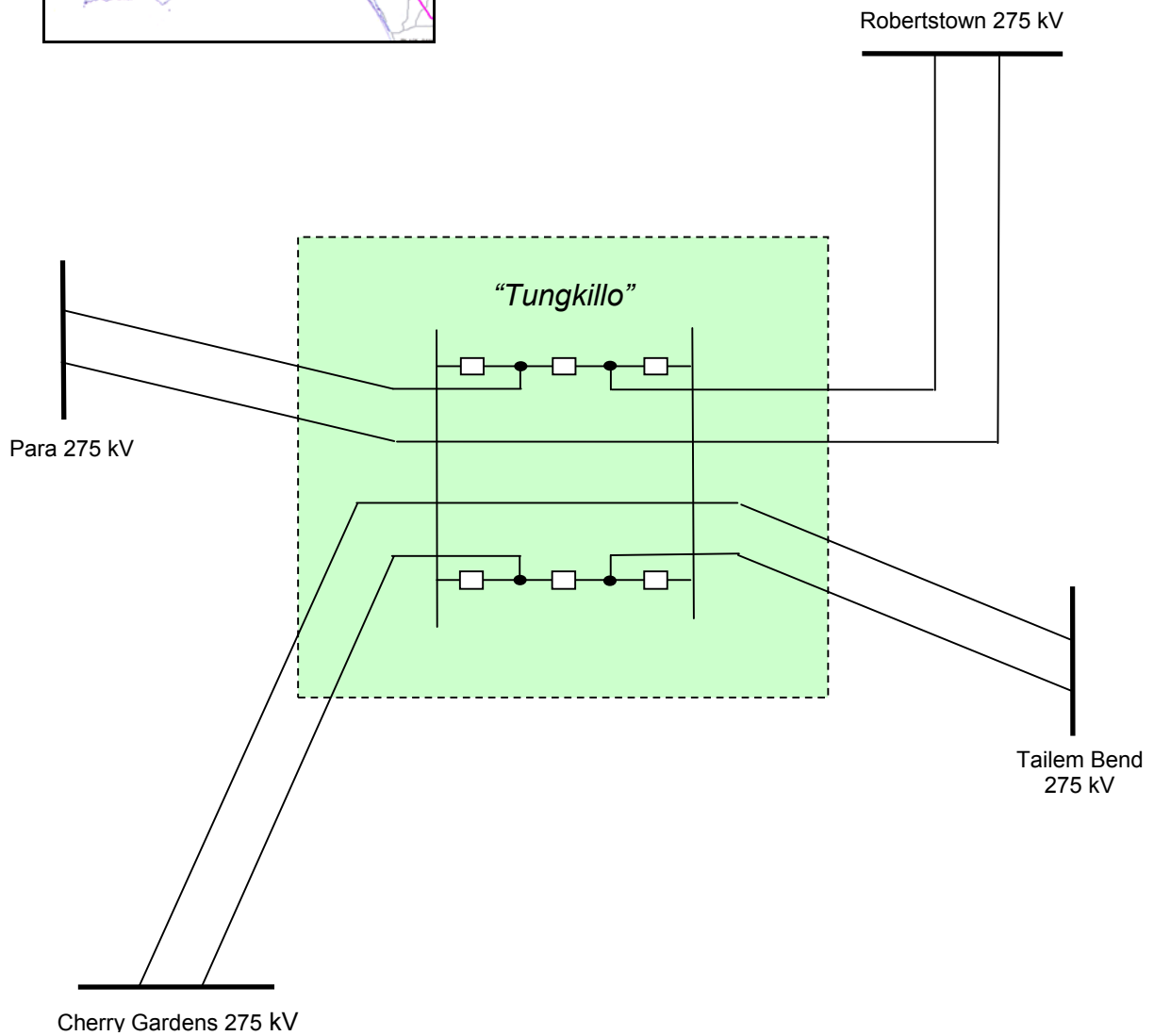
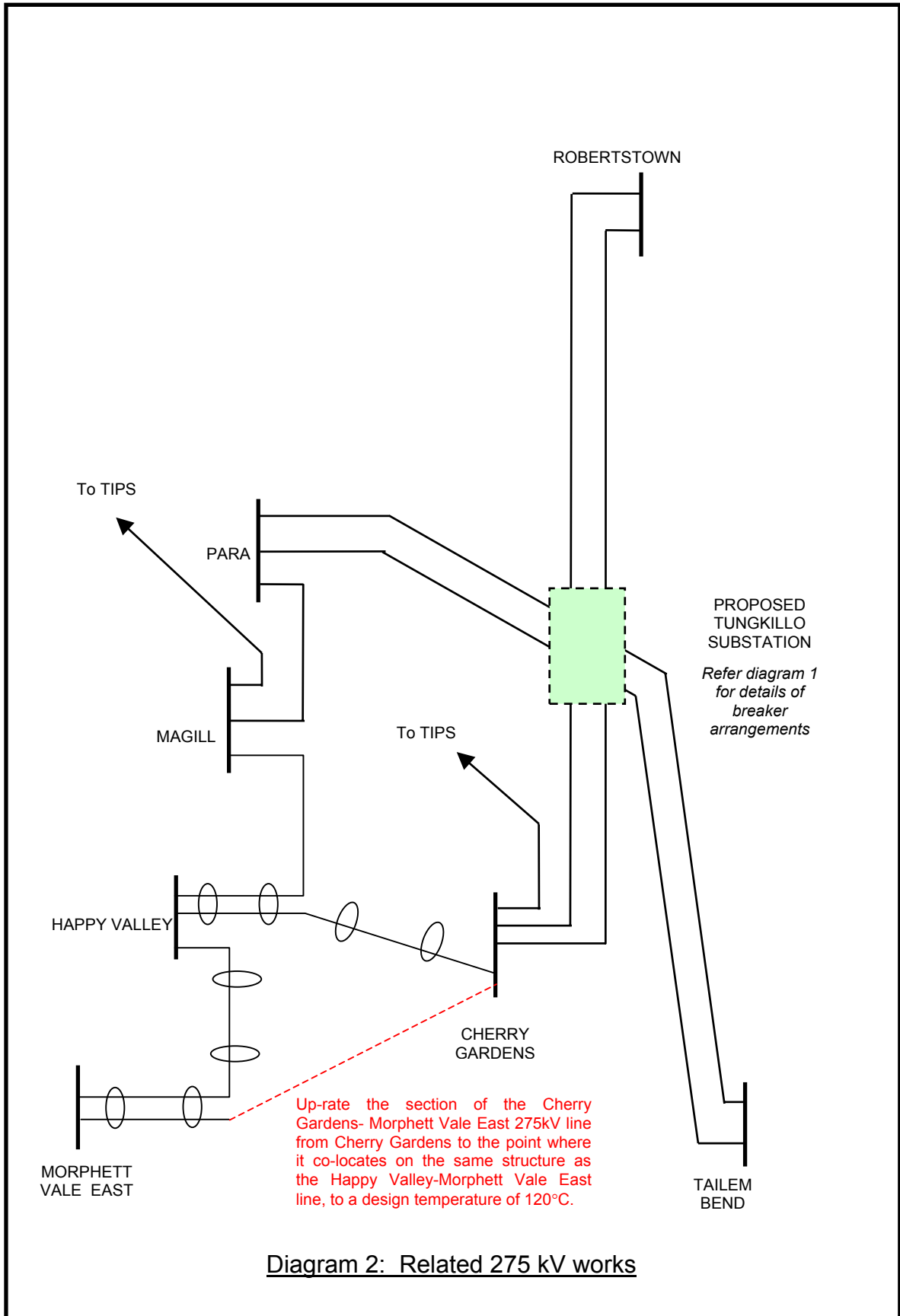


Diagram 1: Proposed layout of Tungkillo 275 kV substation



## 2.0 INTRODUCTION

As part of its ongoing activity of monitoring the performance of the South Australian transmission system, ElectraNet has identified projected limitations in the electricity transmission network that supplies the Southern and Eastern Suburbs of metropolitan Adelaide (including the Adelaide CBD), and that supports the Eastern Hills region. The projected network limitations have been analysed and consulted in accordance with the requirements of the National Electricity Rules and has culminated in the preparation and issue of this Final Report.

This Final Report proposes the installation of the following network assets, along with associated system modifications to accommodate them, collectively referred to as the Tungkillo Network Solution, to address those limitations:

- The establishment of a 275 kV substation at a vacant ElectraNet site at Tungkillo, approximately 40 kilometres east of the Adelaide CBD, at the point where the two Taillem Bend - Para 275 kV lines cross the two Robertstown - Cherry Gardens 275 kV lines;
- The reconfiguration of the four lines at Tungkillo to form:
  - One Robertstown to Para 275 kV circuit;
  - One Taillem Bend to Cherry Gardens 275 kV circuit;
  - One Robertstown to Tungkillo 275 kV circuit;
  - One Taillem Bend to Tungkillo 275 kV circuit;
  - One Tungkillo to Para 275 kV circuit, and;
  - One Tungkillo to Cherry Gardens 275 kV circuit;as shown in Diagram 1;
- The up-rating of the Cherry Gardens – Morphett Vale East 275 kV line to a design temperature of 120°C;  
as shown in Diagram 2, and;
- The upgrading of communication facilities at Mount Beevor Radio Station, and Para, Taillem Bend, Robertstown and Cherry Gardens substations to provide necessary 275 kV protection and SCADA functionality.

The establishment of the Tungkillo 275 kV substation results in a re-balancing of power flows to Cherry Gardens that results in improved utilisation of existing transmission assets that supply the Southern Suburbs network. This re-balancing of power flows also increases power flow on the Cherry Gardens - Morphett Vale East 275 kV line under single contingency conditions to the extent that the existing line would be overloaded under critical operating conditions from the summer of 2007/08. As a consequence, it is necessary to up-rate the Cherry Gardens – Morphett Vale East 275 kV line to a design temperature of 120°C as part of this project.

Without network augmentation, it would not be possible to meet the system security requirements of the NER while meeting the reliability and quality of supply criteria contained in the ETC.



The proposed augmentation to remedy the projected network limitations in the 275 kV transmission supply system is driven by service standards outlined in the South Australian ETC as well as the technical standards of the NER, making it a *reliability augmentation*. As such, it must satisfy the Regulatory Test promulgated by the Australian Energy Regulator (AER) for reliability augmentations<sup>1</sup>.

The recommendations in this Final Report are based upon:

- Identification of projected network limitations in the 275 kV transmission network supplying the Southern and Eastern Suburbs of metropolitan Adelaide, and supporting the Eastern Hills region, during credible single network contingencies, from summer 2006/07 onwards;
- The initial consultation undertaken by ElectraNet in conjunction with ETSA to identify potential non-network solutions to address the projected network limitations;
- The ensuing independent consultation undertaken solely by ElectraNet and aimed specifically at the projected transmission network limitations;
- A review of the submissions received as a result of the consultation process;
- The subsequent analysis of the feasible options in accordance with the ACCC's Regulatory Test for reliability augmentations, and;
- An assessment that network augmentation is required as soon as possible after the summer of 2005/06 to maintain system security and reliability of supply to customers in accordance with the requirements of the NER and the South Australian ETC.

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1 A reliability augmentation satisfies the Regulatory Test if..."in the event the option is necessitated solely by the inability to meet the minimum network performance requirements set out in schedule 5.1 of the Rules or in relevant legislation, regulations or any statutory instrument of a participating jurisdiction – the option minimises the present value of costs, compared with a number of alternative options in a majority of reasonable scenarios"...

## **3.0 PROJECTED NETWORK LIMITATIONS**

### **3.1 Reliability Standards and Service Obligations**

The South Australian ETC allocates each customer connection point on the transmission system a reliability category, with specific reliability standards applying to those categories. The ETC has allocated Category 4 status to the *Happy Valley - Morphett Vale East* grouped connection point (Southern Suburbs), and Category 5 status to the *Magill – East Terrace – Northfield* grouped connection point (Eastern Suburbs). This requires ElectraNet, as a licensed transmission entity in South Australia, to meet certain legally binding reliability and service standards with respect to the provision of transmission services at those connection points.

The specific (N-1) transmission line reliability standards and service obligations that ElectraNet must comply with for both the Southern and Eastern Suburbs are summarised below.

- The provision of N-1 line capacity of at least 100% of the Agreed Maximum Demand at each of the two grouped connection points;
- The continuous availability of at least 100% of N-1 line capacity supplying each of the two connection points, and;
- The restoration of contracted line capacity to each of the two connection points within 12 hours of an interruption, using best endeavours.

ElectraNet is not permitted to contract for an amount of Agreed Maximum Demand (AMD) greater than 100% of installed line capacity. Furthermore, in the event that the AMD at the grouped connection point exceeds available N-1 line capacity, ElectraNet must use its best endeavours to meet the standards within 12 months and, in any case, within 3 years of becoming aware of a violation.

This service standard requires that 100% of the AMD (which is effectively equivalent to the forecast peak demand in that year) for the Southern and Eastern Suburbs must be capable of being supplied instantaneously following a contingency without any loss of customer supply in the intervening period. Accordingly, ElectraNet's assessment of all proposals to meet the projected network limitations - both its own and those offered by other NEM participants and interested parties - had to ensure that due consideration was given to the requirement for a continuous supply of electricity and the ability to have contracted line and transformer capacity reinstated to agreed levels within the prescribed times.

The South Australian ETC also requires that ElectraNet provide N-2 transmission line capacity for the Eastern Suburbs grouped connection point as a Category 5 load. However, this N-2 provision is non-firm and permits considerable load shedding in the Eastern Suburbs. There is no similar requirement for N-2 capacity in the ETC for the Southern Suburbs.

The Eastern Hills loads comprise Category 3 and Category 1 loads, and contribute in a pre-contingent sense to the loading of the 275 kV transmission lines southwards from Para. Consequently, the Eastern Hills loads need to be taken into consideration when analysing the capability of the interconnected 275 kV system that supplies the total region.

## **3.2 Load Forecasts and Assumptions**

ElectraNet obtains electricity demand forecasts over a ten-year horizon from ETSA. Those forecasts take account of any known demand management programmes that are in-place or committed, and also the presence of embedded generation that may reduce the forecast peak demand supplied by a transmission connection point. However, to be effective in reducing the AMD at a connection point, those programmes or facilities must be continuously available and be operating at times of peak load.

ETSA's most recent demand forecasts for the connection points supplying the Southern Suburbs region of metropolitan Adelaide suggest that the overall load growth, based on medium economic growth, will continue at an average rate of about 3.5% per annum for the foreseeable future (3.2% in the northern portion, and 4.2% in the southern portion). This growth in electricity usage is largely attributable to the continuing development of residential housing estates in the area. The Eastern Suburbs load, that includes the Adelaide CBD, is forecast to continue to grow at an average rate of about 2.7% per annum, while the Eastern Hills region is forecast to grow at a rate of about 3.6% per annum.

ETSA's latest load forecasts and supporting assumptions were reproduced in Section 7 of the ESIPC's Annual Planning Report published in June 2005.

## **3.3 Capability During Single Contingencies**

As previously described in section 1.2, the Eastern and Southern Suburbs load regions, as defined in the ETC, are supplied by the 'Magill - East Terrace - Northfield' and 'Happy Valley - Morphett Vale East' grouped connection points, respectively. The majority of this supply has to be transferred southwards from Para via Magill and Cherry Gardens substations, and this transfer is limited by the thermal capacity of the lines between Para and Magill. In addition, the 132 kV network known as the Eastern Hills region is also supported via Cherry Gardens substation.

The Eastern Suburbs load comprises the Adelaide CBD, and the eastern and north-eastern suburbs of Adelaide. Two of the three main substations that supply the Eastern Suburbs grouped connection point, Magill and East Terrace, are responsible for supplying about 50% of the combined load via their 275/66 kV transformers. Northfield 275/66 kV substation supplies the remainder of the Eastern suburbs load from an electrically separate 275 kV transmission network. Two 275 kV lines, one from Torrens Island Power Station, and the other from Para substation, supply Magill substation and also contribute significantly to the supply of the Southern Suburbs grouped connection point. East Terrace 275/66 kV substation is supplied by a radial 275 kV circuit from Magill substation.

Happy Valley and Morphett Vale East 275/66 kV substations jointly supply the Southern Suburbs connection point, and obtain a significant portion of their 275 kV supply from Magill substation, about 20 kilometres to the north-east of the connection point, with the remainder being supplied from Cherry Gardens substation. Cherry Gardens is supplied via a single circuit from TIPS and two lines from Davenport substation, at Port Augusta, about 300 kilometres to the north of Adelaide. The two lines from Davenport also supply Robertstown 275/132 kV substation that is located about 110 kilometres to the north of Adelaide and which supplies the Riverland 132 kV system. Because of their length, the two circuits from Robertstown provide relatively weak in-feeds into the Southern Suburbs supply system, whereas the remaining three in-feeds (two from TIPS and one from Para) provide strong 275 kV supply to both the Southern and Eastern Suburbs and the Eastern Hills load region.

Cherry Gardens substation provides a 275/132 kV in-feed into the Eastern Hills load region. This region is also supported from Para and Tailem Bend 275/132 kV substations, and includes major connection points at Mount Barker, in the Adelaide Hills, and Mobilong, near Murray Bridge. Additionally, all Murray River water pumping for Adelaide is supplied from this 132 kV network.

Detailed analysis has shown that the transfer capability of the existing transmission system supplying the Southern Suburbs connection point is limited southwards from Para towards Magill. Beyond Summer 2005/06, action is necessary to prevent thermal overloads in the TIPS - Magill and Para - Magill 275 kV lines, the remaining two circuits that provide supply for the Happy Valley – Morphett Vale East connection point, during an outage of the TIPS -Cherry Gardens in-feed at times of peak demand. The overloads could be avoided by limiting the load in the Southern Suburbs to pre-Summer 2006/07 levels. However, the South Australian ETC states that the transmission network must be able to *continuously* supply the peak load of a Category 4 connection point (such as the Happy Valley - Morphett Vale East one) under all credible single contingency operating conditions. The thermal limitations in the Southern Suburbs supply network will also adversely impact the transmission network’s ability to supply the Eastern Suburbs (including the CBD), where more onerous reliability requirements apply.

In addition to the thermal limitations discussed above, a voltage level limitation also exists, specifically in the Southern Suburbs load area, as identified in the Request for Information / Request for Proposals paper published in April 2004 and the subsequent Application Notice published in March 2005. An outage of either the Magill - Happy Valley or the TIPS - Cherry Gardens 275 kV lines will result in substantially reduced 275 kV transmission voltages at the Southern Suburbs supply points, which could ultimately lead to voltage collapse across the entire region should the contingency occur at a time of high loads.

ElectraNet’s analysis of the projected network limitations shows that NEM-compliant 275 kV voltage levels and operation within transmission line rating limits will not be achievable beyond summer 2005/06 without some form of additional reinforcement, extension, or augmentation of the power system that supplies the Southern and Eastern Suburbs and that provides support to the Eastern Hills region.

The table presented below is based on the most recent load forecast supplied by ETSA. It provides an indication of the level and period of load reduction that could be required under contingency operating conditions if no augmentation occurs. In the absence of augmentation, load reduction would be required to maintain the transmission system in a secure operating state and to ensure that plant and equipment remains within acceptable ratings. As noted, augmentation is required because such load reductions are not permitted for Category 4 or Category 5 loads under the reliability obligations of the South Australia ETC.

Year	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Load at risk (MW)	0	1.0	25.6	50.9	77.2	104.4	132.6	161.7	191.9	223.1
Duration at risk (hrs)	0	0.3	7.7	14.9	21.8	28.4	34.9	41.1	47.1	52.9

\* Load at risk is the load that would not be able to be supplied from the existing transmission or sub-transmission system following the occurrence of a critical single contingency event and the utilisation of permitted means of supporting the remaining load. Periods may occur following a critical contingency when significantly larger portions of the total load are without supply until contingency arrangements are placed into operation.

## **4.0 RESPONSES TO THE ‘APPLICATION NOTICE’**

ElectraNet SA issued an ‘Application Notice’ in accordance with NER requirements in April 2005. That Application Notice contained a proposed recommendation to address the projected network limitations. The recommendation was that:

- A 275 kV substation be established at a vacant ElectraNet site at Tungkillo, approximately 40 kilometres east of the Adelaide CBD, at the point where the two Tailem Bend - Para 275 kV lines cross the two Robertstown - Cherry Gardens 275 kV lines;
- The four lines at Tungkillo be reconfigured to form:
  - One Robertstown to Para 275 kV circuit;
  - One Tailem Bend to Cherry Gardens 275 kV circuit;
  - One Robertstown to Tungkillo 275 kV circuit;
  - One Tailem Bend to Tungkillo 275 kV circuit;
  - One Tungkillo to Para 275 kV circuit;
  - One 275 kV circuit from Tungkillo (via Cherry Gardens) to tee into the Magill - Happy Valley 275 kV line;
- A new section of 275 kV line be strung on the vacant side of the Cherry Gardens - Happy Valley 275 kV line between Cherry Gardens and the point where it meets the Magill - Happy Valley line, that the new section of line be tee-ed into the Magill -Happy Valley line, and that the 275 kV transmission line entries be modified at Cherry Gardens substation to accommodate a by-pass arrangement for the Cherry Gardens end of that new line, thereby creating a three-way Magill - Happy Valley -Tungkillo 275 kV line, and;
- Communication facilities at Tungkillo, Happy Valley and Magill substations be upgraded to facilitate a protection scheme for that three-way connection.

One submission was received in response to that draft recommendation.

### **4.1 Submission Received**

One single submission was received in response to the Application Notice of April 2005. That submission was from the South Australian 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.

#### **4.1.1 ESIPC Submission**

In its submission, the ESIPC strongly supported the development of Tungkillo both as an important component of addressing the needs of the southern suburbs and as a key new node in the future development of the network. The ESIPC went further to recommend that, because of its importance, the switchyard’s design, layout, size, and equipment ratings be scoped and determined with a view to permit simple expansion and operating flexibility as and when may be required in the future.

The ESIPC also recommended that ElectraNet proceed with upgrading “relevant circuits where unused capability exists (in particular, the Cherry Gardens-Happy Valley and Cherry Gardens-Morphett Vale East 275kV circuits)”. This work would be in lieu of ElectraNet’s proposal to build a new section of line on the vacant side of the Cherry Gardens – Happy Valley line with the purpose of forming a teed Tungkillo-Magill / Happy Valley line.

ElectraNet has given careful consideration to the proposals presented by the ESIPC and has reviewed them in accordance with the requirements of the NER and the Regulatory Test.

ElectraNet is supportive of the intent of the ESIPC recommendation to expand the design of the proposed Tungkillo substation to a 'fully-switched' Tungkillo solution, where all four lines (the two Robertstown – Cherry Gardens and the two Tailem Bend – Para 275 kV lines) are turned in and out of Tungkillo. However, an economic assessment of the proposal in light of the NER requirements has shown that the additional cost associated with the ESIPC recommendation could not be justified.

Under the NER Regulatory Test requirements, the augmentation that passes the test must ... "minimises the present value of costs, compared with a number of alternative options in a majority of reasonable scenarios". On these grounds ElectraNet is unable to implement the ESIPC recommendation at this time.

ElectraNet has also undertaken an evaluation of the ESIPC's second recommendation regarding the up-rating of the Cherry Gardens – Morphett Vale East 275 kV line in lieu of constructing a new circuit between Cherry Gardens and the Magill - Happy Valley 275 kV line. This evaluation shows that the ESIPC's proposal would provide additional capacity for the local network in the short term, which would defer the need for more substantial reinforcement, as originally proposed by ElectraNet, by about five years, depending on load growth. The economic evaluation demonstrates that the deferment in capital expenditure brought about by implementing the ESIPC recommendation is sufficient to justify the up-rating work. Consequently, ElectraNet has adopted this suggestion.

## **5.0 OPTIONS CONSIDERED**

### **5.1 Summary of the Consultation Process undertaken**

In accordance with advice from ElectraNet, the ESIPC's Annual Planning Reviews<sup>2</sup> have from 2001 foreshadowed that some form of reinforcement would be required to address projected transmission network limitations impacting on the 275 kV supply for metropolitan Adelaide.

In April 2004, ElectraNet and ETSA jointly issued a consultation paper providing more-detailed information on the projected network limitations in the Southern Suburbs. This paper sought information from NEM Participants and interested parties regarding potential solutions to address a number of projected network limitations.

The closing date for submissions on this preliminary notification of network limitations was 26<sup>th</sup> May 2004. No formal submissions or proposals for practical alternative non-network solutions were received.

ElectraNet subsequently conducted its own independent consultation specifically regarding the projected limitations on the transmission network by publishing, in April 2005, an Application Notice addressing the projected limitations, the network solutions that ElectraNet had considered, and a description of ElectraNet's proposed course of action, in accordance with the NER requirements. The document included invitation for submissions from NEM participants and interested parties regarding ElectraNet's proposed augmentation.

The closing date for submissions was 6<sup>th</sup> May 2005, with one submission being received. That submission was from ESIPC, and provided constructive comment on the overall concept, and recommendations regarding two specific aspects of ElectraNet's proposal. The first recommendation was that ElectraNet broaden the scope of its intended solution to maximise the potential benefits that could be derived from implementing a fully switched Tungkillo solution at the outset. The second recommendation queried the need to construct a new section of line to tee into the Magill-Happy Valley 275 kV line from Cherry Gardens. As discussed in section 4.1 of this report, ElectraNet is unable to implement the first of these recommendations because of the economic requirements of the Regulatory Test. However, the second recommendation would pass the requirements of the Regulatory Test and has been adopted in this Final Report.

### **5.2 Non-Transmission Options Identified**

#### **5.2.1 Existing and New Generation**

At present there are three existing sources of generation operating in the Southern Suburbs load area. They are the diesel generators located at Kingscote on Kangaroo Island, the Cummins distillate fired power station at Lonsdale, and the Starfish Hill wind powered generating station located at Cape Jervis on the Fleurieu Peninsula.

The diesel generators located at Kingscote on Kangaroo Island have a total capacity of 2.4 MW and are only used when the supply from the mainland is unavailable. Their contribution to contingency support for the Southern Suburbs has therefore been discounted.

The Lonsdale generating plant comprises twenty individual distillate-fuelled generating units, each with a rating of 1 MW. It connects to the 11 kV system at Port Stanvac substation and

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<sup>2</sup> Published annually in June

runs infrequently, generally in response to the NEM, and has therefore been assumed to be off-line for the purposes of analysing the existing Southern Suburbs electricity supply system.

The Starfish Hill wind farm comprises 23 individual wind generators, each with a capacity of 1.5 MW, making a total installed capacity of 34.5 MW. This generating station connects into the Southern Suburbs 66 kV sub-transmission system at Yankalilla on the Fleurieu Peninsula.

ElectraNet and ETSA are aware of several proposals for the establishment of additional wind farms along the coast between Adelaide and Rapid Bay. However, in the absence of any firm commitment by the proponents to date, these possible developments were excluded from the analysis of the existing network.

Despite the potential abundance of wind farm developments, both existing and proposed, in the region, the unpredictable nature of the wind that provides their energy source inherently introduces a high level of uncertainty and volatility regarding the availability of generating capacity from those wind farms. Because of this, it has been assumed that this source of generation would provide a negligible contribution to the firm generating capacity that would otherwise be needed to meet network requirements.

It should be noted that load growth within the Southern Suburbs supply area is such that even if an optimistic view was taken regarding the output of existing power stations in the area, the additional capacity that could be provided would only be sufficient to delay the need for augmentation by 12 months or less.

Dry Creek Power Station is the only source of existing generation in the Eastern Suburbs. It can inject approximately 2x40 MW into ETSA's 66 kV network on a hot summer day. However, the off-loading effect of this power station is more noticeable at Northfield substation, which is supplied from a completely different 275 kV transmission network, and is essentially insignificant at Magill and East Terrace substations due to the relatively high impedance of ETSA's 66 kV network.

ElectraNet is not aware of any additional existing or committed wind or non-wind generation developments, other than those discussed above, that will potentially impact the 275 kV transmission network that supplies the Southern and part of the Eastern Suburbs and adjoining southern rural area of South Australia. No firm generation alternatives that could address the identified network limitations were received in response to either the RFI/RFP document or the Application Notice.

### 5.2.2 Demand Side Management

The electricity demand forecasts that ElectraNet obtains from ETSA take into account both existing and proposed demand management programmes that may reduce the forecast demand at transmission connection points. Neither ElectraNet nor ETSA received information regarding demand-side or other initiatives in response to the public consultation that has been undertaken regarding these projected network limitations.

### 5.2.3 Embedded Generation

As with demand-side management programmes, ETSA's electricity demand forecasts take account of embedded<sup>3</sup> generation that is in-place, committed, or likely to occur, and that may

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<sup>3</sup> 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.



similarly reduce the forecast demand at transmission connection points. Again, no information about initiatives was obtained from any other party during the consultation process.

### **5.3 Distribution Options Identified**

Joint planning has been undertaken between ETSA and ElectraNet regarding these projected network limitations. However, ETSA has advised that they do not have any economic distribution system solutions to address these particular transmission limitations. Only relatively weak 66 kV (dead) transfers are available between metropolitan regions, and notwithstanding this, all practical distribution in-feed alternatives are ultimately supplied from the same 275 kV transmission network. The use of “dead” transfer of load for network support is not permitted for Category 4 and 5 loads under the ETC.

### **5.4 Transmission Options Identified**

In addition to the consultation process to identify possible non-network solutions, ElectraNet has carried out studies to determine the most appropriate transmission network solution to address the projected network limitations. Two feasible options were identified, and are described in detail in the following section.

## 6.0 IDENTIFIED TRANSMISSION SOLUTIONS

An overview of the feasible transmission options that have been identified is provided in this section, with a more detailed summary of the financial analysis provided in Appendix 2.

### 6.1 Feasible Transmission Solutions

Option 1 – Tungkillo Network Solution <sup>4</sup>		
<u>Date required</u>	<u>Proposed Augmentation</u>	<u>Total capital cost</u>
October 2006	<p><i>At Tungkillo</i></p> <p>Establish a 275 kV substation at the point where the two Tailem Bend - Para 275 kV lines cross the two Robertstown -Cherry Gardens 275 kV lines ('Tungkillo');</p> <p>Reconfigure the four lines at Tungkillo to form:</p> <ul style="list-style-type: none"> <li>• One Robertstown to Para 275 kV circuit;</li> <li>• One Tailem Bend to Cherry Gardens 275 kV circuit;</li> <li>• One Robertstown to Tungkillo 275 kV circuit;</li> <li>• One Tailem Bend to Tungkillo 275 kV circuit;</li> <li>• One Tungkillo to Para 275 kV circuit, and;</li> <li>• One Tungkillo to Cherry Gardens 275 kV circuit.</li> </ul>	\$23.7 M
	<p><i>On the Cherry Gardens – Morphett Vale East 275 kV line</i></p> <ul style="list-style-type: none"> <li>• Up-rate the Cherry Gardens – Morphett Vale East 275 kV line to a design temperature of 120°C;</li> </ul>	\$3.8 M
	<p><i>Communications / Protection</i></p> <ul style="list-style-type: none"> <li>• Upgrade communication facilities at Mount Beevor Radio Station, and Para, Tailem Bend, Robertstown and Cherry Gardens substations, to provide necessary 275 kV protection and SCADA functionality.</li> </ul>	\$2.8 M
	<b>TOTAL</b>	<b>\$30.3 M</b>

This relatively simple reconfiguration of the existing 275 kV network is shown in Diagram 3. It provides the dual benefits of augmenting supply to ElectraNet's connection points that supply the Southern and Eastern Suburbs, and supports the Eastern Hills region, while providing an additional source of reactive power to support voltage levels on ETSA's Southern Suburbs 66 kV network. It also achieves a more diverse and balanced high voltage in-feed into the Adelaide metropolitan area, which improves supply reliability and reduces electrical losses (both real and reactive) by providing an alternative path for southerly power-flow from Para via Tungkillo rather than from Magill via the Adelaide hills face. The diversity of this arrangement also provides improved circuit separation in the event of a major Adelaide Hills bushfire.

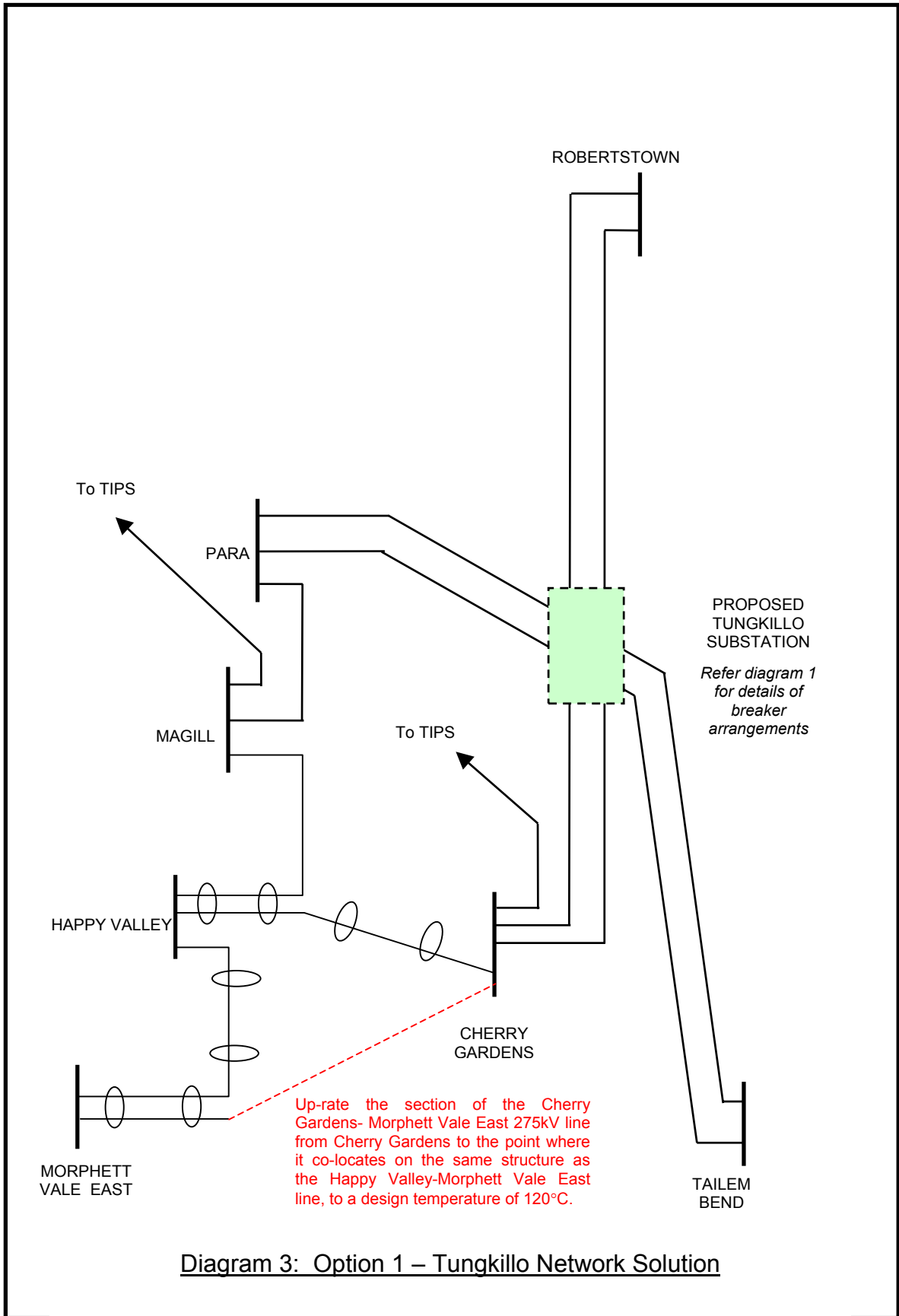
<sup>4</sup> The timing of the augmentation is based on the electricity demand forecast as published in the initial consultation paper issued by ElectraNet in April 2004. The financial analysis evaluates possible variations to the timings for different load growth forecasts using the market development scenarios in section 7.0.

The Tungkillo 275 kV substation will be constructed using a 'breaker-and-a-half' arrangement, essentially as shown in Diagram 1. This arrangement provides for greater system security and operational flexibility both during and following construction than would other switchyard arrangements. This is considered essential given the significance of the four 275 kV circuits that are involved not only in transferring power from Victoria to South Australia, but also in supplying the Adelaide metropolitan, CBD and Eastern Hills loads.

Option 1, the Tungkillo Network Solution, is expected to minimise environmental and visual impacts in comparison with other alternatives. ElectraNet already owns a vacant parcel of land of sufficient size to accommodate the proposed substation directly adjacent the point where the two Tailem Bend - Para lines cross the two Robertstown - Cherry Gardens lines. The substation site is in an area of low population density that is used predominantly for stock grazing. Necessary work required to up-rate the Cherry Gardens – Morphett Vale East 275 kV line will be performed on existing structures, and as such will have minimal additional environmental or visual impact.

No new line corridors are required for this option.

Planning studies show that Option 1 will not adversely impact other transmission networks, interconnection flows, or generation despatch within the NEM, and provides a tangible reduction in transmission system losses.



Option 2 – Taillem Bend – Cherry Gardens double circuit 275 kV line <sup>5</sup>		
<u>Date required</u>	<u>Proposed Augmentation</u>	<u>Total capital cost</u>
October 2006	<p><i>Between Taillem Bend and Cherry Gardens substations</i></p> <ul style="list-style-type: none"> <li>Construct a new double-circuit 275 kV line of approximately 85 km length between Taillem Bend and Cherry Gardens substations, including two new 275 kV exits at Taillem Bend and two new 275 kV exits at Cherry Gardens substations;</li> <li>Install appropriate communications to facilitate an appropriate protection scheme for the new exits;</li> </ul>	\$65.1M
	<p><i>On the Cherry Gardens – Morphett Vale East 275 kV line</i></p> <ul style="list-style-type: none"> <li>Up-rate the Cherry Gardens – Morphett Vale East 275 kV line to a design temperature of 120°C;</li> </ul>	\$3.8 M
	<p><i>Communications / Protection</i></p> <ul style="list-style-type: none"> <li>Upgrade communication facilities at Mount Beevor Radio Station, and Para, Taillem Bend, Robertstown and Cherry Gardens substations, to provide necessary 275 kV protection and SCADA functionality.</li> </ul>	\$2.8 M
	<b>TOTAL</b>	<b>\$71.7 M</b>

This option requires the construction of a new double circuit 275 kV line between Cherry Gardens and Taillem Bend substations, as shown in Diagram 4.

The double circuit 275 kV line from Taillem Bend to Cherry Gardens substations will provide essentially the same technical benefits as would Option 1; specifically, those of strengthening supply to both the Southern and Eastern Suburbs, supporting the Eastern Hills, and providing an additional source of reactive power to support voltage levels on ETSA's Southern Suburbs 66 kV network.

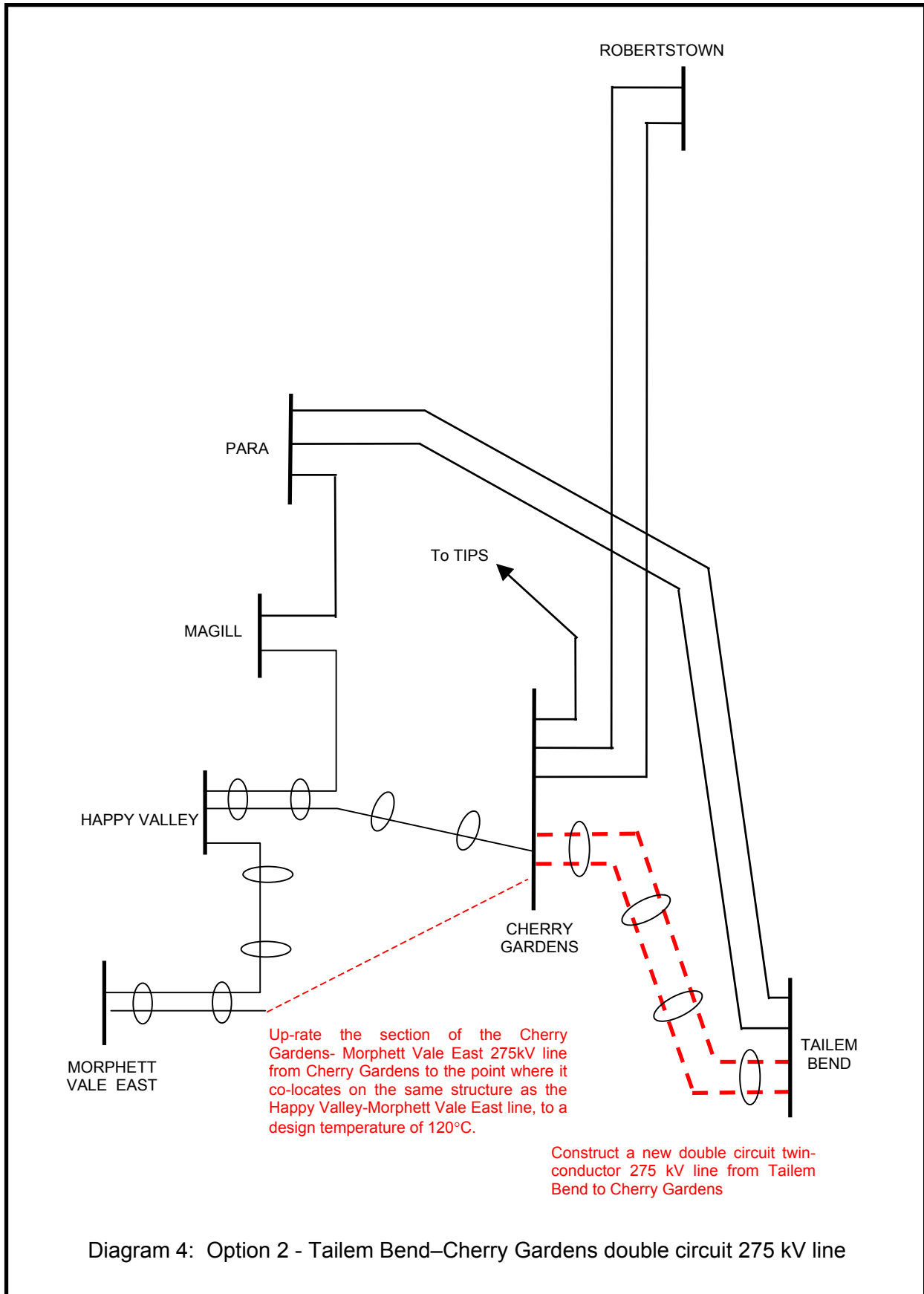
As in Option 1, this scheme proposes up-rating the Cherry Gardens – Morphett Vale East 275 kV line to a design temperature of 120°C. This is to enable the existing network to cope with the altered power flows into the Southern Suburbs network under contingency operating conditions beyond summer 2006/07. This work, as with Option 1, will be performed on existing structures, and as such will have minimal additional environmental or visual impact.

This option is likely to have a higher visual and environmental impact than Option 1 as it involves the construction of approximately 85 kilometres of new transmission line. Obtaining an acceptable line route would require careful consideration of relevant environmental and cultural requirements and extensive consultation with all interested parties. This would be particularly

<sup>5</sup> The timing of the augmentation is based on the electricity demand forecast as published in the initial consultation paper issued by ElectraNet in April 2004. The financial analysis evaluates possible variations to the timings for different load growth forecasts using the market development scenarios in section 7.0

important for the first 25 to 30 kilometres east of Cherry Gardens, given the environmental sensitivity of the southern Mount Lofty Ranges region.

Planning studies show that Option 2 will not adversely impact other transmission networks, interconnection flows, or generation despatch within the NEM.



## 6.2 Other options that were identified but not pursued

### Network reinforcement options

Two variations on Option 2 were considered by ElectraNet, but subsequently dismissed. They were the establishment of a dual circuit 275 kV line between Para and Cherry Gardens substations, and the building of a single circuit 275 kV line from each of Tailem Bend and Para to Cherry Gardens substations. Both of those options would similarly have required the up-rating the Cherry Gardens – Morphett Vale East 275 kV line to a design temperature of 120°C by 2007/08.

These variations were discarded by ElectraNet mostly because any realistic line route between Para and Cherry Gardens substations would of necessity traverse the environmentally sensitive Mount Lofty Ranges region for its entire length of more than 50 kilometres. Since the intervening terrain is generally heavily wooded, the selected line route would require substantial vegetation clearance to meet bushfire and electrical clearance requirements. Furthermore, the area is already relatively congested with transmission lines. It should be noted that in the 1970's the Electricity Trust of South Australia endeavoured to acquire easements northwards from Cherry Gardens towards Para. Easements were obtained with great difficulty from Cherry Gardens as far north as the Verdun area before this was abandoned due to environmental pressures. Consequently ElectraNet considers that it would be extremely difficult to obtain a mutually agreeable transmission line corridor through the region, and that once a suitable line route was agreed, the cost to build such a line would be considerable in view of the nature and sensitivity of the intervening terrain. As these variations provide no technical advantage over either Option 1 or Option 2, ElectraNet considered it reasonable that they be dismissed.

### Generation options

ElectraNet also considered the option of connecting additional generation into the Southern Suburbs system, despite ElectraNet's recognition that it has only limited expertise in this field. This was done to provide ElectraNet with the confidence that all viable alternatives to reinforcing the network had been considered.

In order to be a viable alternative, any generation option would have to provide an equivalent level of network support to that provided by the transmission solutions identified. Furthermore, in order to meet ETC requirements, generation would have to be permanently available, continuously accessible, operate at times of high load, and be capable of supplying, as a minimum, loads in accordance with the table presented in section 3.2 of this document.

ElectraNet's assessment was that a generation option in the area was unlikely to be economically or technically feasible due to issues regarding the location of the plant, development approval, and the availability of suitable economic fuel supplies. This view was supported by the lack of generation proposals received by ElectraNet in response to either the initial RFI/RFP consultation process or the subsequent issue by ElectraNet of its Application Notice.



## **7.0 MARKET DEVELOPMENT SCENARIOS**

### **7.1 Context for Evaluation of Options**

All feasible solutions to the identified network limitations were viewed in the context of wider developments within the NEM. The ESIPC's latest APR, issued in June 2005, contained information on existing and committed generation developments in South Australia, an extract from which follows:

*"... assuming coincident peak demand conditions in the combined South Australian and Victorian region there will be a 152 MW shortfall below the 530 MW reserve margin required by NEMMCO for the 2005-06 summer ...*

*... There are currently no new scheduled generation projects listed as either "Under Construction" or "Committed" in either South Australia or Victoria to alter this situation ...*

*... The completion of Basslink in April 2006 will provide an additional 600 MW of capacity into the combined South Australian-Victorian region resulting in a reserve surplus in the order of 100 MW for the combined region for the summer of 2006-07. Without new investment subsequent years will have an increasing reserve deficit and after 2008-09, there will be insufficient capacity to meet the combined South Australian-Victorian forecast 10% PoE peak demand ..."*

ElectraNet's analysis shows that this proposed large network augmentation will not inhibit the dispatch of existing and proposed new generation, and consequently further erode the situation described above, but rather, depending on the location of any proposed plant, the Tungkillo Network Solution could facilitate the connection of new generation.

### **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, and;
- Potential generation and demand-side developments.

The Regulatory Test also requires sensitivity analysis with respect to key input variables, including capital and operating costs, the discount rate, and the commissioning date. The purpose of utilising this approach is to test the robustness of the outcomes of the test under a range of plausible scenarios that could feasibly occur in the NEM.

The NER require ElectraNet as a TNSP to analyse the expected future operation of its transmission network, taking into account any Market Network Service Provider (MNSP) options (refer Clause 5.6.2 (a) of the NER). However, as this is an intra-regional development, there is by definition no feasible MNSP development (refer Clause 2.5.2 (a) of the NER).

### 7.2.1 Existing Network and Future Transmission Developments

When formulating the market development scenarios, existing network behaviour and the impact of the two potential transmission augmentations identified in this document were taken into account. Other planned transmission augmentations are independent of the identified limitations and were therefore not included in the scenarios.

### 7.2.2 Variations in Load Growth

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

The analysis of ElectraNet's transmission system in the Southern and Eastern Suburbs of metropolitan Adelaide, and the Eastern Hills region, for the 10-year period from 2005, has been based on the *medium* growth forecast provided by ETSA, as this represents the most likely load growth scenario. The results of this analysis have then enabled ElectraNet to identify and assess what potential limitations may occur in meeting system reliability and security standards in accordance with the NER and ETC requirements.

ETSA also provides two other load forecasts - high and low – and ElectraNet has used these 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 are contained in the 2005 Annual Planning Review. The impact of applying the high and low forecasts was to confirm that the preferred option was robust under varying levels of economic activity within the State, a factor that is beyond the control of ElectraNet. The detailed results of the effect of varying levels of economic activity are provided in Appendix 2 of this document.

Market development scenarios were formulated to consider sensitivity to variations in load growth. The scenarios used in the analysis in this report are outlined in section 7.2.4.

### 7.2.3 Existing, Committed and Potential Generation Developments

At present there are three existing sources of generation operating in the Southern Suburbs load area, as discussed in section 5.2.1 of this document; the diesel generators located on Kangaroo Island, the Cummins distillate fired power station at Lonsdale, and the Starfish Hill wind powered generating station located at Cape Jervis. However, these sources of generation are capable of contributing only a small portion of the total generating capacity needed to meet the Southern Suburbs load on a firm basis, as would be required by the ETC should this be a viable alternative.

In the Eastern Suburbs there is only one existing source of non-embedded generation; specifically, Dry Creek power station at Kilburn. However, those gas turbines have minimal effect on the loading of the 275 kV transmission lines south of Para or the 275 kV voltages further to the south.

ElectraNet is not aware of any existing or committed non-wind generation proposals, as discussed in section 5.2.1, that will potentially impact the 275 kV transmission network that supplies the Southern and part of the Eastern Suburbs and adjoining southern rural area of South Australia. No firm generation proposals were received by ElectraNet or ETSA in response to the Southern Suburbs RFI/RFP consultation, nor to ElectraNet's subsequent Application Notice.

Consequently, no scenarios have been developed for differing levels of output by either existing or committed power stations within the Southern or Eastern Suburbs areas, and all scenarios used in the Regulatory Test analysis have assumed zero output from those generators, since this represents a highly plausible scenario in the NEM environment.

It should be noted that load growth within the Southern and Eastern Suburbs and in the Eastern Hills supply areas is such that even if an optimistic view was taken regarding the output of those power stations, the additional capacity that could be provided would not be sufficient to defer the need for augmentation by 12 months. Because those generators are embedded in the distribution system, their output is netted from the load that is seen at the transmission connection points. As such, a market scenario that considers a lower level of load growth would be a surrogate for a market scenario that assumed higher levels of generation from those power stations. Such a market scenario has been considered when undertaking the Regulatory Test.

7.2.4 Market Development Scenarios

Three market development scenarios have been formulated to simulate the impact of variations in load growth by applying the three load forecasts supplied by ETSA (refer section 7.2.2):

Scenario A	Low load growth forecast
Scenario B	Medium load growth forecast
Scenario C	High load growth forecast

These market development scenarios are analysed in detail in section 9 of this Final Report.

## 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 promulgated by the AER in accordance with clause 5.6.5A of the National Electricity Rules (NER).

An option satisfies the *Regulatory Test* if:

- (a) In the event the option is necessitated solely by the inability to meet the minimum network performance requirements set out in schedule 5.1 of the NER or in relevant legislation, regulations or any statutory instrument of a participating jurisdiction – the option minimises the present value of *costs*, compared with a number of *alternative options* in a majority of *reasonable scenarios*.
- (b) In all other cases – the option maximises the expected net present value of the *market benefit* ... compared with a number of *alternative options* and timings, in a majority of *reasonable scenarios*.

The Regulatory Test contains guidelines for the methodology to be used to calculate the present value of costs and the net present value (NPV) of the market benefit. Where an augmentation is required to satisfy minimum network performance requirements (i.e. a reliability augmentation), the published methodology defines “cost” as the total cost of that option (or an *alternative option*) to all those who produce, distribute or consume electricity in the National Electricity Market.

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 projected network limitations in the Southern and Eastern Suburbs of metropolitan Adelaide as outlined in this document is required to satisfy reliability requirements linked to Schedule 5.1 of the National Electricity Rules, ElectraNet’s service obligations under the South Australian ETC, and the requirements of the Electricity Act SA 1996<sup>6</sup>.

According to the Regulatory Test, this means that the costs of all reasonable 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 present value (PV) cost of the various options, are shown in section 9.0.

Cost inputs to the economic analysis are described below.

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<sup>6</sup> Refer section 3.0.

### 8.2.1 Cost of Transmission Augmentations

The costs to implement the two network solutions outlined in section 6.0 of this document have been estimated by ElectraNet. Sensitivity studies have been carried out using variations in those 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. As a component of this, the estimated saving in the cost of network losses for each option has been included, based on the assumption of a typical load factor and an average cost of losses (presently about \$30/MW.h).

Costs for items that are common to both options were not included in the analysis. Those common costs include the capital and operating costs of other future transmission works, where those costs are independent of the identified network limitations. As such, they have no impact on the relative ranking of options resulting from the analysis.

## **9.0 FINANCIAL ANALYSIS**

### **9.1 Description of Financial Analysis Approach**

The economic analysis undertaken considered the present value of the costs of the two options over the fifteen-year period from 2005/06 to 2020/21. A more detailed summary of the results of this analysis is contained in Appendix 2.

### **9.2 Present Value Analysis**

Financial analysis was carried out to calculate and compare the Present Value (PV) of the costs to market participants of both of the options under the three market development scenarios defined in section 7.2.4.

A fifteen-year analysis period was selected for the financial analysis. ElectraNet has elected to use this period as a balance between the National Electricity Rules requirements that TNSPs use a minimum planning horizon of ten years, combined with the view expressed by the Inter-regional Planning Committee (IRPC) that a planning horizon beyond ten years better reflects 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.

As discussed in section 8.2.1, the capital and operating costs for items that are common to both options were not included in the analysis. However, where the timing of common works has been affected by either of the proposed options, the cost of those other works has been included in the PV analysis.

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

Under the Regulatory Test for reliability augmentations, it is the ranking of the options that is important, rather than the actual present value results. This is because the Regulatory Test requires that the recommended option minimise the present value of costs, compared with a number of alternative options, in a majority of reasonable scenarios.

The following table summarises the results of the economic analysis provided in Appendix 2. It shows the present value cost of implementing each of the two options. For each of the scenarios considered, the best-ranked or least cost option has been highlighted.

From the results, it can be seen that the level of load growth in the region impacts on both options in a similar manner.

Discount rate 10%	Option 1 Tungkillo Network Solution		Option 2 Tailem Bend – Cherry Gardens double circuit 275 kV line	
	Present Value Cost (\$M)	Rank	Present Value Cost (\$M)	Rank
Scenario A (low load growth)	\$21.87	1	\$53.21	2
Scenario B (medium load growth)	\$20.59	1	\$52.51	2
Scenario C (high load growth)	\$19.77	1	\$51.28	2

### 9.3 Sensitivity Analysis

In addition to examining the impact of market development scenarios, the sensitivity of the option-ranking to two 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, the resulting present value cost, and the ranking of each option under the stated conditions. The analysis was again conducted using the medium load growth scenario.

Parameter incurring variation (all studies at 10%pa discount rate, DNSP forecast loads and \$30/MW.h cost of losses, unless stated otherwise)	Option 1 Tungkillo Network Solution		Option 2 Tailem Bend – Cherry Gardens double circuit 275 kV line	
	Present Value Cost (\$M)	Rank	Present Value Cost (\$M)	Rank
<i>Discount Rate (% pa)</i>				
7.5%	\$23.43	1	\$60.25	2
10%	\$20.59	1	\$52.51	2
12.5%	\$18.28	1	\$46.28	2
<i>Capital Cost of project</i>				
15% less than estimated cost	\$16.70	1	\$43.29	2
estimated cost	\$20.59	1	\$52.51	2
15% more than estimated cost	\$24.48	1	\$61.73	2

As can be seen in this table, Option 1 is the best-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 these particular parameters, the values of which can quite plausibly change in line with wider economic trends.



## 10.0 SUMMARY AND DISCUSSION OF RESULTS

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

- There is no acceptable 'do-nothing' option. The projected network limitations must be addressed by the summer of 2006/07 in order to maintain system security and reliability standards during a single contingency of either the Torrens Island - Cherry Gardens or Magill - Happy Valley 275 kV transmission lines.
- In April/May 2004 ElectraNet, in conjunction with ETSA, carried out an initial consultation inviting interested parties to propose either network or non-network solutions to the network limitations. No proposals for feasible alternative non-network solutions were received.
- ElectraNet subsequently conducted its own independent consultation specifically aimed at the projected limitations on the transmission network, by publishing an Application Notice addressing the projected limitations on its web site in March. The document included invitation for submissions from NEM participants and interested parties regarding ElectraNet's intended augmentation, with submissions closing on 6<sup>th</sup> May 2005.
- One submission was received in response to the Application Notice. That submission was from the ESIPC, and suggested two alternative recommendations. The first recommendation was that ElectraNet broaden the scope of its intended solution to maximise the potential benefits that could be derived from implementing a fully switched Tungkillo solution at the outset. The second recommendation queried the need to construct a new section of line to tee into the Magill-Happy Valley 275 kV line from Cherry Gardens. The first of these recommendations did not pass the economic requirements of the Regulatory Test. However, the second recommendation would pass the Regulatory Test requirements, and has been adopted in this Final Report.
- ETSA has advised that it does not have an economically feasible distribution network solution that would address the projected network limitations on the transmission system that impact the Southern or Eastern Suburbs connection points.
- Economic analysis has identified that revised Option 1 is the solution that minimises the present value of costs over the fifteen-year period of analysis under all of the scenarios considered. On this basis, augmentation comprising:
  - The establishment of a 275 kV substation at a vacant ElectraNet site at Tungkillo, approximately 40 kilometres east of the Adelaide CBD, at the point where the two Tailem Bend - Para 275 kV lines cross the two Robertstown - Cherry Gardens 275 kV lines;
  - The reconfiguration of those lines to create one line directly from Robertstown to Para substations, one line directly from Tailem Bend to Cherry Gardens substations, and one line each from Robertstown, Tailem Bend, Cherry Gardens and Para substations, to the newly established Tungkillo substation;
  - The up-rating to a design temperature of 120°C of the Cherry Gardens – Morphett Vale East 275 kV line to accommodate the increased power-flows through Cherry Gardens, and;
  - The upgrading of communication facilities at Mount Beevor Radio Station, and Para, Tailem Bend, Robertstown and Cherry Gardens substations, to provide necessary 275 kV protection and SCADA functionality;

is the option that satisfies the Regulatory Test for reliability augmentations.

- Sensitivity analysis has shown that this conclusion is robust when considered against variations in capital cost and other factors outside of the influence of ElectraNet. Option 1 is also the highest-ranked option under all of the applicable market development scenarios.
- Implementation issues significantly favour Option 1 in preference to Option 2. Option 2 involves the construction of 85 kilometres of new transmission line. Obtaining a route for this line would require careful consideration of environmental and cultural issues, particularly for the first twenty-five kilometres or so east out of Cherry Gardens substation through the Southern Mount Lofty Ranges. In contrast, the preferred site for the Tungkillo 275 kV substation is in a predominantly grazing area on land already owned by ElectraNet and directly adjacent the point of intersection of the four lines for which reconfiguration is proposed. All works involved in up-rating of the Cherry Gardens –Morphett Vale East 275 kV line will take place on the existing structures, and as such, will have no increased environmental or visual impact.
- The proposed solution makes efficient use of existing assets, and increases the security, reliability and diversity of supply to the Southern and Eastern Suburbs regions of metropolitan Adelaide.

## **11.0 FINAL RECOMMENDATION**

Based on the conclusions drawn from the analysis, and with consideration for the submissions received in response to the preliminary recommendation contained in the Application Notice, it is recommended that that preliminary recommendation be adopted, with the inclusion of the ESIPC recommendation that the Cherry Gardens – Morphett Vale East 275 kV line be up-rated to a higher design temperature in lieu of constructing a new circuit between Cherry Gardens and the existing Happy Valley – Magill 275 kV transmission line.

It is therefore recommended that the following ‘new large network asset’ be constructed and associated up-rating work be performed to address the projected transmission network limitations in the Eastern and Southern Suburbs of metropolitan Adelaide, and the Eastern Hills region:

### At Tungkillo

- Establish a 275 kV substation at a vacant ElectraNet site at Tungkillo, approximately 40 kilometres east of the Adelaide CBD, at the point where the two Tailem Bend - Para 275 kV lines cross the two Robertstown - Cherry Gardens 275 kV lines.
- Cut into the four lines at their point of intersection and reconfigure them to form:
  - One line directly from Robertstown to Para substation;
  - One line directly from Tailem Bend to Cherry Gardens substation;
  - One Robertstown to Tungkillo 275 kV circuit;
  - One Tailem Bend to Tungkillo 275 kV circuit;
  - One Tungkillo to Happy Valley 275 kV circuit, and;
  - One Tungkillo to Para 275 kV circuit.

### On the Cherry Gardens – Morphett Vale East 275 kV line

- Up-rate the Cherry Gardens – Morphett Vale East 275 kV line to a design temperature of 120°C.

### Communications / Protection

- Upgrade communication facilities at Mount Beevor Radio Station, and Para, Tailem Bend, Robertstown and Cherry Gardens substations, to provide the necessary 275 kV protection and SCADA functionality.

The new large network assets and associated asset refurbishment are required to be commissioned by October 2006.

The total cost of these new large network assets and associated system modifications is estimated to be \$30.3 M.

Technical details relevant to these proposed new large network assets and associated works are contained in Appendix 1.

Having conducted thorough analysis, fulfilled its public consultation obligations in accordance with the NER, and having given due consideration to submissions received from the consultation process, ElectraNet will now proceed immediately to implement the recommendations contained in this Final Report.

The proposed construction timetable provides for award of equipment and construction contracts and the commencement of on-site construction in early 2006, assuming timely obtainment of Development Approvals, to ensure completion within the required timeframe.

## APPENDIX 1

### TECHNICAL DETAILS OF PROPOSED NEW LARGE NETWORK ASSETS

The proposed new large network assets and associated up-rating work recommended in this Final Report comprise the following:

#### At Tungkillo

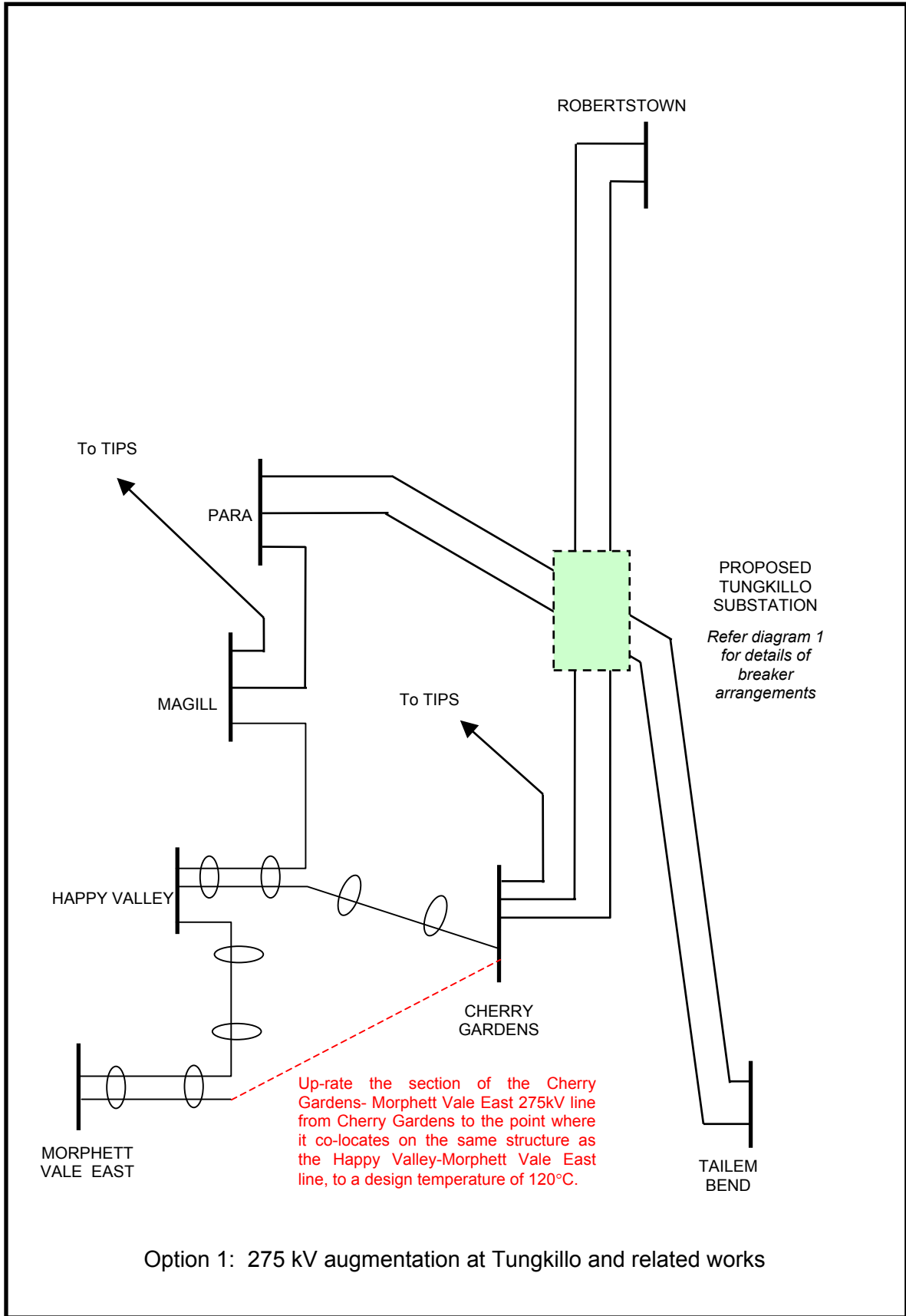
- Establish a 275 kV substation at a vacant ElectraNet site at Tungkillo, approximately 40 kilometres east of the Adelaide CBD, at the point where the two Tailem Bend - Para 275 kV lines cross the two Robertstown - Cherry Gardens 275 kV lines.
- Cut into the four lines at their point of intersection and reconfigure them to form:
  - One line directly from Robertstown to Para substation;
  - One line directly from Tailem Bend to Cherry Gardens substation;
  - One Robertstown to Tungkillo 275 kV circuit;
  - One Tailem Bend to Tungkillo 275 kV circuit;
  - One Tungkillo to Happy Valley 275 kV circuit, and;
  - One Tungkillo to Para 275 kV circuit.

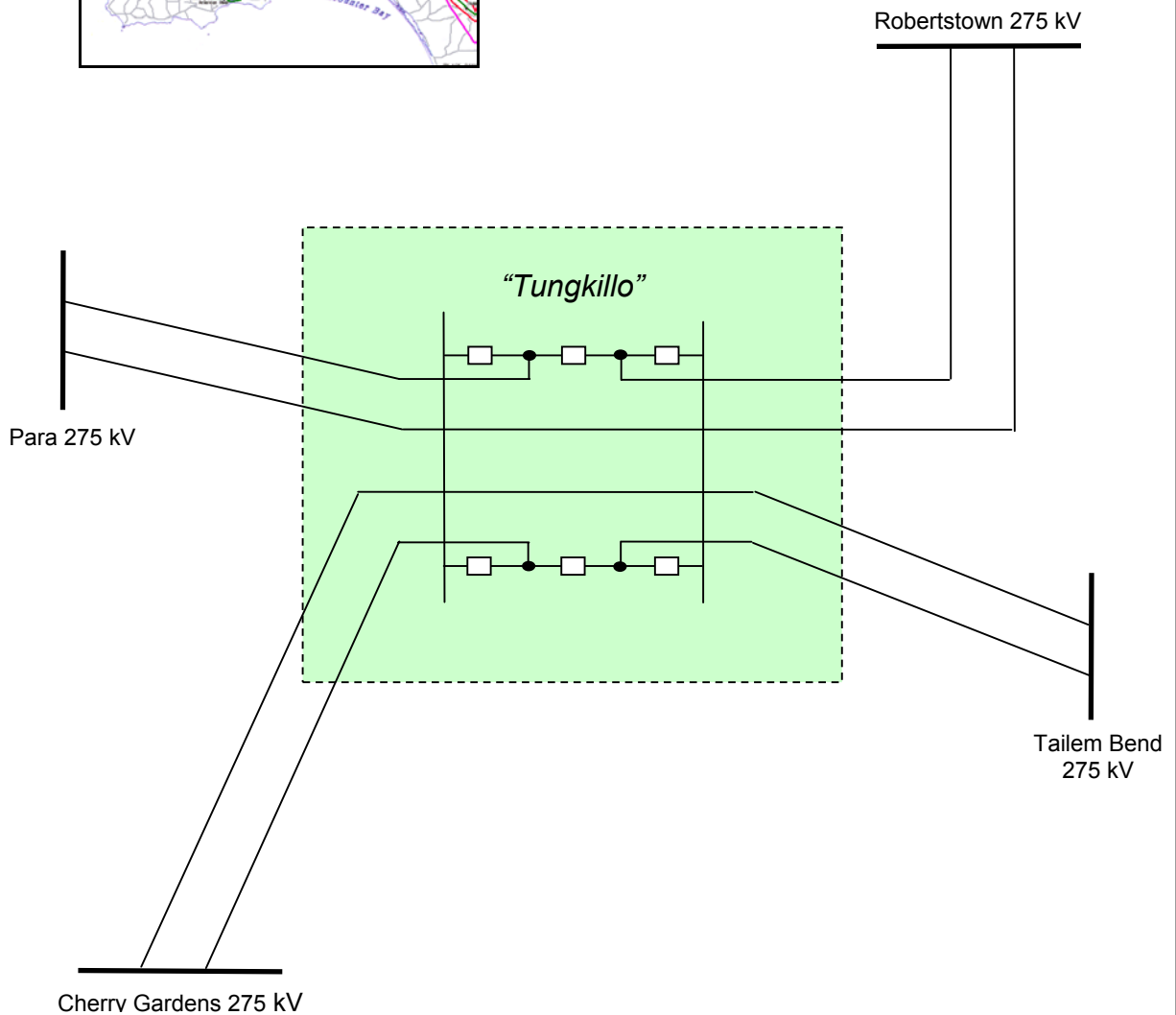
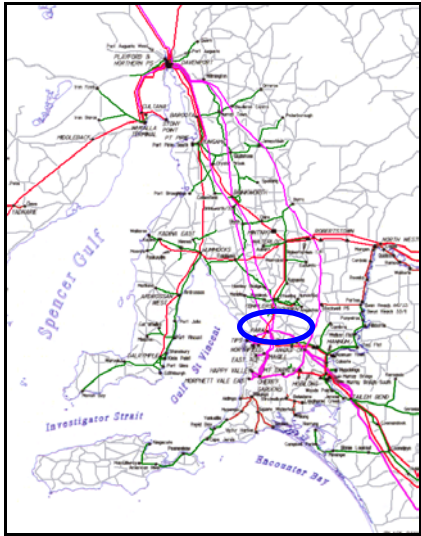
#### On the Cherry Gardens – Morphett Vale East 275 kV line

- Up-rate the Cherry Gardens – Morphett Vale East 275 kV line to a design temperature of 120°C.

#### Communications / Protection

- Upgrade communication facilities at Mount Beevor Radio Station, and Para, Tailem Bend, Robertstown and Cherry Gardens substations, to provide necessary 275 kV protection and SCADA functionality.





Option 1: Proposed layout of Tungkillo 275 kV substation

## APPENDIX 2

### Financial Analysis Summary

15 Year Analysis Period

Discount rate 10%	Scenario A		Scenario B		Scenario C	
	<i>Low load Growth</i>		<i>Medium load Growth</i>		<i>High load Growth</i>	
	PV (\$M)	Rank	PV (\$M)	Rank	PV (\$M)	Rank
Tungkillo Network Solution	\$21.87	1	\$20.59	1	\$19.77	1
Tallem Bend to Cherry Gardens 275kV line	\$53.21	2	\$52.51	2	\$51.28	2



<b>Scenario A</b>		<b>Low load Growth</b>														
<b>Option 1</b>		<b>Establish Tungkillo substation</b>														
<b>Establish Tungkillo substation</b>		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	19/20
=> TUOS		3.812	3.736	3.660	3.584	3.508	3.432	3.356	3.280	3.204	3.128	3.053	2.977	2.901	2.825	2.749
=>> PV of TUOS	\$25.94															
<b>Relative Losses</b>		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	19/20
* Losses \$		-0.410	-0.437	-0.480	-0.497	-0.514	-0.532	-0.551	-0.570	-0.590	-0.611	-0.632	-0.654	-0.677	-0.701	-0.726
=> PV of Losses	-\$4.07															
<b>Total for Option 1</b>	<b>\$21.87</b>															
<b>Option 2</b>		<b>Construct twin dual cct 275kV line from Tailem Bend to Cherry Gardens</b>														
<b>Construct twin dual cct 275kV line from Tailem Bend to Cherry Gardens</b>		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	19/20
=> TUOS		9.030	8.851	8.671	8.491	8.311	8.131	7.952	7.772	7.592	7.412	7.232	7.053	6.873	6.693	6.513
=>> PV of TUOS	\$61.47															
<b>Relative Losses</b>		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	19/20
* Losses \$		-1.043	-1.066	-1.071	-1.076	-1.081	-1.086	-1.091	-1.096	-1.101	-1.107	-1.112	-1.117	-1.122	-1.128	-1.133
=> PV of Losses	-\$8.26															
<b>Total for Option 2</b>	<b>\$53.21</b>															

<b>Scenario B</b>		<b>Medium load Growth</b>														
<b>Option 1</b>		<b>Establish Tungkillo substation</b>														
<b>Establish Tungkillo substation</b>		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	19/20
=> TUOS		3.812	3.736	3.660	3.584	3.508	3.432	3.356	3.280	3.204	3.128	3.053	2.977	2.901	2.825	2.749
==> PV of TUOS	\$25.94															
<b>Relative Losses</b>		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	19/20
* Losses \$		-0.425	-0.471	-0.536	-0.576	-0.620	-0.666	-0.716	-0.770	-0.828	-0.890	-0.956	-1.028	-1.105	-1.188	-1.277
=> PV of Losses	-\$5.36															
<b>Total for Option 1</b>	<b>\$20.59</b>															
<b>Option 2</b>		<b>Construct twin dual cct 275kV line from Taillem Bend to Cherry Gardens</b>														
<b>Construct twin dual cct 275kV line from Taillem Bend to Cherry Gardens</b>		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	19/20
=> TUOS		9.030	8.851	8.671	8.491	8.311	8.131	7.952	7.772	7.592	7.412	7.232	7.053	6.873	6.693	6.513
==> PV of TUOS	\$61.47															
<b>Relative Losses</b>		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	19/20
* Losses \$		-1.062	-1.107	-1.123	-1.140	-1.157	-1.174	-1.191	-1.208	-1.226	-1.244	-1.262	-1.281	-1.300	-1.319	-1.338
=> PV of Losses	-\$8.95															
<b>Total for Option 2</b>	<b>\$52.51</b>															

<b>Scenario C</b>		<b>High load Growth</b>														
<b>Option 1</b>		<b>Establish Tungkillo substation</b>														
<b>Establish Tungkillo substation</b>		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	19/20
=> TUOS		3.812	3.736	3.660	3.584	3.508	3.432	3.356	3.280	3.204	3.128	3.053	2.977	2.901	2.825	2.749
==> PV of TUOS	\$25.94															
<b>Relative Losses</b>		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	19/20
* Losses \$		-0.433	-0.488	-0.566	-0.619	-0.678	-0.743	-0.813	-0.891	-0.975	-1.068	-1.169	-1.281	-1.402	-1.536	-1.682
=> PV of Losses	-\$6.18															
<b>Total for Option 1</b>	<b>\$19.77</b>															
<b>Option 2</b>		<b>Construct twin dual cct 275kV line from Tailem Bend to Cherry Gardens</b>														
<b>Construct twin dual cct 275kV line from Tailem Bend to Cherry Gardens</b>		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	19/20
=> TUOS		9.030	8.851	8.671	8.491	8.311	8.131	7.952	7.772	7.592	7.412	7.232	7.053	6.873	6.693	6.513
==> PV of TUOS	\$61.47															
<b>Relative Losses</b>		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	19/20
* Losses \$		-1.081	-1.149	-1.189	-1.230	-1.273	-1.317	-1.363	-1.410	-1.459	-1.510	-1.562	-1.616	-1.672	-1.731	-1.790
=> PV of Losses	-\$10.19															
<b>Total for Option 2</b>	<b>\$51.28</b>															