Application Notice:

Proposed New Large Network Asset –

Darling Downs Area

(including Toowoomba, the Granite Belt and Lockyer Valley)

Powerlink Queensland
31 March 2003

1.0 EXECUTIVE SUMMARY

Powerlink Queensland has identified emerging limitations in the electricity transmission network supplying the Darling Downs area in south-west Queensland.

A draft recommendation to address these limitations has been developed. In accordance with the National Electricity Code, Powerlink has published this draft recommendation as an ‘application notice’ for a new large network asset.

The Darling Downs area is primarily supplied by a single circuit 275kV line between Tarong and Middle Ridge substation in Toowoomba. Technical studies have identified that, from late 2004, an outage of this circuit will cause loss of supply to customers. Action is required to overcome these limitations before late 2004 to allow Powerlink to meet its obligations under the Electricity Act and technical standards in the National Electricity Code.

Powerlink carried out consultation to identify and determine feasible options to address the emerging network limitations. Powerlink sought information on potential non-network alternatives (eg - involving demand side management initiatives or local generation) as part of this process. The operation of the existing power station at Oakey to provide a grid support service when it might not otherwise be operating in the electricity market was the only potential non-network alternative identified through the consultation process. Negotiations regarding network support determined that it could not be provided with the certainty required to satisfy the reliability requirements. This alternative is therefore not a feasible solution to address the emerging network limitations.

Multiple network augmentation options were considered to address the emerging network limitations on the Darling Downs and a subsequent limitation in supply to south-east Queensland. The two lowest cost feasible options were analysed in detail to compare the Net Present Value (NPV) of the costs to market participants, in accordance with the ACCC Regulatory Test:

Solution A	Double circuit 330kV transmission line between Millmerran and Middle Ridge by late 2004 and associated substation works. Subsequent 275kV augmentation from Middle Ridge to Greenbank (in the Logan area of SE Qld)
Solution B	Single circuit 275kV transmission line between Tarong and Murphy’s Creek by late 2004 and associated substation works. Subsequent 275kV augmentation from Millmerran to Greenbank (in the Logan area of SE Qld)

The financial analysis considered a range of years for the subsequent augmentation into south-east Queensland. Based on load forecasts published in Powerlink’s 2002 Annual Planning Report, the augmentation is required by 2008/09 at the latest to satisfy reliability requirements. Preliminary indications from the updated forecasts being prepared for the 2003 Annual Planning Report are that a date earlier than 2008/09 may be necessary. Market development scenarios were used to assess the impact of varying assumptions regarding the timing of the subsequent augmentation.

The ACCC Regulatory Test requires that for reliability requirements (as is the case for the limitations outlined in this report), the recommended option be the option with the lowest net present value cost compared with alternative projects. The economic analysis in this paper identified that Solution A is the least-cost solution over the period of analysis for the range of scenarios considered. Sensitivity analysis showed the results to be consistent under variations of critical parameters (such as capital cost, cost of network losses and discount rate) in the analysis.

In addition to the cost savings in the Regulatory Test financial analysis, significant other benefits have also been identified that favour Solution A over Solution B. These include higher network reliability, lower overall community impacts by avoiding 80km of overhead line construction, and electricity market benefits with a net present value of approximately $3 million. The market benefits were identified by independent consultants and are a consequential result of reduced future congestion on northwards flows on the Queensland-New South Wales interconnector.

Based on the conclusions in the analysis, this Application Notice contains a draft recommendation to implement Solution A to address the identified network limitations in the Darling Downs area and subsequent reliability limitations in south-east Queensland.

It is recommended that:

- A 330kV double circuit transmission line be constructed between Millmerran and Middle Ridge, with associated substation works. It is proposed to make commitments to begin construction of this proposed new large network asset in mid 2003. The asset, estimated to cost $71.3M, is required to be commissioned by the summer of 2004/05.

- The timing for the proposed subsequent augmentation between Middle Ridge and Greenbank be closely monitored, and if necessary, adjusted in the light of load growth forecasts and system needs. It should be noted that the ACCC Regulatory Test does not permit a network augmentation to be formally recommended for approval more than 12 months prior to the start of construction. It is, however, recommended that all planning consents be obtained and other preparatory works completed to allow the reliability requirements in south-east Queensland to be addressed within the time that corrective action is necessary.

Powerlink invites submissions from Code Participants and interested parties regarding the Code and Regulatory Test processes as covered by this Application Notice. The closing date for submissions is Friday 16th May, 2003.

2.0 INTRODUCTION

Powerlink Queensland has identified emerging limitations in the electricity network in the Darling Downs area of south-west Queensland.

Where a transmission network service provider proposes to establish a new large network asset to address such limitations, it is required to issue an 'application notice' under clause 5.6.6 of the National Electricity Code.

This 'application notice' must contain information regarding:

- the reasons the augmentation is required, including, if relevant, why it is considered a 'reliability augmentation' as defined in the Code;
- feasible options available to address the emerging network limitations, including any proposed non-network alternatives that meet the requirements;
- the recommended solution, including the timetable for implementation; and
- why the solution satisfies the Regulatory Test prescribed by the Australian Competition and Consumer Commission (ACCC).

The draft recommendation in this 'application notice' is based on:

- the assessment that a reliable power supply will not be able to be maintained in the Darling Downs area during single network contingencies from late 2004 onwards.

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

- the interrelationship between the immediate limitations emerging in the Darling Downs area and the future supply needs of south-east Queensland, and

- analysis of feasible options in accordance with the Regulatory Test prescribed by the Australian Competition and Consumer Commission (ACCC).

The recommended solution 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

3.1 Darling Downs Area

Powerlink has identified emerging limitations in the electricity network supplying the Darling Downs area in south-west Queensland. This area incorporates the major regional city of Toowoomba, the towns of Warwick and Stanthorpe to the south, Dalby and Millmerran to the west and the Lockyer Valley centred on the town of Gatton to the east.

Primary electricity supply to the area (refer map below) is via a single circuit 275kV transmission line between Tarong, near Nanango and Powerlink's Middle Ridge substation in the Toowoomba area. This is backed up by a lower capacity double circuit 110kV line from Swanbank, near Ipswich. The power flows on this line are predominantly towards Swanbank, but flows from Swanbank can occur during outages of the above-mentioned 275kV line. As electricity demand in the area has grown, power flows across these lines have increased, with peak loading occurring during the winter months from April to September.

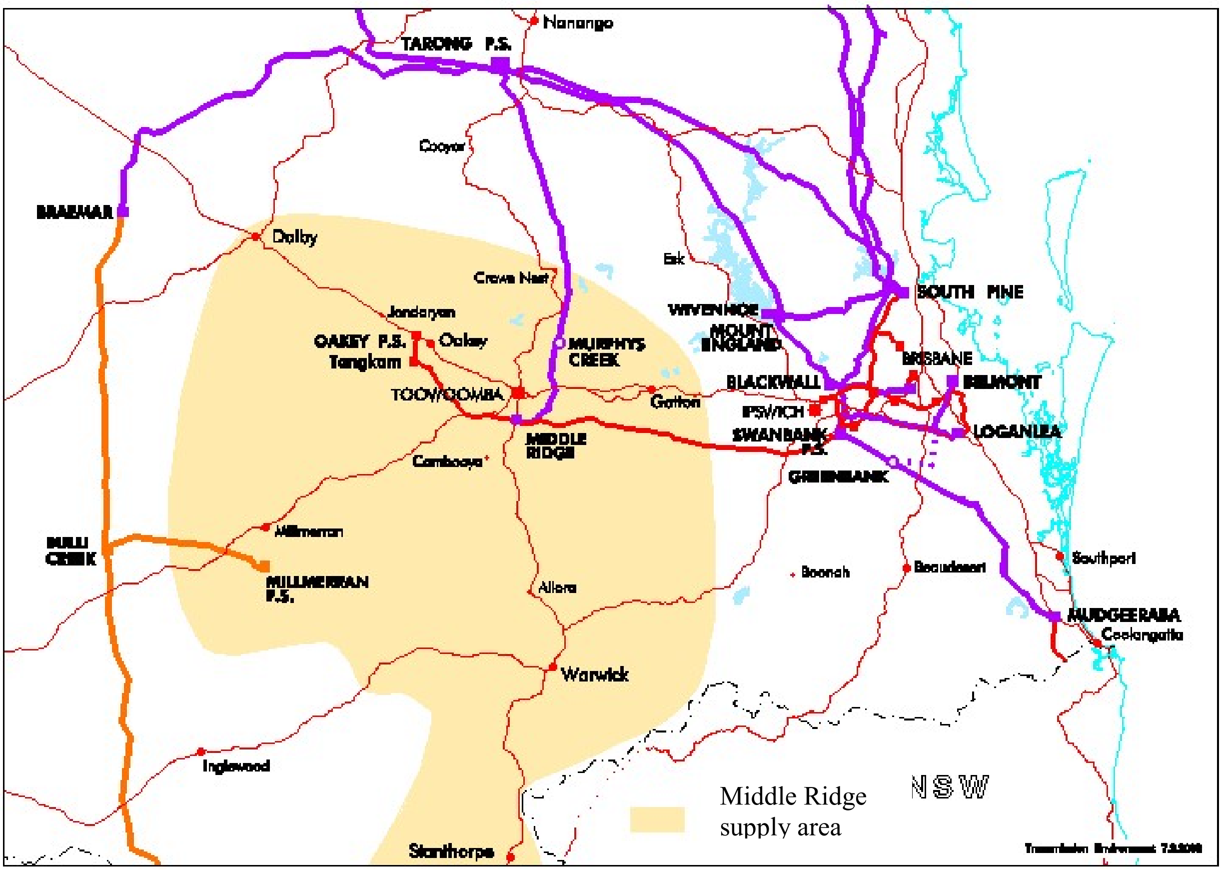

Figure 1 - Existing Supply System – Darling Downs Area

Powerlink's planning studies have identified that, from late 2004 onwards, the capability of its grid will be exceeded during an outage of the 275kV circuit between Tarong and Middle Ridge during both summer and winter peak periods[1]. During a single contingency, the voltage level of the entire area would become unacceptably low. In addition, flow on the Energex 110kV line between

[1] Assumes medium load growth forecasts as published in Powerlink's 2002 Annual Planning Report.

Abermain and Lockrose will exceed thermal ratings during contingency conditions requiring corrective action by late 2004.

Analysis to support this conclusion, including load forecasts and relevant assumptions, was published in the previous consultation document "Request for Information – Emerging Network Limitations Darling Downs Area."[2]

Consistent with the National Electricity Code and its transmission licence requirements, Powerlink plans future network augmentations so that the reliability and power quality standards of Schedule 5.1 of the Code can be met during the worst single credible fault or contingency (N-1 conditions) unless otherwise agreed with affected Code participants.

This is based on satisfying Powerlink's obligation "to ensure as far as technically and economically practicable that the transmission grid is operated with enough capacity (and if necessary, augmented or extended to provide enough capacity) to provide network services to persons authorised to connect to the grid or take electricity from the grid" (Electricity Act 1994, S34.2).

If no corrective action is taken, interruptions to customer supply will need to occur throughout the Darling Downs area from late 2004 onwards to allow the electricity system to be operated safely (ie – to avoid unacceptable line overloads and voltage collapse when a fault or other outage of the existing Tarong to Middle Ridge line occurs). Powerlink therefore considers action to address the emerging network limitations in the Darling Downs area to be a 'reliability augmentation', as defined in the National Electricity Code[3].

The reasons outlined above demonstrate the need for immediate corrective action to augment the existing electricity network in the Darling Downs area.

3.2 Supply to South-East Queensland

There is also a foreseeable and readily identifiable limitation in electricity supply to the south-east Queensland area.

This limitation must be considered in any analysis of solutions to emerging network limitations on the Darling Downs, because the South West Queensland area is a major source of power for south-east Queensland. Large amounts of power from Millmerran Power Station, Tarong Power Station, Central Queensland power stations and power stations in New South Wales feed into the transmission network at Tarong[4] (see Figure 2 on the following page).

This power reaches customers in south-east Queensland via numerous routes. Some power presently flows from Tarong to South East Queensland via the 275kV line to Middle Ridge. As outlined in the previous consultation document, under typical conditions this line supplies power to the Darling Downs and some power to South East Queensland via the smaller 110kV lines between Middle Ridge and Swanbank.

However, the majority of power transferred between Tarong and South-East Queensland flows on the other five 275kV circuits between Tarong and the Brisbane area[5].

[2] Published 17th June 2002 - refer Powerlink's website: www.powerlink.com.au/asp/index.asp?pid=5&page=network

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

[4] The current network configuration would also require all of the output from the uncommitted proposal for a power station at Kogan Creek in south-west Queensland to flow through Tarong.

[5] Some power also reaches south-east Queensland via a coastal route from Central Queensland. This has been taken into account in the analysis of the emerging limitations in south-east Queensland.

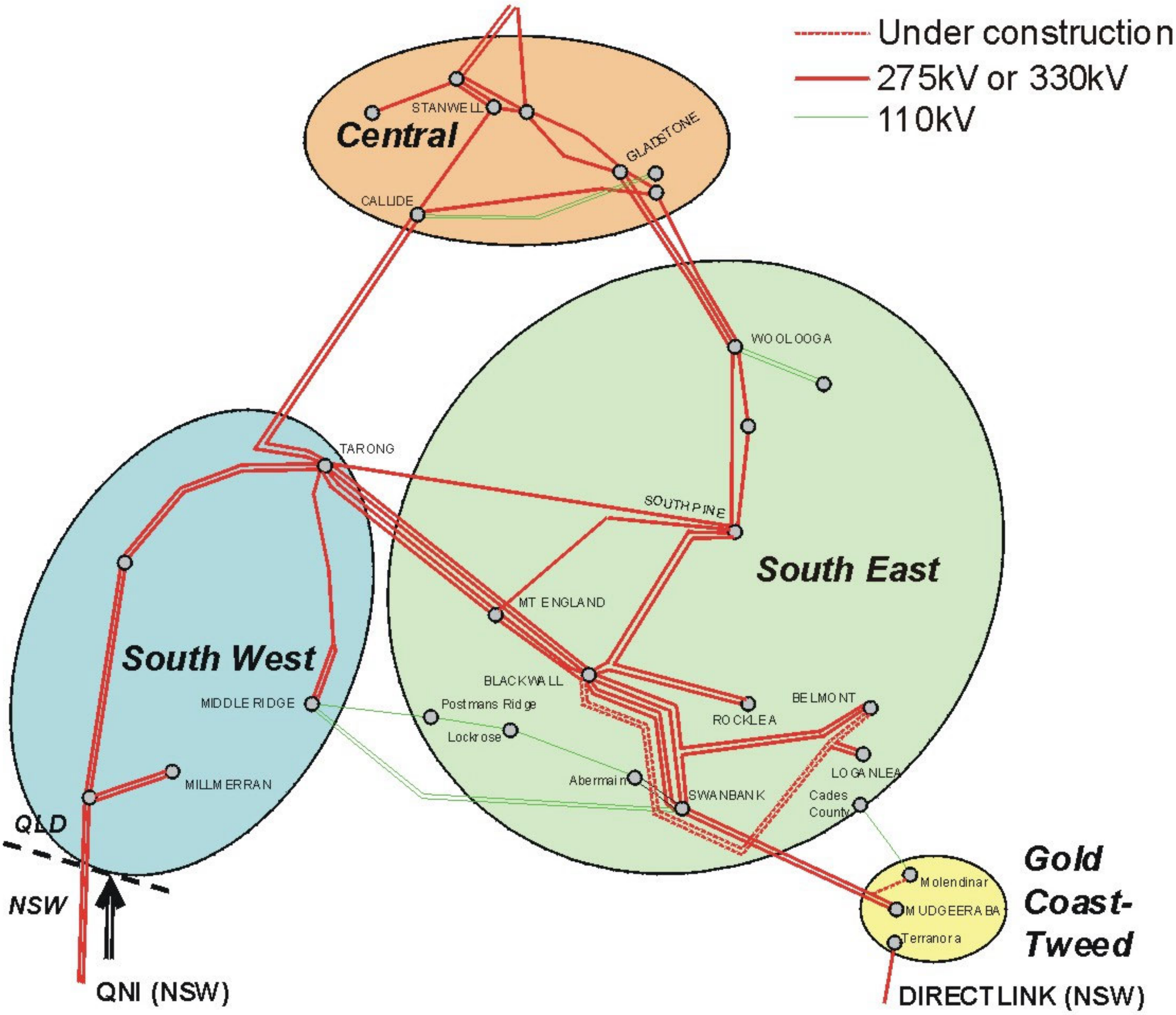

Figure 2 - Transmission Network Relevant to South East Queensland Supply

NOTE: FIGURE 2 IS DIAGRAMMATIC ONLY

Electricity demand in the south-east Queensland area, particularly in the southern Brisbane suburbs and the Gold Coast[6], is growing very rapidly - at a rate of approximately 180MW per year[7]. This additional demand has been met by augmentation of the transmission system[8], as demand growth has not been matched by the installation of additional power sources. There has been no net increase in the power generation capacity installed in south east-Queensland in the last fifteen years[9].

Without corrective action, demand is expected to exceed supply capacity in south-east Queensland by summer 2008/09 at the latest. This conclusion is based on forecast electricity demand, the transfer limits of the grid and existing and committed generation developments and decommitments[10], as published in Powerlink's 2002 Annual Planning Statement.

The unacceptable situation where demand exceeds secure supply capability is a clear reliability limitation. The consequence will be an inability to maintain a reliable power supply to Brisbane and the wider south-east Queensland area in accordance with the Code and Powerlink's transmission licence conditions. In determining the timing at which this situation is likely to arise, the most optimistic generation dispatch pattern was assumed. That is, it was assumed that all generation in south east Queensland could be operated to satisfy customers' electricity requirements, regardless of the merit order cost of operating generation in south-east Queensland in preference to generation outside south-east Queensland [11]. A less optimistic generation pattern would require network augmentation before 2008/09[12].

As noted above, corrective action is required by 2008/09 at the latest to maintain reliability of supply to south-east Queensland customers. Preliminary indications from the updated load forecasts presently being compiled for Powerlink's June 2003 Annual Planning Statement are that an earlier timing may be required (various timings are discussed further in section 6.2).

Market participants should note that electricity market dispatch could be affected by network transfer limitations into south-east Queensland prior to the time at which reliability limitations will arise. There is the potential for high wholesale market electricity prices to occur earlier due to congestion on the grid between south-west and south-east Queensland[13]. The transfer capability between Tarong and the Brisbane area has been reached on a number of occasions during the past few years, and has resulted in high wholesale pool prices. As demand increases without significant new generation, flows on the transmission system will increase.

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[6] Supplied primarily from existing substations at Belmont, Loganlea and Mudgeeraba.

[7] Refer Moreton North, Moreton South and Gold Coast zone forecasts as published in Powerlink's 2002 Annual Planning Report, June 2002.

[8] Such as the 275kV augmentation between Tarong and Blackwall (near Ipswich) in 1999.

[9] New generating units have been installed at Swanbank Power Station, the largest of which is Swanbank E with a capacity of 344/366MW. Several minor cogeneration developments have also occurred in the last few years. However, these new units are similar in total capacity to old generating units that have now been decommissioned. While not a generator, under some market conditions, the Directlink cable between northern NSW and the Gold Coast can provide a power injection of up to 180MW into the Tweed Shire of NSW and a residual amount into south-east Queensland.

[10] It should be noted that Powerlink's forecasts of demand and energy as published in its Annual Planning Report include an independent assessment of future renewable, cogeneration and other embedded generation sources that are likely to be connected to the Energex and Ergon distribution networks in the next ten years. If the allowed level of new generation does not eventuate, the demand/supply limitations will arise earlier.

[11] The assessment allowed for the largest generating unit in south-east Queensland (Swanbank E) to be unavailable due to maintenance or plant breakdown, and for 768MW of other SEQ generation to be operating at peak load. This includes Swanbank B, Directlink flowing northwards and Wivenhoe Power Station (recognising that Wivenhoe as a pump storage hydro station is capacity limited for continuous operation). The analysis considered typical weather conditions (50% probability of exceedance peak load forecasts) only, as published in the 2002 Annual Planning Report.

[12] In this regard, it is noted that Directlink is increasingly exhibiting a predominantly southwards flow pattern in response to market prices.

[13] If bidding behaviour in the National Electricity Market results in dispatch of generation outside south-east Queensland before generation within south-east Queensland, more power needs to be transferred into south-east Queensland on Powerlink's transmission grid. If transmission congestion forces generation outside south-east Queensland to be 'constrained off' (ie – prevented from operating), high wholesale market prices may result.

4.0 OPTIONS CONSIDERED

4.1 Consultation Summary

In its 2002 Annual Planning Report[14], Powerlink identified that action would be required in the short-term to address an anticipated major network limitation related to supply to the Darling Downs area in south west Queensland. The same document also contained information about existing and committed generation, grid transfer limits out of Tarong and forecasts of electricity demand growth in south-east Queensland[15].

In June 2002, Powerlink issued a consultation document[16] providing more detailed information on the emerging network limitations in the Darling Downs area. This paper was the first step in meeting regulatory requirements related to potential network augmentations. It sought information from Code Participants and interested parties regarding potential solutions, including non-network solutions, to address the anticipated network limitations.

Powerlink received a submission from one (1) party in response to the discussion paper:

- Enertrade, the organisation which bids the output of Oakey Power Station into the National Electricity Market. Oakey Power Station is a 344/320MW (winter/summer) gas turbine power station located approximately 25km west of Toowoomba.

During the consultation process, Powerlink also met with two other parties at their request to provide further details regarding the emerging network limitation. No submissions were provided by these parties.

4.2 Non-Transmission Options Identified

The primary purpose of the "Request for Information" paper was to identify feasible non-transmission solutions to be included in the analysis. In summary, the consultation identified the following information regarding solutions to address the emerging network limitations:

4.2.1. Demand Side Management

Existing demand side management programs in the Darling Downs area, and routine hot water switching activities, have already been included in the demand and energy forecasts used in the planning process. No information about other demand side initiatives was put forward during the consultation process.

[14] Published in June 2002

[15] As required by the NEC, Powerlink provides notice in the Annual Planning Report of emerging limitations in its network within a 5 year timeframe. Ten year load forecast information and information about generation commitments and decommitments is provided to allow market participants and interested parties to assess longer term issues.

[16] Request for Information – Emerging Transmission Network Limitations Darling Downs Area. Powerlink Queensland 17 June 2002. Refer Powerlink's website: www.powerlink.com.au/asp/index.asp?pid=5&page=network

4.2.2. New Local Generation

An allowance for potential cogeneration and renewable energy developments embedded[17] in the distribution network in the relevant area is already included in Powerlink's forecasts of energy and demand. Generation above these allowed levels would be required if local generation is to reduce demand on the transmission network and defer the need for other forms of corrective action.

No additional recently committed local generation projects in the relevant area were advised to Powerlink in the initial phase of the consultation. One potential local generation development that was in the very early stages of consideration (ie – pre-feasibility studies) was discussed during the consultation process. There were no indications that this generation proposal could be operational by the required timing of late 2004.

4.2.3. Existing Generation

Enertrade advised Powerlink that it may be interested in providing grid support services from Oakey Power Station to address the emerging limitations in the transmission grid supplying the Darling Downs.

Oakey Power Station is a relatively high cost dual-fuel generator (able to operate on either gas or diesel) that typically only operates during periods of high prices in the wholesale electricity market[18]. It is located approximately 25km west of Toowoomba on the Darling Downs.

Enertrade is responsible for the power purchase agreement under which Oakey Power Station operates, and it bids the output of Oakey into the National Electricity Market (NEM).

Meetings were held with Enertrade to discuss the potential operation of Oakey Power Station to address the emerging reliability limitations on the Darling Downs.

These negotiations did not result in a feasible solution, as a grid support service from Oakey Power Station does not satisfy the reliability requirements as outlined in section 3.1. As pointed out in the previously published consultation document, the nature of the network limitations is such that if the power station is not operating **prior to** any periods when the existing Tarong-Middle Ridge transmission line goes out of service, customers would suffer widespread loss of supply. Discussions were held between Enertrade and Powerlink regarding the availability and operation of Oakey Power Station over an extended period. Negotiations regarding a grid support service determined that it could not be provided with the certainty required to satisfy the reliability requirements. This means that a grid support service from Oakey Power Station is not a technically feasible solution to the network limitations on the Darling Downs.

The emerging network limitation on the Darling Downs will result in potentially severe loss of supply consequences for customers if appropriate corrective action is not taken. Powerlink has an obligation to take all necessary steps to ensure a reliable supply can be maintained.

4.3 Transmission Options Identified

In addition to the consultation process to identify possible non-transmission solutions, Powerlink carried out studies to determine the most appropriate transmission network solution to address the emerging limitations on the Darling Downs in conjunction with other foreseeable reliability limitations in south-east Queensland.

[17] 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.
[18] Which may coincide with periods of peak electricity demand or capacity shortfall

Multiple options were investigated, including some in response to requests from community members on the Darling Downs.

An overview of some of the options examined is provided on the following page. More information regarding Solution A and Solution B, the two lowest cost options examined in detail, is contained in section 5, and in the spreadsheets in Appendix 2.

<table>
<tr><td>Solution A</td><td>1. 330kV double circuit transmission line from Millmerran to Middle Ridge and associated substation works ($71M).
2. Subsequent 275kV augmentation from Middle Ridge to Greenbank in south-east Queensland and associated substation works ($60M).

The first stage addresses the reliability limitations on the Darling Downs. The second stage increases the supply capability into the Logan area of south-east Queensland, to meet that future identified need.

This option has a total estimated capital cost of $131M.</td></tr>
<tr><td>Solution B</td><td>1. 275kV single circuit transmission line from Tarong to Murphy's Creek and associated substation works ($47M).
2. Subsequent 275kV augmentation from Millmerran to Greenbank in south-east Queensland and associated substation works ($113M).

The first stage addresses the reliability limitations on the Darling Downs. The second stage increases the supply capability into the Logan area of south-east Queensland, to meet that identified future need.

This option has a total estimated capital cost of $160M.</td></tr>
<tr><td>Solution C</td><td>1. 275kV single circuit transmission line from Tarong to Murphy's Creek and associated substation works ($47M)
2. 275kV augmentation Braemar – Tarong ($75M)
3. Subsequent 275kV augmentation from Millmerran to Greenbank in south-east Queensland and associated substation works ($113M).

The first stage addresses the reliability limitations on the Darling Downs.

The second stage has been suggested by community members. Stage 1 of Solution A increases the capability to transfer power in a northerly direction from the QLD- NSW interconnector (QNI) and Millmerran Power Station (refer section 9.1), whereas the first stage of Solution B does not. A second line between Braemar (a substation on QNI) and Tarong would provide additional capacity in this section of the grid.

Stages 1 & 2 of Solution C do not satisfy future supply requirements in south-east Queensland. Therefore, Solution C includes a third stage augmentation between Millmerran and Greenbank as per Solution B, to enable all potential solutions to be compared on an even basis. An alternative to this is shown in Solution D.

Solution C has a total estimated capital cost of $235M and was not a preferred option because of the significant additional cost above Solutions A and B.</td></tr>
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Solution D	1. 275kV single circuit transmission line from Tarong to Murphy's Creek and associated substation works ($47M). 2. 275kV augmentation Braemar – Tarong and associated substation works ($75M). 3. Subsequent augmentation from Halys (near Tarong) to Greenbank in south-east Queensland via Springdale (near Gatton) and associated substation works ($180M). Solution D is similar to Solution C, except that it replaces the third stage augmentation between Millmerran and Greenbank with an augmentation between Halys, near Tarong, and Greenbank. The augmentations between Halys – Springdale - Greenbank would utilise strategic easements which Powerlink had obtained for the long-term future 500kV network. In Solution D, the Halys – Greenbank lines would be constructed at 500kV but initially operated at 275kV. This option has a total estimated capital cost of $302M. This option was not a preferred option because of the significant additional cost above Solutions A and B.
Solution E	1. Conventional AC underground cable from Millmerran – Middle Ridge and associated substation works ($511M). 2. Subsequent 275kV augmentation from Middle Ridge to Greenbank in south-east Queensland and associated substation works ($60M). The first stage addresses the reliability limitations on the Darling Downs. The underground line estimate provides for a connection with the same capacity as the overhead line in Solution A (approximately 800MW). The second stage increases the supply capability into the Logan area of south-east Queensland. This option has a total estimated capital cost of $571M, and was not a preferred option because of the significant additional cost above Solutions A and B.
Solution F	1. 4 x DC Light Underground Cables from Millmerran – Middle Ridge, AC/DC converter stations and associated substation works ($525M). 2. Subsequent 275kV augmentation from Middle Ridge to Greenbank in south-east Queensland and associated substation works ($60M). The first stage addresses the reliability limitations on the Darling Downs. The underground line estimate provides for the installation of four cables using DC Light technology to provide a connection with the same capacity as the overhead line in Solution A (approximately 800MW). The installation of four underground/overhead converter stations at Middle Ridge would require substantial land area, and is likely to require additional property acquisition and connection works. This requirement has not been investigated in detail due to the substantial cost disadvantage of this option. The second stage increases the supply capability into the Logan area of south-east Queensland. This option has a total estimated capital cost of $585M, and was not a preferred option because of the significant additional cost above Solutions A and B.

5.0 LOWEST COST SOLUTIONS

This section provides further information about the two lowest cost options analysed in detail, with the financial analysis to compare the two options contained in the spreadsheets in Appendix 2.

Solution A – 330kV transmission line from Millmerran to Middle Ridge. Subsequent 275kV augmentation from Middle Ridge to Greenbank.[19]		
Date Reqd	Augmentation	Capital Cost
Late 2004	Construct double circuit 330kV line from Millmerran to Middle Ridge	$71.3M
Late 2008	Construct double circuit 275kV line from Middle Ridge to Greenbank	$60.4M

Stage 1 – Addressing Emerging Limitations on the Darling Downs

Solution A addresses the limitation on the Darling Downs by the construction of approximately 90km of 330kV double circuit transmission line between Millmerran and Middle Ridge by late 2004 as the first stage of development (refer Figure 3). Middle Ridge substation is located in the Toowoomba area, and is the primary bulk supply point for the entire Darling Downs area.

The proposed double circuit 330kV line in Solution A will initially be operated as a single circuit connection. This will overcome the emerging limitations on the Darling Downs. It will provide substantial additional capacity to transfer power into the Darling Downs area and prevent voltage collapse and line overloads when the existing 275kV line between Tarong and Middle Ridge is out of service[20].

A single circuit line has not been proposed between Millmerran and Middle Ridge, as this would require a second line to be constructed later through the same area to address future limitations in south-east Queensland. A double circuit line is a prudent investment, as it is more cost-effective than two single circuit lines, minimises the impact on communities in the area and maximises utilisation of easements. Construction of double circuit transmission lines provides the capability for increased transmission capacity[21] with significant cost savings over an additional single circuit line, due to easement sharing and common towers.

Solution A requires substation works at the existing Millmerran and Middle Ridge substations to connect the new 330kV line in Stage 1. The estimated capital cost of the first stage of Solution A is $71.3M. Commitments to construction are required in mid 2003 to ensure completion by the required date of October 2004.

[19] The timings in the above table are based on the electricity demand forecasts as published in the initial consultation paper and Annual Planning Report issued by Powerlink in June 2002. The financial analysis evaluates possible variations to the timings in this 'base case' using the market development scenarios in section 6.0.
[20] Maintenance of a reliable power supply to the Energex substation at Postman's Ridge in the Lockyer Valley has also been taken into account.
[21] The capacity of the two 330kV circuits will be fully utilised when the subsequent augmentation into south-east Queensland is completed, and the line is reconfigured to enable double circuit operation (see Stage 2).

Stage 2 – Addressing Emerging Limitations in South-East Queensland

The second stage of Solution A provides for the emerging reliability limitations in south-east Queensland to be addressed by:

- construction of approximately 105km of double circuit 275kV line between Middle Ridge and Greenbank (in the Logan area) in south east Queensland by 2008/09 at the latest (refer Fig. 3);
- substation works at Middle Ridge and Greenbank to connect the new line;
- substation works to reconfigure the Stage 1 augmentation between Millmerran and Middle Ridge from single circuit to double circuit operation.

The Logan area, together with the southern suburbs of Brisbane and the Gold Coast, has one of the highest rates of electricity demand growth in Queensland. A major injection of power into the heart of this growth area is necessary to meet future customer electricity needs. The Greenbank substation site is located in the Logan area, at the conjunction of major 275kV lines which will supply Belmont, Loganlea and the Gold Coast. It is therefore the ideal location for transfer of additional power into south-east Queensland.

Stage 2 of Solution A will allow greater transfer of power into south-east Queensland. It provides a strong double circuit path between Millmerran and Greenbank. This will increase the ability to transfer power to south-east Queensland customers from all power sources interstate (via QNI) and from Millmerran, Tarong and Central Queensland generators[22].

Because it increases supply capacity into south-east Queensland, the proposed augmentation will overcome the emerging reliability limitations associated with demand in the south-east corner of the State exceeding supply capacity.

Plans for the second stage of Solution A provide for a portion of the existing 110kV double circuit line between Middle Ridge and Swanbank to be rebuilt as a double circuit 275kV line.

The economic analysis in Section 8.0 includes both Stage 1 & 2 of Solution A. This is necessary to ensure feasible options are compared on an equivalent basis in terms of the likely long-term development of the electricity grid[23].

[22] Market participants are advised that it is proposed to construct this augmentation by not later than 2008/09 when it is required for reliability purposes. That is, when demand in south-east Queensland would otherwise exceed supply capability taking into account existing and committed generation and existing grid transfer capability from Tarong and Central Queensland to south-east Queensland.

[23] Other works that are common to both options have not been included in the financial analysis as they do not alter the analysis conclusions.

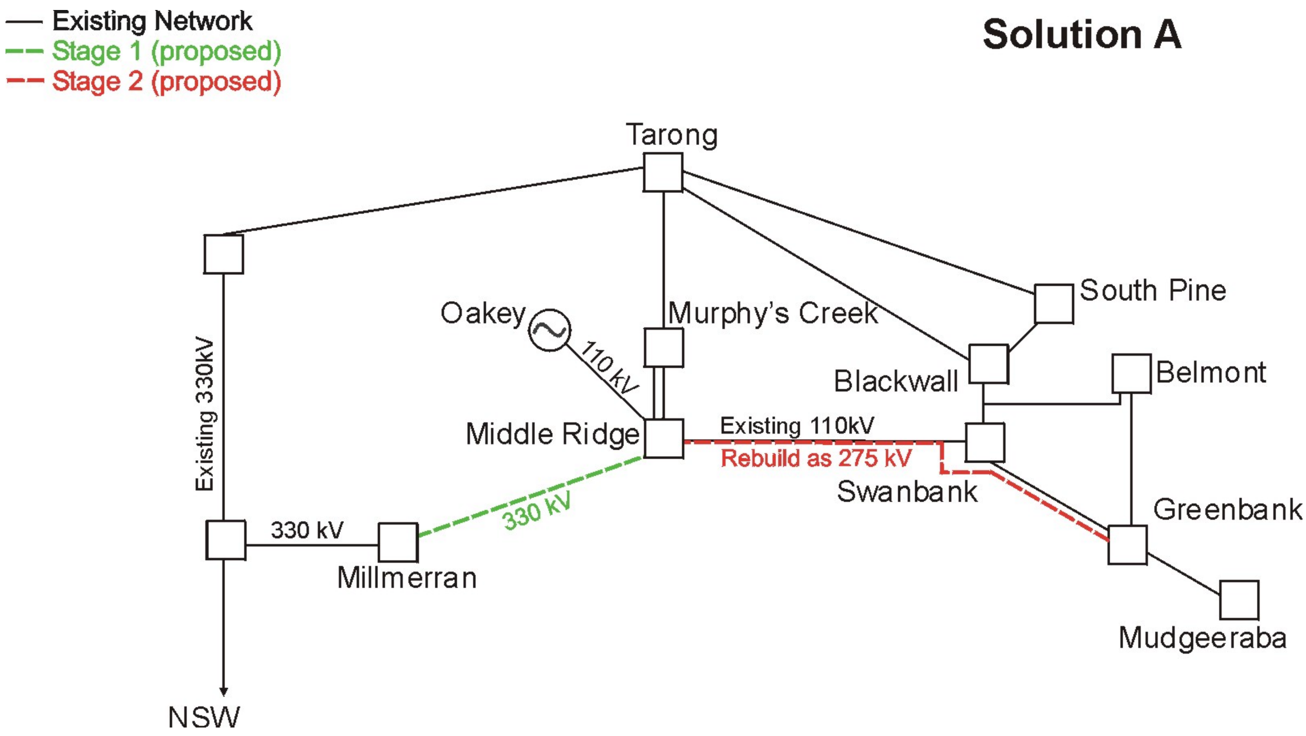


Figure 3 – Diagram Showing Stages 1 & 2 of Solution A

Solution B – 275kV transmission line from Tarong to Murphy's Creek. Subsequent augmentation from Millmerran to Greenbank.[24]		
Date Reqd	Augmentation	Capital Cost
Late 2004	Construct single circuit 275kV line from Tarong to Murphy's Creek	$46.8M
Late 2008	Construct 275kV double circuit line from Millmerran to Greenbank	$113.2M

Stage 1 – Addressing Emerging Limitations on the Darling Downs

Solution B addresses the emerging reliability limitations on the Darling Downs by constructing approximately 80km of single circuit 275kV transmission line between Tarong and Murphy's Creek (refer Figure 4).

Murphy's Creek is located approximately 25km north of Middle Ridge. There is an existing single circuit 275kV line between Tarong and Murphy's Creek, and an existing double circuit 275kV transmission line between Murphy's Creek and Middle Ridge. The proposed new line in Solution B would be located adjacent to the existing single circuit line.

The single circuit 275kV line provides additional capacity to transfer power into the Darling Downs area, although the capacity is significantly less than the 330kV line proposed in Solution A. Solution B also provides less geographical diversity than Solution A, as the primary supply to the Darling Downs will come from a single source at Tarong. In Solution A, high voltage power transfers can occur from either Tarong or Millmerran[25][26].

Solution B would also require substation works at the existing Tarong and Middle Ridge substations, and line rearrangement works at Murphy's Creek, to allow the new circuit to operate as a direct connection between Tarong and Middle Ridge[27]. The estimated capital cost of the first stage of Solution B is $46.8M.

The financial analysis in this document assumes that the first stage of Solution B is commissioned in late 2004. This would require a new easement to be obtained adjacent to the existing easement.

Stage 2 – Addressing Emerging Limitations in South-East Queensland

The second stage of Solution B provides for the emerging reliability limitations in south-east Queensland to be addressed by constructing 195km of double circuit 275kV line between Millmerran and Greenbank (in the Logan area) in south east Queensland and associated substation works by 2008/09 at the latest (refer Figure 4).

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

[25] In both Solution A and B, some limited back-up supply is available from Swanbank if the other circuits supplying Middle Ridge are out of service.

[26] As with Solution A, maintenance of a reliable power supply to the Energex substation at Postman's Ridge in the Lockyer Valley has also been taken into account.

[27] That is, connections would be re-arranged to connect the new circuit between Tarong and Murphy's Creek to one of the existing two circuits between Murphy's Creek and Middle Ridge. The existing circuit between Tarong and Murphy's Creek would be connected to the other circuit between Murphy's Creek and Middle Ridge.

This achieves similar outcomes to the second stage of Solution A, in terms of meeting the power requirements in the fast-growing areas of south-east Queensland. It allows the transfer of additional electricity from power sources in south-western Queensland to customers in these areas, and therefore overcomes the emerging reliability limitations in south-east Queensland.

In Solution B, a second stage augmentation between Middle Ridge and Greenbank as in Solution A is not a technically feasible way of addressing reliability limitations in south-east Queensland. The existing circuits between Tarong and Murphy's Creek and Murphy's Creek and Middle Ridge were built in the late 1980s. The capacity of these older lines is much lower than the proposed new line between Tarong and Murphy's Creek. After Stage 1, the existing and new circuits between Tarong and Middle Ridge would only have sufficient capacity to meet the power requirements of the Darling Downs. These circuits would be technically incapable of carrying significant additional power to meet future requirements in south-east Queensland[28]. It is therefore necessary in Solution B to construct a new double circuit line from Millmerran to Greenbank.

As with Solution A, plans for the second stage of Solution B provide for a portion of the existing 110kV double circuit line between Middle Ridge and Swanbank to be rebuilt as a double circuit 275kV line.

The economic analysis in Section 8.0 includes both Stage 1 & 2 of Solution B. This is necessary to ensure feasible options are compared on an equivalent basis in terms of the likely long-term development of the electricity grid[29].

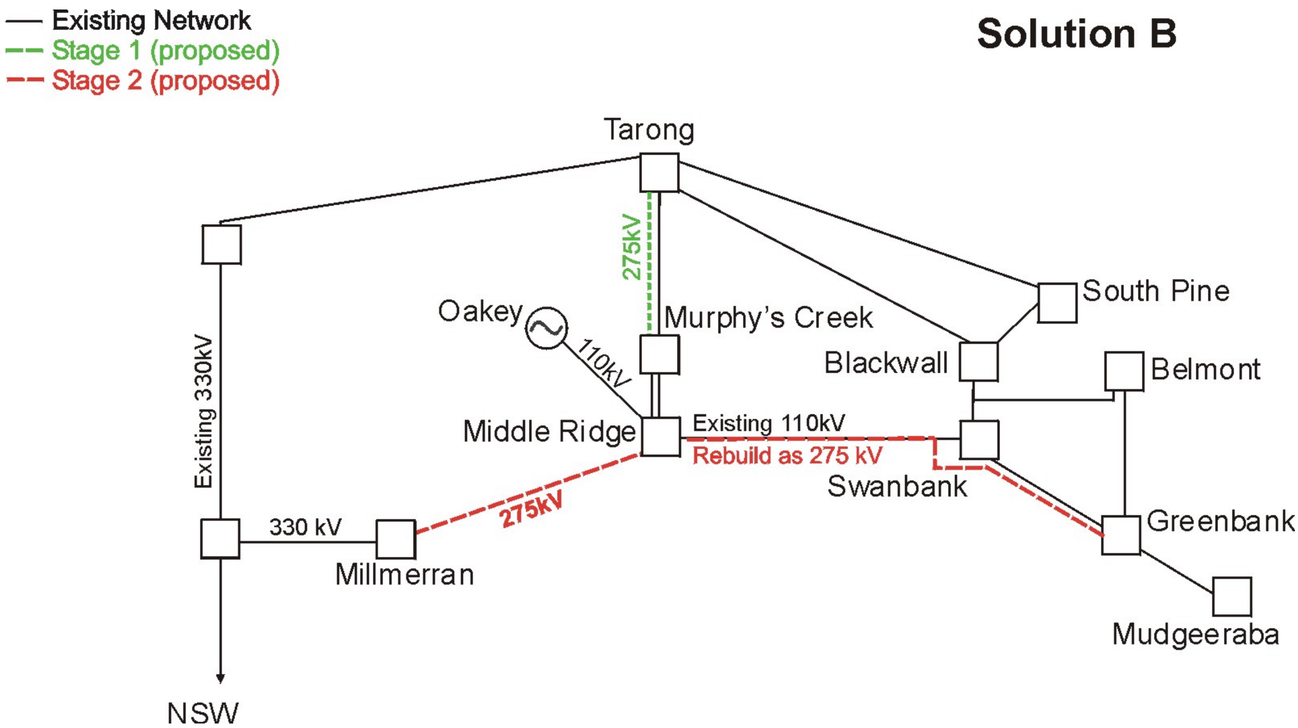


Figure 4 – Diagram Showing Stages 1 & 2 of Solution B

28 Easement and environmental considerations would prevent the construction of a new double circuit 275kV line adjacent to the existing line, unless the existing circuits between Tarong and Middle Ridge were removed after the new line was commissioned. This would be far more expensive than the first stage proposed in Solution A or B.
29 Other works that are common to both options have not been included in the financial analysis as common works do not alter the result.

6.0 MARKET DEVELOPMENT SCENARIOS

6.1 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:

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

- Commonwealth legislation has been in effect since 1 January 2001 to encourage increased generation from renewable energy sources. Powerlink has incorporated independent forecasts of additional renewable energy generation into the forecasts of demand and energy used in assessing the expected incidence of future network limitations;

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

- The large margin between supply capacity and demand for Queensland as a whole does not apply to the localised area of south-east Queensland. As outlined in section 3.2, electricity demand in the Moreton North, Moreton South and Gold Coast zones is growing at approximately 180MW per year. There has been no net increase in power generation installed in south-east Queensland during the past fifteen years to match this demand growth.

6.2 Assumed Market Development Scenarios

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

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

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

The analysis in this document is primarily sensitive to the assumed timing of the second stage augmentations in Solution A and B. Factors such as those listed above impact on the financial analysis and Net Present Value comparison depending on how they affect the timing of the Stage 2 augmentation into south-east Queensland.

As outlined in section 3.2, load forecasts show that the subsequent augmentation into south-east Queensland will be required by 2008/09 <u>at the latest</u>. As preliminary indications of the load forecasts for the June 2003 Annual Planning Report suggest an earlier rather than later timeframe, market development scenarios have been developed for 2008/09, and the two years prior:

Scenario I	Stage 1 Augmentation to address Darling Downs Limitations 2004/05 Stage 2 Augmentation to address South East Queensland Limitations 2006/07
Scenario II	Stage 1 Augmentation to address Darling Downs Limitations 2004/05 Stage 2 Augmentation to address South East Queensland Limitations 2007/08
Scenario III	Stage 1 Augmentation to address Darling Downs Limitations 2004/05 Stage 2 Augmentation to address South East Queensland Limitations 2008/09

Current trends indicating a timing earlier than 2008/09 include:

- South East Queensland electricity demand continues to grow rapidly (by approximately 180MW per year). There are preliminary indications of even higher growth rates in forecast electricity demand in the future, due to factors including the increasing installation of air conditioning;

- On a net basis, there has been little or no increase in generating capacity in the south-east corner of the State for the past fifteen years;

- Proposals for new power stations have been announced, but these are located outside south-east Queensland (eg - Kogan Creek in south west Queensland, Townsville Power Station expansion/conversion in north Queensland etc);

- Reactive power demand is growing in association with the growth in electricity demand. This is a technical characteristic of the power system that requires corrective action to maintain appropriate system voltages. If the growth in reactive power demand is not addressed, it progressively diminishes the existing transfer capability of Powerlink's network supplying south-east Queensland;

- The 2008/09 timing is reliant on full availability and output at Swanbank B, Tarong/Tarong North and partial availability of Wivenhoe and Directlink (flowing northwards) at the time of high south-east Queensland demand. More conservative assumptions regarding the availability of this plant will reduce the load at which voltage collapse could occur and hence would require this augmentation earlier.

Further description of how these issues relate to the market development scenarios is contained in section 6.3.

For the purposes of completeness of this document, a fourth market development scenario has also been developed. This scenario considers the sensitivity of the financial results to a situation where the second stage augmentation into south-east Queensland is deferred for three years beyond the latest date that Powerlink presently considers can be sustained (ie – to 2011/12).

Powerlink would emphasise that the only way this timeframe could occur is if new generation sufficient to satisfy three years load growth (ie – 300 - 500MW) was established in south-east Queensland. There are no indications that such generation is under consideration, and Powerlink's assessment is that its establishment in the short to medium term is not likely. Scenario IV is therefore a plausible, but unlikely scenario, which nonetheless provides a test of the robustness of the analysis.

Scenario IV	Stage 1 Augmentation to address Darling Downs Limitations 2004/05 Stage 2 Augmentation to address South East Queensland Limitations 2011/12

6.3 Relationships between Scenarios and Market Factors

A brief description of the relationship between the scenarios and factors such as load growth, network developments and generation assumptions is provided below:

6.3.1. Variations in Load Growth:

Powerlink carries out the majority of its detailed planning using a medium economic growth, typical weather (50% probability of exceedance) forecast for electricity usage. These forecasts include all known information about existing and planned demand side initiatives, and also include independent forecasts of local embedded generation developments.

The 2008/09 timeframe was determined using these medium growth, typical weather forecasts. Higher or lower economic growth may influence the timing by up to one year. However, the largest impact would be a combination of greater installation of air conditioning and an assumption of extreme summer temperatures (ie – a 10% probability of exceedance forecast). Air conditioning load not only increases electricity demand – it also increases the reactive power demand on the system and impacts the power transfer capability of the transmission network. Under these assumptions, reliability limitations in south-east Queensland may be reached as early as 2005/06.

6.3.2. Future Network Developments:

The need for the augmentations proposed in this report is independent of other identified network limitations that Powerlink is addressing elsewhere in its transmission grid.

Committed network developments, including the transmission line under construction between Blackwall, near Ipswich, and Belmont, in Brisbane's southern suburbs, have been taken into account in the analysis. There are no proposed network developments that are expected to have a material impact on the timing at which augmentation into south-east Queensland is required. Other network developments are therefore considered to be common to the two solutions analysed, and have not been included in the financial analysis.

6.3.3. Existing and Committed Generators

Oakey Power Station output impacts the emerging network limitations in the Darling Downs area, but this power station typically operates only at times of high wholesale electricity market prices which may or may not coincide with peak demand periods on the Darling Downs. Operating this power station under a grid support arrangement is not a feasible solution, as outlined in section 4.0. The emerging network limitations in the Darling Downs area are not sensitive to the generation pattern of other existing and committed generators.

When considering the impact of existing generators on the timing at which augmentation into south-east Queensland will be required, Powerlink assumed a generation dispatch pattern as outlined in section 3.2. The most optimistic generation dispatch pattern was assumed; that is, that all generation in south east Queensland could be operated to satisfy customers' electricity requirements, regardless of the merit order cost of operating generation in south-east Queensland in preference to generation outside south-east Queensland [30].

However, existing generators can impact the reliability limitations in the following ways:

- the MW output and reactive support provided by existing generators are key factors in the constraint equations that determine the capacity of Powerlink's existing transmission grid

[30] As noted in section 3.2, the assessment allowed for the largest generating unit in south-east Queensland (Swanbank E) to be unavailable due to maintenance or plant breakdown.

supplying the south-east Queensland area (eg – the “Tarong Limit”). Generation can increase or decrease the grid transfer capability into south-east Queensland, depending on its location. Additional generation in south-east Queensland reduces the grid transfer capability but increases the amount of load that can be supported in south-east Queensland;

- any further decommitments to existing generating units in south-east Queensland will bring forward the reliability requirement. Powerlink has not been advised of any further decommitments within south-east Queensland;
- Powerlink has allowed for the largest single generating unit in south-east Queensland to be out of service due to maintenance or breakdown when determining the timing at which augmentation into south-east Queensland is required. Implicit in this assumption is the fact that demand will exceed supply capacity earlier than 2008/09, with resulting impacts on reliability of supply, if more than one major generating unit in south-east Queensland is simultaneously out of service during peak demand periods.

6.3.4. Potential Generators and/or Demand Side Response:

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

Smaller generation developments may occur in the Darling Downs and south-east Queensland areas in response to government initiatives to encourage the development of renewable energy generation and generation from gas-fired power sources. Powerlink is not aware of any well-advanced new generation proposals where the network limitations exist, and none have come forward in response to the previous request for information.

Should new generators be established in south-east Queensland prior to 2008/09, they may defer the timing that the reliability limitation will arise. This is heavily dependent on the size of operation of the proposed generator. As described above, the electricity demand in the south-east Queensland corner of the state is growing at approximately 180MW per year. Large amounts of new generation with high anticipated operating levels would therefore be required in the south-east area of Queensland to defer the timing of the reliability limitations[31]. There are no known proposals for large scale new generation in south-east Queensland at this time.

[31] The transfer capability of Powerlink’s grid is dependent on the generation pattern within the National Electricity Market (refer constraint equations in Powerlink’s 2002 Annual Planning Report). The amount of generation required to defer the reliability limitation by one year is therefore not exactly equivalent to the annual load growth. It will depend on the impact of the new generation on the transmission network transfer capability into south-east Queensland. The size of the generator, its location, anticipated operating regime and the number of generating units (and therefore reactive support it can provide) will all be critical in determining the impact of a new generator on the amount of supportable customer load in the south-east Queensland area.

7.0 FINANCIAL ANALYSIS OVERVIEW

7.1 Description of Financial Analysis Approach

Two forms of financial analysis were carried out.

(1) Powerlink carried out economic analysis to calculate and compare the Net Present Value (NPV) of the costs to market participants of each solution under the range of assumed market development scenarios. This analysis was carried out in accordance with the ACCC Regulatory Test, as required for reliability augmentations (refer section 8.0).

(2) In addition, ROAM Consulting Pty Ltd was engaged to carry out market simulations and economic analysis of the market benefits of Stage 1 of Solution A compared with Stage 1 of Solution B (refer section 9.1)[32]. This assessment was carried out for the purposes of providing information to market participants about indicative benefits, and has not been used in the Regulatory Test evaluation of the proposed new large network asset.

    Notwithstanding this, the calculated market benefits are significant in the (unlikely) Scenario IV, and would be worthy of consideration in the event that circumstances changed so that Scenario IV became more likely[33].

7.2 Summary of Results

A summary of the two forms of financial analysis is contained in the conclusions in section 10.0, together with the total capital cost of each option. The economic analysis identifies that Solution A in this paper is the least-cost solution on a net present value and capital cost basis.

[32] Following the implementation of Stage 2, the market benefits of each solution were considered to be similar
[33] If this occurred, the analysis would need to be reassessed to take account of any relevant system changes

8.0 REGULATORY TEST 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)[34].

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".

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

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

8.2 Inputs to Analysis

Solutions to address emerging network limitations in the Darling Downs area and in the south-east Queensland area as outlined in this document are required to satisfy reliability requirements linked to Schedule 5.1 of the National Electricity Code and the requirements of the Queensland Electricity Act[35].

According to the ACCC Regulatory Test, this means that the costs of all options must be compared, and the least cost solution is considered to satisfy the Regulatory Test. The results of this evaluation, carried out using a cash flow model to determine the Net Present Value (NPV) of the various options, are shown in section 8.3.

Cost inputs to the NPV analysis are described below.

The costs of the transmission augmentations outlined in the solutions in section 5.0 have been estimated by Powerlink. Sensitivity studies have been carried out using variations in the capital cost estimates of plus or minus 15% (see section 8.4).

The financial analysis considers all cost impacts of the proposed network augmentations to market participants as defined by regulatory processes. The estimated saving in the cost of network losses for each option has been included based on the assumption of typical load factor and an average cost of losses of $25/MWh. Sensitivity studies have also been carried out on the assumed cost of losses (see section 8.4).

Capital and operating costs for items which are common to all options were not included in the analysis. These common costs include the capital and operating costs of other future

[34] Powerlink is required to evaluate options for new transmission developments under the Regulatory Test in accordance with clause 5.6 of the National Electricity Code.
[35] Refer section 3.0.

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.

8.3 Reliability Assessment - Net Present Value Analysis

The economic analysis undertaken to comply with the ACCC Regulatory Test considered the net present value (NPV) of the costs of alternative options over the fifteen year period from 2003 to and including 2017. Full details of this analysis are contained in Appendix 2. The sensitivity of the analysis to a 20 year evaluation period was also undertaken.

A discount rate of 10% was selected as a relevant commercial discount rate, and sensitivity analysis was conducted to test this assumption. A range of assumed market development scenarios was considered as outlined in section 6.0.

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

The following table is a summary of the economic analysis carried out for the reliability augmentation assessment in accordance with the Regulatory Test (full details in Appendix 2). It shows the net present value of each alternative, and identifies the best ranked option, for the range of scenarios considered.

Discount rate 10%		**Scenario I** *SEQ in 06/07*		**Scenario II** *SEQ in 07/08*		**Scenario III** *SEQ in 08/09*		**Scenario IV** *SEQ in 11/12*	
		NPV ($M)	**Rank**	**NPV ($M)**	**Rank**	**NPV ($M)**	**Rank**	**NPV ($M)**	**Rank**
Solution A	DCST 330 Milm-MR, DCST 275 MR-Grnbk	**$69.79**	**1**	**$63.95**	**1**	**$59.55**	**1**	**$49.09**	**1**
Solution B	SCST 275 Tar-MurCk, DCST 275 Milm-Grnbk	$80.78	2	$73.67	2	$67.16	2	$50.77	2

The summary shows that Solution A has the lowest net present value cost for all scenarios.

8.4 Sensitivity Analysis

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

1. Capital cost of transmission solutions
2. Cost of network losses
3. Discount rate
4. Length of analysis period

A solution must be implemented by late 2004 to overcome the identified network limitations on the Darling Downs. A solution will be required by 2008/09 to address the emerging reliability limitations in south-east Queensland. The NPV analysis considers the immediate limitation to the Darling Downs and the subsequent limitation to South East Queensland through an assessment over a fifteen year analysis period. The sensitivity of the analysis to the assumed timing of the proposed augmentations (and therefore the incidence of the capital expenditure) has been taken into account in the economic comparison through the use of market development scenarios.

The effect of varying capital cost, cost of network losses and the discount rate was investigated using standard Monte Carlo techniques.[36] The following table shows the parameters that were investigated in the sensitivity analysis, the distribution that was assumed for each parameter and the range of values.

Parameter	Distribution
Capital Cost of Transmission Option	The capital cost of the two solutions was tested for sensitivity to variations of plus or minus 15% from the expected value. The variation in each cost was modelled as a triangular distribution with the assumption that the costs are statistically independent. This means that the cost of each network component is allowed to vary within plus and minus 15% independently of the over or underspend of the other components.
Cost of losses	The sensitivity to the average cost of losses was tested by allowing this parameter to vary randomly between \$20/MWh and \$30/MWh using a triangular distribution with a mode of \$25/MWh.
Discount rate	The Monte Carlo analysis was repeated using discount rates of 8%, 10% and 12%.

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

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

	Discount Rate		
	8%	10%	12%
Scenario I (SEQ in 06/07)	A (99%)	A (99%)	A (99%)
Scenario II (SEQ in 07/08)	A (99%)	A (99%)	A (99%)
Scenario III (SEQ in 08/09)	A (98%)	A (97%)	A (96%)
Scenario IV (SEQ in 11/12)	A (72%)	A (66%)	A (61%)

As can be seen in this table, Solution A is the highest ranked option under the majority of scenarios. These sensitivity analysis results are consistent with the base case economic analysis.

The financial analysis was repeated using a 20 year analysis period to address the issue of whether a longer evaluation period should be used to reflect the long asset life of transmission lines. On this basis, the Net Present Value cost of Solution A was \$9.9M lower than Solution B (Scenario III - 2008/09). Results for other scenarios are contained in Appendix 3.

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

On the basis of the financial analysis and the sensitivity studies, Solution A is the option that satisfies the ACCC Regulatory Test.

8.5 Inter-Network Impact

Powerlink is required under the National Electricity Code to assess whether a proposed new large network asset is reasonably likely to have a material inter-network impact. Powerlink has studied the impacts of the first stage of Solution A (the proposed asset recommended in this document) and submitted results to the Transmission Network Service Provider of New South Wales, TransGrid.

Powerlink and TransGrid have determined that the proposed new large network asset will not impose power transfer constraints or adversely impact on the quality of supply within the New South Wales network.

9.0 OTHER FACTORS

Solution A provides significant other cost savings and benefits in comparison to Solution B, in addition to those included in the economic analysis in section 8.0. These are outlined below:

9.1 Market Benefits

The sole purpose of the proposed network augmentation is to address the emerging reliability limitations. Powerlink, as the relevant transmission network service provider (TNSP), must implement corrective action to satisfy its statutory obligations (refer section 3.0). For this reason, the proposed augmentation is classified as a reliability augmentation as defined in the National Electricity Code.

Nonetheless, a study has been carried out to assess the consequential market benefits arising from the proposed reliability augmentation. ROAM Consulting Pty Ltd was engaged to perform market dispatch simulations and determination of the relevant market benefits[37] of Stage 1 of Solutions A and B. ROAM Consulting has considerable experience in electricity market simulations and economic analysis.

9.1.1. Analysis Approach

Presently, all power transferred in a northerly direction from interstate via the Queensland-New South Wales interconnection (QNI) and from Millmerran Power Station must be transmitted to Queensland customers via the transmission network between Bulli Creek substation (on QNI) and Tarong.

The first stage of Solution A (ie – the proposed new transmission line between Millmerran and Middle Ridge) provides an alternative path for this power to reach customers on the Darling Downs and, to a lesser extent, South East Queensland. The additional transmission capacity provided by the proposed new line effectively increases the total transfer capability between Bulli Creek and some of the customers who are presently supplied from Tarong.

Stage 1 of Solution B comprises an augmentation between Tarong and Murphy's Creek. All power from QNI and Millmerran Power Station must continue to be transferred via the existing circuits between Bulli Creek and Tarong. In the first stage of Solution B, there is therefore no alternative path provided between Bulli Creek and customers presently supplied from Tarong.

ROAM Consulting Pty Ltd was engaged to assess the market benefits of the alternative path provided by Stage 1 of Solution A. These benefits are only provided by Stage 1 of Solution A; no such market benefits are available from Solution B until the second stage augmentation occurs.

Stage 2 of each solution was not modelled, as each solution results in a double circuit connection from Millmerran to Greenbank. It was therefore considered that the impact of the second stage on the electricity market was sufficiently similar that there would be little variation in market benefits following Stage 2.

[37] As defined by the ACCC - a similar methodology to that developed for the completion of the Economic Assessment of the proposed SNI Interconnector was applied.

9.1.2. Results of Market Benefit Analysis

ROAM Consulting Pty Ltd identified that Solution A provides savings to the electricity market in comparison to Solution B. Details of the net present value of the market benefits of implementing Solution A are contained in Appendix 4 and summarised in the table below:

Market Benefits Associated with Solution A[38]:

	04/05	05/06	06/07	07/08	08/09
Market Benefits $M	.013	0.06	0.14	1.12	3.73
NPV of Benefits $2.95M					

The estimated net present value of the market benefits provided by Solution A in comparison to Solution B is $2.95M[39]. These benefits arise from allowing the transfer of power from competitively priced generation to Queensland customers. Such benefits include[40]:

- savings in reduction in fuel consumption across all generators in the National Electricity Market (NEM);
- savings resulting from the deferral of investment in new generation infrastructure (responding to market signals and/or to changed reliability parameters).

The annual benefits are small in the initial years because:

- They arise from fuel and operating cost differences only as the increased capacity facilitates increased trading in the NEM. The fuel savings are projected to be small until 2007/08, after which time the savings increase annually;
- Queensland does not have any shortfall in electricity supply from a supply/demand balance perspective until 2008/09 for the conditions that have been studied. It is expected that the second stage augmentation into south-east Queensland will be required by this time, so that Solution A and B will offer similar market benefits after 2008/09. However, market participants are advised that if no alternative path between Bulli Creek and Tarong is created, the market benefits of Solution A over Solution B rise sharply to approximately $12M per annum after 2008/09[41]. The impact of this is of particular relevance to the (unlikely) Scenario IV . Whilst the NPVs of the market benefits for (the most likely) Scenarios I,II,and III are modest, the NPV of the market benefits of Scenario IV is $22.39 million. Given that the key decision criterion for selecting a solution – lowest NPV cost – is "line ball" between the solutions in Scenario IV, there is an argument for then using the market benefits as a "tiebreaker" in that scenario. In which case, Solution A would be clearly superior. However, given the improbability of Scenario IV emerging, this argument is essentially of academic interest only.

[38] For scenario III where augmentation into south-east Queensland occurs in 2008/09. Details of the results for other scenarios are contained in Appendix 4.
[39] See footnote above.
[40] Given the preliminary nature of this assessment and its incidental role in this evaluation, other potential sources of benefits such as reduction in ancillary services costs were not modelled.
[41] Due to the benefits of deferring capital investment in new generation plant.

9.2 Higher Network Reliability

Solution A also results in a more secure power system than Solution B.

Stage 1 of Solution A means that the Darling Downs will have high voltage supply from the Millmerran area in the west and the Tarong area in the north. Stage 1 of Solution B, on the other hand, concentrates the primary supply to the Darling Downs on a single easement corridor from Tarong.

Electricity transmission grids have been identified by the Commonwealth and State Governments as critical infrastructure. The geographic diversity of routes offered by Solution A enhances the reliability of supply to customers and the security of the power system. The electricity transmission system would be less vulnerable to natural disasters such as bushfires and storms, and other events that may cause multiple outages of elements of the transmission system.

9.3 Reduced Greenhouse Impacts

Solution A results in lower transmission system losses than Solution B. This indicates that the total greenhouse gas emissions during the generation of power will be lower for Solution A than Solution B, as less electricity would be lost during transmission.

9.4 Lower Community Impacts

Solution A also has benefits in that it has lower overall community impacts than Solution B.

Solution A requires the construction of fewer transmission lines to satisfy the emerging network limitations on the Darling Downs and in south-east Queensland. Solution A requires the construction of a transmission line between Millmerran and Greenbank. Solution B requires the construction of a transmission line between Tarong and Middle Ridge and a line between Millmerran and Greenbank.

While the community impacts are difficult to quantify as the impacts on specific communities and affected landholders vary, Solution A avoids the construction of approximately 80km of transmission line, thereby avoiding 80km of new easements and the related impacts on property owners and the broader community (eg visual impacts). Broadly speaking, Solution A will therefore result in fewer construction impacts, and fewer environmental and community impacts than Solution B.

10.0 CONCLUSIONS

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 cannot be maintained during single 275kV contingencies on the line between Tarong and Middle Ridge supplying the Darling Downs area. Such a situation is not consistent with reliability standards which Powerlink must meet, as the Queensland transmission network service provider.

- Emerging limitations in supply to south-east Queensland are expected to result in a situation where demand will exceed supply capability by 2008/09. This must be considered in any assessment of local limitations on the Darling Downs as south-west Queensland is a major source of power for customers in the south-east region of the state.

- Powerlink carried out a consultation process in mid 2002, and was not advised of any demand side management initiatives or local generation options capable of addressing the identified network limitations to the Darling Downs. A grid support service from Oakey Power Station was investigated and discussed with Enertrade, but was not a feasible solution to the reliability requirements.

- Economic analysis carried out in accordance with the ACCC Regulatory Test has identified that Solution A in this paper is the least-cost solution over a fifteen year period of analysis under the majority of scenarios considered. Sensitivity analysis showed that this conclusion was robust to variation in capital cost and other assumptions. On this basis, an augmentation comprising a double circuit 330kV line from Millmerran to Middle Ridge at a cost of $71.3M would satisfy the Regulatory Test. Subsequent works in Solution A would be required at a later date, no later than 2008/09, to satisfy reliability requirements in south-east Queensland.

- Economic analysis carried out by independent consultants has identified that Solution A provides consequential savings to the electricity market compared with Solution B. These market benefits have a net present value of approximately $3M. Interested parties should note that such benefits are based on market analysis that includes assumptions about generator bidding behaviour. Such market benefits, if they arise, are a consequence of avoiding future congestion on northwards flows on QNI and are incidental to the purpose for which the proposed augmentations would be constructed.

Solution A 330kV Millmerran-Middle Ridge late 2004; 275kV Middle Ridge-Greenbank - late 2008
Solution B 275kV Tarong-Murphy's Creek late 2004; 275kV Millmerran-Greenbank - late 2008

	Solution A	Solution B
CAPITAL COSTS		
Stage 1	71.29	46.81
Stage 2	60.36	113.24
TOTAL CAPITAL COST ($M)	**131.65**	**160.05**
REGULATORY TEST ANALYSIS		
Stage 1 augmentation of Darling Downs in late 2004		
Stage 2 augmentation of SE Qld in 2008/09		
TOTAL NET PRESENT VALUE COST ($M)	**59.55**	**67.16**
MARKET BENEFIT ANALYSIS		
TOTAL NPV OF MARKET BENEFITS ($M)	**2.95**	**0.00**
NET COST ($M)*	**56.60**	**67.16**
Solution A lower than Solution B by:	$ 10.56	Million (NPV)

*Net Cost = NPV Cost - NPV Market Benefits

- Non-financial benefits were also identified. Solution A will deliver a more reliable and robust transmission network than Solution B. Solution A will also result in significantly lower overall community impacts, as it avoids the construction of approximately 80km of high voltage transmission line.

- Powerlink has carried out technical studies with TransGrid, its counterpart in NSW, and it has been determined that the proposed augmentation will not materially impact other transmission networks within the National Electricity Market.

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

- The proposed construction timetable provides for award of construction and equipment contracts in mid 2003, commencement of substation works in Quarter 3 2003 and commencement of on-site line construction in Quarter 1 2004. The project is required to be commissioned prior to the summer of 2004/05.

11.0 DRAFT RECOMMENDATION

Based on the conclusions drawn from the analysis, it is recommended that the following 'new large network asset' be constructed to address the emerging transmission network limitations in the Darling Downs area:

- A 330kV double circuit transmission line between Millmerran and Middle Ridge with associated substation costs. It is proposed to make commitments to begin construction of this proposed new large network asset in mid 2003. The asset, estimated to cost $71.3M, is required to be commissioned prior to the summer of 2004/05. Technical details relevant to this proposed new large network asset are contained in Appendix 1.

The ACCC Regulatory Test does not permit a TNSP to recommend works for approval under National Electricity Code processes earlier than twelve months prior to the start of construction. Therefore, the second stage augmentation to address south-east Queensland limitations cannot be recommended at this time. However, it is recommended that:

- The timing for the proposed augmentation between Middle Ridge and Greenbank be closely monitored, and if necessary, adjusted in the light of load growth forecasts and generation development. It is further recommended that planning consents be obtained and other preparatory works completed to allow the reliability requirements in south-east Queensland to be addressed within the time that corrective action is necessary.

12.0 CONSULTATION

In accordance with Code requirements, Powerlink invites submissions from Code Participants and interested parties on this application notice. Submissions are due by Friday 16th May, 2003.

Submissions should relate to the framework of the National Electricity Code processes and the Regulatory Test. This process is not intended to address issues such as landholder compensation and environmental impacts assessment. Those matters are being dealt with by other processes.

Please address submissions to:

Manager Network Assessments
PO Box 1193
Virginia QLD 4014
Tel: (07) 3860 2300
Fax: (07) 3860 2388
Agray@powerlink.com.au

Following consideration of submissions, Powerlink expects to publish a final recommendation in early June 2003.

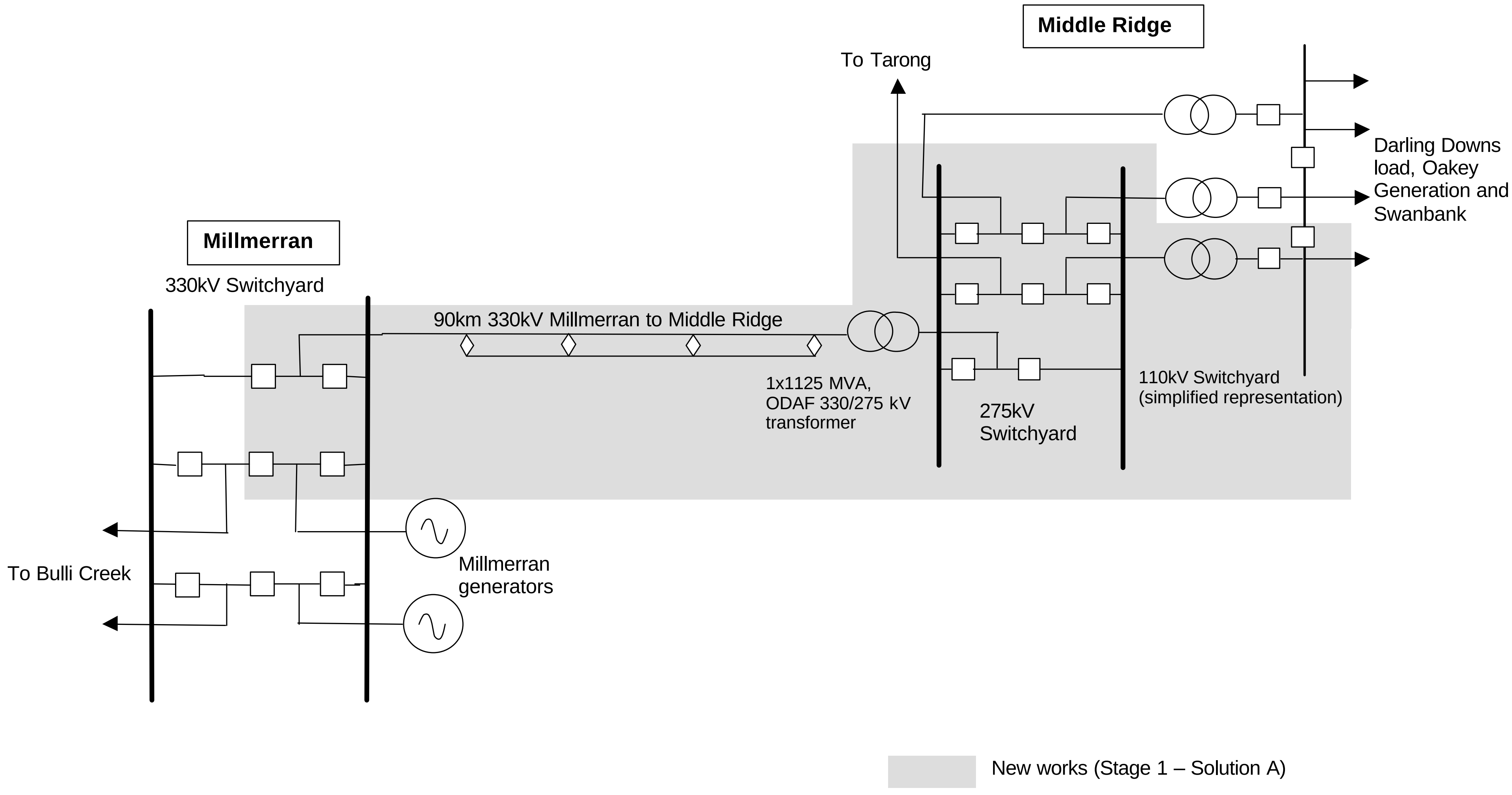
APPENDIX 1:

TECHNICAL DETAILS OF PROPOSED NEW LARGE NETWORK ASSET

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

- 90km of 330kV double circuit twin “sulphur” conductor transmission line from Millmerran to Middle Ridge, including OPGW
- 330kV extensions to Millmerran substation with feeder rearrangement
- A 275kV switchyard at Middle Ridge with the following:
  - 1 x 1125MVA 330/275kV transformer
  - 1 x 250MVA 275/110kV transformer
  - 3 switching diameters
- 110kV works on the existing Middle Ridge bus as follows:
  - 110kV transformer bay
  - installation of a bus section circuit breaker to form three switched bus sections
  - feeder rearrangement
- Minor protection modifications at Tarong substation

New works are highlighted in the following network configuration diagram :



This diagram is representational only and does not necessarily depict physical arrangements

APPENDIX 2

Summary

15 Year Analysis Period

Discount rate 10%		Scenario I *SEQ in 06/07*		Scenario II *SEQ in 07/08*		Scenario III *SEQ in 08/09*		Scenario IV *SEQ in 11/12*	
		NPV ($M)	**Rank**	**NPV ($M)**	**Rank**	**NPV ($M)**	**Rank**	**NPV ($M)**	**Rank**
Solution A	DCST 330 Milm-MR, DCST 275 MR-Grnbk	**$69.79**	**1**	**$63.95**	**1**	**$59.55**	**1**	**$49.09**	**1**
Solution B	SCST 275 Tar-MurCk, DCST 275 Milm-Grnbk	$80.78	2	$73.67	2	$67.16	2	$50.77	2

Development Options	Scenario I *SEQ in 06/07*	Scenario II *SEQ in 07/08*	Scenario III *SEQ in 08/09*	Scenario IV *SEQ in 11/12*
Solution A				
330kV DCST Millmerran-Middle Ridge	04/05	04/05	04/05	04/05
275kV DCST Middle Ridge - Greenbank	06/07	07/08	08/09	11/12
Solution B				
275kV SCST Tarong-Murphy's Ck	04/05	04/05	04/05	04/05
275kV DCST Millmerran-Greenbank	06/07	07/08	08/09	11/12

Scenario I ***SEQ in 06/07***

Solution A — DCST 330 Milm-MR, DCST 275 MR-Grnbk

		02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
330kV DCST Millmerran-Middle Ridge																	
=> TUOS		0.000	0.000	0.000	7.860	7.755	7.650	7.545	7.441	7.336	7.231	7.126	7.021	6.917	6.812	6.707	6.602
==> NPV of TUOS	$43.25																
275kV DCST Middle Ridge - Greenbank																	
=>TUOS		0.000	0.000	0.000	0.000	0.000	6.655	6.566	6.477	6.389	6.300	6.211	6.122	6.034	5.945	5.856	5.767
==> NPV of TUOS	$27.92																
Relative Losses																	
* Losses $		0.000	0.000	-0.838	-1.303	-0.383	0.084	0.100	0.100	0.107	0.130	0.138	0.146	0.153	0.161	0.169	0.184
=> NPV of Losses	-$1.38																
Total NPV for Solution A	**$69.79**																

Solution B — SCST 275 Tar-MurCk, DCST 275 Milm-Grnbk

		02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
275kV SCST Tarong-Murphy's Ck																	
=> TUOS		0.000	0.000	0.000	5.161	5.092	5.023	4.954	4.886	4.817	4.748	4.679	4.610	4.542	4.473	4.404	4.335
==> NPV of TUOS	$28.40																
275kV DCST Millmerran-Greenbank																	
=>TUOS		0.000	0.000	0.000	0.000	0.000	12.485	12.318	12.152	11.985	11.819	11.652	11.486	11.319	11.153	10.987	10.820
==> NPV of TUOS	$52.38																
Relative Losses																	
* Losses $		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$0.00																
Total NPV for Solution B	**$80.78**																

Scenario II ***SEQ in 07/08***

Solution A

DCST 330 Milm-MR, DCST 275 MR-Grnbk

330kV DCST Millmerran-Middle Ridge		02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
=> TUOS		0.000	0.000	0.000	7.860	7.755	7.650	7.545	7.441	7.336	7.231	7.126	7.021	6.917	6.812	6.707	6.602
==> NPV of TUOS	$43.25																

275kV DCST Middle Ridge - Greenbank		02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
=>TUOS		0.000	0.000	0.000	0.000	0.000	0.000	6.655	6.566	6.477	6.389	6.300	6.211	6.122	6.034	5.945	5.856
==> NPV of TUOS	$24.13																

Relative Losses		02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
* Losses $		0.000	0.000	-0.838	-1.303	-1.472	-1.525	-0.442	0.100	0.107	0.130	0.138	0.146	0.153	0.161	0.169	0.184
=> NPV of Losses	-$3.43																

Total NPV for Solution A **$63.95**

Solution B

SCST 275 Tar-MurCk, DCST 275 Milm-Grnbk

275kV SCST Tarong-Murphy's Ck		02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
=> TUOS		0.000	0.000	0.000	5.161	5.092	5.023	4.954	4.886	4.817	4.748	4.679	4.610	4.542	4.473	4.404	4.335
==> NPV of TUOS	$28.40																

275kV DCST Millmerran-Greenbank		02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
=>TUOS		0.000	0.000	0.000	0.000	0.000	0.000	12.485	12.318	12.152	11.985	11.819	11.652	11.486	11.319	11.153	10.987
==> NPV of TUOS	$45.27																

Relative Losses		02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
* Losses $		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$0.00																

Total NPV for Solution B **$73.67**

Scenario III *SEQ in 08/09*

Solution A

DCST 330 Milm-MR, DCST 275 MR-Grnbk

330kV DCST Millmerran-Middle Ridge		02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
=> TUOS		0.000	0.000	0.000	7.860	7.755	7.650	7.545	7.441	7.336	7.231	7.126	7.021	6.917	6.812	6.707	6.602
==> NPV of TUOS	$43.25																

275kV DCST Middle Ridge - Greenbank		02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
=>TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.655	6.566	6.477	6.389	6.300	6.211	6.122	6.034	5.945
==> NPV of TUOS	$20.66																

Relative Losses		02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
* Losses $		0.000	0.000	-0.838	-1.303	-1.472	-1.525	-1.579	-0.460	0.107	0.130	0.138	0.146	0.153	0.161	0.169	0.184
=> NPV of Losses	-$4.36																

Total NPV for Solution A **$59.55**

Solution B

SCST 275 Tar-MurCk, DCST 275 Milm-Grnbk

275kV SCST Tarong-Murphy's Ck		02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
=> TUOS		0.000	0.000	0.000	5.161	5.092	5.023	4.954	4.886	4.817	4.748	4.679	4.610	4.542	4.473	4.404	4.335
==> NPV of TUOS	$28.40																

275kV DCST Millmerran-Greenbank		02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
=>TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	12.485	12.318	12.152	11.985	11.819	11.652	11.486	11.319	11.153
==> NPV of TUOS	$38.76																

Relative Losses		02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
* Losses $		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$0.00																

Total NPV for Solution B **$67.16**

Scenario IV *SEQ in 11/12*

Solution A — DCST 330 Milm-MR, DCST 275 MR-Grnbk

330kV DCST Millmerran-Middle Ridge		02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
=> TUOS		0.000	0.000	0.000	7.860	7.755	7.650	7.545	7.441	7.336	7.231	7.126	7.021	6.917	6.812	6.707	6.602
==> NPV of TUOS	$43.25																

275kV DCST Middle Ridge - Greenbank		02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
=>TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.655	6.566	6.477	6.389	6.300	6.211
==> NPV of TUOS	$11.93																

Relative Losses		02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
* Losses $		0.000	0.000	-0.838	-1.303	-1.472	-1.525	-1.579	-1.656	-1.717	-0.485	0.138	0.146	0.153	0.161	0.169	0.184
=> NPV of Losses	-$6.08																

Total NPV for Solution A **$49.09**

Solution B — SCST 275 Tar-MurCk, DCST 275 Milm-Grnbk

275kV SCST Tarong-Murphy's Ck		02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
=> TUOS		0.000	0.000	0.000	5.161	5.092	5.023	4.954	4.886	4.817	4.748	4.679	4.610	4.542	4.473	4.404	4.335
==> NPV of TUOS	$28.40																

275kV DCST Millmerran-Greenbank		02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
=>TUOS		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	12.485	12.318	12.152	11.985	11.819	11.652
==> NPV of TUOS	$22.38																

Relative Losses		02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
* Losses $		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$0.00																

Total NPV for Solution B **$50.77**

APPENDIX 3

Summary

20 Year Analysis Period

Discount rate 10%		Scenario I *SEQ in 06/07*		Scenario II *SEQ in 07/08*		Scenario III *SEQ in 08/09*		Scenario IV *SEQ in 11/12*	
		NPV ($M)	**Rank**	**NPV ($M)**	**Rank**	**NPV ($M)**	**Rank**	**NPV ($M)**	**Rank**
Solution A	DCST 330 Milm-MR, DCST 275 MR-Grnbk	**$80.89**	**1**	**$74.97**	**1**	**$70.65**	**1**	**$60.43**	**1**
Solution B	SCST 275 Tar-MurCk, DCST 275 Milm-Grnbk	$93.94	2	$86.97	2	$80.61	2	$64.68	2

APPENDIX 4

Market Benefit Analysis — **Benefits of Solution A over Solution B (as calculated by ROAM Consulting Pty Ltd)**

Scenario I

Market Benefits Identified		02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
=> Benefits $M		0.000	0.000	0.013	0.060	0.047	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of Benefits	$0.09																
Total NPV for Scenario I	**$0.09**																

Scenario II

Market Benefits Identified		02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
=> Benefits $M		0.000	0.000	0.013	0.060	0.140	0.373	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of Benefits	$0.38																
Total NPV for Scenario II	**$0.38**																

Scenario III

Market Benefits Identified		02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
=> Benefits $M		0.000	0.000	0.013	0.060	0.140	1.120	3.730	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of Benefits	$2.95																
Total NPV for Scenario III	**$2.95**																

Scenario IV

Market Benefits Identified		02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
=> Benefits $M		0.000	0.000	0.013	0.060	0.140	1.120	11.190	13.240	13.870	4.623	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of Benefits	$22.39																
Total NPV for Scenario IV	**$22.39**																

Net Cost Analysis

	Solution A DCST 330 Milm-MR, DCST 275 MR-Grnbk			Solution B SCST 275 Tar-MurCk, DCST 275 Milm-Grnbk		
Discount rate 10%	NPV COST	**NPV MARKET BENEFIT**	NET COST*	NPV COST	**NPV MARKET BENEFIT**	NET COST*
Scenario I *SEQ in 06/07*	69.79	**0.09**	69.70	80.78	**0.00**	80.78
Scenario II *SEQ in 07/08*	63.95	**0.38**	63.57	73.67	**0.00**	73.67
Scenario III *SEQ in 08/09*	59.55	**2.95**	56.60	67.16	**0.00**	67.16
Scenario IV *SEQ in 11/12*	49.09	**22.39**	26.70	50.77	**0.00**	50.77

* Net Cost = NPV Cost Less NPV Market Benefit